The Carroll Round

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The Ninth Annual Carroll Round

An Undergraduate Conference Focusing on Contemporary International Economics Research and Policy

VOLUME 6

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The Ninth and Tenth Carroll Round Steering Committees
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**WHAT IS THE CARROLL ROUND?**

The Carroll Round is an international economics conference for undergraduate students held annually at Georgetown University in Washington, D.C. It takes the format of a professional academic conference at which students present their original research in international economics (broadly defined) that are typically honors theses. The goal of the Carroll Round is to foster the exchange of ideas among the leading undergraduate economics students by encouraging and supporting the pursuit of scholarly innovation. To date, over 250 students from universities and colleges in North America, Western and Eastern Europe, and Australia have participated, making the Carroll Round the premier conference of its kind. The conference also provides opportunities for participants to interact with prominent academic and policy economists. Alumni have moved on to top Ph.D., J.D., M.B.A., and other graduate programs, positions at the Federal Reserve, World Bank, and other public institutions, and major private corporations.

**NOTES ON PAPER SUBMISSIONS AND CONFERENCE PARTICIPATION**

The Carroll Round Proceedings is a publication of synopses and full-length papers from the Carroll Round Undergraduate International Economics Conference at Georgetown University. We do not accept paper submissions from the general public. If you are interested in presenting at the conference, please log on to our website: http://carrollround.georgetown.edu. All undergraduate students who have written or are in the process of writing original work in the field of international economics (broadly defined) are encouraged to apply.
ACKNOWLEDGEMENTS

In its ten years, the Carroll Round has managed to grow from an ambitious project into the premier conference for students from across the globe to share their research in international economics. Because this achievement and the conference’s future would not be possible without the support of our donors, faculty, speakers, session chairs, and Georgetown University, the Carroll Round Steering Committee would like to represent those who have committed so much of their time and energy.

We would first like to recognize Ms. Marianne Keler for her continued generosity and for proposing the establishment of an endowment account to which every Carroll Round supporter can contribute toward the long-term institutionalization of the Carroll Round. Ms. Marianne Keler and Mr. Michael Kershow have been the primary contributors to and advocates of the Carroll Round since its establishment in 2001. Without this support, the Carroll Round would never have achieved fruition or continued for the past nine years. We thank Mr. Yunho Song, a Georgetown graduate and long-time supporter of the conference, who established an endowment fund that will partly finance the Carroll Round for many years to come. For his support and extremely generous financial contribution, we and all future participants of the Carroll Round are truly indebted.

The Carroll Round has been gifted with many other individuals committed to its cause. Therefore, we would also like to recognize Mr. Mario Espinosa, Mr. Oleg Nodelman, Mr. and Mrs. Kenneth Kunkel, and former Carroll Round Steering Committee members Mr. Stephen Brinkmann and Mr. Scott Pedowitz. We express our gratitude to the Kanzanjian Foundation, which provided the start-up funds without which it would have been impossible to develop the Carroll Round Proceedings.

Within Georgetown, the conference is indebted to Mr. Mohamed Abdel-Kader, Ms. Carma Fauntleroy, Ms. Cara Sodos, and Ms. Reema Ghazi, all of whom have made tireless efforts to advocate the Carroll Round cause from our campus’s development and advancement departments. We are also deeply appreciative of the efforts of Mr. Thomas Esch, Ms. Christine Smith, Dr. Venilde Jeronimo, Ms. Katerina Kulagina, and Ms. Elizabeth Franzino from years past.

Additionally, we would like to recognize those individuals and institutions that have historically been essential to the current status of the Carroll Round. The donations of Mr. Peter Faulkner, Mr. John Kelly, Mr. James Moore, Mr. Philip Vasta, Mr. Geoffrey Yu, and the highly significant contributions from the Sallie Mae Corporation for the first five conferences have made previous endeavors possible and paved the path for future growth.

We would also like to give special recognition to former steering committee members, beyond those already mentioned, who have contributed very generous portions of their post-collegiate income to the Carroll Round after graduation. Therefore, we thank Ms. Stacey Droms, Mr. Brandon Feldman, Ms. Yasmine Fulena, Mr. Christopher Griffin, Ms. Rebecca Heide, Mr. Dennis Huggins, and Mr. J. Brendan Mullen.

Beyond the financial viability of the Carroll Round, the conference also enjoys the grace of many proponents on Georgetown University’s campus to ensure its continuing
ACKNOWLEDGMENTS

and vibrant existence. In particular we would like to thank Provost James O’Donnell, Dean Carol Lancaster of the School of Foreign Service, Dean Kendra Billingslea, Ms. Denisse Bonilla-Chaoui, Dr. Dan Powers, and Mr. Beau Boughamer. We would like to recognize Dean Robert Gallucci as well, who supported the development of the Carroll Round from the inception of the conference to his retirement from Georgetown in 2009.

The Carroll Round has been fortunate for the last ten years to enjoy the substantive quality of the brightest economics undergraduates from across the world. We are particularly grateful to those professors that steer their best students to the Carroll Round, especially Professor Nancy Marion of Dartmouth College, Professor Judith Shapiro of the London School of Economics, and Professor Michael Seeborg of Illinois Wesleyan University.

We also enjoy the professional experience and wisdom of some of the most respected economists in the field. For the Ninth Annual Carroll Round, we were particularly lucky to have presentations from Nobel Laureate Dr. Robert Merton and Dr. Lant Pritchett. Also critical to the substantive development of the Carroll Round and our participants’ work are the session chairs who take the time to read participants’ papers and critique their presentations at the conference. We would like to thank the 2010 session chairs for their contributions to the conference: Professor Matthew Canzoneri, Professor Jose Cuesta, Professor Robert Cumby, Professor Raj Desai, Professor Behzad Diba, Professor Rodney Ludema, Professor Charles Udomsaph, Professor Francis Vella, and Professor James Vreeland.

We thank the past Carroll Round Steering Committees, which have shaped and directed the development of the conference into its current state today. We are also indebted to the contributions of the Carroll Round Advisory Panel for their assistance in developing a long-term vision for the Carroll Round and for grounding where the next ten years may take this institution.

Finally, though not least importantly, we would like to express our ever-growing gratitude to Dean Mitch Kaneda, the Carroll Round Faculty Advisor. Without his support, time, and passion, this endeavor would not be possible.
A Brief History of the Carroll Round

(Revised March 2011)

As the Carroll Round celebrates its tenth anniversary this year, I recognize that the conference increasingly (and fittingly) has become less tethered to its humble roots. The event’s expansion continues unabated, and those of us proud to be Carroll Round alumni marvel at the extraordinary work of the students who organize and participate each year. Yet, perhaps, the Carroll Round’s beginnings mean even more in April 2011 than in any prior spring. A decade ago, the ingenuity and dedication of a stellar group of Georgetown students, combined with the contributions of remarkable young scholars from around the country showed how strong undergraduate economics—and the work of undergraduate economists—can be.

Whenever I am asked about the conference’s origin, a story about Oxford and a pub called the Radcliffe Arms usually comes to mind. While there is truth in this tale, the Carroll Round’s roots extend firmly and unambiguously to the Georgetown University campus. For it was there that an incredible team of friends and colleagues assembled and launched the event in 2001.

During the 1999-2000 academic year, I had the great pleasure of meeting and learning alongside seven outstanding economics classmates. My first meaningful discussions about economics took place that year with fellow students Andrew Hayashi and Ryan Michaels. Andrew and I were both enrolled in Professor Mitch Kaneda’s International Trade class that semester, and Ryan suffered with me through Microeconomic Theory as well as the demanding Introduction to Political Economy. I remember feeling intimidated at first by their ever-expanding knowledge of theory and their boundless enthusiasm for learning. Over time, however, I realized the extent to which I was learning from their unique perspectives; their insights often proved more valuable than the content of weekly lectures. I also became acquainted with a group of young classmates, including Bill Brady, Josh Harris, Kathryn Magee, Brendan Mullen, and Scott Pedowitz. By the spring, our paths all pointed to Europe: Bill, Kathryn, and Scott to the London School of Economics; Brendan to the University of Bristol, and Josh, our resident Slavophile, to Poland and Hungary. Andrew, Ryan, and I planned to spend our year abroad at the University of Oxford studying a mixture of philosophy, politics, and economics. Before departing in October 2000, I knew our shared plans were not the product of mere coincidence—something special would emerge from the experience.

Having established initial ties at Georgetown, Andrew, Ryan and I began meeting on a regular basis to discuss our latest tutorial sessions, grueling problem sets, the future of macroeconomics and, occasionally, the latest gossip about luminaries in the field. Whereas C.S. Lewis, J.R.R. Tolkien, and the other Inklings made The Eagle and Child their intellectual home away from home, we adopted the Radcliffe Arms as our haven. Over pints and pub food, Andrew’s twin passions for game theory and philosophy emerged. The future of monetary policy and development began to vex Ryan’s thoughts, while I hoped...
to better understand the mechanisms of cooperation, or conflict, underlying international trade institutions.

Meanwhile at Pembroke College, I encountered a group of students from universities across the country also spending their junior years at Oxford. Although I befriended the other economists in our contingent, I also developed close relationships with physicists, biologists, literary scholars, and art historians. In the Junior Common Room or over traditional English dinners in the dining hall, we shared stories about life at our respective universities and the latest research we were conducting at Oxford. As thesis and postgraduate plans matured during these conversations, I appreciated ever more my exposure to alternative experiences and approaches to scholarship. The year eventually came to an end, and I worried that these exciting connections would dissolve upon return to the United States.

One evening at the start of my final term in Oxford, I thought about the importance of this dialogue and my growing affinity for international economics. I harbored a distressing feeling that undergraduates, especially in economics, were not afforded adequate opportunities to present their work in a serious research setting. After all, I always felt privileged when Andrew, Ryan, and my fellow Pembrokians shared their original ideas with me. Thus, I concluded that undergraduate economists from around the country deserved an event in which they could interact significantly with each other and the professional academic community. In March 2001, I composed a memo that outlined my solution: the Carroll Round. The following paragraph from that proposal captures my motivating thoughts:

As they prepare for careers in academia, public service, and business, undergraduate students throughout the country also have joined a momentous dialogue in collegiate, national, and global fora. Many are involved in independent research representing the next generation of critical thought in international relations. Others have enjoyed unique experiences through jobs and internship programs that expose them to the front lines of economic policy-making and statecraft. Young women and men also have championed vociferously environmental and labor-related causes through awareness and service programs. Clearly, these timely economic issues are assuming greater importance for the future of international relations and are reflected in the abundance of attendant student research, interest, and initiative. Therefore, I propose to coordinate and host, in association with Georgetown University’s School of Foreign Service and John Carroll Scholars Program, the next ‘round’ of economic and political discussion and debate—the Carroll Round.

Unsure of their likely reactions, I invited Andrew and Ryan to join me in this endeavor over pints at the Radcliffe Arms. I was confident that if such rising stars believed in the concept, other students would join in time. Having worked out more substantive ideas over the summer, I was finally prepared to call upon the other economics celebrities in my class to collaborate on the project. Bill, Josh, Kathryn, Brendan, and Scott fortunately signed on and completed the senior circle. A few months later we welcomed four more students: Cullen Drescher, Mark Longstreth, Waheed Sheikh, and future Chair Meredith Gilbert to
encourage younger students and ensure continuity for the future.

With the unflagging assistance of John Carroll Scholars Program Director John Glavin, the proposal was circulated among university administrators. After gaining their initial support, I asked Mitch Kaneda, my most influential undergraduate teacher and a newly appointed Associate Dean of the School of Foreign Service, to review the proposal. Without hesitation—and somewhat to my surprise—he offered his assistance, embarking on an indefinite and irreplaceable stewardship of the Carroll Round. Also during the fall, Deans Robert Gallucci and Betty Andretta extended moral and financial support, which cemented our institutional sponsorship at Georgetown.

The Carroll Round Steering Committee struggled through many difficult decisions regarding conference content, format, and funding. Should submitted papers be limited to topics in international economics? What elements must be included in submissions and presentations? How do we ensure that financial constraints do not influence students’ decisions to attend? Over marathon sessions in Healy Hall and at the Tombs, we developed a model for the Carroll Round that has largely remained intact. Development Officers Christine Smith and Jim Patti shared our ideas with generous alumni who responded favorably and pledged individual donations. Little by little, our initial concepts materialized into reality. When the Sallie Mae Fund contributed $10,000 to the Carroll Round, we both gained a lead sponsor and secured the long-term future of the conference.

After distributing colorful brochures, contacting the top departments in the country and preparing the Hilltop for the event, applications streamed in during the spring. By late March, we had narrowed our list of invited students to thirty-two. Seniors traveled to Washington from as near as the University of Virginia and as far as Stanford University. The Committee was stunned by the enthusiasm expressed by the participants and their home departments. Among the more notable responses, Illinois-Wesleyan University sent four young economists to the conference and soon after published a special Carroll Round edition of their undergraduate economics journal.

The inaugural Carroll Round officially began on Friday April 5, 2002 and the proceedings came to a close two days later. Participants enjoyed an exclusive audience with Director of the National Economic Council Lawrence B. Lindsey in the beautiful Riggs Library before hurrying to the Federal Reserve for another private meeting with then Vice Chairman Roger W. Ferguson and current Vice Chairman Donald L. Kohn. The two monetary policy experts shared candid stories about the effects of September 11, 2001 on the nation’s banking system and the various roles that the Federal Reserve plays in American economic activity. Dr. Lindsey’s speech marked another first—the first Ibrahim Oweiss Lecture in honor of our beloved Georgetown economics professor. Dr. John Williamson of the Institute for International Economics spoke about development issues over a splendid dinner at Cafe Milano, and Dr. Edwin M. Truman, former Assistant Secretary of the U.S. Treasury for International Affairs, closed the conference with words of wisdom to students considering careers in academia and policymaking.
A total of 28 papers were presented over the weekend, showcasing the impressive work of men and women now at the forefront of academia, law, and business. Georgetown professors who served as panel discussants later remarked that the quality of some presentations met or surpassed the sophistication of recent graduate-level dissertations. Judging by their comments, the conference brought together some of the best young prospects in economics as they approached the frontiers of research.

I never imagined in March 2001 that the first Carroll Round would attain the heights realized one year later, or for that matter even exist. Over the years, the event has grown in size and scope beyond my initial hopes. The participation of Nobel Laureates John F. Nash, Jr. in 2004, Thomas Schelling in 2006, Eric Maskin in 2009, Robert C. Merton in 2010, and Joseph Stiglitz this year, as well as Susan Athey, the first female recipient of the John Bates Clark Medal, in 2008, mark special peaks in the evolution of the conference. Indeed, this year’s slate of speakers could not be more finely tuned to the spirit of the Carroll Round. I am as honored as the University is to host Professor Stiglitz’s Columbia University colleagues Jagdish Bhagwati and Jeffrey Sachs for our decennial celebration. Their groundbreaking work in international economics, including numerous articles and books designed to influence lay readers and public policy decision-makers, demonstrates everything that scholars and practitioners in the field should emulate.

Looking beyond this year’s Carroll Round, I continue to imagine that students from the developing world eventually will be able to attend. Regardless of their home institutions, I continue to enjoy meeting participants and learning about their research interests. As they share in the excitement of presenting their work and the occasional trepidation of fielding questions, I feel humbled to be among such gifted individuals. In fact, alumni from previous years have advanced to graduate study at Berkeley, Chicago, Duke, MIT, Michigan, Northwestern, Oxford, Princeton, Yale, and Wisconsin as well as top government and finance positions around the country. This group of former conference participants has truly grown into a professional and academic network unlike any other for young economists.

As always, I thank the Kazanjian Foundation for their generous support, which made the publication of these Carroll Round Proceedings possible. I also would like to extend my unwavering gratitude to the members of the inaugural Carroll Round Steering Committee without whom this history would have remained fiction. I have great respect and admiration for successive Chairs Seth Kundrot, Meredith Gilbert, Erica Yu, Marina Lafferriere, Stephen Brinkmann, Yasmine Fulema, Rebecca Heide, and Ariell Zimran as they assumed leadership of the conference. Amanda Delp has been a superb leader for the tenth conference. Amanda, her colleagues on the current Steering Committee, and other Committee members past and present have tirelessly ensured the success of the conference each year and deserve our appreciation.

Last year also witnessed the establishment of the Carroll Round’s endowment thanks to the largesse of School of Foreign Service alumnus Yunho Song (‘86). I distinctly remember
meeting with him and some of my closest friends at the Tombs to discuss our fledgling project, uncertain that fall semester in 2001 whether it would ever see the light of day. He was instrumental then in making the Carroll Round a reality, and he now has solidified its place within the fabric of Georgetown and the School of Foreign Service. For that, all of us who have watched the conference grow extend our heartfelt gratitude. The spirit of his gift, though, should live on into the second decade of the Carroll Round. Support from alumni, not just of the financial variety, maintains the conference’s vibrancy long after the proceedings conclude. I encourage each of you to return to Georgetown in April and to consider making any donations to the Carroll Round fund when possible.

Finally, and as always, I must thank Mitch Kaneda who has miraculously preserved my vision for the Carroll Round over the years and watched over past Committees as they built upon its initial success and join the ranks of distinguished alumni. With his continued collaboration and the eagerness of future Georgetown students, the Carroll Round’s next ten years will dwarf the accomplishments of its first ten, creating even more exciting opportunities for undergraduate economists to learn from luminaries in the field and, more importantly, from each other.

Christopher L. Griffin, Jr.
Georgetown Class of 2002
Carroll Round Founder
INTRODUCTION

WHY I SUPPORT THE CARROLL ROUND

Ten years ago when I served as General Counsel of SLM Corporation (Sallie Mae), one of our former directors, Jim Moore (C’68), first suggested that the company should help fund the launch of the Carroll Round. Chris Griffin and Scott Pedowitz, two of the founders, came to our Reston Virginia offices and made a compelling presentation to a number of Georgetown alumni working at Sallie Mae. Soon I became the interface for our connection with the Carroll Round, and when I retired from the company in 2006, my husband (Mike Kershow, L’80) and I decided to continue funding the program through our family foundation.

In the years since I was introduced to the Carroll Round, the scope of its activities and prestige have both grown immensely. Although a novel creation from its roots, the conference has continuously managed to improve and to build a bigger reputation in the undergraduate economics community by attracting the brightest minds in the field finding new directions to cultivate and to highlight student scholarship. As an SFS alumna and benefactor, I have truly been proud to be a part of this endeavor since 2001: besides enjoying impressive student presentations and excellent keynote speeches, I highly value the Carroll Round’s achievements and its significance to me and to its participants.

First, this symposium represents a very targeted and tangible way to support one of the genuinely distinctive features of Georgetown—its focus on international public policy issues—the very attribute that attracted me to the University when I first came to the Hilltop in 1972. At Georgetown I learned to think critically about the national and international issues of my generation and developed my interest in public service. The Carroll Round takes this type of undergraduate dialogue to a whole new level of scholarly excellence.

Second, the program grew out of a student initiative that connects international economics students from all over the country, and increasingly, around the world from Chile to Bulgaria and Latvia to Australia. As we all know, so much of what we learn in college comes from living and learning with our fellow students, both on campus and through our international studies programs. The Carroll Round represents an intensified opportunity for such an experience and significantly enhances the diversity of the academic, professional, and social connections available to undergraduate students.

Third, the focus of the symposium is on real world issues and solutions. Today, more than ever, when we see the lasting impact of the global financial crisis on virtually every community in the world, we need to prepare the next generation of leaders to master concepts of domestic and international economics, understand their real world dimensions, and communicate clearly regarding their implications for public policy.

Georgetown’s School of Foreign Service has a long and distinguished history—and its reputation keeps growing with the quality of its student body and faculty. The Carroll Round has certainly carved its own place into this history by leveraging the best charac-
teristics of the Georgetown experience for ten very successful years. Programs such as this conference offer a one-of-a-kind experience to our best students and burnish our reputation as a center of academic excellence. I am extremely proud to continue my association with this program. I am excited to see what new directions Carroll Round will take and invite others to join me in ensuring an even brighter future for this conference and the institution it has become. I again congratulate the conference’s founders, supporters, and participants and look forward to the continued opportunity to support the Carroll Round in the years ahead.

Marianne M. Keler
SFS’76; L’80
ECONOMIC SHOCKS AND INTERNAL CONFLICT: NEW EVIDENCE FROM THE OPEN-ECONOMY TRILEMMA

Peter Davenport Hull
Wesleyan University

ABSTRACT

Do economic conditions have causal impacts on the likelihood of civil conflict? If so, what country characteristics increase the risk of war during economic downturns? The literature has yet to reach consensus due to difficulties in cleanly identifying exogenous economic shocks for a broad set of developing nations with diverse institutions and economic structures. In this paper, I develop a new empirical strategy to overcome this issue and to measure the extent to which real economic fluctuations affect the probability of civil conflict over a global sample of countries from 1973-2004. Exploiting the so-called open-economy trilemma, I identify via an instrumental variable approach exogenous components of short-run income shocks through differential responses of domestic economies to movements in the interest rates of base countries. My first-stage results are consistent with theory and earlier empirical investigation of the trilemma: short-run economic performance in a small open economy is negatively related to interest rates in its base country, and a country with a fixed exchange rate and open capital account is more sensitive to changes in these rates than a country with a floating exchange rate regime and/or stringent capital controls. Through instrumentation, I find two important second-stage results: one qualitatively similar to earlier work by Miguel, Satyanath, and Sergenti (2004) who study a limited sample of Sub-Saharan African countries, and one new to the literature. First, I find a globally statistically significant and negative relationship between instrumented GDP growth rates and the incidence of civil conflict. The average global effect is found to be smaller than that found by Miguel, Satyanath, and Sergenti in conflict-prone Sub-Saharan Africa, suggesting such geographically limited research may overstate the strength of the conflict-income nexus. Second, I find evidence for nonlinearity in this relationship – countries with more ethnolinguistically fragmented populations tend to fall more easily into civil conflict in the face of a short-term negative income shock. These results are relevant to the discussion of the difficulty with which a culturally divided state absorbs external shocks (Rodrik, 1999) and provides additional evidence for the view that high cultural fragmentation in Sub-Saharan Africa is a lasting cause of its ongoing “growth tragedy” (Easterly and Levine, 1997).
MONETARY POLICY
AND BANK LOAN SUPPLY IN CHINA

Yang Du
Williams College

ABSTRACT
This paper investigates the propagation of monetary policy through the banking system in China by analyzing the effect of policy instruments on banks’ loan supply. Using bank level data for major commercial banks over the past twenty years, I examine the supply side of the narrow credit channel: loan level responses of commercial banks to monetary policy tools of the central bank. I find that banks have disparate but strong responses to different policy levers depending on their type and level of capitalization. Moreover, the major banking reform in the 1990s has changed some characteristics of the bank-dependent propagation mechanism without diminishing its central role in monetary transmission.

1 Introduction

During the recent global financial crisis, the People’s Bank of China (PBC)\(^1\) announced a 586 billion USD stimulus plan in 2008. In the year that followed, the banking sector saw its total credit exploding with more new loans extended in the first four months of 2009 than in all of 2008.\(^2\) Intriguingly, neither the required reserve ratio nor the centrally administered loan and deposit interest rates changed significantly during that period, at least not nearly enough to prompt such a gargantuan scale of lending frenzy from a profit maximizing standpoint. This is but one of the many baffling scenarios where the conventional framework for market economies like the US does not seem to explain the behavior of Chinese banks under a command economy. So how are monetary policies implemented in China and what are the commercial banks’ reactions in the form of loan supply?

This paper sets out to address these puzzles by investigating the response of bank lending to monetary policies in the context of China. In other words, I explore the effectiveness of the narrow credit channel in translating monetary policies into changes in bank loan supply. As pointed out by Agenor & Montiel (2008), the credit channel is of paramount significance in a vast majority of developing countries that lack mature securities markets and whose financial systems are dominated by mega state banks. The relative importance

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1 The People’s Bank of China has assumed the role of Central Bank since 1984.
of the credit channel among all transmission mechanisms in China has also been estab-
lished in Xie (2004), Zhou & Li (2006) and Park & Sehrt (2001). The propagation of
China’s monetary policy through the credit channel is unique in two aspects: the Chinese
central bank has frequently made use of a heterodox combination of monetary instruments
such as excess reserve interest rate, required reserve ratio and window guidance, and the
experience of a major banking reform in mid-1990s that have a potentially huge impact on
the conduct of monetary policies. However, the existing literature has not delved into the
responses of different types of banks to each monetary instrument and the impact of the
reform on these nuances. The focus of this paper is to provide an analysis of the effective-
ness of monetary policy tools on the loan supply of major commercial banks. I assess the
relative responsiveness of the banks both cross-sectionally between large and small banks,
as well as intertemporally spanning 10 years before and after the on-set of the reform. Un-
derstanding the implications of monetary policy for different banks will allow the central
bank to design more effective monetary policies and by analyzing the impact of the reform,
the groundwork can be laid out for the optimal path of a future reform agenda.

First, I briefly explain the essence of the narrow credit channel, which has been dis-
cussed at length in the context of the United States by Romer & Romer (1994), Kashyap
& Stein (1993) and Kishan & Opiela (2000). The classical bank lending channel consists
of mainly four stages. The first stage links the central bank and the monetary base through
monetary policies like open market operations. Changes in the monetary base then trans-
form into changes in banks’ deposit holdings through the constraint of required reserves. In
the next stage, deposit fluctuations cause loan supply to vary accordingly, assuming banks
cannot costlessly substitute between loans and other forms of securities. Lastly, total in-
vestment is affected by the fluctuations in loans available, especially for small and medium
sized enterprises that rely heavily on bank loans for external finance.

In the context of China, the credit channel plays a pivotal role. The People’s Bank
of China wields a heterodox combination of monetary policy instruments that influence
deposits and loans directly, such as credit quota,3 window guidance,4 benchmark loan and
deposit rates, rediscount rate, and required reserve ratio. In mid-1990s, the central bank
started a major overhaul of the banking sector which changed the way monetary policies
were crafted and transmitted. Given the existence of a oligopolistic group of State-owned
Commercial Banks, the implication of the reform on the effectiveness of the credit channel
for different banks is particularly intriguing. I find that distinctions in responses of different
types of banks to monetary policy instruments do exist and some of these disparities can be
attributed to the characteristics of the Chinese banking system. The reform has transformed
the functions of some policy instruments such as the relending rate and changed the way
banks react to some others such as the loan interest rate or the required reserve ratio.

The remainder of the paper is organized as follows. In section 2, I provide some back-

3 The credit quota under China’s context is a directional credit target which dictates the amount and the direc-
tion (to which sector or which area) of loans a bank has to extend in a given year.
4 Window Guidance is often termed 'moral suasion', it has been used to persuade banks and other financial
institutions to keep to official guidelines. The 'moral' aspect comes from the pressure for 'moral responsibility'
to operate in a way that is consistent with furthering the good of the economy.
ground information on China’s financial intermediation. In section 3, relevant literature is discussed. Section 4 establishes a model based on profit maximization behavior of banks tailored to the context of China. Section 5 outlines the specifications of the data. The empirical analysis, interpretation of results as well as a brief discussion of limitations are presented in section 6. Section 7 concludes.

2 Background

The People’s Bank of China (PBC), the Chinese central bank, possesses a variety of monetary policy instruments which could be used to provide stabilization of the economy through the banking sector. The direct quantitative instruments, mainly credit plans, direct PBC lending, and window guidance stem from the legacies of a centrally planned economy before the 1980s. The PBC also has at its disposal the indirect instruments, the most influential of which are required reserve ratios, a full set of heavily regulated interest rates, and open market operations. To adjust to a new financial and economic environment in preparation for deeper integration into the global market, the tools and implementation of monetary policies in China have undergone many changes over the last twenty years, with the most fundamental reforms taking place in the mid 1990s. During this “reform era,” the PBC’s aimed at transforming the financial framework from one in which direct quantitative control was predominant to a more market-oriented structure. Figure 1 summarizes the movements of major PBC policy instruments.\(^5\)

Given the predominance of finance by bank loans in China, it is natural to analyze the effects of monetary policies within the context of the bank lending channel of monetary transmissions. The PBC explicitly states that quantitative credit planning, along with monetary policies, is an important component of its macroeconomic management.\(^6\) As a means to “fine tune” financial structure, credit policies in China are closely connected with monetary policies and mainly carried out in the following forms: (1) setting aggregate growth targets of credit in the economy (credit quota); (2) directing preferential credit to areas and industries that are in need of development and supported by government policies (policy lending); (3) limiting excess commitment of credit to certain industries through “window guidance”; (4) establishing laws and regulations to promote financial reform and innovation, as well as minimizing potential credit risk. Bank lending as the sole carrier of credit policies becomes all-important.

For the bank lending channel to work effectively, the following premises need to be satisfied. First, banks cannot costlessly substitute loans with securities and other types of asset on their balance sheet. This condition is generally true in China for the past twenty

\(^5\) Several characteristics of the graph are worth noting: 1. Instead of adjusting just one policy instrument at a time, the PBC tend to move a combination of policy levers simultaneously; 2. The required reserve ratio stayed constant before 1998 and has been used most frequently in recent years; 3. The law of No Arbitrage failed in early 1987 and mid 1993 when the excess reserve interest rate exceeded the relending rate. The banks could in theory borrow indefinitely from the PBC and deposit the borrowed fund as excess reserve in the PBC again and make an arbitrage profit. This indicates that there are other non-pecuniary costs or constraints that prevented the banks from borrowing excessively from the central bank.

\(^6\) PBC Homepage, www.pbc.gov.cn, Credit Policy, Mission Statements.
Figure 1: Monetary Policy Indicators
years with loans consisting of a large portion of China banks’ assets, approaching 65% in the year 2002, while bonds only made up about 7% of the balance sheet. Second, firms depend predominantly on loans as a source of funding. In 2004, bank loans represented 83 percent of the total funds raised by non-financial sector, while stocks were 5 percent and bonds 12 percent (Garcia-Herrero, et al, 2006). This is again confirmed in Liu & Xie (2006), where the authors find bank loans took up 80.2% of the total financial resources in 2006. In short, I am well-grounded in hypothesizing that the bank lending channel plays the predominant role in China’s monetary policy transmission.

### 2.1 The characteristics of China’s banking system

In analyzing the monetary policy instruments in China, it is important to acknowledge China’s unique financial environment. First, similar to many developing countries, China’s financial market has been dominated by four large State-Owned Commercial Banks (SOCBs): Industrial and Commercial Bank of China, Agricultural Bank of China, Bank of China, and China Construction Bank. The “Big Four” possess more than 80 percent of the entire banking sector’s assets, absorb around 70 percent of the total deposit, and extend over 80 percent of the total lending (Geiger, 2008). The SOCBs do not face much competition from the smaller banks, thus forming a de-facto oligopoly. Furthermore, given their segregated lending targets conveyed partly in their names, the four banks do not compete against each other in all businesses. The scatter plots in Figure 2 of banks in two representative years illustrate the dominant position of the four SOCBs described above.

Second, the balance sheets of Chinese banks consist mainly of loans on the asset side (more than 60 percent in 2002) and deposits on the liability side (around 90 percent in 2002 for the SOCBs). The dependency on deposits as source of funding indicates that Chinese banks do not have means of large-scale external finance from foreign capital markets.

Third, the asset quality of Chinese banks has been historically lower than their foreign counterparts (Barnett, 2004). An unhealthy level of non-performing loans (NPL) persists within the banking system. For example, the share of NPL in total loans for SOCBs in 2004 was 19.15 percent. Moreover, the ratio was much higher before the banking reform, when the majority of bank lending took place as preferential policy lending to specific industries/areas supported by the government.

Fourth, as the Central Bank Law states, “the People’s Bank of China shall, under the leadership of the State Council, formulate and implement monetary policies.” Government intervention is still prevalent despite the reform efforts to steer away from direct control.

Before 1990, the captivity of the central bank was most conspicuously manifested in the “credit plans” that enforced commercial banks to allocate preferential policy loans to industries the government wished to support. Although the use of credit plans has been discontinued after reforms, interest rates are still heavily regulated by the authorities despite slow progress made towards liberalization. Window guidance, which was modeled by...

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7 A significant portion of banks’ securities holding is Central Bank bills which cannot be easily substituted even at the margin. PBC Statistics, Aggregate Data for Year 2003.
8 Both figures are author’s calculation from PBC official statistics at www.pbc.gov.cn.
9 China Banking Regulatory Commission (CBRC) Statistics.
from Japan’s experience, has also played an important role.

Fifth, the banks keep a high ratio of excess reserves, which was well above 10 percent in the 1990s and only gradually dropped to around 5 percent after 2003. Unlike central banks in the developed world, the PBC pays exorbitant interest rates on reserves as well as excess reserves. In mid 1990s, the excess reserve interest rate was at one time as high as 9 percent.\textsuperscript{10} Such high rates on excess reserves predictably dampened the response of financial intermediations to other interest rate fluctuations when banks had the option of using excess reserves as a risk-free investment. Nevertheless, it also played its unique role in that the Central Bank was able to use excess reserve interest rate as an active policy tool.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure2.png}
\caption{Plots of Banks' Total Loans versus Total Deposits (Unit: 100 Million Yuan)}
\end{figure}

\\textsuperscript{10} This is in relative terms to the international standard. For example, the Federal Reserve paid zero interest on excess reserves before 2008 (banks did not keep any excess balance anyways) and is now paying only 0.25\% on the nearly 1 trillion excess reserves in the banking system.
2.2 The reforms of China’s monetary policy

Before a series of reforms that took place in mid 1990s, China’s monetary policy makers aimed for the total credit as the intermediate target, exhibiting the characteristics of a centrally planned economy. PBC and government agencies were the only sources of funding available besides deposits. The common monetary tools used then included credit plans, relending policies, and administered interest rates.

Credit plans were used extensively in the 80s and 90s where the central bank designed and dictated the quantity and direction of loans extended by banks according to its policy objectives. The World Bank has estimated that 60% to 80% of the bank lending went to policy loans (Dickinson, Liu, 2005). Relending policies of the central bank reflect such plans. As was usually the case, large gaps existed between the available funding of the SOCBs through deposit and their assigned loan quota. PBC therefore extended direct lending to the banks through a process called “relending.” The relending rate was the interest rate earmarked for funds provided to SOCBs for policy purposes in the case of deposit shortfalls (Park, Sehrt, 2004). In 1993, PBC refinanced about 40% of the loans from SOCBs. The smaller, non-state-owned commercial banks did not have to shoulder such heavy policy lending responsibilities to state-owned enterprises. Therefore they either did not have to use the PBC relending facility, or could not access central bank funds as easily as the SOCBs.11

Despite having a large proportion of lending directed towards policy loans, banks still had some flexibility in allocating loans. The relending rate as the price of funds from the central bank was the marginal cost of supplying loans. This means that before the reforms, relending policies could have the potential to affect bank’s credit decisions.

Before the 1990s, massive government intervention, low asset quality, and low capitalization characterized the Chinese banking system (Garcia-Herrero, et al, 2006). The first wave of reforms took place in 1994-1995 and the notable changes included relaxation of binding credit plans, adoption of a new Commercial Bank Law to improve managerial incentives and prudential financial regulation, and establishment of policy banks to separate policy from commercial lending12 (Figure 3), as well as the establishment of a unified national interbank market. The purpose of the reform was to converge to the global standard and steer the banks toward becoming more commercially oriented.

In 1998, explicit credit quotas were eliminated once and for all. In its place, PBC started to adopt a policy of “window guidance,” compelling banks to stick to official guidelines (Geiger, 2008). Also since 1998, the required reserve ratio started to assume its importance as a monetary policy instrument and was used frequently in the following years.

Before mid 90s, PBC relending was the main channel of monetary control. After the reforms, open market operations (OMO) were used as the primary tool to manage the monetary base (Bennett, Dixon, 1998). Since 2000, however, as an increasing volume of capital inflows rushed into China, OMOs were used mainly to withdraw liquidity from the

11 The balance sheet data of non-SOCBs demonstrates that they did not borrow from the PBC at all besides for emergency cash clearing purposes which only amounted to a miniscule portion of their liabilities.
12 The large drop in SOCBs’ loan growth demonstrated in Figure 3 around 1994-1995 was justified by the purpose of the policy banks that took over some policy loan responsibilities.
financial system and maintain the de facto peg of the RMB\textsuperscript{13}-dollar exchange rate (Liu, Xie, 2006). Until late 2005 when the peg was relaxed into a crawling peg, repurchase operations (repos)\textsuperscript{14} remained an important sterilization tool. The OMOs have a special implication for loan supply and the credit channel. In order to cope with an increasing pressure from the foreign exchange market, the PBC started issuing Central Bank Bills since the 90s. Although commercial banks acquire such bills at a discount rate through price bidding, some large commercial banks are subjected to directional issuance. That is, they were required to acquire a certain amount of Central Bank Bills by PBC mandate. The acquisition of the bills directly removes excess liquidity from banks and reduces their ability to make loans. The interest rate paid on the short-term Central Bank Bills thus establishes a floor for the rediscount rate.

After the discontinuation of direct central bank lending in 1994 (Geiger, 2008), central bank loans were transformed from a main source of funds for SOCBs’ policy loans to a lender of last resort and a subsidy for policy-oriented activities (Xie, 2004). The reserve requirement that stayed at 13 percent from 1988 to 1998 started to be seen as an effective and direct instrument to manage the liquidity level in the banking system. It has become one of the active tools of monetary adjustments, together with open market operations, rediscount rate, and benchmark interest rates.

Figure 3: Real Loan Growth of SOCBs

\begin{itemize}
  \item The Renminbi (RMB), or the Yuan, is China’s currency which is traded with the US dollar at 6.8 to 1 exchange rate at the moment.
  \item Repo operation is an important arsenal of the PBC which usually consists of the PBC raising yields on its bills and draining liquidity by selling more bonds.
\end{itemize}
3 Overview of Existing Literature

3.1 On China’s banking system and its reforms

The existing western literature has mainly taken interest in the financial reforms of the 90s and their impact on the effectiveness of monetary policies. Geiger (2008) notes that the intermediate target of the PBC has shifted from total credit to money supply after the reform, which is echoed in Liu & Xie (2006). The paper also makes an attempt at investigating the PBC’s usage of multiple monetary policy instruments simultaneously. By analyzing the actual and targeted level of credit, money supply, inflation, and economic growth, Geiger finds that the application of a heterodox mixture of monetary policies has allowed China to reach its final target of price stability and economic growth, even though the intermediate targets were consistently missed. Using two or more instruments concurrently creates various distortions that prevent the interest rate channel of monetary transmission from functioning effectively. Geiger thus proposes a sudden change that suspends all quantity-based instruments like credit quotas, window guidance, and capital controls in order to achieve the original goal of the reforms, restructuring the financial system anchored around interest rates and other market-based instruments.

Garcia-Herrero et al. (2006) identify three centerpieces of China’s reform effort: bank restructuring, mainly aiming at the SOCBs and cleaning their unsustainable level of NPLs; financial liberalization, where credit plans and direct controls of interest rates should be gradually relaxed; and strengthening of supervision and regulation. Similar to Geiger (2008), they also point out that the progress of reforms, albeit commendable, is not fast enough and more radical changes need to take place. Barnett (2004), on the other hand, holds back on his evaluation of the reforms and notes that its full impact will only become clear in a few years. Nonetheless, Barnett supports improvement in banking regulation and transparency.

3.2 On banks’ behavior models in developing countries

Agenor & Montiel (2008) analyze the framework of monetary policy in small open economies where bank loans are the only source of external finance. The paper acknowledges that in many developing countries with an immature securities market, the credit channel becomes all-important. This analysis is relevant for China where firms (especially small and medium enterprises) do resort to bank loans as their main source of funds. The paper proposes a macroeconomic model involving equilibrium in both the financial and goods market, with firms, households, commercial banks, and central banks as players. The part of the analysis of commercial banks is of particular interest to my paper. In their model, banks are assumed to have two assets: lending and required reserves; and two liabilities: central bank borrowing and deposits. Borrowing from the central bank is perfectly elastic at the official refinance rate (the relending rate in China’s context), and banks choose the level of deposit and loan interest rate to maximize their profit subject to balance sheet constraint.

While Agenor & Montiel’s model puts forth a basic framework in analyzing bank behavior in developing countries, we have to be aware of some caveats before applying
it to China’s case. First, Chinese banks hold a large amount of excess reserves. Even in recent years after a decade’s reform, SOCBs still hold around 3 percent excess reserves for which the PBC pays interest. It is an important source of income that affects banks’ lending decisions. Second, I need to take into account the constraint of credit plans in the pre-reform era, which were usually binding for the banks. With the credit quotas to meet, banks were not simply maximizing their profit based on interest rates. Third, the most distinct departure of the Chinese banking system from that in Agenor & Montiel’s model is that all benchmark interest rates, including the central bank relending rate and loan/deposit interest rates, are actively administered by the central government. Banks thus cannot use interest rates as a tool to adjust their balance sheets. Instead Chinese banks choose the level of borrowing, loans, and excess reserves at the exogenously determined rates.

Another notable paper on behaviors of Chinese banks is Park and Sehrt (2001). It argues that the importance of policy lending by Chinese state banks did not fall after the reform and that lending by financial institutions did not respond to economic fundamentals such as sector output and output growth rate. The innovation of their work lies in the development of a bank intermediation model that attempts to incorporate policy lending. The bank intermediation model developed in their paper provides great insight into the behavior of Chinese banks. The incorporation of policy lending into bank’s objective functions implies the existence of window guidance.

Although the paper has shown commendable promise under the constraint of data to model policy lending, it still falls short in several aspects. First, banks should not be able to choose the level of policy lending before the reforms. As discussed earlier, strict lending quotas in the form of credit plans dominated the pre-reform banking system in China. Banks usually were given no alternative but to meet the lending targets, even if it meant borrowing directly from the PBC. Even after reform where window guidance, or moral suasion, replaced credit quotas, it is hard to fathom that banks had much freedom in choosing whether to obey the official guidelines. The legacy of centrally planned economy would have incurred too high a non-pecuniary cost on banks to not abide by the PBC ruling. Indeed more often than not, as demonstrated in Liu & Xie (2006), banks acted according to window guidance in the special period but reversed their actions as soon as window guidance expired, creating undesirable fluctuations in the financial system. Second, the three policy variables in the regression: grain production (GRAIN), state-owned enterprise output (SOEY), and state-owned enterprise profit (SOEP) are insufficient to capture the entire objective function of the PBC in designing the optimal monetary policy or credit targets. Production of different commodities is highly specialized in China. For example, southern China has much higher grain production due to its geographic and climate advantages, while northern China produces more steel. Other factors such as efficiency of transportation in the form of railroads or highways will perceivably also affect the amount of policy lending. Third, it is rather simplistic to infer government’s policy lending objectives from policy variables alone. Besides industrial and area considerations, unobservable factors such as environmental changes and government tastes will all have an impact on the allocation of preferential policy loans.
4 A simple model for Chinese banks

The banking reform in the mid 1990s has profound implications on the behavior of Chinese commercial banks. Before the reform, the PBC set explicit credit plans and banks were subject to loan quotas. There were large volumes of direct lending from the PBC to the SOCBs, implying that the credit quota was binding for banks that resorted to the PBC for funding. A functional interbank market did not exist and banks held large amounts of excess reserves (more than 10 percent).

After the reform, explicit credit quotas were lifted by the PBC. An interbank market was set up where banks could borrow or lend at the interbank offer rate. Although implicit window guidance took place of the credit plans, it was no longer as binding. This is partly because deposit growth has outstripped loan growth in the 1990s for all the SOCBs and banks were flooded with liquidity. Direct borrowing from the PBC discontinued. The banks, however, continued to hold high levels of excess reserves relative to the international norm, exceeding 5 percent entering the year 2000. Therefore I propose separate bank profit maximization models before and after the reform.

4.1 A bank model for the pre-reform era, 1986-1997

Bank’s liability side consists of deposit, $D$, and borrowing from the central bank, $B$. Deposit is assumed to be exogenous. The asset side consists of loans, $L$; required reserves, $\alpha D$ where $\alpha$ is the required reserve ratio determined by the central bank; and excess reserves, $E$. As the level of required reserves is exogenous, I can assume no interest rate paid on them without compromising the analysis of the model. Therefore the balance sheet constraint is such that

$$E + L + \alpha D \leq D + B \quad \text{or} \quad E + L \leq (1-\alpha)D + B$$

Naturally, the level of excess reserves cannot be negative, neither is the level of borrowing from the PBC. Banks face the set of exogenous interest rates that is centrally administered and a credit quota $L^*$ imposed by the PBC. They can choose the levels of $L$, $B$, and $E$ to maximize their objective function:

$$\max_{L,B,E} U = r_L L + r_E E - r_D D - r_B B$$

s.t. $E + L \leq (1-\alpha)D + B$

$$E \geq 0, \quad B \geq 0, \quad L \geq L^*$$

where: $r_L(L,i_L)$ is the return on loans that depends negatively on $L$ and positively on $i_L$, the loan interest rate. The negative partial derivative on $L$ captures the fact that risk assessment becomes more difficult and the ratio of NPLs tend to become higher the larger amount of loans a bank extends (Stiglitz & Weiss, 1981). $r_E(E, i_E)$ is the return

15 See Appendices, Figure 10.
on excess reserves that depends positively on the excess reserve interest rate, \( i_E \). The non-pecuniary return of holding excess reserves also captures the 'safety factor' a bank gains so that they are less likely to face a liquidity crisis. The more excess reserves, the less marginal 'safety' it offers the bank\(^{17}\). Hence \( r_E \) depends negatively on \( E \). \( r_D = i_D \) is the cost of holding deposits which is assumed to be equal to the deposit interest rate and exogenously determined.

\[
r_B(B, i_B) \text{ is the cost of borrowing from the PBC. First it depends positively with the relending rate, } i_B. \text{ We would also expect greater non-pecuniary cost incurred on a bank the more it tries to borrow from the central bank. Such costs can take the forms of ceding more of the bank’s autonomy to the PBC in order to obtain loans, for example. Therefore } r_B \text{ is positively correlated with } B.\]

From the set up it is clear I have assumed that banks are not “pure” profit maximizers because returns on assets and costs on liabilities are not completely pecuniary. Solving the first-order conditions in this case requires us to invoke the Kuhn-Tucker conditions for the nonnegativity constraints. The cases where \( E, B \) are binding will yield rather uninteresting results. Also in reality, excess reserves and direct borrowing from PBC were definitely not zero before the reforms. I only consider the case where neither \( E \) or \( B \) is binding.

If \( L^* \) is non-binding, first-order conditions yield:

\[
\begin{align*}
r'_L L + r_L &= \lambda \\
r'_B B + r_B &= \lambda \\
r'_E E + E &= \lambda
\end{align*}
\]

where

\[
\begin{align*}
r'_L &= \frac{\partial r_L}{\partial L}, \quad r'_B = \frac{\partial r_B}{\partial B}, \quad r'_E = \frac{\partial r_E}{\partial E}
\end{align*}
\]

In short, \( MRL = r'_L L + r'_L \) is the marginal return of loans, \( MCB = r'_B B + r'_B \) is the marginal cost of borrowing from the PBC and \( MRE = r'_E E + E \) is the marginal return of holding excess reserves. Therefore the first-order conditions require \( MRL = MRE = MRB \), keeping in mind the constraint \( L + E = B + (1 - \alpha)D \). See Figure 4 for a simple graphical illustration.

\( r_B(0) = i_B \) is the marginal cost of borrowing when banks just start to borrow and it equals the relending rate. \( r_E(0) \), on the other hand, is the marginal return of excess reserves when \( E = 0 \). It is higher than the excess reserve interest rate \( i_E \) because the non-pecuniary 'safety factor' is the highest when \( E = 0 \). The negative slope of \( MRE \) is steeper than that of \( MRL \) because otherwise banks will start holding excess reserves as soon as \( MRL = r_E(0) \). In the graph, I assume that the level where \( MRL = MRE \) is lower than \( r_B(0) \). Therefore \( B \) becomes binding and the bank splits its resources \((1 - \alpha)D\) between loans and excess reserves, extending loans up to the point where the marginal return of holding excess reserves

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\(^{17}\) Banks that fail to meet the reserve requirement after running out of excess reserves usually face hefty fines. The PBC can, for example, force the bank to acquire central bank bills at a below-market interest rate.
reserve becomes higher. The levels of \( L \) and \( E \) are shown in the graph.

Under this scenario, an increase in the loan interest rate \( i_L \) shifts \( MRL \) upwards, raising the level of loans and decreasing excess reserves provided \( B \) is still binding. Decreasing the excess reserve interest \( i_E \) shifts the \( MRE \) curve down and produces the same effect. If \( B \) remains binding, the relending rate that changes the level of \( r_B(0) \) does not have any effects on bank loans. Increases in the deposit rate \( i_D \), although exogenous in this model, will tend to induce the level of deposit, \( D \), to increase accordingly, thus moving the \( MCB \) curve horizontally to the right. Both loan and excess reserve will increase. A decrease in official required reserve ratio gives the same result.

However, the assumption that \( L = L^* \) is non-binding does not necessarily represent the context of China before reforms. From Appendices, Figure 10, it is clear that banks in the pre-reform era usually had higher lending than their resources from deposit. The deficiency can only be filled with borrowing from the PBC. Therefore, I shall look at the scenario where \( L = L^* \) is binding, and the level of credit quota, \( L^* \), is greater than the costless available resource, \((1 - \alpha)D\). Figure 5 below plots a similar graph under the new constraints.

Now we have \( L = L^* \) fixed. The shortage of funds of the banks is covered by direct lending from the central bank. The bank then hold excess reserves up to the point where the marginal return on excess reserves equals the marginal cost of borrowing. As Chinese banks always hold a certain amount of excess reserves, I can set the level of \( r_E(0) \) to be an upper bound of the \( MCB \) curve with negative second order derivative w.r.t. \( B \).

![Figure 4: \( L^* \) non-binding, \( B \) binding](image)

From the graph I can again interpret the implications of monetary policy before reforms. First note that the level of loans is exogenously determined as banks will always lend at the
minimum required level $L^*$. Loan interest rate, by shifting the $MRL$ curve, does not have any impact on the level of loans, excess reserves, or borrowing. Borrowing is determined first by the difference between $L^*$ and $(1 - \alpha)D$, then by the $MCB$ and $MRE$ curves. All excess reserve holdings are financed by central bank borrowing. Hence if $L^*$ increases, $L$ increases accordingly, $B$ increases, but $E$ will decrease as the $MRE$ curve shifts horizontally to the right, intersecting $MCB$ at a lower level of excess reserve. If the relending rate $i_B$ increases, $MCB$ shifts vertically upwards, resulting in a decrease in both $E$ and $B$. Lower required reserve ratio and larger total deposit (possibly induced by an increase in $i_D$) shifts $MCB$ horizontally to the right, resulting in an increase in both $E$ and $B$.

The figure represents only one possible regime a specific bank could be in given its objective function and non-pecuniary costs associated with its transactions. Different types of banks, or the same group of banks with different sizes, may well fall in disparate regimes where monetary policies will have distinctive effects. In Figure 5, for example, if a bank has higher marginal rate of return from loans at a given level of loan supply, its higher $MRL$ curve could cut the $MCB$ curve beyond the credit quota constraint. Under this scenario, loan interest rate and relending rate will have an impact on loan supply. One of the purpose of this paper is to identify the regimes different banks, or the same bank in different eras, belong, thus drawing conclusions about their responses to monetary instruments.

![Figure 5](image)

**Figure 5**: $L^*$ binding, $B,E$ non-binding, $L^* > (1 - \alpha)D$

### 4.2 A bank model for the post-reform era, 1998-2008

After the banking reform, credit plans no longer exist. Banks have the new option of transaction in the interbank market at the interbank offer rate. I take the basic form of the previous model and make the necessary adjustments. Banks now have net interbank lending $I$ on their asset side. If $I$ is negative, it indicates net interbank borrowing. Assume
the interbank rates for lending and borrowing are the same, the banks’ profit maximization problem then becomes:
\[
\max_{L,I,E,B} U = rLL + rEE + rII - rDD - rBB
\]
\[
s.t. \quad E + L + I \leq (1 - \alpha)D + B
\]
\[
E \geq 0, L \geq 0, B \geq 0
\]
where \( r_j = i_j \) is the interbank offer rate, the universal rate at which banks borrow and lend in the interbank market.\(^{18}\) This rate can be perceived as the marginal return of lending and the marginal cost of borrowing in the interbank market at the same time, i.e. \( MRI = MCI = i_r \).

Assume that none of the nonnegativity constraints are binding (In reality, \( B \) is closest to be binding, but some SOCBs still borrow small amounts from the PBC as a source of emergency funding). The first-order conditions yield:
\[
\begin{align*}
    r'_LL + r_L &= \lambda \\
    r'_LE + r_E &= \lambda \\
    r'_BB + r_B &= \lambda \\
    r_I &= i_I = \lambda
\end{align*}
\]
where the notations are the same as before. Solving the FOCs gives the relationship \( MRL = MRE = MCB = i_r \), which is illustrated graphically in Figure 6. The implication of the model can be clearly seen on the graph. The amount of loans banks choose to lend depends solely on the interbank interest rate \( i_I \) and the return on loans \( r_L \). Banks keep excess reserves until the marginal return on reserves drops below the return on interbank lending. Banks then lend all resources in the interbank market and even borrow from the PBC if the interbank offer rate is higher than the relending rate.\(^{19}\)

Under this framework, the offer rate becomes all important. Although it seems unrealistic that variables such as relending rate, required reserve ratio, and excess reserve interest rate all have no bearings on bank lending, we need to keep in mind that the interbank offer rate is affected by the whole set of interest rates administered by the PBC. The relending rate and excess reserve interest rate are particularly important as they constitute the upper and lower limit for the offer rate (Xie, 2004) significant at the 1% level.

---

18 I assume that there is no transaction or administrative costs in the interbank market, thus the interest on borrowing and lending is the same.

19 Of course in reality, the non-pecuniary cost of non-collateralized borrowing from the PBC may be infinitely high if the banks are using the relending facility for purposes other than policy lending or emergency funding.
For smaller commercial banks, they are thought of being more market-oriented than the SOCBs. In addition, as the smaller banks are not usually burdened with the task of carrying out policy lending, we would expect the proportion of NPLs for them to be much lower than that of the SOCBs. This means that those banks have a much higher $MRL$ curve, which could intersect the $MCB$ curve above $r_B(0)$. This scenario is plotted in Figure 7:
When the return of loans is high, banks borrow from the interbank market and lend to them in the form of bank loans. Excess reserves are also funded by borrowing from the interbank market until the cost of borrowing exceeds the return on reserves. Deriving from Figure 7 alone, interbank offer rate is still the only determinant of the level of $L_B$ and $E$. This model is more consistent with the western banking framework, where the interbank market plays the predominant role in influencing bank lending. This result may, to some extent, demonstrate the progress made by the Chinese banking reforms towards a more global standard.\footnote{I have intentionally left out the rediscount rate from the model, which is thought to be one of the most important monetary policy instruments. This is because the MCB curve effectively captures the cost of borrowing from the central bank, which if we assume no direct borrowing post-reform, is substitutable for a marginal cost of collateralized borrowing (rediscount rate) curve. The slope of this curve is then determined by the rediscount rate in the same way as the MCB curve depends on the relending rate.}

It is important to keep in mind that based on the maintained assumption that loan level is supply constrained, my model is restricted to the partial equilibrium on the “supply side,” or the banks’ response to monetary policy in the form of loan supply changes. To model the demand side, thorough knowledge and understanding of the objectives functions of Chinese firms are required as well as firm-level data which is difficult to obtain. However, I argue that modeling from the supply side is sufficient in most cases in the empirical section.

5 Data

The sample of bank data is compiled from the People’s Bank of China Statistics, China Finance and Banking Almanac 1986-2008, and various other published sources available online.\footnote{Sources: People’s Bank of China Homepage, www.pbc.gov.cn; Financial Research Resource Center, www. ripbc.com.cn; Renmin University of China Economic Forum, www.pinggu.org; individual bank’s web-sites and other available (free) data bases online.} It contains comprehensive annual data of important macroeconomic indicators and bank level data for the major banks. The set of data I have compiled and will be using extensively is the annual balance sheet data of the four SOCBs and eleven smaller commercial banks over a twenty year span, from 1986 to 2007. A summary of the characteristics of the banks is presented in Table 1.

In the previous sections I have outlined the two aspects of the Chinese banking system that motivate the thesis of this paper: the oligopolistic nature of the four dominant State-Owned Commercial Banks (SOCBs) versus the smaller commercial banks and the pre-reform era of direct PBC control versus the post-reform era of indirect market-oriented guidance. Having these objectives in mind, I divide the bank data from 1986-2007 by the nature of the banks and whether it is in the pre-reform or post-reform periods.

It is easy to separate the data by banks as the SOCBs have always consisted of the “Big Four”: Industrial and Commercial Bank of China, Agricultural Bank of China, China Construction Bank, and Bank of China, each of which focuses on a different sector, namely industry and commerce, agriculture, construction and foreign currency transactions.\footnote{In recent years, Bank of Communications has grown both in size and importance to that comparable to...}
four banks will be grouped together under “SOCBs” in my regression analysis. All other banks in the data set are either much smaller national banks such as Bank of Communications and CITIC Bank, or local commercial banks such as Shanghai Pudong Development Bank. They will be categorized under the “non-SOCBs” group.

Separating the two decades from 1986-2007 into pre-reform and post-reform era, however, is not as straightforward. The reform started since early 1990s as described earlier. Although the most groundbreaking steps have taken place before the year 2000, I still cannot assert that the reform has completed.23 The most significant policy changes by the PBC did not happen within a short period of time, but rather spanned across at least five years in mid-1990s. Table 2 (Park & Sehrt, 2004) summarizes the timeline of major policy changes during the reform.

Due to the fact that some of the PBC’s policy instruments did not become fully operational until late 1990s, it is difficult to analyze the entire data set with a reform dummy. The strategy of this paper is to split the data into two periods, pre- and post-reform, and apply empirical analysis specifically suited to that period. Although the reform has been a gradual, and indeed ongoing, process, our strategy requires us to identify a threshold year that distinguishes the pre- and post-reform eras.

I have several candidates to choose from based on the reform summary table. In 1994, the PBC centralized relending and prohibited local PBC branches from making direct lending decisions. This prevented excessive lending arising from the political influence of local government officials on the branch managers. In the same year, the PBC initiated a new method of managing approved credit volume of banks. From a “quantitative management” of setting administrative credit targets, the PBC switched to a “ratio management” of assigning credit volume based on a maximum ratio between deposits and loans (Xie, 1997). Banks were granted more flexibility in allocating funds by drawing on interbank transfers. Also in that year, three policy banks were set up to take away part of the policy loan obligations from the SOCBs, lending them more autonomy in pursuing commercial goals. Another year of interest is 1996. The new commercial bank law aiming at improving managerial incentives were in full swing (it was legislated in May, 1995). A fully functional interbank market was established and CHIBOR (China Interbank Offer Rate) was officially documented. The year 1998 was also marked by exceptional policy turning points. The explicit credit quota was eliminated and central bank relending discontinued its role as a tool of managing total credit and became a lender of last resort. The rediscount rate became an independent monetary policy instrument and started to play a significant role in steering the economy. Before 1998, it was set to float around 5-10% below the ongoing loan interest rate.

In light of the above discussion, I choose 1998 as the first year of the post-reform era noting that the timing of several reforms does not agree exactly with such division.

23 The agenda of liberalizing interest rate and exchange rate has until now stagnated, as argued in Mehran & Quintyn (1996).
Table 1: Summary Statistics of Banks

<table>
<thead>
<tr>
<th>Bank Abbrev.</th>
<th>Years Data Available</th>
<th>Total Assets *</th>
<th>Total Liabilities *</th>
<th>Total Loans *</th>
<th>Total Deposits *</th>
<th>Total Reserves *</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICBC†</td>
<td>1985 - 2007</td>
<td>3287-86843</td>
<td>3062-81400</td>
<td>2963-39575</td>
<td>1935-68984</td>
<td>325-11423</td>
</tr>
<tr>
<td>BOC†</td>
<td>1985 - 2007</td>
<td>2605-50102</td>
<td>2512-46194</td>
<td>947-23360</td>
<td>1162-36178</td>
<td>3-7877</td>
</tr>
<tr>
<td>CCB†</td>
<td>1985 - 2007</td>
<td>1688-65981</td>
<td>1504-61758</td>
<td>552-31832</td>
<td>576-53403</td>
<td>317-9673</td>
</tr>
<tr>
<td>BOCM</td>
<td>1987 - 2007</td>
<td>201-21036</td>
<td>175-19748</td>
<td>66-10827</td>
<td>93-15558</td>
<td>87-2596</td>
</tr>
<tr>
<td>CITIC</td>
<td>1987 - 2007</td>
<td>87-10112</td>
<td>87-9270</td>
<td>38-5658</td>
<td>49-7872</td>
<td>0-1233</td>
</tr>
<tr>
<td>GDBD</td>
<td>1989 - 2007</td>
<td>35-4375</td>
<td>35-4221</td>
<td>22-1938</td>
<td>8-2891</td>
<td>0-616</td>
</tr>
<tr>
<td>SZDB</td>
<td>1987 - 2007</td>
<td>4-3525</td>
<td>4-3395</td>
<td>3-2158</td>
<td>4-2813</td>
<td>1-407</td>
</tr>
<tr>
<td>CMB</td>
<td>1988 - 2007</td>
<td>24-13106</td>
<td>24-12426</td>
<td>19-6544</td>
<td>16-9435</td>
<td>0-1526</td>
</tr>
</tbody>
</table>

Note. 1. All bank level data are compiled from China Finance and Banking Almanac 1986-2008.
2. Total reserve data come from documented results and author’s calculation, which might be prone to errors.
3. All values are the current year value, not adjusted to a base year, rounded off to zero decimal place.
4. Bank Abbreviations stand for: ICBC, Industrial and Commercial Bank of China; ABC, Agricultural Bank of China; BOC, Bank of China; CCB, Construction Bank of China; BOCM, Bank of Communications; CITIC, China CITIC Bank; Everbright, China Everbright Bank; Huaxia, Huaxia Bank; Minsheng, China Minsheng Bank; GDBD, Guangdong Development Bank; SZDB, Shenzhen Development Bank; CMB, China Merchants Bank; CIB, China Industrial Bank; SHPDB, Shanghai Pudong Development Bank; Evergrowing, Evergrowing Bank.
*: All values are of unit 100 million RMB (1 Yi), displaying minimum and maximum value over the years available.
†: State Owned Commercial Banks (SOCB).
Empirical Analysis and Results

6.1 Empirical Strategy

In the previous section I have outlined the method of dividing the data set into four subsets: pre-reform SOCBs, pre-reform non-SOCBs, post-reform SOCBs and post-reform non-SOCBs. From the bank maximization model developed in earlier sections, I can identify the endogenous variables as the quantities of loans, excess reserves and borrowing from PBC, while the exogenous variables are centrally administered interest rates and the level of deposit. Banks choose the level of loans, excess reserves, and borrowing from PBC, while the exogenous variables are centrally administered interest rates and the level of deposit. As the banks cannot autonomously adjust their deposit rate, it is safe for us to assume that they cannot determine the level of deposit in our simple model. I also assume that the depositors in China are generally not sensitive to banks' balance sheet conditions. As a centrally planned economy, China has never allowed

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Guidance, rather than binding credit plans</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>2. Centralized relending</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>3. Ratio management</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>4. Commercial Bank Law</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>5. Policy banks</td>
<td>no</td>
<td>no</td>
<td>yes*</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>6. Interbank market</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>7. Indep. rediscount rate</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

Table 2: Financial Reform Summary: 1991-1998


Policy banks were established gradually throughout the year. Most ADBC branches were established in late 1994.
PBC to maximize profit (objective function). To analyze the working of the credit channel, I posit bank loans as the dependent variable, with independent variables being the various exogenous interest rates and the level of deposit.

Before regression analysis, I take first difference of the loan, excess reserve, PBC borrowing, and deposit levels to eliminate the potential non-stationarity in the panel time series. The difference in levels are normalized by the previous year’s total assets to mitigate the cross sectional heterogeneity of levels. Furthermore, bank fixed effects are controlled for in the regressions. This is because the State-owned Commercial Banks each have their own preferential sectors to which they extend loans. The smaller banks, on the other hand, face different loan situations according to geographical locations or specialized functions. Therefore, there are bank level idiosyncratic characteristics that affect their loan supply.

Although the data set has been divided into SOCBs and smaller commercial banks, banks within the same group still exhibit dissimilar constraints. One of the constraints that directly influences lending decisions and hence the effectiveness of the credit channel is the level of capitalization, or in other words, the shareholders’ equity given by the difference between total assets and total liabilities. Kishan and Opiela (2000) find that from 1980 to 1995, small and under-capitalized banks were most significantly affected by monetary contractions. Without the luxury of a large data set for finer divisions by capital-asset ratio, I propose to include interaction terms between banks’ normalized capitalization and the policy variables in order to explore the cross-sectional differences within a group.

From the earlier discussions of characteristics of the Chinese banking system in the pre-reform era, I hypothesize that credit quotas were not a hard constraint for banks (especially SOCBs which carried the obligation of majority of the policy loans). In other words, although the SOCBs needed to utilize heavily the PBC relending facility to meet the policy lending quotas, they were still able to pursue some degree of commercial lending after meeting the credit targets. This restricted flexibility allowed them to respond to changes in interest rates. The credit quotas were determined by the government’s policy objectives, the state of development of different sectors of the economy, and regional preferential policies, which were intangible characteristics that could not be captured by my model. Thus, for state-owned large banks heavily constrained by the credit quota, they should be much more responsive to the relending rate than to the loan interest rate.

In the pre-reform period, the main policy instruments of the PBC were credit plans, relending policies and benchmark interest rates. Although the required reserve ratio was at the disposal of the PBC, it was never used for most of the 1986-1995 period, staying constant at 13%. I propose the following estimation equation for both SOCBs and non-SOCBs.

---

26 For example, Shanghai Pudong Development Bank was established to support the development of the Pudong pioneer economic zone. China Merchants Bank, on the other hand, is a nation-wide bank founded with the mission of providing retail services.

27 This is because with heavy quantity management like credit plans in place, the usage of another quantity
SOCBs:

\[
\Delta L_{it} = \beta_0 + \beta_1 r_{Bl} + \beta_2 r_{El} + \beta_3 r_{Lt} + \beta_4 \Delta D_{it} + \beta_5 \text{year} \\
+ \beta_6 \text{cap}_{it} + \beta_7 \text{cap}_{it} \ast r_{Bl} (\beta_8 \text{cap}_{it} \ast r_{Et}) (\beta_9 \text{cap}_{it} \ast r_{Lt}) \\
+ \lambda_i + u_{it}
\]

(1)

Where just as in my earlier models, $\Delta L$ denotes change in loans normalized by previous year’s asset, $\lambda_i$ is a vector of bank dummy variables, $r_B$ is the relending rate, $r_E$ denotes excess reserve interest rate, $r_L$ is the weighted average loan interest rate, $\Delta D$ is normalized change in deposit, year represents the time trend, and $\text{cap}$ is bank’s capitalization which is interacted with each policy instrument in separate regressions. The variable $\text{cap}$ is calculated as follows:

\[
\text{cap}_{it} = \frac{\text{capitalization}_{it}}{\text{total asset}_{it} - \text{total liabilities}_{it}}
\]

The parenthesis in the regression model indicates that the interaction terms are applied one at a time and separately estimated. A summary of the variables are reported in Table 3.

After the reforms, direct credit control was discontinued and a large portion of the policy lending obligations was transferred to policy banks. Commercial banks were given more flexibility in making their own credit allocations to pursue greater commercial gains. As a result, changes in loan levels would then respond to a slightly different set of PBC policy instruments.

Besides the usual policy tools such as loan rate, relending rate and excess reserve interest, the rediscount rate became an effective arsenal of the central bank. More importantly, the rediscount rate can be actively managed by the PBC to influence interbank offer rate in the interbank market. The required reserve ratio as a monetary policy instrument has reassumed its importance after the reforms. It has been used frequently to drain excess liquidity from the banking system (Xie, 2004). Thus I propose the following estimation equation in the post reform period for both SOCBs and non-SOCBs:

\[
\Delta L_{it} = \beta_0 + \beta_1 r_{Bl} + \beta_2 r_{El} + \beta_3 r_{Lt} + \beta_4 r_{Rt} + \beta_5 \Delta RR_{Rt} \\
+ \beta_6 \Delta D_{it} + \beta_7 \text{year} + \beta_8 \text{cap}_{it} + \beta_9 \text{cap}_{it} \ast r_{Bl} (\beta_{10} \text{cap}_{it} \ast r_{Et}) \\
(\beta_{11} \text{cap}_{it} \ast r_{Lt}) (\beta_{12} \text{cap}_{it} \ast r_{Rt}) (\beta_{13} \text{cap}_{it} \ast \Delta RR_{Rt}) + \lambda_i + u_{it}
\]

(2)

$r_R$ is the weighted average rediscount rate and $\Delta r_R$ is the change in official reserve requirement. Similar to the pre-reform estimation equation, I interact capitalization with each policy instrument in separate regressions. Table 4 reports a summary of the variables.

28 The capitalization variable is similar to the capital-asset ratio, except that total equity is divided by past year’s assets instead of current year’s assets to avoid potential endogeneity issues.
29 Due to inconsistencies in balance sheet format, some non-SOCBs categorized owners’ equity under liabilities, thus creating equal amount of total asset and total liabilities. This explains the minimum value of zero for the capitalization of non-SOCBs.
30 The culprit for the seemingly impossible negative minimum capitalization for non-SOCBs is the Everbright Bank. From 2004 to 2006, the bank reported negative owners’ equity. Clearly the government has
Table 3: Pre-Reform Summary Statistics: 1986-1997

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Loans (ΔL)</td>
<td>48</td>
<td>0.112</td>
<td>-0.111</td>
<td>0.270</td>
</tr>
<tr>
<td>Change in Deposits (ΔD)</td>
<td>48</td>
<td>0.118</td>
<td>0.0296</td>
<td>0.290</td>
</tr>
<tr>
<td>Capitalization (cap)</td>
<td>48</td>
<td>0.0559</td>
<td>0.0</td>
<td>0.125</td>
</tr>
</tbody>
</table>

Other Commercial Banks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Loans (ΔL)</td>
<td>68</td>
<td>0.275</td>
<td>-0.0583</td>
<td>1.184</td>
</tr>
<tr>
<td>Change in Deposits (ΔD)</td>
<td>68</td>
<td>0.376</td>
<td>-0.104</td>
<td>2.165</td>
</tr>
<tr>
<td>Capitalization (cap)</td>
<td>68</td>
<td>0.0936</td>
<td>0.0</td>
<td>0.463</td>
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</table>

Policy Instruments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relending Rate (r_B)</td>
<td>12</td>
<td>8.73</td>
<td>4.68</td>
<td>11.03</td>
</tr>
<tr>
<td>Excess Reserve Interest (r_E)</td>
<td>12</td>
<td>7.31</td>
<td>4.92</td>
<td>9.18</td>
</tr>
<tr>
<td>Loan Interest (r_L)</td>
<td>12</td>
<td>9.65</td>
<td>7.92</td>
<td>11.52</td>
</tr>
</tbody>
</table>

Table 4: Post-Reform Summary Statistics: 1998-2007

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Loans (ΔL)</td>
<td>40</td>
<td>0.0571</td>
<td>-0.183</td>
<td>0.246</td>
</tr>
<tr>
<td>Change in Deposits (ΔD)</td>
<td>40</td>
<td>0.107</td>
<td>-0.0490</td>
<td>0.193</td>
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<td>Capitalization (cap)</td>
<td>36</td>
<td>0.0561</td>
<td>0.0166</td>
<td>0.0985</td>
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</table>

Other Commercial Banks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
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<td>Change in Loans (ΔL)</td>
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<td>Change in Deposits (ΔD)</td>
<td>110</td>
<td>0.217</td>
<td>-0.286</td>
<td>0.794</td>
</tr>
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<td>Capitalization (cap)</td>
<td>99</td>
<td>0.0486</td>
<td>-0.0139</td>
<td>0.165</td>
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Policy Instruments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
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<tbody>
<tr>
<td>Relending Rate (r_B)</td>
<td>10</td>
<td>4.09</td>
<td>3.24</td>
<td>6.99</td>
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<tr>
<td>Excess Reserve Interest (r_E)</td>
<td>10</td>
<td>2.55</td>
<td>0.99</td>
<td>4.67</td>
</tr>
<tr>
<td>Loan Interest (r_L)</td>
<td>10</td>
<td>5.96</td>
<td>5.31</td>
<td>7.50</td>
</tr>
<tr>
<td>Change in Reserve Ratio (ΔRRR)</td>
<td>10</td>
<td>-0.14</td>
<td>-4.17</td>
<td>3.59</td>
</tr>
<tr>
<td>Rediscount Rate (r_R)</td>
<td>10</td>
<td>3.13</td>
<td>2.16</td>
<td>5.15</td>
</tr>
</tbody>
</table>

allowed the bank to survive when it was effectively bankrupt.
Before discussing the results, I will briefly review the interpretation of coefficients according to the predictions of my earlier model. Before the reforms took place, large banks borrow heavily from the central bank. In addition to meeting the credit quota, PBC loans also helped to fund the limited autonomous loans which the banks could pursue to maximize profit. Therefore, large banks’ loan levels should be strongly affected by fluctuations in relending rate. Loan interest rates may have an impact too, but it is expected to be smaller than the effect of relending rate, depending on the degree of flexibility the individual bank enjoys. Non-SOCBs on the other hand should not respond to the relending rate since they barely borrowed from the PBC. Unencumbered by heavy policy lending responsibilities, the smaller commercial banks were expected to be more profit oriented.

One of the most notable impacts of the reform on the banks is the elimination of credit quotas and discontinuation of PBC direct lending as a means of controlling the total credit in the market. If the reform has achieved its goals, banks would become more market-oriented and react more aggressively to a broader set of interest rates. Rediscount rate affects a bank’s ability to obtain collateralized funds from the central bank and acts as a beacon for the interbank market. Increases in required reserve ratio should directly constrain the resources available for banks to make loans. Even though most banks keep a substantial level of excess reserves which acts as a buffer to such policy shocks, their loan levels would decrease nonetheless if banks are reluctant to allow their excess reserves to shrink substantially.

The story outlined in Kishan and Opiela (2000) should also be true in China’s case. Both before and after the reforms, small banks with low capital-asset ratio would have trouble securing other types of funds when monetary policies are contractionary. Monetary policies would then have the most notable impact on their loan supply. Compared to well-capitalized SOCBs, such banks would be more prone to using the PBC’s relending facility as a lender of last resort in the post reform era, hence becoming more exposed to relending rate fluctuations. Kishan and Opiela identify similar mechanisms that serve as evidence of the existence of the narrow credit channel in the US. Through empirical analysis, I would like to test if such mechanism is at work in China’s context, and whether the large, liquid banks are affected as well.

6.2 Results
Table 5 reports the estimation result of equation (1) for pre-reform period. The effect of the loan interest rate behaves according to our predictions. Increases in the loan interest rate result in increases in the loans by SOCBs, although the coefficients are not statistically different from zero as shown in column 1. The lack of significance suggests that those banks were subject to heavy state control and credit quotas so that they did not respond to market interest rates as one would expect commercial banks to. The non-SOCBs were subject to fewer policy lending obligations and were more profit oriented. Not surprisingly, the loan interest rate has an impact on their loan supply which is significant at 5% level as column 5 and 6 of Table 5 demonstrate. Interestingly, the coefficients are negative for the non-SOCBs. A one percentage point increase in loan interest rate decreases the level of loans by more than 10% of past year’s asset. The characteristic structure of the Chinese
banking system before reforms could be invoked to explain this phenomenon. Before late 1990s, the state-owned enterprises were the largest consumers of loans and were supported by policy loans from the SOCBs. As a result, large state banks dominated the loan market (Geiger, 2008). Their loan supply was the binding constraint that determined the eventual level. Hence increases in loan interest has a positive effect on loan level through influencing the supply side. For small banks, however, loan demand was binding as their customers were either small enterprises or regional businesses. Increase in loan interest depresses demand, thus reducing the loan levels of the non-SOCBs.

Figure 8 is a simple illustration of the above discussion. As price takers facing an exogenous loan interest rate, higher demands for loans from the SOCBs resulted in the market equilibrium above the loan level, while the equilibrium was below the same loan level for non-SOCBs. The figure on the left also shows that credit quotas for the state banks were not a hard constraint.

As expected, positive changes in the relending rate are associated with negative changes in SOCBs’ loan supply. The large state banks extended enormous amount of policy loans, which were mainly supported by the relending facility. This explains their sensitivity towards the interest rate charged on the borrowed funds from PBC. A one percentage point increase in the relending rate is associated with a decrease in the level of loans equivalent to roughly 2.5% to 3% of previous year’s asset. Given the fact that loans comprised more than 70% of the total asset on banks’ balance sheets before 1998, the impact is relatively mild. This result demonstrates the effectiveness of credit quotas even when they are not strictly binding. The state banks did not have much flexibility in utilizing the relending facility to fund their commercial lending.

Surprisingly, non-SOCBs’ loan supply is positively associated with relending rate with a larger elasticity than the SOCBs. The coefficients are only weakly significant, echoing the fact that they did not have access to the relending facility like the SOCBs. A possible explanation for the positive coefficients is the spillover effect from the impact of relending rate on SOCBs. If the market equilibrium loan interest rate for SOCBs remained constantly above the exogenously set rate as hypothesized earlier, loan supply from them was binding. A supply-side shock such as an increase in relending rate would cause SOCBs to issue less loans. The state-owned enterprises as well as small and medium sized enterprises that fell victim to this drop in loan supply would possibly turn to smaller commercial banks. As loan demand was the binding constraint for those banks, their loan level would increase in response to the contractionary relending rate shock. Given the much smaller size of their balance sheets, the positive coefficient is rather large.
Table 5: Pre reform Determinants of Loan Changes

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SOCB</td>
<td>SOCB</td>
<td>SOCB</td>
<td>SOCB</td>
<td>non-SOCB</td>
<td>non-SOCB</td>
<td>non-SOCB</td>
<td>non-SOCB</td>
</tr>
<tr>
<td>Loan Interest ($r_L$)</td>
<td>0.0111</td>
<td>0.00739</td>
<td>0.00670</td>
<td>-0.00895</td>
<td>-0.129**</td>
<td>-0.124**</td>
<td>-0.0886*</td>
<td>-0.135**</td>
</tr>
<tr>
<td></td>
<td>(0.0210)</td>
<td>(0.0205)</td>
<td>(0.0219)</td>
<td>(0.0387)</td>
<td>(0.0503)</td>
<td>(0.0519)</td>
<td>(0.0509)</td>
<td>(0.0540)</td>
</tr>
<tr>
<td>Relending Rate ($r_B$)</td>
<td>-0.0240**</td>
<td>-0.0246**</td>
<td>-0.0315**</td>
<td>-0.0311***</td>
<td>0.0793*</td>
<td>0.0797*</td>
<td>0.0456</td>
<td>0.0774*</td>
</tr>
<tr>
<td></td>
<td>(0.00954)</td>
<td>(0.00998)</td>
<td>(0.0144)</td>
<td>(0.0108)</td>
<td>(0.0412)</td>
<td>(0.0471)</td>
<td>(0.0484)</td>
<td>(0.0446)</td>
</tr>
<tr>
<td>Change in Deposit ($\Delta D$)</td>
<td>0.324*</td>
<td>0.333*</td>
<td>0.315</td>
<td>0.296</td>
<td>0.394***</td>
<td>0.353**</td>
<td>0.339**</td>
<td>0.337**</td>
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<tr>
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<td>(0.168)</td>
<td>(0.173)</td>
<td>(0.202)</td>
<td>(0.209)</td>
<td>(0.143)</td>
<td>(0.151)</td>
<td>(0.141)</td>
<td>(0.133)</td>
</tr>
<tr>
<td>Capitalization ($cap$)</td>
<td>0.235</td>
<td>-0.320</td>
<td>-1.949</td>
<td>0.303</td>
<td>-3.648**</td>
<td>-5.945**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.183)</td>
<td>(1.365)</td>
<td>(3.043)</td>
<td>(0.257)</td>
<td>(1.651)</td>
<td>(2.607)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$cap^*r_B$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.427**</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>(0.177)</td>
<td></td>
</tr>
<tr>
<td>$cap^*r_L$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.246</td>
<td>0.620**</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.335)</td>
<td>(0.256)</td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>68</td>
<td>68</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.280</td>
<td>0.288</td>
<td>0.294</td>
<td>0.312</td>
<td>0.706</td>
<td>0.719</td>
<td>0.753</td>
<td>0.760</td>
</tr>
<tr>
<td>Number of Banks</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Notes 1. Robust standard errors in parentheses, interest rates in percentage points.
2. Panel data unbalanced for non-SOCBs and balanced for SOCBs.
3. * significant at 10%, ** significant at 5%, *** significant at 1%.
Figure 8 also illustrates the working of this mechanism. In the left graph, the loan supply curve for the SOCBs shifts to the left due to an adverse shock from increases in relending rate, creating an additional $Q'_L - Q_L$ of excess loan demands. Some of these excess demands spill over to the demand for non-SOCB loans, causing an outward shift of the demand curve in the right graph. The quantity of loans given by the small commercial banks thus increases. However, this spillover mechanism is unverified and this idea will be left to future research.

The level of deposits has a positive coefficient for both types of banks, reflecting the role of deposit as a source of funding for bank loans. Nevertheless, the coefficient is much more significant for non-SOCBs than SOCBs. This is because state banks could also borrow from the PBC through relending (and they did borrow heavily), while small banks depended almost exclusively on deposits to support loans.
The interaction terms shed light on how capitalization, a measure of a bank’s financial health, influences the scale of impact monetary policies have on a bank’s lending decisions. The interaction terms are statistically insignificant for SOCBs, which can be caused by either the small sample size, or that those banks, directly supported by the state, had little worry about under-capitalization. The opposite signs between the coefficients of loan interest and its interaction term with capitalization for non-SOCBs (both significant at 5% level) indicate that high capitalization served as an effective buffer for adverse monetary policy shocks. In other words, when monetary policy becomes contractionary, a small bank with healthier capital leverage would be able to lessen the reduction in lending. It also means that under-capitalized small banks would face most difficulty raising funds to maintain loan growth in a contractionary environment, coinciding with the findings of Kishan and Opiela (2000).

Post-reform estimation results are reported in Table 6 and Table 7. Compared to the pre-reform era, the striking difference in the banks’ responses to relending rate suggests that credit quota elimination has fundamentally transformed the role of direct central bank lending. SOCBs became insensitive to changes in relending rate, because they no longer needed direct PBC relending to meet loan targets. The relending rate was still managed by the state although central bank direct lending only acted as a lender of last resort which the banks drew on when they were in a tight position, or short on cash. The state-owned commercial banks, with their deposit holdings burgeoning since 1990s, did not have much need for emergency PBC lending. However, the smaller banks, especially those with low liquidity, would be more concerned with the availability of this emergency fund. The fact that on average SOCBs kept a much lower level of excess reserves than non-SOCBs is an indicator of the aforementioned situation. Therefore, higher relending rate represents an increased marginal cost of obtaining such funds, which may cause the under-capitalized banks to become more cautionary in making loans. Table 7 indicates that 1 percentage point increase in relending rate reduces loan supply equivalent to nearly 20% of past year’s asset. Given that the relending rate stayed below 4% after 1999, a 1 percentage point increase represents a highly contractionary monetary policy. Such a scale in loan reduction is hence plausible.

The coefficient on the loan interest rate remains statistically insignificant for SOCBs, although the sign of the coefficients has changed from positive in the pre-reform era to negative. Despite the discontinuation of explicit credit plans, state control on the “Big Four” was by no means lax. Credit quotas were taken over by implicit Window Guidance modeled after Japan’s experience (Geiger, 2008), which could possibly explain the persisting unresponsiveness of SOCBs to loan rate changes.

It is intriguing to note that although the interest rates in the regression are each statistically insignificant, they are jointly very significant, which is an indication that the major

31 See Appendices, Figure 9, Borrowing from the PBC for those banks has decreased sharply since mid-1990s and practically stopped completely after 2000.
32 See Appendix 2. The surplus of deposits net loans has been widening drastically since reforms began.
33 An F-test on the joint significance of relending rate, excess reserve interest, loan interest and rediscount rate rejects the null hypothesis at 5% level.
post-reform policy instruments are highly correlated with each other.\textsuperscript{34} This finding echos one of the unique characteristics of the PBC’s approach to monetary policies as outlined in Geiger (2008): the central bank would quite often make use of a combination of monetary policy tools simultaneously to achieve the fine tuning of the economy.

Although the variable levels do not contain large amount of information, it is likely that the spread between different interest rates could have a significant impact (Friedman & Kuttner, 1992). Therefore, I reestimate the regression with fewer policy variables and the addition of spreads between loan rate and other interest rates. The results are reported in column (4) and (5). Despite the spread terms still being insignificant, we can now clearly see the significantly positive relationship between loan interest rate and loan supply, reinstating the result in the pre-reform case.

\textsuperscript{34} This can also be seen in Figure 1, where major monetary policy instruments move in a roughly synchronized manner.

### Table 6: Post Reform Determinants of Loan Changes for SOCBs

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relending Rate ($r_B$)</td>
<td>0.141</td>
<td>0.213</td>
<td>0.209</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0924)</td>
<td>(0.136)</td>
<td>(0.137)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loan Interest ($r_L$)</td>
<td>-0.0780</td>
<td>-0.122**</td>
<td>-0.102</td>
<td>0.0387***</td>
<td>0.0282**</td>
</tr>
<tr>
<td></td>
<td>(0.0532)</td>
<td>(0.0620)</td>
<td>(0.0639)</td>
<td>(0.0147)</td>
<td>(0.0138)</td>
</tr>
<tr>
<td>Rediscount Rate ($r_R$)</td>
<td>-0.0702</td>
<td>-0.0685</td>
<td>-0.0744</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0666)</td>
<td>(0.0706)</td>
<td>(0.0987)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in RRR ($\Delta RRR$)</td>
<td>0.0338</td>
<td>0.0277</td>
<td>0.0288</td>
<td>0.0174</td>
<td>0.0227</td>
</tr>
<tr>
<td></td>
<td>(0.0258)</td>
<td>(0.0291)</td>
<td>(0.0305)</td>
<td>(0.0160)</td>
<td>(0.0189)</td>
</tr>
<tr>
<td>Change in Deposit ($\Delta D$)</td>
<td>0.910*</td>
<td>0.858*</td>
<td>0.843</td>
<td>0.823</td>
<td>0.978**</td>
</tr>
<tr>
<td></td>
<td>(0.497 )</td>
<td>(0.521 )</td>
<td>(0.561 )</td>
<td>(0.508 )</td>
<td>(0.498 )</td>
</tr>
<tr>
<td>$cap \cdot r_L$</td>
<td></td>
<td>0.354</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.473 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$cap \cdot r_R$</td>
<td></td>
<td>0.127</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.726 )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_L - r_R$</td>
<td></td>
<td></td>
<td></td>
<td>-0.0327</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0216)</td>
<td></td>
</tr>
<tr>
<td>$r_L - r_B$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.0349</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0325)</td>
</tr>
</tbody>
</table>

Notes 1. Robust standard errors in parentheses, interest rates in percentage points.
2. RRR stands for required reserve ratio.
3. The spread variables are calculated as presented in the table.
4. * significant at 10%, ** significant at 5%, *** significant at 1%.
The restriction of window guidance on smaller banks was probably much looser, allowing them to adjust loan supply based on market interest rates in pursuit of maximizing profit. As the result demonstrates, loan rate affects non-SOCBs’ loan level and is significant at 1%. Interestingly, the correlation between loan rate and changes in loan level of the non-SOCBs becomes positive, suggesting that the officially established loan rate was below the market equilibrium and loan supply became binding. This is confirmed by the historical movement of loan interest, which stayed above 8% before 1998 and was kept below 6% after the reforms took place. Furthermore, the growth of non-SOCBs and their increasing shares in the banking system compared to the “Big Four” have made them more attractive to enterprises seeking loans. The taking-off of the economy in late 1990s has also sparked off higher growth in demand for loans, especially from the burgeoning small and medium enterprises that found it hard to obtain loans from the SOCBs, thus outstripping the growth in banks’ ability to supply. Both mechanisms likely contributed to the rightward

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relending Rate ($r_B$)</td>
<td>-0.181***</td>
<td>-0.279***</td>
<td>-0.227***</td>
<td>-0.181***</td>
</tr>
<tr>
<td></td>
<td>(0.0478)</td>
<td>(0.0906)</td>
<td>(0.0881)</td>
<td>(0.0478)</td>
</tr>
<tr>
<td>Loan Interest ($r_L$)</td>
<td>0.108***</td>
<td>0.201***</td>
<td>0.128***</td>
<td></td>
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<tr>
<td></td>
<td>(0.0377)</td>
<td>(0.0696)</td>
<td>(0.0471)</td>
<td></td>
</tr>
<tr>
<td>Rediscount Rate ($r_R$)</td>
<td>0.0984***</td>
<td>0.108***</td>
<td>0.173***</td>
<td>0.207***</td>
</tr>
<tr>
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<td>(0.0308)</td>
<td>(0.0311)</td>
<td>(0.0521)</td>
<td>(0.0643)</td>
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<tr>
<td>Change in RRR ($\Delta\text{RRR}$)</td>
<td>-0.0390***</td>
<td>-0.0287**</td>
<td>-0.0327***</td>
<td>-0.0390***</td>
</tr>
<tr>
<td></td>
<td>(0.0101)</td>
<td>(0.0123)</td>
<td>(0.0116)</td>
<td>(0.0101)</td>
</tr>
<tr>
<td>Change in Deposit ($\Delta\text{D}$)</td>
<td>0.282***</td>
<td>0.281***</td>
<td>0.276***</td>
<td>0.282***</td>
</tr>
<tr>
<td></td>
<td>(0.0807)</td>
<td>(0.0841)</td>
<td>(0.0854)</td>
<td>(0.0807)</td>
</tr>
<tr>
<td>$\text{cap}^* r_L$</td>
<td>-1.348*</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.719)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\text{cap}^* r_R$</td>
<td></td>
<td>-1.378**</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>(0.669)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_L - r_R$</td>
<td></td>
<td></td>
<td>0.108***</td>
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<td></td>
<td></td>
<td></td>
<td>(0.0377)</td>
<td></td>
</tr>
</tbody>
</table>

Notes 1. Robust standard errors in parentheses, interest rates in percentage points.
2. RRR stands for required reserve ratio.
3. The spread variables are calculated as presented in the table.
4. * significant at 10%, ** significant at 5%, *** significant at 1%.
shift of loan demand, making loan supply the constraining factor.

Deposits are still an important source of funding for loans. Both the coefficient and the significance level of changes in deposit remain roughly the same compared to the pre-reform regression for non-SOCBs. Interestingly, the impact of deposits on loans has increased substantially for SOCBs with coefficients increasing from around 0.3 to well above 0.8, showing more than 80% of the changes in deposits manifested as changes in loans on the other side of the balance sheet. One reason could be that SOCBs used to raise funds from both deposit and PBC relending, which are two substitutable sources. After the major reforms took place, PBC direct lending was terminated. Coupled with ballooning deposit growth and limited other external finance options, banks had to depend predominantly on deposits.

Table 7 demonstrates that non-SOCBs reduced their loan supply by little more than 3% of total asset when the required reserve ratio is increased by 1 percentage point. This finding is consistent with both my model and economic intuition: holding everything else constant, banks’ ability to extend loans is reduced if they have to allocate a bigger portion of their assets to required reserve deposits at the central bank. Given the high base level of required reserve ratio (around 8% post reform and well over 10% in 2007) and the high level of excess reserve holdings in non-SOCBs that acts as a buffer to such shocks, the relatively small impact is plausible.

On the other hand, the SOCBs’ loan supply is positively correlated with changes in required reserve ratio, although the coefficients are not statistically different from zero. The existence of reverse causality could be the reason behind this counter-intuitive phenomenon. To check for evidence of reverse causality, I run the same regression again with one period lagged change in required reserve ratio as an additional regressor. I find that although the contemporary change still has a positive slope, the coefficient of the lagged change is negative. This provides some evidence that the positive coefficient in the original regression is inconsistent, possibly attributable to contemporary reverse causation effect.

While the changes in aggregate loans from non-SOCBs did not have a huge impact on the condition of the economy, an excessive growth of credit from the SOCBs is influential enough to induce the PBC to react with contractionary monetary policies: a hike in required reserve ratio in this case. The positive relationship between the rediscount rate and non-SOCBs’ loan changes is puzzling, as an increase in the rediscount rate usually signals a contractionary monetary stance of the PBC. I could not provide an intuition for this observation and further research with a more comprehensive data set is warranted.

In exploring the cross-sectional differences between banks within the same group, analysis of the interaction effects yields similar results as that of the pre-reform regression. Coefficients of loan interest rate and rediscount rate have opposite signs to their interaction terms with capitalization for both groups of banks, although they are statistically more significant for non-SOCBs than SOCBs for the same reason as in the pre-reform era.

This result reaffirms our hypothesis and the findings of Kishan and Opiela (2000): the smaller the size and the lower the capital-asset ratio of a bank, the harder it is for them to solicit external finance and maintain a consistent loan growth after contractionary
monetary policy shocks. In other words, contractionary monetary policies generally affect non-SOCBs more than large state banks.

6.3 Robustness

In the regression strategy, I normalize first difference in levels of loans, deposits, excess reserves, and PBC direct lending by last year’s total assets. As a robustness check for the potential endogeneity arising from total assets, I reestimate the fixed effect model in Equation (1) and (2) with real growth rate of loans and deposits. That is, I divide the first difference of the levels by the level of the same variable in the previous year and adjust the growth rate to take into account inflation. One of the differences between the two models is that the balance sheet identity holds with normalized first differences of levels which are our original dependent variables. With real growth rates, however, the balance sheet identity only holds when I multiply the growth rates with the lagged level of respective variables. The findings of the new models are consistent with the original ones, with slight changes in significance and generally larger absolute value of coefficients.

I have assumed fixed effects in the OLS regressions under the belief of the existence of bank heterogeneity. It could be argued, however, that bank fixed effects would have been mitigated by categorizing them under SOCBs and non-SOCBs, effectively distinguishing them by their size and functionality. Especially for the group of SOCBs, where the entities are all nation-wide banks with minimum heterogeneity arising from geographical locations, there is a strong case for adopting random effects model. Furthermore, since the size of the data set is limited, using a fixed effect model incorporating bank dummy variables incurs the risk of leaving too few degrees of freedom for consistent and rigorous regression analysis. As a check for robustness, I also run the same regressions of equation (1) and (2) with a random effects model. The random effect model yields consistent results: the signs, absolute values and significance levels of the coefficients are all comparable to those in the fixed effect model.

The choice of the threshold year can potentially create bias in the estimation as the major reform measures have spanned over many years in the 1990s. I check the consistency of the results by reestimating the regression models with 1994 and 1996, instead of just 1998, as the threshold year. The outcome demonstrates that both the sign and significance of the new estimation coefficients are largely in agreement with my original result.

Figure 2 demonstrates that although the four official SOCBs are in a dominant position over smaller commercial banks, Bank of Communications (BOCM) comes close. With its loan and deposit level towering over all other non-SOCBs, BOCM is perceived by many as one of the mega state banks. Therefore I check the consistency of my model by categorizing BOCM under SOCB. The signs of coefficients for non-SOCBs are generally consistent with my original estimation and the significance level has improved in the post reform period after removing BOCM as an “outlier” of the small commercial banks. The new SOCB estimations, however, yields results that are insignificant. This suggests that BOCM, despite having a large balance sheet compared to other non-SOCBs, essentially still behaves like a small bank and the inclusion of which in the already small SOCB group would have mitigated the fixed effects.

35 Hausman Tests on the regression models have a clear preference for fixed effect model as well.
would introduce too much noise.

Lastly, my theoretic model predicts that loan levels respond to fluctuations in interest rate levels. It should naturally follow that changes in loan level, which is the dependent variable in my estimation model, respond to changes in interest rates. Nevertheless, I use interest rate levels instead of changes as my independent variables. The strategy is motivated by my belief that monetary policy instruments have a long-run lasting effect on the growth rate of loan supply. In other words, banks may have a loan growth target that is dependent on the levels of various interest rates. To provide support to this hypothesis, I reestimate the regression model with a lag on loan interest and test the null hypothesis that changes in interest rate levels do not have an impact on changes in loan levels (sum of coefficients of $r_{lt}$ and $r_{lt-1}$ is zero). I cannot reject the null hypothesis at conventional significance levels for all estimations besides the post-reform regression on non-SOCBs, where I can reject the null at 1% significance. I conclude, therefore, that it is more appropriate to use interest rate levels instead of changes as regressors.

6.4 Caveats

In section 4, I have identified the possible behaviors of different banks in response to various monetary policy shocks with a profit maximization model. It is also imperative for us to be aware of the limitations associated with the model. Fundamentally, the model only captures the supply side equilibrium in which banks maximize their profits by choosing the level of loans they extend. In terms of describing real life behaviors, this set-up would only be appropriate if loan supply is the binding constraint. As can be seen from the empirical results and discussions of Figure 8, such an assumption does not always hold. Similarly, I cannot simply assume the central bank’s relending or rediscount facilities are only determined by the demands of commercial banks. The PBC’s supply curve may very well be subjected to shifts and become constraining without it actively manipulating one of its monetary policy tools. The shifts could be caused by the PBC managing non-pecuniary costs on its lending facilities, such as the strictness of window guidance. Therefore, to construct a general equilibrium involving firms, commercial banks, and the central bank, thorough knowledge about the objective functions of the different entities is required. This warrants further research.

One should also keep in mind the quality of data available while fashioning empirical strategy and interpreting the results. First, the limited size of the data set poses enormous challenge for consistent and rigorous statistical analysis. The small time dimension (20 years) does not allow me to test for stationarity or serial correlation. The small number of observations also leaves little room to include lags of the policy variables. Our interpretation is thus restricted to the contemporaneous effects of the covariates where reverse causality is highly likely. Second, the data only contains annual observations at the bank level. This is an immediate concern as banks usually respond promptly to monetary policy shocks, and some policy instruments, required reserve ratio for example, are adjusted several times a year. In order to accurately capture the nuances of the financial sector, quarterly or even monthly data would be more suitable for my purposes. Third, due to

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36 See Figure 1.
inconsistencies in the format of documenting balance sheets both cross-sectionally across banks and intertemporally, many numbers are cryptic in nature and some variables, such as Total Excess Reserves, are based on the author’s calculations. The reader needs to bear in mind the inaccuracies of the observations and exercise greater caution when interpreting empirical results.

7 Conclusion

The main focus of this paper is to analyze the effectiveness of monetary policy instruments on Chinese banks both cross-sectionally and intertemporally, incorporating the impact of the banking reform. I find that in the pre-reform period, large state banks and smaller commercial banks’ responses to changes in relending rates and loan interest rates were directly opposite. This result can be explained by the existence of credit quotas for SOCBs and the PBC relending facility that was designed to help the SOCBs meet their targets. I deduce from the sign of loan interest rates that loan supply was the binding constraint for SOCBs while non-SOCBs were demand constrained. This gives rise to a “spillover” effect of loans which provides an explanation for the weakly significant positive relationship between relending rate and non-SOCB’s loan levels.

The fact that relending rate stopped having an effect on SOCB’s loans after the reforms confirms the success of one major reform agenda, the elimination of credit quotas. However, SOCBs’ persisting unresponsiveness to loan interest rate suggests that credit quota might be replaced by a softer constraint, window guidance. The relending rate did not disappear from the PBC’s arsenal though as the non-SOCBs are demonstrated to be very sensitive to its fluctuations. Central bank direct lending continues to act as a monetary signal as well as a lender of last resort and affect smaller banks more due to greater liquidity concerns.

The deposit level, which I assume to be exogenous to the banks, has a significantly positive impact on all banks at all times. In the post reform period, nearly 90% of the total changes in loans by SOCBs are funded by changes in deposits after PBC relending becomes obsolete. This serves as evidence of a unique feature of the Chinese banking system: that the banks do not have much access to external finance options such as foreign capital markets. Deposit holdings have exploded across all banks after the reform, which was brought about by economic growth and stoked by the lack of other capital investment options. Loan supply was still the binding constraint as manifested in the positive coefficients of loan interest rates. The phenomenon that banks exercise great caution in extending loans is consistent with two other characteristics of the financial intermediation in China: banks have lower asset quality than their foreign counterparts and banks keep high levels of excess reserves. An example would be the required reserves a bank holds at the central bank. Some banks accumulate required reserves with interbank deposits, while some accumulate reserves with cash. After 1997, a new central bank rule states that excess reserves should be merged with required reserves into a single “Reserves” account, which changed the appearance of bank balance sheets across the board.

See Appendices, Figure 10.

Ratio of non-performing loans (NPL) is estimated to be 19.15 percent in 2004 and much higher before reforms by CBRC Statistics.
There is no evidence that shows banks are more sensitive to the spread between various centrally administered interest rates than their levels. Nevertheless, I was able to separate the post-reform loan interest impact on the SOCBs by reestimating the regression model with spreads. The interaction terms between capitalization ratio and policy variables investigate cross-sectional differences within a group. From interpreting the interaction results, I reach a similar conclusion as Kishan and Opiela (2000) that banks with smaller size and less capitalization tend to be affected more by contractionary monetary policy shocks. SOCBs, for example, being well-capitalized and “too big to fail,” are insensitive to the interactions.

Overall the reform has achieved certain progress such as the departure from credit planning and direct quantity management. The replacement by window guidance and the monopolistic nature of the SOCBs, however, have mitigated the impact of the reform on the state banks. While generally very effective, the credit channel does exhibit a larger effect on small commercial banks. Because most benchmark interest rates are still centrally administered by the PBC, banks as price takers usually face a disequilibrium in the loan market due to their inability to influence the loan demand curve. To slowly eliminate such market distortions, a gradual deepening of reforms in interest rate liberalization is desirable, however the central government sees fit.

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Appendices

Figure 9: Direct Lending of the PBC to Major SOCBs (Unit: 100 Mil Yuan)

(a) Industrial and Commercial Bank of China

(b) China Construction Bank

(c) Bank of China
Figure 10: Deposit Surplus (Total Deposits - Total Loans) for SOCBs (Unit: 100 Mil Yuan)

(a) Industrial and Commercial Bank of China

(b) China Construction Bank

(c) Agricultural Bank of China
Export-Country GDP Growth, Market Openness, and Antidumping Filings

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ABSTRACT

This paper studies the relationship between a country’s GDP growth, its openness to imports, and its propensity to be targeted by antidumping petitions. Existing literature suggests that decreased growth rates and reduced openness to imports in a particular country should lead to more antidumping petitions targeting it; but these assertions remain empirically unproven. Using a data set of antidumping actions filed by thirty countries between 1995 and 2008—by far the most comprehensive data set used for this type of analysis—and a negative binomial regression, we find strong empirical support for these hypotheses. We also argue that the effect of GDP growth has a differing magnitude depending on the openness of the country in question to imports, but that the direction of this interaction effect is ambiguous in theory. We test for this interaction empirically and find that the antidumping-petition-attracting effects of downturns in GDP growth are weaker in countries that are relatively more open to imports.

1 Introduction

In 1930, the United States enacted the Smoot-Hawley Tariff, imposing prohibitive duties on a broad range of goods. Second in average rates only to the Tariff of Abominations of 1828 (Krugman, 2010), this protectionist legislation led to a trade war that greatly exacerbated the Great Depression. The recent economic crisis has raised fears that protectionism may cast the world into depression once more; but under the WTO, the manifestation of protectionist sentiment in the form of tariffs and quotas is largely prohibited. Instead, governments seeking to curtail imports must rely on three procedures that are condoned by the WTO—safeguard measures, countervailing duties, and antidumping laws. Antidumping laws are the most frequently used of these three measures. Although they are designed to prevent predatory activity in the international market, there is a broad consensus among economists that the over-use of these laws by import-competing industries constitutes a significant obstacle to free trade (Blonigen and Prusa, 2003; Knetter and Prusa, 2003).1

1 Among the sinister traits of antidumping discussed in the literature are its efficacy in enforcing cartel arrangements (Pierce, 1999), its susceptibility to over-use through retaliation for previously filed actions (Blonigen and Bown, 2003; Feinberg and Reynolds, 2006), and its use as the result of rent seeking and protectionism by governments and interest groups (Drope and Hansen, 2004; Olson, 2006). The trade-reducing effects of antidumping actions are also an issue of concern in the literature (Prusa, 2001).
This paper seeks to determine which factors make a country the target of antidumping actions (i.e., cause it to be accused of dumping). Specifically, we investigate how a country’s GDP growth and openness to imports are related to the frequency with which it is named in antidumping petitions. We present arguments that lead us to expect that both reduced growth rates and lower openness to imports on the part of the export country are associated with more filings against the country in question. We also propose and test for an interaction effect between these two variables. The expected direction of this effect is ambiguous in theory, and is treated as an empirical question.

This paper builds on literature studying the relationship between macroeconomic variables and antidumping activity. Within this literature the effect of export-country GDP growth on antidumping filings has received only tangential consideration, with the vast majority of work focusing on the effects of the exchange rate and GDP growth of the import country. The findings of papers that do consider export-country growth are inconclusive. Knetter and Prusa (2003) find that it has no significant effect on filings. Hallworth and Piracha (2006) find a positive and significant, although non-robust, relationship. Due to the limited samples used by these authors, the weak results that they achieve, and the methodological shortcomings of their studies, the effect of export-country GDP growth on antidumping filings remains empirically undetermined.

Other authors (Willig, 1998) provide arguments for a linkage between lower openness to imports of the export country and a greater number of filings against it. While protection from imports serves as a basis for many arguments in support of the use of antidumping laws, no paper exists (to the author’s knowledge) that has tested this relationship empirically. The contributions of this paper are twofold. First, using a large and comprehensive data set, we find that reduced GDP growth and lower openness to imports of a country are associated with more antidumping petitions against it. Additionally, we find that decreased export-country GDP growth should increase the number of filings against less-open countries more than it would increase filings against more-open countries.

The remainder of the paper is organized as follows. Section 2 provides formal arguments for the relationship between growth, openness and antidumping, and derives testable hypotheses from these arguments. It also discusses empirical work that has studied the theories presented. Section 3 discusses the construction of our two data sets. Section 4 presents the empirical strategy for our estimation, including a discussion of the negative binomial model. Section 5 provides the results of our estimation and robustness tests, as well as of instrumentation for openness to imports using gravity model estimates. Section 6 draws conclusions from the empirical results. Section 7 discusses the limitations of this study, which constitute avenues for future research.

2 A Basis in the Literature

The arguments presented in this section are based in the mechanics of the antidumping adjudication process, which is initiated when a firm or group of firms files a petition with the appropriate authority or authorities in its home country requesting that an
investigation into alleged dumping activity be opened. This petition must detail the country from which allegedly-dumped imports originate, and the product that is ostensibly dumped. Given the requirement that a petition name a single product and export country, it is not uncommon for petitioners to target many countries or products by filing several petitions simultaneously.

In order for duties to be imposed on the imports in question, petitioners must meet two burdens of proof. First, they must show that dumping—defined by economists as “a pricing practice in which a firm charges a lower price for exported goods than it does for the same goods sold domestically” (Krugman and Obstfeld, 2006)—has actually occurred. In practice this requirement necessitates showing that foreign firms have priced exports at less- than-fair-value (LTFV), where the “fair value,” or “normal price,” of a good is either the price of the equivalent good in the home market of the exporter, or some “constructed value” measure of cost if the exporter’s home price is deemed to be unreliable for comparison. The second burden requires showing that a domestic industry has been “materially injured” by dumped imports.

Whether these two burdens are investigated by one agency or two varies by country. If both are satisfied, dumping duties are imposed on imports of the product in question from the country named in the petition. In some countries the duties are designed to return the price of the good to its “fair value,” whereas other countries impose duties large enough to alleviate the injury to the domestic injury.²

In deriving our hypotheses, we assume that firms are more likely to file an antidumping action if this action is more likely to lead to the imposition of duties. If meeting either of the two necessary burdens becomes easier, or if political factors are more conducive to affirmative findings of dumping and injury by the relevant authorities, the probability of duties being imposed increases. The expected payoff to a filing firm is therefore higher, making it more likely that a firm will file an antidumping action.³

2.1 Export-Country GDP Growth

Willig (1998) provides a model to explain “cyclical dumping”—dumping driven by cyclical fluctuations in the export country’s economy. He posits that unexpected reductions in demand in a particular country, associated with reduced GDP growth, will leave producers in that country with excess production capacity. Due to low marginal costs associated with the utilization of excess capacity in the short run, as well as competition with compatriot

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2 Those readers with an interest in further studying the economic literature on antidumping, and in learning more about antidumping laws and enforcement are urged to consult the literature review compiled by Blonigen and Prusa (2003).

3 The imposition of duties is not a necessary condition for a firm to benefit on net from filing a petition. Whether they result in affirmative findings or not, antidumping petitions impose a great burden on firms in the export country by forcing them to incur costs of compliance with adjudicating authorities (Moore, 2005). Antidumping laws can thus be used to impose costs on foreign competition. Additionally, Prusa (2001) finds that in the United States even the filing of an antidumping petition, whether it results in the imposition of duties or not, will lead to a reduction in imports. Nonetheless, the magnitude of the reduction differs based on the finding, with cases in which duties are imposed leading to a larger reduction in imports and thus to greater benefits for the filing firm.
firms suffering from the same economic malaise, firms will produce and sell their product abroad at prices that may fall below “full cost” (which includes fixed costs), so long as the price is high enough to meet variable costs.

Knetter and Prusa (2003) point out that such pricing activity will generally not cause firms to price exports below the domestic price, which may also fall as a result of reduced economic activity. These exports will therefore not meet the economic definition of dumping; but Willig (1998) suggests that the label of dumping may still be applied in this situation if the imports in question are subject to constructed-value determination of normal price.\(^4\) In this case, the total cost of production is calculated in order to determine the price that a firm would require to produce in the long run. As this measure includes fixed as well as variable costs, below which the price of exports may fall for reasons discussed above, affirmative findings of dumping are facilitated. Disqualification of the price of the good in the export country as a standard for normal price and its replacement with such cost-based methods is particularly likely if the downturn endures for a sufficiently lengthy period that the imports in question are classified as falling outside the “ordinary course of trade” (Willig, 1998, p. 62).

The incentive for exporting firms to lower their prices, along with the increased probability that constructed-value measures of normal price will be used, increases the probability that imports will be found to have been sold at LTFV. Additionally, the reduction in price resulting from a downturn in growth would necessarily harm import-competing industries in the import country, raising the probability of material injury findings. The expected payoff to any firm that files a petition against a country in this situation is therefore higher, as the probability that antidumping duties will be imposed is greater. This logic leads to our first hypothesis.

**Hypothesis 1.** *Countries experiencing reductions in GDP growth will be targeted by more antidumping filings.*

Knetter and Prusa (2003) test this hypothesis using a data set of filings from the United States, the European Union, Canada, and Australia between 1980 and 1998. They find no significant effect of export-country GDP growth on filings.

Hallworth and Piracha (2006) test the same hypothesis using a data set of filings from Argentina, Brazil, India, and South Africa between 1994 and 2002. They find an unexpected positive and significant relationship between export-country GDP growth and antidumping filings. When they eliminate all filings targeting China, the correlation becomes negative (as they had first hypothesized), although it is insignificant. Only after dropping observations on filings against the four most frequently targeted countries in their sample (China, South Korea, the United States, and Japan) do they achieve the desired negative and significant relationship.

The shortcomings of these studies make them inappropriate for drawing conclusions about antidumping behavior as a whole. The use by each set of authors of filings by

\(^4\) In a sample of 285 antidumping cases in the United States between 1990 and 2004, measures of cost played some role in the determination of normal price in all but fifteen cases (Morkre et al., 2008).
only four import countries limits the extent of the inference possible from their results. Additionally, neither paper was able to find a credible and statistically significant effect of export-country GDP growth on filings. While Hallworth and Piracha (2006) find a positive and significant relationship, it is not robust. Their elimination of countries that are the targets of nearly thirty-five percent of all filings (in our sample period), on which their negative and significant and result is based, leaves a less-than-random sample. In fact, the positive and significant coefficient, which does not appear when filings against China are excluded, is likely driven by the failure of Hallworth and Piracha (2006) to control for different trend GDP growth rates between countries. The cyclical dumping argument presented by Willig (1998) is based on cyclical fluctuations; that is, a reduction in growth occurs when growth falls off of its trend rate, not when it falls below some absolute level. Results from a comparison of growth rates across countries would primarily be driven by different trend rates of growth between countries as opposed to cyclical fluctuations of growth within a country. It is therefore not surprising that the inclusion of a quickly-growing and frequently-targeted country such as China would lead to the result found by Hallworth and Piracha (2006). The effect of export-country GDP growth on antidumping filings therefore remains an open empirical question.

2.2 Market Openness

Proponents of the use of antidumping laws have cited them as a necessary tool to defend against imports that are “unfairly” supported by foreign governments. De Clerq (1988) and Mastel (1998), in attempts to justify the use of antidumping laws, accuse governments that protect their markets from imports of facilitating “attacks” on producers in non-protected markets. Mastel (1998) suggests that firms based in so-called “sanctuary markets” (which are protected from imports) use monopoly profits gained in their home markets to subsidize predatory dumping, aimed at driving their competitors in other countries out of business. He argues that while firms based in open markets must be “conservative” in their production decisions due to the import competition that they face, those based in protected markets are able to make “aggressive production and expansion decisions” (Mastel, 1998, pp. 42–43) that allow them to gain market power.

Although politically motivated, these arguments are based on a fundamental economic reality. Dumping (defined in the economic sense as price discrimination) cannot be sustained without some restriction of trade between the import and export countries. Without such market segmentation dumped imports would simply be resold in the exporting country until the prices of the good in each market equalized. Based on this logic, Krugman and Obstfeld (2006) develop a model in which a firm with monopoly power in its home market charges the monopoly price there while selling exports at the lower world price. This activity qualifies as dumping due to the difference between the two prices. It can be sustained only as a result of protection from imports, which would prevent price discrimination from being upset by re-importation or foreign competition, and would lead to greater markups over marginal cost in the domestic market (Kee and Hoekman, 2007), thus increasing the
difference between the export and home prices.

Willig (1998) elaborates on the link between protection and dumping in order to model “strategic dumping.” He considers a good that can be produced with significant economies of scale. He argues that if producers in the export market have a large enough share of their own market to realize these economies of scale—which would only be possible with protection from import competition—these economies of scale will create a cost advantage over rivals abroad. This cost advantage allows the firm to profitably charge a lower price for its exports and thus undersell producers in the import country. Willig (1998) points out that this behavior need not be predatory in nature. Rather, exporting firms will simply be exploiting a competitive advantage.

Activities of the type modeled by Krugman and Obstfeld (2006) would facilitate findings of sales at LTFV. The probability of findings of material injury would also be increased as a result of strategic dumping, as import-competing firms without the cost advantage provided by protection will suffer due to competition with firms that enjoy this benefit. Based on this logic we draw our second hypothesis.

**Hypothesis 2.** Countries that are relatively less open to imports will be targeted by more antidumping petitions.

The papers discussed in this section provide theoretical underpinnings for a link between antidumping and openness to imports. To the author’s knowledge there has not been any empirical investigation of this proposed link.

### 2.3 The Interaction Effect

The arguments presented in sections 2.1 and 2.2 are both based on demand within the export economy, suggesting the possibility of an interaction effect between the two variables of interest. We therefore consider a reduction in the GDP growth of a particular country from its trend resulting from a cyclical reduction in demand and determine its expected effects based on the arguments presented above. The reasoning presented thus far suggests that this shock may have two opposing effects on dumping and therefore on antidumping activity.

According to the cyclical dumping argument laid out in section 2.1, reduced demand would lead to an increase in filings against the country in question. However, if a country is relatively less open, the opposite result may also be realized. In such a country, dumping activity may be driven by a lack of domestic competition, or may be supported by domestic demand that subsidizes losses from predatory dumping or facilitates strategic dumping by allowing for the realization of economies of scale. Reductions in demand within this country will diminish this demand-based support for dumping, thus making it more difficult for firms to dump and implying a reduction in filings against this country. This petition-reducing effect (which would counteract the petition-inducing cyclical dumping effect) would not be present to as great an extent in a relatively more open country, as it is

5 None of these papers provides a formal mathematical model of this link. Willig (1998) references a formal mathematical model developed by Belderbos and Holmes (1992), which could not be located for this paper.
less likely that dumping activity of the type presented in section 2.2 would exist. We thus expect that in relatively less-open countries, reduced growth will have opposing effects to an extent that would not apply to relatively more-open countries—our third hypothesis.

**Hypothesis 3.** In countries that are relatively less open to imports, the additional filing activity associated with reductions in GDP growth will be mitigated.

It is also possible that the interaction effect acts in the opposite direction. Morkre et al. (2008), in a study of the antidumping adjudication process in the United States, find that countries classified as non-market economies—all of which are developing countries—are subject to significantly larger dumping margins than countries classified as market-oriented economies. They also find that developing countries are likely to have a significantly higher share of their exports to the United States subjected to dumping duties than developed countries are. Based on these findings, they conclude that the US antidumping adjudication process is systematically biased against lower-income countries. As Frankel and Romer (1999) find that lower-income countries tend to be less open, we posit that this same type of bias exists towards relatively less-open countries.

Based on such a bias, and holding the economic merits of an antidumping action constant, a petition is more likely to lead to the imposition of duties if it is filed against a relatively less-open country simply because of the structure of the adjudication process. Thus, any economic shock that would result in an increase in dumping activity by a particular country would lead to more filings against it if it is relatively less open than if it is relatively more open due to the relative ease of achieving affirmative findings of dumping and injury with respect to a less open country.

As Bown (2008) points out that antidumping enforcement during our sample period is relatively standardized across countries, we posit that such a bias exists in countries other than the United States. This bias is the basis for our fourth hypothesis.

**Hypothesis 4.** The antidumping petition-attracting effects of downturns in growth will be stronger for less-open countries than for more-open ones.

As Hypotheses 3 and 4 imply different directions for the effect of the interaction between GDP growth and openness to imports, they are mutually exclusive. We thus seek to determine which of these predictions is supported by data.

### 3 Data

We construct our sample using data on antidumping filings reported to the WTO.
between 1995 and 2008. The choice of the initial year is motivated by Bown (2008), who chooses 1995 as the beginning of his sample because the creation of the WTO in this year standardized antidumping enforcement rules across countries. The choice of ending year is necessitated by limited data availability.

Unlike previous authors in this literature, we do not constrain our sample to any particular import country or group of import countries. Rather, we include all countries listed by Bown (2009) as having filed an antidumping petition in our sample period, as well as all countries named in these petitions. We must exclude a small set of targeted countries due to issues of data availability,\(^8\) leaving thirty import countries and ninety-five export countries in our sample. In a manner similar to Knetter and Prusa (2003), we create two separate data sets.

The first data set is based on aggregated filing activity. The unit of observation is an individual export country in a particular year, and we observe the total number of filings against that country in that year, without regard to the country that files the petition.

The second data set is disaggregated to bilateral filings. In order to build this sample, we pair each import country with each export country in each year, but we do not include pairs in years during which the import country did not have an antidumping law, since it would be impossible for an antidumping petition to be filed in that country pair regardless of the extent of dumping activity that occurs\(^9\). The unit of observation in this data set is a particular pair of import country and export country in a single year, during which we observe the number of filings by that import country against that export country.\(^{10}\)

We perform estimation on the aggregated data set in order to ensure that our results are comparable with previous literature, particularly Knetter and Prusa (2003), who use an aggregated data set with import countries as the unit of observation for each year of their sample. However, it is more appropriate to draw conclusions from the bilateral data set, primarily due to the possibility of aggregation bias when studying the aggregated data set. Failure to differentiate between sources of petitions against a single export country makes it impossible to distinguish between a large increase in filings from a single import country and several small increases in filings from a number of import countries. Analysis of the aggregated data set would attribute both of these phenomena to some factor in the export country, although it is likely that a single large increase would be due to some characteristic of the import country. In fact, several papers (Leidy, 1997; Aggarwal, 2003; Knetter and Prusa, 2003; Irwin, 2005; Hallworth and Piracha, 2006) show that macroeconomic characteristics, either unique to or linked to the the import country, such as its GDP growth, have a statistically significant effect on filings. While accounting for variations in world economic activity may partially account for this deficiency, exclusion of import-country-specific variables may result in omitted variable bias.

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\(^{8}\) We must drop the Faroe Islands, Liechtenstein, North Korea, Qatar, Serbia and Montenegro, Yugoslavia, and Zimbabwe from our sample. We also lose Bosnia and Herzegovina for three of our fourteen years.

\(^{9}\) The import countries that adopt an antidumping law during our sample period are Costa Rica in 1996, Paraguay in 1996, China in 1997, and Jamaica in 1999. We gather the dates of adoption of antidumping laws from Zanardi (2004), and Vandenbussche and Zanardi (2008).

\(^{10}\) Summary statistics for the aggregated and the bilateral data sets are reported in Appendix A.
3.1 Dependent Variable

Information on antidumping filings was gathered from the Global Antidumping Database compiled by Bown (2009). This source contains 3,333 antidumping petitions reported to the WTO in our sample period, along with information on the date of initiation, filing (i.e., import) country, and named (i.e., export) country. After eliminating countries for which data for certain regressors are missing, we are left with thirty import countries and ninety-five export countries. The heaviest filing activity is described in Table 1.

Table 1: Cumulative Filing Activity by the Four Most Active Filers Against the Four Most Filed-Against Countries; 1995–2008.

<table>
<thead>
<tr>
<th>Filing Country</th>
<th>Named Country</th>
<th>China</th>
<th>South Korea</th>
<th>Taiwan</th>
<th>USA</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td></td>
<td>115</td>
<td>43</td>
<td>41</td>
<td>27</td>
<td>318</td>
<td>544</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td>87</td>
<td>29</td>
<td>19</td>
<td>—</td>
<td>297</td>
<td>432</td>
</tr>
<tr>
<td>European Union</td>
<td></td>
<td>84</td>
<td>27</td>
<td>21</td>
<td>13</td>
<td>246</td>
<td>391</td>
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<tr>
<td>South Africa</td>
<td></td>
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<td>13</td>
<td>14</td>
<td>10</td>
<td>150</td>
<td>219</td>
</tr>
<tr>
<td>Other</td>
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<td>352</td>
<td>133</td>
<td>93</td>
<td>128</td>
<td>1,041</td>
<td>1,747</td>
</tr>
<tr>
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<td></td>
<td>670</td>
<td>245</td>
<td>188</td>
<td>178</td>
<td>2,052</td>
<td>3,333</td>
</tr>
</tbody>
</table>

3.2 Variables of Interest

Data on export-country GDP and GDP growth are gathered from the International Macroeconomic Data Set compiled by the USDA Economic Research Service (2009), which conveniently compiles these data for nearly all countries in the world. We measure a country’s openness to imports using its import intensity,\(^\text{11}\)

\[
\omega_{it} = \frac{M_{it}}{Y_{it}},
\]

where \(\omega_{it}\) is country \(i\)’s openness to imports in period \(t\); \(M_{it}\) is total imports by country \(i\) in period \(t\), and \(Y_{it}\) is GDP of country \(i\) in period \(t\). The motivation for the use of this measure is the belief that firms based in countries where imports comprise a greater share of GDP are more likely to face competition from imports. Data on total imports are gathered from the World Trade Organization (2010).

3.3 Control Variables

Knetter and Prusa (2003), and Hallworth and Piracha (2006) find a significant effect of fluctuations in the real exchange rate on filings. They argue that if the export country’s currency depreciates, the marginal cost of firms based in the export country will decline when measured in the import country’s currency. This cost reduction will lead exporting firms to lower their prices in the import market, increasing the probability that they will be pricing at LTFV. Feinberg (1989) argues the opposite point, holding that appreciation of the export country’s currency leads the price of a good in the export country (when measured

\(^\text{11}\) The use of measures relying on trade measures and GDP, such as import intensity or trade intensity (the sum of imports and exports divided by GDP) is common in the cross-country growth literature (Lee et al., 2004; Harrison, 1996, among others).
in the import country’s currency) to be higher than the price in the import country before prices adjust. This activity qualifies as sales at LTFV.

Despite the opposing arguments as to the direction of the effect of real exchange rate fluctuations, this factor has been shown to be important in determining filing activity. We therefore include data on the real exchange rate (for the aggregated data set) and the bilateral real exchange rate (for the bilateral data set) using data from the USDA Economic Research Service (2009) and the International Financial Statistics from the International Monetary Fund (2010b). We normalize these data by dividing by the nominal exchange rate and considering the percent deviation of this value for each country or country pair from its mean over the sample period.

The same papers that study the effects of the real exchange rate also find a statistically significant effect of filing-country GDP growth on filings. They argue that if the import country’s economy is performing poorly, findings of material injury are more likely, thus increasing the expected payoff to filing an antidumping petition. We therefore include the growth rate of the GDP of the filing country in the bilateral data set. In the aggregated data set, we substitute for this measure crudely by including the growth rate of world GDP.

We also posit the need to account for the volume of imports by the import country from the export country. It is to be expected that if two countries trade more with one another, more antidumping petitions will be filed within that pair simply because there are more opportunities to do so. Data on bilateral imports are gathered from the International Monetary Fund (2010a).12

4 Empirical Strategy

The fact that the dependent variable in this analysis—the number of antidumping actions within our unit of observation in a particular year—is a non-negative integer makes the use of a Poisson regression model appealing. However, as this model assumes that the mean and variance of the population are equal to one another (an assumption that seldom holds in practice) a number of authors in this literature (Knetter and Prusa, 2003; Irwin, 2005; Hallworth and Piracha, 2006) use a negative binomial regression, which is similar to the Poisson regression model but does not require equidispersion.13 Cameron and Trivedi (1998) point out that in most cases, the negative binomial arises from a Poisson distribution where there exists unobserved individual heterogeneity.

Figure 1 describes the distribution of filing activity in the aggregated data set. Given the frequency with which zero outcomes occur, it is clear that the law of rare events applies, implying that count models are particularly appropriate. This characteristic is even more

12 Although it is possible to control for total exports by the exporting country in the aggregated data set to crudely capture the same effect, we omit this variable as it would require the omission of export-country dummy variables. The collinearity between these variables, as well as the virtues of export-country dummy variables are discussed in section 4.

13 Some authors studying the same or similar dependent variables in this literature use a Tobit model (Feinberg, 1989), arguing that the number of filings is representative of an underlying distribution that is not observed when the number of filings is zero. Others simply rely on an OLS model (Leidy, 1997).
pronounced in the bilateral data set. We therefore employ the negative binomial regression model in our empirical analysis; but due to the similarity between the Poisson and negative binomial models, we present our framework as a Poisson model for simplicity.

Figure 1: Distribution of Aggregated Filing Activity

4.1 Model and Specification

The Poisson regression model assumes that the true count, $Y$, is related to a vector of explanatory variables, $x$, such that

$$E[Y|x] = \exp(x'\beta),$$

where $\beta$ is a vector of coefficients. The model applies a Poisson distribution to $Y$ so that

$$\Pr[Y = y_i|x_i] = \frac{e^{\exp(x'_i\beta)} \exp(x'_i\beta)^{y_i}}{y_i!}.$$ 

This specification allows us to determine the incidence rate ratio (IRR), which is the increase in the expected count as a result of a unit increase in one explanatory variable, ceteris paribus (Knetter and Prusa, 2003). The IRR for regressor $x_j$ is given by

$$\text{IRR}_j = \exp(\beta_j).$$

It is the ratio of the incidence rates (i.e., the expected count) for $x_j = \bar{x}$ and $x_j = \bar{x} + 1$. An IRR of 1.5, for instance, implies that a unit increase in the regressor causes a fifty-percent increase in the expected count holding all other regressors constant (Knetter and Prusa, 2003). Given the ease of interpreting the IRRs, we report them rather than the coefficients in our results.

The relevant hypothesis test is whether the IRR is significantly different from one. An IRR less than one indicates a negative correlation between the regressor and the dependent variable while an IRR greater than one corresponds to a positive correlation.
We use the following specification with our aggregated data set:

\[ f_{it} = \exp(\alpha_0 + \alpha_1 \gamma_{it} + \alpha_2 \omega_{it} + \alpha_3 \gamma_{it} \cdot \omega_{it} + \alpha_4 r_{it} + \alpha_5 \gamma_{it}^* + \mathbf{x}' \lambda + t' \rho + v_i + \varepsilon_{it}). \]  

(2)

In equation (2), \( f_{it} \) is the number of filings targeting country \( i \) in year \( t \); \( \gamma_{it} \) is the GDP growth rate of country \( i \) in year \( t \); \( \omega_{it} \) is the openness to imports of country \( i \) in year \( t \); \( r_{it} \) is the percent deviation of country \( i \)'s real exchange rate in year \( t \) from its sample mean; \( \gamma_{it}^* \) is the growth rate of world GDP in year \( t \); \( \mathbf{x} \) is a vector of export-country dummy variables; \( t \) is a vector of time dummy variables; \( v_i \) is a country-specific random effect; and \( \varepsilon_{it} \) is an error term satisfying the usual assumptions.

We also adjust equation (2) to fit our bilateral data:

\[ f_{ijt} = \exp(\beta_0 + \beta_1 \gamma_{it} + \beta_2 \omega_{it} + \beta_3 \gamma_{it} \cdot \omega_{it} + \beta_4 r_{ijt} + \beta_5 m_{ij} + \beta_6 \gamma_{jt} + \mathbf{x}' \xi + t' \delta + v_{ij} + \varepsilon_{ijt}). \]  

(3)

In equation (3), the notation is the same as in equation (2) with these exceptions: \( f_{ijt} \) is the number of filings by country \( j \) against country \( i \) in year \( t \); \( r_{ijt} \) is the deviation of the bilateral real exchange rate between countries \( i \) and \( j \) in year \( t \) from its sample mean; \( m_{ij} \) is a time-invariant value of total imports by country \( j \) from country \( i \); \( \gamma_{jt} \) is the growth rate in the GDP of country \( j \) in year \( t \); \( v_{ij} \) is a country-pair-specific random effect; and \( \varepsilon_{ijt} \) is an error term meeting the usual assumptions.

In both equations (2) and (3), we supplement the regressors detailed in section 3 with export-country dummy variables, year dummy variables and export-country or country-pair random effects (as appropriate for the data set being used). Export-country dummies are included primarily to control for differences in the trend growth rate of countries. As discussed in section 2.1, our logic for the effect of growth on filings is based in cyclical changes in growth as opposed to different levels of growth.

Time dummies are included to control for global variations in the use of antidumping laws over time. Figure 2 in Appendix A describes total filings per year. As there is a surge in the number of filings in the late 1990s and early 2000s, it is helpful to determine the implications of controlling for year-specific effects on our results.

Random effects are included to control for unobservable factors that apply uniquely to a particular country or country pair, as appropriate to the data set being used.

4.2 Expected Results

Hypothesis 1 implies that reduced growth rates of export-country GDP should be associated with more antidumping filings. We therefore expect that \( \alpha_1 \) and \( \beta_1 \) will be negative, and thus that the IRRs derived from each of these coefficients will be less than one.

Hypothesis 2 suggests that greater openness to imports is correlated with fewer filings of antidumping petitions against the country in question. We therefore expect that \( \alpha_2 \) and \( \beta_2 \) will be negative, leading to IRRs less than one for openness.

With respect to the interaction term, hypothesis 3 would be supported by coefficients \( \alpha_3 \) and \( \beta_3 \) being negative (leading to IRRs less than one). If these same coefficients take on
positive values (leading to IRRs greater than one), hypothesis 4 is supported.

5 Results

We follow Knetter and Prusa (2003) in the lag structure of our regressors. The growth rates of export-country and import-country GDP are taken as the average annual growth rates from year $t - 3$ to year $t - 1$ (where $t$ is the year in which the petition is filed). Openness is averaged over years $t - 3$, $t - 2$, and $t - 1$ as well. The interaction term is the product of the averages of export-country growth and openness. We use the exchange rate only in year $t - 1$.

We do not allow the measure of total imports by the import country from the export country to vary over time. Since the number of filings in a particular country pair will influence the volume of trade within that pair, reverse causality is clearly an issue. By observing this variable only in 2005 rather than in each year of the sample, we avoid to some extent the endogeneity that may be present if it is permitted to vary over time.\textsuperscript{14}

5.1 Aggregated Filing

Table 2 presents the results of estimation of equation (2) on the aggregated data set. Specifications (1) and (2) of this table replicate the model used by Knetter and Prusa (2003), excluding and including export-country-specific random effects, respectively. When random effects are not included, an unexpected positive and significant relationship is found between export-country growth and filings. The inclusion of random effects changes the direction of this correlation to that implied by the argument in section 2.1. The IRR is statistically significant at the one-percent level.

Specification (3) adds openness and the interaction term to the model in specification (2). The introduction of these variables eliminates several post-Soviet republics from our sample for the first two years due to a lack of import data. In this regression, both export-country growth and openness enter significantly at the one-percent level with the expected IRRs. The interaction term is insignificant in this specification, although its IRR is consistent with hypothesis 4.

Specification (4) replaces the random effects in specification (3) with export-country dummy variables. Export-country GDP growth and openness to imports retain their statistically- significant negative correlations with filings. The interaction term also enters significantly at the one-percent level with an IRR greater than one. It is thus consistent with hypothesis 4.

Specification (5) introduces time dummy variables (which require us to drop world GDP growth to avoid perfect collinearity). We continue to find statistically significant support for hypotheses 1 and 2 with incidence rate ratios less than one on export-country GDP growth and openness to imports. The interaction term, while now significant only at

\textsuperscript{14} When using a time-invariant measure of a regressor in order to avoid endogeneity, it is customary to use the value at the beginning of the sample. We use the value later in the sample in order to increase the number of countries for which data are available. All results presented in this section have been repeated using the value of imports for 1995 as a control rather than its value in 2005, and they are qualitatively identical.
the ten percent level, retains its greater-than-one IRR.

These results provide strong support for hypotheses 1 and 2, as well as slightly weaker support for hypothesis 4. However, it is notable that the exchange rate is significant only in specification (5) of Table 2, where its greater than one IRR agrees with previous findings in the literature (Knetter and Prusa, 2003; Hallworth and Piracha, 2006). In addition to concerns over aggregation bias, this inconsistency suggests that these results may not be entirely reliable. We therefore turn to the bilateral data set to verify our results.

Table 2: Sample of Aggregated Filing Activity

<table>
<thead>
<tr>
<th>VARIABLES</th>
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<th>(2)</th>
<th>(3)</th>
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<th>(5)</th>
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<td>$\gamma_{it}$</td>
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<td>0.971$^a$</td>
<td>0.948$^c$</td>
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<td>(0.00826)</td>
<td>(0.0144)</td>
<td>(0.0145)</td>
<td>(0.0146)</td>
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<td>0.152$^b$</td>
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<td>(0.00862)</td>
<td>(0.116)</td>
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<td></td>
</tr>
<tr>
<td>$\gamma_{it} \cdot \omega_{it}$</td>
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<td>1.134$^a$</td>
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<td>No</td>
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</tbody>
</table>

Standard Errors in Parentheses

$^a p<0.01$, $^b p<0.05$, $^c p<0.1$

Incidence Rate Ratios Reported

Dependent Variable is Number of Filings
5.2 Bilateral Filings

We present the results of estimation of equation (3) on the bilateral data set in Table 3. Specification (1) uses the same variables as Knetter and Prusa (2003) and Hallworth and Piracha (2006) and does not include random effects. We find an unexpected positive relationship between export-country growth and filings. However, adding country-pair-specific random effects in specification (2) brings the direction of this relationship into agreement with hypothesis 1. It is statistically significant at the one-percent level.

Table 3: Sample of Bilateral Filing Activity

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>γ_{it}</td>
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<td>0.941a</td>
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</tr>
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<td>(0.502)</td>
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<td></td>
</tr>
<tr>
<td>γ_{it} · ω_{it}</td>
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<td>1.099b</td>
<td>1.071c</td>
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<td>(0.0416)</td>
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<td>r_{ijt}</td>
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<td>1.000a</td>
<td>1.000a</td>
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<td>(0.0106)</td>
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<td>35923</td>
</tr>
<tr>
<td>v_{ijt}</td>
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<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>x</td>
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<td>Yes</td>
<td>Yes</td>
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</tr>
<tr>
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<td>2677</td>
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</table>

Standard Errors in Parentheses

\( a \ p<0.01, \ b \ p<0.05, \ c \ p<0.1 \)

Dependent Variable is Number of Filings

Incidence Rate Ratios Reported

In specification (3), openness, the interaction term, the measure of imports from the export country to the import country, and export-country dummy variables are added to the model used in specification (1). As in section 5.1 several post-Soviet republics are dropped in early years with the use of import measures. We also lose all observations with
Taiwan as either an import or export country due to its exclusion from the Direction of Trade Statistics produced by the International Monetary Fund (2010a). In specification (3), all three variables of interest draw strongly significant coefficients, supporting hypotheses 1, 2, and 4.

The inclusion of random effects in specification (4) supports these findings. The IRRs for growth and openness are significantly different from one with ninety-nine percent confidence and are consistent with hypotheses 1 and 2. The IRR on the interaction term is significantly greater than one with ninety-five percent confidence, and continues to support hypothesis 4. With the addition of year dummy variables in specification (5), openness enters insignificantly, although the findings for export-country growth and the interaction term hold, albeit with reduced confidence for the interaction term.

These results provide very strong support for hypothesis 1, as well as strong support for hypotheses 2 and 4. Additionally, the results for the control variables in Table 3 are more consistent with previous findings than those presented in section 5.1. The IRR for the exchange rate is consistently greater than one and significant at at least the five-percent level. The same is true for the volume of imports, although the difference from one is small in magnitude. The result for the growth rate of the import-country GDP is perplexing, as we find that higher growth rates are associated with increased filings, while other authors have found the opposite (particularly Knetter and Prusa, 2003; Hallworth and Piracha, 2006). Nonetheless, these results lend credence to the findings for the variables of interest.

5.3 Robustness Checks

We test whether our results are robust to the selection of a different lag structure for the regressors. We replace lags of t − 3 to t − 1 with lags of t − 2 to t and repeat the estimation of equation (3) using the same specifications as presented in Table 3. We present these results in Table 4. This lag structure is motivated by the investigation period used by the USITC to determine whether a domestic industry has been materially injured by dumped imports. These investigations typically collect and consider data from the year of initiation of an investigation, as well as the two years prior. We perform this estimation only on the bilateral data set as the results from section 5.2 are stronger than those found in the aggregated data set and are not subject to concerns of aggregation bias.

The results in Table 4 are generally consistent with our findings in section 5.2. In the first four specifications, the sign of the coefficient on growth agrees with its counterpart in Table 3, although the significance level in specification (2) is not as high. In specifications (3) and (4), openness to imports and the interaction agree with the results in Table 3, with the interaction achieving an even higher significance level with the new lag. The introduction of year dummy variables in specification (5), however, reduces the significance of the IRR on growth to the ten-percent level; nonetheless, the fact that it is less than one supports hypothesis 1. Notably, the inclusion of time dummies in this specification also yields significant IRRs for openness and the interaction where they had not been achieved (or had been achieved with questionable significance, in the case of the interaction) in Table 3. As with prior specifications, these IRRs support hypotheses 1 and 2, respectively.\textsuperscript{15} Although

\textsuperscript{15} We have also repeated the same specifications with a lag structure of \( t - 2 \) to \( t - 1 \). The results are con-
the significance levels achieved for growth in this table are not as high as with the original time lags, our results (particularly those for openness and the interaction) strengthen the support that we have developed for hypotheses 1, 2, and 4.

Table 4: Sample of Bilateral Filing Activity; Lag of $t - 2$ to $t$

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma_{it}$</td>
<td>1.052&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.985&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.950&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.943&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.974&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
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<td>(0.0151)</td>
<td>(0.0125)</td>
<td>(0.0139)</td>
</tr>
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<td>0.0374&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>$\gamma_{it} \cdot \omega_{it}$</td>
<td>1.158&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.183&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.135&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0495)</td>
<td>(0.0454)</td>
<td>(0.0463)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{ijt}$</td>
<td>1.338&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.082&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.665&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.472&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.609&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.115)</td>
<td>(0.0378)</td>
<td>(0.166)</td>
<td>(0.105)</td>
<td>(0.121)</td>
</tr>
<tr>
<td>$m_{ij}$</td>
<td>1.000&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.000&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.000&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(8.09e-07)</td>
<td>(3.20e-06)</td>
<td>(3.34e-06)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\gamma_{jt}$</td>
<td>1.033&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.999</td>
<td>1.054&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.018&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.052&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.0107)</td>
<td>(0.00990)</td>
<td>(0.00996)</td>
<td>(0.0103)</td>
<td>(0.0115)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0596&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.807&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.434&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.366&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.628&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.00353)</td>
<td>(0.197)</td>
<td>(0.0668)</td>
<td>(1.473)</td>
<td>(0.977)</td>
</tr>
<tr>
<td>$N$</td>
<td>38613</td>
<td>38613</td>
<td>36239</td>
<td>36239</td>
<td>36239</td>
</tr>
<tr>
<td>$v_{ijt}$</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>$x$</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>$t$</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of Groups</td>
<td>2818</td>
<td>2677</td>
<td>2677</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standard Errors in Parentheses
<sup>a</sup> p<0.01, <sup>b</sup> p<0.05, <sup>c</sup> p<0.1
Incidence Rate Ratios Reported
Dependent Variable is Number of Filings

5.4 **Endogeneity**

The use of openness in our regression analysis raises the issue of endogeneity, a possible source of which is reverse causality between openness to imports and antidumping filings. Blonigen and Bown (2003), and Feinberg and Reynolds (2006) have shown that retaliation can be a driving factor behind antidumping filings. That is, if a country is targeted by more consistent with Table 3 with the exception of specification (5), where none of the variables of interest enter significantly. Nonetheless, the consistency with which our results for these variables occur significantly lends further support to our findings.
antidumping petitions, its domestic firms are more likely to file, thus reducing the openness of the export country.\(^\text{16}\) It is therefore possible that increased filings against a country will affect its openness, which in turn affects filings in the manner detailed in section 2.2. Frankel and Romer (1999) develop an approach to instrument for openness using gravity model estimates. In this approach an estimate of total imports, \(M_{it}\), is used in order to calculate the openness measure in equation (1). This value serves as an instrument for our estimation\(^\text{17}\).

Table 5: Results of Instrumentation for Openness; Lag of \(t - 3\) to \(t - 1\)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) OLS</th>
<th>(2) 2SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\gamma_{it})</td>
<td>-0.00221(^a)</td>
<td>-0.00163(^b)</td>
</tr>
<tr>
<td></td>
<td>(0.000803)</td>
<td>(0.000798)</td>
</tr>
<tr>
<td>(\omega_{it})</td>
<td>-0.0770(^c)</td>
<td>-0.202(^a)</td>
</tr>
<tr>
<td></td>
<td>(0.0413)</td>
<td>(0.0285)</td>
</tr>
<tr>
<td>(r_{it})</td>
<td>0.0323(^a)</td>
<td>0.0249(^a)</td>
</tr>
<tr>
<td></td>
<td>(0.00928)</td>
<td>(0.00915)</td>
</tr>
<tr>
<td>(m_{ij})</td>
<td>2.99e-06(^a)</td>
<td>2.99e-06(^a)</td>
</tr>
<tr>
<td></td>
<td>(1.10e-07)</td>
<td>(1.10e-07)</td>
</tr>
<tr>
<td>(\gamma_{jt})</td>
<td>0.00544(^a)</td>
<td>0.00609(^a)</td>
</tr>
<tr>
<td></td>
<td>(0.000904)</td>
<td>(0.000895)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.365(^a)</td>
<td>0.375(^a)</td>
</tr>
<tr>
<td></td>
<td>(0.0252)</td>
<td>(0.0273)</td>
</tr>
</tbody>
</table>

Standard Errors in Parentheses
\(^a\) \(p<0.01\), \(^b\) \(p<0.05\), \(^c\) \(p<0.1\)

Dependent Variable is Number of Filings

Unfortunately, the proper use of an instrument in a negative binomial regression is unclear, making direct comparison with the results presented thus far impossible. However, we are able to generate a result for comparison by using an OLS regression, which we present in Table 5. In specification (1) (the OLS regression), both growth and openness are

\(^{16}\) Although this argument suggests that it may be appropriate to control for the number of filings by the export country against the import country, such an approach would simply introduce further endogeneity. Based on the retaliation argument, this variable would be subject to reverse causality with our dependent variable.\n
\(^{17}\) A description of the gravity model, including the results of its estimation, is included in Appendix B.
significant with the expected sign, although openness is significant only at the ten percent level. When instrumentation for openness is performed in specification (2), both growth and openness are significant with the expected signs.\textsuperscript{18} This result suggests that endogeneity of openness may not be a major issue in our estimation.

6 Conclusions

This paper studies the effects of a country’s GDP growth and openness to imports on filings of antidumping petitions against it. It seeks to resolve the unexpected results achieved by Knetter and Prusa (2003), and Hallworth and Piracha (2006), who hypothesize a negative relationship between a country’s GDP growth and antidumping filings against it, but are not able to achieve this result empirically. This paper also looks to confirm the hypothesis that less-open countries are targeted more frequently by antidumping petitions. Finally, we propose and test two competing hypotheses as to the interaction between growth and openness to imports in their relationship with antidumping filings. We compile a comprehensive data set to test these hypotheses, including thirty import countries, ninety-five export countries, and fourteen years of data.

The results presented in section 5 provide strong and robust support for a negative correlation between a country’s GDP growth and filings of antidumping petitions against it. This finding confirms a longstanding hypothesis in the literature that has not been proven empirically. It is directly contrary to the assertion made by Hallworth and Piracha (2006) that lower growth rates will lead to fewer filings against a country.

This result displays a potential pitfall of export-driven recoveries. We have shown that it is precisely when a country is in need of recovery that it is more likely to be the target of antidumping actions, which may frustrate efforts to increase exports. Policy makers must therefore be cognizant of this fact as an obstacle to relying on exports to resolve negative shocks to the economy.

We also find strong support for the hypothesis that countries that are more open to imports are less likely to be targeted by antidumping petitions. This result suggests a potential solution for policy makers wishing to reduce their country’s propensity to be targeted by antidumping petitions. Specifically, such policies as reduced tariffs or stronger competition laws would reduce dumping activity originating in a country and thus reduce antidumping petitions against it.

Finally, we find that decreases in a country’s GDP growth lead to a greater increase in filings against it if it is relatively closed to imports. We do not find support for the hypothesis that the effect of reductions in growth will be less pronounced for less-open countries.

\textsuperscript{18} The choice of this specification for instrumentation is based on the following logic. Of the specifications presented in Table 3, only specifications (3) and (4) achieve the desired results when a least-squares estimator is used rather than the negative binomial. Instrumentation for these specifications including an instrument for the interaction yields insignificant results. As this insignificance is likely due to the strong correlation between the instruments for openness and the interaction, we repeat the two specifications using a least-squares estimator, but exclude the interaction. The specification presented in Table 5 is the only one for which least-squares estimation without the interaction yields significant results with which to compare.
7 Limitations

The major limitation of this study occurs with regard to the measurement of openness. The import intensity measure of openness is rather crude, and may not accurately reflect the degree to which industries in the export country face competition from imports. Directly measuring tariff and non-tariff barriers—an appealing solution to this problem—poses significant problems. It is unclear which industries should be focused on in constructing such a measure, as only a few industries are actually targeted by antidumping petitions. Additionally (and more importantly), measuring policy variables is insufficient to capture all the sources of import competition (or a lack thereof) in the export economy. While policy plays a great role in determining the openness of a country to imports, it is also possible that other factors (e.g., geographic barriers, tastes, etc.) influence the degree of competition that domestic firms face from imports and therefore their dumping activity.

The difficulty of choosing which industry to focus on suggests that concentrating on macroeconomic indicators may not be the best source of information on antidumping. Although the results of this paper show that growth and openness to imports on the macroeconomic level are important factors in understanding antidumping, a more focused approach may yield better information on these variables than we are able to glean through a macro-level analysis. First, a more constrained focus, perhaps to the industry level, would allow for a more precise measurement of openness. Measuring the tariff rates and non-tariff barriers applied to a particular product or class of products is more straightforward than attempting to assemble a holistic measure encompassing all products. Additionally, this approach would make it possible to account for differences in the protection afforded to different industries within the same country that would cause one industry to attract petitions while forcing others to compete openly on the international market. It would also allow for the incorporation of data on competition into the measurement, capturing the extent to which targeted industries face constraints on their pricing behavior and thus their ability to sustain dumping. Additionally, it would be possible to measure the extent of competition that an industry faces from imports simply by observing the import share of domestic consumption of relevant goods (Hansen and Prusa, 1997).

A more disaggregated approach to studying the determinants of antidumping actions would also avoid some of the noise inherent in our results that stems from the use of macroeconomic variables. With respect to our two variables of interest, it is possible that industries that are targeted by antidumping petitions perform counter-cyclically. It is also possible that a country is generally open to imports while only a few politically sensitive industries are protected, and consequently targeted by antidumping petitions. Analysis of macroeconomic variables would provide a distorted view of the link between GDP growth, openness to imports, and antidumping in these cases.

Finally, the omission of filings in 2009 from the sample period due to issues of data availability excludes data from the recent financial crisis. Bown (2010) reports that the global recession was characterized by an increase in antidumping activity, from which valuable information could be gathered.
References


Morkre, M., D. Spinanger, and L. Tran (2008): “Are Unfair Import Laws Unfair to Developing Countries:


Appendices

A. Summary Statistics

Table 6: Summary Statistics for Sample of Aggregated Filing Activity

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Mean</th>
<th>St. Dev.</th>
<th>Min.</th>
<th>Max.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>f_{it}</td>
<td>2.538</td>
<td>6.331</td>
<td>0</td>
<td>72</td>
<td>1298</td>
</tr>
<tr>
<td>γ_{it}</td>
<td>4.095</td>
<td>3.935</td>
<td>-18.567</td>
<td>47.767</td>
<td>1298</td>
</tr>
<tr>
<td>ω_{it} = \frac{M_{it}}{Y_{it}}</td>
<td>0.315</td>
<td>0.245</td>
<td>0.032</td>
<td>1.864</td>
<td>1298</td>
</tr>
<tr>
<td>γ_{it} · ω_{it}</td>
<td>1.457</td>
<td>2.144</td>
<td>-5.578</td>
<td>26.266</td>
<td>1298</td>
</tr>
<tr>
<td>r_{it}</td>
<td>-0.011</td>
<td>0.261</td>
<td>-0.989</td>
<td>1.168</td>
<td>1298</td>
</tr>
<tr>
<td>γ^*_{it}</td>
<td>3.01</td>
<td>0.494</td>
<td>2.071</td>
<td>3.774</td>
<td>1298</td>
</tr>
</tbody>
</table>

Table 7: Summary Statistics for Sample of Bilateral Filing Activity

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Mean</th>
<th>St. Dev.</th>
<th>Min.</th>
<th>Max.</th>
<th>N</th>
</tr>
</thead>
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<tr>
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<td>0.525</td>
<td>0</td>
<td>29</td>
<td>35923</td>
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<td>γ_{it}</td>
<td>4.08</td>
<td>3.893</td>
<td>-18.567</td>
<td>47.767</td>
<td>35923</td>
</tr>
<tr>
<td>ω_{it} = \frac{M_{it}}{Y_{it}}</td>
<td>0.314</td>
<td>0.246</td>
<td>0.032</td>
<td>1.864</td>
<td>35923</td>
</tr>
<tr>
<td>γ_{it} · ω_{it}</td>
<td>1.445</td>
<td>2.115</td>
<td>-5.578</td>
<td>26.266</td>
<td>35923</td>
</tr>
<tr>
<td>r_{ijt}</td>
<td>-0.011</td>
<td>0.294</td>
<td>-0.991</td>
<td>2.313</td>
<td>35923</td>
</tr>
<tr>
<td>m_{ij}</td>
<td>4267.794</td>
<td>24190</td>
<td>0</td>
<td>602641</td>
<td>35923</td>
</tr>
<tr>
<td>γ_{jt}</td>
<td>3.88</td>
<td>2.887</td>
<td>-5.373</td>
<td>15.39</td>
<td>35923</td>
</tr>
</tbody>
</table>

A.1 List of All Import Countries in Sample

Argentina · Australia · Brazil · Canada · Chile · China · Colombia · Costa Rica · Ecuador · European Union · Indonesia · India · Jamaica · Japan · South Korea · Mexico · Malaysia · New Zealand · Pakistan · Peru · Philippines · Paraguay · Thailand · Trinidad and Tobago · Turkey · Taiwan · Uruguay · United States · Venezuela · South Africa
A.2 List of All Export Countries in Sample

United Arab Emirates · Argentina · Armenia · Australia · Austria · Belgium · Bangladesh · Bulgaria · Bahrain · Boznia and Herzegovina · Belarus · Brazil · Canada · Switzerland · Chile · China · Colombia · Costa Rica · Cuba · Czech Republic · Germany · Denmark · Dominican Republic · Algeria · Ecuador · Egypt · Spain · Estonia · European Union · European Union (excl. Germany) · European Union (excl. France) · Finland · France · United Kingdom · Georgia · Greece · Guatemala · Hong Kong · Croatia · Hungary · Indonesia · India · Ireland · Iran · Iraq · Israel · Italy · Japan · Kazakhstan · South Korea · Kuwait · Libya · Sri Lanka · Lithuania · Luxembourg · Latvia · Macao · Moldova · Mexico · Macedonia · Mozambique · Malawi · Malaysia · Nigeria · Nicaragua · Netherlands · Norway · Nepal · New Zealand · Oman · Pakistan · Peru · Philippines · Poland · Portugal · Paraguay · Romania · Russia · Saudi Arabia · Singapore · Slovakia · Slovenia · Sweden · Thailand · Trinidad and Tobago · Turkey · Taiwan · Ukraine · Uruguay · United States · United States (incl. Puerto Rico) · Uzbekistan · Venezuela · Vietnam · South Africa

Figure 2: Aggregated Filing Activity by Year
B. Gravity Model

As discussed in section 5.4, we account for the endogeneity of openness using estimates from the gravity model. The gravity model is typically specified in the form

$$T_{ijt} = \alpha_0 Y_{it}^{\alpha_1} Y_{jt}^{\alpha_2} D_{ij}^{\alpha_3} e^{x_{ij}^T \beta} \eta_{ijt}, \quad (4)$$

where $T_{ijt}$ is the trade flow between countries $i$ and $j$ in period $t$; $Y_{it}$ is the GDP of country $i$ in period $t$; $D_{ij}$ is the distance between countries $i$ and $j$; and $x_{ij}$ is a vector of controls, including measures of whether a country in the country pair is landlocked or an island, and whether the countries share a common language or border (Santos Silva and Tenreyro, 2006).

For purposes of estimation, equation (4) is linearized, giving

$$\ln(T_{ijt}) = \ln(\alpha_0) + \alpha_1 \ln(Y_{it}) + \alpha_2 \ln(Y_{jt}) + \alpha_3 \ln(D_{ij}) + x_{ij}^T \beta + \ln(\eta_{ijt}). \quad (5)$$

Finally, replacing total trade with imports from $j$ to $i$, $M_{ijt}$, as the dependent variable, and setting

$$\ln(\alpha_0) = \delta_0$$

and

$$\ln(\eta_{ijt}) = \epsilon_{ijt},$$

we can rewrite equation (5) as

$$\ln(M_{ijt}) = \delta_0 + \alpha_1 \ln(Y_{it}) + \alpha_2 \ln(Y_{jt}) + \alpha_3 \ln(D_{ij}) + x_{ij}^T \beta + \epsilon_{ijt}. \quad (6)$$

We gather the necessary bilateral import data for estimation of equation (6) from the International Monetary Fund (2010a). GDP data are taken from the USDA Economic Research Service (2009) and other gravity model controls are taken from Nicita and Olarreaga (2006). We present the results of the estimation of equation (6) in Table 8. After performing estimation, we are able to calculate

$$\widehat{M}_{it} = \sum_{j=1}^{n} \exp \left[ \ln(\widehat{M}_{ijt}) \right],$$

where $\ln(\widehat{M}_{ijt})$ is the predicted value from estimating equation (6). $\widehat{M}_{it}$ is an estimate of country $i$'s total imports in year $t$ and can be used to calculate the measure of openness described in equation (1). This expected import intensity serves as an instrument in our estimation.
Table 8: Results of OLS Estimation of the Gravity Model

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>ln($M_{ijt}$)</th>
<th>OLS</th>
</tr>
</thead>
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<tr>
<td>ln($Y_{it}$)</td>
<td>1.493$^a$</td>
<td>(0.00385)</td>
</tr>
<tr>
<td>ln($Y_{jt}$)</td>
<td>1.813$^a$</td>
<td>(0.00388)</td>
</tr>
<tr>
<td>ln($D_{ij}$)</td>
<td>-1.964$^a$</td>
<td>(0.0116)</td>
</tr>
<tr>
<td>Landlocked</td>
<td>-0.614$^a$</td>
<td>(0.0167)</td>
</tr>
<tr>
<td>Island</td>
<td>0.722$^a$</td>
<td>(0.0164)</td>
</tr>
<tr>
<td>Border</td>
<td>0.924$^a$</td>
<td>(0.0651)</td>
</tr>
<tr>
<td>Common Language</td>
<td>2.543$^a$</td>
<td>(0.0293)</td>
</tr>
<tr>
<td>Constant</td>
<td>2.714$^a$</td>
<td>(0.104)</td>
</tr>
<tr>
<td>$N$</td>
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<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.501</td>
<td></td>
</tr>
</tbody>
</table>

Standard Errors in Parentheses

$^a$ p<0.01, $^b$ p<0.05, $^c$ p<0.1
DOES PARTICIPATION IN EXPORT MARKETS INCREASE TFP?
EVALUATING THE LEARNING BY EXPORTING HYPOTHESIS USING FIRM-LEVEL DATA

Daniel Lim
Georgetown University

ABSTRACT

Several international trade theorists hypothesize that export-oriented firms in developing countries experience productivity gains relative to domestic firms via a learning by exporting effect. They argue that exporting facilitates both embodied and disembodied knowledge diffusion by exposing firms to and inducing them to adopt de novo (to the firm) technologies. However, empirical evidence for the aforementioned hypothesis remains inconclusive. Though some studies find evidence of learning, others attribute the productivity differential to the self-selection of more efficient firms into export markets. The ambiguity in empirical findings arises in part because conventional methodologies inadequately control for simultaneity bias in total productivity (TFP) estimates, and for contemporaneous correlation between exporting and TFP. This paper uses the World Bank’s Enterprise Survey Database to construct a panel of 2,017 Malaysian firms between 2002 and 2007. To solve the simultaneity problem, I employ a semi-parametric model developed by Levinsohn and Petrin (2003) that uses intermediate inputs to proxy for unobserved productivity shocks. A pooled OLS regression of TFP on a two-year lagged exporter dummy indicates that exporting leads to additional productivity gains of 9.6%. To establish causality, I run a Gaussian-Kernel variant of propensity score matching, and find that export-oriented firms experience a 55% increase in productivity levels relative to domestic firms. My overall results lend strong support to the learning by exporting hypothesis.
THE EFFECT OF NEWS MEDIA ON UK CONSUMERS' INFLATION ASSESSMENT

Rob Harris
University of Warwick

ABSTRACT

This paper examines the effect of unemployment news coverage on the inflation perceptions and expectations of the British public since 2000. It examines the existence of a ‘cognitive’ Phillips curve; as information concerning unemployment rises, are inflation perceptions or expectations affected? Analyzing two distinct channels, intensity and tone, I find evidence that the intensity of news improves the accuracy of inflation perceptions, whereas front-page news coverage impairs inflation perception accuracy. However, taking news coverage as endogenous and employing Instrumental Variables regression, the hypothesis is rejected. I find little evidence of any effect of news on inflation expectations and conclude that this is evidence that inflation expectations are well anchored by another mechanism in the UK economy.

1 Introduction

Economic policy relies upon understanding and exploiting the economic expectations of market participants. Indeed, Woodford (2005) claims that monetary policy consists purely of managing market expectations. Since its conception in the 1970s, the Rational Expectations Hypothesis has come to dominated macroeconomic theory. However, critics of this hypothesis, such as Ben Friedman, complain that such models lack a clear outline of the way in which economic agents derive the knowledge that they then use to formulate expectations (Friedman, 1979; p24).

The motivation behind this paper derives from the concept of The Economist’s ‘R-Word Index’ and the fear that the media creates negative economic opinions, thereby creating a self-perpetuating decline in economic activity.¹ Benford of the Bank of England shows that UK inflation expectations are largely constructed using a ‘backward rule-of-thumb’ and acknowledges that ‘around a quarter of [survey] respondents cited media reports as being a “very important” factor in influencing their perceptions of current inflation’ (Benford, 2008:Q2). One interesting issue is the disagreement of UK consumers’ current perceptions of inflation with the actual rate, which averaged 0.92% between 2000 and the end of 2009. Disagreement increases towards the end of the decade, a period of high

media intensity concerning the economic situation. Intuitively, more media attention should improve consumers’ awareness of the economic situation, thereby improving the accuracy of inflation assessment. This paper explicitly tests this hypothesis. Rather than concentrate singularly on consumers’ expectations, an understanding the formulation of current inflation perceptions is as important for managing the beliefs of market participants.

This paper examines the relationship between the intensity of unemployment news and the inflation assessment of the British public. The inherent simultaneity problem is countered through the use of an Instrumental Variables (IV) technique; to my knowledge, an approach unique among the literature. Moreover, this paper expands the literature by examining the existence of a ‘cognitive’ Phillips curve; does increased media intensity concerning unemployment affect the accuracy of inflation expectations or perceptions in the expected Phillips curve manner? I find evidence of a negative association between unemployment news intensity and the accuracy of consumers’ perceptions; as media intensity increases, perception error falls, improving accuracy. This paper also finds an opposite relationship for front-page news; an impairment consumer inflation assessment. However, when employing a Two-Stage-Least-Squares (TSLS) instrumental variables approach, neither hypothesis can be confirmed, precluding proof that media coverage causes impairment or improvement in inflation perceptions. Regarding inflation expectations, a relationship between news media and expectations cannot be confirmed, providing evidence that inflation expectations in the UK are well anchored by some other mechanism. Again, the endogeneity hypothesis of news intensity relative to inflation expectations cannot be rejected. This result is consistent with Benford’s finding, that UK consumers use rules of thumb in determining their inflation assessment, exhibited by the significant relationship between realised inflation and expectations and perceptions.

Mankiw & Reis (2002) accept that the crux of New Keynesian economics, wage- and price-stickiness, and its subsequent Phillips curve framework, has trouble squaring with the facts; hence, they propose a sticky-information model of expectation formation, where:

Information diffuses slowly through the population [...] each period a fraction of the population updates itself on the current state of the economy and computes optimal [decisions] based on that information. The rest of the population continues to [make decisions] based on old plans and outdated information. [...] Although prices are always changing, pricing decisions are not always based on current information (Mankiw & Reis, 2002).

Building upon this theory, Reis (2006) and Sims (2003) develop the concept of ‘rational inattention,’ where agents rationally update their information set periodically as they face costs of ‘acquiring, absorbing and processing information’ (Reis, 2006). Carroll (2003) subsequently expands this notion through his so-called ‘epidemiological’ model of informational diffusion; information ‘spreads’ through an economy. Carroll claims to provide a microfoundation for Mankiw & Reis’s model, which this paper in turn develops.
2 Existing Literature & Theory

2.1 Sticky-Information & Inflation Expectations

This section examines the existing theoretical and empirical evidence for the media’s effect on consumers and introduces the model. The model is built upon Mankiw & Reis’ sticky-information Phillips curve. Mankiw & Reis demonstrate that inflation is a function of the output gap, weighted by the ratio of information-updaters to non-updaters, plus the infinite weighted sum of inflation and the change in the output gap. The crucial element of this model is ‘the relevant expectations are past expectations of current economic conditions’ (Mankiw & Reis, 2002; p7).

\[
\pi_t = \left[\frac{\alpha \lambda}{1 - \lambda}\right] y_t + \lambda \sum_{j=0}^{\infty} (1 - \lambda)^j E_{t-1-j}(\pi_t + \alpha \Delta y_t)
\]

where \(\alpha\) is the weight on the output gap, \(\lambda\) is the proportion of agents who update their information, \(y_t\) is the output gap, \(E_{t-j}\) and \(\Delta y_t\) is the quarterly inflation rate. \(\pi_t\) is the expectations operator made \(j\) periods ago.

Carroll’s extension concentrates on the construction of inflation expectations. He makes the assumption that households form their expectations in a similar manner to Mankiw & Reis and claims that contemporaneous inflation expectations, \(E_{t-1-j}\), are equal to the one-step newspaper forecast and the infinite sum, weighted by proportion of information-updaters, of lagged mean inflation expectations, thus:

\[
M_t(\pi_{t+1}) = \lambda F_t(\pi_{t+1}) + [1 - \lambda] \{ \lambda M_{t-1}(\pi_t) + [1 - \lambda] \{ \lambda M_{t-2}(\pi_{t-1}) + \ldots \} \}
\]

or equivalently:

\[
M_t(\pi_{t+1}) = \lambda F_t(\pi_{t+1}) + [1 - \lambda] \{ \lambda M_{t-1}(\pi_t) \}
\]

where \(\lambda\) is the proportion of the population that update their information set each period.

Employing this model, Carroll examines whether an increase in informational availability – via the news media – increases the proportion of agents that update their inflation expectations. Formally, under the assumption that the media publishes a rational forecast provided by professional forecasters, Carroll concludes that the absolute error between consumer and professional inflation forecasts is affected by the intensity of news coverage on inflation, confirmed at the 5% level (Carroll, 2003; p16).

2.2 The Model & Hypotheses

This paper combines these two models by examining the effect of newspaper coverage of economic activity on both consumers’ inflation expectations and perceptions, under the assumption that expectations and perceptions are formed in an identical manner. Equations (1), (2) and (3) are essentially equivalent, and, aside from (1), contain an emphasis on the level of economic activity. Continuing Carroll’s extension, this paper takes the economic activity emphasis by examining the effect of media coverage of economic activity on the inflation assessment of consumers. Formally, from Equation (1):

\[
M_t(\pi_{t+1}) = \lambda F_t(\pi_{t+1} + \alpha \Delta y_t) + [1 - \lambda] \{ \lambda M_{t-1}(\pi_t) \}
\]
This invokes my investigation; are consumers’ inflation expectations influenced by economic activity through a ‘cognitive’ Phillips curve channel? In other words, do consumers have an inherent Phillips curve relationship built into expectations of inflation? This broad theory allows me to posit testable hypotheses, laid out explicitly below.

As Benford shows, consumers themselves believe that the media plays an important role in determination of expectation formation. Intuitively, if media coverage of any incident increases, the total information about the incident rises, and more and more consumers become aware of it. In the ‘rational inattention’ literature, this increase in media content can be seen as improving informational availability, or lowering the costs of absorbing that information, hence increasing the likelihood that consumers will update their information set. This in turn, following the sticky-information approach, can be seen as increasing $\lambda$ in (4), thereby improving the average forecast; $M(\pi_{t+1})$. This paper will explicitly examine this concept, thus my primary hypothesis will be: does increased media coverage of economic activity affect consumer inflation assessment? If so, is accuracy improved or impaired?

It is clear, however, that media content is unlikely to provide perfectly accurate coverage. Profit maximizing media firms compete not merely on accuracy of content, but rather through attention-grabbing stories; the media transmit what is demanded. This concept is widely acknowledged in Social Sciences, for example, DellaVigna & Kaplan (2006) and Marc (1996) both demonstrate that media bias or spin in US media significantly affects voting behaviour or political perceptions of economic competency, respectively. Therefore, complications stem from the concept of media bias; news providers compete through attention-grabbing coverage. In the economic literature, Doms & Morin demonstrate that there are "periods when reporting on the economy has not been consistent with actual economic events" (Doms & Morin, 2004).

Alsem et al. (2004) measure media bias by asking economic professionals to analyse past publications. Examining the variation between consumer and producer confidence, they conclude that the existence of spin is weak, assuming producers are unaffected by media coverage. However, examining a Vector Autoregressive (VAR) model, the authors claim that, as media spin affects consumer but not producer confidence, their hypothesis is confirmed (Alsem et al., 2004). Using a sophisticated media dataset, Lamla & Lein (2008) test whether the intonation of media reporting impairs the accuracy of consumers’ forecasts via a media ‘tone’ variable; a significantly non-zero parameter on such a variable draws the conclusion of bias. Examining sophisticated media indices, Doms & Morin find a significant relationship between both media intensity and tone on consumer sentiment. The importance of media bias on inflation expectations must therefore be examined. The explicit mechanism is discussed at greater length in Section 3.2. For now, I define my second hypothesis as: does accentuated media coverage of economic events have a significant effect on the accuracy of consumers’ inflation assessment?

One further problem is that of simulteneity, or reverse causality; does greater news intensity cause inflation expectation error, or do incorrect expectations induce greater news intensity? Lamla & Lein and Doms & Morin address this issue through the use of
VAR techniques, where all variables are modeled endogenously. Lamla & Lein conclude that ‘the volume channel has an impact on the [expectation error] but not vice versa’, an observation backed up by Granger-causality tests (Lamla & Lein, 2008). This paper will seek to counter this problem through the use of an Instrumental Variables technique. Intuitively, an instrumental variable must be inextricably connected with economic news intensity, but unrelated to potentially unobserved variables that affect the state of the economy, contained in the error term.

3 Data Methodology and Analysis

3.1 Dependent Variable: Inflation Expectations

The data on consumer inflation expectations comes from the Bank of England’s quarterly GfK/NOP survey. Following Badarinza & Buchmann’s approach, this paper will analyse the effect of media coverage on both current inflation perceptions and future expectations (Badarinza & Buchmann, 2009) Therefore, I employ the median of the GfK/NOP survey response to the questions about current inflation expectations, which is equivalent to $M_t(\pi_{t+1})$ from Equation (2) and (3) above, and for inflation perceptions is $M_t(\pi_t)$.

I determine the consumers’ observation and forecast error, which Carroll measures as the difference between the consumers’ and professionals’ inflation estimates, as do Lamla & Lein (2008), Sabrowski (2009) and Badarinza & Buchmann (2009). However, as Laster et al (1999) point out, the assumption that professionals provide unbiased, rational forecasts cannot be made with confidence. Furthermore, Branch (2004) suggests different methods to determine consumers’ forecast error: perfect foresight, error between forecast and outcome, or between consumer forecasts and forecasts derived from the Central Bank’s benchmark statistical model. This paper determines the error of consumers’ inflation perceptions and expectations as the absolute difference between consumers’ estimates and the actual outcome of inflation, the strictest form of the REH. Formally;

$$P^e_t(\pi_t) = \sqrt{(M_t(\pi_t) - \pi_t)^2}$$

and

$$E^e_t(\pi_{t+1}) = \sqrt{(M_t(\pi_{t+1}) - \pi_{t+1})^2}$$

where $P^e_t$ is the perception error, $E^e_t$ is the expectation error of a forecast made in period $t$.

From Figure 1, it seems inflation expectations trails perceptions by one quarter, indicating that consumers do not use their previous expectation to determine their current perception. It is interesting to note that, even during the period of high inflation in the UK, consumer expectations remained fairly accurate while perception error grew, especially around in the peak of the UK recession. As elucidated above, a key motivation for this paper is the fact that UK consumers are unaware of the current inflation rate. Furthermore, the mean squared error of inflation perceptions is 0.92 while, for expectations, it is 0.69 for the entire sample, but mean errors are lower for a restricted sample (up to 2007Q3). Interestingly, expectation accuracy improves over the recessionary period, but perception accuracy falls. The origin of the error is interesting here; consumers almost always consistently over-estimate their inflation assessment, but is this caused by economic news intensity? Examining the Auto-
Correlation functions (ACF) shows limited persistence – presenting serial correlation issues – and Box-Jenkins analysis suggests the inclusion of a lagged dependent variable.

3.2 Independent Variables: News Media Coverage & Controls

The media dataset is constructed using the Dow Jones Factiva news database, examining coverage from the UK’s largest non-tabloid weekday newspapers; the Daily Express, the Daily Mail, the Daily Telegraph, the Financial Times, the Guardian, the Independent and The Times. In this way, at least 50% of the UK’s newspaper circulation is captured. Unfortunately, tabloid newspapers are not stored on Factiva, so top-selling newspapers such as The Sun are missing from the analysis. The Factiva database allows searches to be run of news articles since 2000. All articles are categorised by Dow Jones Intelligent Indexing; for our purposes, include; ‘Economic Performance/Indicators’ with subcategories such as ‘Employment/Unemployment’, etc., are of interest. To determine the media variables, a search was run for articles either within a specific category, or containing a certain word or phrase, and the number of hits for each quarter 2000Q1 through 2009Q4 was taken.

Since I examine the concept of a ‘cognitive’ Phillips curve, I take unemployment as the archetypal measure for economic activity. Following Badarinza & Buchmann and Lamla & Lein, this paper improves on Carroll’s news intensity measure through creation of a ratio: the number of articles concerning unemployment relative to the quantity of articles in Factiva’s ‘Economic News’ category. Here, the tone variable is defined as the number of articles containing the word ‘unemployment’ that are published on the front-page, relative to the total number of articles concerning unemployment. Logs are taken to reduce variances and produce elasticities.

Contrastingly, the intensity of front-page articles containing ‘unemployment’ spiked at the end of 2001 and remained volatile until mid-2003. The period 2003 – 2007 is quiet in terms of economic news and unemployment continued to fall. From the onset of the 2007 financial crisis, media intensity grew; front-page news quickly rises before falling back again. This could be evidence that continuous front-page news about unemployment is not sustainable in the market; the public do not continue to demand such stories. However, the unemployment news intensity has continued to rise. This could be due to the general acknowledgment that unemployment lags economic growth.

Economic control variables may also be required to negate bias from omitted variables and, ‘if media just report what is happening in the real world, this would imply that no extra effect of media would be present’ (Lamla & Lein, 2008; p23). The model includes controls for quarterly UK unemployment rate and CPI inflation. From Figure 3 the distortion from the economic crisis in the late 2000s can be clearly seen and stationarity cannot be rejected. Following Perron (1989), this could be as a result of a ‘one-time change in the level or in the slope of the trend function’, leading to under-rejection of the null (Perron, 1989). As unemployment is non-stationary after 2008Q1, I restrict the sample to check for robustness of the results in section 4.1.

Figure 1: Absolute Errors of Inflation Perceptions & Expectations

Figure 2: Evolution of Independent Variables
3.3 Instrumental Variables

This paper utilises an Instrumental Variables (IV) approach to control for the simulteneity problem. Any instrument must satisfy two conditions: relevance and exogeneity. The former concerns correlation with the potentially endogenous variable, while the latter imposes no correlation with with the error term. For my model, this implies that any instrument must be correlated with unemployment news but uncorrelated with factors that affect the state of the economy, which will be picked up by the error term. Again, the instruments are news media measures, but are here composed of stories regarding ‘Cricket’ and ‘Sport’ relative to the total number of news articles (cric and sport, respectively). A third instrument is constructed as total ‘General/Political News’ (political). Given an external constraint on the number of pages in a newspaper, an increase in unemployment news should be associated with less coverage of other news; hence the negative correlation shown. Although cric is positively correlated with unemployment news, cricket news may increase in order to compensate readers for the emphasis on economic news. Furthermore, the seasonality of sporting news also helps to satisfy my exogeneity assumption. I explicitly test for exogeneity using the Durbin-Wu-Hausman test below.

Stock & Yogo (2002) show that weak instruments can produce biased IV estimators and distorted hypothesis tests. Since I employ Two-Stage Least Squares (TSLS) estimation, I examine the first-stage $F$-statistic, using the Stock & Yogo critical values, which in this case – with 2 potentially endogenous variables (tone and news), six instruments (3 instruments, 2 controls & constant), and a 10% bias tolerance – is 8.67 (Stock & Yogo, 2002; p21). The weakness of the instruments is tested explicitly in Section 4.

4 Regression Analysis

Now I develop the model from Equation (4) into a regression model and introduce the estimation procedure. Employing the recent literature of weak instruments, I finalise my Instrumental Variables model. From my first hypothesis, testing the effect

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Max</th>
<th>Min</th>
<th>Std. Dev.</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{t}^{e}(\pi_{t})$</td>
<td>0.62</td>
<td>0.64</td>
<td>1.19</td>
<td>0</td>
<td>0.30</td>
<td>39</td>
</tr>
<tr>
<td>$E_{t}^{e}(\pi_{t+1})$</td>
<td>0.49</td>
<td>0.47</td>
<td>0.96</td>
<td>0</td>
<td>0.27</td>
<td>39</td>
</tr>
<tr>
<td>news$_{t}$</td>
<td>-3.87</td>
<td>-3.93</td>
<td>-2.55</td>
<td>-4.68</td>
<td>0.44</td>
<td>39</td>
</tr>
<tr>
<td>tone$_{t}$</td>
<td>-1.91</td>
<td>-1.67</td>
<td>-0.22</td>
<td>-3.64</td>
<td>0.84</td>
<td>39</td>
</tr>
<tr>
<td>CPI$_{t}$</td>
<td>1.84</td>
<td>1.50</td>
<td>4.80</td>
<td>0.60</td>
<td>0.90</td>
<td>39</td>
</tr>
<tr>
<td>UN$_{t}$</td>
<td>5.39</td>
<td>5.20</td>
<td>7.80</td>
<td>4.70</td>
<td>0.73</td>
<td>39</td>
</tr>
<tr>
<td>cric$_{t}$</td>
<td>-1.89</td>
<td>-1.86</td>
<td>-1.48</td>
<td>-2.62</td>
<td>0.21</td>
<td>39</td>
</tr>
<tr>
<td>sport$_{t}$</td>
<td>0.776</td>
<td>0.77</td>
<td>0.85</td>
<td>0.68</td>
<td>0.04</td>
<td>39</td>
</tr>
<tr>
<td>political$_{t}$</td>
<td>10.75</td>
<td>10.77</td>
<td>10.96</td>
<td>10.55</td>
<td>0.10</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 1: Descriptive Statistics
of unemployment news intensity on consumers’ inflation perceptions and expectations I determine my first model thus:

$$P_t^e(\pi_t) = \alpha + \beta_1 \text{news}_t + \gamma \text{Control}_t + \varepsilon_{1t}$$

The variable of interest is clearly $\beta_1$, and from my hypothesis of a ‘cognitive’ Phillips curve, I expect the coefficient to be negative, signifying that increased media intensity of unemployment induces consumers to revise their inflation perceptions towards the actual rate. I again test the primary hypothesis, this time for inflation expectations, using a similar argument:

$$E_t^e(\pi_{t+1}) = \alpha + \beta_1 \text{news}_t + \varphi \text{Control}_t + \varepsilon_{2t}$$

front-page is likely to receive greater attention and indeed greater readership than less pronounced articles. Therefore, from my second hypothesis, I expect the coefficient on tone to induce more substantial revisions to consumers’ inflation perceptions and expectations. The outcome of the sign of the coefficient is currently ambiguous; a positive coefficient implies that front-page news actually has adverse effects on consumers’ beliefs. I define my tonal models, thus:

$$P_t^e(\pi_t) = \alpha + \beta_1 \text{news}_t + \beta_2 \text{tone}_t + \varphi \text{Control}_t + \varepsilon_{3t}$$

$$E_t^e(\pi_{t+1}) = \alpha + \beta_1 \text{news}_t + \beta_2 \text{tone}_t + \varphi \text{Control}_t + \varepsilon_{4t}$$

To define the IV estimation, I must outline the first stage regression, the instrument list. I include all exogenous regressors (control variables) and instruments defined above, thus:

$$\text{news}_t = \alpha + \gamma_1 \text{cric}_t + \gamma_2 \text{sport}_t + \gamma_3 \text{total}_t + \varphi \text{Control}_t + \varepsilon_{Rt}$$
4.1 Robustness

Preliminary estimation of the above models allows refinement of the specification. I check for serial correlation or heteroscedasticity in the standard errors. From running Equation (5), the Durbin-Watson statistic indicates positive serial correlation of order 1, consistent with the Box-Jenkins result above. The same is true of Equation (7). I counter this through the inclusion of a lagged dependent variable. Examining Equations (6) and
permits rejection of serial correlation in both models. Both the ARCH-LM test and White’s test reject heteroscedasticity in models (5), (6), and (7). However, model (8) exhibits CPI-dependent heteroscedasticity; employing White’s robust standard errors, the T-stat of CPI falls, but the coefficient remains significant in OLS but not so for TSLS. Furthermore, by restricting the dataset to pre-2008Q1, I implicitly check the stability of the results. The Chow stability test is ineffective owing to the size of the dataset. In the restricted regressions, the coefficients change slightly, but not substantially.

I briefly examine the specification of the IV models by comparing TSLS with OLS. If the coefficients are substantially different, or indeed have opposite signs, then the instruments may be ill-specified. For model (5), the coefficients all keep the same sign, the controls remain almost identical, but the magnitude of increases. The same is true for model (6), but the news coefficient increases by larger degree. In model (7) too, the coefficients on tone and news increase in magnitude indicating that OLS causes a downward bias in both news measures. Here, I test the exogeneity of the instruments, via the Durbin-Wu-Hausman test. I estimate the reduced-form equation, and procuring the residuals ($\varepsilon_{Rt}$ from (9)). Then, by including these residuals in the simple OLS regression, I test the hypothesis that the coefficient on the residual series is zero. Formally, and by using Equation (5) as an example:

$$P_t^e(\pi_t) = \alpha + \beta \text{news}_t + \phi \text{Control}_t + \psi \varepsilon_{Rt} + \epsilon_{1t}$$

$$H_0: \psi = 0 \quad H_\alpha: \psi \neq 0$$

Estimation of this model, as well as a similar model built from Equation (6), does not allow rejection of the hypothesis above and I conclude that my exclusion restrictions are sufficient. Furthermore, following the ‘weak’ instruments issues raised in Section 3.3, it is clear from Table 3 that the F-Stat of the first-stage regression is substantially greater than 8.78 at 12.0. Thus, I can conclude that my instruments are neither weak nor endogenous and can comfortably continue to use them.

4.2 Preliminary Findings

This section presents a brief discussion of the results displayed in Table 3. From the OLS regression of model 5, I find evidence in favor of my primary hypothesis; an increase in unemployment news intensity is associated, on average, with a 0.156% improvement in consumers’ inflation perception, through an increase in informational availability. Conversely, an increase in the realised rate of unemployment is associated with a decline in the accuracy of perceived inflation. One interesting result is that an increase in the actual level of inflation is associated with an improvement in perception accuracy. Examining the effect of tone, the most notable result is that the coefficient on tone is positive; an increase in front-page unemployment news intensity is associated, on average, with a 0.123% impairment of consumers’ inflation perception. The coefficient on news has fallen to zero, however. Despite the increase in informational availability, the negative connotation associated with front-page news deteriorates the accuracy of consumers’ perceptions.

The TSLS regressions, however, tell a different story. The rate of inflation is the sole statistically significant coefficient in each regression, while the parameter values remain largely the same. From this, it is clear that the associations outlined above are largely as a
result of possible reverse-causality in the model; increased media intensity may improve consumers’ perceptions, but alternatively, inaccurate consumer perceptions could lead to more intense media coverage. Thus I reject my hypotheses with regard to UK consumer inflation perceptions; while I find an association between unemployment news and perception accuracy, I am unable to confirm my hypotheses that media intensity explicitly causes improvement or impairment in inflation assessment. From the outset, the results from models (6) and (8) oblige rejection of my primary hypothesis; increased media intensity appears to have no statistically significant effect on UK inflation expectations. However, increased front-page news is associated with an impairment in inflation expectations accuracy. Consistent with before, an increase in the true inflation rate improves consumer forecast accuracy, but the realised rate of unemployment is no longer a significant factor. The unemployment rate has no significant effect on consumer inflation expectations. The TSLS results are almost identical except now the coefficient on tone is insignificant. Again, OLS biases the coefficients on the news measures downwards. Since no news variables significantly affect expectation error, I conclude that inflation expectations are determined by some mechanism other than news media. The result that inflation has a limited effect adds to the conviction that expectations in the UK are well anchored.

4.3 Analysis of Regression Results

Although I am forced to reject my hypotheses, many of my findings are concurrent with the existing literature on the effect of the news media and with the sticky-information hypothesis. Carroll (2003), Badarinza & Buchmann (2009) and Lamla & Lein (2009) all find that increased media coverage significantly improves consumer inflation assessment efficiency. Furthermore, the differing signs of the news and tone variables is consistent with Lamla & Lein’s findings; an increase in accentuated news impairs the accuracy of consumers’ inflation perceptions. My results also find that news intensity has a greater effect on perceptions than expectations, which Badarinza & Buchmann also find. Sadly however this paper must reject the hypothesis of a causal relationship and the concept of a ‘cognitive’ Phillips curve.

The fact that this paper finds almost no causal relationship between news and consumer inflation assessment is likely to be because expectations and perceptions are well anchored in the UK economy. Kelly (2008) has shown that British expectations are well anchored to the actual rate and my conclusions cannot reject this. As the actual rate of inflation is significant in all perception models, (5) and (7), the results are also evidence in favour of Benford’s conclusion that consumers use rules of thumb in their perceptions of inflation. This conclusion also is concurrent with Kelly, as the actual rate of inflation plays a significant role in affecting consumer accuracy.

5 Concluding Remarks

5.1 Problems and Extensions

One important consideration of my regressions is the extremely small sample and is
likely to lead to biased estimators. The most important aspect here is the quarterly frequency of the series. It is a stretch to believe that newspaper articles printed three months prior are as likely to have as great an impact as more recent information. With more frequent data, not only can bias be negated, but the simultaneity issue can be solved through using simple lags of news intensity. In my case, using news from up to six months before the consumer forecast is made, appears at best erroneous, especially since Doms & Morin have shown that the effect of the media is short-lived (Doms & Morin, 2004; p28). Because of this, I believe that improving the dataset could lead to more robust results. Firstly, my dependent variable has a very low frequency because surveys are costly. Barclays BASIX survey would improve this variable. The frequency of the remainder of the data could be increased in a straightforward manner.

Furthermore, my news media variables are crude relative to others used in the literature. Lamla & Lein use Mediatenor, which provides sophisticated analysis of media content, including tone and bias. Doms & Morin create indices from Factiva based on various criteria. To improve the media dataset, using recent technological advances I could use Google News, a modern database of news articles, or even Google Insights, which provides statistics on Google searches as a proxy for information. The downside with this is that the data only goes back a few years, despite the higher frequency. One issue I have neglected is the readership of each newspaper. I have assumed that as the information is available to all, and equal access is unlikely as consumers have preferences over their source of news. Ideally the media data would be weighted by newspaper circulation, or even examining different papers directly. Also, given a more sophisticated dataset, it would be interesting to test for non-linearity in the tone variable.

This research could be built upon in several ways. Firstly, Mankiw & Reis’ model assumes an unrealistic Phillips curve; that is, inflation is dependent on the contemporaneous output gap. Under the prior assumption that information disseminates slowly, it is limiting to solely examine contemporaneous unemployment news. Given the hypothesis of a ‘cognitive’ Phillips curve, different Phillips curve dimensions could be tested using different lag lengths for news. In my case, the dataset frequency is a severe constraint to this. Similarly, further work could examine the role of news in determining inflation assessment over the transmission mechanism, by controlling for interest rate changes.

Another avenue of exploration would be to examine heterogeneous expectations of actors. This paper has concentrated on the expectations and perceptions of UK consumers, but it would be simple to explore the relationship of news on financial agents. Perceptions and expectations measures could be constructed from inflation-linked bond data. This data is also a much higher frequency.

5.2 Conclusion

This paper has attempted to examine the effect of news regarding unemployment on UK consumers’ inflation assessment in terms of current perceptions and future expectations. While I find an association that a greater intensity of news improves inflation perception accuracy and front-page news impairs it, I am unable to concretely claim a causal
relationship due to the inherent simulteneity. I find a small association between news and consumer expectations, which I cannot confirm either. My findings are in agreement with Benford in that UK consumers use rules of thumb in their assessments of inflation, and also with Kelly that expectations are well anchored in the economy. From these findings, the Bank of England can assume that their credibility and the anchoring of expectations are unaffected by news intensity about unemployment.

6 References


Keynesian Phillips Curve, Quarterly Journal of Economics, Vol. 117, No. 4


### Table 3: OLS & TSLS Regression Results from Equations 5 to 8.

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>OLS (6)</td>
<td>−0.015</td>
<td>0.123</td>
<td>−0.174</td>
<td>0.237</td>
<td>0.363</td>
<td>(0.049)</td>
<td>(0.548)</td>
<td>1.707</td>
<td>0.470</td>
<td>(0.209)</td>
<td>1.735</td>
</tr>
<tr>
<td>TSLS (6)</td>
<td>0.247</td>
<td>0.095</td>
<td>0.022</td>
<td>0.222</td>
<td>0.357</td>
<td>(0.049)</td>
<td>(0.548)</td>
<td>1.707</td>
<td>0.470</td>
<td>(0.209)</td>
<td>1.735</td>
</tr>
</tbody>
</table>

OLS (9): Cons. = 5.741, news’tone = 0.703, 1st-Lag Cons. = −1.725, CPIt = −0.482, UNt = −0.482, F-Sat = −0.482, S. E. = 0.319, D.W. Stat = 0.452, Std. Error = 0.357, R² Stat = 0.470, D.W. Stat = 1.735

**Note:** + indicates heteroscedastic-robust standard errors and *=10%, † indicates heteroscedastic-robust standard errors.
DETERMINANTS OF ASYLUM MIGRATION
TO GERMANY 1980-2008

In Un Flora Ng
Dartmouth College

ABSTRACT

In my paper, I investigate the determinants of asylum migration to Germany from 1980-2008. Using unbalanced panel data from 202 source countries, I show that GDP per capita, political repression, and human rights violations in the source country have a significant and robust relationship with the number of asylum applicants. As predicted by gravity models of migration, population and distance to Germany are also significant factors. Country-specific migrant networks in Germany serve as a "pull" factor for prospective migrants. I also find nonlinear relationships between the number of asylum applicants, and levels of political repression and standard of living in the source country.

Acknowledgements

I would like to thank Professor Nancy Marion for her guidance and encouragement throughout the research and writing process for this paper and my participation in the Carroll Round.

1 Introduction

Why do people choose to leave the place of their birth, the place where they have built their lives and their homes, in order to risk an uncertain future in an unfamiliar country? In my paper, I attempt to answer the above question by looking at the determinants of asylum migration to Germany from 1980-2008. My hypothesis is that while economic factors will have a significant relationship with the decision to seek asylum migration, political factors and violence will also have a significant relationship with the migration decision. Using a cost-benefit framework to analyze the asylum migration decision, I found that factors that raise the cost of staying in the home country (political repression, human rights abuses, low standards of living) have a positive relationship with the number of asylum applicants in Germany. Factors that raise the costs of migration, such as an increase in border patrols or deterrence measures, have a negative relationship with asylum applicants.
2 Refugees and Asylum Seekers

The 1951 Refugee Convention that established the United Nations High Commissioner on Refugee (UNHCR) defines a refugee as a person who "owing to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality, and is unable to, or owing to such fear, is unwilling to avail himself of the protection of that country." The UNHCR defines an asylum-seeker as someone who is a refugee, but whose claim has not yet been definitely evaluated. Asylum-seekers who are granted refugee status enjoy the right of non-refoulement, or the right not to be returned to their country. The right was codified in both the 1951 convention as well as the 1967 UN Protocol Relating to the Status of Refugees.

3 Theories and Models

3.1 Migration Theory

In order to find a long-term solution to reduce the number of refugees and asylum seekers, policy makers must first understand why people migrate in the first place. Borjas (1989) proposed a model of immigration that views the migration decision as an investment decision. Borjas argued that variables representing characteristics of the destination and source countries (such as standards of living, political governance, and immigration policies) have relative implications on population migration (Karemera 2000). Since Borjas, many economists have viewed migration as an investment decision. An individual will migrate if the expected discounted difference in the income stream between the home and destination locations exceeds moving costs (Hanson and Spilimbergo 1999, 1338).

Although many migration theories are based on cost-benefit models, Neumayer (2005, 6) makes an important note that asylum migration decisions differ from theories on voluntary migration decisions. Specifically, he notes that the asylum migration decision might not be based on the discounted difference in earning streams. Rather, the asylum migration decision is often made only when people are forced to flee their country under imminent threat to their own personal integrity or that of their family (Neumayer 2005). With this important qualification in mind, migration theories based on the cost-benefit models nevertheless provide an important conceptual framework as to why individuals might choose to leave their country and apply for asylum. I will slightly adjust the discounted earnings streams model by assuming that the asylum migration decision is made by weighing the costs of staying in the home country against the costs of migration.

3.2 Gravity Model of Migration

The gravity model of trade predicts that bilateral trade flows are a function of the
economic sizes of the two countries and the distance between the countries. The model predicts that the countries’ economic sizes have a positive relationship with trade volume, while distance has a negative relationship with trade volume. Similar gravity models have been developed for migration between the source country and the destination country. Karemera et al. (2000) suggest that gravity models for migration are derived from a system of demand and supply relationships. The demand and supply for migrants can be linked systematically to the size of the source countries and the destination country’s populations, economy size, or per capita income (Karema 2000: 1746). $S_i$, the supply of migrants from source country $i$, depends on source-country specific “push” factors such income, population, and factors endowments. Likewise, demand factors $D_j$ in destination country $j$ serve as “pull” factors that attract immigrants. A simple equation that Karemera et al. use to summarize this gravity model is as following:

$$F_{ij} = \frac{\alpha_0 S_i D_j}{R_{ij}}$$

(1)

$F_{ij}$ represents the migrant flows between source country $i$ and destination country $j$. $R_{ij}$ represents factors aiding or restraining migrant flows from source to destination country, including physical distance, information barriers, high transport costs and so on (Karemera 2000: 1746-1747).

4 Data

My dependent variable is the number of first-instance asylum seekers who filed a formal application for asylum in Germany (gerasylum) in the years 1980-2008. I obtain data on first-instance asylum applications in Germany from the United Nations High Commissioner for Refugee’s Statistical Online Population Database. I collected panel data from 202 countries and territories from 1980-2008. My dataset is an unbalanced panel data set. The data reflects the number of applicants or individuals who filed applications, rather than the number of applications or families. Repeat or appeal applications are also excluded from the data. Only those refugees who have filed for formal asylum are included, and illegal immigrants are excluded. In my analysis, I log the number of first-instant asylum applicants, GDP per capita, and population to facilitate interpretation of my regression results (See Appendix for summary of dataset and correlation matrix, see Table 2 for a complete explanation of all variables and their sources).

The independent variables in my analysis include both economic and political variables. I consider various measures of the Purchasing Power Parity adjusted real GDP per capita from the World Development Indicators in each of the source countries. In addition, to measure standards of living, I include explanatory variables that capture the political climate of the source country, such as the level of political openness, protection of civil liberties, and instances of human rights violations. Variables of note include $lgerasylumstock$, the log of the moving sum of asylum applicants in years $t-2$ and $t-3$. I use this variable as a proxy measure for migrant network effects. A large and strong migrant network in
Germany would decrease the information and settlement costs associated with migration for prospective asylum seekers. I sum only the second and third lags (and exclude the first lag) of \( gerasylum \) because I want the migrant network variable to measure the longer term presence of migrant communities from the source countries. I also exclude the first lag in order to exclude temporary surges in asylum applicants that may not reflect the long-term presence of established migrant communities in Germany and to decrease the correlation between this stock variable and my dependent variable (Neumayer 2005).

Other variables include the squares of the \( autocracy \) and \( gdppcopp \) variables. Vogler and Rotte (2000) theorize that the effect of the level of economic development on migration could be bell-shaped, resulting in a migration “hump.” People in countries that are extremely impoverished do not have the resources to finance the transportation and information costs of asylum migration. On the other hand, people who live in countries with high standards of living have no reason to migrate. Similarly, people who live under extremely autocratic political regimes may not have the means to exit the country, since harsh autocracies often impose limitations on exit visas. On the other hand, those who live in democratic countries have the means, but not the motivation, to migrate. Therefore, I also suspect that the effect of \( autocracy \) on asylum migration might be similarly bell-shaped and non-linear.

Please see table 2 for a complete list and description of all dependent and independent variables and their sources.

4.2 Data Qualification

In the case of unbalanced panel data, there is a tradeoff between having a large number of observations for the regression analysis and having a constant regression sample size throughout all specifications. Unfortunately, the number of observations I have for certain variables (such as \( mortinf \) and \( unemployment \)) are much fewer than those of other variables. In this paper, I allow the observations in the regression samples to change throughout specifications, in order to keep the number of observations as large as possible.

5 Methodology

The equation I want to estimate in my regression analysis is:

\[
Y_{i,t} = \alpha + \beta_1 \sum_{k=2}^{3} Y_i(t-k) + \beta_2 X_{i,t} + \sum_{j=1}^{t-1} \gamma_j D_i + \varepsilon_{i,t}
\]  

(2)

This model combines the estimation technique employed by Neumayer (2005) as well as the gravity model of migration. The term \( \sum_{k=2}^{3} Y_i(t-k) \) is the \( lgerasylumstock \) variable and measures the source-country specific asylum stock by summing the source country’s past two to three year asylum applicants. The coefficient, \( \beta_1 \), captures the relationship between migrant networks and asylum applicants. \( X_{i,t} \) is a vector that contains other explanatory
variables, such as GDP per capita and unemployment. This vector term also contains the gravity, “push” and “pull” variables that we want to test. $D_j$ is the year-specific dummy variable that captures developments that affect all migrants from all source countries equally in a given year. Such developments include lower transportation and information costs, more stringent visa restrictions, increased border controls, and the increased use of deterrence measures such as “safe” lists. The summation term for the year dummy variables is employed to control for changes in the number of asylum applicants that can be attributed to a general time trend. Finally, the error term $\varepsilon_{i,t}$ contains both stochastic error and country characteristics that are not observed or are not captured by our explanatory variables.

I estimate the above equation by using a year fixed-effects (FE) estimator. I regress my dependent variables $lgasylum$ on the many explanatory variables that are represented by vector $X$ in the above equation. My standard errors are robust and corrected for heteroskedasticity and serial correlation through the cluster (by country) command on STATA. I do not use a country fixed-effects estimator because that would drain the explanatory power of some of my independent variables. Variables such as autocracy, which measure the political atmosphere of a country, do not experience much variation over time. Using a country fixed-effects would very likely decrease the significance of this and several of my independent variables that do not vary much over time.

6 Results

6.1 Parsimonious Regressions

The first regression estimation I run is based on the UNHCR’s strict definition of who a refugee is. That is, I include only the explanatory variable (rightsviolation) that measures the level of targeted human rights abuses and political violence. I exclude variables that affect the entire population of the country, such as autocracy and domstate. I include lpopulation and gdistance, the variables measuring source country population and distance to Germany, respectively, to examine whether gravity model can be applied to asylum migration. Asylum migrants and refugees fleeing political violence in their home countries would most likely go to a safe country with the lowest transportation and information costs, and countries with greater populations would send more asylum migrants to Germany, all else equal. My parsimonious regression equation is:

$$lgasylum_{i,t} = \beta_0 + \beta_1 lgdppc_{i,t} + \beta_2 lpopulation_{i,t} + \beta_3 rightsviolation_{i,t} + \beta_4 gdistance_i + \varepsilon_{i,t}$$ (3)

The results for the above estimation are shown in Table 2, equation (1). All four explanatory variables are significant to $p<0.01$. The signs of the coefficients are all as we expected. Our coefficient estimates indicate that an increase of 1% in the GDP per capita of the source country would correspond to a decrease of 0.819% of first-instance
DETERMINANTS OF ASYLUM MIGRATION TO GERMANY 1980-2008

applicants who apply for asylum in Germany. We also find that \( l_{population} \) has a positive and significant coefficient of 0.414, which indicates that a 1% increase in a source country’s population would correspond to an increase in the number of asylum applicants by 0.414%. \( g_{distance} \) has a very large and negative coefficient of -1.785, which means that a 1% increase in the distance between the source country capital and Berlin would correspond to a decrease in asylum applicants by approximately 1.785%. The \( r_{ightsviolation} \) coefficient is also quite large, positive, and significant (0.744, se 0.146), indicating that a change from a rating of 0 to a rating of 1 on the Political Terror Scale would correspond with an increase of 116.8% in the number of asylum applicants.

6.2 Migrant Network Effects

Next, I gradually include other economic and political variables in my regression, including the variable \( l_{gerasylumstock} \) as a proxy measure for migrant networks. The results for including migrant network effects are shown in table 3. I find the coefficient on this variable to be extremely significant, positive, and large. The coefficient is remarkably robust throughout all specifications, ranging from 0.789 to 0.812. The coefficient indicates that a 1% increase in the sum of asylum applicants in years t-2 and t-3 would correspond with approximately a 0.8% increase in the number of asylum applicants in year t. My results in table 8 confirm Neumayer (2005)’s findings of the strong positive relationship between migrant networks in destination countries and the number of asylum applicants. The basic equation I estimate in table 8 is:

\[
l_{gerasylum} = \beta_0 + \beta_1 lgdpcc_{i,t} + \beta_2 l_{population}_{i,t} + \beta_3 r_{ightsviolation}_{i,t} + \beta_4 d_{omstate}_{i,t} + \beta_5 a_{utocracy}_{i,t} + \beta_6 g_{distance}_{i,t} + \beta_7 l_{gerasylumstock}_{i,t} + \epsilon_{i,t} \tag{5}
\]

6.3 Robustness Check: Non-Linearity of Autocracy and GDP per capita

In table 4, I explore the non-linear relationship between \( a_{utocracy} \) and GDP per capita on the one hand, and asylum applicants on the other. As mentioned earlier, autocracy and GDP per capita might in fact have a bell-shaped or an inverse U shape effect on the number of asylum applicants. That is, people who live in countries that are at the extreme ends of the autocracy scale and the GDP per capita measure are less likely to apply for asylum than those individuals who live in countries with middling levels of autocracy or GDP per capita. I would therefore expect the coefficients on the square terms to be negative, since increased political repression first has a positive effect on the number of asylum applicants up to a certain level, after which autocracy will have a negative effect on the number of asylum applicants. Autocracy squared as an explanatory variable confirms this non-linear relationship between autocracy and asylum applicants. The basic equation I estimate is:

\[
l_{gerasylum} = \beta_0 + \beta_1 lgdpcc_{i,t} + \beta_2 l_{population}_{i,t} + \beta_3 r_{ightsviolation}_{i,t} + \beta_4 d_{omstate}_{i,t} + \beta_5 g_{distance}_{i,t} + \beta_6 a_{utocracy}_{i,t} + \beta_7 a_{utocracysq}_{i,t} + \epsilon_{i,t} \tag{6}
\]

The coefficient on the linear term for \( a_{utocracy} \) remains positive, large, and very significant.
The coefficient on the squared term \((\text{autocracysq})\) is negative and significant to the \(p < 0.01\) level. Similarly, the regression results in table 4 also show that GDP per capita has a non-linear relationship with asylum applicants. \(\text{gdppesq}\) is negative and very significant \((p<0.01 \text{ and } p<0.05)\) to all specifications, except when the asylum stock regressor is added as a control (in equation (6) of table 4). However, when I substitute the GDP per capita differential for GDP per capita, I found that \(\text{gdppesq}\) is negative and significant even when asylum stock is added as a control. My core explanatory variables all remain robust. My regression analyses confirm the bell-shaped effect of GDP per capita on asylum applicants, suggesting that standards of living and level of political repression in the source country does indeed correspond with a migration “hump.”

6.3 Robustness Check: Excluding Outlier

For my final robustness check, I exclude Turkey in my regression analysis. There is a large Turkish immigrant community in Germany, and people of Turkish nationality or descent now constitute 2.4% of Germany’s population. The coefficients for \(\text{lpppdif, lgdppc, rightsviolation, autocracy, gdistance, lgerasylumstock, autocracysq, and lgdpsq}\) remain highly significant. The signs on these coefficients are also completely consistent with past regression estimations. The gravity variables \((\text{lpopulation and gdistance})\) are all significant to the \(p<0.01 \text{ or } p<0.05\) levels, with signs that are consistent with my earlier regression results.

7 Conclusion

In my paper, I examine the determinants of asylum migration to Germany from 1980-2008. I found that variables measuring the GDP per capita, level of human rights violations, political repression, and domestic wars/state failure in the source countries had consistently significant coefficients in all my regression equations. Domestic wars/state failure were at times insignificant when regressed in the same equation as human rights violations, but this could be due to the high correlation between the two variables. Once the variable on human rights violations was dropped, the variable measuring domestic wars/state failure became significant and robust to numerous specifications. I also found migrant networks to have a very strong positive relationship with the number of asylum applicants, and my regression analyses confirmed the bell-shaped relationship between autocracy and GDP per capita on the one hand, and asylum applicants on the other. Variables on infant mortality and population density were found to be very insignificant, and the inconsistent significance of the coefficients on urban population and the proportion of fifteen to sixty-four year olds could only be interpreted as ambiguous. Nevertheless, the large magnitude, high significance, and robustness of my core explanatory variables indicate that even modest improvements in the political and human rights atmosphere in a source country can have a significant impact on the number of asylum-seekers in Germany. My results also found that distance and population, my gravitational variables, are significant and robust to all specifications. The coefficients on population are consistently positive, and the coefficients
on the distance variable are consistently negative. Such robust and consistent results suggest that the gravity model can be used to explain asylum migration to Germany from 1980-2008.

**References**


Appendix

Table 1: Variables, source, and description (listed in alphabetical order)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>autocracy</td>
<td>Freedom House</td>
<td>Political Rights and Civil Rights index, 1-7 scale for each index; sum of two scores.</td>
</tr>
<tr>
<td>autocracysq</td>
<td>Freedom House</td>
<td>Square of autocracy</td>
</tr>
<tr>
<td>domstate</td>
<td>U.S. State Failure Taskforce Project</td>
<td>Combines the domestic war and state failure indices and takes the maximum of the two scores for a given country in a given year.</td>
</tr>
<tr>
<td>ecdiscrim</td>
<td>Minorities at Risk Discrimination Database</td>
<td>Measured on a 0-4 scale; each minority group in a country is given a score; variable is the maximum score (0= no discrimination, 4= institutional discrimination) out of all the scores given.</td>
</tr>
<tr>
<td>gdp00us</td>
<td>World Development Indicators, World Bank</td>
<td>Total Gross Domestic Product in constant 2000 USD</td>
</tr>
<tr>
<td>gdppc</td>
<td>World Development Indicators, World Bank</td>
<td>GDP per capita, in constant 2000 USD</td>
</tr>
<tr>
<td>lgdppc</td>
<td>World Development Indicators, World Bank</td>
<td>Log of GDP per capita in constant 2000 USD</td>
</tr>
<tr>
<td>gdppcsq</td>
<td>World Development Indicators, World Bank</td>
<td>Square of the Log of the GDP per capita of source country, in constant 2000 USD $gdppcsq = \log(gdppc)^2$</td>
</tr>
<tr>
<td>gdppcppp</td>
<td>World Development Indicators</td>
<td>GDP per capita, Purchasing Power Parity, PPP, adjusted in constant 2005 International Dollars</td>
</tr>
<tr>
<td>lgdppcppp</td>
<td>World Development Indicators</td>
<td>Log of the GDP per capita, PPP adjusted in constant 2005 International Dollars</td>
</tr>
<tr>
<td>pppdif</td>
<td>World Development Indicators</td>
<td>Difference between the PPP adjusted GDP per capita of Germany and that of the source country.</td>
</tr>
<tr>
<td>lpppdif</td>
<td>World Development Indicators</td>
<td>Log of the difference of the PPP adjusted GDP per capita of Germany and that of the source country.</td>
</tr>
<tr>
<td>gerasylum</td>
<td>United Nations High Commissioner for Refugees</td>
<td>Number of first instance asylum applicants in Germany, 1980-2008</td>
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### DETERMINANTS OF ASYLUM MIGRATION TO GERMANY 1980-2008

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>Description</th>
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<tbody>
<tr>
<td>lgerasylum</td>
<td>Log of the number of first instance asylum applicants in Germany, 1980-2008</td>
</tr>
<tr>
<td>lgerasylumstock</td>
<td>Sum of the number of asylum applicants in Germany in years t-2 and t-3, logged</td>
</tr>
<tr>
<td>growth</td>
<td>Change in the PPP adjusted GDP per capita from previous year.</td>
</tr>
<tr>
<td>mortinf</td>
<td>Infant mortality rate per 1,000 live births.</td>
</tr>
<tr>
<td>population</td>
<td>Total population, annual.</td>
</tr>
<tr>
<td>popdens</td>
<td>Population density, people per sq. kilometer.</td>
</tr>
<tr>
<td>popfs</td>
<td>Population ages 15-64, % of total population.</td>
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<tr>
<td>rightsviolation</td>
<td>Scale score, 1-5; average of 2 scores from Amnesty International and the U.S. State Department, respectively; only one score was used when the other was missing.</td>
</tr>
<tr>
<td>urbanpop</td>
<td>Urban population, as % of total population.</td>
</tr>
<tr>
<td>urbangrowth</td>
<td>Urban population growth, annual %.</td>
</tr>
<tr>
<td>unemployment</td>
<td>Total unemployment as % of total labor force.</td>
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### Table 2: Parsimonious Regressions Using Logged PPP Adjusted GDP Per Capita

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<tr>
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<th>(3)</th>
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<td>Robust standard errors in brackets</td>
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Table 3: Migrant Network Effects

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- **Observations:** 2340 2331 2329 2278 1814 1560 1537
- **R-squared:** 0.526 0.548 0.561 0.575 0.584 0.876 0.874
- **Robust standard errors in brackets**
MONEY ILLUSION AND ITS IMPLICATION ON UNEMPLOYMENT

Takuma Habu
University of Warwick

ABSTRACT

The paper discusses the implication of money illusion on persistent unemployment. A particular form of money illusion is assumed and this is modeled into the efficiency wage theory while separating the analysis into nominal and real frames. The model shows that the level of unemployment in the nominal and the real frame are likely to be different and that the government has an incentive to provide a signaling mechanism to the workers to reduce unemployment levels. Additionally, the government is shown to have an incentive to announce unemployment rates.

1 Introduction

Economists have made many attempts to explain the existence of persistent unemployment. Long-term unemployment is usually seen as the result of one or many labor market failures resulting in some stickiness of wages. Generally, the real wage is believed to be approximately procyclical and in addition, shifts in the labor demand are said to lead to a large shift in employment in the short run, but only a small movement in real wage (see: Geary and Kennan, 1982; Solon, Robert and Parker, 1994). In the long run, however, unemployment is said to have no trend (Romer, 2006).

One idea that is lacking in literature is the possibility that money illusion may be a cause of this market failure. I define money illusion as the "tendency to think in terms of nominal rather than real monetary values," following Shafir, Diamond and Tversky (1997). This gap in the subject is not surprising since it is widely perceived that the concept of money illusion violates the assumption of rationality-- a somewhat dangerous stand for economists to take. To quote Tobin (1972); “An economic theorist can, of course, commit no greater crime than to assume money illusion.” Subsequently, many theories have been constructed to account for the consequences of money illusion while ignoring the very concept. Shafir, Diamond and Tversky (1997) highlight the need for economic theories to account for money illusion by presenting results from a survey designed to capture the psychology behind the decision making process, specifically looking at framing effects. Their results show that agents make systematic mistakes and use both real and nominal
frames when presented with an economic problem, a view also supported by Blinder and Choi (1990, pp. 1009). They suggest that people choose to work in nominal values “because it is salient, easy to gauge . . . [and it is often a] reasonable estimate of real worth.” Moreover, they suggest that by modeling the consequences of money illusion into existing models, its effect can be studied using framework based on rational agents. This paper takes a similar approach to Shafir et al. (1997) and extends the efficiency wage theory to account for money illusion and study the implications.

One school of thought to explain the existence of residual unemployment was initially proposed by Solow (1979); the efficiency wage theory in which he argued that the productivity of a worker is affected by the amount of effort that he puts in, which in turn is determined by the real wage he is paid. Since, many have extended this idea, each with varying reasons behind the relationship between wage and productivity. The two notable models are the shirking model by Shapiro and Stiglitz (1984) and the fair wage effort hypothesis by Akerlof and Yellen (1990).

Shapiro and Stiglitz (1984) proposed that workers may shirk if there is no possibility of punishment, which is the case under perfect labor market (as all wages are equal and workers are able to obtain another job immediately even when fired). They postulate that firms pay wages above the market clearing level in order to deter workers from shirking and these higher wages imply that unemployment will exist in the economy. However, the model is unable to explain the fact that the unemployment rate stays constant even under technological or population growth. Additionally, it cannot produce the low real wage variation and high employment variation seen in empirical data (see: Strand, 1992; Gomme, 1999). In order to eliminate the long run decreasing trend predicted by the model, Phelps (1994) and Brecher et al. (2002) introduced the idea that households save optimally which allows the unemployment rate to be constant even when there is technological progress. However, as Alexopoulos (2003) highlights, their models fail to account for the variations in the real wage and employment. Alternatively, Burnside et al. (2000), Alexopoulos (2001) and Felices (2001) complemented the shirking model by introducing monetary punishments for workers who shirk to account for the aforementioned variations. It is difficult to criticize the performance of these models in terms of their predictions of unemployment behavior; however, the idea that wage is determined to deter workers from shirking is not concretely supported by empirical data (see Blinder and Choi, 1990).

In contrast to the shirking model, Akerlof and Yellen (1990) found motivation for their fair wage effort hypothesis in theories from sociology and psychology and succeeded in providing concrete evidence for their idea. The model assumes that workers have a concept of a fair wage and if they are paid less, they provide proportionately less effort to spite their employers. The model segregates the labor force into skilled and unskilled workers and they find that the effect of a productivity increase on unemployment is opposite in each group. Thus, an equal increase in productivity for both groups causes no change in unemployment providing an explanation for the lack of long run trends in the unemployment rate. Furthermore, by assuming non-instantaneous adjustment of workers’ perception of the fair wage, the model can produce cyclical variation in the unemployment
rate. However, the exact type of cyclical nature is ambiguous. The inherent problem with unemployment theories is the fact that they make similar predictions and thus empirical studies can only distinguish different models imperfectly. Consequently, it is extremely difficult to prove that one theory rules over all else. In this way, there is a need for another method of evaluating various models. One way to do this is to look at the foundations of the models; for example, by considering the validity of the assumptions of the model. In this regard, the fair wage effort hypothesis can be seen as a better model than the shirking model.

Economic theorists often run the risk of thinking in an overly hypothesized world. Recent literature on experimental and behavioral economics tries to overcome this weakness and can be seen as a natural extension to the conventional method of developing models. By ensuring the robustness of the motivations behind economic models, one may be able to reduce the danger of over-thinking.

It is difficult to argue against the existence of money illusion among economic agents as shown by Shafir et al. (1997). Thus, the study of money illusion with respect to unemployment can be seen to have a concrete foundation. In the next section, I discuss the current understanding and behavior of unemployment. In section 2, I explain the concept of money illusion and in section 3, I develop the efficiency wage model with money illusion. Finally, in the last section, I discuss the implications of the model, its weaknesses as well as possible extensions.

2 Persistent Unemployment

2.1 What causes persistent unemployment?

The existence of persistent unemployment in the labor market is a result of inefficiency. In other words, the labor market may not be perfectly competitive and thus the demand for labor and the supply of labor cannot be matched by itself. The tendency is that the market is left with excess supply of labor; that is, unemployment. Clearly, there are demand or supply factors which cause this mismatch.

Recall that the price of the labor is the wage. The traditional view is that the workers and the firms calculate their supply and demand for labor using the real wage. This stems from the assumption of rationality where agents are assumed to know everything that they could know about the current market. Following this view, the existence of persistent unemployment implies that the real wage is somehow sticky; it does not adjust fully to match demand and supply. Thus, the explanation for the existence of persistent unemployment is analogous to the explanation of real wage stickiness. In this way, the existence of persistent unemployment contradicts the classical dichotomy and thus when analyzing, both real as well as nominal economic variables must be considered.

2.2 Stylized Facts about Unemployment

In order to evaluate the accuracy of models for persistent unemployment, it is essential to identify the behavior of unemployment and the real wage. One observation is
that, in the short run, shifts in labor demand lead to large movements in unemployment but only small changes in the real wage. In other words, labor supply is elastic in the short run. However, in the long run, the shifts in labor demand fall almost entirely on the real wage; that is, labor supply is inelastic in the long run (Romer, 2006). In addition, unemployment level does not seem to follow any trend in the long run.

Geary and Kennan (1982) found that the real wage was approximately acyclical or slightly procyclical using aggregate data. However, when composition bias is accounted for in the data, Solon, Robert and Parker (1994) found that the real wage (in the US between 1967-87) was more procyclical than previously thought, possibly supporting the New Keynesian model of sticky prices for aggregate supply. However, in the end, they concluded that their findings do not necessarily support the New Keynesian model, which subsequently implies that non-Walrasian features of the labor market may be important in explaining the movement of quantity of labor and real wages.

3 Money Illusion

Money illusion can ultimately be seen as the violation of the assumption of homogeneity of degree zero in utility functions with nominal prices (Leontief, 1936). More generally, it can be seen as an example of framing effect where agents make different decisions depending on whether they are given nominal or real prices/wages. As argued by Fehr and Tyran (2001); Shafir et al. (1997), the fact that people often take the nominal wage as a proxy for real wage is natural in the sense that people are ordinarily dealing with money and thus are unaccustomed to working under the real price/wage representation. Clearly, problems occur when price level is changing. Agents may be making rational decisions in nominal terms but strictly speaking, agents may be irrational as they should base their decision on real variables. At first sight, it might seem difficult to model money illusion into conventional economic theory as it seems to require a new notion of rationality, but it can be done by separating the analysis into real and nominal frames then assuming a particular form of money illusion. To demonstrate, assume the following form of money illusion. Firms are rational; that is, they base their decision on the real wage. However, assume that workers base their decisions on the nominal wage alone. A possible rationale behind this is that it is costly to calculate the real wage, which requires knowledge of the past, current and future price levels; consequently, firms that incur greater losses from making mistakes (as workers make individual decisions) use real wage whereas individuals workers base their decisions only on nominal wage. Recall the ordinary relationship between the real and nominal wage,

\[
\frac{W}{P} = \omega,
\]

where \(W\) is the nominal wage, \(P\) is the price level and \(\omega\) is the real wage. If the economy exhibits inflation then this implies \(\omega < W\). Consequently, if workers were solely interested in the nominal wage then conventional theory, which uses the real wage, would underestimate
the labour supply. This should pose a sufficient case for money illusion to be incorporated into unemployment theories.

In order to model the previous situation formally, suppose that there is no direct relationship between the real and the nominal wage and that they are completely independent of each other, at least for workers. Wage can then be defined as

$$\hat{\omega} = \theta W + (1-\theta)\omega$$

(1)

where

$$\theta = \begin{cases} 
1 & \text{for workers} \\
0 & \text{for firms.} 
\end{cases}$$

(1) is the form of money illusion assumed throughout the paper and implies that workers are unable to convert nominal wage into real wage and vice versa. In the next section, the efficiency wage model by Solow (1979) is extended using the relation in (1) because of two reasons: its ability to explain the behavior of persistent unemployment and its simplicity. Solow’s model can be extended to account for wage stickiness and a lack of long run trend in the unemployment. In addition, the model need not require the use of a game between firms and workers.

The efficiency wage model assumes that individual labor supply is inelastic at unity. Consequently, labor supply is constant regardless of whether workers use nominal or real wage level. However, in order to use the model to account for the effect of money illusion, I assume that the labor supply may not be inelastic, at least with respect to nominal wages. Given that workers make decisions solely based on the nominal wage, I can then suppose a situation where labor supply is inelastic with respect to real wages but elastic with respect to nominal wages. In such a case, it is possible that labor demand and labor supply match in nominal wages even when there is unemployment given by the demand and the supply in real wages which is fixed (at the efficiency wage level) as shown in Figure 1. This suggests the idea that persistent unemployment may be an unavoidable result of heterogeneous agents working in nominal or real terms. However, the situation described in Figure 1 is a particular case; it is more likely that there will be unemployment in both nominal and real labor market. In this case, unemployment is caused not only by money illusion and the efficiency wage, but by other factors that affect both frames.

4 Data

In the previous section, I discussed the potential for money illusion to help explain persistent unemployment. In this section, I develop a more rigorous model based on the efficiency wage model by Solow (1979). For reference, the traditional efficiency wage model is exposed in Appendix 1.

4.1 Assumptions

In the model, some of the assumptions from the traditional efficiency wage theory still hold. Specifically: $I$ is the number of homogeneous firms with $L$ number of homogeneous
workers willing to work, and output price at unity.

Money illusion is modelled into the efficiency wage model by implicitly assuming the nominal wage-real wage relationship given by (1). In words, firms know both the nominal and the real wage, but workers only know the nominal wage and do not have the ability to calculate the real wage.

Assume that the effort function is a logistic function which is convex initially but concave after the point of inflexion. In other words, I suppose worker effort to exhibit increasing returns to wages until what the worker considers a fair wage is reached, after which I expect worker effort to exhibit diminishing returns. This is intuitive; a small increase from zero nominal wage is unlikely to convince a worker to give any effort but as wage converges to the perceived fair wage they expect that higher effort will induce firms to give them a higher wage. After this fair wage is reached, workers are content knowing that any further increase in effort is unlikely to lead to a rise in the wage. Given a logistic effort function, the point of inflexion is the perceived fair wage by workers.

The value of nominal wage may vary greatly thus I will use the normalised nominal wage $\tilde{W}$ defined as

$$\tilde{W} = \frac{W}{\bar{W} - \underline{W}} \in (0, 1),$$  

where $\bar{W} - \underline{W}$ is the range of possible nominal wages. Notice that with a strictly monotonic
production function, nominal wage transformation given in (2) will not affect the maxima of the profit maximization problem for the firm.

The generalized logistic effort function \( g(\tilde{W}) \) is given by

\[
 g \left( \tilde{W} \right) = A + \frac{K - A}{\left( 1 + Qe^{-B(\tilde{W} - M)} \right)^{\frac{1}{\nu}}},
\]

where

- \( A \): Lower asymptote; equals to zero.
- \( K \): Upper asymptote; determines the productive difference between the amount of effective and ordinary labor.
- \( B \): Growth rate; adjusted appropriately with the value of \( K \).
- \( \nu \): Affects near which asymptote the point of inflexion (fair wage effort) lies given positive value.
- \( M \): Determines where the fair wage lies.
- \( Q \): Equals \( g(0) \).

In order to obtain the result that the firms pay nominal wage above the perfect labor market case, the point of inflection must lie above 1 where the amount of effective labor and the ordinary labor are equal. For simplicity, we let \( \nu = 1 \) and \( K > 2 \); that is, the fair wage is at where \( \tilde{W} = 1/2 \) and the fair wage effort lies at \( K/2 > 1 \) implying that the firms have the incentive to pay above the perfect market case. Letting \( g_N \) denote the effort function with respect to nominal wage, then

\[
 g_N \left( \tilde{W} \right) = \frac{K}{1 + e^{-B(\tilde{W} - 0.5)}} \in (0, K).
\]

Let \( L^S_N \) and \( L^S_R \) be individual labour supplies in terms of nominal wage and real wage, respectively. Assume that \( L^S_R \) is given by

\[
 L^S_R \left( \omega \right) = 1
\]

In words, the individual labour supply with respect to real wages is assumed to be inelastic at unity (the same as in the traditional efficiency wage theory). For simplicity, assume LSN is linear and worker supplies zero units of labour at wage levels below the reservation normalised wage \( \tilde{\omega} \geq 0 \):

\[
 L^S_N \left( \tilde{W} \right) = \tilde{\omega} + D\tilde{W} \in [0, 1].
\]

From equation (5), \( D \) is the extent to which a given change in the nominal wage affects labour supply. However, it is possible to let \( D \) be a signal that the workers receive with the wage, independent of the wage. For now, \( D \) is assumed to be a fixed constant. By relaxing this assumption, it is possible to obtain a situation in which there is always an equilibrium in the nominal labour market but disequilibrium in the real labor market.
4.2 The Model

Consider the profit maximization problem of a representative firm:

$$\max_{\bar{W}, L} F\left[g\left(\bar{W}\right) L\right] - \omega L, \quad (6)$$

where $F(\cdot)$ is a concave, at least twice continuously differentiable production function, $g(\bar{W})$ is the effort function given in (4) and $L$ is the amount of labor the firm hires. Recall the assumption that firms can readily convert between nominal wage and real wage thus (6) becomes

$$\max_{\bar{W}, L} F\left[g\left(\bar{W}\right) L\right] - \frac{\bar{W}}{P} L. \quad (7)$$

Solving gives

$$\frac{\bar{W}g'(\bar{W})}{g(\bar{W})} = 1. \quad (7)$$

(7) is simply the Solow condition in terms of the normalized nominal wage and determines the equilibrium nominal wage. Given the effort function in (4), the Solow condition in (7) implies that the following must hold

$$e^{-B(W - 0.5)} \left(B\bar{W} - 1\right) = 1. \quad (8)$$

The solution to (8) is the efficiency wage. It can be seen graphically that for reasonable values of $B$ and $K$, equation (8) has a solution in $(0.5, 1)$ as one expects. The equation also has another solution closer to zero which can be ignored as the fair wage is fixed to be $1/2$ in the model.

Note that the labour demand $L_N^D$ at the normalised efficiency nominal wage $\bar{W}^*$ is given by

$$L_N^D(\bar{W}^*) = g(\bar{W}^*) F'[g(\bar{W}^*) L].$$

In addition, the labor demand $L_R^D$ at the normalised efficiency real wage $\tilde{\omega}^*$ is given by

$$L_R^D(\tilde{\omega}^*) = g(\tilde{\omega}^*) F'[g(\tilde{\omega}^*) L]$$

and the two are equal in value. The level of unemployment in the real labor market $U_R$ is

$$U_R(\tilde{\omega}^*) = L_R^S(\tilde{\omega}^*) - L_R^D(\tilde{\omega}^*) I$$

$$= \bar{L} - L_N^D(\bar{W}^*) I.$$

The model in the real frame is equivalent to the ordinary efficiency wage theory.

Alternatively, the level of unemployment in the nominal labor market $U_N$ is
\[
U_N\left(\bar{W}^*\right) = L_N^S\left(\bar{W}^*\right) \bar{L} - L_N^D\left(\bar{W}^*\right) I.
\]

Given that \(L_N^S\) has the range \([0, 1]\) then \(U_R \geq U_N\).

4.3 A Simple Extension

Previously, it was assumed that the coefficient on the normalized nominal wage in the individual labor supply function was a constant; that is, \(D\) was exogenous in (5). However, consider the case when \(D\) is determined by a signal sent out to the workers along with the nominal wage offer. Suppose the signal was an indication as to how fair the wage offered by the firms were from a third-party who is indifferent between the two types of agents. The signal can then alter the preference of the workers such that there is no unemployment in the nominal frame; by setting \(D\) such that

\[
L_N^S\left(\bar{W}^*\right) \bar{L} = L_N^D\left(\bar{W}^*\right) I
\]

This implies that there is an incentive for the government to provide the labor market with a signaling mechanism which could eliminate unemployment, at least in the nominal frame.

5 Evaluation of the Model

5.1 Implications

The similarity between the Solow condition from the ordinary efficiency wage theory and (7) is unsurprising given that money illusion amongst workers implies that only the nominal wage is relevant for workers. In other words, firms no longer minimise the real labor cost per efficiency unit but nominal labor cost per efficiency unit.

Note that the inability of workers to calculate the real wage means that the firms could extract more surplus from the workers. The representative firm employs a certain amount of effective labor at a given nominal wage, however, it only has to pay that nominal wage to the workers; a number smaller than the amount of effective labor. Furthermore, as the firm can readily convert between the nominal and real wage, the cost of employment of a worker is \(\omega\). Given \(P > 1\), this gives the firm benefits from being able to control effort at an even lower nominal wage than in the case without money illusion.

The efficiency wage solution from (8) does not involve \(K\), which determines the maximum difference between effective labor force and the number of workers. However, recall that the value of \(B\) is partially dependent on the value of \(K\) thus we get the intuitive result that a higher value of \(K\) (that is, higher potential productivity) leads to a lower efficiency wage; workers who return greater effort given a nominal wage level require lower nominal wage level to achieve the optimal outcome for the firm.

The model in section 4.2 suggests that there will be unemployment in both the real and nominal frame but in most cases, unemployment will be higher in the real frame. This
discrepancy in the level of unemployment in the two frames implies that money illusion can indeed cause unemployment in the economy. Furthermore, given that this effect is persistent over time, I conclude that money illusion is one of the causes of persistent unemployment. In addition, the overlapping level of unemployment in the two frames is likely to be caused by factors, which affect both the real and the nominal frames.

The simple extension provided in section 4.3 suggests that there is an incentive for a third party (most likely the government) to provide workers with a signal to indicate the fairness of the wage offered by the firms. Such a mechanism can eliminate unemployment in the nominal frame, however, the level in the real frame would remain unchanged. The question remains whether the government would have the incentive to create such a mechanism as it will not lead to a reduction in the level of unemployment in the real frame. It can be shown, however, that the government indeed has the incentive to provide the signaling mechanism. Assume heterogeneous workers where some have the ability to convert between the nominal wages and the real wages. In addition, suppose a proportion $p$ of workers are able to calculate the real wage. Previous assumption of inelastic labor supply with respect to real wage was based on the fact that workers were unable to calculate the real wage. Hence, it is reasonable to think that for $p$ proportion of workers, labor supply is elastic with respect to real wage and denote this function $L_{R'}^{S}(\tilde{\omega})$. The level of unemployment in the real labor market is then

$$U_{R}(\tilde{\omega}^*) = \left[pL_{R'}^{S}(\tilde{\omega})\bar{L} + (1-p)L_{R}^{S}(\tilde{\omega})\right] - L_{R}^{p}(\tilde{\omega}^*)$$

$$\neq \bar{L} - L_{N}^{p}(W^*) I.$$ 

Thus, the signal can have an effect in the real labor market as $L_{R'}^{S}(\tilde{\omega})$ is affected by the value of $D$.

5.2 Announcements of Unemployment Rates

It is shown in the appendix that the efficiency wage theory can account for the long run behaviour of the unemployment level by including the unemployment rate in the effort function. The intuition is simple; a higher unemployment rate implies higher cost of being out of work and thus it leads to greater effort given a wage level. Applying this approach to the model with money illusion requires consideration of whether one uses the nominal or real unemployment rate; unemployment that exist in nominal and real frames. It is reasonable to assume that the workers, as they work in nominal terms, can only see the nominal unemployment rate. However, firms know both nominal and the real unemployment rates. Following the convention used already, let $u_R$ be the real unemployment rate and $u_N$ be the nominal unemployment rate.

Notice that the firm always has the incentive to make workers believe that the unemployment rate is higher as this signifies a costless increase in effective labor for firms. Workers will know this and any suggestion made by the firm about the level of unemployment will not be credible.

Now consider the following three cases:
Case 1: \( u_R > u_N \); workers’ perceived level of unemployment is below that of the level in the real frame. The firms will benefit if they could make a credible announcement to the worker.

Case 2: \( u_R < u_N \); workers’ perceived level of unemployment is above that of the level in the real frame. The firms have no incentive to correct workers’ belief. It is able to capture even more of worker surplus. Workers, on the other hand, have an incentive to deduce the real unemployment rate if only they knew the real wage.

Case 3: \( u_R = u_N \); workers’ perceived level of unemployment is the same as that of the level in the real frame. Optimal.

In cases 1 and 2 (the two most likely cases), either the firms or the workers have an incentive to act to improve the situation. One way to correct the differences is to have a third-party who is indifferent between the firm and the worker making credible announcements about the unemployment rate; for example, the government which is what happens in many countries. Given these credible announcements, nominal unemployment will converge in the long run to the real unemployment, while they may be different in between announcements. Notice that having credible announcements may not lead to a more Pareto efficient outcome, instead, they can be seen to result in a fairer outcome; that is, to negate the consequence of money illusion on worker surplus.

5.3 Weakness & Extensions

The model developed here has inherent weaknesses arising from the use of the efficiency wage theory. However, these may be negligible as empirical evidence seems to support the existence of an efficiency wage (see Krueger and Summers, 1988; Cappelli and Chauvin, 1991; Wadhwani and Wall, 1991). Instead, the weaknesses of the model are likely to arise from the additional assumptions made. Clearly, it is unreasonable to assume homogeneous firms and workers, and the simplified effort function may not reflect the real effort function. However, the simplification is there to make the implications of the model clear. The former problem can be tackled by generalizing the relationship defined in (1); for example, by assuming that \( \theta \) may be distributed on some truncated normal distribution. The latter problem can be solved by further generalization of the effort function; for example, by assuming \( v > 1 \) in (3). This is likely to have a similar effect to the efficiency wage level as changing the values of \( K \); that closer the point of inflection is to the upper asymptote, the lower the efficiency wage level. One important aspect of this model, which needs empirical verification is the labor supply function which assumes that workers change their preferences according to a signal sent by a neutral third party.

Other weaknesses of the model arise from two factors: perfect information for the firms and lack of interaction between the two types of agents. The model assumes that the firms know the effort function of the workers. In most cases, the firms will not know the exact effort function. Note that even if the firm is uncertain about the effort function, it is unlikely that this will lead to any significant changes in the implication of
the model discussed here except that the possibility to eliminate unemployment in the nominal frame disappears. The lack of interaction between the firms and the workers essentially means that the model does not make use of incomplete information games. It is possible to model the behaviour of the workers by separating them into two groups. For example, considering one group as the leaders of a union and the others as its members. In this case, one could make use of principal-agent games where union members are the principal and the agents are the union leaders with the assumption of costly calculation of real wages. Furthermore, the paper did not consider the possibility of learning by the workers after announcements of unemployment rates by a neutral third party. A richer model would consider the effect that the announcements may have on the ability for workers to deduce the real wage at a lower cost.

6 Conclusion
I first showed that money illusion should not be feared but instead, embraced into general economics; money illusion need not lead to an abandonment of traditional economic approach. I showed that by using the relation given in (1) (that is, a particular form of money illusion), one can systematically study the effect of money illusion by considering both the nominal frame and real frame separately.

I argued that the efficiency wage model is a good candidate to explain persistent unemployment and extended this model to incorporate money illusion. By considering the labor market with respect to nominal wages and real wages separately, I showed that the economy can be in a situation where there is unemployment in the real market but exhibit market clearing in the nominal market with the aid of a neutral third party. However, realistically, unemployment is likely to exist in both frames at different levels. The difference between the two is the direct consequence of money illusion. Furthermore, I proposed a reason for why the unemployment rate is usually announced by the government with the suggested outcome of converging values of real and nominal unemployment rates in the long run.

In the past, money illusion has been largely ignored and there is a lack of study into the field. I support the view held by Shafir et al. (1997), that money illusion can be systematically studied, and introduced an alternative way in which it may be incorporated into existing models.

References


\section{Appendices}

\subsection{Traditional Efficiency Wage Theory}

Based on Romer (2006), chapter 9.

\subsubsection{The Model}

Assume a large number, \( I \), of homogeneous competitive firms who are wage-setters in the labor market. They believe that higher wage induces higher average productivity and thus they are willing to offer wage above the market clearing level. Additionally, assume that effort is driven by real wage and the output price is unity. Then the representative firm’s maximisation problem is

\[
\max_{\omega, L} F[\omega L] - \omega L,
\]

where \( F(\cdot) \) is the production function, \( g(\cdot) \) is the average effort/productivity of workers, \( L \) is the number of workers, and \( \omega \) is the real wage.\(^{25}\) First order conditions lead to the Solow condition:

\[
\frac{\omega g'(\omega)}{g(\omega)} = 1.
\]

\( \tag{9} \)

In words, elasticity of effort with respect to wage is unity. The real wage satisfying (9) is known as the efficiency wage. Let \( \omega^* \) and \( L^* \) denote the values of wage and labor that satisfy (9). Given the assumption of identical firms, the total labor demanded is simply \( IL^* \) and if labor supply \( \bar{L} \) exceeds this amount then there will be unemployment of amount \( \bar{L} - IL^* \).

The model is clearly able to predict the existence of unemployment. Furthermore, because wage is fixed at the efficiency wage level, it is unresponsive to demand shifts. Consequently, this can explain why shifts in labor demand lead to large movements in employment but only small changes in the real wage. Consider the long run implication of the model; as economy grows, demand for labor increases, however, the real wage remains constant and therefore unemployment trends downward until it reaches zero. Thus, this model is unable to explain the behaviour of unemployment in the long run.

\subsubsection{The Extended Model}

Generalise the effort function to the following

\[
g = g(\omega, u), \quad e_1(\cdot), e_2(\cdot) > 0,
\]

where \( u \) is the unemployment rate. Provided that labor supply is above \( IL^* \), there is unemployment of amount \( \bar{L} - IL^* \). Now, consider the long run implication of this model. As before, with economic growth, unemployment level trends downward. However, because lower unemployment level has a negative effect on the level of effort, the model can account for the absence of trends in unemployment in the long run.

The extended model is able to explain the behaviour of unemployment described in the main text and thus constitutes as a possible candidate for the explanation of the existence of persistent unemployment.

\(^{25}\) \( e(\omega) L \) is the amount of effective labor.
A.2 Graphical Solution to Efficiency Wage

A.3 Analysis of Efficiency Wage
Determinants of Cost of Credit Across Firms in Eastern Europe and Central Asia

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ABSTRACT

This paper analyzes the effect of the Studi di Settore (SDS), an Italian policy aimed at combating tax evasion, on Italian firms’ income tax declarations. The SDS is an innovative audit strategy that helps tax authorities in Italy to identify possible tax evaders. It provides firms with a tool to estimate “normal” revenues, which becomes a benchmark: if firms declare fewer revenues than this benchmark, the probability of audits increases. Using data on income declarations and SDS implementation provided by the Italian revenue agency, I test the hypothesis that the implementation of the SDS led to a shift in the distribution of returns closer to the benchmark, which in practice becomes an increase in the share of returns in the middle-income brackets (for tax purposes), and also led to a decrease in share of returns in the low- and high-income brackets. At first, the results of the empirical study confirm my initial hypothesis, but the results are not robust to a falsification exercise, indicating that other factors, and not the SDS, might be affecting income distribution.

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1 Introduction

Of critical interest to a firm is its cost of credit, which influences a firm’s ability to take out a loan and the sum that it can borrow.1 While a myriad of loan- and firm-specific factors influence firms’ cost of borrowing, institutional and legal characteristics of a country or region may be even more important given that their influence extends to a multitude of businesses. Up to this point, economics literature has identified stronger creditor legal protection, a more effective judicial system, and improved information about potential borrowers facilitated by public credit registries (PCRs) and private credit bureaus (PCBs)

1 While “credit” is a term that technically encompasses more than just loans, for the purpose of this paper, “loans” and “credit” will be used interchangeably.
as channels that should lower the cost of credit.\textsuperscript{2}

However, due to a previous lack of data, only a recent 2009 study by Brown, Jappelli, and Pagano (hereafter, BJP) has examined this particular issue with firm-level panel information. Using 2002 and 2005 panel data from the World Bank and European Bank for Reconstruction and Development’s collaborative Business Environment and Enterprise Performance Survey (BEEPS), a component of the World Bank Enterprise Surveys (WBES), BJP found that PCRs and PCBs improved firms’ perception regarding the cost of obtaining financing in a weak creditor rights environment.

While BJP does contribute to the literature on this topic, the paper’s use of the aforementioned subjective variable as the only measure of borrowing costs limits its value. Aside from the issue of whether firms’ perceptions are accurate reflections of the cost of credit, there is also the problem of translating results obtained from using a subjective variable into a more concrete figure.

My paper will contribute to the literature by addressing this gap in BJP. Given the importance of the three aforementioned factors, my study will therefore focus on examining their impact on several non-perception based BEEPS cost of credit indicators. These indicators respectively measure the interest rate, whether collateral is required, and the relative collateral amount of various loans. The benefit of focusing on three cost of credit indicators is that it provides one with a more comprehensive set of measures against which to evaluate the three main explanatory variables. Furthermore, it also allows one to tease out differences regarding how the three main explanatory variables influence each of the cost of credit factors. This is particularly important given that to the best of my knowledge, only Qian and Strahan (2007) has focused on the indicator that captures whether collateral is required for a loan, and no published study has utilized the amount of collateral measure as a cost of credit dependent variable.

Due to a lack of more elucidating alternatives, country-level institutional and legal cost of credit measures have also dominated the literature. The limitation of these explanatory variables is that they only allow for cross-country comparison. While some recent studies have utilized sub-national measures to study a particular country (Visaria, 2009), I have not come across any published paper that uses sub-national indicators across a large sample of states. Thus, my paper will also attempt to contribute to the literature by supplementing the three cross-country measures I use in my primary analysis with firm-level proxies found in BEEPS.

In my primary analysis, I find that creditor rights are the most important determinants of cost of credit. Improved creditor rights are associated with lower interest rates and collateral amounts but an increased likelihood of collateral being required. The last result is elucidating because it shows that contrary to what one may predict, the three main explanatory variables do not necessarily have a positive impact on all cost of credit factors. Consistent with a study conducted by Safavian and Sharma (2007), I also find that the

\textsuperscript{2} Other than being respectively publicly and privately operated, the main difference between PCRs and PCBs is that the former generally consists of a government sponsored database to which it is mandatory for creditors to submit information about borrowers, while the latter are voluntary institutions in which creditors can choose to participate.
impact of creditor rights on cost of credit is enhanced by a more effective judicial system. Furthermore, the presence of weak creditor rights enhances the impact of PCRs and PCBs on the cost of credit indicators. This supports the theory posited by Djankov, McLeish, and Shleifer (hereafter, DMS) in their 2007 paper.

As for my secondary analysis, I only obtained significant results for my judicial efficacy variable. Because this measure is a strong proxy, it supports my primary analysis, which suggest that judicial efficacy is also an important determinant of cost of credit. The lack of significance for the other two variables is not surprising given that they are poor proxies and thus a large limitation in my research.

The paper will proceed as follows. Section II provides an overview of the theoretical and empirical literature that serves as the foundation of my study. Section III describes the data. Section IV presents my empirical models, hypotheses, and a discussion of my findings. Section V concludes.

2 Literature Review

One of the first studies pertaining to this topic was Pagano and Jappelli (1993), which explored the potential benefits of information sharing between creditors. The logic is that through credit bureaus that facilitate the exchange of information regarding firms’ credit histories, creditors are able to obtain information more easily. This should reduce the adverse selection challenge creditors face when evaluating potential borrowers and increase overall credit market performance. Using an adverse selection model, the paper’s theoretical findings support this hypothesis.

The obvious limitation of Pagano and Jappelli is that it lacked empirical analysis to support the above theoretical work. Jappelli and Pagano address this limitation in their 2002 study by creating a novel database regarding PCRs and PCBs. The study found that across two different cross-country measures of PCRs and PCBs, improvements in both increased a country’s relative quantity of private debt (a measure of credit access) and decreased average default rates. The correlation with the default rates variable is revealing because it supports the idea that in addition to adverse selection, improved information sharing also reduces borrowers’ moral hazard behavior. While the evidence suggests that information sharing increases lenders’ propensity to lend, the theory is less clear. On one hand, information sharing can increase overall credit access by making lenders less risk-adverse because they now have better information with which to evaluate potential borrowers. On the other hand, information sharing can result in lenders discovering that some borrowers are riskier than they would have thought without access to PCRs or PCBs, and this in turn can reduce overall lending.

Another distinguishing aspect of this study is its inclusion of the creditor rights variable created by La Porta, Lopez-De-Silanes, Shleifer, and Vishny (hereafter, LLSV) for their seminal 1998 paper, and a judicial efficacy variable called Law & Order from the International Country Risk Guide (ICRG). The inclusion of these variables is important because it lent credence to these variables. Furthermore, the theoretical support for these
variables was bolstered by the results they obtained, which found that improvements in both creditor rights and judicial efficacy had a positive effect on credit access. Thus, while this study did not offer direct evidence as to whether creditor rights, judicial efficacy, and information sharing lowered borrowing costs, its findings are important for paving the way for further research in this direction.

Two papers that build on the preceding literature by focusing on cost of credit indicators are Demirguc-Kunt, Laeven, and Levine (hereafter, DLL) (2004) and Laeven and Majnoni (2005). Across a dataset that consists of more than 1400 banks in 72 countries, DLL finds a negative correlation between improvements in a property rights enforcement measure and institutional quality variable and bank-level interest spreads. Laeven and Majnoni obtain similar results in an analysis across 102 countries, in which a composite judicial efficacy measure that combines the Law & Order index and property rights enforcement variable used in DLL is negatively correlated with a country-level measure of interest rate spreads.

The two papers are important because they are the first major cross-country studies to directly examine the relationship between institutions and laws and cost of credit. By finding that improvement in the former is negatively correlated with interest rate spreads, the evidence suggests that in line with expectations, institutions and laws facilitate lower borrowing costs for firms. However, the explanatory power of these studies is limited by their use of cross-sectional analysis and their focus on aggregate country and bank data. DLL also does not control for PCRs or PCBs, and Laeven and Majnoni only control for the former. The problem with controlling only for PCRs is that Jappelli and Pagano found that PCRs and PCBs are effectively the same when it comes to their role in promoting information sharing. Also, in many countries, both do not operate simultaneously.

Qian and Strahan improve on the two aforementioned papers through their use of cross-sectional times-series data, which allows one to distill possible relationships with a higher level of confidence. Furthermore, the study’s use of loan- and firm-level information overcame the limitations of previous literature (e.g. DLL and Laeven and Majnoni) that could not/did not control for loan and firm characteristics.

As noted in the study, one expects improvements in creditor rights and judicial efficacy to lower interest rate spreads. The logic behind the former relationship is that with stronger legal protection during bankruptcy proceedings, lenders are more likely to obtain financially favorable outcomes regarding their outstanding debt. This will reduce the risk associated with lending and thus the interest rates lenders impose as compensation for risk. A judicial system that is more effective at enforcing the rights of creditors should have the same impact and also lower interest rates. However, similar to what was described in Jappelli and Pagano, information sharing can have both a positive and negative effect on firms’ interest rates. On one hand, information sharing leads to lower interest rates because it reduces moral hazard and adverse selection on the part of borrowers. On the other hand, information sharing can also lead to higher interest rates because it can help creditors discover that some firms are riskier borrowers than they originally thought.

Examining loans from a database called Dealscope, Qian and Strahan found, using an updated version of LLSV’s creditor rights index, that improved creditor rights lowered the
interest rate spread on loans. These results were also robust to the inclusion of a dummy variable that measured whether a country had a PCR or PCB and a legal formalism variable that proxied for judicial efficacy. However, both control variables did not have a significant impact on interest rate spreads. Also, the paper found that none of the three measures had a significant impact on a dummy variable measuring whether a loan was secured (required collateral). What is interesting is that for this dependent variable, the creditor rights and judicial efficacy coefficients were positive, but the information sharing coefficient was negative. It is not surprising that the information sharing variable is not significant. At the same time, the fact that its coefficient was negative seems to suggest that the positive dynamics of information sharing, which would result in lower interest rates, outweigh the negative ones. What is surprising is the lack of significance for the judicial efficacy measure. One likely explanation is that the legal formalism variable is not a good proxy for judicial efficacy. However, the negative coefficient on the variable is in line with expectations.

As for the collateral requirement variable, the signs on the coefficients are important because they seem to indicate that institutional and legal mechanisms do not have the same impact on all cost of credit factors. Like with increased interest rates, having to provide collateral for a loan poses an additional cost on a borrower. Thus, one could assume that stronger creditor rights and a more effective judicial system should reduce the need for secured loans. However, in line with the results, improvements in both actually give creditors an incentive to request a secured loan because, in the case of a default, both improve the creditor’s chances of being able to seize the collateral in a timely and cost-effective manner. Overall though, the net effect is positive because lower interest rates decrease the direct financial cost of borrowing and thus the likelihood of a firm actually losing the posted collateral as a result of defaulting.

Bae and Goyal conducted a comparable study in 2009 using the Dealscan commercial loans database, which is very similar to Dealscope. In their study, they focused on the revised version of LLSV’s creditor rights index compiled by DMS and a series of strong judicial efficacy variables, including the Law & Order measure. Across the various regression specifications, the paper found improvements in the creditor rights measure and the judicial efficacy variables to have a significant positive impact on lowering interest rate spreads. While the study did not control for PCRs and PCBs, the consistently significant results support the idea that improvements in creditor rights and judicial efficacy help to lower interest rates. Another problem with this study and with Qian and Strahan’s is that their two respective databases only contain loan data for large, typically multinational, firms. This means that their results may not be able to be generalized to small and medium-sized businesses.

Finally, there is the aforementioned BJP study, on which I will now elaborate. In the baseline panel regression and a regression where information sharing is interacted with a variable that captures firms with low levels of financial transparency, BJP finds that improvements in PCR/PCB quality decrease firms’ perception regarding cost of financing. In contrast, in two other interaction term specifications, including one where the information sharing variable is interacted with one measuring whether a country has poor creditor rights,
the former measure is no longer significant. Due to the theoretical ambiguity surrounding information sharing and these mixed results, there is a lack of evidence to support the idea that information sharing influences firms’ perception regarding the cost financing. However, the information sharing*poor creditor rights variable is marginally significant at 10% and has a positive effect on firms’ perception of borrowing costs. This result is elucidating because it offers preliminary support for DMS’s idea that there is a substitution effect regarding PCRs and PCBs and creditor rights. In a weak legal environment, the role of PCRs and PCBs in improving credit market performance is enhanced.

Other than the fact that BJP examines this topic using firm-level panel analysis, another strength of the paper is that it employs a particularly useful information sharing index. The index not only identifies the presence of PCRs and PCBs in a particular country but also evaluates their quality and efficacy. Finally, unlike Qian and Strahan and Bae and Goyal, BJP was able to examine small- and medium-sized firms given that the majority of the firms in BEEPS fall into one of the category.

However, the BJP study has two main limitations, with the primary one being the focus on only one perception-based cost of borrowing variable. The other one is that due to a lack of data prior to 2003, the judicial efficacy variable included in the study’s cross-sectional analysis could not be included in the panel regressions. Given the importance of controlling for this aspect, my paper therefore also improves on BJP by utilizing the Law & Order index, for which data prior to 2002 is available, as my measure of judicial efficacy.

3 Data

The information for the dependent variables, main firm-level explanatory variables, and firm and loan-level controls comes from the 2002 and 2005 rounds of BEEPS. The data for the remaining country-level controls comes almost exclusively from the World Bank’s World Development Indicators. The only exception is Estonia, where missing GDP/capita and inflation data was supplemented with information from Eurostat and the Estonian Ministry of Finance’s statistical website.

3.1 Dependent Variables

This study examines four dependent variables taken from BEEPS, the three variables mentioned in the introduction as the focus of this paper and for comparison purposes, the cost of finance variable found in BJP. Table II in the appendix provides a description of each. Out of the three variables, only Collateral Amount merits further discussion. Collateral Amount is an appropriate cost of credit measure because an increase in the relative amount of required collateral increases the burden a borrower faces. Unlike Collateral Requirement, however, one expects improvements in creditor rights and judicial efficacy to decrease the amount of collateral demanded. The intuition behind this hypothesis is the same as the one that applies to interest rates and like with interest rates, the expected impact of information sharing is ambiguous.

One limitation of the main dependent variables is that as noted in the appendix, they only
pertain to a firm’s last loan. This is especially problematic because BEEPS contains very little additional loan information. Given that the interest rate and collateral requirements of a loan can vary depending on characteristics such as the size of the loan, being unable to control for these variations may bias my results. However, BEEPS does have a question that asks firms about the length of their respective loans. It is important to include this variable as a control for heterogeneity because one of the fundamental risks that lenders account for is a loan’s time to maturity. From a lender’s perspective, longer loans are typically considered to be riskier than shorter ones.

The focus on firms’ last loans also leads to challenges that arise from working with loans with different years of origination. The inherent problem is that depending on the year the loan was created, there could be a mismatch between the independent variables and the loan-based dependent variables. For example, if according to the 2002 BEEPS, a firm’s last loan was taken out in 1999, then, depending on how much the company has changed over the three-year period, the firm-level controls from the 2002 survey may not be appropriate.

One way to mitigate this problem would be to control for year of origination. However, while the 2005 survey has a question that asks firms when they received their last loans, a similar question does not appear in the 2002 version. Thus, the best solution I had at my disposal was to remove all the firms for which their last loan, according to the 2005 survey, was taken out in 2001 or prior because if this were the case, then the same loan data would also appear in the 2002 survey. One must remove firms that have this redundancy given that it does not make any sense that 2002 and 2005-centered independent variables are simultaneously applicable to one particular loan. There is also the possibility that a firm in the panel dataset took out a loan before it was surveyed in 2002, and this loan was still the firm’s most recent one prior to the 2005 survey. To control for these loans, I went through the panel dataset by hand to identify these firms. In all, 54 firms were dropped. The good news is that out of the remaining 2005 observations, close to 70% received their last loans in 2004 or 2005. This statistic should be a close indication of the loan composition of the 2002 observations, which is a positive sign because it suggests that the fundamental problem of mismatching between the independent and dependent variables does not apply to the large majority of observations.

After dropping the aforementioned firms, there are a total of 2,688 panel observations (1,344 firms) spanning 25 countries across the 2002 and 2005 BEEPS. Table I in the appendix lists all 25 countries and the number of observations in each. However, missing data for variables included in my analysis will drastically reduce the sample size of my main dependent variable regressions to around 400 to 600 per regression.

3.2 Independent Variables

The independent variables in my analysis are described in the appendix as follows. Table III of the appendix describes the three primary country-level explanatory variables.

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3 This is not always the case and thus why I did not automatically drop all the firms for which their last loans according to the 2005 survey originated in 2002. It is possible for a firm to have received a 2002 loan prior to the BEEPS survey implementation and then received another loan afterwards in 2002 that was its last one prior to the 2005 survey.
Table IV describes the three primary firm-level explanatory variables. Table V describes the firm and loan-level controls. Table VI describes the country-level controls.

Before elaborating on the independent variables, it is important to note that like BJP, I took three-year averages for the country-level indicators. For the 2002 data, I took 1999 to 2001 averages, and for the 2005 data, I took 2002 to 2004 averages. The logic behind taking averages is that in comparison to only using values from one year, mean values are more representative of the trend of institutional and economic development in a country and controls for possible outlier values. At the same time, the number of years is small enough so that one is not considering values that are too far removed from the period of focus.

3.2.1 Primary Country-level Explanatory Variables

The data for the creditor rights index compiled by DMS was found on the World Bank’s Doing Business website. The frequent and continued use of the index or a variant in past literature (e.g. BJP and Qian and Strahan) is a clear indication that it is the most reliable and appropriate indicator of creditor rights.

According to the ICRG’s methodology report, the Law & Order index is comprised of a law subcomponent and an order subcomponent. Like the creditor rights index, there is precedence for using this particular measure (e.g. Jappelli and Pagano and Bae and Goyal).

In regards to information sharing, BJP compiled two separate discrete 0 to 5 indices for PCRs and PCBs. Like BJP, I decided to use the maximum of the two scores for each country in my panel analysis. This makes empirical sense given that as noted previously, PCRs and PCBs are close substitutes for each other and thus if a country has both, one can assume that the type of higher quality compensates for the one of lower quality.

Finally, given that the indices are on different scales, I normalized them to a 0 to 1 scale in order to facilitate consistent interpretation across the three variables. The same was also done with Legal Enforcement and Information Access, the two primary firm-level explanatory variables discussed below that are also indices.

3.2.2 Primary Firm-level Explanatory Variables

To proxy for creditor rights, I use a variable that measures the percentage of a firm’s sales it sells on credit. The logic behind this proxy is that, ceteris paribus, firms are more willing to sell on credit if they believe that the legal code offers them stronger protection against customers who are unwilling or unable to pay. While the outstanding “credit” one is talking about here is accounts receivables, as opposed to loans, given that both are forms of outstanding payment, one would expect that stronger legal protection regarding the former implies that there is also stronger protection regarding the latter. Thus, this measure only serves as an indirect proxy for creditor rights. Another limitation is that it being influenced by many other factors, such as company policy regarding selling on credit, limits its applicability.

As for judicial efficacy, my proxy, Legal Enforcement, is based on a question that

4 The only variable for which this was not the case is the information sharing variable. Because there was no 2004 data available, I took the average of the 2002 and 2003 data.
measures firms’ confidence that the legal system will uphold their contract and property
rights. This measure is a very appropriate proxy because while creditor rights are only
one component of the contract and property rights that exist in a particular location,
one would assume the two to be strongly correlated. Thus, measuring the latter offers
a general sense of the level of protection that the legal system specifically affords to
creditors.

Finally, I have decided to use a variable that measures firms’ perceptions regarding
the ease with which they can obtain information regarding laws and regulations that are
relevant to them as a proxy for the quality of information sharing about borrowers. The
idea is that an environment where it is easier to find out more about laws and regulations
is one in which information, in general, is more accessible, thus allowing creditors to
more easily obtain relevant information concerning borrowers. Like the proxy for creditor
rights, it is imperfect but, it is the best available measure in BEEPS.

3.3 Control Variables

Other than Loan Length, which was discussed previously, my control variables can be
separated into two broad categories: firm-level and country-level indicators. Starting with
the firm-level measures, Transparency is a very important control because it has direct
financial implications. Furthermore, it is also typically assumed that smaller and younger
firms are riskier than their peers. Past studies have also often controlled for public firms due
to their unique ownership structure. However, there are competing theories as to the impact
of public ownership on cost of credit. On one hand, public ownership can reduce the cost of
credit because it allows firms to access public funding, which strengthens their liquidity and
 solvency. On the other hand, public ownership can increase borrowing costs for a number
of reasons, of which one is when government priorities impede firms’ abilities to pursue
profit-maximization (BJP). In addition, industry dummies are also commonly included as
controls. Finally, there is also the macroeconomic instability perception variable, which is
only included in the Cost of Finance regressions. The purpose of including this measure is
to crudely control for any bias that may skew firms’ perception of their own cost of finance.5

In regards to the country-level measures, while inflation and log of GDP per capita
are very common controls, M2/GDP needs to be elaborated on. As noted in King
and Levine (1993) and Akimov, Wijeweera, and Dollery (2009), it is a proxy for
the size of the financial sector relative to the entire economy.6 A larger value reflects
a more developed financial sector, which should lower the overall cost of borrowing.

4 Empirical Models, Hypotheses, and Discussion of Results

4.1 Model

My baseline panel regression model (1) and interaction terms panel regression model (2):

5 I would like to thank Professor Desai for recommending this variable.

6 M2 is a measure of the money supply in a country and is comprised of currency in circulation and close
alternatives.
As shown, I have included country fixed effects and time fixed effects. The first interaction variable found in my regression interacts the creditor rights term with the Law & Order measure. The inspiration for it comes from Safavian and Sharma (2007), who make the important point that laws are not as meaningful if they are not properly enforced by the judicial system. Motivated by DMs and BJP, the second interaction term in my model interacts the information sharing variable with a weak creditor rights dummy variable, where a country with a creditor rights score of 2 or lower is considered to have weak creditor rights. Because there are no obvious collinearity issues between the two interaction terms, I have decided to include them in the same regression.

4.2 Hypotheses

Based on the preceding literature, my hypotheses regarding the three main dependent variables are as follows. For the baseline regression, I predict that improvements in Creditor Rights and Law & Order will lead to lower interest rates and relative collateral amounts but will increase the likelihood of collateral being required. Because of the conflicting theories regarding the impact of PCRs and PCBs, the coefficients for Information Sharing could be either positive or negative. Thus, it will not be surprising if they are insignificant. As for Creditor Rights*Law & Order, it should have the same impact on the dependent variables as presented for the individual subcomponents. Based on BJP, I believe that it is likely for the Information Sharing*Weak Creditor Rights coefficient to be significant and negative for Interest and Collateral Amount. The rationale is that the higher lending risks associated with weak creditor rights induces creditors to place a premium on mechanisms that will enable them to decrease their risk. This in turn should magnify the positive effects of information sharing and allow them to outweigh the negative ones. It is not clear, however, how Information Sharing*Weak Creditor Rights should impact Collateral Requirement.
4.3 Discussion of Results

4.3.1 Discussion of Primary Results

Table VII displays my primary regression results. These regressions only include firms from 20 of the 25 countries in my dataset because there is missing data for Georgia, Kyrgyzstan, Macedonia, Tajikistan, and Uzbekistan. As noted, the coefficients for the sector controls have been omitted for the sake of brevity. Robust standard errors are used because I found, after using a modified Wald test, that the distribution of my residuals is highly heteroskedastic. In order to create a balanced panel, I also had Stata omit all firms for which in any one of the two BEEPS survey years, there was missing data for at least one variable. Furthermore, I display OLS results for all of my regressions, including those for Collateral Requirement and Cost of Finance, which are dummy variables. The problem with using probit or logit for Collateral Requirement and Cost of Finance is because as noted in BJP, using a probit or logit makes it difficult to interpret interaction terms. For these two variables, I also found there to be no significant difference between the baseline results I obtained using an OLS and Probit model. I will now elaborate on the results for the three main dependent variables, before analyzing the results obtained for Cost of Finance.

According to the baseline results, an improvement in creditor rights and judicial efficacy leads to lower interest rates and a smaller collateral requirement, and an increase in creditor rights also increases the likelihood of lenders requiring collateral. As for information sharing, it was only found to have a significant impact on Collateral Requirement. This result is revealing because it shows that the net effect of information sharing is such that the access to additional information reduces creditors’ perceived risk of borrowers, which in turn decreases the need to require collateral. While insignificant, the negative coefficients of large magnitude obtained for Interest and Collateral Amount are additional evidence that seem to suggest that the positive impact improved information sharing has on firms’ borrowing costs outweighs the negative influence it can have. Overall, the baseline results are largely consistent with expectations and suggest that the strength of creditor rights is the most important determinant of firms’ cost of credit. The specific results obtained for Collateral Amount and Collateral Requirement are also important due to the insight they provide. Given that no previous paper had focused on the former variable, this study is the first to provide empirical support in favor of a statistically significant relationship between it and creditor rights and judicial efficacy. As for the latter variable, the results contrast with those obtained by Qian and Strahan. However, the positive coefficient for creditor rights supports their hypothesis regarding this variable and its impact on whether collateral is required. Thus, while the aggregate findings confirm that improvements in creditor rights, judicial efficacy, and possibly information sharing will lead to a net decrease in firms’ cost of credit, the above analysis shows that this is not always the case in regards to specific loan cost factors.

In regards to the interaction term regressions, the results are as expected. For Interest and Collateral Amount, both interaction terms are significant and negative. This further validates
the theory behind these variables because it shows that in regards to lowering both cost of credit measures, creditor rights are more effective when there is a stronger judicial system, and PCRs/PCBs make a positive contribution when creditor rights are weak. For Collateral Requirement, the significant and positive coefficient on the Creditor Right*Law and Order variable provides further support for Qian and Strahan’s aforementioned theory regarding these variables. The importance of the judicial system in enhancing the effectiveness of creditor rights can also be seen from the creditor rights variable, which decreases in magnitude and in the case of Interest, statistical significance, upon the introduction of the interaction term. In comparison, the coefficients for the interaction term are also larger than the respective coefficients for the creditor rights variable.

As noted above, one potential limitation of the findings is the restricted sample size. While there are 2,336 panel observations spanning the 20 countries in my analysis, the sample size for each dependent variable is only around 19% to 26% of the total. As a rough test to gauge whether sample bias was driving the findings, I ran the baseline and interaction term regressions with the cost of financing variable used by BJJP. This variable is a good proxy through which to evaluate the strength of the obtained results because after firms are omitted from the sample for missing values, there are still a total of 2,044 observations in the cost of finance regressions.

Before proceeding to the results, it is important to note that Loan Length was omitted from the Cost of Finance regressions given that it is no longer applicable, and the results for Macroeconomic Instability are not shown because the variable was only included to control for perception issues. One can see from Table VI that the results for the main explanatory variables and interaction terms are generally consistent with those previously attained. Creditor Rights is again the most important determinant, as seen from the baseline and interaction term regressions. Although the evidence is not as compelling as before, there is also some indication that increased judicial efficacy helps improve firms’ borrowing costs. The information sharing variable is also negative and significant at 10% in the baseline regression, but the significance of the coefficient and its magnitude decreases once the interaction terms are included. Thus, as before, there is only weak evidence in favor of an increase in PCR/PCB quality having a positive impact by itself on the cost of financing. Finally, both interaction terms are also significant and negative.

4.3.2 Discussion of Secondary Results

As noted in the introduction, using country-level measures for creditor rights, judicial efficacy, and information sharing does not allow one to account for intra-country variation, which may lead to novel insights. In an attempt to overcome this problem, I conducted a secondary analysis that replaced the three country-level explanatory variables with the aforementioned firm-level proxies from BEEPS. To construct these variables, I clustered the firm-level observations and used the cluster averages as the data for these proxies. As noted by Dollar, Hallward-Driemeier, and Mengistae (2005), taking averages of these observations helps to control for firm heterogeneity and biases that will be captured by the individual values. Furthermore,
directly using firm-level observations in the analysis does not make sense given that one would not expect institutional and legal factors to vary on a firm-to-firm basis. Ideally, one would cluster observations by province or city because geographical location is the most logical division by which institutions and laws would differ. However, this is not possible with the BEEPS data given that except for country capitals, neither the provincial or city locations of firms are provided. As an alternative, I decided to cluster the firm-level observations by the size of the city in which each firm is located and whether it is located in the capital of the country. Similar to the breakdown found in BEEPS, there are four clusters for each country: 1) capital city or non-capital city of over 1 million 2) non-capital city of 250,000 to 1 million 3) non-capital city of 50,000 to 250,000 4) non-capital city of under 50,000. These clusters make sense because in comparison to smaller cities, capital cities and larger cities should have more sophisticated governing and regulatory structures and more developed economic and financial systems. These factors should be correlated with creditor rights and judicial efficacy because the former is more conducive to the development of an effective legal system while the latter creates a demand for stronger property and contract rights, and thus creditor rights. Lenders in capital and larger cities should also be in a better position to obtain information about borrowers because the aforementioned factors should also promote the transmission and flow of information.

To construct the cluster averages, I used the complete 2002 and 2005 BEEPS dataset of 16,322 observations, which includes both panel and non-panel firms. Doing so is preferable to only using the panel observations because it allows one to construct averages using a more comprehensive sample. As for the Low Credit Sales dummy variable found in the interaction term Information Access*Low Credit Sales, I designated any firm selling less than 10% of its sales on credit as having low credit sales.7

The results for my secondary analysis are displayed in Table VIII. Due to missing data, my analysis does not contain any firms surveyed in Tajikistan. For the sake of brevity, I have also not included the results for my control variables. As seen from the results, the only variable for which there are significant coefficients is Legal Enforcement. An improvement in firms’ perception of the strength of contract and property rights enforcement improves firms’ perception of cost of financing, and the former is also associated with lower interest rates and collateral requirements. The lack of significance for the other two main explanatory variables and interaction terms is not surprising given that, as noted above, they are tenuous proxies for creditor rights and information sharing. In contrast, Legal Enforcement is a relatively good proxy and thus captures the expected relationship. Thus, while this evidence supports judicial efficacy as being an important determinant of cost of credit, drawing meaningful conclusions from the other results is difficult due to the limitations of the two other proxies. As a result, one cannot determine the relative importance of judicial efficacy.

7 I chose 10% as the threshold because in the panel dataset, around 50% of the firms were above and below this cut-off.
5 Conclusion

In support of previous studies, my primary panel analysis of EECA firms finds that improvements in creditor rights and judicial efficacy lead to a net decrease in firms’ cost of credit. More specifically, I find that creditor rights are the most important determinant, followed by judicial efficacy. Given the composition of firms in the sample, these effects can be generalized to small- and medium-sized businesses. The statistical support for information sharing is much weaker given that significant coefficients were only attained for Collateral Requirement. However, based on the other evidence that was discussed above, the probability of information sharing having on average a net positive effect on cost of credit seems more likely than it having a negative effect or no effect at all.

In addition to these findings, there are also some more elucidating results concerning areas that have received much less attention in past studies. The positive association between improved creditor rights and the likelihood of lenders requiring collateral not only provides valuable support for Qian and Strahan’s hypothesis but also highlights the value of focusing on multiple cost of credit factors. To the best of my knowledge, this study is also the first one spanning multiple countries, while focusing on non-perception based cost of credit measures, to show: 1) improved judicial efficacy enhances the impact that creditor rights have on borrowing costs and 2) information sharing helps lower cost of credit when creditor rights are weak.

From a policy standpoint, the above results suggest that for a country with inadequate creditor rights, strengthening them is the most effective channel through which to lower firms’ overall borrowing costs. At the same time, one must also improve the court system and its ability to enforce rulings because of the complementary effect it has on creditor rights. While the evidence regarding information sharing is more ambiguous, the above discussion regarding the role it serves and the benefit it brings to creditors means that creating PCRs and PCBs and improving their quality is important for enhancing credit market performance. More importantly, in a country where creditor rights are weak and it is difficult to strengthen them, information sharing becomes a valuable alternative channel through which to promote lower cost of credit.

References


The World Bank Group. World Development Indicators.
APPENDIX

Countries and Number of Panel Observations in 2002 and 2005 BEEPS (caption for Table 1)
Description of Variables (caption for Tables II through VI)
Regression Results (caption for Table VII and VI)

Table I

<table>
<thead>
<tr>
<th>Countries</th>
<th>Number of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>118</td>
</tr>
<tr>
<td>Armenia</td>
<td>96</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>136</td>
</tr>
<tr>
<td>Belarus</td>
<td>82</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>176</td>
</tr>
<tr>
<td>Croatia</td>
<td>118</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>62</td>
</tr>
<tr>
<td>Estonia</td>
<td>122</td>
</tr>
<tr>
<td>Georgia</td>
<td>116</td>
</tr>
<tr>
<td>Hungary</td>
<td>108</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>118</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>80</td>
</tr>
<tr>
<td>Latvia</td>
<td>106</td>
</tr>
<tr>
<td>Lithuania</td>
<td>108</td>
</tr>
<tr>
<td>Macedonia</td>
<td>64</td>
</tr>
<tr>
<td>Moldova</td>
<td>62</td>
</tr>
<tr>
<td>Poland</td>
<td>152</td>
</tr>
<tr>
<td>Romania</td>
<td>128</td>
</tr>
<tr>
<td>Russia</td>
<td>80</td>
</tr>
<tr>
<td>Serbia and Montenegro</td>
<td>86</td>
</tr>
<tr>
<td>Slovakia</td>
<td>54</td>
</tr>
<tr>
<td>Slovenia</td>
<td>138</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>36</td>
</tr>
<tr>
<td>Ukraine</td>
<td>286</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>56</td>
</tr>
</tbody>
</table>

Total Observations 2688

*Note: The above figures pertain to the observations still remaining in the dataset after dropping the observations that suffered from the loan origination issue discussed in my paper.*

Table II

Dependent Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest Rate</td>
<td>Annual % Interest Rate of Firm’s Last Loan</td>
</tr>
<tr>
<td>Collateral Requirement</td>
<td>Dummy variable that equals 1 if above mentioned loan required collateral</td>
</tr>
<tr>
<td>Collateral Amount</td>
<td>If applicable, the collateral amount as a % of the value of the above loan</td>
</tr>
</tbody>
</table>

Cost of Finance

Firm asked the degree to which "Cost of financing (e.g. interest rate and charges)" are problematic to the firm's operations and growth. This dummy variable equals 0 if a firm responds "No Obstacle" or "Minor Obstacle" and equals 1 if a firm responds "Moderate Obstacle" or "Major Obstacle."

Sources: 2002 and 2005 BEEPS
### Determinants of Cost of Credit across Firms in Eastern Europe and Central Asia

#### Table III

**Primary Country-level Explanatory Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creditor Rights&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Ranges from 0 to 4 where 4 reflects a country with the strongest creditor rights. A country is assigned 1 point for each instance when it has laws and regulations that codify the following guidelines: 1) There are restrictions, such as creditor consent or minimum dividends for a debtor to file for reorganization. 2) Secured creditors are able to seize their collateral after the reorganization petition is approved (i.e., there is no automatic stay or asset freeze). 3) Secured creditors are paid first out of the proceeds of liquidating a bankrupt firm, as opposed to other creditors such as government or workers. 4) Management does not retain administration of its property pending the resolution of the reorganization.</td>
</tr>
<tr>
<td>Law &amp; Order&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Ranges from 0 to 6 where 6 reflects the strongest level of law &amp; order. Countries are ranked separately on the law subcomponent and the order subcomponent on a 0 to 3 integer scale. The two scores are added together to produce the final score. The law component measures the efficacy of a country’s court system, and the order component measures whether a country’s citizens abide by the law.</td>
</tr>
</tbody>
</table>

#### Table III

**Primary Country-level Explanatory Variables - Continued**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Sharing&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Ranges from 0 to 5 where 5 reflects the highest quality regarding credit information bureaus. Separate scores are compiled for public credit registries and private credit bureaus, with the highest of the two scores included in the dataset. 1 point is awarded for meeting each of the following criteria: 1) Both firms and individuals are covered. 2) Positive and negative information is collected and distributed. 3) The registry distributed data that is at least two years old. 4) The threshold for included loans is below GDP/capita. 5) The registry has existed for more than three years.</td>
</tr>
</tbody>
</table>

**Sources:**
1. World Bank's Doing Business website
2. International Country Risk Guide

**Note:** For the regression analysis, all three indices are normalized into 0 to 1 indices.
Table IV
Primary Firm-level Explanatory Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Sales</td>
<td>% of a firm's sales that are sold on credit.</td>
</tr>
<tr>
<td>Legal Enforcement</td>
<td>Firm asked the question &quot;To what degree do you agree with this statement? I am confident that the legal system will uphold my contract and property rights in business disputes.&quot; Variable converted so that it ranges from 0 to 5, where each integer value corresponds to a particular firm response: 0 = Strongly disagree 1 = Disagree in most cases 2 = Tend to disagree 3 = Tend to agree 4 = Agree in most cases 5 = Strongly agree</td>
</tr>
<tr>
<td>Information Access</td>
<td>Firm asked the question &quot;To what degree do you agree with this statement? 'Information on the laws and regulations affecting my firm is easy to obtain.'&quot; Variable converted so that it ranges from 0 to 5, where each integer value corresponds to a particular firm response: 0 = Strongly disagree 1 = Disagree in most cases 2 = Tend to disagree 3 = Tend to agree 4 = Agree in most cases 5 = Strongly agree</td>
</tr>
</tbody>
</table>

Sources: 2002 & 2005 BEEFS

Note: For the regression analysis, the latter two variables are normalized into 0 to 1 indices.

Table V
Firm and Loan-level Control Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Firm</td>
<td>Dummy variable that equals 1 if firm has fewer than 50 employees.</td>
</tr>
<tr>
<td>Young Firm</td>
<td>Dummy variable that equals 1 if firm is 5 years old or younger.</td>
</tr>
<tr>
<td>Public Firm</td>
<td>Dummy variable that equals 1 if firm has majority public ownership.</td>
</tr>
</tbody>
</table>
| Transparency  | Ranges from 0 to 2 where 2 reflects the highest level of transparency. A firm is awarded one point for meeting each of the following requirements:
1) Financial statements are reviewed and certified by an external auditor
2) Firm uses international accounting standards or U.S. GAAP. |
| Loan Length   | Length of the firm's last loan in years.                                    |
| Sector        | Sector dummies included for the following industries: 1) Mining and Quarrying 2) Construction 3) Manufacturing 4) Transport Storage and Communication 5) Wholesale and Retail 6) Real Estate, Renting, and Other Business Services 7) Hotels and Restaurants 8) Other Services |
| Macroeconomic Instability | Firm asked to respond to question "Can you tell me how problematic are these different factors for the operation and growth of your business?" as it pertains to macroeconomic instability (e.g. inflation, exchange rates). Variable converted so that it ranges from 0 to 3, where each integer value corresponds to a particular firm response: 0 = Major Obstacle 1 = Moderate Obstacle 2 = Minor Obstacle 3 = No Obstacle |

Sources: 2002 & 2005 BEEFS
Table VI  
Country-level Control Variables  

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation</td>
<td>Measured as the growth rate of the implicit GDP deflator.</td>
</tr>
<tr>
<td>GDP/Capita</td>
<td>Measured in constant 2000 U.S. Dollars.</td>
</tr>
<tr>
<td>M2/GDP</td>
<td>M2 as a % of GDP.</td>
</tr>
</tbody>
</table>

Sources: World Development Indicators, Eurostat, and Statistics Estonia

Table VII  
Panel Regressions with Country Fixed Effects and Country-level Primary Exploratory Variables  

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Interest</th>
<th>Interest</th>
<th>Collateral Requirement</th>
<th>Collateral Requirement</th>
<th>Collateral Amount</th>
<th>Collateral Amount</th>
<th>Cost of Finance</th>
<th>Cost of Finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Rights</td>
<td>-4.201**</td>
<td>-1.774*</td>
<td>0.185**</td>
<td>0.113**</td>
<td>-27.305**</td>
<td>-14.291**</td>
<td>-0.101**</td>
<td>-0.139**</td>
</tr>
<tr>
<td></td>
<td>(1.660)</td>
<td>(0.863)</td>
<td>(0.076)</td>
<td>(0.048)</td>
<td>(11.756)</td>
<td>(6.466)</td>
<td>(0.061)</td>
<td>(0.063)</td>
</tr>
<tr>
<td>Law and Order</td>
<td>-1.623**</td>
<td>-0.687**</td>
<td>0.317</td>
<td>0.112</td>
<td>-22.559**</td>
<td>-11.816**</td>
<td>-0.051**</td>
<td>-0.019</td>
</tr>
<tr>
<td></td>
<td>(0.788)</td>
<td>(0.342)</td>
<td>(0.126)</td>
<td>(0.033)</td>
<td>(12.484)</td>
<td>(6.453)</td>
<td>(0.027)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Information Sharing</td>
<td>-5.027</td>
<td>-3.447</td>
<td>-0.306**</td>
<td>-0.257**</td>
<td>-35.803</td>
<td>-29.504</td>
<td>-0.312**</td>
<td>-0.140</td>
</tr>
<tr>
<td></td>
<td>(0.435)</td>
<td>(0.265)</td>
<td>(0.133)</td>
<td>(0.054)</td>
<td>(0.050)</td>
<td>(0.045)</td>
<td>(0.061)</td>
<td>(0.051)</td>
</tr>
<tr>
<td>Small Firm</td>
<td>2.544**</td>
<td>2.449**</td>
<td>0.029</td>
<td>0.017</td>
<td>5.622**</td>
<td>4.657**</td>
<td>0.128**</td>
<td>0.094</td>
</tr>
<tr>
<td></td>
<td>(1.173)</td>
<td>(1.103)</td>
<td>(0.240)</td>
<td>(0.247)</td>
<td>(2.141)</td>
<td>(2.035)</td>
<td>(0.049)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>Young Firm</td>
<td>0.627</td>
<td>0.828</td>
<td>0.199</td>
<td>0.174</td>
<td>21.951</td>
<td>23.127</td>
<td>0.022</td>
<td>0.056</td>
</tr>
<tr>
<td></td>
<td>(0.607)</td>
<td>(0.737)</td>
<td>(0.048)</td>
<td>(0.078)</td>
<td>(2.452)</td>
<td>(2.905)</td>
<td>(0.018)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>Public Firm</td>
<td>2.159**</td>
<td>2.201**</td>
<td>0.297**</td>
<td>0.269**</td>
<td>23.371**</td>
<td>24.132</td>
<td>0.072</td>
<td>0.079</td>
</tr>
<tr>
<td></td>
<td>(0.949)</td>
<td>(0.995)</td>
<td>(0.126)</td>
<td>(0.132)</td>
<td>(13.664)</td>
<td>(14.497)</td>
<td>(0.049)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>Transparency</td>
<td>-0.711**</td>
<td>-0.691**</td>
<td>-0.122</td>
<td>-0.114</td>
<td>-3.729**</td>
<td>-3.662**</td>
<td>-0.174**</td>
<td>-0.158**</td>
</tr>
<tr>
<td></td>
<td>(0.328)</td>
<td>(0.303)</td>
<td>(0.109)</td>
<td>(0.108)</td>
<td>(7.772)</td>
<td>(7.423)</td>
<td>(0.079)</td>
<td>(0.071)</td>
</tr>
<tr>
<td>Length of Loan</td>
<td>0.048</td>
<td>0.041</td>
<td>0.038</td>
<td>0.042</td>
<td>0.265</td>
<td>0.233</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.139)</td>
<td>(0.161)</td>
<td>(0.286)</td>
<td>(0.382)</td>
<td>(0.538)</td>
<td>(0.552)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log(GDP/Capita)</td>
<td>-3.801</td>
<td>-1.393</td>
<td>-0.554</td>
<td>-0.532</td>
<td>-30.393</td>
<td>18.107</td>
<td>-0.117</td>
<td>-0.112</td>
</tr>
<tr>
<td></td>
<td>(0.107)</td>
<td>(0.037)</td>
<td>(0.196)</td>
<td>(0.209)</td>
<td>(36.435)</td>
<td>(36.162)</td>
<td>(0.216)</td>
<td>(0.340)</td>
</tr>
<tr>
<td>Inflation</td>
<td>0.212***</td>
<td>0.196***</td>
<td>0.001</td>
<td>0.001</td>
<td>0.559***</td>
<td>0.506***</td>
<td>0.004</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.048)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.017)</td>
<td>(0.017)</td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>M2/GDP</td>
<td>-0.136**</td>
<td>-0.091**</td>
<td>0.002</td>
<td>0.002</td>
<td>-4.316**</td>
<td>-4.266**</td>
<td>-0.054**</td>
<td>-0.038**</td>
</tr>
<tr>
<td></td>
<td>(0.053)</td>
<td>(0.038)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.169)</td>
<td>(0.139)</td>
<td>(0.031)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>CR*LO</td>
<td>-2.521**</td>
<td>-2.521**</td>
<td>0.048</td>
<td>-1.763**</td>
<td>-0.056**</td>
<td>-0.056**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.937)</td>
<td>(0.221)</td>
<td>(0.021)</td>
<td>(0.262)</td>
<td>(0.021)</td>
<td>(0.021)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>E<em>W</em>CR</td>
<td>-1.804**</td>
<td>-1.277</td>
<td>1.493</td>
<td>1.493</td>
<td>-2.921**</td>
<td>-0.053**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.658)</td>
<td>(0.218)</td>
<td>(0.403)</td>
<td>(0.403)</td>
<td>(0.403)</td>
<td>(0.403)</td>
<td>(0.549)</td>
<td>(0.549)</td>
</tr>
</tbody>
</table>

R² = 0.267  0.331  0.115  0.158  0.172  0.212  0.078  0.095

Note: 1) Robust standard errors used.
2) All regressions are linear.
3) For purposes of brevity, the results for sector controls are not shown for all regressions, and the results for the macroeconomic variability variable are not shown for the Cost of Finance regressions.
4) CR = Credit Rights, LO = Law & Order, and IS = Information Seeing

** = 1% significance, * = 5% significance, ** = 10% significance
### Table VIII
**Panel Regressions with Country Fixed Effects and Firm-level Primary Explanatory Variables**

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Interest Effect</th>
<th>Interest Requirement</th>
<th>Collateral Requirement</th>
<th>Collateral Amount</th>
<th>Collateral Finance</th>
<th>Cost of Finance</th>
<th>Cost of Finance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Sales</td>
<td>-0.035</td>
<td>0.033</td>
<td>0.002</td>
<td>0.032</td>
<td>-0.124</td>
<td>-0.137</td>
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<tr>
<td></td>
<td>(0.030)</td>
<td>(0.056)</td>
<td>(0.004)</td>
<td>(0.035)</td>
<td>(0.125)</td>
<td>(0.158)</td>
<td>(0.034)</td>
</tr>
<tr>
<td>Legal Enforcement</td>
<td>-1.98***</td>
<td>-3.95***</td>
<td>0.083</td>
<td>0.077</td>
<td>-5.371***</td>
<td>-4.978***</td>
<td>-0.048**</td>
</tr>
<tr>
<td></td>
<td>(0.561)</td>
<td>(0.110)</td>
<td>(0.088)</td>
<td>(0.068)</td>
<td>(2.238)</td>
<td>(2.147)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>Information Access</td>
<td>-1.573</td>
<td>-1.274</td>
<td>0.028</td>
<td>0.022</td>
<td>-4.629</td>
<td>-4.515</td>
<td>-0.032</td>
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<td></td>
<td>(1.845)</td>
<td>(1.680)</td>
<td>(0.065)</td>
<td>(0.054)</td>
<td>(9.654)</td>
<td>(9.291)</td>
<td>(0.049)</td>
</tr>
<tr>
<td>CS*LE</td>
<td>-0.149</td>
<td>0.014</td>
<td>-0.036</td>
<td>0.036</td>
<td>0.026</td>
<td>-0.003</td>
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<tr>
<td></td>
<td>(0.142)</td>
<td>(0.046)</td>
<td>(1.121)</td>
<td>(0.122)</td>
<td>(3.200)</td>
<td>(3.020)</td>
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<tr>
<td>LA*Low CS</td>
<td>-2.763</td>
<td>0.028</td>
<td>-1.735</td>
<td>0.020</td>
<td>0.020</td>
<td>0.020</td>
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<tr>
<td></td>
<td>(2.424)</td>
<td>(0.022)</td>
<td>(3.200)</td>
<td>(0.023)</td>
<td>(3.020)</td>
<td>(3.020)</td>
<td></td>
</tr>
</tbody>
</table>

R²: 0.021  0.061  0.041  0.036  0.085  0.094  0.148  0.157

Number of Observations: 554  554  600  600  556  556  2062  2062

Number of Countries: 24  24  24  24  24  24  24  24

Note: 1. Robust standard errors used.
2. All regressions are linear.
3. For purposes of brevity, the results for control variables are not shown for the above regressions.
4. CS = Credit Sales, LE = Legal Enforcement, and LA = Information Access.

*** = 1% significance, ** = 5% significance, * = 10% significance
Determinants of Bank Profitability in Ukraine

Antonina Davydenko
American University in Bulgaria

Acknowledgements
I would like to express my deepest gratitude to my advisor, Professor Didar Erdinç for her guidance and support. I would also like to thank Professor Kudret Topyan for his inspirational econometrics lessons. Special thanks to Shkamb Qavdarbasha for help with data collection and overall support.

1 Introduction

After almost ten years of growth at an average annual growth rate of 7%, late 2008 brought Ukraine to its deepest recession since the early 1990s. With global demand shrinking, imports collapsed, lowering GDP by 20% in 2008. The banking sector contributed significantly to the previously observed growth through the increasing availability of credit. Banking was also one of the most affected industries in the turmoil. The global financial crisis evoked existing refinancing risks of large private sector debts accumulated in recent years as well as risks associated with the banking sector. Recognizing the need for an efficient banking system to stimulate economic recovery, we aim to analyze the main determinants of bank profitability in Ukraine.

2 The Ukrainian Banking Sector

The Ukrainian banking sector has its roots in the inefficient Soviet banking system. Prior to 1991, the few existing state controlled banks served as a de facto channel to subsidize state owned enterprises rather than to issue loans.

In the early years of Ukraine's independence, the number of banks increased dramatically from 76 in 1991 to 230 in 1995. Such an increase was triggered by low barriers to entry, specifically by the extremely low capital requirements. In the end of 2009 there were 179 licensed banks operating in Ukraine. Compared to other countries in transition, the share of state owned banks in Ukraine is not significant. Until the time of the crisis, when three private banks were nationalized, there were only 2 state owned banks in the country.
Ukrainian banking is, however, highly concentrated with approximately 50% of total assets controlled by the ten largest banks. This highly concentrated organization of the industry suggests strong competition between the market leaders. It also indicates that the other 170 banks are small pocket banks serving the needs of individual firms.

Most of the banks in Ukraine are universal banks, providing all corporate and individual services under one roof. Bank assets are invested overwhelmingly in real sector financing. The share of securities is less than 6 percent (Baum, Caglayan, Schäfer, and Talavera, 2008). The high degree of currency risk is another characteristic of Ukrainian banking. In the recent years approximately half of the sector’s total assets were in foreign currency while the majority of deposits were in domestic currency.

The institutional maturity of the Ukrainian banking sector has developed slowly in the last several years. One measure of progress in the reform of the banking sector is the indicator of European Bank of Reconstruction and Development. Ukraine’s index of the banking sector reform improved from 2.3 in 2003 to 3.0 out of maximum 4 in 2009. As a comparison, neighboring Poland has a 3.7 score, Romania has a 3.3 score, and Russia has a 2.7 score.

Significant institutional improvements were implemented in 2004. The National Bank of Ukraine raised capital adequacy requirements, and implemented new legislation on mortgages and mortgage-backed securities. These actions were followed by a wave of foreign acquisitions from 2006 to 2008 when over 24 major transactions took place. Foreign investors acquired mostly large banks with some instances of medium size banks acquisitions.\(^2\)

Baum et al. (2008) suggests that banks that have political linkages attract foreign investors. The link between politics and banking is very strong in Ukraine as it is in other post-Soviet States. Banks seek political support to gain advantage in dealing with the bureaucratic obstacles of obtaining a license to operate or a license to carry out transactions in foreign currency which are important sources of income for Ukrainian banks. Another problem of political patronage is that these banks have a different objective function from that of strict profit maximization, lending to related parties under sub-optimal conditions.

Inefficiency is another problem in the Ukrainian banking sector. The country is often cited as one of the least efficient and highest cost banking markets among transition countries together with Bulgaria, the Czech Republic, and Russia (Fries & Taci, 2005; Grigorian & Manole, 2006). There is also evidence that more than half of scarce bank resources are being wasted during the production of financial services in Ukraine. (Kyj & Isik, 2008).

### 3 Literature Review

Prior literature on bank profitability explains profitability through internal and external variables. Internal, or bank specific, factors are under the control of bank management.

---

1. French bank BNP Paribas controlling stake in UkrSibbank, the #4 bank in Ukraine, UkrSotsBank bought by Banca Intesa (Italy), Commerzbank buys 60% of Ukraine's Bank Forum.
2. Eurobank EFG concluded its acquisition of Universal Bank.
External variables trace the effect of the macroeconomic environment on banks’ performance.


### 3.1 Internal Factors

#### 3.1.1 Cost

A bank's operating costs as a percentage of its profits are expected to be negatively correlated with profitability. In the literature, the level of operating expenses is viewed as an indicator of the management’s efficiency. For example, Abreu & Mendes (2001) in their study of several European countries conclude that operating costs have a negative effect on profit measures despite their positive effect on net interest margins. Several studies on cost efficiency that included Ukraine, including (Fries & Taci (2005); Grigorian & Manole (2006)), identified Ukraine as the highest cost banking sector in its region.

#### 3.1.2 Size

The impact of a bank’s size on its profitability is not uniform. In a study of European banks for the period of 1992 to 1998, Goddard et al. (2004) identified only a slight relationship between size and profitability. Some earlier studies had different results. Smirlock (1985) proves a significant positive impact of a bank's size on its profitability. Short (1979) goes further by claiming that size has a positive influence on profitability through lowering the cost of raising capital for big banks. Later studies by Bikker & Hu (2002) and Goddard et al. (2004) support the proposition that increasing a bank’s size positively affects profitability through cost of capital. Some research, including that by Berger, Hanweck & Humphrey (1987) claim that there is no significant relationship between profitability and size.

#### 3.1.3 Capital

Various studies suggest that banks with higher levels of capital perform better than their undercapitalized peers. Staikouras & Wood (2003) claim there exists a positive link between greater equity and profitability among EU banks. Abreu & Mendes (2001) also trace a positive impact of equity level on profitability. Goddard et al. (2004) support the prior finding of a positive relationship between the capital/asset ratio and bank earnings.
3.1.4 Liquidity

Insufficient liquidity is one of the major reasons for bank failure. However, holding liquid assets has an opportunity cost of higher returns. Bourke (1989) finds a positive significant link between bank liquidity and profitability. However, in times of instability banks may chose to increase their cash holding to mitigate risk. Unlike Bourke (1989), Molyneux and Thorton (1992) come to the conclusion that there is a negative correlation between liquidity and profitability levels.

3.2 External Factors

Another group of variables impacting bank profitability is macroeconomic control variables. GDP is one of the most common measures of the total economic activity within a country. We expect GDP growth to have a positive impact on the profitability of individual banks in the study.

Inflation is often cited as a significant determinant of bank profitability. First analyzed by Revel (1979), the effect of inflation on bank profitability depends on whether a bank's operating expenses increases faster than the inflation rate. Therefore, the impact of inflation is contingent on the overall macroeconomic stability that allows the correct prediction of inflation. According to Perry (1992), the relationship between inflation and bank performance depends on whether the inflation is anticipated by a bank’s management. By correctly predicting inflation and adjusting interest rates, managers can raise revenues faster than costs. Among studies that find a significant positive relationship between inflation and bank earnings are those conducted by Molyneux and Thorton (1992) and Bourke (1989).

3.2.1 Exchange rate

Abreu and Mendes (2001) identify no impact of effective exchange rates on bank profitability in their study of EU banks. This result may not be valid for Ukraine since, unlike their European counterparts, Ukrainian banks operate in an environment where income from foreign exchange transactions can be generated due to lack of transparency in the pricing of financial products.

3.2.2 Industry Characteristics

Concentration in the banking industry should lead to monopolistic profits for some banks, according to Molyneux & Thorton (1992) and Bourke (1989). The effect of concentration is studied in the light of the structure-conduct-performance (SCP). SCP hypothesis suggests that increased market share leads to monopolistic profits. According to Short (1979), Gilbert (1984), and Molyneux et al. (1996), banks in highly concentrated markets tend to collude, which leads to monopoly profits. However, various studies have found no evidence in favor of the SCP hypothesis. For example, in their study of EU banks for the period of 1994–1998, Staikouras & Wood (2003) found no support for the SCP hypothesis.
3.2.3 Foreign versus Domestic ownership

In reviewing literature on the impact of foreign ownership on bank profitability a distinction between emerging and developed countries must be made. Studies conducted in the US, such as Hasan & Hunter (1996), Mahaja, Rangan & Zardkoohi (1996) and Chang, Hasan & Hunter (1998) find foreign banks to be less cost efficient. In the emerging markets, results usually defer leaning in favor of banks with foreign ownership. Ukrainian banks were included in the Fries & Taci (2005) study of transitional banking, which concludes that banks with a majority foreign capital are more cost efficient than domestic ones. Isik & Hassan (2003) and Isik (2007) suggest that foreign ownership is crucial in developing countries to discipline local banks and boost their efficiency.

4 Determinants and Variables

4.1 Dependent Variables

Two ratios are commonly used to describe bank profitability: the return on equity (ROE) and the return on assets (ROA). ROA indicates how effectively a bank manages its assets to generate income. It indicates income earned on each unit of assets. The problem with ROA is that it excludes off-balance sheet items of a bank creating a positive bias in evaluating bank performance. ROE measures the return to shareholders per unit of their capital. The drawback of ROE is that banks with lower level of capital will generate a higher ratio. These banks have a high level of financial leverage which is undesirable and associated with a high degree of risk. Moreover, ROE is not an optimal measure of profitability since degree of capitalization is often established by the regulatory authority. The view in favor of ROA versus ROE is also supported in the literature (Golin, 2001).

4.2 Independent variables

4.2.1 Bank specific Determinants of bank profitability

The capital level- capta- of banks in this study is described by a ratio of total equity over total assets. Well capitalized banks have lower perceived risk and according to the finance theory should produce lower returns. However, banks with a higher level of capital are viewed as having a safety net in case of liquidation. Being better insured from bankruptcy they also enjoy a lower cost of capital contributing to their profitability. A well-capitalized bank has more flexibility to both pursue unexpected opportunities and deal with unpredicted losses and is thus more profitable. The capital to assets ratio is an endogenous variable for determining profitability. The causality may run in both directions. As explained above, an increasing level of capital may enhance profits. However, a portion of profits may be ploughed back into a bank’s increasing capital to assets ratio. Moreover, banks that have better performance can choose to communicate this information to the public through higher capital levels.

Credit risk is modeled by the ratio of provisions for loan losses over total loans - provloan. This ratio measures the ability of bank managers to screen for credit risk and
therefore increase profitability. Provisions for loans could also be an endogenous variable due to two-way causality. On one hand, income decreases when loans are not collected. Meanwhile, in times of steadily high profits banks may decrease provisions for loan losses since stable cash inflows allow them to better bear sudden defaults. However, we model provisions ratio as a predetermined variable because provisions ratio is set by the bank in view of its debt collection in the prior period. This makes this endogenous variable predetermined and, therefore, not correlated with the error term in equation.

Size is described by the accounting value of banks' total assets. Size is an important determinant of profitability. The effect of a bank’s size on profitability is not settled in the literature. We expect a positive effect on earnings to be derived from economies of scale and lower perceived probability of default of larger banks. However, increase in size can lead to decreasing profits for banks due to cumbersome bureaucracy. In an attempt to track a possible non-linear relationship between banks’ profits and size, we include size squared into the model.

Cost management - admin - we use a ratio of administrative expenses including personnel over total assets in order to estimate how efficiently banks manage their expenses relative to their size. We chose this ratio over cost/net income due to inconsistencies that arise when profits are negative. In line with earlier studies, we expect this effect of expenses ratio on profits to be negative.

Liquidity – liquid – is measured by a ratio of cash and cash equivalents over total assets. We expect a positive coefficient. High liquidity may allow a bank to avoid costly borrowing of funds, should the need for cash arise. However, there is also an opportunity cost that banks incur by not investing the cash available to generate returns. Therefore, the sign may appear to be positive.

Loans to total assets – loanta – is a variable measuring what percent of total assets is comprised by loans. We expect a positive coefficient as more loans would generate interest income for the bank.

Deposits to total assets – depos – is a variable measuring the amount of deposits held by a bank proportional to its size. Deposits are banks’ primary sources of funds that they can invest to generate income. Therefore we expect a positive correlation between ROA and deposits ratio.

4.2.2. Industry specific determinants

The Concentration variable in this study is defined as a ratio of the ten largest banks assets over the assets of the whole system. The Ukrainian banking sector is highly concentrated with ten largest banks controlling approximately 50% of the total sectors assets. Partially due to the short time span of the study, from 2005 to 2009, we do not observe considerable variations in the concentration ratio. If the Structure Conduct Performance hypothesis stands for Ukrainian banking, we expect a positive impact of the concentration variable on profitability.

Foreign ownership - for - is a dummy variable, taking a value of 1 if 30% or more of a bank’s capital is foreign owned and 0 otherwise. Considering the prior reported inefficiency
of domestic banks, we expect a positive correlation between foreign ownership and profitability.

4.2.3. Macroeconomic indicators

We use a logarithm of nominal GDP - lngdp - to account for the growth of the Ukraine’s output. We expect GDP growth to have a significant positive effect on the profitability of banks. In line with the literature, we expect a strong positive correlation between the overall economic activity and the performance of the financial sector.

We use the current inflation - infl - increase of the Consumer Price Index over the previous quarter, to proxy for the expected inflation. In the highly inflationary environment of Ukraine we predict this variable to be a significant determinant of profitability. The effect of inflation on banks’ earnings depends on whether it is correctly anticipated by the bank. By making accurate inflation forecasts managers can increase the rates on loans faster than the operating costs allowing earning higher profits.

In this study exchange rate - exchn - is the quarterly depreciation of Ukrainian hryvna with respect to the US dollar. Ukraine’s exchange rate regime is characterized as a crawling peg. However, recently the NBU has advanced towards more flexibility. Having approximately 50% of their total assets in foreign currency, Ukrainian banks face significant foreign currency risk. By lending to its customers in foreign currency, banks face a risk of not collecting their loans in case of domestic currency depreciation. Therefore, we expect a negative effect of depreciation on banks’ earnings.

Crisis. Suspecting a decline in profits after the financial crisis of late 2008 we also experiment with various time dummy variables. For the sake of simplicity and considering the short time span of the study we chose a single crisis dummy, which is equal to one for quarters following the crisis and zero for preceding quarters.

5 Data Description

This study uses the detailed quarterly balance sheet and income statement information for a universe of Ukrainian banks. This is an unbalanced panel for the period from the first quarter of 2005 to the fourth quarter of 2009. Banks that have fewer than eight quarters of available data are excluded from the sample. These banks are either newly-chartered or those that have been liquidated. We acknowledge the problem in analyzing profitability may arise because the worst performing banks were liquidated in this period and therefore excluded from our study. In this way the reason for attrition may be correlated to the idiosyncratic error and cause biased estimators. However, Wooldridge (2009) claims that fixed effects estimation can be still used if attrition is correlated with the unobserved effect (p.488). After all screenings, our sample size consists of about 3236 bank-quarter observations.
6 Econometric Methodology

We first specify a linear model of profitability:

\[ \Pi_{it} = c + \sum_{j=1}^{\beta_j} X_{ij}^l + \sum_{l=1}^{\beta_l} X_{il}^l + \sum_{m=1}^{\beta_m} X_{im}^m + \epsilon_{it}, \quad \epsilon_{it} = \nu_i + \mu_{it}. \]

Where the dependent variable \( \Pi_{it} \) is the ROE of a bank, \( c \) is constant term, \( \sum_{l=1}^{\beta_l} X_{il}^l \) is a vector of bank specific variables, \( \sum_{m=1}^{\beta_m} X_{im}^m \) is a vector of industry-specific variables and is a \( \sum_{m=1}^{\beta_m} X_{im}^m \) vector of macroeconomic variables. Later, suspecting a dynamic structure of industry profits, we add a lagged dependant variable on the right hand side.

\[ \Pi_{it} = c + \delta \Pi_{i,t-1} + \sum_{j=1}^{\beta_j} X_{ij}^l + \sum_{l=1}^{\beta_l} X_{il}^l + \sum_{m=1}^{\beta_m} X_{im}^m + \epsilon_{it} \]

To evaluate the stationarity of the variables in the model we use unit root test applicable to unbalanced panels (Fisher-type tests based on Augmented Dickey Fuller). The results indicate that all variables are stationary besides size and admin.\(^3\) We proceed with generating logarithms of size and admin expense, which are stationary.

We first estimate the model using fixed (FE) and random (RE) effects. However, banks’ profits may exhibit a considerable degree of persistence over time. Therefore, we suspect a dynamic structure of the model with lagged profits included to be more efficient in determining the current period’s performance. Yet, including a lagged dependent variable in the model can cause autocorrelation. Therefore we use Arellano and Bond (1991) framework to account for dynamic effects in our model. This framework is suitable for panels with relatively small time dimension (20 quarters in our case) and large number of panels (178 banks studied here).

In order to use the Arellano and Bond structure we set all explanatory variables to be strictly exogenous besides capta and provloan as explained in the dependent variables section. es loanta for, deposfor, liquidfor, inflationfor. The results are reported in Table 1.

7 Empirical Results Interpretation

Lagged profitability (l.roa) appears to be highly significant which confirms the dynamic character of bank profits. The obtained coefficient of lagged roa is .25 which indicates a moderate persistence of profits. The higher the value of the coefficient \( \delta \) the greater is the departure from the perfect competitive markets. In the case of Ukraine the coefficient indicates a moderate deviation from competitive markets suggesting a considerable degree of competition.

\(^3\) With a critical value (378), \( \chi^2 \) roa= 628.1321, provloan= 495.7310, capta= 962.8644, liq uid=1000.9915, admin= 258.3852, size= 286.7672.For the generated lnsize Inverse \( \chi^2=2923.1675 \), Lnadmin=638.2254.
Provisions for loans (provloan) are significant and have a strong negative effect on profitability with a -0.83 coefficient. As expected, an increased exposure to risk lowers bank’s earnings. This result suggests that in the emerging market environment with booming credit prior to the financial crisis bank managers should improve the screening of credit risk in order to raise profits.

The evidence of insufficient credit risk monitoring is supported by the negative coefficient obtained for loanta (-.146). The fact that loans as percent of total assets have a significant negative impact on profitability is alarming pointing to a very low quality of bank loans in Ukraine. In light of these findings, the National Bank of Ukraine should endorse credit risk screening measures within banks. For example, one measure could be setting a limit on the maximum credit risk exposure to a single party. The NBU could also provide instructions to banks on effective risk monitoring in line with worldwide best practices. However, when interacted with foreign ownership, loans have a positive

Table 1

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Coefficients</th>
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<td>gdp</td>
<td>0.0001663</td>
</tr>
<tr>
<td></td>
<td>(0.00001)</td>
</tr>
<tr>
<td>infl</td>
<td>-0.0015855</td>
</tr>
<tr>
<td></td>
<td>(0.00006)</td>
</tr>
<tr>
<td>inflfor</td>
<td>0.0020534</td>
</tr>
<tr>
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<tr>
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<td>(0.00061)</td>
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<tr>
<td>大小危机</td>
<td>-2.67E-10</td>
</tr>
<tr>
<td></td>
<td>(0.00000)</td>
</tr>
<tr>
<td>_cons</td>
<td>0.0248807</td>
</tr>
<tr>
<td></td>
<td>(0.00623)</td>
</tr>
</tbody>
</table>

Wald Test p-value = 0.000
Sargan test p-value = 1.00

Two step robust standard errors reported
All significant at 1%.
coefficient indicating higher quality of loans of foreign banks

The coefficient of capital is positive and significant at a 1% confidence level which is in line with theory. Such a result may indicate that Ukrainian banks that increase their equity have a lower cost of capital and thus are more profitable. A policy implication of such results may be for NBU to sanction higher capital requirements to improve the low profitability in the banking system.

Administrative expenses as percent of total assets have a negative impact on profits. The negative sign indicates the lack of competence in expenses management in a bank. When administrative costs are managed properly, an increase in expenses will increase the interest margin of a bank and raise income.

Liquidity has a significant negative impact on profitability in line with prior studies but contrary to the findings of Baum et al.’s (2008) for Ukrainian banks who have determined a positive correlation of the bank interest margin and liquidity. When interacted with foreign ownership dummy liquidity has a positive effect indicating the ability of foreign banks to better manage liquidity. This may possibly be due to the fact that foreign banks have more opportunities to invest in various short term liquid assets abroad while the underdeveloped domestics markets do not offer a variety of financial products.

Deposits measured relatively to banks size (depos) have a negative impact on bank performance. This is unexpected, since banks normally should strive to attract more deposits as a source of funds. However, Baum et al. (2008) also found a negative effect of deposits to interest margin in Ukrainian banking. Banks fail to extract profits from deposits possibly due to the prevalence of short-term deposits in the system. Also foreign bank’s profitability appears to be positively affected by an increase of deposits.

The impact of the size is significant only at 10% confidence level. The correlation between size and profitability is positive suggesting that higher profits can be derived from mergers in Ukrainian banking. The negative quadratic effect of size indicates that there is point after which the increase in a bank’s size provides diseconomies of scale due to bureaucracy and other difficulties in operating a large structure.

The concentration ratio is not significant which is expected considering the small change in concentration index during the time of the study.

GDP has an expected positive effect since the banking sector is sensitive to the overall development of the economy. With the real sector growing, banks can successfully collect their loans and extend new ones.

Holding other factors constant, inflation has a significant and negative effect on profitability of Ukrainian banks in general. Yet, foreign banks appear to successfully anticipate inflation, enhancing their profits with increasing inflation.

The exchange rate depreciation has a positive significant effect on income which could be explained by the ability of bank managers to anticipate exchange rate fluctuations. This could result in gains on foreign exchange transactions. This outcome is in line with the available information on significant gains from foreign exchange transactions in the last five quarters.

The foreign ownership dummy has a significant negative effect on the profitability
of Ukrainian banks when considered on a standalone basis. This finding is surprising considering the higher perceived efficiency and expertise of foreign banks. Such a result may suggest that domestic banks enhance their profitability through factors other than pure technical efficiency.

References


THE MONOPOLY-BANK MODEL AND EQUITY MARKETS

Vera Chau
New York University

ABSTRACT

This paper proposes a model for analyzing the relationship between the banking sector and equity markets in which the banking sector is seen as monopolistic. Under a monopoly bank model, the stock market introduces competition into the banking sector which could make the market for loans more efficient. The empirical tests conducted indicate that stock market growth increases the amount of credit that the banking sector is willing to lend, decreases the lending rate (or price on those loans) and decreases the intermediation spread, a characteristic that is indicative of a monopoly. Finally, this paper shows that the positive effects of the stock market are even larger in a country pool that eliminated North American and Western European countries. This is important as the remaining regions are where there is much academic concern that dysfunctional stock markets could be harmful for the local banking sector but this paper shows that in these regions, stock market growth actually makes the banking sector more efficient.

1 Introduction

In 1973, Edward Shaw and Robert McKinnon’s empirical work on the negative effect of financial sector repression on real sector growth inspired a wave of reforms across emerging and less developed markets in the late 1980s and 1990s. Over 34 countries enacted major policy changes that involved everything from allowing foreign capital flows into formerly restricted domestic markets, releasing government control on interest rates and exchange rates, and privatizing the banking sector. As Shaw writes in Financial Deepening in Economic Development, it is inefficiencies in the financial sector which have often stunted real sector growth. The inability to properly allocate savings earned in the real sector inhibits an economy from growing in the next period (Shaw, 1973). Banking sector reforms were especially important, playing the role of sole financiers of real sector capitalization in the absence of well-functioning equity markets.

Although banking sector and interest rate reforms were often the top priority in the quest to reform financial systems, another change occurred around the same time period;
stock exchanges began to develop. But as Todd Moss writes in Adventure Capitalism, the idea that impoverished populations investing in highly volatile and dysfunctional stock markets could improve the financial system came under heavy criticism. Critics considered stock markets too unpredictable and dangerous for the delicate economies of emerging and less developed markets.

This paper considers the possibility that the competitive relationship between stock markets and the banking system opens a less direct role for stock markets to play in improving the inefficiencies of the financial system. Caprio (1994) and Shaw (1973) both note that even if banks in emerging markets were allowed to set their own interest rates and make decisions on loans, the market for bank loans would still contain some inherent inefficiency. Notably, Shaw points to the limited number of banks lending in emerging markets as one of these inefficiencies. In 2007, as many as 11 countries were reported as having 100% of the assets in their banking sector held by 3 major banks and 20 more were at the 90% level or higher. Because financial repression has created an environment in which there is often only one or a small handful of banks supplying credit to the private sector, banks have the opportunity to act monopolistically and keep the interest rate, which is representative of the cost of borrowing, on loans high in order to make higher profits.

This paper will analyze the effect that a stock market (and less extensively, bond markets) has on the market for bank loans through the lens of monopolistic behavior. If banks are acting monopolistically, the development of equity markets introduces competition into the supply and demand for capitalization funding. This places pressure on the bank to move toward the competitive price and increase its supply of loans or risk being replaced by equity markets, their new competitors. This paper will consider whether this relationship does in fact exist in the empirical data. Is there a tendency for stock markets to result in a lower lending rate as well as an increase in the volume of loans a bank lends out? Additionally, this paper will observe the effect that the stock market has on intermediation spreads, another factor that is characteristic of monopolistic banking sectors.

The novelty of this paper is in applying the concept of the monopoly banking model to the stock and debt market relationship. Previously, the monopoly bank assumption has been shown to drastically alter predictions made with models that assume competitive banking sectors. Furthermore, the empirical work done with these new predictions has yielded significant results which contest the conclusions of past policy analyses. This paper proposes that the same could be true in the market for external financing. Under assumptions of perfectly competitive banks, the introduction of a stock market lowers the demand for debt

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1 The 100% level countries include Afghanistan, Antigua and Barbados, Republic of Congo, Cyprus, Gabon, Guyana, Haiti, Jamaica, Kyrgyz Republic, Namibia, and Swaziland. The 90% or above countries include Finland, Norway, Algeria, Malawi, Sweden, Belgium, Bermuda, Cote d’Ivoire, Netherlands, Madagascar, Singapore, Estonia, Benin, Sierra Leone, Niger, Mozambique, Gambia, Portugal, Liechtenstein, and Belarus.

2 Intermediation spread is defined as the deposit interest rate which banks pay depositors for their loans minus the lending interest rate borrowers pay the bank for their loan.

3 For example, Mlachila and Chirwa (2004), which will be discussed in related literature, analyze the impact of financial reform on interest rate spreads under a monopoly model and find results that are drastically different from previous literature which assume competitive equilibrium. Demetriades and Luintel (1994), show that interest rate ceilings would have different effects under monopolistic and competitive banking sectors.
which raises concern that because stock markets are volatile this could be a less efficient allocation of capital. However, if under the monopoly bank model, the introduction of competition for capital funding forces banks to move towards the competitive rate, the outcome is both a decrease in price and an increase in the total value of loans that banks are willing to supply. The overall consequence is increased efficiency in the financial sector. The fact that a monopoly exists then, is not the primary concern of this paper but rather how banks react to changes in the market for their good, external financing, because they have monopoly power and the effects of that reaction on the market as a whole.

2 Related Literature & Important Concepts

The monopoly bank model in emerging markets has been the subject of multiple studies in the past. Many of these studies apply the model to analyses of policy changes to observe whether the results are markedly different from results analyzed under perfectly competitive models. Because of the comparable similarities between policy changes and the introduction of a stock market in the sense that both alter conditions in the banking sector to which banks must react, this paper draws on many of the processes used in previous literature. Demetriades and Luintel (2001) propose that controls on the lending interest rate could have positive effects when set at the right level because banks are reacting not as price takers but as monopolists. They test their model in South Korea and do indeed find that under certain policies, interest rate controls have a positive effect on financial deepening. Hubler et al. (2007) propose that because banks in emerging markets act as monopolies, opening up the domestic market to foreign lending sources will result in competition in the market for debt. In addition to the literature on monopolistic banking systems above, there is also another concept that is crucial to this paper, measurements of financial system inefficiency. In particular, this paper draws on the work of Mlachila and Chirwa (2002) on the deposit-lending rate spread. In a perfectly competitive world, deposits that the population make to banks are efficiently loaned out to the most competitive entrepreneurs. Financial systems where the financial intermediation role of players like banks are efficient and allow for the best use of savings in capital accumulation tend to have lower intermediation spreads, or lower divergence between the rates banks charge on loans and the rate they give out in deposits (Mlachila and Chirwa, 2002). As in the previous papers, Mlachila and Chirwa (2002) consider whether policy reforms enacted to ease entry into the banking sector and increase the efficiency of the banking sector actually worked. They use the interest rate spread to measure this change. Their results indicate that financial liberalization actually results in a less efficient banking system (the interest rate spread increased significantly in their data). Mlachila and Chirwa propose that the inefficiency in the banking system is due to the monopoly power of the banks in Malawi. This potential explanation was tested in the data, and the authors found that spreads are nearly perfectly elastic with respect to the degree of market concentration.
3 Theoretical Framework

Building off of the theoretical work discussed in the relevant literature above, this paper proposes the use of the bank monopoly model as a mechanism for observing changes in the market for corporate loans as a consequence of the development of stock markets. Specifically, the paper will observe how characteristics that tend to suggest monopoly power reacts to different measurements of the stock market. These characteristics include the rationing of loans to maintain high lending rates and the deposit-lending rate spread.

First, the monopoly bank model. As Demetriades and Luintel (2001) propose, under a monopoly bank model, banks are monopoly suppliers of loans which allow them to set the interest rate at the quantity where they stand to benefit the most, at point A, the monopoly equilibrium price and quantity in Figure 1 below. This is where marginal revenue equals marginal cost for the monopoly bank.

The establishment of a stock market introduces competition into the banking sector. Firms now have the option of issuing equity to raise capital funds if interest rates in the banking sector are too high.

![Figure 1: Monopoly Bank Model](image)

Figure 2 illustrates that this new exogenous source of competition shifts the demand curve to the left, lowering the demand for loans in the banking sector. The dotted lines in the figure represent the new demand and the new marginal revenue curve as competition from equity markets lowers the demand for bank credit. For the monopoly bank, this shift lowers the profits to be gained from holding monopoly prices. This is represented by the move from point A on the graph to point B, the new monopoly equilibrium where the
marginal cost and the new marginal revenue line intersect. At point B, banks are lending even less than before and they are receiving a lower price for it. Under a banking system that is competitive, however, the decrease in demand would be represented by a move from point C, the competitive equilibrium to, point D, the new point where Demand and Supply intersect.

This paper hypothesizes that as stock markets develop and become more stable sources of external financing, banks with monopolistic powers will choose to move from point B on the curve above to point D, the competitive market rate. While the banks still hold the ability to act monopolistically and charge the higher price at point B rather than point D, the bank will begin to move toward D as the lower price and lower volume of loans lent out decreases the revenue for the bank. At some point, the profits at point B will not be enough to justify maintaining the monopoly price, and the bank will move to point D, the competitive rate.

Under a perfectly competitive model, the shift from point C to point D that is induced by the introduction of the stock market results in the bank(s) lending less and at a lower lending interest rate. If the stock market is not as efficient an allocator of funds as the banking sector, this shift could be harmful for the economy as less firms are able to receive loans. If however, the banking system is actually monopolistic and the bank or small number of banks in the economy is acting as such, the introduction of a stock market would result in a shift from the original monopoly equilibrium at point A to the competitive rate at point D. In figure 2 above, this shift results in an increase in quantity as well as a decrease in price.
More firms are now able to attain a loan and at a lower price than before as a result of the competition introduced by the stock market. The increased efficiency in the system could result in increased capital accumulation which is necessary for growth. The methodology for studying this change will be described in section 5 below.

4 Data

The data for this study comes primarily from the World Development Indicators (WDI) published by the World Bank. Table 1 summarizes the descriptions and the units of measurement for these variables. This study utilizes several variables from the WDI to estimate the variables described in the model above. First, “quantity” in the model is the “quantity of loans” being lent out by the banks. More specifically, the variable used is a measurement of the total credit provided to the private sector by the banking sector as a percentage of GDP (referred to as “bank credit” from here on). This is a total volume measurement and does not take into account the number of borrowers to which the bank lends. Price is represented by the interest rate on loans, or the lending rate in this paper. The measurement of the level of “monopoly-like” power held by major banks in a country is estimated by the percentage of total assets in a domestic sector that is concentrated within the top 3 banks (referred to as bank concentration).

The indicator that a stock market is healthy and liquid is the market capitalization as a percentage of GDP and in $US, turnover rate, and number of domestic companies listed on the local exchanges although the primary focus is on market capitalization 1 and 2 as those measure actual capitalization of the stock market. Also, there are two other markets that could act as competition to the banking sector and they’ve been included here, private bond and international markets. The natural log has been taken of the market capitalization measurements, private and public bonds, and GDP in order to normalize the distribution. In the actual analysis, the high level of correlation between the four measurements of stock market health makes it difficult to get an unbiased result if it is tested in the same regression so it is tested separately using the method described below.

5 Testing Monopolistic Behavior (Methodology)

This paper seeks to estimate the effect of stock markets and bond markets on characteristics of monopoly behavior in banking sectors to consider whether there is evidence that monopolies do indeed exist and more importantly, whether banks react to the stock market as monopolists. The study utilizes random effects panel regressions of different countries over time to observe whether high levels of stock market activity is highly correlated with the monopoly-like system indicators discussed in the theoretical framework section. The analysis covers the entire world for countries that have the necessary data available between 1987 and 2008. Because this paper hypothesizes that this relationship will be more effective in countries with less developed financial systems, this analysis also considers how the results change when North American and Western European countries are taken out of the sample.
5.1 Quantity and Price
As discussed in the theoretical framework above, we expect that under the perfect competition model, banks are already lending out all the reserves they have above the required reserve ratio. Thus, the introduction of a stock market may decrease the lending rate, but should not increase the lending volume. The first test this paper will conduct is to estimate whether a well-developed stock market has a positive or negative effect on the volume of loans credited by the domestic banking sector and the interest rate charged on those loans. The relationship is tested with equations 1 and 2 below.

\[ E^* [\ln (Q)] = \alpha + \beta(B) + \theta(\ln (MK)) + \mu(s) + \rho(D) + \pi(PR) \]  
And  
\[ E^* [r] = \alpha + \beta(B) + \theta(MK) + \mu(s) + \rho(D) + \pi(PR) \]  
Where  
\[ MK = (MC, T, firms, prbond, intl) \]

\( E^* [\cdot] \) denotes the linear predictor of Q, the volume of credit provided by banks as a percentage of GDP, and the interest rate on loans, \( r \). B is the percentage of assets concentrated in the top three banks, s is the gross savings in the economy as a percentage of its GDP, D is the deposit interest rate, PR is the total domestic credit provided to the private sector as a percentage of GDP, and MK is a vector of stock market development indicators: market capitalization (MC), turnover rate (T), and the number of firms listed on the stock market (firms). These development indicators tend to be high when the stock market is active and liquid. Because of high multicollinearity issues, the test is run separately with the same controls but different market development indicators. The analysis also considers the effect of \( prbond \), the capitalization of the private sector bond market as a percentage of GDP on quantity and price. Intl, the amount of financing via international markets is also tested but because the data is only available from 2004 to 2008, it is a limited analysis.

The model controls for the amount of savings in the economy and the deposit rate because these could influence a bank's willingness to lend and the price at which it does it. The final control, PR, controls for the tendency to borrow and lend in general. It could be that the effect of the stock market on lending decisions differs between countries where the total amount of borrowing (from other sources such as bonds markets in addition to loans and stocks) in general is different. If this effect does exist, it would be a more indirect source of bias on the stock market coefficients than this control seeks to avoid.

5.2 Deposit-Lending Rate Spread
In the market for commercial bank loans, the price for a loan can be thought of as the lending interest rate charged by the banks. In markets where the banking sector is considered efficient, savings in the financial market are costlessly allocated to the firms that have the greatest probability of success, screened through competition. Because banks in efficient financial markets face competitive markets in the supply and demand of both loans and deposits, the two tend to converge and the spread between them decreases. In
other words, loan rates are only significantly higher than deposit rates when banks have the ability to set their own lending rates as high as they want while paying relatively low deposit rates. As Mlachila and Chirwa (2002) observed, financial liberalization in emerging markets tended to increase this spread not decrease it. This paper will test for the effect that the stock market has on the interest rate spread because banks that are forced into a competitive lending rate will have to decrease the intermediation spread as their price comes down. Using $MK, B, D,$ from the two previous equations but with, $SP,$ or the interest rate spread as the dependent variable, the following regression formula will be used to analyze the deposit-lending rate's reaction to stock market growth.

$$E^*[SP] = \alpha + \beta(MK) + \rho(D) + \gamma(B)$$

(3)

5.3 Bank Concentration

Finally, the majority of the analyses on the effect of bank concentration will be conducted using the results of the tests above where it is used as a control. Additionally, an interaction term between bank concentration and stock market health will be added to consider the effect that the level of bank concentration has on the stock market and banking sector relationships.

6 Empirical Results

6.1 Bank Concentration

This first section discusses the results regarding the relationship between bank concentration and bank credit. The first analysis is a part of equations 1, 2, and 3 where bank concentration is used as a control variable for the stock market indicator analyses. In every instance where the coefficient for bank concentration was significant, the coefficient yielded the opposite reaction from what was expected. Namely, in the bank credit analysis, we expected that as banking sectors become more concentrated, bank credit would decrease and the opposite for the lending rate and intermediation spread results. Instead, highly concentrated banking sectors tended to lend more than weakly concentrated banking sectors. Additionally, highly concentrated banking sectors also tended to have lower lending rates and intermediation spread. These first two results indicate that in general, there isn’t a tendency for banks that have the ability to act monopolistically to do so. But it still doesn’t indicate how bank concentration affects the relationship of stock markets and bank credit.

When an interaction term between bank concentration and, or stock market health, is added to equations 1 and 2, it is not significant for the lending rate analysis but it is for the bank credit analysis. Using equation 5, the interaction term suggests that for market capitalization measured in $US, the increase in bank concentration results in a more pronounced effect of the stock market on the amount that banks are willing to lend whereas in the analysis of market capitalization as a percentage of GDP, the increase in bank concentration actually serves to dilute the effect of the stock market on the banking sector. For example, when the level of bank concentration goes from 0 to 1 for an economy that has a stock market capitalization, which represents 50% of GDP, the influence of the stock market on bank credit...
decreases from 3.445 to 3.417. This means that for a country that has a bank concentration value of 0 (no monopoly power at all), a 10% increase in the stock market capitalization as a % of GDP results in a 53.634% change in the amount that banks lend. In a country that has a bank concentration value of 1, that change in bank credit decreases to 53.349%.

For regression analysis

\[ E^* [Q] = \alpha + \beta(B) + \theta(MK) + \delta(MK \times B) \]

The partial effect of MK on Q =

\[ \alpha + \theta(MK) + (\beta + \delta \times B)MK \]

(5)

The difference is a fairly small one but it does indicate that in the country with a higher level of bank concentration, the effect of the stock market on bank credit is smaller than in the less concentrated banking system country. The more monopolistic a banking sector, the less influential the stock market will be on the bank credit and lending rates in the banking sector.

6.2 Price and Quantity

The results of \( \theta \) and \( \pi \), the coefficients for stock market indicators and the private bond market in equation 1 and 2 above are summarized in table 2 below. As the table illustrates quite well, both market caps 1 and 2 are positively correlated with bank credit and negatively correlated with lending rates. Thus, countries with well functioning and liquid stock markets also tend to have both higher volumes of credit provided by the banking sector and lower lending rates. The fact that both of these relationships occur in the direction that was first hypothesized suggests that there is a tendency for stock market growth to have a positive effect on the banking sector when controlling for banking sectors with the same level of bank concentration.

The extent to which this relationship is due exclusively to the monopoly power of banks is difficult to ascertain with just this analysis alone. The bank concentration analysis in the section above leaves the influence of bank concentration on this relationship inconclusive. There is no clear tendency for banks with monopoly power to act as such and highly concentrated banks don’t react as much to growth in the stock market as less concentrated ones. Interestingly, in every analysis, higher gross savings as a % of GDP results in lower credit provided by banks. This is a problematic result for interpretation as many things could be causing this result. It could be that banks are acting monopolistically and as the supply of funds for lending is increasing, they are rationing off the loans to maintain monopoly profits. It could also be that some exogenous, macroeconomic event that is causing people to save more is also decreasing the demand for loans. Finally, because this model doesn’t incorporate elements of the banks’ portfolio, it could be that the banks are just taking these funds and investing them elsewhere instead of lending. Private bond markets also had the same effect of increasing bank credit and decreasing lending rate which suggests that it too

4 This % is calculated using % change in the following formula:

\[ \ln(Q) = \alpha + \text{partial effect of } MK'(MK) - \alpha + \text{partial effect of } MK(MK') \]

where MK’ – MK represents a 10% change in stock market capitalization as a % of GDP.
acts as competition to the banking sector.

The results for the turnover rate and number of listed companies were inconclusive as they were both negatively correlated with bank credit and lending rates. Additionally, the only value that was statistically significant was the inverse relationship between the number of companies listed on the domestic stock exchange and bank credit. This is not surprising as both of these variables are weak measurements of liquidity and activity on stock market and have little direct relationships with the banking sector.

Finally, it is noteworthy that when a control for the capitalization of public sector bonds (treasury-bills) as a percentage of GDP is added in, the coefficient for Market Cap 2 actually increases indicating that when one controls for the availability or frequency of public sector debt, the stock market has a larger effect on bank credit. The coefficient for public bonds itself is also high (around .3) which is an interesting result because banks could invest in these bonds instead of equity but countries where the government issues a lot of bonds (in capitalization value) are also countries where the banking sector provides a huge proportion of the credit to the private sector.

When North America and Western Europe were taken out of the analysis, the results

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**Table 1: Regression results for equation 1 and 2, worldwide. The value on the left indicates the coefficient for bank credit and the value on the right indicates the lending rate.**

<table>
<thead>
<tr>
<th>Credit provided by banks/GDP &amp; Lending Rate</th>
<th>Coefficient (credit provided by banks)/Lending rate)</th>
<th>Std. Error (credit provided by banks)/Lending rate)</th>
<th>P-value (credit provided by banks)/Lending rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market cap 1 (US$)</td>
<td>.0209*</td>
<td>.2659</td>
<td>.0069</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.4691</td>
<td>.7003</td>
<td>.4850</td>
</tr>
<tr>
<td>Market cap 2 (% of GDP)</td>
<td>.0208*</td>
<td>-.7104*</td>
<td>.0086</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.4695</td>
<td>.7341</td>
<td>.2937</td>
</tr>
<tr>
<td>Turnover</td>
<td>-.0127</td>
<td>-.2722</td>
<td>.0074</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.4862</td>
<td>.7764</td>
<td>.2182</td>
</tr>
<tr>
<td># of Listed companies</td>
<td>-.0265*</td>
<td>-.5459</td>
<td>.0106</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.4743</td>
<td>.7324</td>
<td>.3131</td>
</tr>
<tr>
<td>Private sector bonds</td>
<td>.0376*</td>
<td>-.9802*</td>
<td>.0111</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.6207</td>
<td>.7750</td>
<td>.2938</td>
</tr>
</tbody>
</table>

Values in bold are significant at the 10% level

Values with * are significant at the 5% level
remain the same although the lending rate is much more negatively affected by Market Cap 1 and 2 than in the world wide analysis. Private sector bonds also react the same way as before, following the hypothesized directions.

Although there were variations in the results, several things stand out. First, although the results weren’t always significant, countries with healthier stock and bond markets always had lower lending rates. Countries with bigger stock markets (measured by capitalization) tended to have banking sectors that provided more credit.

6.3 Deposit-Lending Rate Spread

Table 2 does a good job of putting together the results for the analysis of intermediation spreads and the equity markets and the results are evident. Every variable is negatively correlated with the intermediation spread in every analysis although not every result is statistically significant. This indicates that stock markets are negatively correlated with intermediation spreads. Over time, as stock markets develop, the difference between the lending rate that banks charge for loans and the deposit rate that the bank gives to depositors tends to converge to 0.

<table>
<thead>
<tr>
<th>Table 2: Intermediation Spread analysis, worldwide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediation Spread</td>
</tr>
<tr>
<td>Effect on intermediation spread</td>
</tr>
<tr>
<td>Market cap (US$)</td>
</tr>
<tr>
<td>Market cap (% of GDP)</td>
</tr>
<tr>
<td>Turnover</td>
</tr>
<tr>
<td># of Listed companies</td>
</tr>
<tr>
<td>Private Sector bonds</td>
</tr>
</tbody>
</table>

Values in bold are significant at 10% level
Values with * are significant at 5 % level

In the analysis without North America and Western Europe, the results are far more pronounced in these regions. In the analyses above, stock markets have a larger effect on the lending rate in the smaller country pool than in the worldwide analysis and likewise, equity markets have a larger effect on the intermediation spread of the smaller country pool.

7 Conclusions

The banking sector is a critical link between the financial sector and real sector growth. Inefficiency in this sector can impede the capital accumulation process if firms are unnecessarily kept out of the market for loans. Drawing on the monopoly bank model of Demetriades and Luintel (2001), this paper built a model for applying the monopolistic bank assumption to the stock and debt market relationship. The model tests the validity of this assumption as well as its impact on the relationship by considering the impact of the
stock bond markets on the rationing of loans and the deposit-lending rate spread. The paper hypothesized that equity markets introduce competition into the market for loans. The decrease in demand forces banks to lower their lending interest rate and simultaneously loosen their rationing of loans as they move to the competitive rate. The stock market is also expected to decrease the deposit-lending rate spread as banks lose the ability to set their lending rates high above what they are paying to depositors.

In general, the results tend to indicate that stock and bond market growth is actually good for the banking sector in the sense that it doesn’t take business away from banks but rather increases lending as well as the price of those loans. Also, the results suggest that financial systems with larger stock markets also increase efficiency in the system by lowering the intermediation spread. Both of these statements are strongly supported by the statistically significant results of the two measures of market capitalization. The dual reaction of being both positively correlated with bank credit and negatively correlated with lending rates implies a monopoly-like reaction to stock market growth which is further complemented by the negative correlation of gross savings to bank credit and the positive coefficient result of the interaction variable between bank concentration and stock market capitalization. The results for turnover rate and number of listed companies on the exchange did not yield meaningful results, which is not surprising as these are supplementary measures of stock market health and don’t directly measure the stock market’s development. Two other potential sources of competition, private bond markets and international financing had the same and the opposite effect, respectively. The result on international financing just scrapes the surface of a much deeper debate on market liberalization that is beyond the scope of this paper but could have important implications for bank reform. The limited data available for this study makes it difficult to speak decisively about the results.

Nonetheless, how frequently the existence of monopoly-like ability results in monopoly-like behavior is not completely evident from this analysis as the bank concentration study was so inconclusive. Further, to what extent the bank lending reaction to stock exchanges manifest in this test is due exclusively to monopolistic characteristics could warrant further study. As was mentioned in the introduction however, the central goal of this paper is to examine whether our understanding of the relationship between equity markets and the banking sector changes when we alter the assumption of a competitive market and the conclusion of this paper is that it does. This is especially true of the analysis which removes North America and Western Europe from the sample pool as these are the countries where much academic work has focused on the negative impact of unstable stock markets on the banking sector. In contrast, the results of this paper show that the banking sector actually increased in efficiency as the stock market developed.

This study has far from exhausted the topic though. Several components in this particular model would benefit from further analysis. First, this model does not take into account the bank’s portfolio of assets. This idea is slightly represented by the presence of gross savings and deposit rates in the regressions but it doesn’t fully account for the impact that a bank’s portfolio has on its lending decisions. This also leads to the fact that this model treats the banks’ decision to lend as static. The model doesn’t consider the dynamic changes
that occur each period which could also influence a bank’s lending decisions. Second, the idea of excess reserves mentioned in the review of literature is a deeper examination of monopoly bank behavior and would be a great topic of further study. It was not utilized here due to time constraints but it would better inspect how much bank reaction to the stock and bond markets is attributable to monopolistic characteristic

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Microenterprises Performance Under Consulting Services and Clustering: A Study of Egypt and Turkey

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ABSTRACT

Besides access to credit, the presence of consulting services and formation of clusters play an important role in microenterprises’ performance. I analyze the impact of consulting services and clustering on microenterprises’ profits and assets in Egypt and Turkey, using a unique dataset on medium and small enterprises in both countries. I find that the use of consulting services and clustering positively affects the profits and assets of microenterprises.

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1 Introduction

Besides small enterprises, microenterprises (MEs) play a vital role in generating employment and assisting economic growth in all countries, especially developing countries. Nevertheless, MEs face both pecuniary and non-pecuniary constraints in developing countries. For instance, it is difficult for MEs to acquire credit from the formal credit sector. A lack of enough assets deprives the enterprises of collateral (De Soto, 1989). Still, MEs in developed countries have better access to formal credit than

1 Taking numbers of workers into consideration, United Nations Industrial Development Organization (UNIDO) defines microenterprises to be employing 1-9 workers, and small enterprises employing 10-49 workers. In this paper, microenterprises are defined to be employing 1-5 workers, so that the implication of results can be extended to a microfinance environment.

2 The collateral and high interest rates that bars credit to the poor are most likely responses of market due to
MEs in developing countries (Duman, 2009). Providing a fertile economic environment for MEs remains a high priority on the developing countries’ development agenda because supportive policies for MEs are crucial to economic development of these countries.

While most of the focus in research and practice is devoted to credit needs of MEs, the consulting needs of MEs are not talked about as much as needed. I did not find any previous work that included information on consulting services and clustering, besides credit services, in the context of MEs. Indeed, if credit services are one side of MEs’ needs, consulting services and clustering (social capital) are the other side of it. Consulting services as described in this study are: setting up the enterprise, communication services, information (know-how, technology), financial services, management services, training of workers, production, promoting inter-firm linkages, domestic marketing, importing, exporting, and dispute settlement.

Some studies have looked into different variables, especially non-credit, to explain their significant impact on profits (proxy for repayment rates). McKernan (2002) finds large positive effects of participation in microcredit programs and the noncredit aspects of participation on self-employment profits. Gomez and Santor (2001) find that social capital has a positive impact on self-employment earnings. Bhatt and Tang (2002) find that educational level and physical proximity to the micro lending program have positive impacts on borrower’s likelihood of repayment. I am motivated to find whether any other factors are associated with repayment rates of MEs. For this purpose I study MEs in Egypt and Turkey due to availability of data on MEs and consulting services received by them. In this paper I ask: can consulting services help increase profits and assets (repayment rates) of MEs in Egypt and Turkey. Does clustering of homogenous MEs in these two countries enable them to have higher profits and assets? In order to answer these questions, I utilize a unique panel dataset on Micro and Small Enterprises (MSEs) for Egypt (2003/04) and Turkey (2001/02). The data was collected for a project “Promoting Competitiveness in Micro and Small Enterprises in the MENA region” initiated by the Economic Research Forum (ERF). The regression models are divided into profits and assets models, both for Egypt and Turkey. All regression models are multivariate log-levels models. Empirical results indicate that consulting services and clustering of MEs have substantial impact on MEs’ profits and assets. Meanwhile, access to credit is also important for MEs.

This paper is structured as follows: section II discusses determinants of profits and assets in Turkey and Egypt; section III describes the data; section IV reports the econometric methodology; section V describes the results; and section VI concludes.

2 Determinants of Profits and Assets in Egypt and Turkey

In this part of the paper, I present a literature review along with a simple theoretical model considering a number of independent variables impacting outcome variables of interest i.e. profits $\pi$ and assets $\psi$; and how the independent variables determine changes in these variables. The specific focus of the simple theoretical model is in the context of screening, monitoring, and enforcement problems (Hoff and Stiglitz, 1990).
MEs in Egypt and Turkey. Other studies that look for the impact of credit programs (i.e. microcredit), and MEs’ performances, consider slightly different models. McKernan (2002) for the first time measures the noncredit and total effect of Grameen Bank’s microcredit program on self-employment productivity.  

3 Her model presents a restricted profit function that estimates microcredit’s total effect on profit, and microcredit’s noncredit effect on profit while controlling for productive capital. Kaboski and Townsend (2005) study the impact of specific policies of several microfinance institutions on growth in assets (1991-1997) and four other variables.  

4 Gomez and Santor (2001) demonstrate the effect of social capital on self-employment earnings, and the significance of neighborhoods in improving social capital.  

Since the model here considers only enterprises with fewer than six employees, these enterprises are referred to as MEs. The MEs in this study do not receive microcredit from the Grameen Bank or other microfinance institutions.  

6 The sources of financial capital, as mentioned in the survey questionnaire received by all microenterprise in Egypt and Turkey are inheritance, personal savings, liquidation of assets, formal loans, informal loans, and remittances. However, I assume that acquiring credit for MEs in Egypt and Turkey is as difficult as it is in other parts of the world. This assumption would have been very unrealistic if the degree of constraint of acquiring credit from sources other than microfinance institutions were on favorable terms. However, the degree of constraint on obtaining credit from moneylenders, relatives, and commercial banks is usually greater than from a microfinance institution. With available data, the model will not be biased toward any specific informal credit source like moneylenders and relatives; instead, the random sample of MEs in the data provides information on firms with a range of informal credit sources.

The production function for microenterprise output is given as

\[ Y = y(L, K, Cg, I; H, N, C, e) \]

where the entrepreneurial labor allocated to enterprise activity is L. Other variable inputs are capital K, consulting services Cg, and a vector of inputs I; human capital H, land N, and clustering C are fixed variables determining production Y; and e is an unobserved random variable with mean zero. A novel variable in this production function is the dummy variable for clustering C. UNIDO defines a cluster as a local agglomeration of enterprises producing and selling a range of related or complementary products within a particular industrial sector or subsector.  

7 Given the production function, the profit π equation is defined, conventionally as

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3 See McKernan (2002) for details.
4 Four variables (1991-1997): (1) the probability of reducing consumption or input in a year with bad income shock, (2) probability of becoming moneylender customer, (3) probability of starting a business, (4) probability of switching primary occupation.
5 Social capital is defined as, “features of social life – networks, norms, and trusts – that enable participants to act together more effectively to pursue shared objectives.”
7 See Richard (1996)
\[
\pi = \text{revenue} - \text{costs} \quad 8
\]

\[
\pi = p_y Y - (p_l L + p_k K + p_g C_g + p_i I) \ldots 2
\]

where lower case letters, \(p_y\), \(p_l\), \(p_k\), \(p_g\), and \(p_i\) are prices of output and variable inputs. Consulting services can be provided through explicit programs, or implicitly through the cluster due to joint interaction of enterprises, or through a business association. In either case, they are considered free to the firm as a public good or as a benefit of clustering, since firms do not incur costs for consulting services in this model and the profit function can be written as

\[
\pi = y Y - (p_l L + p_k K + p_i I) \ldots 3
\]

Each entrepreneur tries to maximize profits given the production function and prices. The profit function can be written as

\[
\Pi = \pi(p_y, p_l, p_k, p_i, C_g, H, N, C, e) \ldots 4
\]

Alternatively, I can work with an asset function which can also be written as,

\[
\Psi = \psi(p_y, p_l, p_k, p_i, C_g, H, N, C, e) \ldots 5
\]

The asset functions of MEs are assumed to be a function of the same factors as profits. I did not consider interest rates as a component of asset function because the MEs in Egypt and Turkey mostly operate in an informal credit market where the interest rate is not uniform and investment due to interest rate is not institutionalized. I want the econometric model for profits and assets to be as close to the theoretical models as possible; however, some factors, like prices, are absent in the econometric model due to their absence from the dataset.

The production and profit functions are somewhat similar to McKernan’s (2002) production and profit functions. However, the microcredit setting of Grameen Bank (Bangladesh) for which McKernan designed the model “considers the restricted profit function when production decisions are separable and nonseparable from household utility considerations.”

I consider the restricted profit function when production decisions are separable from household utility considerations because household labor and hired labor in Egypt and Turkey can be perfect substitutes. Both in Egypt and Turkey, women can work outside of home and produce.

The main new elements in this study are consulting services and clustering. Consulting services as described in the survey questionnaire are: services for setting-up enterprise, communication services, information (know-how, technology), financial services, management services, training of workers, production advice, promoting inter-firm linkages, domestic marketing, importing, exporting, and dispute settlement. I couldn’t find any previous work on credit provision programs that included information on consulting services and clustering in the context of MEs. In order to find the effect of consulting services and clustering on profits and assets of enterprises operating in a microcredit environment, I select the unit of observation as MEs in Egypt and Turkey, with fewer than six employees.

Consulting services are likely to have a positive effect on MEs. Only providing credit to

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8 The profit \(\pi\) function according to survey questionnaire has the total costs as an addition of, wage bill (including social security and fringe benefits per month), raw materials and purchase of goods, energy consumption, rent, value added taxes, costs of financial services, and others.

9 See McKernan’s (2002) paper for her details of theoretical model.
poor people is not enough because sustaining a livelihood requires much more than that.\textsuperscript{10} Ashby et al (2009) note, ‘effective coordination is especially important for pro-poor market linkages because a threshold level of complementary investment in several, co-dependent activities is needed (e.g. input delivery, finance, trading and skill training), below which separate investments can all be ineffective.’ Ahmed (2009) claims that ultra-poor in Bangladesh are unable to benefit from microcredit programs alone. When a capability development programme is provided, the programme positively impacts livelihoods and 63% of households maintain asset growth and join microcredit programs. Even the average-level poor, who are eligible for microcredit need consulting services through some channel to increase productivity and to promote marketing of products.

Clustering is also likely to be important to MEs. Schmitz (1999) explains that clusters, a geographical and sectoral concentration of enterprises, gain collective efficiency as a competitive advantage through local external economies and joint action. He further explains joint action as, ‘individual enterprises cooperating (for example, sharing equipment or developing a new product), and a group of firms joining forces in business associations, producer consortia and the like.’ UNIDO defines a cluster as a local agglomeration of enterprises producing and selling a range of related or complementary products within a particular industrial sector or subsector.\textsuperscript{11} In this setting, a cluster is defined as a group of MEs engaged in related activities and located in close proximity to each other. As Schmitz (1999) hypothesizes, enterprises in a cluster can allow joint action which increases collective efficiency. In this model clustering is expected to provide benefits for the MEs, thus contributing positively to growth in their profits and assets. The benefit of clustering is access to implicit consulting services. Thus, this model looks at the effect of consulting services, made available through business associations and clusters, on growth in profits and assets.

\textit{Context of MEs in Egypt and Turkey:}

Almost all developing economies are subject to credit markets divided into informal and formal credit markets. Hoff and Stiglitz (1990) note that a dual rural credit market operates in developing countries, where institutions provide credit at relatively low interest rates in the formal credit market, and private individuals (moneymen, traders, commission agents, landlords, friends, and relatives) provide credit in the informal credit market. Egypt with a GDP per capita of $2,184 is subject to informal credit markets due to credit market imperfections.\textsuperscript{12} El-Mahdi (2006) notes that financial institutions are unwilling to lend to small enterprises due to high risk and high transaction costs associated with small loans. Mohieldin and Wright (2000) find that beside formal collateral, social collateral is also very important in obtaining credit in the informal sector, and the most common source of informal finance is through Rotating Savings and Credit Associations (RoSCAs). They further conclude that the informal credit sector, though important for development, has its own barriers, and is a very imperfect substitute for formal credit in Egypt. It is apparent

\textsuperscript{10} Jonathan Morduch
\textsuperscript{11} See Richard (1996)
\textsuperscript{12} World Bank, Egypt’s GDP figure for 2008.
that the MEs for Egypt are facing credit market problems, and are subject to high costs of obtaining credit.

Turkey with a GDP per capita exceeding $8,000 is also subject to credit market imperfections.\(^\text{13}\) The UNDP microfinance assessment report for Turkey (1997) notes that the prevalent source of informal credit is moneylenders, and in the formal sector, credit to MEs is provided through Halk Bank (the state-owned Peoples Bank) and to lesser degree through Ziraat Bank (the state-owned Agricultural Bank). Duman (2009) notes that chances of facing wealth and credit constraints are very high for self-employed microentrepreneurs, and the share of formal and informal Small and Medium Enterprises (SMEs) obtaining funds from the formal banking sector have never exceeded 4%. Meanwhile, MEs employing fewer than 10 people make up 95% of all establishments in the Turkish economy. The small share of formal and informal credit going to SMEs paints a bleak credit picture for MEs in Turkey.

Informal labor markets account for a significant portion of total employment in developing countries due to imperfections in labor market. The report of ERF on Egypt (2004) describes the strong growth in the number of employees in the informal sector, 2.4 million in 1976 to 4.8 million in the late 1990s, to be due to the informalization of employment in the Egyptian labor market in the 1990s. In the Egyptian labor market, according to this same report, ‘there were 9.9 million workers in the private sector, including 2.7 million females in 2001… even the more reliable generator of employment, non-establishments and micro and small enterprises in the private sector, are (were) generally characterized by low productivity and modest earnings.’ Furthermore, participation rates of males and females in the Egyptian labor force are dependent upon a number of factors like life cycle, educational attainment especially for females, urban/rural location, marital status, and number of children. So, the microenterprise employment that our model considers falls in the so called informal sector of Egyptian labor market.\(^\text{14}\)

Employment in the MEs that our model considers for Turkey also mostly falls in the informal labor market of Turkey, which is deemed inefficient. The ERF report for Turkey (2005) describes the informal sector as the main source of employment for poor, and where job creation is less costly due to evasion of taxation and inflexible labor market regulations. The report quotes Turkey’s State Institute for Statistics (SIS) definition of the informal sector: “all nonagricultural economic units that are incorporated (establishments whose legal position is individual ownership or simple partnership), paying lump-sum tax, or no tax at all and working with 1-9 engaged person.” However, due to similarities, the agricultural sector is also considered informal in the report. According to the report, of total informal employment for 2003, wage earners are 54.5%, self-employed are 35.1%, and unpaid family workers are 10.5%. The ratio of officially unregistered employment in the nonagricultural sector has risen steadily from 26.4% in 1995 to 34% in 2004. Informal employment

\(^{13}\) World Bank, Turkey GDP figure for 2008

\(^{14}\) ERF report for Egypt notes, ‘the growth in number of microfirms has been phenomenal over the last two decades (80s and 90s), but the depth of the regulatory constraints… discourages the bulk of these enterprises from registering or abiding by most of the rules of formalization.'
differs across sectors, with females being less often found in informal employment.\textsuperscript{15}

Implications of Economic Structure for Models:

Given the setting in which MEs in Egypt and Turkey operate, most of them are likely to fall in the informal sector where they are faced with credit constraints. The MEs are operating on limited credit mostly from informal sources. In such a setting, besides other inputs, the presence of consulting services is expected to enable MEs’ overall performance to increase. Clustering of related MEs should increase their profits and assets, too. The empirical implications of the theory can be stated as following hypotheses:

1. Access to credit increases the profits and assets of MEs.
2. Consulting services increase the profits and assets of MEs.
3. Clustering of related MEs increase their profits and assets.

The next two sections describe the data on micro enterprises in Egypt and Turkey, and econometric methodology to test the aforementioned hypotheses.

3 Data

A unique panel dataset on MSEs is utilized to estimate the model. The data was collected for a project “Promoting Competitiveness in Micro and Small Enterprises in the MENA region” initiated by the ERF. Data was collected for four Middle Eastern countries: Egypt, Turkey, Lebanon, and Morocco. The estimation here utilizes only panel data for Egypt and Turkey due to incomplete information on Lebanon and Morocco. The baseline years for Egypt and Turkey panel datasets are 2003 and 2001. A follow-up survey was conducted in each country one year later to learn about the performance of enterprises. Meanwhile, a separate dataset is provided for the households related to surveyed entrepreneurs.

There are many advantages to using MSE datasets; first, they convey extensive information about enterprises. I utilized variables provided in the enterprise datasets. The 300 variables collected on each enterprise can be classified under one of three subsections: "identification of enterprise and entrepreneur, characteristics of an enterprise and entrepreneur, and future prospects for enterprise. The second benefit to MSE datasets is the presence of information (variables) on consumption of or availability of consulting services. Also, information is available on social capital of an enterprise in the form variables like clustering, perceived benefits of clustering, and linkages with other enterprises and associations. It was really difficult to find a dataset that includes variables on consulting services for micro and small enterprises because most surveys focus on credit aspects of MEs. The third benefit is the big sample size and national coverage that results from multi-stage probability sampling for Egypt, and multi-stage systematic sampling (stratification) for Turkey. The big sample sizes and random sampling help to take care of selection bias that usually appears in microfinance studies, meanwhile, providing the convenience of asymptotic normality.

There are specific problems related to the datasets being used in this study. First, a recession in Egypt (2003/04) led to bankruptcies among large companies, and the 15 Unregistered is defined as, 'all employed persons who were no registered to any social security institutions corresponding to their main job during the reference period.'
disappearance of a large number of micro and small unfit enterprises.\textsuperscript{16} Having such a dataset from stable years would have helped this study to collect information on aforementioned unfit MEs. The Turkish dataset faces the same problem because Turkey went through a serious financial crisis in 2001 and most MEs were affected. The second problem is typical of survey data; there are multiple non-responses to critical questions. For instance, almost 60-80\% of variables relating to consulting services, and access to credit have missing values. The third problem is the absence of sampling weights to correct for the oversampling of specific types of MSEs. As a result, female-headed enterprises make up a larger share of the sample than of the population of MEs.

For estimation and study purposes, only those MEs are selected that have fewer than six workers. This cut-off point is selected because of the objectives of this study as to see if consulting services for MEs bring any significant change to performance. Although the micro-enterprise definition in the broader microfinance literature means self-employed businesses that mostly have one or two workers, i.e. husband and wife, this study choose to inflate this number to five to get enough observations for estimation. And I assume that inflating the workers number to five should not affect the interpretation of study-results even for a microfinance environment.

The Egyptian panel contains observations on the same MSEs surveyed in 2003 and 2004. The Egyptian enterprise dataset (2003) contains 4957 observations, out of which 97\% are observations on firms with fewer than six employees. Only 3\% of firms sampled have six or more employees. The follow-up enterprise dataset (2004) contains 4944 observations; only 13 observations or enterprises drop.

The Turkish panel datasets include the years 2001 and 2002. The first survey in Turkey (2001) contains 5000 observations and the second survey (2002) contains 5000 observations, too. Out of 5000 observations 82.3\% of the MSEs observed have fewer than six workers; 17.4\% have six or more workers.

Most of MSEs in Egypt (2003) are situated in just three governorates: Cairo (23.56\%), Giza (18.11\%), and Assuit (18.86\%). The remaining four governorates are home to 40\% of these enterprises. Interestingly, a high percentage 89.43\% of Egyptian MSEs are in urban areas and 10.57\% in rural.

It is important to understand whether MSEs’ activities are seasonal to know if there is need for seasonal adjustment. However, the percentage of permanent enterprises (Egypt) is quite high (97.76\%), large enough to ignore seasonal dummies in our regressions. The same is true for enterprises in Turkey; most of the MSEs, 96.94\%, are permanent.

In the sample for Egypt, 89.53\% of entrepreneurs are male and the remaining 10.47\% are female. In Turkey, an even higher percentage of entrepreneurs are male, 93.12\%. The fact that the sample is weighted to over-represent female entrepreneurs is due to the much lower percentage of female entrepreneurs in the population.

Another interesting fact of the Egyptian MSEs, in terms of structure of work place, turns out to be the high percentage of shops, 77.76\%. Only 11.51\% of MSEs operate in a workshop or factory. Most of the shops and workshops are privately owned, since 66.2\% of entrepreneurs are the owners, and 33.8\% are managers.

Similar to Egypt, a high percentage of Turkish MSEs operate in shops, 65.61%, and only 24.34% in factories or workshops. 77.52% of the business entities have their owners as person in-charge of the economic unit, and the remaining 22.48% are managed by a non-owner of the enterprise.

4 Econometric Methodology

In this part I report on the econometric models used to test the hypotheses. The first set of regressions has the regressand as profits in the baseline year. The estimates use the cross-sectional variation in baseline characteristics of the enterprises to explain variation in baseline profits across MEs. The second set of estimates differs only in the regressand, having profits from the second sample, following year. The second equation is estimated to see if regressors of interest in the baseline year can explain profits in following years. The same two types of equations are estimated with assets as regressand. All four equations are estimated for Egypt and Turkey, separately; thus making eight tables of results in total.

All models are multivariate OLS log-level models. Careful attention is paid to testing for violations of the assumptions required for best linear unbiased estimators, and normality of population error $u$.\textsuperscript{17} Due to the random stratified sampling nature of data and the large samples, the econometric analysis is safe of any serious pitfalls. Lagged profits and assets are included as regressors in profits and assets models, respectively, to account for those relevant enterprise characteristics that carry over from the previous year. Self-selection bias is avoided since these are large random samples, which average out self-selection of MEs for clustering and consulting services because clustering and consulting services also benefit firms that are not performing well. Clustering is a form of social capital that can emerge separately in between firms, whether they perform well or not, especially in developing countries. Due to large sample sizes and log-level models, error $u$ will be normal.\textsuperscript{18} Testing for covariance between variables, multi collinearity does not seem an issue.

Endogeneity is always a potential problem. It seems likely that there is simultaneity between regressors i.e. $credit\_access$, $workers$, $work\_hrs$ and regressands i.e. $profits$ and $assets$, in the eight regression models. Initially, the use of IV was tried, to take care of endogeneity; however, finding reasonable IV in the given dataset was difficult. Indeed, including lagged $profits$ and $assets$ as regressors can take care of simultaneity. For instance, it is possible that an increase in profits in 2004 can increase likelihood of having access to credit; however, the regressor $credit\_access$ is from base year (2003) meaning that increase in profits of 2004 is unlikely to affect access to credit in 2003. Still, $profit03$ has positive correlation with $credit\_access$ (2003) and so $profit03$ is included as a lagged control regressor in $profit04$ regression model. The main problem of endogeneity arises in those profits and assets regression models where both the regressands and regressors are from baseline years. In this case, there is likelihood of simultaneity between regressands.

\textsuperscript{17} See Wooldridge (2009), Introductory Econometrics, 4e, for assumptions.
\textsuperscript{18} Page 119, Wooldridge (2009), Introductory Econometrics, 4e.
and regressors of concern, for instance, between profit03 and credit_access (2003), then the inclusion of profits02 does not help considerably because of the memory bias attached with it. The survey question on profits02 asks, “What were your profits in the survey month during last year?” so the data on profits02 is based on recall not on specific business records. Therefore, in the results section, I only report the robust results from four regression tables that have regressors from baseline years and the regressand from the following year.

Having the first dataset containing information on clustering, Consulting services, and credit makes it possible to test the hypotheses for micro and small enterprises. Following is the general empirical model for both profits and assets and their determinants:

\[ Y_{atj} = \beta_0 + \beta_1 x_{2tj} + \ldots + \beta_{22} x_{22tj} + \varepsilon_{ij} + \ldots \ldots 7 \]

where

- \( a = \) profits or assets for Egypt (2002 or 2003); for Turkey (2000 or 2001)
- \( t = \) year, 2003 baseline year for Egypt, and 2001 baseline year for Turkey
- \( j = \) micro-enterprise, \( j = 1, 2, 3, \ldots, n \)

Starting with regressands, profits and assets, each one measures the performance of a micro-enterprise in a given month of a year, at the time of interview. Both profits and assets appear in natural log form in the regressions.

5 Results

In this section, the outcomes of the regression models are presented.\(^{19}\) As described in the previous section, out of eight set of regression results only four have robust estimates. The four sets of regression results reported are the ones that have all regressors from baseline year and the regressand from following year. Since there are more than 15 variables, it is better to focus first on variables of interest relevant to the main three hypotheses.

First, the results from profit regression models for Egypt and Turkey are discussed. Few of the coefficients in the profit regressions have the expected signs and significance. In Egypt’s second regression model (2004) there is insignificance among all of hypotheses-related variables’ coefficients, except access \((t=2.45)\) significant at 5% level, and it implies that, on average, MEs that have access to unit support services in 2003 have 35.6% decrease in profits in 2004, which is certainly unexpected because support services can’t harm performance of a firm.\(^{20}\)

In Turkey’s second profit regression model (2002), almost all of the hypotheses-related variables are insignificant at 10% level. Coefficient on variable credit_access \((t=1.61)\) is significant at 15% level, thus MEs that have access to credit services in 2001 have on average 24.32% less profit in 2002 compared to MEs that do not have credit services access.

\(^{19}\) OLS estimates of regression for profit and asset model are presented in Appendix A.

\(^{20}\) In order to approximate \(\%\Delta\hat{y}\) more accurate, \(\%\Delta\hat{y}=100[\exp(\beta^k)-1]\) is used. Wooldridge (2009) explains, “the approximation error occurs because, as the change in log(y) becomes larger and larger, the approximation \(\%\Delta\hat{y} \approx 100*\Delta\log(y)\) becomes more and more inaccurate.”
everything else fixed. Once again access to credit services shouldn’t be affecting profits negatively, for instance, studies like Love and Sanchez (2009) find “that credit constraints influence negatively the investment (capital assets) behavior of individual entrepreneurs and enterprises,” which in return can affect the profits of enterprises. I will rely on Love and Sanchez (2009) finding in this case and consider some type of minor problem in the regression that makes coefficient on credit_access negative.

Second, the results from asset regression models for Egypt and Turkey appear more supportive to hypotheses. In Egypt’s assets regression model (2004) coefficients on access ($t=1.83$), cluster ($t=2.06$), cluster_estate ($t=2.57$), assoc_benefit2 ($t=4.33$), and needed_finance ($t=4.49$) are individually significant at 10%, 5%, 5%, 1% and 1% levels, respectively. On average, access to consulting services in 2003 helps MEs’ assets to grow by 103.6% in 2004 compared to MEs that don’t have access to consulting services, other factors fixed. MEs that exist in a cluster in 2003 have on average 41.62% more assets in 2004 compared to MEs that do not exist in cluster, other factors fixed. On average, MEs that exist in cluster or estate have 34.63% fewer assets in 2004 compared to MEs not existing in cluster or estate, other factors fixed. The lower assets can be due to estates that are unlike clusters. MEs that receive intangible consulting services from associations, on average, have 58.6% more assets in 2004 compared to MEs that don’t have, other factors fixed. This again signifies the importance of consulting services and cluster type structures in affecting MEs performance positively. Interestingly, MEs that are in need of financial services in 2003 have on average 29.7% fewer assets in 2004 compared to MEs that are not in need of financial services, other factors fixed. This finding indirectly supports the hypothesis that access to credit (financial services) increases assets of MEs.

In case of Turkey’s assets regression model (2002), all of the coefficients on hypotheses-related variables are insignificant, except cluster_estate ($t=1.74$) which is significant at 10%. Thus, being part of a cluster or industrial estate in year (2001) increases assets level by 22.2% in 2002 compared to MEs that are not part of cluster or industrial estate, everything else fixed. A finding that clustering helps better performance of MEs. The four regression models provide interesting results regarding non-hypotheses related variables. Coefficient on variable workers is significant in three regression models i.e. Egypt profit 2004, Egypt assets 2004, and Turkey assets 2002 with 5%, 1%, and 1% significance levels, respectively. MEs in Egypt that increase numbers of workers by one unit, on average, have 2.3% decrease in profits in 2004; however, an increase in number of workers increase assets level in Egypt (2004) and Turkey (2002) by 26.9% and 17%, respectively, other factors fixed.

Coefficient on variable technology is significant in regression model Egypt profit 2004 and Turkey assets 2002 with 10% and 1% significance levels, respectively. MEs in Egypt and Turkey that are using up to date technology have 4.9% more profits and 27.3% more assets, respectively, compared to MEs that utilize old technology, on average.

In case of variable safety, the coefficients are significant in two regression models i.e. Turkey profit 2002 and Turkey assets 2002 with 1% significance levels. Turkish MEs that have safe work environments have 97.7% more profits and 26.5% more assets in 2002
compared to MEs that don’t have safe work environments, on average.

**Non-hypotheses related variables**

The four regression models provide interesting results regarding non-hypotheses related variables. Coefficient on variable *workers* is significant in three regression models i.e. Egypt profit 2004, Egypt assets 2004, and Turkey assets 2002 with 5%, 1%, and 1% significance levels, respectively. MEs in Egypt that increase numbers of workers by one unit, on average, have 2.3% decrease in profits in 2004; however, an increase in number of workers increase assets level in Egypt (2004) and Turkey (2002) by 26.9% and 17%, respectively, other factors fixed.

Coefficient on variable technology is significant in regression model Egypt profit 2004 and Turkey assets 2002 with 10% and 1% significance levels, respectively. MEs in Egypt and Turkey that are using up to date technology have 4.9% more profits and 27.3% more assets, respectively, compared to MEs that utilize old technology, on average.

In case of variable safety, the coefficients are significant in two regression models i.e. Turkey profit 2002 and Turkey assets 2002 with 1% significance levels. Turkish MEs that have safe work environments have 97.7% more profits and 26.5% more assets in 2002 compared to MEs that don’t have safe work environments, on average.

To conclude the results section, I find scattered evidence supporting the hypotheses: clustering of MEs, consulting services, and access to credit affect *profits* and *assets* of MEs in a positive fashion. The evidence in Egypt and Turkey profits models is limited, with only two significant variables *access* and *credit_access*, which supports two hypotheses i.e. the consulting and access to credit hypotheses. The negative signs of both coefficients can be refuted because I find that access to consulting services increase assets, so the relation should be the same to profits. And the negative sign of credit_access can be refuted based on Love and Sanchez (2009) findings.

In the case of the *assets* equation, our hypotheses find strong evidence. Ample evidence is found in two models of assets that clustering of MEs is beneficial for assets level of MEs. Access to consulting services or usage of these services helps MEs with acquisition of new assets. Access to credit eases investment in assets, Love and Sanchez (2009).

### 6 Conclusion

Since MEs contribute substantially to economic growth of countries and are the main source of employment for the poor, various studies have looked into different factors, especially credit, affecting MEs’ performance. As much as credit is vital to MEs performance, by the same token, consulting services and clustering are also vital. Due to this reason, this study looked into Egyptian and Turkish MEs to find the effect of consulting services and clustering on MEs’ profits and assets.

Considering four regression models of profits and assets, altogether, for Egypt and Turkey, I find that consulting services and clustering have substantial impact on MEs’ profits and assets. Meanwhile, access to credit is also important. For policy considerations,
it is necessary that governments and microfinance institutions provide MEs with consulting services, for instance, managerial know-how, product marketing, and communication services. Besides, those MEs that already have formed a cluster or exist in a cluster should be supported through services that would further increase cooperative interaction among them and enhance innovation plus productivity.

References


Table 1 – OLS Regression Results for Egypt (profit04&assets04) and Turkey (profit02&assets02)

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*** p<0.01, ** p<0.05, * p<0.1

Source: Author’s computations based on 2003/04 ERF data for Egypt. Data available in “The Micro and Small Enterprises Dataset for MENA countries (Egypt, Lebanon, Morocco, Turkey).
**How Do Capital Losses Affect Investment Following Natural Disasters?**

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**ABSTRACT**

Using a panel of 168 countries from 1968-2008, I explore the relationship between natural disasters and domestic investment. I find that the loss of human capital (proxied by loss of life scaled by population) due to a natural disaster is negatively correlated with domestic investment while the loss of physical capital (property damage scaled by real GDP) is positively correlated with investment. Interestingly, domestic investment in developing countries increases with property damage but is not sensitive to loss of life. In contrast, domestic investment in developed countries falls with loss of life but is not sensitive to property damage from natural disasters.

1 Introduction

The United Nations cites a four-fold annual increase in natural disaster frequency since the 1970s and over the past several decades. Such has been the case particularly in the 21st century with the December 2004 Indian Ocean tsunami, the September 2005 flooding of New Orleans by Hurricane Katrina, the May 2008 Sichuan earthquake in China, and the recent 2010 earthquakes in Chile and Haiti. These disasters have been brought to the forefront of global attention for their devastating human costs and material damage.

In the wake of such crises, much attention has been directed toward disaster detection and mitigation and what could have specifically been done to better prepare countries for such crises, and it is only recently that economists have begun turning their attention to the aftermath of these disasters, specifically how growth dynamics are impacted by disasters (seen as exogenous shocks) and what some of these determinants of growth are.\(^1\)

However, little research (or none to the author’s knowledge) has been done in examining

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\(^1\) For example, Raddatz (2005) and (2009) finds that natural disasters do have negative short-run impact on output as does Noy (2009). Noy also examines various determinants of growth following disaster growth and finds that developing countries are hit harder by disasters and that countries with higher literacy rates, government spending, and better institutions have smaller declines. In Noy (2007), Noy examines the neoclassical model in relation to disasters and includes investment as one of his long-term growth determinants following a disaster.
the effect of natural disasters on investment, particularly the formation of capital goods such as the purchase of new equipment or plants by firms. This question, though seemingly less relevant than growth on the surface, has important implications for classical growth theory in the context of disasters.

Standard neo-classical theories such as the Solow model predict that the destruction of physical or human capital, seen as damage to property or loss of life, will enhance growth over a period of time since it will move countries away from their steady states leading to faster capital accumulation. Similarly, models of creative destruction suggest that negative capital shocks can lead to re-investment and the adoption of new technologies that promote long-term growth. However, all such models hinge on the assumption that new investment really does occur and new capital is indeed created in the wake of a disaster. Yet, it is not entirely clear if the empirics of this question hold true, particularly in the short-run when it is uncertain how disasters may affect investment.

To analyze this question, I conduct a short-run analysis of investment, defined as real gross capital formation divided by real GDP\(^2\), to analyze the impacts of physical capital and human capital loss resulting from a natural disaster on investment. Using this short-run framework, I find that loss of human capital due to a natural disaster (proxied by loss of life) is associated with a negative impact on investment while loss of physical capital due to a natural disaster is associated with a positive impact on investment. This effect of physical capital loss appears to be driven primarily by developing countries and the effect of human capital loss, interestingly, is prominent in developed countries.

This paper is organized as follows. Section 2 outlines the channels through which a disaster might affect investment and a motivation for studying investment. Section 3 discusses our data and empirical methodology. Section 4 and 5 report the results of our regression specification. Section 6 concludes.

2 Literature Review and Difficulties of Studying Disasters

At first blush, it may appear that new investment would be considered a natural response in the wake of a natural disaster. With a large stock of once used capital being wiped out, in theory it would only seem natural to think that a loss of productive capital would need to be replaced with new capital to maintain productive efficiency. The empirics of such a question are not as straightforward, however.

First, the impact of a disaster is difficult to measure. Disasters occur all the time but most are slight fractions of macroeconomic aggregates such as GDP or investment. Also a disaster, unlike a financial crisis such as a banking or currency crisis, is not systemic, in that its effects are isolated to a particular geographical region in a country. For instance, Joyce and Nabar (2008) look at the impact of banking crises and capital stop crises, sudden freezes in capital flow, on investment in emerging markets which accord with sharp clearly, observable drops in GDP and investment (seen in Figure 1 for Indonesia at year 1998). However, it takes a very large natural disaster to observe even a slight deflection in GDP or investment that may or may not be different from trend (such as in Indonesia for the year 2005, following the Indian Ocean tsunami).

2 Both gross capital formation and GDP are defined in terms of constant 2000 US$
In addition, while investment may ostensibly increase, especially when essential infrastructure is damaged, one could also imagine a situation in which loss of capital may not necessarily lead to new capital production. For example, in cases in which the loss of human capital is tantamount to losses in physical capital, an area impacted by a disaster may have no need to produce large amounts of new physical capital.

Furthermore, uncertainty could play a key role in investment and capital production. Destruction of infrastructure, rather than attracting flows supporting investment, may deter further investment, particularly from foreign sources. For instance, foreign firms and investors may be wary of providing funds to build a plant in a recently disaster-stricken country if a country’s roads or ports are blocked. This uncertainty might rise if it is doubted that the government will be able to rebuild damaged areas quickly. Alternatively, in cases in which a disaster both physically and politically fractures a government’s institutions, such as in the 2010 Haiti earthquake, firms and investors might be discouraged from investing in a country with a weakened political system. Developing countries in particular may be more vulnerable to natural disasters since they may lack efficient disaster response and prevention mechanisms such as evacuation procedures, shelters, well-enforced building codes, or even the ability to pursue counter-disaster economic policies without taking on a budget deficit.³

Moreover, there are many standard investment determinants unrelated to natural disasters (to be discussed later) that affect investment. My goal then will be to see if there is at least a correlation between natural disasters and investment while controlling for these basic determinants, and to try to isolate the impact of larger natural disasters to see if they have bigger impacts.

### 3 Data and Summary Statistics

Data on natural disasters are taken from the EM-DAT database, collected by the Center for Research on the Epidemiology of Disasters (CRED).⁴ The EM-DAT is a country-level database with data from 1900 to the present documenting the incidence and effects of disasters throughout the world. The data is compiled from a number of sources including UN agencies, non-governmental organizations, insurance companies, research institutions and press agencies. Priority is given to non-partisan agencies like the UN or Red Cross or Red Crescent Societies, and data is checked prior to publishing.

The EM-DAT adds a disaster to its database only if it meets at least one of four criteria: (1) if 10 or more people are killed; (2) if 100 or more people are affected; (3) there is a declaration of a state of emergency; or (4) there is a call for international assistance. According to the EM-DAT, disasters are grouped according to five subgroups, geophysical, meteorological, hydrological, climatological, biological, which are in turn divided into ten more specific disaster types such as storms, earthquakes, and volcanoes for example.⁵

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³ Additionally, these same factors resulting from a disaster could influence flows of a domestic firm.

⁴ I kindly thank Professor Ilan Noy at the University of Hawaii for providing a version of the EM-DAT database assembled by the Inter-American Development Bank.

⁵ Other disaster types include droughts, epidemics, extreme temperature, mass movement (wet), mass move-
For a given disaster that occurs in a country and year, the dataset includes three primary measures to account for the magnitude of the disaster. These measures are 1) the number of deaths (the number of persons confirmed dead or missing and presumed dead), 2) the number of total affected (the sum of the number of affected, homeless, and injured), and 3) the estimated physical damage costs in US dollars (in 2000) in the disaster year. Thus, the EM-DAT can be assembled into a panel for each country and year, listing the disaster type, number killed, total affected, and estimated damage costs. In addition, each disaster is accompanied by a start and end month and the duration of the disaster in months.

In this paper, I streamline the EM-DAT data by examining 165 countries from 1968 to 2008, grouping all disasters into five types: earthquakes, storms, floods, other disaster types, and combined disasters (disasters of more than one type in a given year). Following Noy’s convention, for combined disasters, the disaster magnitude variables for each type are summed over a given year and the earliest disaster in a given year is marked as the month of onset.

Furthermore, to account for the effects of disasters on different economies, I normalize the disaster magnitude measures by scaling number of deaths and total affected by population in the prior year and the amount of damage costs by real GDP in 2000 US dollars in the prior year; the year prior to disaster is used to avoid the contemporaneous effect of the disaster on population and GDP. I label these scaled variables KIL, AFF, and DAM.

The magnitude of disasters varies broadly. Table 1 and 2 provide summary statistics and a correlation matrix for the three scaled disaster magnitude variables. The variable KIL, the number killed as a percentage of the population, ranges from a minimum of 1.25E8 to 0.0082, or a max of 0.8 percent of the population. The mean for KIL is also 0.004 percent of the population, with the max representing a nearly two hundred fold increase in scaled deaths over the mean. The scaled number affected, AFF, and damage, DAM, have similarly large ranges with the maximum scaled damage being 0.3 percent of GDP. Table 1 also provides these same values, removing scale effects for reference.

Considering how widely natural disasters vary in their intensity, some disasters may have negligible impacts on investment while others due to their larger magnitudes may have significant impacts. To explore this wide variation in disaster magnitude, I create several dummy variables to categorize disaster magnitudes by percentile. For both KIL...
and DAM, I look at five non-overlapping percentile groups. The values and frequency of disasters in each percentile group are shown in Table 3. Large magnitude disasters are more infrequent than low magnitude disasters.

Table 4 demonstrates summary statistics for the disaster variables by World Bank classifications such as income level and region. Along all three measures, poorer countries on average have much higher magnitudes for deaths, affected, and damage scaled by population or GDP than high income or OECD countries. The data suggests that poorer, developing countries may be more vulnerable to natural disasters since they may lack efficient disaster response and prevention mechanisms such as evacuation procedures, shelters, well-enforced building codes. Apart from immediate disaster prevention or mitigation procedures, developing countries may lack the organization and institutional quality to rebuild infrastructure or pursue counter-disaster economic policies without taking on deficits.

Finally, macroeconomic data on investment, GDP in constant 2000 US dollars, GDP per capita, inflation, trade, population, and other macroeconomic variables are taken from the World Banks World Development Indicators (WDI). Other factors such as government consumption expenditures, foreign direct investment inflows, and imports and exports are also supplied by the WDI. Investment is constructed by using the WDI’s measure of gross capital formation in constant 2000 US dollars and scaling by GDP. I also use the World Bank’s Worldwide Governance Indicators (WGI) rule of law index as a proxy for institutional quality (higher numbers indicate better rule of law).

Finally it should also be noted that this is an unbalanced panel in which a disaster measure, such as KIL, may be missing from the same country and year that another such as DAM is not; some variables from the WDI are also missing in certain countries and years. Other variables from the WDI such as literacy are filled in with previous observations because they don’t move drastically over time, are not a central part of the analysis, and help to prevent loss of other variable observations when running regressions.

4 Empirical Methods

To formally test the relationship between investment and a natural disaster, investment is determined by

\[ \text{inv}_{i,t} = \alpha_i + \beta_1 \text{KIL}_{i,t} + \delta_1 \text{DAM}_{i,t} + \chi_{i,t} + \epsilon_{i,t} \]

where KIL is scaled disaster deaths and DAM is scaled disaster damage in country i and year t. \( \chi \) is a vector of control variables, and \( \alpha \) are country fixed effects to account for different levels of investment in countries. The vector of controls consists of variables that, according to Joyce and Nabar (2008), are used commonly in the empirical literature.

9 The percentile groups are the 0 to 25th percentile, the 25th to 50th percentile, the 50th to 75th percentile, the 75th to 95th percentile, and 95th to 100th percentile. For example, a dummy for the 25th to 50th percentile of KIL is coded as 1 if KIL is greater than the 25th percentile and less than or equal to the 50th percentile.

10 No year fixed effects are used as doing so sapped out much of the significance in any variables of interest once controls were added.

11 I do not use all five of the non-overlapping dummy groups from earlier due to correlations among these dummies that may negate results.
of investment. This vector includes lagged investment, inflation as measured by the growth of the Consumer Price Index, trade openness measured by the sum of exports and imports in goods and services scaled by GDP, net inflows of foreign direct investment (FDI) scaled by GDP, and total debt service scaled by GDP.

The existing literature cited by Joyce and Nabar (2008) suggests a few mechanisms through which each of these controls may act upon investment. Investment displays persistence according to Joyce and Nabar, suggesting a process of partial adjustment, so an investment lag is included. Inflation adds to uncertainty by changing price and real interest rates, discouraging investment. Markets more open in their terms of their goods and service trade also tend to be have more sophisticated financial intermediaries to promote trade flows. Due to both more sophisticated intermediation and greater financial accessibility, these markets often draw out more investment. FDI can often be an important external source of funding domestic investment. Finally, increased debt service, the sum of principal and interest payments, can diminish the supply of loanable funds available to go toward investment and moreover discourage foreign investors due to higher perceived risk. Country fixed effects are also added to control for time-invariant factors influencing investment.

Next, because larger-scale disasters may impact investment more so than smaller disasters, I then augment the prior regression to allow larger disaster intensities to impact investment. Selecting two of the three disaster magnitude variables I later find statistically significant in a preliminary regression (Table 5), I use the 75th percentile of KIL and DAM and produce the following specification:

\[
(2) \text{inv}_{it} = \alpha_i + \beta_1 \text{KIL}_{it} + \beta_2 \text{KILDUM}_{it} \times \text{KIL}_{it} + \delta_1 \text{DAM}_{it} + \\
\delta_j \text{DAMDUM}_{it} \times \text{DAM}_{it} + \chi_i + \epsilon_{it}
\]

where KILDUM and DAMDUM correspond to a dummy for the 75th percentile of KIL and DAM and above.\(^12\)

5 Results

A preliminary regression was run without controls of the three scaled disaster measures on investment. The scaled number affected variable, AFF, is not significant but the scaled number of deaths, KIL, and damages, DAM, do come in as significant—negatively for killed and positively for damages, suggesting that the two measures of a disaster have opposite effects on investment.

One hypothesis is that losses in physical and human capital may be fundamentally different. Whereas a loss in physical capital alone may spur investment as the capital can be quickly replaced, a loss in human capital may be more permanent and negatively impact investment. Human capital is needed to use physical capital and a loss of human capital could decrease demand for investment. I focus on these two measures henceforth as the

\(^{12}\) I do not use all five of the non-overlapping dummy groups from earlier due to correlations among these dummies that may negate results.
impact of a disaster, continuing to use country fixed effects throughout my analysis.13 Table 6 studies the relationship between investment and KIL and DAM (our proxies for human and physical capital loss) by expanding our preliminary regression with controls such as in specification (1). These controls account for other factors influencing investment outside of disasters. In these regressions, KIL and DAM are included separately at first to keep observation numbers higher due to the unbalanced nature of the dataset. KIL and DAM are then put together in the same regression to see if human capital and physical capital losses are seen as effects separate from one another. In column (1), KIL does not enter significantly though our other control coefficients show the expected correlations. Trade openness and FDI are associated with greater investment while debt service is negatively correlated with investment. I see similar effects for these controls in columns (2) and (3). In column (2), DAM enters very significantly being positively correlated with investment, suggesting that physical disaster damage may lead to new investment. In column (3), DAM is again significant and KIL is not. However, the two are jointly significant at a 5 percent level with a p-value of 0.018, suggesting the possibility that our two disaster measures jointly may affect investment even though KIL is not significant alone.

In column (4), KIL and DAM are interacted to see if there are any relationships between loss of physical and human capital. For instance, one might expect loss of physical capital to increase investment less if significant human capital is lost too; there might be less demand for investment even though physical capital has been lost because there is less human capital to use it. This interacted term is not statistically significant however.

KIL and DAM are continuous variables ranging from low-level disasters to high, it is also possible that because high level disasters are much less abundant than low level ones the effect of disasters on investment may be diluted. Table 7 uses specification (2) to test if disasters with more deaths per capita or greater damage relative to GDP are associated with more significant patterns of investment change. To do so, I interact the KIL and DAM variables with a dummy indicating whether a disaster had the 75th percentile or more of KIL or DAM. Again, the results for deaths are insignificant and even the general effects of DAM become statistically insignificant. Only the interacted effect of DAM is significant at a 10 percent level with a positive coefficient suggesting that disasters with DAM higher than the 75th percentile are correlated with more investment than those below the 75th In Table 8, I try to break down the results from Table 6. Table 8 illustrates specification (1) for different groups of countries according to their World Bank classification. The primary motive behind disaggregating the data is to see if there are certain groups of countries driving our aggregate results. By looking at non-OECD countries and lower income countries as specified by the World Bank we find that disaster damage in developing countries is highly and significantly correlated with higher investment rates in non-OECD and lower income countries. On the other hand, disasters in higher income countries have no significant relationship with disaster damage, suggesting that the significant damage results in Table 6 were likely driven by developing countries with the majority of disaster events. Developing countries are typically more prone to losses of capital because they 13 Year fixed effects were not used in the ensuing analysis because they seemed to absorb most of the explanatory power of the regressors.
may have weaker physical infrastructure in place such as roads and buildings, potentially due to weaker enforcement by institutions. As a result, these countries may have to recoup more of their investment following a disaster, which may explain the positive link between investment and a disaster.

Interestingly, Table 8 also shows a negative relationship between human capital and investment for upper income countries but no statistically significant relationship with damages. To some extent, the negative effect of human capital on investment may make sense for richer countries that generally are more educated and have greater stocks of human capital. In addition richer countries tend to produce more skilled-labor intensive goods that make good use of their human capital; however, if human capital is lost there may be less individuals to operate sophisticated physical capital, lowering investment. In relative terms, the loss of human capital in a developing country may also not be as deleterious its well-being. Developing countries with more rural areas may not be as impacted by loss of human capital as lower skill is required in the use of physical capital.

6 Robustness Checks

6.1 Construction of Disaster Measures

In the analysis of Section 5, all disaster variables were scaled by population or GDP to give KIL, AFF, and DAM. However, in Noy (2009) which looks at growth dynamics following a natural disaster, Noy weights his disaster measures to reflect the month of incidence. Because disaster magnitude measures are for the disaster year, disasters of the same size that occur earlier in the year may have a bigger impact on variables of economic significance. For instance a disaster that occurs in late December may have a much more minimal effect on that year’s investment than a very similar disaster that occurs in early January of that year. As a result, I create an additional weighted measure of disaster damage in which disaster measures are multiplied by the months remaining in the year, divided by 12, and then scaled by population or GDP such that earlier disasters are weighted more heavily than later disasters in a given year. I then use this weighted disaster measure in my preliminary and disaggregated regression and observe very similar results with number killed and damages being significant with the same signs and richer countries being more sensitive to human capital shocks while developing countries are more sensitive to physical capital shocks.

6.2 Disaster Lags

In the prior results section, I only considered contemporaneous impacts of KIL and DAM on investment. But it is possible and certainly more realistic that disasters may have lagged impacts on investment. To do so, I include lagged variables for KIL and DAM for specification (1). For example, in Table 6 I found that KIL was not statistically significant in the same time period. In Table 10 column (1), I similarly find that human capital losses are not significant in a contemporaneous manner or with a one-year lag.

14 The OECD countries are based on a limited number of observations (¡30), are found to be statistically insignificant, and are not shown.
Physical capital loss is again positively significant contemporaneously but has a negative impact on investment with a one-year lag. It is not clear why investment would be negative a year following a disaster. Though one might argue that most investment might be done in the same year as a disaster in some cases, in other cases it may take longer or the disaster may simply happen later on in a given year. Future work could focus on these lagged impacts, especially in tracing them through time.

7 Conclusion

Using a panel dataset of 168 countries from 1968-2008, I find that loss of human capital due to a natural disaster is correlated with negative impacts on investment while loss of physical capital due to a natural disaster is correlated with positive impacts on investment. I find no statistically significant results when trying to see if there are larger impacts on investment in disasters with more damage relative to GDP, which is a perplexing result since that certainly would seem to be make sense. Also, I find that developing countries and poorer countries are more sensitive to physical capital shocks whereas developed countries are more sensitive to human capital shocks. These results are robust to the inclusion of different controls. I also use different disaster intensity variables such as dummies to see if significant results are found but only continuous versions of the variables seem to hold significance. Finally, I find that disasters are correlated with lagged impacts on investment but the direction of the sign for the lagged impact of damages changes from the contemporaneous impact’s sign.

Future studies may try to clarify the path of investment following a disaster using a framework similar to the financial crisis literature (Cerra and Saxena (2008)) with an impulse response function charting the path of investment. This may elucidate the story behind lags better and more clearly delineate how physical and human capital losses affect investment with time. Such analysis could also be extended to certain groups of countries to see if different trends exist for different groups of countries in the wake of a disaster. Also, it may be useful to examine the effect of a disaster in general without separating physical and human capital loss effects on investment. However, this may prove difficult as dummies for disasters did not yield significant results in this study. Instead, an index of disaster magnitude incorporating existing disaster magnitude measures might better capture disaster intensity.15

To better understand the impact of large magnitude studies, it may also be useful to look at disasters and their effect on investment on a more case-study basis using local, more disaggregated data from the location of the disaster. This may allow one to see effects unseen in large macroeconomic aggregates such as national GDP or investment or perhaps take into account the location of a disaster (whether it occurred in a rural or commercial area for example). Finally, considering investment’s key role in growth, future examinations may involve interacting investment with disaster measures to see the impact on growth and more thoroughly examine of how various political variables such as institutions (and other

15 This might require assigning a value to lives lost or number affected when there is no standardized way to do this.
measures), aid, and capital openness change the impact of disasters on investment.

References


Selected Tables

Table 1

Summary Statistics for kilsc, affsc, damsc

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Table 3

Percentile Values for kilsc and damsc Dummies Categories and Frequency of Disasters

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Observations: 2093
R-squared: 0.848

Standard errors clustered by country in brackets.
*** p<0.01, ** p<0.05, * p<0.1

### Table 8: Effect of disaster measures on investment by group

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Observations: 2093
R-squared: 0.848

Standard errors clustered by country in brackets.
*** p<0.01, ** p<0.05, * p<0.1
PRIVATE ELECTRICITY: CURE OR CONSTRAINT?
MEASURING THE EFFECTS OF INCREASED LEVELS OF PRIVATE INVOLVEMENT IN THE NON-RENEWABLE ELECTRICITY GENERATION PROJECTS OF DEVELOPING ECONOMIES

Jorge A. Aponte M.
Georgetown University

ABSTRACT

Developing countries all over the world must constantly expand their electricity generation capabilities to be able to meet the demands of local businesses and families. This can be a tough challenge for many, as countries face financial constraints that limit their ability to invest and reinvest in power generation plants. Bringing in private investment may be solution to this issue. Nevertheless, recent work in this topic suggests that the private sector’s role may be severely limited as higher levels of private involvement and larger projects have been hypothesized to be correlated with higher failure rates for such investments. This thesis tests econometrically whether these hypotheses are true, and finds that there is no significant evidence to support either of them. This study finds that if these hypotheses hold, they only do so for extreme cases of very high private involvement and very large projects, and even then the risks don’t seem to surface systematically. Moreover, this thesis finds that countries can expect benefits in the form of lower electricity tariff rates and less power outages if they bring in more private investment. These expected benefits on average outweigh the risks faced by host countries.

Acknowledgements

I would like to give special thanks to of my faculty advisors, Profs. Bora Durdu and Rodney Ludema, for making this thesis possible. I also want to recognize the work of Prof. Marius Schwartz for his exciting classes that led me to make the decision to pursue a degree in the field of economics, Prof. Phillip Cross who taught me everything I know in statistics and econometrics, and Prof. Gerald West for introducing me to the interesting world of private investment in the electricity sector of developing countries. I also have to thank everyone in the Dominican Republic that agreed to interview with me in the initial stages of this project, Mr. Temístocles Montás, Mr. Edwin Croes and Mr. Jaime Aristy Escuder, and the man that made those interviews happen, Mr. Luis Crouch. I dedicate this thesis to my family members who have endured great hardship to guarantee that I receive the best education possible and to my girlfriend and friends, who are always there for me.
1 Introduction

A well-functioning electricity sector is fundamental for development. High electricity tariffs lower the competitiveness of almost all businesses, and widespread blackouts force them to choose between paralyzing their operations during energy shortages and incurring huge costs to produce energy internally. It is estimated that developing countries will need to invest over $13 trillion dollars to meet anticipated demand by 2030 and prevent the previous scenario (International Energy Agency, 2009a). Private investors can be valuable allies to states who wish to accomplish this goal, having already invested more than $350 billion dollars from 1990 to 2008 (World Bank, a). Nevertheless, private investment in infrastructure is extremely complicated, which has caused it to be awfully volatile.

Given the needs of developing countries and the complexity of private investment, it is important to identify the tools governments and investors have at their disposal to ensure the projects that are implemented have the highest chance of success possible. One interesting variable is that of project size. Intuition would lead to the assumption that the largest projects would be more successful as they are the ones whose design led them to attract the largest number of investors, and similarly, countries with the highest proportion of private involvement in electricity will be those better able to manage times of distress. Nevertheless the work of Erik Woodhouse and others suggests exactly the opposite. This alternative theory contends that larger projects will have a higher probability of failure because they will represent a bigger financial burden on governments in times of distress (Woodhouse, 122). This theory also suggests that countries with a higher proportion of private investment in the electricity sector will also have a higher proportion of their private projects failed. It is important to establish the extent to which this alternative theory holds, as it will determine the extent to which private investment can aid governments meet the electricity demands of their countries. This thesis finds there is limited econometric evidence in support of this alternative theory in cases where the projects are particularly large using a large sample of cross-country projects in developing countries all over the world. Nevertheless, this study also finds extensive evidence that increasing private involvement in the electricity sector can provide countries with benefits that will, on average, outweigh the risks of having a large slice of the local electricity generation market being controlled by private investors.

Woodhouse’s study suggests that smaller projects and countries with a smaller proportion of their electricity sector being held by private investors are better equipped to weather times of distress. Nevertheless, the study is lacking in three areas. First, its sample is restricted to 34 projects in 13 countries. Second, Woodhouse does not employ any quantitative statistical model. Third, the study can only accurately assess a project’s outcome for the investor, as the developmental outcome for the country is measured in a subjective and arbitrary manner. Other authors have failed to even address the determinants for project success. This paper seeks to bridge this gap in the literature and take an important first step in using econometric models to help governments determine the steps they can take to seek private investment in the smartest way.
2 Literature Review

At the onset of the Asian financial crisis, Yves Albouy and Reda Bousba wrote a small article that documented among other things a new trend in negative outcomes for some of the countries that had the largest share of Independent Power Projects (IPPs) in their electricity generation sector (Albuoy and Bousba, 1998). Albouy and Bousba hypothesized that excessive investment in Malaysia, Indonesia and Pakistan had led to suboptimal outcomes as excess capacity piled up and fuel savings could not offset high investment costs. Nevertheless, they treated this as a marginal point in their paper.

However, later studies would expand more on the importance of size in project outcomes. Deloitte submitted a report on financial issues and options for sustainable power sector reform in emerging markets. The report looks at 20 specific cases and identifies 10 key success factors that lead to a project’s sustainability. This study focuses on the “constrained power expansion” category (Deloitte, 2004). The authors claim that in good economic times electricity demand growth projections can be excessively optimistic and cause investment in more capacity than is needed (Deloitte, 2004). This results in utilities being forced to buy excess electricity under long-term contracts with IPPs and market prices for electricity dip increasingly lower due to excessive competition among merchant power producers, which makes investments of existing producers riskier. Nevertheless, the report only identifies four cases in which it claims constrained power expansion was significant for the success of projects.

Another relevant article written in the topic of project outcomes in the electricity sector is Eric Woodhouse’s “Obsolescing Bargain Redux?” Here Woodhouse summarizes his findings over a series of country-level studies on the subject of IPP investment in electricity generation that surveyed 34 IPPs in 13 emerging market economies. Here, Woodhouse classifies the level of success of each project for both the investor and the country and identifies general trends that arise from the analysis of all projects. Woodhouse concludes that projects are most likely to be successful when the relevant parties engage in “strategic management techniques” rather than traditional “risk engineering” procedures (Woodhouse, 2005-2006). Such strategic management techniques include flexibility in contract renegotiation, conservative fuel choice, and the variables that are the main focus of this study, size of the project and of private participation in electricity as a share of the total electricity market, among others (Woodhouse, 2005-2006).

The contributions of these studies are enormous, as they started a serious scholarly dialogue on the determinants for project success. Woodhouse was particularly savvy in recognizing the need to identify determinants for project success that are within reasonable control of the parties involved. Countries cannot easily improve their macroeconomic stability, the quality of their laws and regulations and their political and social shortcomings. Singh, for instance, cites the “setting up of an independent regulatory institution, macroeconomic stability and financial sustainability” as the elements to guarantee good investments in the electricity sector (Singh, 2006). However, these feats are almost

1 Merchant power producers are producers that have not signed long-term contracts with the host government or country’s utilities. See section 3.
impossible to accomplish for many developing nations, which have been attempting to achieve some of these for their own sake forever without much success. Nevertheless, countries and investors can easily engage in the strategies outlined by Woodhouse without bearing heavy political costs.\(^2\)

Nevertheless, the past studies that deal with the determinants of project success that are within reasonable control of governments and investors have their own shortcomings as well. Neither study has used a large sample size. Deloitte looked at 20 projects and Woodhouse at 34, a small fraction of the worldwide total. Moreover, these previous studies do not present a sound statistical model, relying heavily on anecdotal evidence. Furthermore, the projects selected for these case studies are decidedly not a random sample. Both Woodhouse and Deloitte handpicked the projects they wanted to use on their studies for different reasons, which creates tremendous academic issues. Therefore, a study based on hard statistical ground, such as the one conducted here, is a significant addition to the current literature on the subject.

3 Model

Consequently, this study uses a sound statistical model to test the conclusions about the effects of project size on investments. In this model there are two relevant actors, the host country government and the investors. Moreover, investors can be divided into two types: IPPs, who are offered long-term PPAs to expand local electricity production capacity; and merchant power producers, who do not have a long-term contract. Governments seek investment from these groups with the same main goals: reducing power outages and lowering local prices of energy. Investors, on the other hand, seek to maximize profits and recuperate their investments.

The typical relationship between governments and private investors is described below. First, the government decides it needs investment in its electricity sector and determines such investment should be for any reason. After this decision has been made, the government seeks out private investors by either a competitive bidding process or bilateral negotiations. After an agreement has been reached, a construction and operation license is granted to the investor, and a contract is signed in the case of an IPP. When the project starts producing electricity, the government then buys the electricity from the private investor and sells it to the public utility, which distributes the electricity to its final consumers.

Nevertheless, according to the theory this thesis intends to test, over the life of IPP projects the host country will face external shocks that negatively affect its ability to pay for the contracted energy, sometimes leading a project to delve into financial distress. Moreover, merchants will also be affected in times of stress since demand will be lower, leading them to become energy suppliers of last resort as compared to IPPs. Furthermore, even if all energy producers in a given economy are merchant producers, extreme competition among them will lower the tariffs they charge to unsustainable levels.

This study intends to test two related but distinct hypotheses. **Hypothesis #1** states that countries with smaller proportions of private investment in their electricity sectors will be better prepared to weather shocks and will thus face better outcomes from the private investment in their countries. **Hypothesis #2** states that smaller projects within each country will also have a comparative advantage over larger ones as they pose a lower financial burden on the host country in times of crisis. Thus, the government will be more likely to choose to honor contracts of smaller projects than to start a dispute that will deteriorate the country’s image with the investment community. However, in larger projects the financial burden will become too large to ignore.

## 4 Empirical Strategy

This empirical study will test two related hypotheses. First, it will test **Hypothesis #1**: the impact the size of private electricity investment relative to the country’s electricity sector has on the success of all of private investments in electricity for any given country. Here, the study employs an ordinary least squares linear regression. Nevertheless, the study uses a probit statistical model for **Hypothesis #2** since the most suitable proxy for individual project success is a binary variable.

### 4.1 Hypothesis #1

#### 4.1.1 Dependent Variables

To test **Hypothesis #1** the study employs three different dependent variables. The first dependent variable used is simply the proportion of capacity of the private projects in the country that are canceled or in distress. The World Bank’s PPI Database classifies each project as “operational,” “canceled,” or “distressed.” Operational projects are considered to be successful and those canceled or in distress as failures. Then, the proportion of failed projects is calculated by the following formula:

\[ P = \sum (c_i * f_i / t) \]

where \( c_i \) is the capacity of a specific project, \( f_i \) is the success or failure of a project (where \( f=1 \) if the project is failed and \( f=0 \) if the project was successful) and \( t \) is the total capacity of all private projects in any given country.

One advantage of this variable is that it provides results that are consistent with those of **Hypothesis #2**, since the variable can easily be compared to the one used to test that hypothesis, as they come from the same source and use a similar coding system. Another advantage is that data are available for every country in the Database, providing a rich dataset. The main drawback of using such a variable is that the number of failed projects may be understated. Using this definition only 5-7% of the projects can be quantified as failures, which limits the explanatory power of the dataset significantly. Therefore, this model is complemented by two others, which use different dependent variables: average tariff rates for residential consumers (end-user prices) and the country’s rate of power outages. The main weaknesses of these measures are less data availability and the fact that
many aspects unrelated with power generation influence their behavior. The data for power outages is in hours per month units. Energy prices are given as US dollars per kilowatt-hour.

### 4.1.2 Independent Variables

To test Hypothesis #1 this study sums the individual capacity of every ‘private’ project included in the PPI database to obtain the total generation capacity in private hands in each economy. The resulting integer is then divided by the country’s total generation capacity to obtain the private share of the generation capacity in each country. Two different notions of what constitutes ‘private’ investment are utilized for illustrative purposes. One is to use solely projects that are 100% private. The other is to include projects that have some public ownership as well. In such cases, each project’s capacity is multiplied by the proportion of the project that is private when the data is being aggregated to better reflect the project’s reality.

Utilizing two notions of what constitutes ‘private investment’ provides for an interesting comparison of the effects of purely private investment and those of private investment mixed with public-private partnerships in investment success. Furthermore, using data from public/private partnerships also provides a richer database.

### 4.1.3 Control Variables

One vital aspect that must be controlled for in a study about investment success is what provokes investment to happen in the first place. The decision to seek private investment in electricity generation is a conscious policy decision made by governments, and thus the independent variable is relatively exogenous. Nevertheless, there may be other variables influencing whether governments choose private investments and their levels of success at the same time. This study uses GNI per capita adjusted for purchasing power parity to control for the level of development of an economy (World Bank b, 2004). This thesis also follows the example of Bergara, Heinsz and Spiller, who show that the institutional development of a country is a great tool for predicting investment (Bergara Heinsz & Spiller, 2007). These authors construct an index that accurately forecasts investment patterns, called the ICRG5. To accomplish this they compile five measures from the International Country Risk Guide (ICRG). This thesis constructs a new index, hereafter referred to as the ICRG5.2, by substituting the last two measures of the ICRG5 (PRS Group). One reason for this change are that measures of Contract Repudiation and Government Expropriation are not easily available to researchers, while most of their effect is accounted for in the newly included Investment Profile measure. Furthermore, the Socioeconomic Conditions measure can be useful in controlling for both the economic and the ‘quality of life’ effect on investment decisions.

The level of economic openness in a given country can also alter investment patterns. This study controls for this using Chinn and Ito’s KAOPEN index (Chinn & Ito, 2007). Moreover, in the electricity sector the consequences of generation can never be fully separated from the effects of distribution and transmission utilities. Therefore, this study
controls for these effects by including a variable for transmission and distribution losses as a percent of output (World Bank b, 2004).

A last variable that is controlled for is the involvement of multilateral lenders or IFIs. These type of institutions often ‘strongly encourage’ countries to seek private investment and help them select projects that they perceive as those with higher chances of success. For hypothesis #1 this study will use a weighted average of the multilateral involvement in the private projects of an economy.

4.1.3 Summary Empirical Model

The empirical model will then be as follows for the linear model:

\[ Y_{i1} = \alpha + \beta_0 Q_i + \beta_1 X_i + \beta_2 G + \beta_3 T + \beta_4 I + \beta_5 K + \beta_6 F + \beta_7 M + \epsilon \]

Where \( Y \) is the percent of failed project in an economy, \( \alpha \) is a constant, and \( X_i \) is the percentage of private projects, measured as 100% private projects only when \( i=1 \) and as the percentage of capacity in private hands when \( i=2 \). \( \beta_1 \) is predicted to be positive by Hypothesis #1. \( Q_i \) is a quadratic term for the percentage of capacity in the country that is private and is only included in the quadratic regressions. In these regressions \( \beta_0 \) is hypothesized to be positive. \( G \) is the GNI per capita control, it is expected that richer countries will have more successful projects. \( T \) is the transmission and distribution losses control, and its coefficient should be positive, as more inefficient distribution channels exacerbate the problems in the electricity sector, causing failures. The variable \( I \) represents the ICRG5.2 index, whose coefficient is hypothesized to be negative, as better investment climates should lead to less failures. \( K \) is the KAOPEN Financial Openness Index, which should have a negative coefficient as well, as more open economies should be able to provide investors with a better business environment. Nevertheless, this coefficient could be positive as open economies might have a tendency to seek more foreign private investment than what they need, resulting in higher failure rates. \( F \) is the average financial closure year of a country’s projects. Its coefficient should be negative as younger projects have experienced less periods of financial stress and therefore have a higher probability of remaining operational. \( M \) is the weighted average of multilateral support in a country’s projects. \( \beta_7 \) should be negative as multilateral entities should be able to help governments design and select smart electricity generation projects and higher rates of support should lead to less failure. Lastly, \( \epsilon \) is the error term.

For two other tests of hypothesis #1 the empirical models look as:

\[ P_i = \alpha + \beta_0 Q_i + \beta_1 X_i + \beta_2 G + \beta_3 T + \beta_4 I + \beta_5 K + \beta_6 F + \beta_7 M + \epsilon \]
\[ E_i = \alpha + \beta_0 Q_i + \beta_1 X_i + \beta_2 G + \beta_3 T + \beta_4 I + \beta_5 K + \beta_6 F + \beta_7 M + \epsilon \]

Where \( P_i \) is the residential tariff rate in any economy and \( E_i \) is the level of electrical outages faced by a country. The other variables remain intact. In a last regression to test Hypothesis #1, changes in the same variables from 1990 to 2003 instead of actual values for the variables of the tariff rate and transmission and distribution losses. Also, a variable for change in GNI per-capita is added. In this last regression \( F \) is dropped, as project effects are not incremental. Therefore, the age of projects is irrelevant.
4.2 Hypothesis #2

4.2.1 Dependent Variables
The dependent variable that is utilized to test Hypothesis #2 is relatively straightforward. Each project is coded as a success if the project is still operational or has already concluded in a positive note, or as a failure if the project has been canceled or is in financial distress. Successful projects are given the value of 0 and failed projects a 1. Unfortunately, it is impossible to draw a theoretical connection between the size of one specific project to the overall tariffs or blackout rate of an economy, and electricity production costs for individual projects are not easily available. Moreover, it would be impossible to distinguish from the effects of two projects in the same economy. Therefore, the study of this hypothesis is severely limited by the drawbacks of using only success as measured by the PPI database as the dependent variable.

4.2.2 Independent Variables
For Hypothesis #2, this study will measure the relative size of a project using the ratio of generation capacity in a project to the host country’s overall electricity generation capacity. This study will only include projects whose financial closure year is no later than 2003. Moreover, the study only includes projects operating on non-renewable fuels, as renewable energy projects face different constraints and investor-government dynamics than the one described in section 3.

4.2.3 Summary Empirical Model
The model used to test hypothesis 2 looks as follows:

$$Y_2 = \alpha + \beta_0Q + \beta_1X + \beta_2H + \beta_3G + \beta_4T + \beta_5I + \beta_6K + \beta_7F + \beta_8M + \varepsilon$$

Where all the variables stand for the same values as they did for the Hypothesis #1 test, but at the project rather than the country level where it applies. Variable H is a dummy variable for if the country is 100% private or not that is used to test whether there is a different effect between wholly privately owned projects and public-private partnerships.

5 Empirical Results

5.1 Hypothesis #1
There is almost no evidence in support of the hypothesis that countries with a larger share of private participation in their electricity markets will be in danger of higher rates of project failure. Table I illustrates that the regressions that used the proportion of cancelled projects as the independent variable both had negative correlations and were not statistically significant. This suggests that countries with higher levels of private investment actually faced lower risks of failure than those with smaller levels of investment. Moreover, the $R^2$ for this model under both definitions of what constitutes ‘private investment’ is fairly low. Nevertheless, interesting results arise when a quadratic model introduced. The quadratic terms for both models are positive. Nevertheless, only the coefficient for the quadratic term in the model using only purely private investment is remotely significant, and for this to happen the definition of statistical significance has to be extended to include the 15% level,
which is not standard by any means. Moreover, the F-test for the quadratic term and the linear term in conjunction returns a p-value of 0.23 for this model, which is quite outside of standard levels of statistical significance.

These results suggest that the relationship between project size and success might actually be quadratic in the case of 100% private investment. Perhaps very small projects are those unable to attract large quantities of capital and thus are more liable to fail. However, as the size of private involvement increases the dangers of overinvestment may become apparent. Nevertheless, it is impossible to be certain of this from these results. On the other hand, these relatively insignificant results could simply signify that cancelled or distressed projects as defined by the PPI Database are not a great metrics for project failure.

Nevertheless, according to the next set of regressions to be analyzed in this study, the benefits of increasing levels of private investment can more than outweigh the risks of project failure that may be associated with a bigger private sector. The models that measure the relationship between blackouts and the proportion of private investment in a country’s electricity market found significant negative relationships between the two variables. It is observable in Table II that in the model that used all private projects this significance was at the 10% level and when only 100% private projects are included, the level of significance improves to the 5% level. Therefore, governments that increase the level of private involvement in their country’s electricity sector can expect a decrease in the power outages faced by local businesses and their constituents. Moreover, these models account for about half of the variation observed in outcomes, with R2 values of 0.60 and 0.48 respectively.

**Table I: Hypothesis #1 with Canceled or Distress Classification of Failure**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Only 100% private investment, linear</th>
<th>All private investment, linear</th>
<th>Only 100% private investments, quadratic</th>
<th>All private investment, quadratic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadratic Percent Private</td>
<td>-</td>
<td>-</td>
<td>2.925976 (1.53) - P&gt;F=0.23</td>
<td>1.186226 (0.79) – P&gt;F=0.72</td>
</tr>
<tr>
<td>(</td>
<td>t</td>
<td>) - F-test Quad Model</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Percent Private</td>
<td>-0.2948785 (0.85)</td>
<td>-0.0448277 (0.18)</td>
<td>0.0000244 (1.07)</td>
<td>0.0000178* (2.01)</td>
</tr>
<tr>
<td>(</td>
<td>t</td>
<td>) GNI Per-Capita PPP</td>
<td>0.000026 (0.95)</td>
<td>0.0000386** (2.23)</td>
</tr>
<tr>
<td>Transmission and Distribution Losses</td>
<td>0.0110455 (1.12)</td>
<td>0.0077343** (1.01)</td>
<td>-0.0020201 (0.12)</td>
<td>-0.0135945 (1.10)</td>
</tr>
<tr>
<td>ICRG5.2 Index</td>
<td>-0.0002191 (0.58)</td>
<td>-0.0152416 (1.26)</td>
<td>0.0108822 (0.31)</td>
<td>0.0166897 (0.56)</td>
</tr>
<tr>
<td>KAOPEN Financial Openness Index</td>
<td>0.0027906 (0.08)</td>
<td>0.0097929 (0.35)</td>
<td>0.0108922 (0.31)</td>
<td>0.0166897 (0.56)</td>
</tr>
<tr>
<td>Multilateral Support</td>
<td>0.1880779 (1.10)</td>
<td>0.0311616 (0.24)</td>
<td>0.2077936 (1.24)</td>
<td>0.0589083 (0.44)</td>
</tr>
<tr>
<td>(</td>
<td>t</td>
<td>) Average Financial Closure Year</td>
<td>0.0051633 (0.21)</td>
<td>0.0059829 (0.31)</td>
</tr>
<tr>
<td>Observations</td>
<td>36</td>
<td>39</td>
<td>36</td>
<td>39</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.13</td>
<td>0.23</td>
<td>0.20</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Notes: ***Significant at the 1% level, **at the 5% level, *at the 10% level and `at the 15% level.
Moreover, private investors have done so at a cheap price. Table II shows that the coefficients for the dependent variables of the ratio of 100% private investments and all private investments to the country’s electricity market are both negative and significant at the 5% level. Therefore, countries with more private investments on average offer lower electricity tariff rates for their population. The R2 statistics for these models are also respectable. Moreover, these results were tested for endogeneity with a model that used only changes in prices from 1990 (the date when private investment in electricity started to happen) to 2008. Results (not shown here for space issues) here were even more significant, with both independent variables of interest being negative and significant at the 1% level. Thus, governments may want to increase their propensity to seek out private investment.

This price decline caused by increased private sector penetration in the electricity markets, however, might not be ideal for investors. Deloitte had warned merchant private investors that capacity buildup could result in tariffs that were too low to be able to recuperate the desired rate of return on their capital commitments, and thus capacity expansion constraints became a valuable tool for them. Moreover, IPPs investors are also sometimes forced to renegotiate their contracts by host governments. A drawback of this statistical model is that it cannot determine if the tariff reductions are caused by more efficient production in part of the privately owned plants or to excessive competition or forced renegotiation of contracts imposed by the host governments after investors have committed large amounts of capital.

Nevertheless, it is unlikely that the latter accounts for all of the variation in tariff levels. Woodhouse explores the ‘obsolescing bargain’ phenomenon that might affect the 75% of investors that have contracts with the host government, namely, that political pressure leads host governments to renegotiate contracts after investors have made large upfront capital commitments. However, the renegotiations described in Woodhouse’s study occur primarily in projects that due to hasty or substandard design produce significantly costlier energy than the national average, as forced renegotiation also has high political costs for the host government in face of the international community (Woodhouse). Furthermore,
that merchant competition explain all the statistical significance of the dependent variable is unlikely since merchants only account for 25% of all private power producers and additional statistical analysis shows that both merchants and IPPs contribute a comparable amount in lowering electricity tariffs.3

5.2 Hypothesis #2

Evidence in support of Hypothesis #2 is scarce. Nonetheless, the regressions used to test Hypothesis #2 follow the same pattern of the evidence seen in the Hypothesis #1 tests, but with lower levels of statistical significance. Neither the linear nor the quadratic regression for Hypothesis #2 returns a significant coefficient for the independent variable. Perhaps the reason for this is that larger projects possess some qualities yet to be observed that helps them survive crises better than their smaller counterparts. Possible explanations are political clout or better access to financing. Nevertheless, the coefficient on the quadratic term is positive, suggesting that problems may arise in projects larger than a set amount. The linear and quadratic regressions do a similar job at estimating the overall behavior of the variables used in terms of pseudo-R².

Table III: Hypothesis #2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Linear Relationship</th>
<th>Quadratic Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadratic Relative Capacity</td>
<td>-</td>
<td>20.01007</td>
</tr>
<tr>
<td>[z] - F-test of Quadratic Model</td>
<td>-</td>
<td>(0.73) – P&gt;chi²=0.64</td>
</tr>
<tr>
<td>Project Relative Capacity</td>
<td>-1.607201</td>
<td>-5.490439</td>
</tr>
<tr>
<td>[z]</td>
<td>0.64</td>
<td>0.90</td>
</tr>
<tr>
<td>100% Private Dummy Variable</td>
<td>-0.3232864</td>
<td>-0.3184372</td>
</tr>
<tr>
<td>[z]</td>
<td>1.54</td>
<td>(1.52)</td>
</tr>
<tr>
<td>GNI Per-Capita</td>
<td>0.000067*</td>
<td>0.0000679*</td>
</tr>
<tr>
<td>[z]</td>
<td>1.90</td>
<td>1.91</td>
</tr>
<tr>
<td>Financial Closure Year</td>
<td>-0.0265234</td>
<td>-0.0293827</td>
</tr>
<tr>
<td>[z]</td>
<td>0.84</td>
<td>2.56</td>
</tr>
<tr>
<td>Transmission and Distribution Losses</td>
<td>0.0310132*</td>
<td>0.0313212*</td>
</tr>
<tr>
<td>[z]</td>
<td>1.92</td>
<td>(1.92)</td>
</tr>
<tr>
<td>ICRG5.2 Index</td>
<td>-0.0417306</td>
<td>-0.043173</td>
</tr>
<tr>
<td>[z]</td>
<td>1.38</td>
<td>1.41</td>
</tr>
<tr>
<td>KAOPEN Financial Openness Index</td>
<td>0.1162043</td>
<td>0.1322951*</td>
</tr>
<tr>
<td>[z]</td>
<td>1.32</td>
<td>(1.44)</td>
</tr>
<tr>
<td>Multilateral Support</td>
<td>-0.1148751</td>
<td>-0.1036168</td>
</tr>
<tr>
<td>[z]</td>
<td>0.48</td>
<td>(0.43)</td>
</tr>
<tr>
<td>Observations</td>
<td>443</td>
<td>443</td>
</tr>
<tr>
<td>R²</td>
<td>0.07</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Notes: ***Significant at the 1% level, **at the 5% level, *at the 10% level and +at the 15% level.

An interesting finding arises from the study of the 100% private dummy variable. This variable had negative coefficients that were statistically significant at the 15% level in both regressions realized to test Hypothesis #2. This result suggests that 100% private projects actually fare better than private-public partnerships. These results run contrary to Deloitte’s

3 The same regression was ran using electricity tariffs as the dependent variable and the proportion of first only IPP projects and then only merchant projects separately and both dependent variables ended up with negative coefficients that were not statistically significant. Further, the coefficient for the dependent variable using only IPPs was larger than the one for the model that used merchant IPPs only. Therefore, it is reasonable to conclude that the combined effect of all private investments is what can significantly lower tariffs in an economy. Ask author for extended thesis if more details needed.
findings described the Literature Review section that that strong public participation aids in the success of a project. These results are far from conclusive, since the significance level had to be pushed back to 15% to include these coefficients. However, they can contribute to the case for more private investment in electricity.

6 Conclusion and lessons to be learned

*If size has a negative effect on success, it only occurs in extreme cases.* The data shows that larger projects have not fared consistently worse than smaller ones, and problems may only arise after projects reach a certain size. Moreover, even as anecdotal evidence shows that large size has been an issue for some projects, the lack of a strong relationship between project size and success suggests that large projects must have other characteristics that help them counterbalance the risks in the long term. Therefore, this study finds no evidence suggesting that private investors looking to invest in countries that already have an established private sector presence in electricity should be wary that the size of the private sector would be a large obstacle for their operations. Furthermore, the fact that this variable was not found to be a significant determinant for success is good news for developing economies, as it signals that they may be able to continue to rely on private investors to supply a good amount of their energy needs in the future.

*Governments will benefit from lower prices and higher quality electricity if the private sector is expanded.* The evidence shows that countries that have promoted more private sector involvement in their electricity sectors in average have seen reductions in their tariff rates and in the presence of blackouts. This could be an explanation for the lack of significance in the relationship between size and distress. Since private projects have actually been effective at lowering prices, the countries with more private involvement may be better suited to respond to times of crisis. This conjecture, however, has not been explored in this study and more work is needed to determine if a dynamic such as the one described above occurs.

References


THE ROLE OF THE INFORMAL SECTOR IN EQUITABLE WATER DISTRIBUTION:
A CASE STUDY OF THE TANKER MARKET IN AYN AL-BASHA, JORDAN

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Harvard College

ABSTRACT

This paper investigates the extent to which the informal water market equitably distributes water to urban households. Stated differently, given a government monopoly that falls short of its purpose, can the “invisible hand” equitably distribute a precious resource? Development economists commonly find evidence of ethnic discrimination—here defined as horizontal inequity—and regressive pricing—here defined as vertical inequity—in free market settings, while contradictory neoclassical analysis suggests that mutual self-interest will result in a naturally equitable marketplace. The paper probes this under-researched question by constructing a household water demand model with household-level data gathered during a field survey in July and August 2009 of 265 households in the Emir Ali neighborhood of Ayn al-Basha, Jordan. The paper uses the household water demand model to analyze the equity characteristics of the local water market using OLS and IV methods. The results suggest that the informal market is non-discriminatory but exhibits regressive pricing, which implies that the informal market falls short of a truly equitable distribution.

1 Introduction

In an interview, Munther Haddadin, the former Jordanian Minister of Water and Irrigation, summarized the implications of his country’s water scarcity on the optimal distribution of the resource at the household level: “Local water stress can only be met with a unity of purpose, which requires equity” (Interview K, 2009). Local distribution of water in Jordan occurs through not only the formal sector—the public water utility—but also through informal entrepreneurs who sell water from tanker trucks to households. Equity in the formal market is ensured by 91% access rates to water and a progressive tariff structure (World Development Indicators, 2005). In the tanker market, however, the level of equity is unknown.

There are two types of equity: horizontal equity and vertical equity. Horizontal equity concerns the similar treatment of all similar households and the dissimilar treatment of all dissimilar households. The designation of a similar versus a dissimilar household should only be made on the basis of willingness to pay (WTP) differences among households, and not issues of race, ethnicity, or religion. I call horizontal inequity discrimination. Vertical equity occurs when pricing is progressive, like progressive taxation (Mohamed, Kremer,
This paper investigates the extent to which the informal water market improves the horizontal and vertical equity of water access and distribution. Stated differently, given a government monopoly that falls short of its purpose, can the “invisible hand” equitably distribute a precious resource? Using the Emir Ali neighborhood of Ayn al-Basha, Jordan as a case study, I find mixed results: the informal market is non-discriminatory, but exhibits regressive pricing.

In brief, the findings presented in this paper are based on empirical, qualitative, and quantitative case study research. The basis of the study is a randomized survey of households I conducted in Ayn al-Basha during August 2009. The survey concerned household demographics, water use, and water satisfaction. I also conducted in-depth interviews of key informants at the local and national levels, including in the health care sector, the local water authority, the national water office, and private firms that operate in the water sector. Despite detailed study of the local context of water service provision, the case study of Ayn al-Basha is necessarily a snapshot in time, as I was unable to conduct longitudinal studies. My work remains, however, the first step into an under-researched field.

This paper presents the first econometric inroads to understanding the phenomena of the informal market in distributing water to urban households. As climate change accelerates the aridity of already water scarce countries—namely those in the Middle East—establishing mechanisms that equitably distribute this precious resource will become matters of domestic political stability and global security. Most likely, higher water scarcity will mobilize the informal market to play a greater role in resource distribution. Development economists and natural resource practitioners must understand the informal market and find ways to improve its performance. The inter-disciplinary methods mobilized in this paper can be applied to other informal markets in the region.

1.1 The Household Water Market and the Invisible Hand

The formal sector in Jordan inadequately distributes water due to the severe water scarcity facing the country (FAO, 2009). This problem is regional; according to the International Water Management Institute, the Middle East is the most water scarce region in the world (2009). In response to its extremely low levels of water, the Jordanian government rations water. Residents store water in tanks, such as shown in Figure 1A. Local entrepreneurs capture residual household water demand by selling spring water directly to households from water tanker trucks. The water tanker market exhibits the three characteristics of the market laid out by Adam Smith: the interaction of supply and demand, competition, and self-interest (Smith, 1759). The tanker market is informal because the Water Authority Jordan (WAJ) does not regulate the tanker prices, and thereby operates without meaningful institutional oversight or regulation (Interview N, 2009; Odeh, 2009; Sass and Brubach, 2008).

Household demand in the informal water market, let alone the level of equity in the market, is currently poorly understood. Two competing hypotheses exist on the ability of
this special water market to equitably distribute the resource. On the one hand, neoclassical economic analysis suggests that the tanker market results in equity gains because it exists as a free market response to the inefficiencies of the public market. Both the suppliers and consumers voluntarily enter the market so even if there is inequity, it must improve welfare based on the assumption that households are rational economic actors. On the other hand, development economic analysis suggests that households have no choice but to enter the informal market to meet household water needs. As a result, these households exhibit extremely inelastic demand for water and must accept the price set by the suppliers. The tankers maximize profit by favorably distributing to households in their family network, which creates inequity in the forms of discriminatory distribution and a regressive pricing scheme.

1.2 Local Context

Ayn al-Basha is a city in the Balqa governorate, adjacent to Amman, the capital city of Jordan. Figure 1B is a regional map of Emir Ali, a small neighborhood of about two square kilometers and 1,383 households (Dorsch Consult, 2007). Figure 1C outlines the area of Emir Ali neighborhood. This area is ideal to study the informal water market for four reasons:

1. Emir Ali, with its Muslim majority and level of water scarcity, is representative of other areas in the region (Department of Statistics, Jordan, 2006; Sass and Brubach, 2008). Hence, this case study may be meaningfully generalized to the greater region.
2. The local tanker water market is robust because household water demand is greater than piped water supply due to the use of sub-par materials and low-skilled public workers.
3. Both public workers and households in the area are familiar with foreign water professionals who work in coordination with international organizations.
4. The neighborhood exhibits high levels of ethnic diversity because it is adjacent to the Baqa’a Palestinian refugee camp. This enables the exploration of discrimination issues.

1.3 Literature Review

The empirical literature confirms that household water demand obeys the law of demand. First, water demand increases as household size increases, but less than proportionally due to household economies of scale (Strand and Walker, 2005; Whittington and Bal Kumar, 2005). Second, numerous studies establish that household demand for primary sources of water is inelastic, which is consistent with demand for a necessary good (Ruijs, Zimmerman and Van den Berg, 2008; Strand and Walker, 2005).

In addition to demand elasticity, many authors consider income elasticity. Kanyoka, Farolfi, and Mordet (2008) combine an analysis of demand and income elasticity by considering how demand elasticity of a household changes as income changes. Their model uses a choice modeling approach in surveying to determine household preferences
and WTP, willingness to pay, for water services in rural South Africa. The households surveyed had only inconsistent water access. The authors find that households with lower incomes have higher price elasticity, which negatively impacts their WTP, as compared to more well off households. Strand and Walker (2005) find income elasticities below 0.1. Additionally, lower income households are often those with more children.

While there is some disagreement on the particular level of income elasticity, there is near universal agreement that household demand for its primary source of water exhibits positive income elasticity. Hajisyprou, Koundouri, and Pashardes (2002) establish the theoretical basis of water as a normal good, and Le Blanc (2008) empirically demonstrates this finding. He finds that household expenditures on water increase with income and the percentage of income spent on water decreases with income. In South Asia, Le Blanc finds that households spend, on average, 2% of their income on water consumption. The share of income increases to 3.5% in Latin America and Eastern Europe. No comparable review papers consider the Middle East.

The preponderance of the literature on household demand for water from the informal market is based on studies in peri-urban areas where the informal market is the sole supplier of water to these households. In such situations, the household water demand exhibits the same qualities as the demand for water from the formal sector. This is not representative of Ayn al-Basha, however, because households use both the piped water and tanker water supply. When households are presented with water from the informal sector to supplement or substitute for water from the formal sector, such as in my study area, then demand may be different. In fact, Strand and Walker (2005) note an enormous effect of the water’s source on the household’s level of demand elasticity. Additionally, numerous papers by Dale Whittington, considered by many to be the preeminent economist on water demand in all of its forms in the developing world, find that the mix of water supply sources available to households changes the optimal household consumption of the various sources (Whittington and Bal Kumar, 2005).

I can find only one paper that constructs household demand in the informal market based on observed behavior. Many other authors, such as Whittington, use the household cost of coping mechanisms and contingent valuation surveys to estimate household water demand (Whittington, et al., 1990; Whittington and Bal Kumar, 2005; Whittington, Lauria and Mu, 1991; and Whittington, Mu, and Roche, 1990). Iskandarani’s (2001) seminal paper is notable not just because it applies econometric analysis to a new market, but also because she does so in Jordan.

Iskandarani (2001) models household demand for the tanker market based on a household survey of 200 households in Jordan conducted in the summer of 1999. She first models the discrete choice of households to consume tanker water based on the price of the tanker water, the amount of piped water that the household receives, the household’s monthly income, the household’s water storage capacity, and the household’s level of satisfaction with piped water supply. Iskandarani does not explain, however, why households have a choice at all to consume tanker water or piped water, or if the quantity of piped water is set exogenously to the household. Iskandarani finds that household demand for tanker water is
price inelastic. She finds that when the full price of water is considered, households spend more than 1 to 3% of income on water than is currently assumed.

1.4 Overview of the Paper

The paper proceeds in four sections. Section II presents the theoretical model of household water demand. The assumptions of the model are based on the dominant assumptions in the literature and my assessments from fieldwork. The model predicts both horizontal and vertical inequity. Section III describes the data mobilized to evaluate the theoretical model. Section IV uses the data to empirically investigate the informal water supply in Emir Ali neighborhood. I construct household demand for tanker water using instrumental variables, as suggested in the water demand literature. I find no evidence of horizontal inequity, and some evidence of vertical inequity. Finally, Section V concludes.

As demonstrated in the literature review, very few microeconomic papers convincingly construct household demand for water from observed household behavior, let alone demand for a good in the informal market. This paper advances the natural resource and development economics literature by addressing this challenge.
2 Theoretical Model

“If you don’t have (money), then consume less...and some people, they wash the trees.”
-Answer of a water official in the government in response to a question about the variation in water use among local households, 11 August 2009

This section presents an analytical framework for determining the equity of the private water market operating in tandem with the public market. The framework models and evaluates horizontal and vertical equity in the tanker market. To do this, I first construct a theoretical model of household water demand. From there, I examine both whether the household characteristics that influence water demand are congruent with horizontal equity and whether the dominant pricing structure exhibited by the demand curve is consistent with vertical equity.

I build household demand for tanker water based on fundamental water needs. Households require a certain quantity of tanker water for basic survival and will pay all of their income, short of income for other necessary goods like food and shelter, to receive this quantity of water. Household consumption at all quantities less than or equal to the survival quantity will take place irrespective of the price of the tanker water. Once the basic quantity is secured, however, household willingness to pay (WTP) for water is a function of its price, and households will consume less water as the price increases. At low quantities of household water consumption, a small decrease in price induces a large increase in water consumed, while at high quantities of household water consumption the household already has sufficient water and needs a large decrease in the price to warrant purchasing any additional quantities. The household demand curve for tanker water that exhibits these characteristics is shown in Figure 2A.

The supply relationship is similarly constructed. Tanker drivers exhibit a degree of power in setting prices, which allows them to better recover costs and increase profits. In essence, this means the more a given household consumes, the higher price the tanker driver will charge the household for the water. A tanker supply curve exhibiting such monopolistic competition is shown in Figure 2B.

The interaction of the household demand and tanker driver supply creates the tanker water market, as shown in Figure 2C. The optimal allocation of water, on the figure, occurs at the intersection point of the supply and demand curves.

One would expect all households of similar income levels to share the same equilibrium point. However, my interviewees suggested that at each income level, Jordanians, or those with influential family networks, are preferentially served by the market relative to Palestinians, or those without influential family networks. Although both ethnic groups may access the market, ethnicity results in two market demand curves and water allocations rather than one, as shown in Figure 2D. If true, this violates horizontal equity. This conclusion is expected because tanker water is distributed within family networks, so tanker drivers set lower prices to their family than to other consumers. Given that families are all of one ethnicity, the model predicts the tanker market is horizontally inequitable because the price the tanker driver sets for water is determined by ethnicity.
Additionally, the shape of the demand curve presented predicts that the tanker market will be vertically inequitable. As shown in Figure 2E, the quantity of water consumed by poor households is closer to their minimum survival level, thus occurring at a place on the demand curve with nearly complete inelastic demand. Therefore, price-setting tanker drivers may improve their profit margin by exploiting this high inelasticity and setting higher prices for poor consumers than for wealthy ones.

The appendix derives a model of household demand for tanker water to support these predictions.

2.1 Theoretical Applications of the Model on Equity

The theoretical model of the tanker market forms the basis for predicting the extent to which the tanker market improves equity in the water market. An analysis of horizontal and vertical equity in the water market surveys the household distribution of access to fairly priced, high-quality, reliable, satisfactory water. The model captures household access by the quantity received and the price paid at the household’s optimal demand. The demand defines the household’s willingness to pay for the water, or the value of the tanker water to the household.

2.2 Horizontal Equity

Evidenced by the role of $C$ in the theoretical model, the tanker market is horizontally inequitable because household ethnicity mediates household access to tanker water. The discrimination effect is demonstrated in the optimal quantity demanded, the elasticity of demand, and the income elasticity. Holding all else constant, Equation (15) in the Appendix predicts that Palestinian households will consume an amount less of tanker water than Jordanian households

$$\Delta M_T^* = \frac{-w}{2q_T} (y - \alpha_{\text{min}}).$$

Likewise, holding all else constant, Equation (16) predicts that Palestinian households will have less elastic demand than Jordanian households across all quantities

$$\Delta \varepsilon_{D(e)} = \left[ \frac{1}{(1-w)} \frac{y - \alpha_{\text{min}}}{2q_T} \right].$$

Equations (16) and (17) demonstrate that Palestinian households derive less utility from a given quantity of tanker water consumed than their Jordanian counterparts. Finally, holding all else constant, Equation (15) in the Appendix predicts that the income elasticity of Palestinian households will be half that of the Jordanian households. Lower income elasticity means that Palestinian households across different income groups will have less variation in tanker water consumption patterns than Jordanian households, and be charged more at every quantity consumed than their identical Jordanian counterparts. None of the other variables in the theoretical model pose a threat to the horizontal equity criteria.

Figure 2D illustrates the horizontal inequity evidenced by the model. The figure modifies the depiction of the household demand curve to represent only the price, $\varphi$, along
the y-axis, rather than \( \phi C \) as in the other figures. In Figure 2D, \( C \) impacts the shape of the household demand curve. The graph shows that for equivalent levels of consumption, Jordanian households always pay less per cubic meter than Palestinian households. The difference in demand between the ethnicities peaks at a consumption quantity past the minimum level of water required by the household. Additionally, as the Jordanian demand curve is always greater than the Palestinian demand curve, the Palestinian households have less elastic demand, as the model predicts.

2.2 Vertical Equity

The theoretical model predicts that the tanker market is vertically inequitable. As explored in the horizontal equity section, the theoretical market model predicts that Palestinian households will pay more per cubic meter because the tanker drivers will respond to the differential WTP by charging the Palestinian households more to exploit the associated efficiency gains. The additional price that the Palestinian households must pay to consume the same amount of water as their otherwise equal Jordanian counterparts is double the price that the Jordanian households pay

\[ M_r(H_J) = M_r(H_P) \quad \text{if} \quad \phi_J = \frac{\phi_P}{2}. \]  

(18)

The pricing structure is most regressive when the level of piped water consumed by the household does not meet the household’s \( M_{\text{min}} \) for two reasons. First, poor households are more inelastic in the tanker market than in the piped water market, given the elasticity of piped water supply. Second, usually a small increase in price means that the tanker driver will lose a considerable amount of quantity supplied, however households have extremely high tolerance for price increases in their survival surplus portion of the demand curve. Therefore, tanker drivers may face an incentive to increase prices for households that consume less water, which in most cases are the poorest households.

2.3 Limitations of Model and Theoretical Analysis

The theoretical model is the best approximation for actual behavior in the tanker market in Ayn al-Basha because nearly all assumptions are based on observation and interviews, and not solely on the models in the literature. However, no model can capture the diversity of choices facing households and their resulting behaviors. The model does not account for family time investments in consuming tanker water, such as boiling and freezing water. Although the quality and reliability of the tanker water may impact the vertical equity of the market based on which households disproportionately bear the costs of low quality and unreliable water, these differences have been assumed negligible in the theoretical model. Also, while \( n \) is likely exogenous in the short term (or < 9 months), \( n \) may be endogenous in the long term (Becker, 1991). Additionally, \( \text{wasta} \) is not as simplistic as a binary variable that represents household ethnicity. There are enormous ranges of influence demonstrated by households. In many cases, relative levels of social power are not clear to the researcher, but future iterations of the model should relax the assumption of \( \text{wasta} \) as a binary variable.
THE ROLE OF THE INFORMAL SECTOR IN EQUITABLE WATER DISTRIBUTION:

Figure 2A.

Figure 2B.

Figure 2C.

Figure 2D.
3 Data

“Studies are needed to focus on understanding the nature of household demand for water and should attempt to express it in terms of household demand functions.” - An appeal for new research by Munther Haddadin, the Former Minister of Water and Irrigation in his 2006 book, *Water Resources in Jordan*

The quality of the data available to a study determines the basic value of an empirical investigation. My data comes from three sources. First, the Water Authority Jordan (WAJ) central statistics office in Amman provided the household-level piped water data. Second, I used Geographic Information Systems (GIS) to interpret all of the household-level geographic relationships from the maps of Emir Ali neighborhood in Ayn al-Basha. Engicon produced the maps in coordination with Dorsch Consult. Third, all other household-level data comes from a randomized household-level survey that I conducted in Ayn al-Basha during 2009. Each set of data offers its own advantages and limitations that in concert uniquely qualify this paper’s novel investigation of equity in the informal market.

3.1 Government Data

The centralized urban water database unit of WAJ, one of the three main institutions of the Ministry of Water and Irrigation, provided me with household piped water consumption and corresponding pricing from 2006 through 2009 based on household water meters for the Prince Ali neighborhood in Ayn al-Basha. I am confident in the precision of the consumption figures from the government that I received, however I suspect that many wealthy households who consume vast quantities of water were left off of the consumption rolls because they do not pay for the water. This may create an under-reporting bias.

3.2 Geographic Data

During the time of my research, Engicon, Dorsch Consult, and Reetaj were finishing up a project on behalf of WAJ to reduce non-revenue water at the tertiary sector, or leaking piped water at the household level. As part of the early stages of this project, Engicon created detailed, interactive maps of Ayn al-Basha, including the piped water network,
houseplots, and altitude. The maps have been useful in two primary ways. First, I used the map with the uniquely identifying houseplot numbers during the summer 2009 to conduct the randomized household survey. Second, I used the piped water sector information to test the assumptions of the theoretical model that households stochastically received a quantity of piped water sufficient to cover their minimal survival needs.

3.3 Survey Data
Methodology

All other data comes from the randomized household survey of 295 households (ME 1.8%) that I conducted over three weeks during July and August 2009, in the Prince Ali neighborhood of Ayn al-Basha. Pre-field work, a uniquely identifying houseplot number, randomly chose the households to be surveyed. Every household survey followed the survey script. The surveys were conducted in Arabic with a translator unless the respondent elected to speak in English.

The final sample is only 265 households. Ten households declined to participate in the survey, I was unable to interview seven households, and an additional thirteen surveys had to be excluded due to failure to follow the survey script. The respondents at households who declined to participate did so only when I was with a male translator. I speculate that this was due to the cultural apprehension about speaking with non-familial males. These families were scattered throughout the study area, so I expect their exclusion to create no bias in the survey. At the seven households where I was unable to find someone to interview, the house itself was either under construction or there were only family members under the age of 18 at home. The exclusion of the households under construction has little bearing on the distribution of households included in the survey because these houseplots do not yet represent families demanding tanker water until they live in their homes.

On the other hand, the second class of families who I was unable to interview due to no adult being present are likely the very poor families in which both parents (and any grandparents) select to work outside of the home and do not come home for lunch time (as is customary). As I only surveyed during normal working hours (8AM to 4PM), these very poor households are thus excluded. Consequently, my equity analysis will likely overestimate the true equity effects because the poorest of the poor have been excluded. Finally, the households who were excluded due to not following the household script were randomly distributed throughout the area and more often than not occurred on the first day of a translator’s time with me.

3.4 Variables for the Empirical Investigation

The primary variables used in the analysis are the dependent and independent variables. The key dependent variable is the tri-monthly consumption of tanker water. I consider all households in the survey area—those that consume tanker water and those that do not consume tanker water. The tri-monthly consumption is the total volume of a household’s ground level and rooftop tankers multiplied by the probability that the tanker water comes daily, multiplied by 90 for the number of days in three months. If a household does not

1 I received approval for the research from the Harvard University Committee on the Use of Human Subjects.
consume tanker water then the family has a zero probability of consuming tanker water on a given day, then the household’s tri-monthly consumption of tanker water is 0. I use a three-month time period because this is the period over which piped water billing occurs.

The key independent variable is the per cubic meter cost of tanker water. As in many other utility markets, no distinction can be made between the average and marginal cost of the tanker water due to the structure of this question in the survey. The question asked respondents: “How much do you pay per cubic meter for water from tankers?” The price included in the regressions, thereby, is the average price and the marginal price is indeterminate.

The empirical investigation of equity relies on the accuracy and precision of two household-level characteristics: income and ethnicity. Regarding household ethnicity, this was gathered carefully and incidentally. As a foreigner, it was inappropriate and politically incorrect in all circumstances to ask any individual his or her ethnicity. Many locals regard this to be an improper question to ask each other as well, although at times my translators encountered resistance during the survey when the interviewee refused to continue unless the translator said to be of the interviewee’s ethnicity. Household ethnicity was recorded only when one of the following three situations occurred: the interviewee volunteered his or her ethnicity during the course of the survey; the interviewee gave his or her surname and the surname is known to be of one ethnicity or another; or the interviewee spoke in the dialect consistent with one ethnicity or the other.

4 Empirical Investigation

“Water didn’t come this week and pressure was bad last week, so we haven’t bathed....”
-Respondent from Household 252 describing her satisfaction with the quantity of water supplied, 19 July 2009

This section empirically tests the predictions of horizontal and vertical inequity in the tanker market from the model in Section II, with the data described in Section III. The objective of this section is three-fold: first, to confirm empirically the assumptions of the theoretical model; second, to construct household demand for tanker water; and third, to use demand to test the predictions of horizontal and vertical inequity from the theoretical analysis.

I begin by confirming two assumptions underlying the theoretical model: one, the tanker water is a uniform good, or a good that is identical across all units sold; and two, all households have equal access to the tanker market. Next, I construct household demand for tanker water. Due to simultaneous determination of price in demand and supply models, I reduce the threat of reverse causality in the demand function by constructing the tanker water price that the household faces using household characteristics, or instrumental variables (“IV”), that determine the price and do not determine the quantity demanded by the household.

I use the predicted demand to determine the level of equity in the tanker market. First, I reject the predictions of the theoretical model by finding evidence of horizontal equity. I find the ethnicity variables insignificant in the demand equation, which means
discrimination does not determine tanker water consumption. This result is robust to the demand specification. On the other hand, I confirm the theoretical model’s prediction of vertical inequity. Using means tests, I find that the poor pay more for tanker water given their household income than the rich, which is evidence of a regressive pricing structure.

4.1 Methodology

Constructing Demand

Demand for a normal good, such as water, is a function of three considerations: the price of the good; household income—their budget constraint; and household preferences. I mobilize the empirical implications of the model in Section II to specify the demand relationship among these factors.

The naïve model is the simplest version of household demand for tanker water. This model simply regress the quantity of water consumed on the price of water, controlling for the household’s budget constraint and household preferences:

\[
\ln(\text{Quantity Consumed}) = \beta_0 + \beta_1 \ln(\text{Price}) + \beta_2 \ln(\text{Income}) + \beta_3 \ln(\text{Preferences}) + \epsilon
\]  

where \(\text{Income}\) is a vector of a household’s relevant budget constraint variables, \(\text{Preferences}\) is a vector of a household’s relevant preferences variables, and \(\epsilon\) is the common measurement error. Elasticity of demand is defined as

\[
\varepsilon_D = \text{The \% change in quantity given a \% change in price} = \beta_1
\]  

The results of the naïve model are threatened by simultaneity bias, which results from reverse causality between variables. Assuming that water is a normal good, reverse causality could arise in the demand equation if the price impacts the quantity consumed and vice-versa. This creates bias in the estimation of demand elasticity that may lead to spurious results.

I disentangle the effect of price in the demand equation from the determination of price in the supply equation by creating the price variable anew. I extract of price what is meaningful to households but not meaningful in determining the price in the supply equation. I use four instrumental variables:

- **House_Years** - the number of years the household has lived in the house. The longer the family has lived in the same house, the more likely they are to be established in the community and have established stronger social connections with local business owners, including tanker drivers. These households face the low tanker price. The time that a household has lived in an area has no bearing on how much tanker water the household consumes;

- **Prob_Piped** - the probability that the piped water comes to the household over the course of a representative day. The lower the probability that water will come, the greater the desperation of the household, and the higher the price that the household will support. Note that the probability of piped water supply is not directly correlated with the quantity of piped water that comes during a particular supply period;

- **Reader** - whether or not the household knows their water meter reader. Knowing the water meter reader indicates how well connected to the local community is a household. It also demonstrates the respondent’s attention to the individuals that handle the household’s water. There is no reason why knowing the piped water meter reader would motivate higher or lower demand for tanker water; and
Each of these instruments consistently and efficiently estimates the endogenous parameter, \( Price_{Low} \). I confirm by testing the exogeneity and relevance of each instrumental variable. The instruments are relevant because each is strongly correlated with the tanker price, or the covariance of the instrumental variable and the endogenous independent variable, \( Price_{Low} \), is not zero. The practical test for relevance is the first stage F-statistic, which must be above 10. An instrument is valid if it is not correlated with the quantity of tanker water that the household consumes, or if the covariance of the instrumental variable and \( \varepsilon \) is equal to zero. The test for exogeneity is the Hansen J-statistic of the over identifying restriction test, which is the F-statistic computed using the homoskedasticity-only chi-squared distribution with \( m-k \) degrees of freedom.

The IV with Continuous Price model is as follows:

First Stage:

\[
\overline{Price} = \beta_0 + \beta_1 House\_Years + \beta_2 Prob\_Piped + \beta_3 Re\_ader + \beta_4 Unskilled \\
+ \beta_5 Income + \beta_6 Preferences + \beta_7 Preferences * Preferences + \varepsilon
\]

Second Stage

\[
\text{Quantity Consumed} = \beta_8 + \beta_9 Over\_Price + \beta_{10} Income + \beta_{11} Price * Income + \\
\beta_{12} Preferences + \beta_{13} Preferences * Preferences + \varepsilon
\]

where all variables are defined as above. The elasticity of demand is

\[
\varepsilon_D = \frac{\% \text{ change in quantity given } \% \text{ change in price}}{Price_{Consumed}} = \frac{(\beta_1 + \beta_3 * Income) Over\_Price}{Quantity\_Consumed}
\]

The estimation of tanker water demand may be biased if there are any omitted variables. Possible omitted variables include the altitude of the household’s houseplot and the quantity of water received from other water sources. First, a local Jordanian mid-level worker in the water sector suggested that altitude directs tanker water consumption in Ayn al-Basha because the households at highest altitude receive insufficient quantities of water from the piped supply. These households must rely on tanker water to meet their water needs (Interview A, 2009). I tested this effect by including the altitude in the demand regressions. I determined houseplot altitude by interpolating from the altitude isoclines at 50-meter intervals in the GIS data of Emir Ali from Engicon (Engicon, 2009). I found altitude to be insignificant and non-informative in the demand regressions. Therefore, the omission of altitude from the demand function does not bias the results.

Second, the quantity of water received from other water sources may affect the quantity of tanker water demanded if a household receives large amounts of water outside of the tanker and piped water sources. In this case, the quantity of water received by the
household from the third source of water should be controlled as the quantity of piped water is controlled. My survey includes household level data on bottled and cooler water consumption. I included this water in the demand regressions and found bottled and cooler water consumption to be insignificant and non-informative. However, many households also consume spring water. The survey did not ask households how much spring water they consume. If the omission of household spring water creates omitted variable bias, then this would overestimate household demand for tanker water because consuming spring water leads a household to consume less tanker water and be less willing to pay more for tanker water. The threat of this bias is minimal because only a small fraction of households in the area also consumed spring water.

4.2 Testing Equity

First, I test horizontal equity by including ethnicity in the demand function, as given by the theoretical model. The specification becomes

First Stage:

\[
\text{Price} = \beta_0 + \beta_1 \text{House\_Years} + \beta_2 \text{Prob\_Piped} + \beta_3 \text{Reader} + \beta_4 \text{Unskilled} + \\
\beta_5 \text{Income} + \beta_6 \text{Preferences} + \beta_7 \text{Preferences} * \text{Preferences} + \beta_8 \text{Ethnicity} + \\
\beta_9 \text{Ethnicity} * \text{Income} + \epsilon
\]

(6)

Second Stage

\[
\text{Quantity Consumed} = \beta_{10} + \beta_{11} \text{Price} + \beta_{12} \text{Income} + \beta_{13} \text{Price\_Low} * \text{Income} + \\
\beta_{14} \text{Preferences} + \beta_{15} \text{Preferences} * \text{Preferences} + \beta_{16} \text{Ethnicity} + \\
\beta_{17} \text{Ethnicity} * \text{Income} + \epsilon
\]

(7)

The null hypothesis is \( \beta_{16} = \beta_{17} = 0 \), and the alternate hypothesis is \( \beta_{16} = \beta_{17} < 0 \). There is ethnic discrimination in the tanker market if I reject the null hypothesis, and there is discrimination against households of Palestinian ethnicity if I reject the null in favor of the alternate hypothesis.

Additionally, I check to see if the result is robust to alternate specifications of demand by determining the relationship between ethnicity and the quantity of tanker water consumed at its most basic linear relationship with all possible interaction terms, as given below

\[
\text{Quantity consumed} = \beta_0 + \beta_1 \text{Price} + \beta_2 \text{Family members} + \\
\beta_3 \text{Piped Water Consumed} + \beta_4 \text{Frequency Piped Water Supplied} + \beta_5 \text{Income} + \\
\beta_6 \text{Ethnicity} + \beta_7 \text{Price} * \text{Ethnicity} + \beta_8 \text{Family members} * \text{Ethnicity} + \\
\beta_9 \text{Piped Water Consumed} * \text{Ethnicity} + \\
\beta_{10} \text{Frequency Piped Water Supplied} * \text{Ethnicity} + \beta_{11} \text{Income} * \text{Ethnicity} + \epsilon
\]

(8)

The null hypothesis that \( \beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = 0 \), and the alternate hypothesis is that \( \beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} < 0 \). There is ethnic discrimination if I reject the null hypothesis, and there is discrimination against Palestinian households if I reject the null in favor of the alternate.
I test vertical equity by analyzing the distribution of costs for tanker water across the households on the basis of income. First, I confirm that tanker water is a normal good by analyzing the income elasticity in the optimal model, the IV with Continuous Price model. The income elasticity is

$$\frac{\partial M_T}{\partial (y-\alpha_{\text{min}})} = \frac{(\beta_{10} + \beta_{11})\text{Income}}{\text{Quantity Consumed}}$$

(9)

The theoretical model assumes that tanker water is a normal good, so I expect positive income elasticity.

Second, I analyze the variable role of tanker water consumption in a household’s budget constraint. I determine who pays the highest prices for water, absolutely and relatively. Additionally, I discuss the role of coping mechanisms in clarifying the level of vertical equity.

4.3 Demand Results

The informal market plays a significant role in providing households access to water. The total water supply for three months to households averages 55.9 cubic meters. Forty-six percent of households use tanker water in some capacity. On average, tanker water constitutes 8.4% of household water supply.

4.4 Uniformity of Tanker Water

I test the assumption from the theoretical model that tanker water is a uniform good. If tanker water is not uniform, then the quantity demanded should be qualified by the quality of the water, as suggested by Olmstead (2010) and the World Bank (1995).

Based on my field research, I predict that there is only one variety of tanker water. Though the water comes from different springs, the tanker drivers consider the quality of the water at these different springs equivalent because they are all equally monitored by the government and the tanker drivers switch among the various springs when filling up the tanks depending on the daily quota of water to be sold at the springs, which is announced each morning by the spring owner.

The alternate hypothesis is that there are multiple varieties of tanker water. If there were more than one variety, I would expect the better quality water to be more expensive. To test the alternate hypothesis, I run an OLS regression with heteroskedastically-robust standard errors of the per unit price of tanker water on the household’s satisfaction with tanker water, controlling for the household’s satisfaction with piped water. Table 4A presents the results. Regression 1 includes the most relevant satisfaction variables to the perceived “quality” of the water. Regression 2 includes additional satisfaction variables. Finally, Regression 3 includes only the aggregate satisfaction variables, the Satisfaction Index variables, for tanker and piped water.

As the table shows, the only significant predictor of the per cubic meter cost of tanker water is satisfaction with the quantity of tanker water received. The significant variable describes the quantity dimension of the uniform good and not the quality dimension, so it
does not indicate that there is more than one quality of tanker water. The significance of the Satisfaction Index in Regression 3 suggests that the price paid influences the perceived quality of the water, but Regression 4 confirms that this significance comes wholly from the satisfaction with the quantity of the tanker water supplied as the price per cubic meter increases. I conclude that the tanker water in the study area is a uniform good.

4.4 Predicting Tanker Use

In order to construct household demand for tanker water, all observed households must be on the same demand curve. The theoretical model demonstrates that this occurs as long as two conditions are met. First, no household that uses tanker water to meet its minimum survival threshold should be considered in the data set. Since such a household would have an exorbitantly high willingness to pay for tanker water, this behavior would not accurately represent the normal tanker market. Therefore, all households must meet their minimum water needs through the piped water network. This insures that the portion of the demand curve of all households that does not increase utility—since it is below the survival level—is piped water. Second, WTP characteristics should be the only demographic household characteristics that explain whether or not a household uses tanker water. If a particular household characteristic excludes a household from the tanker market, then household demand will be biased. As long as these two conditions are met the consumption and price data from all households will construct one demand curve, after controlling for WTP characteristics.

The first condition is met if households receive more piped water than the minimum quantity required for survival. The full model from Section II in the Appendix adopts the assumption from Gleick (1996) that humans require at least 20L of water per day for basic survival, or 1.8 cubic meters of water per person over a three-month period. Empirically, I find that the average level of piped water consumption per person among households is 9.175 cubic meters for three months, with a range extending from a minimum of 1.88 cubic meters to a maximum of 67.38 cubic meters. This demonstrates that all households included in the survey meet their minimum water needs through piped water, and confirms the applicability of the theoretical model to household water demand in Emir Ali.

I test the second condition by determining which characteristics differentiate families that consume tanker water from those that do not consume tanker water. To determine which household characteristics, if any, are significantly related to the use of water tankers, I regress the Tanker Use dummy on all household characteristics. The Tanker Use dummy is 1 if the household uses tanker water. Table 4B presents the household characteristics that are expected to influence water demand. None of the characteristics are significantly related to Tanker Use, indicating that there is no demand-based reason why some households use tanker water and others do not and it must instead be related to the particular water supply conditions of a household.

Table 4C considers whether any other household demographic characteristics are correlated with the Tanker Use dummy, including the household’s ethnicity. The only significant coefficient is whether the respondent is male or female. Regression 1 suggests that when the sex of the survey respondent is male, then the household is 15.0% less likely
to use tanker water. This is likely because males advocate better for the household to
the local water ministry to ensure that the household’s water needs are met through the
piped water. Ethnicity is included in each regression, though it is never significant. This
invalidates the theoretical model assumption that Palestinian families are more likely to
purchase water from tankers as a result of under-fulfilled water needs from the piped water
network.

The only significant difference between families that use tanker water and those that do
not use tanker water is whether or not the piped water network provides for the water needs
of the household. There are no demographic household characteristics that explain the
distribution of household tanker water use, including ethnicity. All observed households
share the same demand curve because both conditions are upheld. The empirical household
demand construction may proceed by the assumptions of the theoretical model.

4.5 Specifying Demand

Given the wide array of available budget constraint and preference variables available in
the data to measure household demand for tanker water, I use the naïve model to determine
which have the most explanatory power. The best model is

\[ \text{Quantity Consumed} = \beta_0 + \beta_1 \text{Price} + \beta_2 \text{Income} + \beta_3 \ln(\text{Family members}) + \]
\[ \beta_4 \text{Income Low} + \beta_5 \text{Income Middle} + \beta_6 \text{Income High} + \]
\[ \beta_7 \text{Piped Water Consumed} + \beta_8 \text{Tank Volume} + \]
\[ \beta_9 \text{Rooftop Tank Volume} + \beta_{10} \text{Tanker Satisfaction Index} + \epsilon \]  

4.6 IV with Continuous Price Model Results

First, I confirm the relevance and relative exogeneity of the four instruments using
as indicators the second-stage F-Statistic and J-statistic. The F statistic is 14.195, well
above the desired 10, confirming relevance. The J statistic is 2.794, which rejects the
null, and suggests that the instruments are jointly valid. This model most successfully
constructs household tanker water demand because it best explains the variation in the
independent variable, the price. Additionally, this model largely confirms the predictions
of the theoretical model.

Table 4D presents the results and Figure 4A illustrates the constructed demand
relationship. There are five significant determinants of household tanker water demand. When the price increases by one JD, household consumption of tanker water decreases by
3.5 cubic meters. This amount—more tanker water than the average household consumes
in one month—is considerable. This result is consistent with the traditional model of
household demand and with the theoretical model’s predictions.

Additionally, with each additional family member, the household demands about 1
additional cubic meter per month, or 1000 liters of water per month. As there are returns to
scale in household water use in terms of cooking, cleaning, gardening and other household
activities, it is consistent with the existing literature that a marginal family member would
require the household to reconfigure household water demand just above the quantity
required for survival (i.e. 600 liters per month). The theoretical model predicted the
positive relationship between demand and the number of family members.

All of the variables are consistent with the predictions of the theoretical model, except for income, which is discussed below. To confirm that the elasticity differential is not caused by a difference in the quantity of piped water available to households, Regression 2 adds an interaction term between the per capita income and the quantity of piped water consumed. This interaction term is insignificant.

I cannot conclude whether or not the theoretical model’s prediction that household demand for tanker water decreases in the quantity of piped water consumed is true. In the first regression the household’s quantity of tanker water consumed is increasing in the quantity of piped water that the household consumes, indicating a positive correlation between household consumption and demand. However, this effect is likely spurious because the independent effect loses significance when I add the interaction term of per capita income and quantity of piped water consumed. This suggests that there is some positive correlation between higher income households and households who receive substantial quantities of water through the piped network. To further explore the possibility of negative feedbacks, I include in Regression 3 a new binary variable to capture consumption of piped water that is 1 when the household consumes less than the average amount of piped water in the area. Controlling for piped water consumption, all of the coefficients on the variables interacted with piped water consumption lose significance. However, the new binary variable has a negative coefficient, which is consistent with the interpretation that when households receive small quantities of piped water, tanker water consumption is lower, and vice versa.

The final determining factor warranting special attention in the household demand function is the tanker satisfaction index. In Regression 1, the level of household satisfaction with the tanker water has the most positive and significant effect on the quantity of water consumed by the household. This is consistent with the role of the reliability and quality variables in the theoretical model. As predicted by the theoretical model, the interaction term between the quantities of piped water consumed and tanker satisfaction is negative, albeit insignificant.

The IV with Continuous Price model is the optimal model of household demand for tanker water given the available data, however it is far from a complete or perfect specification for two main reasons. First, the demand regression has a very small number of observations because the data includes few households with complete characteristics. The number of observations considered is only 44, or embarrassingly low. Second, the constructed model of demand fails to predict nearly half of the variation in the quantity demanded. This is shown by the R² value of 50%, which means that the model explains only about 50% of the variation in household demand. However, it is worth noting that this R² is on the upper edge of those in other water demand models in the literature.

Part of the remaining 50% of unexplained variance may be due in part to errors in variable bias. There may be measurement error in some of the variables, particularly in two variables critical to the demand regression, income and the number of people in the household. Some households probably underestimate their income due to fear of tax repercussions or jealousy, while others likely overestimate their income out of pride. The
net result does not wash away this concern of errors in variable bias, but magnifies it.

In conclusion, I find that the elasticity of demand at the average price and average quantity consumed is -1.5863. This suggests that when the price increases by 1%, the quantity of tanker water demanded decreases by 1.59%, holding all else constant. The elasticity likely changes throughout the year based on changing local weather conditions and the complementary availability of water. This elasticity is higher than the average elasticity of demand in the formal water market as demonstrated in the literature. Consistent with the theoretical model, the elasticity is increasing in the relative price of the water to the household and decreasing in the quantity consumed. However, the elasticity is not dependent on household income or the quantity of piped water consumed, as predicted.

4.7 Equity Results

Horizontal Equity

Horizontal equity occurs when all similar individuals are treated the same – an absence of discrimination – and households are only differentiated by their willingness to pay (WTP) for a good. I consider the level of horizontal equity in the informal water market by analyzing to what extent ethnicity influences water consumption patterns. Table 4E presents the results of household demand that is modified to include the ethnicity terms as set forth by the theoretical model. Regression 1 includes a dummy for Palestinians households, while the subsequent regressions include both the dummy and interactions between the ethnicity term and household income, as recommended by the theoretical model. Each of the instrumental variables regressions maintained the relevance and relative exogeneity of the instruments.

Across all of the regressions presented, the household’s ethnicity has no significant effect on the quantity of tanker water consumed. It is noteworthy that the direction of the ethnicity dummy suggests that Palestinian households consume less tanker water than their non-Palestinian neighbors, however this effect is insignificant. Even if the results were significant, the coefficient in Regression 1 shows that magnitude of the effect would be trivial. On average, Palestinian households demand about 1.5 cubic meters less of tanker water than Jordanian households, which is half of the effect of a 1JD change in price and even smaller than any of the income effects. Additionally, including the ethnicity variable in the demand specification decreases the magnitude of the price coefficient by a cubic meter and the magnitude of the coefficient on the natural log of the number of people in the household by one-half cubic meter.

I check the robustness of these results by creating a new specification of demand. Rather than assuming the demand specification motivated by the theoretical model, as given by the IV with Continuous Price model, I assume a strictly linear relationship among the classic demand determinants: price, family size, quantity of piped water supplied, income, ethnicity, and all interactions with ethnicity. I vary the identification of the price variables as well, considering the identity, square, and natural log. Changing the specification allows me to see if the horizontal equity evaluation is hindered by the former specification. Tables 4F and 4G present the results: across all specifications of tanker water demand, ethnicity
has no significant effect.

Therefore, I accept my null hypothesis that there is no discrimination on the basis of ethnicity in the tanker market in Ayn al-Basha. This finding rejects three components of the theoretical model. First, the ethnicity variable is insignificant in the demand equation. Second, the interaction term is also insignificant. Third and finally, the aggregate demand is unaffected by the relative distribution of household ethnicity in Ayn al-Basha.

**Vertical Equity**

Vertical equity occurs when individuals face a neutral or progressive pricing scheme, similar to the structure of progressive taxes. Under progressive pricing, which refers to a transfer from the rich to the poor, the poor households pay a lower proportion of income for water than wealthy households pay.

First, I analyze the elasticity of income to determine whether or not tanker water is a normal good, as predicted by the theoretical model. Household consumption of normal goods increases as household income increases. I use the IV with Continuous Price model to test for normalcy of tanker water, but use the natural log of the quantity variable, so income elasticity is simply the coefficient of the natural log of the income variable. Tanker water may be one of three types of goods depending on the value of the coefficient. A positive coefficient less than 1 suggests that tanker water is a normal good because the quantity demanded increases as income increases, but less than linearly. A positive coefficient greater than 1 suggests that tanker water is a luxury good because the quantity demanded increases more than linearly as income increases. Finally, a negative coefficient suggests that tanker water is an inferior good because the quantity demanded decreases as income increases.

I find that the elasticity of income is negative, but extremely insignificant. This suggests that tanker water may be an inferior good. This is inconsistent with the theoretical model, albeit inconclusively, which predicted the tanker water to be a normal good. In fact, the preferences specification model, Stone-Geary preferences, does not allow goods to be inferior. I can resolve this empirical finding with the theoretical model by conceiving of as a number somewhere between 0 and -1 for tanker water, and not 0 as assumed in Section II. The possibility that \( q \) is -1 precludes households who can avoid using the tanker water from participating in the market. Therefore, tanker drivers only enhance equity in the water market to create inequity in the water supplied by taking advantage of the ready market by selling suboptimal products.

Moreover, the finding of tanker water as an inferior good is consistent with reports that the piped water supply outlines the local power structure, or that wealthy and powerful households receive more consistent water supply than poor households (Interview M, 2009). There is a chance, however, that the possibility of inferiority is spurious because the water supplied to the rich households in the area is likely underreported in the government data. The possible inferiority of tanker water has incredible implications—unforeseen in the theoretical model—on the very existence of vertical equity in the tanker market. If tanker water is an inferior good, then households who can choose to consume water from
sources other than tankers do. This suggests that the very existence of the tanker market serves some social good of enhancing equity because households with no other options for water supply turn to this market. The question of whether or not the tanker market \textit{a priori} serves a social good cannot be addressed empirically due to insufficient data.

Regardless of the income elasticity, many households use tanker water to fulfill their water demand, making vertical equity an important consideration in either case. If the good is normal, then vertical equity must be assessed to analyze the distribution of costs for this desirable and necessary good across the households on the basis of income. Alternatively, if the good is inferior, then the question of vertical equity is even more important because regressive pricing would be a double whammy against poor households: consuming an inferior product—perhaps due to questionable quality of the good—and paying more for the good.

In vertical equity terms, the question is whether the high-income households pay a smaller fraction of their income for tanker water than do low-income households, as predicted by the theoretical model. Given that the first stage least-squares regressions in the IV with Continuous Price model explains little variation in the price, I am unable to construct a reliable model to predict the price of water that households face. Therefore, I rely on price point comparisons to analyze the progressivity of the tanker market.

I analyze the prices paid in two ways. First, I consider the absolute prices by dividing the households into two groups based on those with income above the median and those with income below the median. Among those families that demand tanker water, the mean price in the lower half is 6.236JD (4.464). Among those in the upper half the mean price is 7.330JD (5.728). Approximately equal numbers of families in both income levels consume tanker water. Histograms of the price faced by low-income and high-income households are shown in Figures 4B and 4C. This means that the average household in the higher income group is paying more for tanker water per cubic meter than the average household in the lower income group. However, given the variation in prices, fully 31%—nearly a third—of households in the lower income bracket pay a higher price than the average price in the higher income bracket.

Second, I consider the relative prices paid in terms of per capita income. I divide the households into five income brackets. The average monthly income of the first bracket is 100JD, of the second is 250JD, of the third is 400JD, of the fourth is 600JD, and of the highest is 1000JD. Table 4H summarizes average and total prices paid by the households in the five income brackets, both absolutely and relatively—the absolute level weighted by income. According to these values, it is clear that the system is absolutely neutral, but relatively regressive. The poorest households pay the lowest absolute price, though the average prices paid by the poorest and wealthiest households are not significantly different ($T = 0.5227$). However, the poorest households pay the highest price relative to their income (Bracket 1 vs. Bracket 2, $T = 2.21257$; Bracket 1 vs. Bracket 3, $T = 2.2409$; Bracket 1 vs. Bracket 4, $T = 2.5478$; Bracket 1 vs. Bracket 5, $T = 2.3185$). Additionally, as is expected in an income neutral market, the households of the poorest income bracket pay the median total amount for water in the tanker market.
The percentage of income used by households on tanker water ranges between 1% and 23% of the household income. These numbers seem to be absurdly high. However, a 2008 survey of household water use by a German consulting firm found that households spend upwards of 6.3% of their income to receive enough water to cover only 100 liters per capita per day (Sass and Brubach, 2008). The high envelope for the percentage of income required suggests that the income estimation has consistent downward bias. Regardless of the specific value, however, the poorest households pay the highest price relative to their income.

There is vertical inequity evidenced by this regressive relative pricing scheme. The regressive scheme most likely results from quantity-restricted demand. Based on interviews with households and corroborated by this data, the amount of water that households receive from tanker drivers is contingent on the size of their rooftop tanks. Yet, the amount of water that households pay for from tanker drivers is based on the size of the tanker driver’s tank truck. Not all households have an equal total volume of water tanks or total number of water tanks because household storage tanks are expensive (Gerlach and Franceys, 2009). Tank size increases with household income ($T = 2.42$), and so the gap between quantity received and the quantity that should be received given the total amount paid is larger in poor households than it is in rich households (corroborated by field observations of Interview W, 2009; and Odeh, 2009). In other words, poor and rich households pay similar amounts, but poor households receive less tanker water due to the limitation of smaller household rooftop tanks.

The role of the volume of household water tanks in contributing to the vertical inequity suggests that the issue may also be described as a technological problem that reinforces the local cycle of poverty.

Table 4A. The Uniformity of Water

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) $M^3$ Price Tanker Water</th>
<th>(2) $M^3$ Price Tanker Water</th>
<th>(3) $M^3$ Price Tanker Water</th>
<th>(4) $M^3$ Price Tanker Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanker Taste Satisfaction</td>
<td>1.400</td>
<td>-0.702</td>
<td></td>
<td>2.380**</td>
</tr>
<tr>
<td></td>
<td>(1.775)</td>
<td>(1.529)</td>
<td></td>
<td>(1.178)</td>
</tr>
<tr>
<td>Tanker Quantity Satisfaction</td>
<td>1.578</td>
<td>1.972</td>
<td>2.029</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.931)</td>
<td>(1.687)</td>
<td>(1.595)</td>
<td></td>
</tr>
<tr>
<td>Tanker Price Satisfaction</td>
<td>0.746</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.616)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piped Water Taste Satisfaction</td>
<td>0.960</td>
<td>-2.491</td>
<td>1.129</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.393)</td>
<td>(3.974)</td>
<td>(1.284)</td>
<td></td>
</tr>
<tr>
<td>Piped Water Quantity Satisfaction</td>
<td>0.120</td>
<td>1.838</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.488)</td>
<td>(3.862)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piped Water Price Satisfaction</td>
<td>1.502</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(1.407)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanker Satisfaction Index</td>
<td>1.190***</td>
<td>0.654</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.437)</td>
<td>(0.614)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piped Water Satisfaction Index</td>
<td>0.443</td>
<td>0.453</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.541)</td>
<td>(0.530)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>5.093***</td>
<td>3.832***</td>
<td>4.449***</td>
<td>4.298***</td>
</tr>
<tr>
<td></td>
<td>(0.599)</td>
<td>(0.757)</td>
<td>(0.768)</td>
<td>(0.759)</td>
</tr>
<tr>
<td>Observations</td>
<td>83</td>
<td>72</td>
<td>76</td>
<td>76</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.094</td>
<td>0.182</td>
<td>0.132</td>
<td>0.149</td>
</tr>
</tbody>
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Table 4B. Predicting Tanker Use

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>People in Household</td>
<td>0.00519</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00841)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income quartile, 2</td>
<td>-1.06e-07</td>
<td>(6.07e-07)</td>
<td></td>
</tr>
<tr>
<td>Income quartile, 3</td>
<td>0.0904</td>
<td>(0.191)</td>
<td></td>
</tr>
<tr>
<td>Income quartile, 4</td>
<td>-0.0236</td>
<td>(0.563)</td>
<td></td>
</tr>
<tr>
<td>Per capita income quartile, 2</td>
<td></td>
<td>0.0772</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0934)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per capita income quartile, 3</td>
<td></td>
<td>0.0500</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0875)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per capita income quartile, 4</td>
<td></td>
<td>-0.0828</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0915)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unskilled labor family</td>
<td></td>
<td>0.0815</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0782)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilled labor family</td>
<td></td>
<td>0.0713</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0938)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>244</td>
<td>244</td>
<td>215</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4C. Predicting Tanker Use

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female dummy</td>
<td>-0.155*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0876)</td>
<td></td>
</tr>
<tr>
<td>Years lived in house</td>
<td>0.00382</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00504)</td>
<td></td>
</tr>
<tr>
<td>Number of families in house</td>
<td>-0.0360</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0566)</td>
<td></td>
</tr>
<tr>
<td>Total tank volume</td>
<td>-0.00520</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00518)</td>
<td></td>
</tr>
<tr>
<td>Percent of people under 4</td>
<td>0.493</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.376)</td>
<td></td>
</tr>
<tr>
<td>Percent of people 12-18</td>
<td>0.528</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.338)</td>
<td></td>
</tr>
<tr>
<td>Percent of people 18+</td>
<td>0.197</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.251)</td>
<td></td>
</tr>
<tr>
<td>Palestinian dummy</td>
<td>0.0316</td>
<td>0.00883</td>
</tr>
<tr>
<td></td>
<td>(0.0851)</td>
<td>(0.0742)</td>
</tr>
<tr>
<td>Mom works dummy</td>
<td></td>
<td>0.0999</td>
</tr>
<tr>
<td></td>
<td>(0.104)</td>
<td></td>
</tr>
<tr>
<td>Dad works dummy</td>
<td>-0.0877</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.101)</td>
<td></td>
</tr>
<tr>
<td>Number of children that work</td>
<td>0.0371</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0296)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>149</td>
<td>187</td>
</tr>
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</table>
## Table 4D. IV with Continuous Price Model

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Tanker Water Consump ($M^3$)</th>
<th>(2) Tanker Water Consump ($M^3$)</th>
<th>(3) Tanker Water Consump ($M^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instruments:</strong> House_Years, Prob_Piped, Reader and Unskilled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td>-3.449* (1.892)</td>
<td>-3.440* (1.919)</td>
<td>-3.296* (1.833)</td>
</tr>
<tr>
<td>People in Household, Ln</td>
<td>35.12*** (13.35)</td>
<td>35.31** (14.50)</td>
<td>36.21** (14.26)</td>
</tr>
<tr>
<td>Income Quartile, 2</td>
<td>-12.54** (6.191)</td>
<td>-12.60** (6.283)</td>
<td>-12.21** (6.211)</td>
</tr>
<tr>
<td>Income Quartile, 3</td>
<td>-32.91*** (10.48)</td>
<td>-33.10*** (11.44)</td>
<td>-34.72*** (11.24)</td>
</tr>
<tr>
<td>Income Quartile, 4</td>
<td>-31.01** (13.40)</td>
<td>-31.64** (15.73)</td>
<td>-35.18** (15.92)</td>
</tr>
<tr>
<td>Piped Water Consump</td>
<td>0.194* (0.109)</td>
<td>0.187 (0.126)</td>
<td></td>
</tr>
<tr>
<td>Total volume of tanks</td>
<td>0.197 (0.257)</td>
<td>0.197 (0.260)</td>
<td>0.173 (0.277)</td>
</tr>
<tr>
<td>Total vol. of rooftop tanks</td>
<td>0.362 (0.756)</td>
<td>0.361 (0.755)</td>
<td>0.420 (0.848)</td>
</tr>
<tr>
<td>Price*Per Capita Income</td>
<td>0.0424* (0.0224)</td>
<td>0.0420* (0.0227)</td>
<td>0.0360* (0.0207)</td>
</tr>
<tr>
<td>Tanker Satisfaction Index</td>
<td>5.440* (3.133)</td>
<td>5.473 (3.363)</td>
<td>3.245 (3.200)</td>
</tr>
<tr>
<td>Piped Water Consump*Tanker Satisfaction Index</td>
<td>-0.0817 (0.0552)</td>
<td>-0.0820 (0.0567)</td>
<td>-0.0363 (0.0492)</td>
</tr>
<tr>
<td>Piped Water Consump*Per Capita Income</td>
<td>0.000135 (0.00193)</td>
<td>0.00125 (0.00170)</td>
<td></td>
</tr>
<tr>
<td>Piped Water Consump Dummy</td>
<td></td>
<td></td>
<td>-2.681 (5.711)</td>
</tr>
<tr>
<td>Constant</td>
<td>-55.63** (22.97)</td>
<td>-55.84** (24.72)</td>
<td>-48.47* (26.12)</td>
</tr>
<tr>
<td>Observations</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.507</td>
<td>0.507</td>
<td>0.497</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 4E. Horizontal Equity in Demand

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tanker Water Consump (M³)</td>
<td>Tanker Water Consump (M³)</td>
<td>Tanker Water Consump (M³)</td>
<td>Tanker Water Consump (M³)</td>
</tr>
<tr>
<td>Instruments: House_Years, Prob_Piped, Reader and Unskilled Price</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td>-2.817** (1.135)</td>
<td>-3.022** (1.298)</td>
<td>-2.760** (1.233)</td>
<td>-2.886** (1.202)</td>
</tr>
<tr>
<td>Palestinian dummy</td>
<td>-1.592 (3.643)</td>
<td>-4.973 (6.801)</td>
<td>-7.574 (6.275)</td>
<td>-3.769 (6.421)</td>
</tr>
<tr>
<td>Ethnicity*Income Level 2</td>
<td>5.14e-05 (5.76e-05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity*Income Level 3</td>
<td>10.46 (18.99)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity*Income Level 4</td>
<td>-55.06 (53.38)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity*Income</td>
<td>0.00954 (0.0127)</td>
<td></td>
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<td>-11.26* (5.824)</td>
<td>-9.335* (5.542)</td>
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<td>-31.32*** (10.46)</td>
<td>-41.01*** (11.88)</td>
<td>-29.76*** (9.997)</td>
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<td>Income Quartile, 4</td>
<td>-25.23*** (8.298)</td>
<td>-31.14** (13.27)</td>
<td>-20.68* (11.94)</td>
<td>-28.36** (11.58)</td>
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<td>Piped Water Consump</td>
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<td>0.111 (0.1000)</td>
<td>0.127 (0.0992)</td>
<td>0.114 (0.0987)</td>
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<td>Total volume of tanks</td>
<td>0.281* (0.157)</td>
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<td>0.166 (0.123)</td>
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<td>Total vol. of rooftop tanks</td>
<td>0.848 (0.605)</td>
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<td>0.0273** (0.0129)</td>
<td>0.0288** (0.0141)</td>
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Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Table 4F. Horizontal Equity, Specification 1

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Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Table 4G. Horizontal Equity, Specification 2

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Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4H. Vertical Equity: Pricing Across Household Incomes

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<td>250</td>
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<td>400</td>
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<td>0.019 (0.061)</td>
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<td>600</td>
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<td>1000</td>
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<td>0.007 (0.064)</td>
<td>288.680 (618.092)</td>
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THE ROLE OF THE INFORMAL SECTOR IN EQUITABLE WATER DISTRIBUTION:

Figure 4A. IV with Continuous Price Model

Figure 4B. Histogram of Tanker Prices Faced by Low-Income Households

Figure 4C: Histogram of Tanker Prices Faced by High-Income Households
5 Conclusion

“The regular type of water management in Jordan is crisis management.” -Leading Engineer, who has worked in the area for a foreign consulting firm for more than fifteen years, 17 August 2009

Through its role mediating access to goods, the informal sector has increasingly substantial and far-reaching implications on household welfare. This paper aims to redirect the attention of economic practitioners in the developing world from the formal sector to the informal sector. I construct household demand for water from the informal market, and use the demand curve as the basis to explore the informal market’s performance. The scarcity of econometric work in this area is due in part to the lack of data. I embraced this difficulty as a challenge, not a limitation. I came to understand the market by carefully mapping the interactions of households in my study area with water from the formal and informal sectors through observation, interviews, and primary source data collection. This paper offers a glimpse into the elusive informal market, and the theoretical and empirical methodologies herein developed may serve as a basis for future investigations of the informal market in other areas.

In Section 1, I provide motivation for the paper by asking to what extent the informal market, given the failure of the formal sector, can equitably distribute a precious natural resource. I find that the informal market in the Emir Ali neighborhood of Ayn al-Basha, Jordan is an equitable distributor so long as a household’s payment for water is tied to consumption alone, not the consumption of others who buy from the same supplier. Stated differently, for the most part the tanker market equitably improves access to and distribution of water. However, when tanker drivers quote an inflated price to one household to compensate for a lower price offered to another, the informal market exhibits vertical inequity, and the poor suffer.

Section 2 develops a theoretical model of household demand for water from the informal sector as the residual demand not met by the piped water market. I assume that tanker firms are monopolistically competitive and that tanker drivers use their price-setting power to both discriminate against Palestinian households and charge more to poor households. To empirically test these predictions, I conducted a randomized household survey of 275 households in the Emir Ali neighborhood, as described in Section 3.

The empirical investigation in Section IV confirms two antecedents to the empirical application of the theoretical model; constructs household water demand using three specifications that independently address simultaneity in supply and demand; and finally determines the level of equity in the market by exploring discrimination and regressive pricing. I use an IV with Continuous Price model to estimate the household elasticity of demand as -1.56, or that when the price per cubic meter of tanker water increases by 1%, the quantity of tanker water demanded decreases by 1.59%, holding all else constant. The other significant predictors of household water demand are as predicted by the theoretical model: income, the number of people in the household, the quantity of piped water consumed, and interaction terms among these variables. I identify and dismiss possible omitted variables, and conclude that the only other threat of bias in the estimation of demand may be errors-
in-variables bias.

Third, I use the IV with Continuous Price model to estimate the extent to which there is horizontal and vertical inequity in the tanker market. I find no evidence to corroborate the theoretical model’s prediction of horizontal inequity in the informal water market because I find that ethnicity has no significant influence on water consumption patterns. Additionally, I am unable to validate the theoretical model’s assumption that tanker water is a normal good. The possible inferiority of tanker water suggests that the informal market may be more important to the water allocation of poor households than wealthy households. This possibility raises the stakes of vertical inequity in the tanker market because the consumers in question are the most vulnerable water users in the area. I find that the poor households pay a greater proportion of their income for less water than wealthy households pay and receive. Two confounding factors likely create the vertical inequity: on the supply side, tanker drivers provide water at lower prices to households in their family network; and on the demand side, poor households have household storage tanks of less volume than wealthy households.

As water scarcity continues to increase in coming years, the formal supply will continue to fall short of household water demand, thus expanding the size of the informal tanker water market. The larger the tanker market, the more important the consequences of the vertical inequity in the market become. Intervening today may preempt a crisis tomorrow.

References


Mohamed, Ahmed Shawky, Alexander Kremer, and Manish Kumar. “Assessing the Efficiency and Equity of Water Subsidies: Spending Less for Better Services.” In Water in the Arab World, edited by N.


**Interviews**

Interview A. Conducted by the researcher with a local Jordanian mid-level water worker. 10 August 2009.

Interview H. Conducted by the researcher with a local tanker driver. 20 July 2009.

Interview K. Conducted by the researcher with a former Minister of Water and Irrigation. 10 August 2009.

Interview M. Conducted by the researcher with a Western contractor who has worked in the water sector for more than 40 years. 1 July 2009.

Interview N. Conducted by the researcher with a Jordanian water engineer. 7 July 2009.

Interview W. Conducted by the researcher with the leading engineer at a foreign consulting firm that has worked in the area for more than fifteen years. 17 August 2009.

**Summary Statistics and Variables Description**

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THE ROLE OF THE INFORMAL SECTOR IN EQUITABLE WATER DISTRIBUTION:

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Appendix: A Microeconomic Model of the Tanker Market

This simple model presents household demand for water. All households are risk-averse, rational economic actors because they make decisions that result in the maximum utility for the household given the available information. To construct household demand for tanker water, I first derive the optimal level of household consumption of piped water to determine the surplus demand that households assign to tanker water. Fundamentally, households maximize household utility, \( U(M, \alpha) \), subject to their basic budget constraint,

\[ y = qM + \alpha \]  

(1)

and water survival constraint,

\[ M \geq ns, \]  

(2)

where \( y \) is household income, \( M \) is household consumption of water, \( q \) is the unit price of water, \( \alpha \) is the amount of goods and services other than water that the household consumes, \( n \) is the number of people in the household, and \( s \) is the minimum amount of water per capita required for survival. The cost to the household of consuming a unit of water or a unit of \( \alpha \) is constant across all units of water and \( \alpha \). I assume that the cost of each \( \alpha \) good is 1, so the value of \( \alpha \) goods is. I assume that the household consumes from a water market in equilibrium. I also assume there are two sources of water: piped water, \( M_p \), and tanker water, \( M_f \). In this case, I combine all uses of water in the household in the one water variable.

Household Budget Constraint

Households in Ayn al-Basha are either Jordanian or Palestinian, and I assume all household members have the same ethnicity. Based on the characterizations from interviews with local Jordanians and Palestinians along with expatriates working in the field, both ethnic groups have identical water consumption habits except that Jordanian families benefit from \( C \), or \( \text{wasta} \). \( \text{Wasta} \) is an Arabic word indicating how connected the household is to those in power with the property that the smaller the \( C \), the larger the household’s \( \text{wasta} \). Sass and Brubach (2008) define \( \text{wasta} \) as “an attempt to use the influence of relatives or acquaintances to achieve certain objectives.” I assume that \( C \) is a binary variable such that \( C = 1 \) for Jordanian households, \( C = 2 \) for Palestinian households, and \( C \) is the only difference between Palestinian and Jordanian households. Since I assume that all Jordanian households have \( \text{wasta} \) and that all Palestinian households do not have \( \text{wasta} \), I refer to only Jordanian and Palestinian households.

Piped water is not always available when the households wish to use it for drinking, cooking, bathing, laundry and gardening because it is supplied intermittently. Households have developed numerous coping mechanisms, represented as additional costs in the budget constraint, to address this imperfect water supply. According to a household water supply and sanitation survey across Jordan conducted by GFA Consulting, nearly all households engage in two coping mechanisms: household water storage and health care.

First, to address the unreliability of water, 99% of households install a water tank at the household site (Sass and Brubach, 2008). This adds an additional cost of the weekly water tank depreciation, \( \tau \). The effective budget constraint is

\[ y = \alpha + qM + \tau. \]  

(3)

Second, households must cope with the negative health effects of low quality water. According to the GFA Consulting survey, approximately 4% of individuals, or 29% of households in the governorate of Balqa, have experienced diarrhea within the last year (2008). When households consume poor quality water the household incurs cost \( \eta \) of medical expenses. The probability that water causes illness is 0.3 as per the GFA Report, and I smooth the cost of all water-borne illnesses to 1. To simplify, the budget constraint is

\[ y = \alpha + qM + \tau + 0.3\eta. \]  

Assuming \( y = y - \tau - 0.3\eta \), the effective budget constraint becomes
THE ROLE OF THE INFORMAL SECTOR IN EQUITABLE WATER DISTRIBUTION:

\[ \tilde{y} = \alpha + qM. \] (4)

The household’s preference for clean water also affects the household’s maximization problem through the utility function, as I discuss in the following section.

**Household Utility**

I assume all households have identical quasi-homothetic preferences over the consumption of \( M \) and \( \alpha \), which is to say that consumption above the minimum levels of \( M \) and \( \alpha \) creates increasing utility to the household. Household demand for water is dependent on both satisfying subsistence levels of consumption of water and other goods, and consuming additional goods when income allows, which implies that households have nonconstant elasticities for water. The best functional form for a utility function that fits these conditions is Stone-Geary. This is preferred to standard Cobb-Douglas form because Cobb-Douglas requires a constant elasticity of demand at all quantity levels of a good. The resulting utility function is

\[ U(M, \alpha) = (M - M_{\text{min}})^{\gamma} (\alpha - \alpha_{\text{min}})^{1-\gamma}. \] (5)

The amount of water that the household consumes weekly is \( M \), and the quantity of goods other than water that the household consumes weekly is \( \alpha \). \( M_{\text{min}} \) represents the minimum level of weekly water required for the household’s survival – estimated to be 20 liters per family member per day (Gleick, 1996). Likewise, \( \alpha_{\text{min}} \) reflects the minimum level of other goods required for basic survival, such as food, immediate medical care, and shelter. I assume that the utility strictly increases in both \( M \) and \( \alpha \) for all household consumption occurring above \( M_{\text{min}} \) and \( \alpha_{\text{min}} \), respectively. The utility levels \( U(M_{\text{min}}) \) and \( U(\alpha_{\text{min}}) \) are both 0, called “survival utility.”

Households will spend up to \( (\tilde{y} - \alpha_{\text{min}}) \) to achieve survival utility in water and up to \( (\tilde{y} - qM_{\text{min}}) \) to achieve survival utility in the non-water survival goods. Above the level of survival utility, there are decreasing marginal returns to additional \( M \) and \( \alpha \).

Households derive additional utility from two particular characteristics of their water: reliability and quality. Households strictly prefer reliable and clean water. The utility functions expand to reflect these two attributes

\[ U(M, \alpha) = \left[ M - M_{\text{min}} \right]^{\gamma} \left[ \alpha - \alpha_{\text{min}} \right]^{1-\gamma} \] \text{ and } \[ U(M, \alpha) = \left[ M - M_{\text{min}} \right]^{\gamma} \left[ \alpha - \alpha_{\text{min}} \right]^{1-\gamma}. \] (6) \( \text{and} \) (7)

The reliability factor, denoted \( r_p \) and \( r_t \), such that \( 0 < r_p < r_t < \frac{1}{2} \), reduces household utility because water supplied unpredictably causes shocks to a family’s water consumption patterns. Although this claim is repudiated by some local water engineers, in the assessment of the majority of my informants, ethnicity further affects the reliability of piped water supply through the presence of wasfa, since more public service workers are Jordanian than Palestinian, particularly in positions of power. Therefore, \( r_p \) is raised to the power of \( C_p \), or \( r_p^C \). In the tanker water market, however, I assume that tanker drivers acting in their own self-interest will sell to customers of any ethnicity. Thus, the reliability of tanker water supply is not affected by wasfa – though wasfa does impact the water price.

Considering only reliability and ethnicity, Palestinian households would appear to always prefer tanker water to piped water. However, households also derive increased utility from high quality water, denoted by \( q \). This variable is a vector of household preferences, including satisfaction with water price, taste, cleanliness, and a lack of negative health effects, such that \( q = \{0,1\} \). Positive quality indicates the household is satisfied with the water’s quality, and zero quality means the household is dissatisfied with the water’s quality. Since piped water is routinely tested for these satisfaction characteristics and tanker water is not, I set \( q = 1 \) for piped water and...
\( q = 0 \) for tanker water.

With quality added to the utility function, a household always derives more utility from piped water consumption than tanker water consumption, meaning households always prefer to consume piped water. This is consistent with interviews with households who say that the only reason they demand tanker water, \( M_T \), is due to quantity concerns (Sass and Brubach, 2007). These concerns of quantity of piped water supplied will be explored in the following section.

**Piped Water Supply**

The official supply function for government piped water is established. The price of piped water is \( \varphi_p \), and the supply function is:

\[
S_p(\varphi_p).
\]

Given Jordan’s water scarcity, the piped network may supply less water than a household demands. The particular amount that the household receives daily appears to be random. Therefore, the maximum amount a household can purchase through the piped water supply, \( \zeta \), is a stochastic variable with the property

\[
0 \leq \zeta \leq D_p(\varphi_p).
\]

This supply shortage results in a water demand gap between \( D_p(\varphi_p) \) and \( \zeta \) left unfilled by the piped water supply. This gap is smaller for Jordanian households than Palestinian households due to the differential reliability of piped water. The measured consumption of piped water is

\[
M_p = \min\{M^*_p \zeta\},
\]

where \( M^*_p \) is the optimal level of piped water demand given the household’s utility function, subject to the budget constraint. I simplify the stochastic variable to an indicator variable, \( \Theta \), with dummy properties for the purpose of analysis. When households meet their minimum quantity through piped water (\( \zeta \geq M_{\text{min}} \)), \( \Theta = 0 \), and when households are supplied less than their minimum quantity through the piped system (\( \zeta < M_{\text{min}} \)), \( \Theta = 1 \).

**Tanker Water Supply**

In the tanker supply market, the price of piped water is \( \varphi_t \) and the supply function is

\[
S_t(\varphi_t(C)).
\]

I assume tanker water suppliers exhibit quasi-monopolistic competition. The 250 or so tanker drivers operating in Ayn al-Basha exhibit market power that allows them to set their prices. Unlike traditional forms of monopolistic competition, the water sold by each driver is not differentiated by any particular characteristic of the water. In this market, however, each individual tanker driver exerts market power by preferentially selling water to his given social network, thus exhibiting wasata, or \( C \). Furthering this restraint to perfect competition are significant barriers to entry, including the price of the capital goods for water distribution, securing a license for distribution from the Ministry of Health, and developing relations with the local, private spring owners. It normally takes 10 years for a tanker driver to pay off the capital costs of market entry (Interview H, 2009).

**Household Utility and Budget Constraint in the Market**

To summarize the previous sections, households only derive utility in the tanker market from the water consumed that is above the piped water consumed. Household utility is

\[
U(M_T, \alpha) = [M_T r_T (1 + q) - M_T^\wedge (\alpha - \alpha_{\text{min}})]^{1-\wedge},
\]

where \( M \) is a placeholder for \( M_{\text{min}} \) when the household consumes less piped water than the survival minimum and \( M_p \) when the household consumes more piped water than the survival minimum.
Given the decision to consume tanker water, the household next determines how much tanker water to consume. This decision depends on $q_T$, and as shown in Equation (11). The $q_T$ depends on the relationship between the tanker driver and the household. Tanker drivers charge $q_T C$, which means that Palestinian households ($C = 2$) face a higher price than Jordanian households ($C = 1$). I estimate the values of $C$ based on interviews with households of both ethnicities. The budget constraints for public and tanker water, therefore, are as follows

$$y_i = \begin{cases} \frac{M_p q_p + \alpha}{M_T (q_T C) + \alpha} & \text{when } M = M_p, \\ \frac{M}{M_T} & \text{when } M = M_T. \end{cases}$$

(13)

Optimal Household Behavior in the Tanker Water Market

Household Tanker Water Demand

To solve for the household demand for tanker water, I first must solve for $M_p^*$, the optimal quantity of $M$ that maximizes household utility, Equation (6), subject to the household budget constraint, Equation (13). Second, I can solve for $M_T^*$, the optimal quantity of tanker water that maximizes household utility, Equation (12), subject to the household budget constraint, Equation (13). I use the Lagrange multipliers method for both of the constrained optimization problems.

First, I solve for $M_p^*$. Using Lagrangian multipliers, households optimally demand

$$M_p^* = \frac{w}{q} (y - \alpha_{\min}) + (1 - w) \frac{M_{\min}}{r_p C (1 + q)}.$$

(14)

This household demand function makes sense because the first term is the weighted price of $M_p$ multiplied by the supernumerary income, or the income remaining to spend on $M_p$. The second term is a small, additional amount weighted by the vector of household satisfaction and preferences for water. As is expected, the Palestinian households have greater demand than the Jordanian households because the Palestinians have a higher willingness to pay for piped water because tanker market water is more difficult to access for them.

Second, I turn to the household’s choice of tanker water consumption, $M_T^*$, to maximize utility subject to the budget constraint for tanker water. I derive solutions separately for households that meet their full water needs through the piped water network and those that do not. One solution for both is not possible because $\zeta_T$ is a stochastic variable, meaning it has no associated probability distribution. I reduce the two solutions to one by using the variable $\tilde{M}$ to represent $M_{\min}$ and $M_p$, depending on the outcome in the piped water market. The solution is $M_T^*$, the household demand for tanker water

$$M_T^* = \frac{w}{(q_T C)} (y - \alpha_{\min}) + (1 - w) \frac{\tilde{M}}{r_T (1 + q)}.$$

(15)

This household demand function makes sense because household demand increases in income, decreases in price, and is negatively correlated with increasing water quality and reliability. The first term is the price of $M_T$ weighted by the household’s relative preference for water over other goods, multiplied by the supernumerary income. The household demand function shows that wasta induces consuming additional tanker water by lowering the effective price. Moreover, this suggests that the more supernumerary income that the household has, the greater the difference in quantity of tanker water consumed by Jordanian and Palestinian households. The second term
is a small additional quantity of water that compensates for the household’s satisfaction with the water consumed. Water quality essentially weights the household’s water demand. Water quality is negatively correlated with water demand because households receiving less satisfactory water must demand additional water to ensure sufficient quantities of high enough quality water.

The theoretical household demand function provides insights for the empirical model that moves beyond the basic empirical demand relationship of quantity of tanker water consumed by the household on the price. First, the linear relationships in Equation (15) among household income, price of tanker water, ethnicity, and relative emphasis on water consumption, in the first term, and between $M$ and the household satisfaction vector, in the second term, suggests that the empirical demand specification must interact these terms. Also, when the empirical model considers the presence of discrimination, household income should interact with the ethnicity of the household. $M$ may be interpreted as the non-utility-improving quantity of water consumed by the household—either piped water consumption or the minimum water needs of the household. The second term suggests the empirical specification of household water demand must interact $M$ with the household’s perception of tanker water reliability and quality.
EARLY PARTICIPANTS OF MULTILATERAL ENVIRONMENTAL AGREEMENTS AND THEIR EFFECT ON LATER MEMBERSHIP

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ABSTRACT

This paper studies the causes of success in the signing and ratification of Multilateral Environmental Agreements (MEAs). Following previous studies, the paper examines the domestic factors contributing to whether or not a country has signed or ratified a particular environmental treaty at a particular time. However, the paper also attempts to isolate the effect of the characteristics of the first countries to participate in an MEA by adding variables, which measure the relative influence of early signatories and parties. The study finds that the early participation of United Nations Security Council members encourages latter participants to join an agreement.

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1 Introduction

Over the past few decades, awareness of environmental protection has skyrocketed. Transnational bodies have labored to regulate activities affecting the environment through Multilateral Environmental Agreements (MEA). Better understanding of the support an environmental treaty requires can lead to better construction and promotion of treaties, and regulations helping the environment can be more quickly enacted. This thesis discusses the factors contributing to whether a country has signed or ratified an MEA, particularly the effects of other countries joining the MEA. Does the early support of high-GDP countries
guarantee that others will follow? Do countries with a higher percentage of industry sway others to sign more quickly? Are United Nations Security Council members influential upon the decisions of others? We compare the explanatory power of factors internal to each country – the main focus of previous literature – and of external relations.

In the provision of a clean environment, countries must deal with externalities caused by activities such as pollution and overuse of resources. Countries try to limit these externalities by committing to environmental protection through multilateral agreements. The major difficulty regarding MEAs is in the voluntary nature of ratification and adherence to them. A country individually decides whether it is in its best interest to sign an agreement, taking into account domestic variables as well as foreign relationships. A country which has signed then decides whether to bind itself legally to the agreement and become a party through ratification. A country which did not originally sign the agreement can still become a party through acceptance of the agreement. However, even once a treaty is ratified, there still may be little to no control over its implementation, and parties can choose to depart from the agreement. Without enforcement mechanisms within the treaty, fellow signers must resort to indirect pressure on the delinquent. This paper rests on the idea that since the influence of other countries is already present in treaty enforcement, it may prove important in the decision to join the treaty. The study confirms the hypothesis that early participation from wealthy and politically powerful countries serves as a “carrot” and causes a larger amount of countries to sign afterward. The early participation of Security Council members does increase the probability that other countries will join, while the effect of the total wealth of the leader countries is significant but so miniscule as to be negligible.

The paper is divided as follows: Section 2 discusses the relevant literature and how this paper departs from it, Section 3 introduces the theoretical model, Section 4 details the data sources used, Section 5 presents the empirical model, Section 6 summarizes the results of the paper’s regressions, Section 7 checks the model’s robustness, Section 8 offers conclusions, and Section 9 elaborates possible extensions of the research.

2 Literature Review

A number of papers discuss the game theory dynamics behind MEAs. Some choose to model negotiations as cooperative games (such as Stag Hunt, in which the goal of the game is for players to cooperate), while others support a non-cooperative model (such as Prisoner’s Dilemma, in which one cannot assume a goal of cooperation because most of the time the game ends with non-cooperation). Wagner (2001) finds unrealistic the possibility of describing MEA signature as a cooperative game, since a cooperative scenario presupposes the country’s ultimate desire to sign and precludes a nation’s right to withdraw from negotiations and the agreement itself. Through his own theoretical analysis and a summary of other papers’ empirical results, Wagner examines self-enforcement provisions, such as minimum participation clauses, transfers (cash, in-kind), and sanction threats, that contribute to the success of an agreement.

Finus, Altamirano-Cabrera, and Ierland (2005) look at the hypothetical effects of
membership rules and voting schemes in keeping out free-riders and promoting MEAs. They simulate long-run greenhouse gas accumulation in twelve world regions and its responses to various coalitional groupings of these regions. They describe three benchmark scenarios: singleton coalition structure, grand coalition, and Kyoto coalition. Grand coalition involves MEA ratification and implementation by all countries, having the highest global payoff. However, it requires an unequal amount of sacrifice from countries, causing most to prefer the singleton structure of non-cooperation. The so-called Kyoto coalition, which entails partial cooperation, is similarly unstable as grand coalition and can quickly dissolve into non-cooperation. This instability is demonstrated in the “real world” by the decision of the United States to participate in negotiations regarding the Kyoto Protocol, but ultimately not to ratify the mentioned treaty in favor of private environmental protection efforts.

Murdoch, Sandler, and Vijverberg (2001) build a two-stage game to separate the ratification and implementation stages for environmental agreements regarding CO\(_2\) emissions. In the ratification stage, which takes place after negotiation and signature, a country decides whether to legally bind itself to the agreement. In the implementation stage, all countries decide whether or not to reduce emissions, regardless of membership, though parties in particular decide whether to go beyond the agreement’s mandated levels. Murdoch et al. then use the sub-game perfect equilibrium to form an empirical model, which they test with regards to the Helsinki Protocol. They find that the separation of decision stages allows for a better understanding of which variables affect a country’s decision to ratify an MEA and which variables affect a country’s environmental performance afterwards, regardless of signing. They find that spill-ins of polluted air (in the form of an emissions wind-transport matrix) positively affect the ratification decision. They also find that domestic environmental attributes, such as forest land, do affect the ratification decision, even though previous literature had rarely found significance in similar variables. Most interestingly, they find that wealth (GNP) has no effect on the ratification stage, though it has a positive influence on the implementation stage. Thus, wealthier countries were more likely to reduce their emissions beyond the levels mandated by the Helsinki Protocol, though they had no extra incentive to ratify the agreement.

Further studies have examined the effects of non-environmental international activities upon MEAs. Egger, Jeßberger, and Larch (2009) investigate how free trade affects MEA participation. Egger et al. also discuss how numerous other domestic factors and economic coalitions contribute to the number of MEAs a country signs. They divide their explanatory variables into three categories: economic determinants (such as GDP and exports), political determinants (political freedom, trade liberalization), and environmental determinants (current emissions, forests). Their variable of interest is international economic openness, and they find that international economic coalitions, in the form of bilateral investment treaties, improve the conclusion of environmental agreements.

Rose and Spiegel (2009) turn the typical model around and use MEA membership as an explanatory variable for international economic exchange seen in asset cross-holdings. They find that non-economic partnerships such as MEAs signal far-sightedness which, in turn, promotes international lending. Countries join MEAs for both direct environmental
benefits, as well as the indirect benefits of reputation spillovers. Combined with Egger et al. (2009), the two papers seem to imply a story of two-way causality between MEAs and international investment agreements.

Most relevant to this thesis is the examination of Beron, Murdoch, and Vijverberg (2003) of how interdependence among nations affects participation in MEAs. Beron et al. believe that interdependence causes free-riding to decrease because certain countries can exert influence over others. They argue that countries can exert political pressure over countries from which they import goods. They use power matrices constructed from wealth and bilateral trade flows to model the effect of interdependence. These power matrices prove insignificant in the empirical study of the Montreal Protocol. Their examination is then expanded with matrices reflecting military alliances, neighboring countries, and other trade considerations, but the only significant power matrix was based on differentiated exports as a share of GDP.

While many have focused on domestic variables of influence – wealth, production, cost, freedom, and so forth – this paper takes specific interest in interdependence effects. Concerned with the intent of countries to participate in an MEA, the study counts both signatories and parties as “members,” another departure from the literature. Similarly to Beron et al. (2003), this thesis looks at the question of whether certain countries serve as leaders in signing agreements. It departs, however, from trade relationships and focuses on how other measures of the political influence of the first members contribute to overcoming the voluntary nature of agreements and lead to a snowball effect of participation.

3 Model

A country will sign or ratify an MEA if its expected utility from partaking in the agreement is greater than its expected utility from not cooperating. Utility is affected by domestic attributes, as well as international relations. In this second area, Beron et al. (2003) focused on the influence a net importer could have over its trade partners. However, sanctions and similar pressures can only be exerted upon countries already legally bound to an MEA. Though overall trade relationships may indicate a general willingness to participate in international agreements, net importation should exert little pressure upon countries in the decision stage and seems unrelated to MEA participation. Withholding voluntary aid may influence a country’s decision to partake in the agreement, but it appears that this reasoning can be modeled better by the total income of the first participants than by trade relationships.

This thesis considers two other theoretical possibilities of how international characteristics may affect MEA participation. Early signatories and parties may consist of countries who have better information with regards to signing the treaty or whose membership contributes to the utility of the agreement itself. First, while a country has the best information regarding its own characteristics, it may not have reliable or complete information as to the international merits of the agreement. Thus, it may be swayed in its decision to sign or ratify an agreement when it witnesses which countries declare
participation early. Second, countries have asymmetric interests which help overcome the free-rider problem (Stigler, 1974). A country with great interest in participating in the agreement may overcome its scruples about externality provision and free-riders and join the agreement early. If enough such countries participate, they may increase the value of the MEA in such a way as to persuade even more countries to join, as their commitment indicates partial success of the agreement and increases expected success and value of the agreement.

4 Data Sources

Data was collected from various sources in order to construct an appropriate set. The dependent variable - treaty participation - was coded using information from the Socioeconomic Data and Applications Center, operated by the Center for International Earth Science Information Network. The SEDAC offers the Environmental Treaties and Resource Indicators (ENTRI), which compose a comprehensive dataset of MEA signatories. Because of interest in more current MEAs and limitations in data available for control variables, the time period for MEA introduction was limited from 1980 to 1999. This stipulation allowed for 199 MEAs and 208 participants, of which the majority consisted of sovereign nations. To control for treaties with a regional focus, a dummy variable was constructed to make note of especially regionally-specific, non-environmental titles, such as the “Treaty Establishing the African Economic Community” and the “Agreement Establishing the European Bank for Reconstruction and Development.”

The SEDAC dataset also contains the current status of the country, i.e. whether it is a signatory or party. Signatories are those negotiate and sign an agreement. Parties, on the other hand, ratify or accede to the MEA domestically and are legally bound to follow its terms. This paper deems signature as a statement of intent to follow the agreement, even if a signatory never formally ratifies the treaty, and signatories, parties, and an aggregate of both serve as the dependent variables. The dataset also contains information as to when the agreement was signed, and, if the country is a party, when the agreement was ratified or accepted. In the main regression analysis, these two were combined, and the earlier of the two was used as the date of declaration of intent when determining the leader countries.

The control variables take into account political, economic, and environmental factors. As do Egger et al. (2009), this study includes the Fraser Institute’s indicator of political and economic freedom. Data is available in five-year increments from 1970 until 2000, after which data is presented yearly until 2007 (Fraser Institute, 2009). To account for the costs of signing an MEA, the paper uses the percent of GDP from industry, available from the Earth Trends database of the World Resources Institute. Participation benefits are proxied by the adjusted savings of depleted forests as a percentage of Gross National Income, available from the World Development Indicators, and alternatively by the percent of land area covered in forests, available from the Global Environment Outlook database of the UN Environmental Programme.

The variables of interest are measures of the influence of countries which have signed
the MEA in question before a specific time. Their purpose is to capture the effect of leaders in the provision of the public good. This influence is measured in three ways: the leaders’ summed environmental impact, wealth, and international negotiating power. Total environmental impact is proxied by percentage of GDP from industry – the control variable described above, summed over the defined leader countries. This measure can indicate general environmental impact, or at least international perception of impact, for the same reasons that the measure could reflect cost of participation. Wealth can be another demonstration of size: countries may sign an MEA that a wealthy country has already signed, in hopes of establishing good rapport and receiving increased aid and investment in the future. Wealth is measured by real GDP, taken from both the World Development Indicators and the United States Department of Agriculture’s Economic Research Service, and by GDP per capita, also from the WDIs. Finally, a country’s international negotiating power is represented by a binary variable for whether a country is on the United Nations Security Council at the time of the treaty’s introduction. Being a member of the Security Council obviously increases power and recognition within the UN itself, where many MEAs are signed, and may add to the influence of a country.

5 Empirical Strategy

The effects of the variables listed in the previous section were tested on participation in an MEA. The empirical model was specified as:

$$y_{ijt} | (f_{ij} \neq 1) = \beta_0 + \beta_n X_{it} + \delta_m Z_j + \alpha_j W_j + \gamma_i V_i + u_{ijt},$$

where $y_{it}$ is a binary variable which is equal to 1 if treaty $j$ is signed or ratified by country $i$ at time $t$, and 0 otherwise, $X_{it}$ is a vector of $n$ control variables that vary by country and year, $Z_j$ is a vector of $m$ variables of interest that vary by treaty, $W_j$ is a vector of $j$ fixed-effects dummy variables distinguishing treaties, and $V_i$ is a vector of $i$ fixed-effects variables distinguishing countries. The dependent variable is conditional upon being not equal to one, where $f_{ij}$ is a binary variable that indicates if country $i$ is one of the early signers of treaty $j$. In order to make sure the model is robust, the early signers were defined in a few different manners, namely as those who indicated interest within the first week of negotiation and as the first third of those who participated.

5.1 Independent Variables of Interest

The variables of interest sum the Security Council membership, real GDPs, GDPs per capita, and percentages of GDP from industry across the leader countries. All four variables are expected to have positive coefficient, though $total\text{realGDP}_j$ and $totalGDP\text{per\,capita}_j$ are not present in the same regressions, owing to correlation concerns. More high GDP countries among the leaders may indicate more resources given to the implementation of the treaty, and countries seeking aid may support the treaty in hopes of receiving aid. High GDP per capita indicates wealth similarly, but the measure may also capture the effect
of a wealthy population and its demands. If a clean environment is a luxury good, then wealthier populations may pressure their governments to participate in MEAs more than poorer populations. Furthermore, as Kuziemko and Werker (2006) find, having a turn on the UN Security Council increases receipt of foreign aid, indicating the general sentiment that other countries wish to gain favor with the Council members. Thus, more Security Council members among the first participants should lead to more membership intention, as other countries may want to express their goodwill and common interests with those on the Security Council in order to gain favor in other matters. Finally, a large sum of percentages of GDP from industry shows that higher polluting countries committed to the agreement, increasing the value of the MEA and overcoming the free-rider problem.

5.2 Control Variables

Signing environmental treaties has been shown to be highly persistent (Egger et al., 2009). Thus, \( \text{preSigned}_{it} \) is the number of previous MEAs country \( i \) has signed at time \( t \). A positive coefficient is expected. If a country has signed environmental agreements in the past, it has indicated interest in such action and is more likely to sign subsequent treaties. Also, a number of the treaties in the study are amendments to prior treaties; this variable captures the effect of ongoing commitment to an amended treaty.

Whether or not an individual country served on the UN Security Council in the year of the treaty’s introduction is represented by \( \text{securityCouncil}_{it} \). A positive coefficient is expected. With a seat on the Council, a country could desire to fulfill some sort of perceived duty or to wield its influence more noticeably even if that country may have prioritized other issues ahead of environmental protection when not on the Council.

The Fraser Institute’s Economic Freedom of the World index is represented by \( \text{freedom}_{it} \). Though index is only available for every fifth year in the decades of this study, the coefficient is expected to be positive, as countries with more political freedom have been shown to be more likely to sign MEAs (Egger et al., 2009). Since countries with greater political freedom directly report to constituents, if the population believes environmental protection to be important, then politicians are more likely to support MEAs to increase chances of personal reelection. Autocrats, on the other hand, do not have this same incentive to participate in MEAs.

As mentioned before, \( \text{GDP}_{industry, it} \), which is the percentage of GDP attributed to industry, will attempt to capture country \( i \)’s costs of signing the MEA. Industrial pursuits have a high rate of emissions and pollution, a high cost of reducing said emissions and pollution, and monetary clout to lobby a government against signing an MEA. Thus, a negative coefficient is expected: the higher the percentage of GDP due to the industrial sector, the lower the chance of a country signing a particular MEA. Benefits from signing the MEA will be captured by \( \text{forests}_{it} \), which is the adjusted savings of net forest depletion for a country. A negative coefficient is expected, as countries with high depletion percentage have already demonstrated less regard for the environment.

Finally, included are fixed-effect dummies for individual treaties, \( \alpha_j \text{W}_j \). Treaties may be more or less attractive based on the actual provisions of the MEA: requirements, self-
enforcement strategies, etc. This fixed effect will also capture the effect of the treaty’s subject upon membership success. Also in the model are fixed effects for individual countries, $y_i V_f$. This vector of dummies controls for the aspects of culture not captured in other variables that may determine interest in MEAs, as well as political determinants that may affect the length of time it takes a country to declare its participation in a treaty.

6 Results

This section presents the results of the regressions run. The first tested dependent variable is whether or not a country is a member of a treaty, meaning whether the country has signed, ratified, or accepted the agreement in some manner. Table 1 shows six regressions, three using GDP as the measure of wealth, three using GDP per capita. The first regression for both includes all the controls, as well as the variables of interest. The second adds both country and treaty fixed effects, while the third adds a regional dummy. The summed leader variables are initially significant. Adding the fixed-treaty effects improves the explanatory power of the model greatly, though it causes GDP and summed leader GDP to lose significance and changes the sign on summed percentage of GDP from industry. Adding the fixed-country effects adds little explanatory power and wipes out the significance of most of the controls as well as summed GDP. Finally, the dummy $\text{regionaltitle}$ is significant when included. From this first round of regressions, the study finds that number of leader countries on the Security Council has a positive and significant effect, while the summed percentages of GDP from industry have a small, negative, but significant effect. Summed leader GDP is statistically insignificant, and the coefficient is so close to zero as to be real-world insignificant as well. Also, when $\text{freedom}$ and $\text{previoussigned}$ are significant, they are positive as expected. When using GDP per capita, the measure of wealth is more significant than GDP was; nevertheless, its coefficient is also especially close to zero. Surprisingly, the coefficient on $\text{freedom}$ is negative when the variable is significant. Out of the summed interest variables, percentage of GDP from industry is also unexpectedly negative (though small), and Security Council leaders is positive. The coefficient of summed GDP per capita is, like the coefficient of summed GDP was, also very close to zero.

For the next regression, the dependent variable was further restricted. In the full data set, many of the treaties were only intended for regional participation. Thus, Table 2 shows the results for the regression on membership (signatory or party) for treaties where $\text{regionaltitle}$ is equal to zero. The set-up parallels that of the previous two regressions. Initially, four of the controls are significant, and they stay significant after the inclusion of the three summed variables of interest. Adding the treaty fixed effects renders $\text{freedom}$ insignificant, and this time adding the fixed country effects does not wipe out the significance of the other variables. The country effects appear to reverse the freedom index’s negative sign, which occurs in the presence of GDP per capita. The inclusion of the country effects also changes the coefficient of previous agreements signed to negative, which is rather unexpected. The signs and coefficients on the variables of interest are similar as before: summed GDP per capita is close to zero, summed percentage of GDP from industry is negative but small, and
the summation of Security Council members is positive. In addition, the R-squared values are highest in this set of regressions.

For comparison, a probit model is used to test the same relationship – the same vector of controls on the dependent variable member, restricted to the non-leader countries of non-regional treaties. Table 2 also shows the probit results for regressions including the vector of controls, the three variables of interest, and combinations of the fixed effects. The treaty effects are significant in both regressions. Without the country effects, freedom and depleted forest area adjusted savings are insignificant, but the other variables – including the summed leader variables – are significant. The country effects appear to be insignificant when added. They decrease the significance of two control variables, but they do make freedom significant and improve upon the R-squared value. The effect of total of Security Council members among the leader countries is positive and significant as before, the effect of the summation of percentages of GDP due to industry is negative and significant, and the coefficient on summed GDP per capita is, once again, very close to zero. Of the control variables, freedom and GDPpercap are significant in both regressions, and the coefficients of their signs are positive as expected. The variable previous_signed is also significant in both, but it switches signs, which is unexpected.

Table 1: LPM Using Membership^ as the Dependent Variable

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* significant at 10%
** significant at 5%
*** significant at 1%
^ where firstweek=0

a most effects significant
b most effects insignificant
Table 2: LPM and Probit Model Using Membership as the Dependent Variable, GDP per capita as an Independent Variable, Restricted on Non-Regional Treaties

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R-squared                | 0.11875                  | 0.0722                   | 0.0301                   | 0.2270                   | 0.2870                   | 0.4776                   |
Adjusted R-squared       | 0.0869                   | 0.0712                   | 0.4989                   | 0.5140                   |                         | 0.5292                   |
Pseudo-R-squared         | 148.17***                | 67.44***                 | 81.05***                 | 40.27***                 |                         |                         |
F-stat                   | 157.27                    | 126.03                   | 161.27                   | 64.20                    |                         |                         |
LR χ²                    | 3355.42***               | 3713.16***               |                         |                         |                         |                         |
Number of Observations   | 9280                     | 7800                     | 7800                     | 7800                     | 6420                     | 6404                     |

* significant at 10% ** significant at 5% *** significant at 1%  
(a) most effects significant  (b) most effects insignificant  (c) where firstweek=0  (d) where regionaltitle=0

7 Robustness Checks

The main study examined the aggregate of signatories and parties. As explained earlier in the paper, either indicates some sort of intent to participate in the agreement. Of further interest are the differences between the decision to sign and the decision to ratify or accept an MEA. Thus, the first robustness check was to repeat the analysis from the previous section using signatories and parties as separate dependent variables. The results are presented in Tables 5 through 8 in Appendix A. The variables of interest are significant under the majority of specifications. The amount of leader Security Council members has a consistently positive effect on the decision to participate, while the coefficient on summed GDP per capita is always very close to zero. The coefficient on the summation of percentage of GDP from industry is also rather small, and the sign changes from regression to regression.

Because many of the treaties are region-specific, and since the study is more concerned with global environmental treaties, this second robustness analysis restricts MEAs in the same time period (1980-1999) to those with at least 30 members, excluding three treaties with especially regionally-specific, non-environmental titles underwent further elimination. These specifications narrow the sample to 28 MEAs (listed in Table 14 in Appendix B) and 194 countries. For variable robustness, adjusted savings of forest depletion have been replaced by forestedarea, the percentage of the country’s land area that is covered in...
forests in the year the agreement was initially introduced, and real GDP (taken from the
US Department of Agriculture) is used as the measure of wealth instead of GDP per capita.
In addition, while one set of regressions controls for treaty fixed effects, a second set of
regressions controls for subject fixed effects, to isolate the effect of the subject matter of
the treaty. Table 15 in Appendix B presents the eight treaty subject dummies created using
treaty descriptions from the SEDAC database.

The regression results using this dataset are summarized in Table 9 and Table 10 in
Appendix A. Once again, the effect of total Security Council members is positive, while
the effects of summed real GDP and summed percentage of GDP from industry are very
close to zero. The coefficient on realGDP is higher using this data set than it was in the
study’s main regressions, though it is still close to zero. Adding the fixed-subject effects
increases the significance of realgdp (though the coefficient is still close to zero) but
makes previoussigned and firstweekgdpi insignificant. The inclusion also switches the
signs on firstweekrealgdp and firstweekgdpi, though both coefficients are so small as to be
negligible in real-world situations. The results of the probit regressions – once without the
fixed-subject effects and once with them – are also shown in Tables 9 and 10 in Appendix
A. The significance of the results largely corresponds to the LPM model with the same
specifications.

A third robustness check using the smaller dataset involves an alternate definition of
“leader” countries as the first third of participants. Rather than set the cut-off date a week
after the first signature, the date was set so that at least one third of the members indicated
participation before it. Treaty fixed effects are used once more, as opposed to the subject
effects. The regressions using this specification are summarized in Table 11 in Appendix A.
Without controlling for fixed-treaty effects, all of the variables of interest are significant:
totalsc and totalGDPind are positive, while totalrealGDP is negative. Of the controls,
freedom is the only significant variable, and it has a positive coefficient. When fixed-
treaty effects are added to capture the influence of the treaties’ subject matters and legal
constructions totalGDPind and totalrealGDP become insignificant. The variable totalsc
is still positive and significant, indicating that the joining of Security Council members
in the first third of the agreement encourages those countries which later join. A probit
model yielded similar results, also shown in Table 11 in Appendix A. Without fixed-treaty
effects, freedom was positive and significant out of the control variables, as were all three
the interest variables. Once fixed effects were added, freedom and totalsc was still positive
and significant, but totalGDPind and totalrealGDP were no longer significant. In addition
when moving from the LPM to the probit, the standard errors increased for both significant
variables and several observations were dropped.

8 Conclusions

With regards to UN Security Council membership, this thesis found that the total number
of Security Council members among the early participants does increase the likelihood
of an individual country joining the agreement afterward. This variable was significant
in each of the regressions, in both the main study and the robustness checks, showing strong evidence that the early participation of Security Council members increases overall membership – a point to be noted for those interested in promoting MEA participation. The results are less clear in regard to the real GDP, GDP per capita, and percentage GDP from industry summed over the leader countries. The coefficients on these were significant in the majority of regressions, but the signs changed frequently and the magnitudes were so close to zero as to be negligible. Thus, this paper cannot offer conclusions as to how these measures of economic size and environmental impact of the leader countries affect MEA participation.

For the control variables, the study confirmed that the number of previous treaties signed was significant, as found Egger et al. (2009). The paper also confirms that political freedom is a factor in MEA participation, though opposite of what was expected. Freedom and per capita GDP are highly correlated, and when controlling for both, the study finds that freedom’s effect becomes negative. The positive effect when only real GDP is controlled for could be an artifact of how the wealth of citizens affects MEA participation. When this effect is captured by GDP per capita, it appears that greater political freedom decreases the likelihood of a country joining an MEA as a non-leader. Though the study does not replicate the significance of forested area shown in Murdoch et al. (2003) when tested in the robustness checks, the variable measuring adjusted savings of net forest depletion was found to be significant and negative in many of the regressions, indicating it a more appropriate proxy for environmental motivation.

9 Expansions

One of the main ways this study could be expanded would be to use a different proxy or instrument to measure the “size” of pollution of the leader countries. As environmental issues gain prevalence, new indices of pollution are constructed, which can be used to ascertain the effect of leader environmental impact upon membership decision. Currently, such indices are not constructed retroactively, especially in the time period of this study. The collapse of the Soviet Union led to the creation of many new states, and data from the Soviet period is difficult to obtain and to disaggregate for the shape of the world today.

Furthermore, since the model appears to function well in the case of MEAs, it could be expanded to other types of transnational agreements. Does the early support of Security Council members push countries to sign other types of treaties, such as those concerning human rights or disarmament? What are the determinants of participation in international agreements in general, and what variables influence specific types of agreements?

Also of interest would be a study of the particular determinants of ratification as opposed to signing. While this study examines both types of members separately and together, it could be expanded to examine the dynamics of the combined probabilities, perhaps with a bivariate probit model. Such a study would be especially informative for policy makers hoping to increase accountability in MEA participation.

Most intriguing, though, would be to expand the research and theory behind how
the influence of the leader countries affects the others. Is the free-rider problem overcome and are countries enticed to commit? Is there some other information factor behind the existence of leader countries? Further research into the negotiations of the treaties, as well as detailed utility modeling, could more fully reveal the decision process behind MEA participation.

Appendices
Appendix A contains the regression tables for the robustness checks discussed in Section 7. Appendix B details the construction of the data set, listing countries and treaties used in the study. Tables within the paper have been shortened as well. The full-length paper, including both appendices, is available upon request from the author.
References


PARENTAL DEATH:  
EFFECTS ON INTELLIGENCE

Benjamin Arnold  
University of Michigan

ABSTRACT

This paper examines the effect on a girl’s intelligence scores due to the loss of a parent. The paper takes data from Kenya and determines that in Kenya, the loss of a father is more detrimental to the intelligence of his daughter than the loss of a mother. The impact is greater for the loss of a father because males have a higher earning power than females. At some point during the year, fatherless families are more likely to be without cash, income, and food. This outcome forces girls to seek employment, taking time away from their education. The study also concludes that having more brothers and sisters decrease the intelligence of a girl because the income of the household is spread over more people. Lastly, the conclusions from this paper only further support the belief that intelligence is acquired through experiences, in addition to innate ability, rather than solely through innate ability.

Acknowledgements

A special thanks to my professor, Rebecca Thornton

1 Introduction

Death is arguably the toughest event through which human beings struggle. Adults struggle through the grieving process because they understand that they will never see their lost loved ones again. In this world, death is final and cannot be taken back. If adults are traumatically affected by death, we expect that it will influence children as well. This paper probes the impact on intelligence tests when a female pupil loses a parent. We assume that death is random. This assumption claims that the natural ability of a girl and other covariates are not correlated to her mother or father’s death, allowing us to attribute differences on the Raven test to effects from the death. Raven scores are significantly higher for girls who have not lost a parent compared to those who have. To the extent that Raven scores measure IQ, this result opens the discussion to whether or not intelligence is innate or based on one’s life experiences. Further, due to specific characteristics of the
setting, results show that the loss of the father is more significant on test scores than the loss of the mother.

The effects of parental loss on children becomes especially important in developing nations due to the high percentages of children who have lost at least one or both parents. According to one study, one in ten African children under the age of 15 has lost one or both parents (Hunter and Williamson, 2000). In our study examining Busia girls in Kenya, the rate was one in ten children had lost their mother, while one in five had lost their father. This rate is alarming high, increasing the importance of our analysis. Further, the majority of the pupils in the study esdo not live with their fathers. We utilize this truth to explore factors affecting intelligence between girls who lost their father and girls who simply do not live with him.

The analysis discovers that the loss of the father significantly lowers his daughter’s test score, while the loss of the mother does not yield statistically significant results. Without controlling for other variables in the interactive model, at a 10 percent level, we conclude that the loss of a father does significantly impact the resulting test score on the Raven test. When including covariates in our regression, the coefficient on whether or not the dad is alive becomes significant at a 5 percent level. Using a simple linear model, the results show that when the father is still alive, our model predicts that girls will score 0.12 standard deviations higher than those girls whose father is dead. This conclusion is very important for policymakers because it is another educational input that should be considered when discussing reforms to the educational system. In regard to the loss of the mother, the estimated coefficient shows an increase in intelligence scores when the mom is still alive, but this coefficient is not close to being significant.

As well as decreased test scores, girls who have lost a parent report to be significantly less happy and less healthy, have higher employment rates, eat fewer meals in the day, and are not asked as many questions in class. These are the direct effects of parental loss and should be included in policy debates.

2 Background

The fundamental result of this paper shows that results on the Raven test, an IQ test, are not strictly based on natural ability, but partially on natural ability and partially on life factors. Originally, the Raven test was created to eliminate language as a bias for intelligence testing. The test focuses on the child’s ability with spatial interpretation, pattern recognition, attention to detail, and memory. The Raven test consists of three matrices. There are matrix A, B, and AB. The test includes multiple choice questions that appear on colorful backgrounds that ask for the pupil to complete the patterns. Figure 1 is an example of a question from a Raven test. Three rows of three shapes are presented, with the last box asking to complete the pattern. In Figure 1, the correct answer is 5: “Rule A specifies that the answer should contain a square (because the first two columns of the third row contain a triangle and diamond). Rule B specifies it should contain a dark line. Rule C specifies that the line orientation should be oblique, from upper left to lower right” (Carpenter,
Figure 2 is the answer key used by the field officers in our study. Like all IQ tests, this test does not explain the entire picture. The test fails to capture a child’s intelligence if she has issues with visual memory or directionality. Although it has its limitations, the Raven test is thought by many to be culturally unbiased because of the reduction in the use of language (Coleman, 2009).

In the early 1900s, when the first IQ tests were being written, test writers believed that intelligence was totally based on genetics and, barring a serious accident, a person could not affect his intelligence:

“Intelligence...is conditioned by a nervous mechanism which is inborn: that the degree of efficiency to be attained by that nervous mechanism and the consequent grade of intelligence or mental level for each individual is determined by the kind of chromosomes that come together...that it is but little affected by any later influences except such serious accidents as may destroy part of the mechanism” (Goddard 1920).

Although outdated, this opinion would conclude that identical twins, split at birth, would have identical intelligences, regardless of their schooling or environment. Countless studies have proven otherwise, but it raises the question of what percentage of intelligence is based on nature and what percentage consists of living life (Holzinger, 1929). There are no correct percentages that balance the nature verse nurture argument; however, we must realize that each individual has a different given ability and that their lives build on this ability, resulting in an ever-developing intelligence. In our analysis, the increase in test scores for girls whose fathers are still alive is roughly 0.13 standard deviations higher than for girls who lost their fathers. This increase translates into a one point increase (out of 34 points), thus raising the score by 2.94 percentage points. Therefore, we can state that the event of losing a father negatively impacts intelligence. The reasons originate from the outcome of a fatherless home.

For a moment, let us consider what outcomes may be affected by the death of a father. First and foremost, the family lose earnings from the father’s work, which among other things, pays for school fees, school supplies (including uniforms), and school tests. Second, with the loss of earnings, the responsibility falls on the children of the family to increase their earnings to offset the loss. We observe a sharp spike in employment for fatherless daughters, taking time away from their schoolwork. The earnings potential for children is much less than that of their fathers, and we would expect to see lower household dispensable income. Thus, we see the effects in the number of meals eaten per day, the percentage of households without cash income at some point during the year and the percentage of people who own their property.

These observed differences in cash flow, number of meals, and employment rates between families where the father is living or not lead us to a conclusion that household income decreases when the father dies. Numerous studies have analyzed the correlation between parental educational expenditure and student achievement. In Taiwan, one study
found higher income is correlated to higher college rates and higher spending on education (Han, 2003). Thus, one theory could be that a father who is still alive spends more money on his daughter’s education, thereby raising her intelligence. The study also is consistent with this theory, concluding that single-parent children are less likely to go to college and that single-parent families spend less on education.

Intuitively, we might assume that the loss of the mother would be more detrimental than the loss of the father. Mothers typically bear the responsibilities of child-raising. The responsibilities, however, tend to decrease as the children age and become more independent. Therefore, maternal loss should adversely impact elementary school children to a greater degree, and this claim is supported by Ainsworth et al. (2000). From the study, the researchers concluded that maternal orphan status delayed schooling of the youngest children (ages 7-10), while maintaining enrollment of older children (ages 10-14) in Tanzania (Ainsworth et al., 2000). In our sample, however, the pupils range from age 9 to 20, implying that the loss of a mother will not be as significant as it might be.

Furthermore, a study in Indonesia claims that losing one’s father is more significant than losing one’s mother if males have higher earnings power (Gertler, Levine, and Ames, 2002). Although evidence suggests that mothers invest more of their income in their children (Haddad & Hoddinott, 1994; Thomas, 1997), we see in Kenya that school is not free, and parents oftentimes have to bargain with the headmaster because they cannot afford to pay the entire amount (Kremer et al., 2004). Recently, Kenya abolished primary school fees, resulting in an increase in enrollment of 1.2 million additional pupils (U.N., 2008). Gertler et al. (2002) concluded that if liquidity constraints are the limiting factor on children’s education then we would expect to observe a greater affect due to the loss of a father than that of a mother. In our results, we see a greater impact on the Raven total when the father dies than when the mother dies. If we believe that results on an intelligence test are correlated with schooling, these results signal liquidity as being the main constraint.

Before finishing this section, we briefly examine two studies that find the effects of a parental loss might not be uniformly distributed over a specific household. The first study found several conditions, that shift a disproportionate share of the adverse impact onto daughters. For example, if males have higher returns to education, a son will be given preferential status, receiving more investment in his education than his sisters (Alderman & Gertler, 1997). The second study found that in cultures that place higher importance on males than females, a girl with many brothers will receive less than a girl with zero brothers (Garg & Mardouch, 1998). Although our data does not contain Raven scores for males, the findings could prove to be important in the interpretation of our results.

3 The Data Set

The data used in this paper comes from the data in Incentives to Learn, a paper published by the National Bureau of Economic Research (Kremer, Miguel, & Thornton, 2004). It was chosen because the amount of information known about each individual is quite large. The data allows us to measure many different theories resulting from the lost of a parent.
Incentives to Learn set up a merit-based scholarship program in rural Kenya to measure the effects that the program had on student effort and test scores. The scholarship was awarded to girls in the sixth standard, who placed in the top 15% in a five subject test taken at the end of the year. The scholarship paid for the following two years of schooling. However, the test was not free to take (cost: between US$1-2). In addition to this cost, schools charged fees to cover non-teacher related expenses, and parents had to pay for uniforms and schools supplies (both estimated to be approximately US$6.40). These expenses may be a barrier to entry for poorer families.

The incentives program was set up in two districts, Busia and Teso that included 127 schools. The schools were randomized into a treatment group (implementation of the scholarship program) and a control group. In 2002, the students were asked to fill out a survey, given by the researchers. “Note that random measurement error is likely to be reasonably large for these survey responses, since rather than being filled in by an enumerator who individually interviews students, the surveys were filled in by students (at their desks) with the enumerator explaining the questionnaire to the class as a whole” (Kremer et al., 2004). This measurement error occurs during the first survey but does not happen in the follow-up survey. Our analysis is based on the follow-up questionnaire.

Three years later, in 2005 and 2006, field officers revisited the schools, randomly selecting (through a lottery) female students to conduct a follow-up interview. Due to the size of the original sample, the field officers did not have time to interview each pupil. The questionnaire was 57 pages long, which explains why we have a tremendous amount of data for each respondent. During this interview, the respondents were administered the Raven test as well as asked reading, math, and spelling questions. There were over 1750 follow-up interviews completed, and the results have been correlated with the individual’s answers from the original questionnaire.

Due to where surveys were administered, the internal validity is threatened when we consider the effect of death on attendance rates. Surveys were administered at school. In a recent study, researchers found that children in Indonesia with a widowed parent are roughly 50 percent higher to leave school than their classmates (Gertler et al., 2002). Consequently, pupils who lost a parent do not attend school and would not complete a survey. We would fail to represent the true population of children struggling with a parental loss. This is selective inclusion and is a threat to our validity. This selection bias also threatens external validity because we fail to account for all children who do not attend school or who have dropped out. Our data does not represent the general population in the Busia district of Kenya. For example, suppose that one hundred pupils left school after their fathers’ deaths because they decided that school was a waste of time, and they started working full-time. Further, these one hundred pupils were in the same religious group that for some reason tend to do worse in school. Our results would not represent the correct distribution of deaths among religious groups and underestimate the difference between intelligence test results among the two groups. Because the surveys are only administered at school, we may be misrepresenting the population.

Along those same lines, there are a few shortcomings of the data that must be stated.
First, we have no information on males’ results on Raven test scores. This fact narrows the conclusions this paper can draw because we only have data for girls. The limitations hamper our ability to measure parents’ preferences. Commonly practiced, parents may have higher preferences for the sons to obtain higher education because of gender roles in society. If this were true in Kenya, it would be interesting to compare educational inputs on brothers and sisters who lost their father and see the resulting impact on intelligence. Nonetheless, this data does not permit such a study.

Second, as previously mentioned, the ratio of dead fathers is not representative of the mean countries around Kenya. Differing statistics claim that the rate that an African child under the age of 15 has lost either one or both parents is between 10 to 15 percent (10 percent comes from Hunter and Williamson, 2000 and 15 percent comes from Case, Paxson, and Ableidinger, 2004). Hypothetical situations can be imagined for why widowed rates are especially high in Kenya, but there is no clear explanation why our observed rate is higher. This uncertainty, as well as the selection bias, limits the strength of the conclusions made by this paper.

4 Identification Assumption

The conclusions made by this research have been made on the assumption that death is random, but we must reconsider this assumption. In this section, we refer to Tables 1 and 2. The tables are the same, except that Table 2 specifically looks at ownership of goods. Columns 1 (dad) and 4 (mom) show the estimated average for the variable of interest if the parent is dead. Columns 2 (dad) and 5 (mom) show the estimated average for the variable of interest if the parent is still alive. Column 3 takes the difference between column 2 (the average for the group of girls whose father is still alive) minus column 1 (the average if the father is dead). Column 6 is computed in the same way as column 3 except that it takes the differences of the averages between whether the mom is alive or dead.

Death is not random if it is more prevalent in a certain group of people. Consider the example in which death is more common in a certain ethnic group that tends to be very poor. Then when we measure its members’ intelligence, we might observe other income effects such as lower educational inputs or malnutrition. On the surface, death does not appear to be random when examining the correlation between the language that the father speaks and death rates of mothers. Referring to Table 1, we find that if the mother is still alive, then the father is 21 percent more likely to speak Luhya, the predominant language spoken by fathers in our study. This result is significant at a 5 percent level. This difference, however, is the only correlation found between the father’s language and mother’s death. Conversely, after regressing the variable dadlives on indicator variables for different father languages, the coefficients are not significant, suggesting that there is not a correlation between the language the father speaks and father’s death.

In addition to language, we find that the average years of education for both the father and the mother are not statistically significant different between the two groups, alive and dead. As shown in Table 1, the differences in the amount of schooling between dead
fathers and living ones are small and not statistically significant. This outcome is important for our internal validity. The insignificant differences in education mean that death is not correlated to the amount of education one has. To contrast, a retrospective study of the 1919 influenza epidemic shows that, as each census passed, the years of schooling increased for the cohorts, reflecting that less educated people died sooner than those with more education (Almond, 2006). Our study does not demonstrate this result, and we can conclude that the amount of a parent’s education is not correlated with death.

Examining physical differences, we discover that a parent’s death does not affect the daughter’s height and weight. Both the girls’ height and weight between the groups are not significantly different. This similarity is extremely valuable information because we do not observe results that point to wasting or stunting in the fatherless or motherless group. Stunting, the retardation of height due to chronic under nutrition, is a long-run measurement of health, while wasting focuses more on the short-run nutrition inadequacies. Wasting and stunting are two problems facing development countries: “The prevalence of stunting, underweight, and wasting is decreasing in most areas of the world; however, in most of Africa, stunting is increasing” (Caulfield et al., 2006). This result is important as we consider the amount of food consumed by the girls in both groups.

When a girl has lost her father or mother, she will receive a tenth of a meal less per day than if her father had not died. These differences in the number of meals yesterday and the number of meals two days ago are statistically significant at a 1 percent level. Furthermore, when a father dies, the household is 18 percent more likely to go without food at some point during the year. These results show that the amount of food per household decreases with the loss of a parent. Although our balancing table shows less food for families who have lost a parent, that loss does not have a significant effect on the height and weight of a child.

Lastly, we must consider the interpretation of the percentage of households who at some point in the year leading up to the interview did not have a cash income. The difference between the group of girls whose mother is dead and whose mother is alive is basically zero. On the other hand, the difference between the girls whose father is still alive and whose father is dead are statistically significant. Thus, we see that when a household loses the father, there is a large impact on cash income, which is not observed when the mother dies. This is an important implication because it proves that males are the dominant generators of income in Kenya.

Referring to Table 2, we see more significant differences because with lower income, the household ownership of assets is lowered. When a family loses its father, Table 2 shows that the family will own significantly fewer cattle, pigs, chickens, bikes, phones, and televisions. All of these assets are at least significant to the 10 percent level. Although this table shows significant differences between our groups, it does not affect our assumption that death is random because Table 2 accounts for not only pre-death ownership but also for post-death ownership.
5 Estimation and Results

Aggregating the knowledge accrued from the previous section, we attempt to identify a regression that correctly estimates Raven scores on whether or not the parents are alive. The dependent variable is the pupil’s normalized score on the Raven test. The variable was measured by first taking the sum of each section to produce a total raw score. The total Raven test score should be out of 36 points (three sections of twelve raw questions), but the field officers used the first two questions in section A as examples for the pupils. The Raven total was then normalized using the mean Raven total of the population and its corresponding standard error, creating the variable NormalizedRaven with mean 0 and standard deviation of 1. Other variables that apply through our estimation section are Dadlive and Momlive. Dadlive is a dummy variable, taking on the value of 1 when the pupil’s father is still living and taking on a value of zero when the pupil’s father is dead. The variable Momlive is coded the same way, but refers to the mother’s status.

5.1 Simple Linear Regression Model

The independent variables of interest are Momlive and Dadlive. In both our simple linear models, the intercept is the estimated normalized result on the Raven test if the parent of interest is dead. When they are alive, the intercept plus the value of the coefficient on the independent variables equals the estimated normalized score on the Raven test. When interpreting the coefficient produced from our regression, we will define the value as the change in standard deviations (because the variables are normalized). In Table 3, Column 1 in Panel A shows the values of the coefficient and the intercept in equation (1), while Column 1 of Panel B shows them for equation (2).

When the father is dead, Dadlive equals zero and the intercept, -0.0975, estimates that fatherless girls will score 0.0975 standard deviations below the mean, regardless of the size of the coefficient on the variable. When the father is alive, the estimated normalized score increases by 0.122 standard deviations, which is significant at a 5 percent level. Now, the girls are performing better than the overall average of the study. In comparison, the estimated score for a girl who lost her mother is -0.0582 and this increased by 0.0649 standard deviations when the mother was alive. The coefficient on Momlive, in this case, is not statistically different from zero, which means we fail to reject the hypothesis that Momlive affects one’s intelligence score.

5.2 Multiple Linear Regression Model

One of the most difficult aspects of creating multiple linear regression models is determining which variables to include and which variables to omit. Including all variables does not necessarily affect the resulting coefficient on Dadlives, but it will affect our standard errors and inferences. As we discuss omitted variable bias, we should carefully observe our R-squared value to see how much of the sample variation explains the variation in our dependent variable.

The regression contains the total number of brothers and sisters because of the findings from Garg & Murdoch (1998), which concluded that as the number of siblings increased,
less money would be spent per child, and school performance would be adversely affected. The variable total siblings is the only variable of the four that is not a dummy variable. The interpretation of coefficients on total number of siblings is that by adding one more sibling to a household, the estimated test score will change by the value of the coefficient. From Table 3, the estimated coefficient on total brothers and sisters is negative, which concurs with the findings of Garg & Murdoch (1998) that intelligence decreases as the number of siblings increases.

The model also includes a dummy variable for employment in the last twelve months. This variable is used because employed students are more likely to go without food during the year. They are forced to work because the family loses the income generated by the father. Working could have one of two effects. Either working girls have higher intelligence as someone saw their ability and decided to hire them or working girls have lower intelligence because they forgo schooling to make money. Our results regretfully prove the latter; that is, students with jobs are significantly less intelligent than those who do not work.

The model also controls for whether or not the individual is on a school committee. The committee variable is a dummy variable, taking on the value of 1 when the student is on a committee. It is included in our model because respondents who have lost a parent are significantly less likely to participate in a committee. It is hypothesized that the effect of being in a school committee will have a positive effect on intelligence scores because the students are both more involved and more active in their schools. Our hypothesis is correct, reflected in a large positive coefficient on committee, significant at a 1 percent level.

Lastly, we include the variable whether or not the family owns the land it lives on because we saw in Table 2 that families who have not lost a parent are more likely to own the land they live on. Owning land is correlated with higher levels of wealth. Also, owning the land provides stability in a student’s life, as the family has an incentive to stay in the region. Unexpectedly, the coefficients on this variable prove to be interesting. The coefficients on own or rent are not only negative, but statistically significant at a 1 percent level. This result states that once we have controlled for the variables in the model, if a family owns their property then their children will be less intelligent. Due to limited knowledge of Kenya, we can only wonder and ponder over this result as it seems backwards.

5.3 Interpretation of the Regressions

In Column 1 of Table 4, we see the model that only controls for the loss of each parent. It does not include the control variables we just discussed, but Dadlive controls for the status of the mother’s status and vice versa. The results are quiet interesting. The coefficient on Dadlive does not change when we include Momlive in our model. On the other hand, when we control for Dadlive, we observe a decrease in the value of the coefficient on the Momlive, making it even less significant. This means the impact of the loss of a mother is smaller, when we consider the status of the father.
In Table 3, Column 2, when controlling for the number of siblings, committee participation, employment, and property ownership, we estimate coefficients on Momlive and Dadlive that shift upward by roughly 0.01 standard deviations compared to those estimates in the simple model. The significance levels have not changed. Thus, we will look to another model to further explore the impact on parental loss.

5.4 Interactive Model

At last, we reach the most important regression of the paper. In this regression, we not only include both Momlive and Dadlive in our regression, but we add an interaction term because there is reason to believe that Momlive and Dadlive are dependent on each other. When interpreting Table 4, it is not as simple as previous interpretations because now we have three coefficients, each representing a partial effect on intelligence scores. We will use just the interaction model, not controlling for the same four variables as before (Column 2). Column 1 is just the two variables without any interaction. Column 2 includes the interaction, while Column 3 includes both the interaction term and the control variables.

When both parents are dead, the estimated normalized test score is 0.2 standard deviations below the sample mean. When the father is alive but the mother is dead, the estimated normalized test score is 0.078 standard deviations higher than the sample mean. When the mother is the only parent alive, the resulting estimate is -0.07 standard deviations. When both parents are alive, the estimate is 0.0234 standard deviations higher than the sample mean but below the estimate for when children are in single-father homes! At first glance, we may think these estimations are biased or just plain wrong. But consider what this estimation is telling us. A girl, aged 10 to 18 years old, is more intelligent when she has lost her mother but not her father. When the girl loses her mother, new responsibilities are placed on her shoulders because, typically, daughters are expected to make up for the death. For example, if the girl has younger siblings, she might be given the responsibility of caring for her brothers and sisters. She might be given the responsibility of cooking, cleaning, or shopping, which forces a quicker intellectual development. This extra responsibility could impact intelligence negatively in the long-run if the responsibilities limit the daughter’s ability to attend school.

6 Measurement Issues

From the outset, we have known a lot of information about the participants in our data. After respondents answered that their fathers were alive, the field officers asked whether they lived with their father. Of those whose fathers were alive, 38 percent of them did not live with their fathers (see Figures 3). Furthermore, when we include the respondents whose fathers were dead, we observe that a majority of the respondents did not live with their fathers. There are numerous reasons for fathers to live away from their daughters. For example, fathers could live in a different place, close to their job. This poses a problem because we now question whether it is the physical presence of the father in the household
or his earnings or his influence on his daughter that results in higher intelligence. After generating a new dummy variable that equals one if the dad is alive but does not live with daughter and 0 if the dad is dead, we learn that test scores of the two groups are not statistically different. To test this problem further, Table 5 shows the same regression as Table 4, but the Dadlive and Momlive variables have been replaced with dummy variables that equal 1 if the girl lives with her father/mother and 0 if the girl does not live with her father/mother.

The results from Table 5 are consistent with the results from Table 4, demonstrating that it is the father’s presence in the household which increases his daughter’s intelligence. When the children do not live with either parent, their expected test score is .16 standard deviations below the mean. When she lives with just the mother, her test score rises to .09 standard deviations above the mean of 0. Most important, we see that when living with only her father, her test scores are significantly higher than if she lived with both parents. Without her mother, a girl is forced to mature into a woman faster than if she lived under the same roof as her mother. This is important as we move to discuss the policy implications of this study.

7 Conclusion and Policy Implications

What does this all mean? First, we must highlight the minor conclusions from this paper. Data reveals that a liquidity constraint faces Kenyan children, enrolling in school. Kenya has taken the first step by eliminating school fees, but it remains to be seen if the Kenyan education system will thrive without generating school fees to offset costs of teachers and materials. The data also suggests that mothers have their greatest impact on children before the age of 10. This result is significant for parents because it proves that they should start giving more responsibilities to their daughters. Daughters, who shoulder more of the load, appear to be more intelligent. The greatest flaw of this paper is the lack of data for males. If we had data on males in Kenya, we could further extrapolate the affects of between boys and girls to see if the same patterns hold. Further, we learned that as the number of brothers and sisters increases, the intelligence of each one decreases. If we were to study this correlation more, we are likely to find that the data is not linear. This implies that there is an optimal number of siblings a child should have to maximize her intelligence. This is important because as the world population starts to reach its limit, and we are forced to limit human reproduction, this could increase in importance.

Specifically relating to the loss of a parent, this study concludes that increased financial support is necessary to ensure there is no loss in intelligence once a father has died. Financial support should depend on certain characteristics of the family. The financial support should obviously depend on the total number of kids in the family. In addition, increased financial support should be given to families who are forced to make the oldest children work. Work takes away from time that a student is in class and from time that a student could be studying. Furthermore, food stamps would be an interesting policy for families who recently loss the primary income in the family because as we saw, fatherless
families tend to have fewer meals per day. There are more creative solutions to increase financial support to widowed families, but now, we know they need it!

Lastly, the paper demonstrates that intelligence is acquired through experience and is not just determined at birth. If intelligence were innate, then we should not have found so many significant correlations between intelligence and our independent variables. Intelligence develops through after-school activities such as school committees, through attending school, and through unobserved events that happen on a day-to-day basis. And intelligence is affected by parental death.
### Table 1: Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Effects from father death</th>
<th>Effects from mother death</th>
<th>Difference</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Height (cm)</td>
<td>162.5592</td>
<td>161.35</td>
<td>-1.209</td>
<td>164.189</td>
</tr>
<tr>
<td></td>
<td>[1.823]</td>
<td>[0.67]</td>
<td>[1.615]</td>
<td>[3.745]</td>
</tr>
<tr>
<td>Average Weight (kg)</td>
<td>59.1102</td>
<td>57.005</td>
<td>-2.106</td>
<td>60.902</td>
</tr>
<tr>
<td></td>
<td>[2.073]</td>
<td>[0.573]</td>
<td>[1.544]</td>
<td>[4.355]</td>
</tr>
<tr>
<td>Number of meals yesterday</td>
<td>2.115</td>
<td>2.218</td>
<td>0.103***</td>
<td>2.108</td>
</tr>
<tr>
<td></td>
<td>[0.033]</td>
<td>[0.016]</td>
<td>[0.035]</td>
<td>[0.047]</td>
</tr>
<tr>
<td>Number of meals 2 days ago</td>
<td>2.092</td>
<td>2.202</td>
<td>0.109***</td>
<td>2.071</td>
</tr>
<tr>
<td></td>
<td>[0.029]</td>
<td>[0.015]</td>
<td>[0.033]</td>
<td>[0.043]</td>
</tr>
<tr>
<td>Number of meals yesterday that included meat or fish</td>
<td>0.666</td>
<td>0.64</td>
<td>-0.027</td>
<td>0.599</td>
</tr>
<tr>
<td></td>
<td>[0.0342]</td>
<td>[0.017]</td>
<td>[0.038]</td>
<td>[0.0465]</td>
</tr>
<tr>
<td>Average Years of Education for the Father</td>
<td>10.549</td>
<td>10.816</td>
<td>0.267</td>
<td>10.857</td>
</tr>
<tr>
<td></td>
<td>[0.289]</td>
<td>[0.137]</td>
<td>[0.313]</td>
<td>[0.425]</td>
</tr>
<tr>
<td>Average Years of Education for the Mother</td>
<td>8.957</td>
<td>9.131</td>
<td>0.174</td>
<td>9.171</td>
</tr>
<tr>
<td>Total Number of Brothers and Sisters</td>
<td>3.806</td>
<td>5.167</td>
<td>1.362***</td>
<td>3.018</td>
</tr>
<tr>
<td></td>
<td>[0.120]</td>
<td>[0.059]</td>
<td>[0.132]</td>
<td>[0.165]</td>
</tr>
<tr>
<td>Father language= luhya</td>
<td>0.583</td>
<td>0.567</td>
<td>-0.016</td>
<td>0.479</td>
</tr>
<tr>
<td>Father language= kiteso</td>
<td>0.051</td>
<td>0.047</td>
<td>-0.004</td>
<td>0.066</td>
</tr>
</tbody>
</table>

**In the last year, % of households that:**

- Never go without food | 0.454 | 0.537 | .083** | 0.473 | 0.524 | 0.051 |
|                        | [0.026] | [0.013] | [0.03] | [0.039] | [0.013] | [0.041] |
- Never go without water | 0.777 | 0.787 | 0.01 | 0.736 | 0.79 | 0.054 |
|                        | [0.022] | [0.011] | [0.024] | [0.034] | [0.01] | [0.033] |
- Never go with health services | 0.459 | 0.506 | 0.047 | 0.449 | 0.501 | 0.052 |
|                        | [0.026] | [0.013] | [0.03] | [0.038] | [0.013] | [0.041] |
- Never go with cooking oil | 0.58 | 0.652 | 0.072** | 0.575 | 0.644 | 0.069* |
|                        | [0.026] | [0.013] | [0.028] | [0.038] | [0.012] | [0.039] |
- Never go with cash income | 0.076 | 0.117 | .041** | 0.108 | 0.109 | 0.001 |

Notes: Standard errors in brackets. Asterisks are in reference to statistical significance: * is significant at the .10 level, ** is significant at the .05 level, and *** is significant at the .01 level.

Notes on “In the last year, % of households” variables: Respondents were asked whether in the last 12 months, how often had they gone without food, water, health treatment, cooking oil and cash income. Results were then made into dummy variables signifying a difference between households who never went with out the good and households that went with out the good sometimes or often.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Effects from father death</th>
<th>Effects from mother death</th>
<th>Difference</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dead</td>
<td>Alive</td>
<td>2-1</td>
<td>5-4</td>
</tr>
<tr>
<td>Number of Cattle</td>
<td>1.073</td>
<td>2.11</td>
<td>1.037***</td>
<td>1.413</td>
</tr>
<tr>
<td>Number of Pigs</td>
<td>0.383</td>
<td>0.523</td>
<td>0.14**</td>
<td>0.287</td>
</tr>
<tr>
<td>Number of Chickens</td>
<td>7.411</td>
<td>8.826</td>
<td>1.415*</td>
<td>7.724</td>
</tr>
<tr>
<td>Number of Phones</td>
<td>0.327</td>
<td>0.397</td>
<td>.07*</td>
<td>0.455</td>
</tr>
<tr>
<td>Number of Televisions</td>
<td>0.214</td>
<td>0.282</td>
<td>.067**</td>
<td>0.251</td>
</tr>
<tr>
<td>Number of Bicycles</td>
<td>0.913</td>
<td>1.226</td>
<td>0.314***</td>
<td>0.97</td>
</tr>
<tr>
<td>Number of Car/Trucks</td>
<td>0.045</td>
<td>0.054</td>
<td>0.009</td>
<td>0.048</td>
</tr>
<tr>
<td>% of households that own the land they live on</td>
<td>0.862</td>
<td>0.921</td>
<td>0.059***</td>
<td>0.82</td>
</tr>
<tr>
<td>% of households that have electricity</td>
<td>0.09</td>
<td>0.065</td>
<td>-0.024</td>
<td>0.132</td>
</tr>
<tr>
<td>% of houses with an iron roof</td>
<td>0.583</td>
<td>0.569</td>
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<td>0.962</td>
<td>0.007</td>
<td>0.964</td>
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</table>

Notes: Standard errors in brackets. Asterisks are in reference to statistical significance: * is significant at the .10 level, ** is significant at the .05 level, and *** is significant at the .01 level.

Notes on Variables: During the interview, respondents were asked how many of each item the household owned. The reports are the averages in the different groups.
Table 3: Regression Models

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
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<tr>
<td><strong>Panel A</strong></td>
<td></td>
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</tr>
<tr>
<td>Dadlive</td>
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<td>[0.060]</td>
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<tr>
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<tr>
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<td>2.019***</td>
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<tr>
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<td>[0.278]</td>
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<td>[0.066]</td>
<td>[0.374]</td>
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</tr>
<tr>
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<td>-2.114***</td>
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<tr>
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<td>[0.082]</td>
<td>[0.466]</td>
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<td></td>
</tr>
<tr>
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<td>0.249**</td>
<td>18.53***</td>
<td>20.53***</td>
</tr>
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<td>0.059</td>
<td>0.002</td>
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<tr>
<td><strong>Panel B</strong></td>
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<td>[0.462]</td>
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<td>[0.061]</td>
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<tr>
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<td>2.014***</td>
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</tr>
<tr>
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<td>[0.049]</td>
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<td>Employed in the last year</td>
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<td></td>
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<tr>
<td>Own or rent property</td>
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<td>-2.088***</td>
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<td>[0.083]</td>
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<td>18.75***</td>
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<tr>
<td>R-squared</td>
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<td>0.056</td>
<td>0</td>
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</table>

Notes: Standard errors in brackets. Asterisks are in reference to statistical significance: * is significant at the .10 level, ** is significant at the .05 level, and *** is significant at the .01 level
Table 4: Interaction Model

<table>
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</thead>
<tbody>
<tr>
<td>Panel A</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Dadlive</td>
<td>.122**</td>
<td>0.278*</td>
<td>0.310**</td>
<td>1.471*</td>
<td>1.667*</td>
</tr>
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<td>[.061]</td>
<td>[0.155]</td>
<td>[0.151]</td>
<td>[0.878]</td>
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<td>Momlive</td>
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<td>0.13</td>
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<td>[.084]</td>
<td>[0.127]</td>
<td>[0.124]</td>
<td>[0.715]</td>
<td>[0.702]</td>
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<td>Interaction: mom*dad</td>
<td>-0.185</td>
<td>-0.216</td>
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<tr>
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<td>[0.169]</td>
<td>[0.165]</td>
<td>[0.956]</td>
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<td>Total Brothers and Sisters</td>
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<td>[.011]</td>
<td>[0.062]</td>
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<td>On a school committee</td>
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<td>2.005***</td>
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<td>[0.049]</td>
<td>[0.279]</td>
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<td>Employed in the last year</td>
<td>-0.208***</td>
<td>-1.239***</td>
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<td>[0.066]</td>
<td>[0.375]</td>
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<td></td>
</tr>
<tr>
<td>Own or rent property</td>
<td>-0.374***</td>
<td>-2.131***</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>[0.083]</td>
<td>[0.467]</td>
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<tr>
<td>Constant</td>
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<td>-0.201*</td>
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<td>18.00***</td>
<td>19.88***</td>
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<td>R-squared</td>
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<td>0.003</td>
<td>0.06</td>
<td>0.003</td>
<td>0.059</td>
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</tbody>
</table>

Notes: Standard errors in brackets. Asterisks are in reference to statistical significance: * is significant at the .10 level, ** is significant at the .05 level, and *** is significant at the .01 level.

Notes on Interaction Term: The interaction terms multiples the values of momlive and dadlive. Therefore, it only has a value of 1 when both the mom and dad are alive.

Notes on Variables: Normalized Raven Score are the normalized scores on the test. Raven total is the raw score on the test out of 34. Total Brothers and Sisters measures the number total number of brother and sisters the student has. “On a school committee” is a dummy variable, meaning the student on a school committee take on a value of 1, while those who are not on a school committee take on a value of 0. Employed in the last 12 months is also a dummy variable with 1=being employed in the last year. Own or rent property is also a dummy variable, taking on the value of 1 if the student’s family owns the land that they live on.
Table 5: Interaction Model

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Normalized Raven Score</th>
<th>Normalized Raven Score</th>
<th>Normalized Raven Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Live with Dad</td>
<td>0.0694</td>
<td>0.470***</td>
<td>0.400**</td>
</tr>
<tr>
<td></td>
<td>[0.056]</td>
<td>[0.179]</td>
<td>[0.175]</td>
</tr>
<tr>
<td>Live with Mom</td>
<td>0.163***</td>
<td>0.258***</td>
<td>0.222**</td>
</tr>
<tr>
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<td>[0.060]</td>
<td>[0.093]</td>
<td>[0.093]</td>
</tr>
<tr>
<td>Interaction: mom*dad</td>
<td>-0.507***</td>
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<tr>
<td></td>
<td>[0.195]</td>
<td>[0.193]</td>
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</tr>
<tr>
<td>Total Brothers and Sisters</td>
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<tr>
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<td>[0.057]</td>
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</tr>
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<td>Employed in the last year</td>
<td>-0.151*</td>
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<tr>
<td></td>
<td>[0.083]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own or rent property</td>
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<td>-0.430***</td>
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<tr>
<td></td>
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<td>[0.109]</td>
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<td>-0.163***</td>
<td>0.329***</td>
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<td>[0.125]</td>
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<td>1301</td>
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<tr>
<td>R-squared</td>
<td>0.01</td>
<td>0.011</td>
<td>0.058</td>
</tr>
</tbody>
</table>

Notes: Standard errors in brackets. Asterisks are in reference to statistical significance: * is significant at the .10 level, ** is significant at the .05 level, and *** is significant at the .01 level.

Notes on Interaction Term, Live with Dad and Live with Mom: In Table 5, we change our independent variables slightly, measuring whether or not the respondent lives with her mother and/or father. The interaction terms multiples the values of lives with mom and lives with dad. Therefore, it only has a value of 1 when she lives with both the mom and dad.

Notes on Variables: Normalized Raven Score are the normalized scores on the test. Raven total is the raw score on the test out of 34. Total Brothers and Sisters measures the number total number of brother and sisters the student has. “On a school committee” is a dummy variable, meaning the student on a school committee take on a value of 1, while those who are not on a school committee take on a value of 0. Employed in the last 12 months is also a dummy variable with 1=being employed in the last year. Own or rent property is also a dummy variable, taking on the value of 1 if the student’s family owns the land that they live on.
Figure 1
(Carpenter, 1990)

![Figure 1](image)

Figure 2. A problem to illustrate the format of the Raven items. (The variation among the three geometric forms [diamond, square, and triangle] and three shades of the line [dark, striped, and clear] is each governed by a distribution of three-variables rule. The orientation of the line is governed by a constant-in-a-row rule. The correct answer is B.)

### Figure 2 - Raven Score Sheet

<table>
<thead>
<tr>
<th>Section 4.5 Raven Tests</th>
<th>Correct?</th>
<th>Test Aa</th>
<th>Correct?</th>
</tr>
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<td></td>
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<tr>
<td>1</td>
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<td>1 (1) (2) (3) (4) (5) (6)</td>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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<tr>
<td>8</td>
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<tr>
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</tr>
<tr>
<td><strong>TOTAL</strong></td>
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<tr>
<td><strong>Test B</strong></td>
<td>Correct?</td>
<td>Test B (continued)</td>
<td>Correct?</td>
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<tr>
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<tr>
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<td>11 (1) (2) (3) (4) (5) (6)</td>
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</tr>
<tr>
<td>6</td>
<td>(1) (2) (3) (4) (5) (6)</td>
<td>12 (1) (2) (3) (4) (5) (6)</td>
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</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 3: Bar Graph

Notes:
1) Mean of Mornlive is the percentage of mother that are still alive. It is 50.41%
2) Mean of Dadlive is the percentage of father that are still alive. It is 79.635%
3) Mean that both parents are alive. This percentage is 74.78%
4) Mean of Livemom is the percentage of girls that live with their mothers, regardless of whether or not the mother is alive. This means that if a pupil's mother is dead, she will not live her. This percent is 67.80%
5) Mean of Livedad is the percentage of girls that live with their fathers. It is 49.43%
6) Mean that the pupil lives with both her parents. This percentage is 45.43%
References


INTERGENERATIONAL TRANSFER OF HUMAN CAPITAL AMONG IMMIGRANT FAMILIES

Kelsey Hample
Illinois Wesleyan University

ABSTRACT

While immigrants in the United States tend to earn less than comparable natives, their children close the earnings gap. The purpose of this study is to determine how differences in intergenerational transfer of human capital between immigrant families and native families affect different earning outcomes for respondents of each group. Specifically, this study uses a human capital framework to analyze both the direct effect of parental education on respondent earnings and the indirect effect on earnings by first affecting respondent education, which in turn affects respondent earnings. Data from the 1979 National Longitudinal Survey of Youth allows background variables within a family from 1979 to be related to respondent earnings in 2006. Thus, human capital investments made by parents can be linked to respondent outcomes several years later. The analysis shows that while parental education is a strong predictor of respondent education and earnings in the native population, it is weaker for second generation immigrants. Perhaps second generation immigrants overcome deficiencies in their parents’ human capital through higher levels of motivation.

Acknowledgements

I am very grateful to my advisor, Michael Seeborg, for his guidance.

In 1970 the foreign-born population in the United States was 4.7%; in 2003 it had increased to 11.7% (Census, 2009). Since revisions to the Immigration and Nationality Act began in 1965, relaxing the 1920’s quota system, the number of immigrants has climbed to new heights. An important implication of the increasing number and diversity of immigrants is the increasing number of immigrant descendants. As this number grows, it becomes increasingly important to study the differences in human capital that immigrants offer compared to natives, and how that human capital benefits their children. This study will compare the intergenerational transfer of parental human capital from parents to children for native and immigrant families. The major focus is on how the human capital of immigrant parents affects the earnings of their children.
1 Review of the Literature

The statistical phenomenon of “regression towards the mean” accounts for some of the improvement in earnings second-generation immigrants experience over their parents. Theoretically, second-generation immigrants should naturally do better than their parents who perform below the native mean, but they should not, due solely to statistics, perform above the native average (Borjas, 2006). Previous research can be divided into two schools of thought on this issue. Some work, especially early research, supports the theory that second-generation immigrants outperform natives, while other studies conclude that second-generation immigrants do not perform above the mean but merely regress towards it.

Advocates of regression beyond the mean assume there is something unaccounted for that gives second-generation immigrants the extra boost to outperform comparable natives (Borjas, 2006). Djajic (2003) proposes that while immigrants are at the mercy of discrimination and are likely to settle for a low-wage job, their children will not accept discrimination, thus earning higher wages than their parents. Complementing this line of reasoning is the theory that immigrants have very high levels of motivation and pass them on to their children. This, along with assimilation into the U.S. labor force, accounts for second-generation immigrants earning more than natives, thus surpassing the mean.

These conclusions, however, are misleading because early experimental designs considered members of different generations (immigrants and second-generation immigrants) within the same census year. The problem here is that because different cohorts often have different characteristics, the results may be confounded (Borjas, 2006). Subsequent research gathered cohort data from different census years (immigrant data from 1940 and second-generation data from 1970). Thus, it was assumed that many of the second-generation immigrants were direct descendants of the 1940 immigrants (Borjas, 2006). Hum and Simpson (2007) concluded that early single-census research found second-generation immigrants to outperform their parents and their children (regression beyond the mean), while later multi-census research found the second- and third-generation immigrants inherit the disadvantage faced by their ancestral immigrants (regression toward the mean but not beyond). Multi-census designs still have inherent confounds, including changing social patterns. For example, research has found a large increase in labor force participation among second-generation women over time, but this does not account for the societal increase for all women across the society. To this end, the factual difference between the two cohorts is probably overstated with this design (Borjas, 2006).

Chiswick and Miller (2009) found that immigrants are more likely to be over-educated or under-educated for their jobs than are natives. Over-education among immigrants is due to the imperfect transferability of human capital across nations and diminishes over time as the workers can prove their qualifications. Under-education occurs when immigrants specialize in a specific skill or substitute immense motivation to accommodate for their lack of education (Chiswick & Miller, 2009). For example, if an immigrant and a native have the same job and level of education, the immigrant may supplement his or her education
with other skills or work harder and longer so that the immigrant will be the employee to get a raise. This theory does not allow for all second-generation immigrants to improve beyond natives, but does allow under-educated workers to specialize and appear to rise above the mean for natives with the same education.

In support of the over- and under-education theory, Roy’s Model argues that immigrants tend not to be average representatives of their origin countries. Because the move to America is not geographically difficult or expensive, immigrants from nearby and poor nations likely possess less education and general human capital than the average citizen of their countries (Borjas, 2008). In the case of negative selection, for instance, a poor person who receives little government assistance can move to America and receive higher income through work and transfers, thus benefiting despite lower-than-average human capital and a low-skill job.

People from faraway nations, demonstrating positive selection, tend to represent above-average levels of human capital, relative to their own nation. With regard to social institutions, citizens of more socialist countries will benefit if they are among high wage earners in America due to lower taxes (Borjas, 2008). Thus, Roy argues that second-generation immigrants from some countries perform above the native mean due to positive selection.

2 Theoretical Model

To analyze the earnings of second-generation immigrants, the most appropriate theoretical framework to use is human capital theory. The basic theory is that, as with a firm, individual people invest in themselves, through education for example, in the hopes of reaping higher returns, often in the form of income. These investments in human capital produce all the income generating skills and productive knowledge the person has.

Of special importance to the analysis of second-generation earnings is Alfred Marshall’s work, which stated that human capital investments are long-term and emphasized the function of the family as a unit in acquiring these skills and knowledge (Rosen, 2008). This results from the motivation of parents to invest in their children in the hopes of securing them higher earnings in the future. The present project will use human capital theory in predicting the success (measured in earnings) of second-generation children based on the human capital of their parents.

One implication of human capital theory is that as the second generation acquires more U.S.-specific human capital than their parents, they should experience upward income mobility and some sort of regression toward the mean earnings of natives. Chiswick studied intergenerational mobility of human capital among immigrants and their native-born children and found that while immigrants earn much less than comparable natives, their second-generation children earn more than comparable natives (Rosen, 2008).

The work of Chiswick acts as a foundation for the current analysis of second-generation earnings. Using his findings along with previous work in the field, the intergenerational mobility of immigrant and native human capital can be further analyzed. Based on
previous literature and an understanding of the theory of human capital, it is hypothesized that second-generation immigrants will attain higher levels of education and thus record higher earnings than immigrants, and possibly natives, due to their high level of human capital contributed by their immigrant parents.

3 Data

The data used in this study is from the National Longitudinal Survey of Youth beginning in 1979 (National Longitudinal Survey, 2009). The data set follows 12,686 men and women who were between the ages of 14 and 22 years old in 1979, and contains information about family history, education, and labor force participation. It is assumed that most of these participants lived at home at the time of the 1979 interview and thus reflect the direct influence of their parents. The most important aspect of the NLSY is that it is longitudinal. This allows respondents to be tracked from a young age, when they are presumably inheriting human capital from their parents, through adulthood when they are settled into the labor market.

An initial problem with the data, however, is that there is no direct racial information. The question offered included political affiliations, nationalities, and race within the same set of answers. Thus, the thirty possible responses to this question were divided into two distinct categories: Close to the U.S. and Not Close to the U.S. Close includes Cuban, Chicano, Mexican, Mexican-American, Puerto Rican, and Other Hispanic, so that all other responses are coded as Not Close. This strategy reduces the immediate problems with the variable in that the original coding mixed places of origin and ethnic/racial identity. In the context of Roy’s Model, the Close category represents immigrants who tend to underperform natives and the averages of their heritage nations, though geography is not the only variable in Roy’s theory (Borjas, 2008). This is due to the negative selection of immigrants from places near the U.S.

The dependent variable used throughout this paper is usually Respondent Earnings (the dollar amount earned in 2005 from wages, salaries, and tips before taxes). The Immigrant Parents variable (defined as 1 if one or both of the parents was born outside of the U.S.) measures the effect of having immigrant human capital available on future earnings, and thus, is the primary variable of interest in this study. Parent Education (the higher of either the mother’s or father’s education measured from 1 to 20) is predicted to be the most powerful variable in predicting respondent earnings due to extensive literature showing a strong correlation between it and child earnings (Perreira, Harris, & Lee, 2006). Respondent Education (Highest grade completed from 1 to 20 as of May 2006) is important as a control for most analyses but is also the dependent variable in one regression. The presence or absence of a Library Card (defined as 1 if there was a library card present in the respondent’s household at the age of 14) serves as a proxy for parental motivation. Having a library card signifies motivation by an adult either to increase his or her knowledge, or possibly to increase that of the entire family. Family Size (the number siblings the respondent has) is included to control for competition for resources within the family. Parents can offer all their spare time to a single child while they must divide their time if they have several
children. Thus respondents with more siblings may have less interaction with their parents and may receive less of their parents’ human capital (Lynn, 1996). A dummy variable for sex (defined as 1 for females) is included as an important control because males and females tend to earn different amounts. The final variable, Close, is included as a control in view of Roy’s Theory (Borjas, 2008).

4 Analysis

The research in this paper will use longitudinal data so that the second-generation immigrants can be linked directly to their immigrant parents. The data base allows exact matching of immigrant parents with their second generation children. This will reduce cohort bias found in cross-sectional census studies that were critiqued by Borjas (2006).

4.1 Descriptive Statistics

Simple descriptive statistics shown in Table 1 compare second generation immigrants to natives. Within the data set, second-generation immigrants do earn significantly more than natives and obtain significantly higher education levels. The low significance of the earnings difference (probability equals .017) may be due to high variation of earnings in the second generation immigrant population, possibly reflecting different characteristics based on country of origin. This supports the observations of much of the previous research, notably Djajic (2003) that show second-generation immigrants surpass the native average level of education, thereby regressing beyond the mean on this measure. Table 1 also shows that immigrant parents have significantly lower levels of education than natives. This undermines the assumption offered that parental education is a strong predictor of respondent education (Perreira, Harris, & Lee, 2006). Thus, second-generation immigrants appear to be propelled into above-average earnings by something other than parental education.

One implication of Roy’s theory of negative and positive self-selection is that immigrants from nations close to the United States will underperform natives while immigrants from faraway nations will outperform natives (Borjas, 2008). Though Roy also considers several other factors of self-selection, including income equality in both the origin and target countries, social institutions among others, this analysis will only consider geographic relation of the origin country to the U.S. Comparing education levels of the parents of second generation immigrants who are from places close to the U.S. to those who are from places that are not close will identify whether positive and negative selection occur in this limited form of Roy’s theory. Furthermore, a comparison of Close and Far second generation immigrants will determine whether negative and positive selection (from the limited definition of Roy’s theory used) of immigrants is stable into the next generation. These three comparisons are presented in Table 2, and each one of them supports Roy. The largest difference is, as expected, found in the Parent Education variable. The Close and Far groups begin to converge in the second generation, showing smaller differences, and may converge completely after many generations in the United States. This supports the
above-mentioned precaution that the second generation immigrant sample may have more
variation than natives. These conclusions require precaution because the identification of
place of origin was subjective—both in initial selection and group assignment—but they
do make it apparent that this distinction (Close or Far) should be used as a control variable
throughout the rest of analysis.

Table 1: Descriptives of Second-Generation Immigrants and Natives (Standard Deviation)

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Second-Generation Immigrants</th>
<th>Natives</th>
<th>Mean Difference t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages and Salaries</td>
<td>$51,465.07 (48588)</td>
<td>$45,689.44 (46428)</td>
<td>-2.378*</td>
</tr>
<tr>
<td>Independent Variables:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent Education</td>
<td>10.29 (4.580)</td>
<td>11.96 (3.048)</td>
<td>11.18***</td>
</tr>
<tr>
<td>Respondent Edu EduEEducation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Library Card</td>
<td>75% (0.435)</td>
<td>71% (0.455)</td>
<td>-1.92</td>
</tr>
<tr>
<td>Family Size</td>
<td>3.96 (2.734)</td>
<td>3.83 (2.623)</td>
<td>-1.09</td>
</tr>
<tr>
<td>Close</td>
<td>58% (0.494)</td>
<td>8.9% (0.285)</td>
<td>-34.88***</td>
</tr>
<tr>
<td>Female</td>
<td>50% (0.500)</td>
<td>51% (0.500)</td>
<td>0.63</td>
</tr>
<tr>
<td>Approx. Sample Size</td>
<td>379</td>
<td>4872</td>
<td></td>
</tr>
</tbody>
</table>

*** significant at .00 level          **  significant at .01 level          *  significant at .05 level

Table 2: Descriptives of Close and Far second generation immigrants (Standard Deviation)

<table>
<thead>
<tr>
<th></th>
<th>Close</th>
<th>Far</th>
<th>Mean Difference t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent Education</td>
<td>8.36 years</td>
<td>(4.33)</td>
<td>12.90 years (3.50)</td>
</tr>
<tr>
<td>Respondent Edu</td>
<td>13.15 years</td>
<td>(2.56)</td>
<td>14.03 years (2.62)</td>
</tr>
<tr>
<td>Earnings</td>
<td>$46,330.94</td>
<td>(41541.18)</td>
<td>$58,990.88 (56680.75)</td>
</tr>
</tbody>
</table>

*** significant at .001 level          **  significant at .01 level          *  significant at .05 level

4.2 Oaxaca Decomposition

Having identified a difference in earnings between second generation immigrants and
natives, a Oaxaca Decomposition is performed to explain the cause of this gap. According
to the Oaxaca Decomposition, this difference in earnings is the result of two causes: different
means and different returns (Oaxaca, 1973). First, there can be different characteristics
between natives and second generation immigrants that cause part of the difference in
earnings. For example, the average educational attainment of natives is lower than it is
for second generation immigrants. Second, a portion of the earnings gap could be due
to differences in returns from these characteristics. For example, an additional year of
education could produce a larger increase in earnings for one group than the other.

The basis of the Oaxaca Decomposition are Ordinary Least Squares (OLS) regressions
for both natives and second generation immigrants that predict earnings as a function of
family background characteristics and Respondent’s own Education.

\[
\text{Native Earnings} = \alpha + \beta_1 \text{ (Parental Education)} + \beta_2 \text{ (Library Card)} + \beta_3 \text{ (Female)} + \beta_4 \text{ (Family Size)} + \beta_5 \text{ (Respondent’s Education)} + u
\]

\[
\text{Second Generation Immigrant Earnings} = \alpha + \beta_1 \text{ (Parental Education)} + \beta_2 \text{ (Library Card)} + \beta_3 \text{ (Female)} + \beta_4 \text{ (Family Size)} + \beta_5 \text{ (Respondent’s Education)} + u
\]

The Oaxaca decomposition requires that only one of the two equations presented above be chosen for estimation purposes. It is also sensitive to changes in coefficients; therefore, an insignificant coefficient is a strong threat to the accuracy of the technique. The demographic variable identifying how geographically close the respondents’ ancestors were from the United States was initially included in this regression, as in Model 1 from the OLS Regression, but was dropped because it was not statistically significant. The native regression was chosen for estimation because all of its coefficients were statistically significant once Close was removed.

The native regression has highly significant results so that the decomposition will not be compromised, but the second generation regression has fewer significant variables. This is a preliminary indication that these variables are not equally important for both groups.

Table 3: Earnings regressions for Natives and Second Generation Immigrants

<table>
<thead>
<tr>
<th></th>
<th>Native Coefficients</th>
<th>t-statistic</th>
<th>Second Generation Immigrant Coefficients</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-41682.118***</td>
<td>-10.176</td>
<td>-48308.017***</td>
<td>-3.578</td>
</tr>
<tr>
<td>Parental Education</td>
<td>1167.876***</td>
<td>4.939</td>
<td>1079.931*</td>
<td>1.982</td>
</tr>
<tr>
<td>Library Card</td>
<td>4570.328***</td>
<td>3.262</td>
<td>-1650.725</td>
<td>-0.308</td>
</tr>
<tr>
<td>Female</td>
<td>-24373.302***</td>
<td>-20.303</td>
<td>-31704.399***</td>
<td>-7.330</td>
</tr>
<tr>
<td>Family Size</td>
<td>-696.834**</td>
<td>-2.784</td>
<td>245.365</td>
<td>0.282</td>
</tr>
<tr>
<td>Respondent Edu</td>
<td>6265.159***</td>
<td>22.488</td>
<td>7612.725***</td>
<td>8.255</td>
</tr>
<tr>
<td>Sample Size</td>
<td>4872</td>
<td></td>
<td>379</td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>207</td>
<td></td>
<td>2.72</td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>1.87</td>
<td></td>
<td>2.06</td>
<td></td>
</tr>
<tr>
<td>White’s Test</td>
<td>384.89</td>
<td></td>
<td>67.08</td>
<td></td>
</tr>
</tbody>
</table>

*** significant at .001 level   ** significant at .005 level   * significant at .05 level

The White’s Test for the Second Generation Immigrant regression found heteroscedasticity.

The Oaxaca Decomposition proceeds in five steps.
1. (Second Generation Immigrant Earnings - Native Average Earnings);
   
   \[
   \text{Earnings Gap} = 51,465.07 - 45,689.44 = 5,775.63
   \]
2. The native and second generation immigrant earnings equations are presented in Table 3.
3. The estimated earnings for second generation immigrants assuming the native reward structure is calculated: 
   
   \[
   -41,682.118 + 1,167.876 \times (10.29 \text{ Parental Education}) + 4,570.328 \times (0.75 \text{ Library Card}) - 24,373.302 \times (0.5 \text{ Female}) - 696.834 \times (3.96 \text{ Family Size}) + 6,265.159 \times (13.52 \text{ Respondent Education}) = 43,521.91
   \]

   This is the difference due to returns.
4. To find the difference in earnings between the children of immigrants and those of natives that is due to different average characteristics, the earnings number calculated from the Oaxacaregression (in step three) is subtracted from the average earnings for native children. 

\[ \$45,689.44 - \$43,521.91 = \$2,167.53 \]

5. Differing returns, as measured by coefficients, on these characteristics must cause the rest of the difference in earnings between second generation immigrants and natives. The difference due to means (step 4) is subtracted from the observed difference in average wages (step 1). 

\[ \$5,775.63 - \$2,167.53 = \$3,608.10 \]

In sum, $2,167.53 of the $5,775.63 earnings gap can be attributed to differences in characteristic averages. These may include different average levels of parental or respondent education, different probabilities of having a library card, different ratios of males to females, or different average number of siblings. This only makes up 37.5% of the earnings gap, so the reward structures (i.e., returns) must be operating differently for the two groups.

Over $3,500—62.5%—of the earnings gap is due to differences in the returns the children of natives and those of immigrants receives on the included variables. Somehow second generation immigrants acquire more from each additional unit of some or all of these characteristics than comparable natives.

Finally, two simple decompositions are executed to determine the effect of each of the education variables. To find the effect Respondent Education has on the earnings gap, the difference in averages (average Second Generation Immigrant Education – average Native Respondent Education) is multiplied by the coefficient obtained from the native regression. Again, the native regression is used. This \((0.23*6,265.159)\) yields a positive \$1,440.99, or 24.95% of the total earnings gap. Thus, Respondent Education is responsible for second generation immigrants earning approximately \$1,500 more than natives. Using the same technique, the effect of Parental Education was found to be a negative \$1,950.35, or \(-33.77\%) of the gap \((-1.67*1167.876)\). The negative sign means that second generation immigrants earn about \$2,000 less than natives because of this variable. This is largely due to the higher average of native Parental Education.

4.3 Path Analysis

Thus far, the Oaxaca Decomposition determined that most of the difference in earnings between second generation immigrants and natives is due to differing returns (rather than differing mean characteristic values). Further decompositions found parental and respondent education to both be highly responsible for these differing returns. Thus, the next step is to investigate the path of returns by determining the relationship between Parental Education and Respondent Education in regard to Respondent Earnings. While parental human capital (especially parental education) can affect respondent earnings directly, it is likely that it also works through the intervening variable of respondent education.

The direct effect maps the relationship between the parents’ human capital to the respondent’s 2006 earnings. This path indicates the effect that background variables,
specifically parental education and characteristics of the respondent’s childhood home, have on the respondent’s future earnings. Directly, a parent may teach his or her child at home, thereby increasing the child’s human capital. With increased human capital, the child will be more valued in the labor market and should earn more.

The indirect path is mapped in two steps: the first step measures the effect of parental human capital on respondent education, and the second step measures the effect of respondent education (with parental capital characteristics held constant) on respondent earnings. Thus, there are two regressions needed to measure the indirect path and a single regression to measure the direct path. Parents can indirectly affect a child’s earnings by affecting the child’s educational attainment. A parent’s high education level, for example, may increase the education level of the child. The higher educational attainment of the child will, in turn, cause that child’s earnings to be higher, regardless of parental human capital.

The path analysis, based on the work of Israel and Seeborg (1998), will determine the importance of both the direct and indirect paths of transmission for natives and second generation immigrants using three equations.

The first equation predicts Respondent Earnings from parental human capital background variables. It accounts for both the direct and indirect paths of intergenerational transfer of human capital, thus offering an estimate of the overall effect of Parental Education on Respondent Earnings. Thus, this regression model focuses on the impact of background characteristics without controlling for the respondent’s own investment in human capital (for example, their own education). By not controlling for Respondent Education, the coefficient of Parental Education will pick up its own effect on Respondent Earnings along with any indirect effect it might have through Respondent Education. The Background Regression is:

\[
\text{Respondent Earnings} = \alpha + \beta_1 (\text{Parental Education}) + \beta_2 (\text{Library Card}) + \beta_3 (\text{Female}) + \beta_4 (\text{Family Size}) + \beta_5 (\text{Close}) + u
\]

The second equation includes a control for Respondent Education and provides two important details. Firstly, it gives an accurate prediction of the direct effect of Parental Education on Respondent Earnings because all other variables, including the respondent’s own education, are controlled for. Secondly, the coefficient of Respondent Education explains how much one year of respondent education affects his or her own earnings. This value will be crucial in translating years of education into earnings. The Direct Effect Regression is:

\[
\text{Respondent Earnings} = \alpha + \beta_1 (\text{Parental Education}) + \beta_2 (\text{Library Card}) + \beta_3 (\text{Female}) + \beta_4 (\text{Family Size}) + \beta_5 (\text{Close}) + \beta_6 (\text{Respondent Education}) + u
\]

The final regression estimates the first part of the indirect path, predicting Respondent Education from Parental Human Capital. This equation explains how Respondent Education
reacts to one additional year of Parental Education. The **Intervening Regression** is:

\[
\text{Respondent Education} = \alpha + \beta_1 (\text{Parental Education}) + \beta_2 (\text{Library Card}) + \beta_3 (\text{Female}) + \beta_4 (\text{Family Size}) + \beta_5 (\text{Close}) + u
\]

The regression results of all three equations (Direct, Controlled, and Intervening) for natives and second generation immigrants are displayed in Tables 4 and 5 respectively, and the four empirical steps of the path analysis are carried out below each table.

**Table 4: Path Analysis Regressions for Natives (t-statistic)**

<table>
<thead>
<tr>
<th></th>
<th>Background (Earnings in $)</th>
<th>Direct (Earnings in $)</th>
<th>Intervening (Education in yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>15865.71*** (4.65)</td>
<td>-42841.83*** (-10.27)</td>
<td>9.30*** (64.12)</td>
</tr>
<tr>
<td>Parental Edu</td>
<td>3287.78*** (13.81)</td>
<td>1256.53*** (5.15)</td>
<td>0.32*** (31.26)</td>
</tr>
<tr>
<td>Library Card</td>
<td>7294.54*** (4.97)</td>
<td>4494.19*** (3.21)</td>
<td>0.52*** (6.33)</td>
</tr>
<tr>
<td>Female</td>
<td>-22086.04*** (-17.58)</td>
<td>-24391.92*** (-20.32)</td>
<td>0.33*** (6.04)</td>
</tr>
<tr>
<td>Close</td>
<td>4326.53 (1.83)</td>
<td>3311.83 (1.47)</td>
<td>0.09 (0.88)</td>
</tr>
<tr>
<td>Family Size</td>
<td>-1169.93*** (-4.47)</td>
<td>-700.18*** (-2.80)</td>
<td>-0.08*** (-6.91)</td>
</tr>
<tr>
<td>Respondent Edu</td>
<td></td>
<td>6256.94*** (22.46)</td>
<td></td>
</tr>
</tbody>
</table>

Sample Size          | 4872                       | 4872                    | 6307                           |
Adjusted R²           | .125                       | .207                    | .220                           |
Durbin-Watson         | 1.82                       | 1.87                    | 1.72                           |
White’s Test          | 253.34                     | 384.89                  | 113.53                         |

*** significant at .001 level  ** significant at .005 level  * significant at .01 level

The Intervening D-W statistic was inconclusive at 5% and found autocorrelation at 1%. The White’s test for the Intervening regression found heteroscedasticity at the 5% and 1% levels.

1. Each of the three regressions (Background, Direct, and Intervening) is estimated for the native respondents and shown in Table 5.
2. The direct effect of Parental Education (from the Direct Regression) is $1,256.53 of increased respondent earnings for every additional year of parental education.
3. For natives, the intervening regression model shows that one additional year of parental education causes about an additional one-third of a year of respondent education. Because one extra year of respondent education leads to a $6,000 increase in earnings, the additional one-third year of respondent education caused by the additional year of parental education translates into an estimated increase in earnings of: 0.32 years * $6,256.94 = **$2,002.22. This is the calculated indirect effect for natives.
4. Adding the indirect effect of parental education on respondent earnings (calculated in step two) with the direct effect of parental education (from the Direct regression) yields the overall effect of parental education on respondent earnings. **$2,002.22 + $1,256.53 = $3,258.75. This is slightly lower than the $3,287.78 effect predicted with the Background Regression.
Table 5: Path Analysis Regressions for Second Generation Immigrants (t-statistic)

<table>
<thead>
<tr>
<th></th>
<th>Background (Earnings in $)</th>
<th>Direct (Earnings in $)</th>
<th>Intervening (Education in yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>39896.26*** (3.60)</td>
<td>-46338.38*** (-3.17)</td>
<td>10.84*** (21.36)</td>
</tr>
<tr>
<td>Parental Education</td>
<td>2143.46*** (3.43)</td>
<td>997.51* (1.68)</td>
<td>0.17*** (5.76)</td>
</tr>
<tr>
<td>Library Card</td>
<td>6410.23 (1.11)</td>
<td>-1907.85 (-0.35)</td>
<td>1.15*** (4.38)</td>
</tr>
<tr>
<td>Female</td>
<td>-30.179.47*** (-6.42)</td>
<td>-31686.79*** (-7.32)</td>
<td>0.27 (1.21)</td>
</tr>
<tr>
<td>Close</td>
<td>-1869.92 (-0.33)</td>
<td>-1853.36 (-0.02)</td>
<td>0.15 (0.59)</td>
</tr>
<tr>
<td>Family Size</td>
<td>272.43 (0.29)</td>
<td>287.21 (0.33)</td>
<td>0.03 (0.63)</td>
</tr>
<tr>
<td>Respondent Edu</td>
<td></td>
<td>7612.60*** (8.25)</td>
<td></td>
</tr>
<tr>
<td>Sample Size</td>
<td>379</td>
<td>379</td>
<td>484</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>.140</td>
<td>.271</td>
<td>.144</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>2.02</td>
<td>2.06</td>
<td>1.69</td>
</tr>
<tr>
<td>White’s Test</td>
<td>40.93</td>
<td>74.66</td>
<td>14.04</td>
</tr>
</tbody>
</table>

*** significant at .001 level  ** significant at .005 level  * significant at .01 level

The Intervening regression has autocorrelation at the 5% level and the D-W test for the Background regression is inconclusive at 5% and not autocorrelated at 1%. All three equations are heteroscedastic.

In order to compare the path of transmission in native families with that in immigrant families, it is necessary to repeat the path analysis for second generation immigrants.

1. Each of the three regressions (Background, Direct, and Intervening) is estimated for the second generation respondents and shown in Table 5.
2. The direct effect of Parental Education (from the Direct Regression) is $997.51 of increased respondent earnings for every additional year of parental education.
3. For second generation immigrants, one additional year of parental education leads to an additional one-fifth of a year of respondent education. Because one extra year of respondent education leads to a $7,000 increase in earnings, the additional one-fifth year of respondent education caused by the additional year of parental education translates into an estimated increase in earnings of: 0.17 years * $7,612.60 = $1,294.14.
4. Adding the indirect effect of parental education on respondent earnings (calculated in step two) with the direct effect of parental education (from the Direct regression) yields the overall effect of parental education on respondent earnings. $1294.14 + $997.51 = $2291.65. This is slightly higher than the $2143.46 effect predicted with the Background Regression.

The direct effect of parental education on respondent earnings is larger for native than immigrant families ($1,256 > $997). This signifies a difference in the effect of parent’s education between natives and immigrants. An immigrant’s additional year of education may lead to a lesser increase in children’s earnings because the parent’s education is not
fully applicable to America. The indirect effect of human capital transfer is also larger for natives ($2,002 > $1,294). The main reason for this is that an additional year of education by immigrant parents causes a much smaller increase in the educational attainment of their children compared to the larger effect that native parents have on their children’s educational attainment. This could easily be another argument for imperfect transferability of international human capital in America, but it may also have to do with preferences. Because many immigrant parents have relatively low levels of education, they may choose to stress aspects of their human capital other than education. Immigrants may transfer time management, work ethic, or motivation to their children that is independent of their own educational attainment. Native parents, however, may use their own education level as a goal for their children to meet or surpass.

This is an important conclusion because it requires further consideration of what causes second-generation immigrants to obtain higher levels of education than natives (Table 1), if it is not due to their parents’ education.

Finally, the Path Analysis finds that for both groups the Indirect path of human capital transfer consists of over half of the total effect of parental education on respondent earnings (61.44% for natives and 56.47% for second generation immigrants). Both paths are stronger in the native population, due to the larger effect of native parental education on respondents in the United States. This further emphasizes the importance of culturally relevant human capital.

5 Conclusion

This study provides a detailed analysis of second-generation immigrant earnings compared to native earnings while controlling for cohort bias. Respondents with immigrant parents earn more, measured in wages and salaries, than natives. Though the exact reason for this is not identified, it is concluded that second-generation immigrants surpass their parents’ levels of education and earnings, and also rise above native earnings. This does not appear to be merely regression toward the mean because the analysis suggests that second generation immigrants actively pursue higher success (i.e. receive significantly more education than natives and reap greater returns from their investments), which entails regression beyond the mean.

The Oaxaca Decomposition shows that the wage gap is mostly due to differing returns, rather than different average characteristics. This may be because the two groups have different reward structures or, following Chiswick and Miller’s (2009) theory of under-education, because second generation immigrants learn to supplement their education with additional investments in human capital. A likely explanation is that second generation immigrants earn more money for each additional year of education by supplementing that education (Chiswick & Miller, 2009). One explanation, working through the idea of an “American Dream,” is that because the children of immigrants are grateful for their American opportunities, such as education, they work harder to ensure that they reap as
much benefit from them as possible (Diajic, 2003). Native children, on the other hand, may see the same options of education as rights rather than privileges and may not be inclined to maximize their benefits. Another possible explanation relates to the inspiration of this paper: immigrants earn much less than comparable American-born workers. It is possible that the children of immigrants strive for higher returns on their investments so that they can financially support their parents. Contrariwise, the children of natives may not feel that responsibility, or to extend this reasoning, their parents may be able to support them financially so that they can accept less than optimal returns on previous investments.

The Path Analysis finds that both the Direct and Indirect paths of human capital transmission are stronger for native than immigrant families. While parental education is a good predictor of ultimate earnings for natives, the predictive power is not as strong for second-generation immigrants. There is a strategy among immigrant families that overcomes the low educational attainment of immigrants so that second generation immigrants regress beyond the native mean. One explanation borrowed from Diajic (2003), is that an “American Dream” motivates immigrants or their children to try harder. If they believe that America offers more opportunity, second- generation immigrants may feel obligated to take advantage of those opportunities, including education. Finally, the Path Analysis proves that the Indirect path is more important for both groups than the Direct path, emphasizing the importance of respondent educational attainment over the Direct effect of parental education on respondent earnings.

Future research could explore the level of motivation (the idea of an “American Dream”) in immigrant families compared to natives. Parental assimilation and country of origin could also be controlled for. Finally, the social acceptance of immigrants and their families in America should be considered. It is important to understand the role natives play in letting immigrant families have the same opportunities as natives and accepting them into society.
References


THE UNDERVALUATION OF RENMINBI AND
THE ROLE OF PEOPLE’S BANK OF CHINA IN
THE MISALIGNMENT

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ABSTRACT

Applying a Purchasing Power Parity approach enhanced by the Balassa-Samuelson effect, we estimate that the Renminbi (RMB) is undervalued by about 8%. The RMB has also displayed a widening gap relative to its “equilibrium” rate since 2000. Both the misalignment and the widening gap are robust to various model specifications. Nevertheless, the misalignment is not statistically significant. Various People’s Bank of China policies, such as foreign exchange intervention and monetary policies, may have contributed to the misalignment to some extent, but there is no statistically significant evidence to support this claim.

1 Introduction

As China experienced a rapid growth over the past decades, its currency, the Renminbi (RMB) has been fixed to the US Dollar (USD) nominally for a very long time. Although the central bank, the People’s Bank of China (PBC), announced the decision to revalue the RMB, it was pegged to the USD again after a 17.5% nominal rise from 8.28 to 6.83 RMB/USD in mid-2008 (Figure 1). As many politicians argue, China may unfairly enjoys the advantage in international trade resulting from the peg, and the huge current account surplus as well as soaring foreign reserves are evidence of the undervaluation.

[Figure 1] RMB/USD Official Nominal Exchange Rate
Source: Federal Reserve System Board of Governors
Partly in response to the view of politicians, this study measures the magnitude of the undervaluation of the RMB and tests whether the PBC contributes to the misalignment either voluntarily or involuntarily through foreign exchange policies.

In order to estimate the misalignment, we apply enhanced Purchasing Power Parity (PPP) theory, which can be described as Balassa-Samuelson Effect or relative price-sector productivity correlation, to predict a real equilibrium exchange rate (REER) for the Chinese currency. Real exchange rate (RER)\(^1\) is defined as the relative price levels in two countries, and it captures more precisely the exchange rate advantage of a country in trade. Based on previous studies, for example, Cheung, Chinn, and Fujii (2007), and Coudert and Couharde (2005), relative GDP per capita to the US is a good proxy for productivity gain. Therefore, by constructing a relation between relative price and relative GDP per capita, one can estimate the REER for every country in the world with data available.

However, the Balassa-Samuelson effect may not always hold in the real world. As argued by economists, real determinants may affect the RER in the long-run while nominal ones can influence it in the short-run (Joyce and Kamas 2003). Motivated by this theory, we consider the possibility of the PBC to control the bilateral RER through nominal monetary channels and model the central banks’ control on the RER to test whether the PBC is able to influence the rate. Although central banks have the choice of controlling the nominal rate, it does not necessarily imply that central banks have the ability to influence price level at home given the globalized business environment today. Therefore, when we include current and lagged foreign exchange and monetary policy variables\(^2\) in the relative price-GDP model, we can examine whether these variables can explain the misalignment in real terms. According to the theory, both foreign reserve variable and money supply variable should enter into the regression with negative signs, which indicate a depreciating effect on RER. If the RMB is no longer misaligned in this new model, it is reasonable to conclude that the PBC did affect RER through its intervention in the past. Otherwise, the model may suggest that the Chinese central bank actually did not play an important role in the misalignment of the currency.

The rest of the paper is organized as the following. Section 2 provides theory background for the measure of misalignment and the ability of the central bank to affect RER. It also spells out the main regression models applied in this study. Section 3 describes the data used in this study. Section 4 lays out the results of misalignment measure while Section 5 presents the model with central bank variables and its implication. Finally, Section 6 concludes the paper with directions in future studies.

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1 Although there may be two ways to define RER, either in foreign currency over domestic currency or the inverse, in this study, we use \( RER = \frac{E_{USD/DC}}{P_{USD}} = \frac{E_{USD/DC} \times P_{USD}}{P_{USD}} \), where \( E_{USD/DC} \) is the exchange rate per home country’s currency, \( PP \) is the price level for home country, and \( P_{USD} \) is the price level for the US. Therefore, an increase in RER is associated with a real appreciation and a decrease represents a real depreciation. Please also note the usage of REER and RER. REER usually indicates an estimated equilibrium value of RER.

2 Foreign reserves and money supply, detailed discussion on proxy variables will be provided in Section 2.2.
2 Theories and Empirical Strategy

Summarized by Cline and Williamson (2008), there are three major approaches, Enhanced-Purchasing Power Parity (PPP-E), Behavioral Equilibrium Exchange Rate (BEER), and Fundamental Equilibrium Exchange Rate (FEER,) to estimate the equilibrium exchange rate and measure the magnitude of misalignment of a currency. The magnitude can be based on either a RER range or a nominal exchange rate range. This study will focus on misalignment in bilateral RER terms measured by PPP-E.

Among the three approaches, BEER and FEER may not be applicable for China. As argued by Frankel (2008), BEER “can only deliver a statement about the valuation of a given currency today relative to its own past history.” Due to limited length in the history of RMB, BEER may fail to diagnose the misalignment if the currency was undervalued for a long time. FEER is to “search for a set of exchange rates that will simultaneously achieve internal and external balance (Cline and Williamson 2008).” However, because countries need to achieve their goals on both internal and external balance at the same time, the exchange rate policy alone may not provide sufficient policy tools to achieve the balance (Frankel 2008.) Therefore, these shortcomings of the two models limit their effectiveness in measuring the misalignment. But the Balassa-Samuelson approach is not perfect either. One of the limitations is that the USD can never be undervalued or overvalued. Since we only care about US-China RER in this study, the limitation should not affect the results. Thus, the PPP-E approach should be given preference here.

2.1 Purchasing Power Parity (PPP)

A simple version of the PPP generally fails to explain the overtime development of RER. According to the theory, exchange rate between two currencies equals the ratio of price levels in the two countries. Some strong assumptions must be held to achieve the PPP condition across countries. For example, the price levels should be referred to a same product basket for the two countries. However, since the price levels are unobserved and governments publish price indices based on their own baskets of goods and services with different weights, it is impossible to test PPP given such data. Furthermore, perfect cross-border arbitrages in goods and services require no transportation costs and trading barriers in the world. Without perfect arbitrage opportunities, PPP hardly stands. Therefore, it is not applicable to estimate the REER based on this simple version of PPP.

A more reliable approach, starting from the strong empirical linkage between per capita income and RER, was introduced by Bela Balassa (1964) and Paul Samuelson (1964.) As they suggest, the productivity gain resulting from development is largely captured by tradable sectors. The productivity in non-tradable sectors does not benefit a lot from trade and globalization. With the assumption of wage equalizing effect across tradable and non-tradable sectors, keeping tradable price constant, an increase in the tradable productivity will increase the wage in both sectors. Therefore, without the productivity gain in non-tradable sectors, the price of non-tradable must rise. Hence, we can expect a positive correlation between relative price level or RER and relative GDP or income per capita, which proxies the relative productivity. Albeit the underlying assumption is unrealistic.
in the world, the Balassa-Samuelson effect can still be observed even if wages are not perfectly equalized across sectors.

A handful of studies have been done based on the theory. Rogoff (1996) numerically estimates the positive correlation between relative price and relative real GDP per capita, and finds that a 10 percent increase in country’s relative real GDP per capita will lead to a 3.66% increase in its RER relative to the US using 1990 data. Applying a similar methodology to China, Frankel (2006) directly treats the log of GDP per capita in home country as the independent variable on a cross sectional dataset. He estimates that RMB is undervalued by 42% and 44.8% in log terms in 1990 and 2000 respectively. These findings correspond to an undervaluation of 34% and 36.1% in absolute terms. Similarly, Coudert and Couharde (2005) estimate the effect with GDP and population controls on samples and find a 40%-50% undervaluation for the currency. Expanding the test to a panel dataset, Cheung, Chinn, and Fujii (2007) analyze the correlation with between, fixed, and random effects while also subdividing their samples based on development, income, region, and time. They further include controls on capital account openness, corruptions, government deficits, and money supply. Their findings agree with previous studies in the nature of undervaluation, but they argue that the magnitudes of misalignment are very imprecise because all these measures are still within two standard errors of the predicted value.

Motivated by Balassa-Samuelson effect and previous studies, we set up the baseline model regressing relative price level on relative GDP per capita on a panel dataset.

\[
\ln\left(\frac{P}{P_{US}}\right)_{it} = \beta_0 + \beta_1 \ln\left(\frac{GDP}{GDP_{US}}\right)_{it} + \alpha_t + \alpha_i + \epsilon_{it} \quad (1)
\]

In the above regression model, \(P/P_{US}\) is the price level of home country to US price level. It is calculated by dividing the country’s nominal GDP in current dollar by its GDP PPP in current dollar\(^3\). On the right hand side of the equation, we are using the real GDP per capita for both US and home country and dividing them accordingly. \(\alpha_t\) is the time fixed effect and \(\alpha_i\) is the country fixed effect.

2.2 The Role of Central Banks

Considering the persistent claims from politicians and western media that the mountain-high foreign reserve indicate that the PBC deliberately control the exchange rate to unfairly benefit the manufacturing sector in China, we respond to these arguments with a test on the impact of central bank foreign exchange policy on RER. Expanding the PPP-E approach, we add central bank variables into the regression. Although, as mentioned by Cline and Williamson (2008), most other studies may add net foreign assets and terms of trade into the model, a limited number of studies have systematically discussed the PBC’s contribution

\(^3\) Although it seems that the value has nothing to do with the price level in the US, because each year, GDP PPP is converted based on the price level of the US, this implies that the ratio we calculated out is actually the relative price level to the US for that country. Mathematically, \(\frac{\text{Nominal GDP in USD}}{\text{Nominal GDP PPP in USD}} = \frac{E_{USD/PC\times P}}{P_{US}} = \frac{E_{USD/PC}}{P_{US}} = \frac{P_{US}}{P_{USD}} = \text{RER}\), where \(E_{USD/DC}\) is the exchange rate per home country currency, \(PP\) is the price level in home country, \(P_{US}\) is the price level in the US, and \(yy\) is the real GDP for home country.
to the misalignment.

The most important channel for central banks to affect foreign exchange market is foreign exchange intervention. They can use their money stock to purchase either foreign or domestic currencies to depress or boost nominal exchange rates. However, central banks may involuntarily increase or decrease the reserves. Speculative attacks or hot money inflows can force central banks to dump or absorb more reserves than they originally planned. Nonetheless, the observed changes of reserves still reflect their policies to defend the peg or the current exchange rate to some extent. Furthermore, the greater the change in foreign reserves, the greater is the magnitude of speculative action, which is positively correlated with the extent of fundamental mismatch in home country. Therefore, a larger change in foreign exchange should be associated with a greater magnitude of the deviation from the REER. Hence, it is reasonable to use the growth of foreign reserve to proxy the extent of foreign intervention policy of central banks. As we expected here, an increase in the annual growth rate of foreign reserve should reflect an increase in the magnitude of foreign currency purchasing, which leads to a real depreciation of home currency if we keep prices unchanged.

In addition, the central bank has another policy tool to sterilize the change in foreign reserve in domestic market and achieve the goal on nominal exchange rate through expectation. In theory, currency sterilization may not affect nominal exchange rate in the long run since money supply will not change due to the operation, but in the short run, there is still a possibility for the expectation channel to affect the market. Therefore, in order to reflect the sterilization policy of the central bank, we also include money supply in the model. Since an increase in money supply level, in a ceteris paribus situation, usually depreciates a currency, we can also expect a negative sign on this variable.

Finally, taking into consideration of the capital account openness, we use an index constructed by Schindler (2009) to control the structure of the capital inflow and outflow system of a country. Albeit China’s capital account policy is not determined by the central bank, considering the importance of the policy in an exchange rate regime, we still include it in the model. However, it is difficult to predict the effect of capital account openness since a free capital account may lead to inflow and outflow increase.

Summarizing the above analysis, we construct a model as below.

\[ \ln(P/P^*)_{it} = \beta_0 + \beta_1 \ln(GDP/GDP_{0S})_{it} + \beta_2 FRSVGR_{it} + \beta_3 M2/GDP_{it} + \beta_4 KA_{it} + \delta_1 FRSVGR_{it-n} + \delta_2 M2/GDP_{it-n} + \alpha_i + \alpha_i + \epsilon_{it} \]  

Inheriting some variables from equation (1), equation (2) has \( FRSVGR_{it} \) as the growth rate of foreign reserve for country \( i \) in year \( t \). \( M2/GDP_{it} \) captures the aggregate money supply scaled by nominal GDP of home country in that year. \( KA_{it} \) reflects the capital account openness for country \( i \) in year \( t \). In the model, we also include lagged variables of foreign reserve growth and money supply level, \( FRSVGR_{it-n} \) and \( M2/GDP_{it-n} \). Because we are not clear how long the short-run effect of intervention and money supply change

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will persist, we assign a subscript \( n \) to indicate the lagged nature of the variables.

3 Data

We collect data for the variables, except capital account openness index, from the World Development Index (WDI) for the period from 1975 to 2008 spanning 209 economies. However, some countries, especially low-income countries, do not have complete data available. Therefore, we maintain an unbalanced panel for this study. In order to calculate the relative price level, we collect both country level GDP and GDP PPP data in current dollar and divide them accordingly. For relative GDP per capita, we use the real GDP per capita for home country and divide them by US real GDP per capita. We compute the growth of foreign reserve by dividing the current year-end level by previous year-end level subtracting 1. Regarding the money supply variable, we rely on the data of M2 as a percentage of GDP in WDI. Because there are outliers in inflation, we need to exclude any observation with an annual inflation rate greater than 100% from the regression in the regression. The inflation rate for each country in each year is taken from the CPI data in WDI.

The capital account openness index is obtained from Martin Schindler\(^6\). The dataset contains measures of \textit{de jure} restrictions on cross-border financial transactions for 91 countries from 95-05. The index is a 0-1 value with 0 associated with the greatest capital account openness.

4 Misalignment Measurement

4.1 A Cross Sectional Overview

To get a simple picture of the development of undervaluation of the RMB, we replicate Frankel’s (2006) approach and estimate the misalignment of the currency using cross-sectional data for year 1990, 1995, 2000, 2005, and 2008. In [Table 1], the coefficients in all regressions suggest a strong positive correlation between RER and relative GDP. From the residuals, we get a long-standing undervaluation measure for the RMB. Interestingly, the RMB experienced an undervaluation correcting over late 1990s but it started to deviate from the predicted REER after 2000 (Figure 2 and Table 1). The RMB is 1.52% undervalued in log terms in 2000, but the log misalignment increased to 10.93% and 13.60% in 2005 and 2008 respectively. These values correspond to undervaluation of 1.51%, 10.35%, and 12.72% in absolute terms.

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5 Please refer to “Appendix I: Data” for detailed diagnostics for the variables and data.
Admittedly, there are some problems in the regression analysis above. The number of observations is not equal in each regression, but it should not be a concern here since we only use this section to lay out the broad picture of the misalignment rather than directly draw any conclusion from them. Noticeably, over the whole regression analysis, we consistently get the coefficients on relative GDP in a range of 0.15-0.25. Those coefficients imply that a 10% increase in GDP per capita relative to the US will lead to a real appreciation of 1.5%-2.5% in log terms, which is smaller than the effects estimated in other studies. Datasets used in previous studies usually contain include fewer countries than we do. For example, Cheung, Chinn, and Fujii (2007) only include about 170 countries in their study. We think the additional observations may cause this difference. Although we do not test if our hypothesis regarding the difference is true, our subsample analyses provide some arguments to support the view.

At the same time, a cross sectional approach does not provide too much insight for the issue since the models themselves lack the reliability over a long period of time, which can only be captured by a panel dataset.

4.2 A Panel Data Approach on the Complete Sample

Expanding the PPP-E approach to a panel data, we adopt the same baseline model and estimate the model with OLS and fixed effect to capture the time dimension of the dataset. [Figure 3] depicts the overall trend for all observation in the dataset. We can easily perceive a positive correlation between RER and relative GDP. In [Table 2], we report the

7 In the later section, we estimate that Balassa-Samuelson Effect is more pronounced in advanced and high-income economies. This finding agrees with the finding from Cheung, Chinn, and Fujii (2007). We provide some possible explanation in Section 4.3.
result of OLS regression in column (1). In column (2), we exclude any observation that has an annual inflation greater than 100%. In column (3), we run the model in column (2) with both time and country fixed effects. As shown by [Table 2], all the estimated coefficients on relative GDP per capita in the first three columns are positive and significant. The 0.11-0.17 coefficient range agrees with that for the cross sectional models. We can observe that with the inflation control, as well as the fixed effect, the Balassa-Samuelson effect becomes increasingly more pronounced. A Hausman statistics of 14.27 rejects the null hypothesis that the difference in the regression models in column (2) and (3) are not systematic. We can conclude here that the fixed effect models can generate more accurate regression results for the study, but we leave the OLS estimations as robustness checks for the signs of coefficient when we measure the misalignment for the RMB.

[Figure 3] Balassa-Samuelson Effect
Source: WDI Dataset and Author’s Calculation

In [Table 2.1], we display the measure of misalignment for China after 2000. Only the estimation with fixed effect gives us a growing trend of undervaluation, which agrees with the increasing political pressure on the Chinese exchange rate regime. The results of OLS, regardless of controlling for inflation or not, both show a larger undervaluation in early 2000s and a close to zero undervaluation of the RMB in 2008, but they are not meaningful since the significance of the regressions has been rejected by the Hausman Test. Finally, comparing with the standard error in predicted values, none of these misalignments is significantly from zero. We are not able to state any misalignment with statistical confidence at this point.
4.3 Subsample Analyses

Furthering the study, we divide the sample by country development and income level. These analyses can spell out a more appropriate specification for us to study the RMB case. Since high inflation can distort the regression results, in the rest of the study, all regressions will exclude observations with annual inflation greater than 100%.

[Table 3] reports the results for dividing the sample based on development level. Column (1) and (2) apply the model only to developing countries. When we include country and time fixed effects in the model (column 2), we get a coefficient of 0.128 with statistical significance, which is in the 0.1-0.2 range as estimated by other models. As a robustness test, the result from OLS (column 1) is positive and significant, but a 0.4% real appreciation in log terms resulting from a 10% increase in relative GDP hardly makes any economic significance. Predicted by the model of developing countries with fixed effect, the RMB is 6.85% undervalued in 2008 and the magnitude of undervaluation increased after 2000 (Table 3.1).

In column (3) and (4), we include the regression for developed countries to serve as a robustness test, but the coefficients are not in line with those in the baseline models. One possible explanation is that the number of sample countries is too small, which leads to incorrect regression results.

[Table 4] divides the sample by income level for each country. Focusing on the model for middle income countries (column 3 and 4), we observe a similar pattern in the comparison between OLS and fixed effect regression. The fixed effect model estimates a 1.4% real appreciation in log terms resulting from 10% increase in relative GDP per capita, which agrees with the baseline model and the model for developing country. According to this model, the RMB is 8.16% undervalued in 2008 (Table 4.1). The misalignment of the RMB, according to this estimation, increases after 2000 as shown by other model too.

Although in the model of low-income countries, we estimate a negative correlation between RER and relative GDP per capita, the coefficients are not significant for both fixed effect and OLS regressions. Turning to the high-income countries, with a larger sample size compared with developed country group, the fixed effect spells out a strong positive coefficient of 0.179.

Interestingly, from [Table 3] and [Table 4], we observe that the higher the income of a country, the larger the coefficient on relative GDP per capita. Cheung, Chinn, and Fujii (2007) find this result in their study too. Although the tables cannot show any statistical evidence for the claim, considering the underlying wage-equalizing assumption, which is associated with labor mobility, one plausible explanation is that wage-equalizing assumption holds better for developed economies since those countries enjoy greater labor mobility, which drives the Balassa-Samuelson effect. Therefore, we can observe a larger coefficient for developed economies. Echoing the discussion in Section 4.2 regarding the difference in the magnitude of coefficient, by including more developing countries, most of which are in lower income classification group with limited labor mobility, we should expected a smaller coefficient on relative GDP.

In [Table 5], we apply the model only to observations after 1990 in the developing
country category or middle-income country category. From these models, we estimate similar results for both fixed effect and OLS regressions. Comparing with the results for those models without a time subdivision, we find little difference in the estimated coefficient. Not surprisingly, similar to the results of other estimations, applying these two models to China, we find that the RMB is 5.64% - 7.43% undervalued in 2008. In addition, the trends of misalignment over time estimated by these two models again confirm the finding in previous specifications. In the middle-income specification, the 7.43% undervaluation is at least one standard error away from the predicted value.

[Table 6] reveal the estimation for the period before 1990. Since the time span has limited implication for the situation today, especially for a high-growth country like China, given the space limit here, we omit the discussion for those models. Originally, we also use the region classification to divide our sample, but due to the limited number of observations available for each region, the results of the regressions are not reliable. Therefore, we decide not to report them here. [Table 7] and column (5) and (6) in [Table 5] and [Table 6] are related to region classification. Together with [Table 6], these regression results, especially those with fixed effect, can serve as a robustness check here for our baseline models as well as subsample analyses.

Concluding the section, we find strong positive correlation between RER and relative GDP based on our panel dataset. The RMB posts an undervaluation of about 5%-8% for every model we estimated. The increasing misalignment of the currency after 2000 is also robust to every specification.

4.4 The Role of Central Banks

Considering the result of the Hausman test as well as the economic insignificance of the OLS regression, we only apply fixed effect model to specifications with regard to central bank controls in the rest of the study.

In theory, nominal monetary intervention from central banks can affect RER in short-run, but the effect will gradually fade out in long-run. Therefore, in order to figure out an applicable definition for short-run and long-run here, we investigate the significance of central bank variables in current and lagged terms based on equation (2).

In [Table 8], we estimate the model with foreign reserve growth rate and M2/GDP in current terms. In column (1), as we expected, the result displays a negative coefficient on foreign reserve growth together with an in-range coefficient on relative GDP. Both of the coefficients are significant at less than 1% level. However, adding M2/GDP in column (2), we find that the additional variable does not have any explanatory power in the model. The same thing happens when we control for capital account openness in the regression. The results are not significant on variables except relative GDP in all of the three specifications with capital account openness regressions. Taking into account the limited time-varying nature as well as the limited number of observations of the capital account openness indices, we are not surprised that models with fixed effects and these variables do not return significant regression results.

Before we draw any conclusion on an applicable model for central bank controls, we
expand the model by including lagged central bank variables. When we add one lag for both foreign reserve growth and M2/GDP, we estimate significant coefficients for all of the variables (column 2 in Table 9). However, if we add more lags to the specification, the significance of most variables does not hold anymore. Limiting the number of lags to one, we add capital account openness variables again. Similarly, we cannot get any reliable measures.

Combining the results we get in [Table 8] and [Table 9] and taking into account the statistical significance of each variable, we choose to apply the specification with one lag for both foreign reserve growth and M2/GDP to our regression analyses for central bank controls. This model implies that aside from relative GDP between home country and the US, the foreign reserve growth rate and money supply of home country can also affect RER significantly in one-lag terms. The only surprise from the model is the negative coefficient on contemporaneous M2/GDP. It indicates that a current increase in money supply level will bring a real appreciation in the currency while after a year, and it may depress RER in a similar magnitude. The offsetting effect of M2/GDP in two consecutive years kills the statistical significance of the variable in the contemporaneous model (column 1, Table 9).

Continuing the study, we investigate the RMB case with subsamples based on country development and income level using the specification above. Since previous subsample analyses tell us about the insignificance of subsamples based on region classification, we dismiss regional subsamples here too. In addition, comparing the regression results we get in [Table 6], which only models the development of RER after 1990, we find similar coefficients on relative GDP. Therefore, given the space limit here, we only focus our study on subsamples based on development and income level.

In [Table 10], we summarize our findings and results for estimations based on development and income level subsamples. Interestingly, although the specification does not hold for developed economies at all, the results from developing countries are strongly significant. In column (2), both current and lagged terms of foreign reserve growth rate tell us that a stronger foreign intervention is associated with real depreciation in a short-run of two years if the central bank also undertakes sterilization policy. As indicated by the regression result, a one-fold increase in foreign reserve growth rate is associated with a real depreciation of 0.06%-0.07% in current year and a further 0.01% real depreciation in the consecutive year. However, turning to money supply level, we still get a positive coefficient on M2/GDP for current terms and an offsetting effect on the first lag. The results hold similarly for middle-income countries as reported in column (5) while the specification does not hold for high income and low income countries.

In order to make reasonable comparison, we re-estimate the bivariate model using the same observations in regressions in column (2) and (5). In [Table 10.1], we lay out the misalignment measure in percentage log terms for the RMB after 2000. Apparently, applying both subsample estimations, we find a lowered undervaluation for the currency after 2003 in general. The trend of increasing undervaluation magnitude after 2000 also agrees with our findings in the previous section though at a lower level. It is inappropriate to draw a solid conclusion with statistical confidence that PBC has a 2-3% effect on an
undervaluation of 8-9%, but we still see that after controlling for central bank variables, the RMB appears to be less undervalued after 2003.

5 Conclusion

Our results, in spite of being in a smaller magnitude, generally agree with the finding of other authors that the RMB is undervalued. In addition, we also find an increasing development trend of the undervaluation after 2000. We cannot conclude that the impact of the central bank is significant because we fail to get any misalignment in either the original specification or the central bank controlled model more than two standard errors away from the predicted value. However, the central bank of China, the PBC, may still have some impact on RER when they intervene in the foreign exchange market and control the money supply in China, as indicated by the models for developing and middle-income countries. Therefore, we would like to argue that the PBC did have some impact on RER in the short-run based on the regression analyses on historical data, but the misalignment of RMB cannot be explained by the behaviors of PBC completely. There is still a possibility of other factors imbedded in the Chinese economy that may affect RER of the RMB.

We will dedicate our future work to explain the difference in coefficient magnitudes. Although Rogoff (1996) gets a 0.336 coefficient for relative GDP, while others get a larger coefficient (Coudert and Couharde 2005), a coefficient in between 0.1-0.25 is relatively too small, which concerns us. As we proposed in the discussion on the difference among subsample estimations based on income level and development, the labor mobility in the home country is very likely to contribute to the misalignment measured by the bivariate model. We also argued that the labor mobility may be a cause for the smaller coefficients estimated by us. Therefore, in future studies, we will concentrate on the impact of labor mobility of China and investigate the restriction of hukou policy, a rigid inter-province labor mobility control in China, as well as its impact on China’s RER.
References


Appendix I: Data Description

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
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<td>5711</td>
<td>1.43E+11</td>
<td>6.93E+11</td>
<td>2.06E+7</td>
<td>1.42E+13</td>
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<tr>
<td>GDP PPP in Current Dollar</td>
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<td>7.77E+11</td>
<td>5.03E+7</td>
<td>1.42E+13</td>
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<td>Relative Price Level</td>
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<td>Real GDP per capita PPP</td>
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<td>9429.103</td>
<td>11278.27</td>
<td>150.807</td>
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<td>Foreign Reserve Level</td>
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<td>1.53e+12</td>
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<td>M2/GDP</td>
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<td>278.7502</td>
<td>0.9180915</td>
<td>11048.2</td>
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</tbody>
</table>

Note: The negative value on the foreign reserve level may be due to the net borrowing in foreign currencies of some countries from the IMF or other countries.

Appendix II: Regression Results

<table>
<thead>
<tr>
<th>[Table 1] Cross Sectional Misalignment Measurement in Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>------</td>
</tr>
<tr>
<td>(1)</td>
</tr>
<tr>
<td>(2)</td>
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<td>(3)</td>
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<tr>
<td>(4)</td>
</tr>
<tr>
<td>(5)</td>
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<tr>
<td>Relative GDP per Capita_{it}</td>
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<tr>
<td>[0.0162]</td>
</tr>
<tr>
<td>Misalignment in Log Terms</td>
</tr>
<tr>
<td>Misalignment in Absolute Terms</td>
</tr>
<tr>
<td>Standard Errors in Predicted Values</td>
</tr>
<tr>
<td>Observations</td>
</tr>
<tr>
<td>Countries</td>
</tr>
<tr>
<td>R-squared</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
</tr>
</tbody>
</table>

Note: Although the observation number or country number (due to unbalanced panel dataset) in each regression is not equalized, it will not affect the use of this table. The purpose of this table is to demonstrate the overall misalignment overtime, which lays down the broad picture of the performance of RMB over time. Robust standard errors are in brackets. The standard errors of predicted values are the result of Root MSE in the regression output.

*** p<0.01, ** p<0.05, * p<0.1
### Table 2: Panel Misalignment Measurement

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>Inflation &lt;100%</th>
<th>Inflation &lt;100% with FE</th>
<th>OLS clustered by Country</th>
<th>Inflation &lt;100%, clustered by Country</th>
<th>Inflation &lt;100% with FE, clustered by Country</th>
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</thead>
<tbody>
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<td>(1)</td>
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<td>(4)</td>
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<td></td>
</tr>
<tr>
<td>(5)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>(6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative GDP per Capita$\text{it}$</td>
<td>0.110***</td>
<td>0.134***</td>
<td>0.173***</td>
<td>0.110***</td>
<td>0.134***</td>
<td>0.173***</td>
</tr>
<tr>
<td></td>
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<td>[0.0299]</td>
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<td>0.21501</td>
<td>0.11309</td>
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<td>0.21501</td>
<td>0.11309</td>
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<td>4614</td>
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<td>178</td>
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<td>167</td>
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<td>Hausman Statistics</td>
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<tr>
<td>R-squared</td>
<td>0.219</td>
<td>0.377</td>
<td>0.836</td>
<td>0.219</td>
<td>0.377</td>
<td>0.836</td>
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<td>Adjusted R-squared</td>
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<td>0.3769</td>
<td>0.8276</td>
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</table>

Note: The maximum period is from 1975-2008, 34 years in total in the above regression. The panel is unbalanced due to some missing observations. Worried about serial correlation within data, standard errors are clustered by countries from column (4) to (6). All fixed effects are estimated using both country and time. Standard errors are in brackets. The standard errors of predicted values are the result of Root MSE in the regression output. 

### Table 2.1: Panel Misalignment Measure Results

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
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<th>(3)</th>
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<th>(6)</th>
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<tbody>
<tr>
<td>2000</td>
<td>-10.24%</td>
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<td>4.32%</td>
<td>-10.24%</td>
<td>-8.30%</td>
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</tr>
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<td>5.57%</td>
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<td>-10.89%</td>
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<td>-10.89%</td>
<td>3.66%</td>
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<tr>
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</tr>
<tr>
<td>2004</td>
<td>-12.21%</td>
<td>-10.96%</td>
<td>-4.92%</td>
<td>-12.21%</td>
<td>-10.96%</td>
<td>-4.92%</td>
</tr>
<tr>
<td>2005</td>
<td>-12.35%</td>
<td>-11.27%</td>
<td>-8.10%</td>
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<td>-11.27%</td>
<td>-8.10%</td>
</tr>
<tr>
<td>2006</td>
<td>-11.91%</td>
<td>-11.04%</td>
<td>-9.71%</td>
<td>-11.91%</td>
<td>-11.04%</td>
<td>-9.71%</td>
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<tr>
<td>2007</td>
<td>-8.86%</td>
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<td>-11.32%</td>
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<tr>
<td>2008</td>
<td>-2.65%</td>
<td>-2.23%</td>
<td>-11.30%</td>
<td>-2.65%</td>
<td>-2.23%</td>
<td>-11.30%</td>
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</table>
### Table 3: Subsample: Developed and Developing Countries

<table>
<thead>
<tr>
<th>Relative GDP per Capita</th>
<th>(1) Pooled OLS</th>
<th>(2) FE</th>
<th>(3) Pooled OLS</th>
<th>(4) FE</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>0.0402***</td>
<td>0.128***</td>
<td>0.514***</td>
<td>0.0827</td>
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<td></td>
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<td>[0.0283]</td>
<td>[0.0870]</td>
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<td>850</td>
<td>850</td>
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<td>136</td>
<td>31</td>
<td>31</td>
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<tr>
<td>R-squared</td>
<td>0.070</td>
<td>0.638</td>
<td>0.340</td>
<td>0.854</td>
</tr>
</tbody>
</table>

Note: The classification of developed (advanced or industrial) and developing countries is drawn from IFS dataset provided by IMF. Standard errors are clustered by country. Robust standard errors are in brackets. The standard errors of predicted values are the result of Root MSE in the regression output.

*** p<0.01, ** p<0.05, * p<0.1

### Table 3.1: Subsample: Developed and Developing Countries: Measure of Misalignment

<table>
<thead>
<tr>
<th>Year</th>
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<tr>
<td>2000</td>
<td>-6.92%</td>
<td>2.75%</td>
</tr>
<tr>
<td>2001</td>
<td>-7.36%</td>
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</tr>
<tr>
<td>2002</td>
<td>-8.11%</td>
<td>2.84%</td>
</tr>
<tr>
<td>2003</td>
<td>-8.22%</td>
<td>-0.26%</td>
</tr>
<tr>
<td>2004</td>
<td>-6.91%</td>
<td>-2.11%</td>
</tr>
<tr>
<td>2005</td>
<td>-6.55%</td>
<td>-5.30%</td>
</tr>
<tr>
<td>2006</td>
<td>-5.52%</td>
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</tr>
<tr>
<td>2007</td>
<td>-1.73%</td>
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</tr>
<tr>
<td>2008</td>
<td>5.03%</td>
<td>-6.85%</td>
</tr>
</tbody>
</table>

### Table 4: Subsample: Income Classification

<table>
<thead>
<tr>
<th>Relative GDP per Capita</th>
<th>(1) OLS</th>
<th>(2) FE</th>
<th>(3) OLS</th>
<th>(4) FE</th>
<th>(5) OLS</th>
<th>(6) FE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.0241</td>
<td>-0.0608</td>
<td>0.0471***</td>
<td>0.144***</td>
<td>0.350***</td>
<td>0.179***</td>
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<td></td>
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<td>[0.0867]</td>
<td>[0.0165]</td>
<td>[0.0410]</td>
<td>[0.0885]</td>
<td>[0.0500]</td>
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<tr>
<td>Standard Errors in Predicted Values</td>
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<td>0.0919</td>
<td>0.15155</td>
<td>0.09772</td>
<td>0.25765</td>
<td>0.11615</td>
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<td>1110</td>
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<td>35</td>
<td>85</td>
<td>85</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.005</td>
<td>0.664</td>
<td>0.038</td>
<td>0.623</td>
<td>0.263</td>
<td>0.860</td>
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</table>

Note: The classification of Income level of each country is drawn from WDI dataset. Middle Income group includes the countries in Lower Middle Income and Upper Middle Income in the original classification. High Income group includes the countries in High Income: OECD and High Income: Non-OECD in the original classification. Standard errors are clustered by country. Robust standard errors are in brackets. The standard errors of predicted values are the result of Root MSE in the regression output.

*** p<0.01, ** p<0.05, * p<0.1

### Table 4.1: Subsample: Income Classification: Measure of Misalignment

<table>
<thead>
<tr>
<th>Year</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>-6.33%</td>
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<td>2001</td>
<td>-6.82%</td>
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<td>2002</td>
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</tr>
<tr>
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<td>-1.00%</td>
</tr>
<tr>
<td>2004</td>
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<td>-2.85%</td>
</tr>
<tr>
<td>2005</td>
<td>-6.20%</td>
<td>-6.14%</td>
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<td>-8.00%</td>
</tr>
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<td>2007</td>
<td>-1.52%</td>
<td>-8.70%</td>
</tr>
<tr>
<td>2008</td>
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<td>-8.16%</td>
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### Table 5: After 1990: Specification Related to China

<table>
<thead>
<tr>
<th></th>
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<th>East Asia and Pacific</th>
</tr>
</thead>
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<tr>
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<td>(1) OLS</td>
<td>(2) FE</td>
<td>(3) OLS</td>
</tr>
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<td><strong>Relative GDP per Capita</strong></td>
<td>0.0479***</td>
<td>0.118***</td>
<td>0.0647***</td>
</tr>
<tr>
<td></td>
<td>[0.00739]</td>
<td>[0.0242]</td>
<td>[0.0178]</td>
</tr>
<tr>
<td><strong>Standard Errors in Predicted Values</strong></td>
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<td>0.1382</td>
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<td>2147</td>
<td>1382</td>
</tr>
<tr>
<td><strong>Countries</strong></td>
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<td>134</td>
<td>85</td>
</tr>
<tr>
<td><strong>R-squared</strong></td>
<td>0.128</td>
<td>0.739</td>
<td>0.081</td>
</tr>
</tbody>
</table>

Note: Because the number of regressions will be too many to report here if we do all the time subsample permutations, we decided to just to estimate the regressions that related to China. Standard errors are clustered by country. Robust standard errors are in brackets. The standard errors of predicted values are the result of Root MSE in the regression output.

*** p<0.01, ** p<0.05, * p<0.1

### Table 5.1: After 1990: Specification Related to China: Misalignment Measurement

<table>
<thead>
<tr>
<th>Year</th>
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<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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</thead>
<tbody>
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<td>-3.09%</td>
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</tr>
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<td>7.55%</td>
</tr>
<tr>
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<td>2.84%</td>
<td>-7.58%</td>
<td>5.92%</td>
</tr>
<tr>
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<td>2.40%</td>
</tr>
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<td>-3.77%</td>
<td>-2.05%</td>
<td>-7.20%</td>
<td>2.76%</td>
</tr>
<tr>
<td>2005</td>
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<td>-7.27%</td>
<td>-0.49%</td>
</tr>
<tr>
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<td>-5.96%</td>
<td>-2.77%</td>
<td>-7.25%</td>
<td>-6.75%</td>
<td>-1.65%</td>
</tr>
<tr>
<td>2007</td>
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<td>0.76%</td>
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<td>-3.60%</td>
<td>-1.74%</td>
</tr>
<tr>
<td>2008</td>
<td>7.40%</td>
<td>-5.64%</td>
<td>7.33%</td>
<td>-7.43%</td>
<td>2.69%</td>
<td>1.72%</td>
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</table>

### Table 6: Before 1990: Specification Related to China

<table>
<thead>
<tr>
<th></th>
<th>Developing</th>
<th>Middle Income</th>
<th>East Asia and Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) OLS</td>
<td>(2) FE</td>
<td>(3) OLS</td>
</tr>
<tr>
<td><strong>Relative GDP per Capita</strong></td>
<td>0.00983</td>
<td>0.202**</td>
<td>0.00391</td>
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<tr>
<td></td>
<td>[0.0168]</td>
<td>[0.0773]</td>
<td>[0.0255]</td>
</tr>
<tr>
<td><strong>Standard Errors in Predicted Values</strong></td>
<td>0.17818</td>
<td>0.0983</td>
<td>0.16663</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>805</td>
<td>805</td>
<td>533</td>
</tr>
<tr>
<td><strong>Countries</strong></td>
<td>97</td>
<td>97</td>
<td>60</td>
</tr>
<tr>
<td><strong>R-squared</strong></td>
<td>0.003</td>
<td>0.736</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: Because the number of regressions will be too many to report here if we do all the time subsample permutations, we decided to just to estimate the regressions that related to China. Standard errors are clustered by country. Robust standard errors are in brackets. The standard errors of predicted values are the result of Root MSE in the regression output.

*** p<0.01, ** p<0.05, * p<0.1
### Table 7: Subsample: Region

<table>
<thead>
<tr>
<th>Region</th>
<th>East Asia and Pacific</th>
<th>Europe and Central Asia</th>
<th>Latin America and Caribbean</th>
<th>South Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) OLS</td>
<td>(2) FE</td>
<td>(3) OLS</td>
<td>(4) FE</td>
<td>(5) OLS</td>
</tr>
<tr>
<td>Relative GDP per Capita&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>0.110**</td>
<td>-0.0198</td>
<td>0.112***</td>
<td>0.157**</td>
</tr>
<tr>
<td></td>
<td>[0.0476]</td>
<td>[0.0811]</td>
<td>[0.0176]</td>
<td>[0.0707]</td>
</tr>
<tr>
<td>Standard Errors Predicted Values</td>
<td>0.14823</td>
<td>0.07463</td>
<td>0.10566</td>
<td>0.12974</td>
</tr>
<tr>
<td>Observations</td>
<td>349</td>
<td>349</td>
<td>274</td>
<td>722</td>
</tr>
<tr>
<td>Countries</td>
<td>16</td>
<td>16</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.147</td>
<td>0.811</td>
<td>0.334</td>
<td>0.196</td>
</tr>
</tbody>
</table>

Note: The classification of regions is drawn from WDI dataset. Due to the nature of oil-exporting economies, as well as previous and current hyperinflation history in Africa, those countries are not included in the subsample analysis. Standard errors are clustered by country. Robust standard errors are in brackets. The standard errors of predicted values are the result of Root MSE in the regression output.  
*** p<0.01, ** p<0.05, * p<0.1

### Table 7.1: Subsample: Region: Measure of Misalignment for China

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>-7.60%</td>
<td>-8.56%</td>
<td>-9.83%</td>
<td>10.45%</td>
<td>-9.58%</td>
<td>-9.73%</td>
<td>-9.30%</td>
<td>-6.26%</td>
<td>-0.05%</td>
</tr>
<tr>
<td>(2)</td>
<td>5.99%</td>
<td>8.72%</td>
<td>7.53%</td>
<td>4.33%</td>
<td>5.05%</td>
<td>2.22%</td>
<td>1.56%</td>
<td>1.99%</td>
<td>5.88%</td>
</tr>
</tbody>
</table>

### Table 8: Central Bank Regression: Short Term Effect

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative GDP per Capita&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>0.168***</td>
<td>0.139***</td>
<td>0.232**</td>
<td>0.246**</td>
</tr>
<tr>
<td></td>
<td>[0.0295]</td>
<td>[0.0277]</td>
<td>[0.0944]</td>
<td>[0.0972]</td>
</tr>
<tr>
<td>Foreign Reserve Growth Rate&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>0.000809**</td>
<td>0.000718**</td>
<td>-0.00760</td>
<td>-0.00866</td>
</tr>
<tr>
<td></td>
<td>[0.000322]</td>
<td>[0.000299]</td>
<td>[0.00788]</td>
<td>[0.00816]</td>
</tr>
<tr>
<td>M2/GDP&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>0.000755</td>
<td>-0.00159*</td>
<td>-0.00158*</td>
<td>-0.00157*</td>
</tr>
<tr>
<td></td>
<td>[0.000548]</td>
<td>[0.000892]</td>
<td>[0.000888]</td>
<td>[0.000892]</td>
</tr>
<tr>
<td>Capital Account Openness&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>0.0525</td>
<td>-0.00950</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.0581]</td>
<td>[0.0502]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Account Outflow Openness&lt;sub&gt;i,t&lt;/sub&gt;</td>
<td>0.0755</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.0497]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Capital Account Openness index is from Schindler (2009). Because the index for each country does not vary too much over time, when we use a fixed effect model to control time and country factors, the regression result may not be significant. Standard errors are clustered by country. Robust standard errors are in brackets.  
*** p<0.01, ** p<0.05, * p<0.1
### Table 9: Central Bank Regression: Lagged Model

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative GDP per Capita</td>
<td>0.139***</td>
<td>0.141***</td>
<td>0.142***</td>
<td>0.237**</td>
<td>0.251**</td>
<td>0.232**</td>
</tr>
<tr>
<td></td>
<td>[0.0277]</td>
<td>[0.0283]</td>
<td>[0.0291]</td>
<td>[0.0940]</td>
<td>[0.0968]</td>
<td>[0.0934]</td>
</tr>
<tr>
<td>Foreign Reserve</td>
<td>0.000718**</td>
<td>0.000698**</td>
<td>0.000681**</td>
<td>-0.00865</td>
<td>-0.00972</td>
<td>-0.00771</td>
</tr>
<tr>
<td>Growth Rate</td>
<td>[0.000299]</td>
<td>[0.000274]</td>
<td>[0.000270]</td>
<td>[0.00793]</td>
<td>[0.00820]</td>
<td>[0.00771]</td>
</tr>
<tr>
<td>Foreign Reserve</td>
<td>-0.00117*</td>
<td>-0.000975</td>
<td>0.00431</td>
<td>0.00365</td>
<td>0.00515</td>
<td></td>
</tr>
<tr>
<td>Growth Rate</td>
<td>[0.000641]</td>
<td>[0.000790]</td>
<td>[0.00504]</td>
<td>[0.00479]</td>
<td>[0.00526]</td>
<td></td>
</tr>
<tr>
<td>Foreign Reserve</td>
<td>-0.000574</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth Rate</td>
<td>[0.000627]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2/GDP</td>
<td>0.000755</td>
<td>0.00298***</td>
<td>0.00274***</td>
<td>0.00127</td>
<td>0.00127</td>
<td>0.00129</td>
</tr>
<tr>
<td></td>
<td>[0.000548]</td>
<td>[0.000796]</td>
<td>[0.000777]</td>
<td>[0.00111]</td>
<td>[0.00111]</td>
<td>[0.00111]</td>
</tr>
<tr>
<td>M2/GDP</td>
<td>0.00240***</td>
<td>-0.000697</td>
<td>0.00329**</td>
<td>0.00327**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.000769]</td>
<td>[0.000657]</td>
<td>[0.00137]</td>
<td>[0.00137]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M2/GDP</td>
<td>-0.00158**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.000664]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Account Openness</td>
<td>-0.0566</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.0580]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Account Inflow Openness</td>
<td>-0.0147</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.0510]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Account Outflow Openness</td>
<td>-0.0774</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.0492]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Capital Account Openness index is from Schindler (2009). Because the index for each country does not vary too much over time, when we use a fixed effect model, the regression result may not be significant. Standard errors are clustered by country. Robust standard errors are in brackets.

*** p<0.01, ** p<0.05, * p<0.1
## Table 10: Central Bank Regression: Subsamples

<table>
<thead>
<tr>
<th></th>
<th>Developed</th>
<th>Developed</th>
<th>Developed</th>
<th>Hing Income</th>
<th>Middle Income</th>
<th>Middle Income</th>
<th>Middle Income</th>
<th>Low Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td>Relative GDP per Capita&lt;sub&gt;t&lt;/sub&gt;</td>
<td>-0.0108</td>
<td>0.131***</td>
<td>0.129***</td>
<td>0.173***</td>
<td>0.124***</td>
<td>0.133***</td>
<td>-0.0447</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.0832]</td>
<td>[0.0283]</td>
<td>[0.0274]</td>
<td>[0.0458]</td>
<td>[0.0398]</td>
<td>[0.0378]</td>
<td>[0.0963]</td>
<td></td>
</tr>
<tr>
<td>Foreign Reserve Growth Rate&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.0393</td>
<td>-</td>
<td></td>
<td>0.00289</td>
<td>-</td>
<td>0.000676**</td>
<td>-0.00131</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.0313]</td>
<td>[0.000255]</td>
<td>[0.00435]</td>
<td>[0.000268]</td>
<td>[0.00101]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Reserve Growth Rate&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>0.0270</td>
<td>-0.00113*</td>
<td></td>
<td>0.00315</td>
<td>-0.00135*</td>
<td>-0.00336</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.0347]</td>
<td>[0.000605]</td>
<td>[0.00534]</td>
<td>[0.000749]</td>
<td>[0.00443]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M&lt;sub&gt;2&lt;/sub&gt;/GDP&lt;sub&gt;t&lt;/sub&gt;</td>
<td>0.00101</td>
<td>0.00266***</td>
<td></td>
<td>0.00330**</td>
<td>0.00326***</td>
<td>0.000368</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.00128]</td>
<td>[0.000795]</td>
<td>[0.00149]</td>
<td>[0.00103]</td>
<td>[0.00178]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M&lt;sub&gt;2&lt;/sub&gt;/GDP&lt;sub&gt;t-1&lt;/sub&gt;</td>
<td>-0.000510</td>
<td>-</td>
<td></td>
<td>-0.00267*</td>
<td>0.00312***</td>
<td>-0.00248</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>[0.00104]</td>
<td>[0.000803]</td>
<td>[0.00136]</td>
<td>[0.00107]</td>
<td>[0.00223]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

|                        |             |           |           |             |               |               |               |            |
| Standard Errors in Predicted Values | 0.12172 | 0.09439 | 0.09506 | 0.12618 | 0.09144 | 0.0924 | 0.09211 |            |

|                        | Observations |             |           |             |               |               |               |            |
|                        | 452          | 2788       | 2788      | 683         | 1812          | 1812          | 716           |            |

|                        | R-squared    |             |           |             |               |               |               |            |
|                        | 0.839        | 0.667       | 0.662     | 0.852       | 0.663         | 0.655         | 0.674         |            |

Note: Robust standard errors are in brackets. The standard errors of predicted values are the result of Root MSE in the regression output.

*** p<0.01,
** p<0.05, *
p<0.1

## Table 10.1: Central Bank Regression: Subsamples: Measurement of Misalignment

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2) Developing Country</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group with Central Bank Control</td>
<td>3.06%</td>
<td>4.76%</td>
<td>2.22%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(3) Developing Country</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group without Central Bank Control</td>
<td>2.38%</td>
<td>3.69%</td>
<td>2.64%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(5) Middle Income</td>
<td>1.15%</td>
<td>3.00%</td>
<td>0.83%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
A COMMON CURRENCY FOR MERCOSUR:
TRADE AND FOREIGN DIRECT INVESTMENT
IMPLICATIONS

Paul Unanue
Princeton University

Acknowledgments

This paper would not have been possible without the guidance and support that I have received along the way. I cannot imagine this process without Professor Kiyotaki as an advisor. I thank him for his many insights and the curiosity he has sparked in me. My deepest thanks go to Prof. Kenen for sharing his expertise in currency areas. I greatly appreciate Prof. Weyerbrock's advice concerning econometric techniques. I thank Prof. Ramondo for helping me gain a deeper understanding of multinational enterprises. I would also like to thank my parents for their continual love and support; without them this thesis would not have been possible. Oscar Torres-Reyna has helped me tremendously in applying my econometric knowledge, for which I am very grateful. Last but not least, I owe a great deal to Lina Mendez, who has supported me endlessly through the ups and downs of my research.
TRADE LIBERALIZATION AND THE
GEOGRAPHY OF INCOME:
PRODUCTION, MIGRATION, AND INEQUALITY
IN LATIN AMERICA

Allison Kern
Georgetown University

ABSTRACT

The effect of trade liberalization on the spatial concentration of economic activities has not been soundly established. It has been argued that protectionism increases concentration of production and encourages urban primacy through forward and backward linkages in the domestic market. However, recent studies, most notably those from individual developing countries, have found contrary results: openness, not protectionism, increases spatial concentration by favoring existing industrial centers. If this were the case, liberalization would lead to growing regional inequality and have devastating welfare implications. Fortunately, by analyzing the effect of openness on the concentration of income in Latin America from 1981 to the present, we find that trade liberalization actually led to both a significant decrease in the concentration of income and population. Even though we assert that liberalization has positive effects on developing economies, we are tentative to prescribe it as a universal solution to alleviate income inequality.

1 Introduction

In the post-war period, globalization has linked developed countries to those of the developing world. The latter, as a result, have increasingly benefited from foreign direct investment in their core production areas. However, the relative accumulation of wealth in core areas has created only a limited number of opportunities, which have appeared inflated when compared to the depleted rural areas of these countries. Consequently, the unemployed rural sectors have migrated at an accelerated pace to burgeoning urban centers, causing a relocation of poverty, not an amelioration. Of the six billion people on earth, slightly less than one-half live in urban areas (United Nations 2001).

During the last fifty years, the process of urbanization, especially in Latin America, has been remarkable. However, from late 1970s, most Latin American economies started to experience serious difficulties, most notably urban poverty (Cerruti and Bertoncello 2003, United Nations 2001). Latin America countries, like most in the developing world, were unable to match its swelling urban population with an equal increase in employment and infrastructural resources.

Unfortunately, cities compete with one another to attract capital, yet developing countries
are handicapped by inadequate urban services, communication and transport systems, and education. Hence, cities in developing countries have paradoxically underutilized labor supplies because of an absence of industry, but industry is deterred from entering these cities because of the insufficient resources to support the population. Nevertheless, an increase in growth can break this cycle by enriching a country, enabling it to invest in infrastructure and human capital.

The accession of developing countries to multilateral trade agreements has incited greater interest in the WTO’s positive impact on the developing world. To many economists and promoters of globalization, the fact that trade improves welfare may seem to be a truism. They argue that since trade increases the scope for specialization through the mechanisms of comparative advantage, allocative efficiency is advanced and, hence, gains in welfare are achieved. Corollaries to this argument have also shown that, as a particular benefit to developing countries, the expansion of trade can help mitigate some palpable problems that hinder economic growth – most notably, the excessive concentrations of population, economic activity, and wealth in primary urban centers.

Urban primacy and industrial concentration, Krugman and Livas (1996) contended, are likely to decrease as a result of trade liberalization as producers are no longer confined to the domestic market and may utilize foreign production chains outside of the central urban area. However, not all economic geographers concur. Paluzie (2001), for example, asserted that the diffusion of global trade could increase, not decrease, urban concentration within developing countries. A number of studies, targeted at individual economies, followed that of Paluzie and extracted similar conclusions. These contrary results are especially bewildering, considering that the aforementioned authors employed similar theoretical models, each using only a slight modification of the other’s. Consequently, despite the universal presumption that trade liberalization garners growth, little can be said about neither the mechanisms through which growth affects production nor the welfare implications. As a contribution to this single-country literature, we examine the cross-country effect of trade liberalization on the concentration of population and income. Our findings support those of Krugman and Livas (1996), whereby an increase in openness foments a dispersion of both people and economic activity.

This paper is organized as follows. Section 2 presents a brief summary of previous literature established on the subject of agglomeration, including an overview of the prevailing theories. Section 3 introduces the data sets used and presents the empirical specification. Section 4 states and discusses the regression results and policy implications. Section 5 concludes and reviews the previous arguments.

2 Literature Review

Krugman and Livas, in their 1996 paper, argued that urban primacy and industrial concentration should theoretically decrease as a result of the liberalization of trade. The authors drew a correlation between the giant metropolises that proliferated in the developing world after World War II and the import-substitution industrialization policies of these
countries. By studying the effects of trade liberalization in Mexico in the 1980s, their theory and model assumed that increased access to foreign supply and demand markets weakened the gains from forward and backward linkages in the primate city and, hence, encouraged the dispersion of industry. For example, if a typical manufacturer sold primarily to export markets, diminishing backward linkages, and relied primarily on imported inputs, negating forward linkages, there would be little advantage to locating near a metropolitan center and be subject to relatively high prices of labor and non-tradable inputs.

On the other hand, Paluzie (2001), by studying the pattern of regional inequalities after Spain’s accession into the European Community in the 1980s, asserted that trade liberalization can increase the urban concentration of production within developing economies. Paluzie employed the same model as that of Krugman and Livas but substituted the pull of the dispersed rural market for the commuting cost/land rent as the model’s centrifugal force. Paluzie argued that while the Krugman and Livas model may be suitable to a phenomenon of urban concentration like that of Mexico City, her model seemed more adequate to universally describe regional inequality processes.

Further, within the study of urbanization, like that of industrialization, a similar bifurcation with regard to anticipated outcomes exists. The vast literature on development, and more specifically on the efficacy of structural adjustment programs, has often asserted that globalization and trade expansion tend to strengthen urban primacy, or the concentration of the population in core production areas. Economists refer to this as “dependent” urbanization. Likewise, a secondary effect is often complicit in the promotion of the primate city, that of “interdependent” urbanization. Interdependent urbanization is the idea that the main political and industrial center of a developing country has the greatest potential to benefit from openness, often at the expense of the country’s hinterlands (Clark 1998). Therefore, the theory of (inter)dependent urbanization predicts that trade liberalization will cause, first, an increase in geographic concentration of the population – dependent urbanization – and, second, a heightened disparity in regional wealth – interdependent urbanization. As is evident, both facets of the theory endorse a path dependency of urbanization.

While European urbanization of the 19th century had a distinctly different trajectory than does that of present-day developing economies – namely, higher costs of spatial interaction, weaker economies of scale, and a less elastic supply of labor to the urban sector, all of which resulted in more dispersed urbanization – Paluzie’s conclusions are affirmed by a number of later papers focusing on the contemporary developing world (Puga 1996). Sjöberg and Sjöholm (2004), for one, contended that both external scale economies – localization advantages and, more generally, urbanization economies – and internal scale economies have caused a constant or increasing degree of concentration in the Indonesian manufacturing sector.

Nevertheless, while Sjöberg and Sjöholm agreed that their results are more consistent with the (inter)dependent urbanization theory of Paluzie (2001), in which liberalization tends to reinforce the role and prominence of primate cities, than with the structural adjustment theory of Krugman and Livas (1996), they were hesitant to generalize their
findings across the developing world. They reasoned that, first, Indonesia’s over-crowded rural population may have led to an atypical migration to urban centers or, second, that the establishments engaged in trade were over-represented in port cities, given Indonesia’s unique condition as an archipelago.

Sjöberg and Sjöholm (2004) warned that their results and those of similar studies could be subject to idiosyncrasies based on the spatial configuration of the economy under scrutiny. A country’s spatial configuration encompasses its geographical location and climate, the quality and density of its infrastructure, its access to financial capital, and its political orientation (Henderson 2000). Accordingly, studies of other regions have revealed variant results. While some authors conclude that concentration has left core urban areas in favor of periurban or suburban areas, further studies, most notably those pertaining to planned economies, have revealed that increased openness exposed the ineffectiveness of government orchestrated development and, therefore, precipitated dispersion (Henderson, Shalizi, and Venables 2001; Fan and Scott 2003). Fan and Scott (2003) focused on the effects of openness on the concentration of production in China. Their results affirm that large-plant, capital-intensive, and government-owned sectors benefited little from agglomeration economies, in which firms utilize inter-firm linkages, dense labor and supply markets, and knowledge spillovers; thus, market liberalization stimulated a factor outflow from these state-run industrial zones. Given the active role that government played in Central and South American industrialization, we expect the effect openness had on industrial and factor concentration in Latin America from the 1980s to the present to emulate Fan and Scott’s findings.

In this paper we resolve the inconsistency of previous single-country findings by executing a cross-country analysis of Latin America. We scrutinize the equality implications that trade liberalization imparts on each country via domestic migration and relocation of production. Likewise, a recurring theme among development economists has been that of (inter)dependent urbanization. To vet the theory, we will examine the effect of openness on both the population concentration and the disparity of GDP across sub-national regions. Latin America, like many developing areas, has experienced rapid urbanization, undergone industrial policy, and only recently opened up to trade. Since international institutions, most notably the International Monetary Fund (IMF), imposed the majority of Latin American trade liberalization, the reduction of protection was relatively exogenous to domestic political and economic forces, thereby making Latin America an ideal microcosm for studying the relationship between trade liberalization and the geographic concentration of income. Given the extensive industrial targeting and capital-city favoritism employed in Latin America preceding liberalization, we expect to generate results in accordance with the theory established by Krugman and Livas (1996).

3 Empirical Strategy and Data
To test the theories of agglomeration pioneered by Krugman and Livas (1996) and Paluzie (2001), we model the impact of openness on the concentration of income, and to measure the concentration of income, we employ the Adjusted Geographic Concentration
index (AGC) developed by the Organization for Economic Cooperation and Development (OECD).

The AGC is defined by the following:

\[
AGC = \sum_{i=1}^{N} \frac{y_i - p_i}{y_i - a_i} \frac{|y_i - a_i|}{2(1 - a_{\text{min}})} + \sum_{i=1}^{N} \frac{p_i - a_i}{y_i - a_i} \frac{|y_i - a_i|}{2(1 - a_{\text{min}})}
\]

where \(y_i, p_i, \) and \(a_i\) are the income, population, and area of region \(i\) as a share of the national total, respectively, and \(N\) stands for the number of regions within the country. \(a_{\text{min}}\) is the relative area of the smallest region; hence, \(2(1 - a_{\text{min}})\) is the maximum potential value of geographic concentration for the country.\(^1\) The AGC index ranges between zero (no concentration of income) and one (complete concentration in one sub-national unit).

By employing the AGC index, as opposed to the more popular Herfindahl index or locational Gini coefficient, we avoid any complications propagated by cross-country differences. The Herfindahl index and its derivations essentially sum the square of income shares across regions, yet by doing so, they fail to take into account the systematic differences in regional area across countries. This is problematic if, hypothetically, Country A is divided into two regions with equal income shares and Country B is divided into seven regions, one of which comprises forty percent of income with the rest divided equally among the remaining regions. The countries will have Herfindahl indices of 0.5 and 0.22, respectively.\(^2\) However, this signifies that the first country is more concentrated than the latter, which is erroneous because while fifty percent of land constitutes fifty percent of income in Country A, forty percent of income is concentrated in fourteen percent of land in Country B. The locational Gini coefficient, on the other hand, confuses inequality and concentration; it is constructed for the analysis of income inequality between individuals whereas we are interested in the disparity between regions (OECD 2003).

The AGC index of the concentration of income can be decomposed into the two components displayed on the right-hand side of Equation 1: the regional disparity of GDP per capita and the geographic concentration of the population. We employ each as a regressand to analyze the extent of industrial and labor relocation, respectively.

The regional disparity of GDP per capita:

\[
\text{regdisp} = \sum_{i=1}^{N} \frac{y_i - p_i}{y_i - a_i} \frac{|y_i - a_i|}{2(1 - a_{\text{min}})}
\]

measures the effect of territorial disparity in GDP per capita for each country. Large values of \(\text{regdisp}\) equate to countries where most of national income is concentrated among a few people in a small geographical area. This index, though, can be negative if the population share is larger than the income share \((y_i p_i < 0)\), while the income share, in turn, is larger

\[
\text{GC MAX} = \max_{i=1}^{N} a_i - 1 - a_{\text{min}} = 1 + 1 - 2a_{\text{min}} = 2(1 - a_{\text{min}})
\]

\(^1\) Where \(GC\) stands for the Geographic Concentration Index.

\(^2\) Country A: \(0.5^2 + 0.5^2 = 0.5\). Country B: \(0.4^2 + 6(0.1^2) = 0.22\)
than the area share \((y_i - a_i > 0)\), or the converse \((y_i - p_i > 0 \text{ and } y_i - a_i < 0)\). The smallest possible value is, therefore:

\[
\min(\text{regdisp}) = \frac{-1}{2(1 - a_{\min})}
\]

In fact, Bolivia and Chile often generated negative \text{regdisp} values for the observed period. The geographic concentration of the population:

\[
\text{conpop} = \sum_{i=1}^{N} \frac{p_i - a_i}{y_i - a_i} \frac{|y_i - a_i|}{2(1 - a_{\min})}
\]

measures the effect of concentration of the population for each country. The greater the index, the greater is the number of people who live in a small region within the country. Since the income-share term is present only within the two expressions \((y_i - a_i)\) and \(|y_i - a_i|\) that cancel out, with the exception of the sign of \((y_i - a_i)\), we observe only the relationship between population share and area share.

We model the relationship between openness and concentration using a log-log least squares dummy variable specification with country and year fixed-effects. Fixed effects will control for any unobserved heterogeneity across countries. We assume that the causal effect of openness on the regressands – \text{AGC}, \text{regdisp}, and \text{conpop} – is the same for each country. The following specification represents our concentration model:

\[
D \ln \text{AGC}_{ct} = D_c + D_t + b \text{open}_{ct} + e_{1ct}
\]

where \text{AGC} can be substituted by \text{regdisp} and \text{conpop}; \text{open} is the ratio of the sum of imports and exports to GDP. Subscripts \(c\) and \(t\) denote country and time, respectively, and \(D_c\) and \(D_t\) are full sets of country and year dummies, respectively.

All regressions are constructed using an unbalanced panel data set from 1981 to 2009 with annual observations and include all Latin American countries for which sufficient data were available.

### 3.1 Index data

We source the majority of our data for the AGC index from the Socio-Economic Database for Latin America and the Caribbean (SEDLAC). SEDLAC is compiled under the auspices of La Universidad Nacional de La Plata and The World Bank and operates in conjunction with the national statistics offices of each country. It includes statistics on distributional and social variables from 25 Latin American and Caribbean countries, based on microdata from household surveys. We used SEDLAC data to record the annual regional population and income shares of 17 observed countries from 1981 to 2009. SEDLAC, though, did not provide data on area share. We acquired the missing data from each country’s national statistics office.

---

3 Accordingly, the index will be negative when \(p_i > y_i > a_i\), or \(a_i > y_i > p_i\).

4 All Argentine estimates are computed from the Encuesta Permanente de Hogares (EPH). The EPH covers only urban areas – about 42 percent of the total population.
Openness

We obtain two measures of openness from the Penn World Tables 6.3: $openc$ is the ratio of exports plus imports to GDP at current prices, and $openk$ is that ratio at constant prices. A third measure, the ratio of exports to GDP at current prices, is supplied by The World Bank’s World Development Indicators.

4 Results

Table 1 summarizes the average values of each AGC component and the aggregated index for all countries in the observed period. Uruguay and Panama are the most concentrated countries both in terms of population and the AGC index, while Ecuador and El Salvador have the greatest disparity in GDP per capita.

<table>
<thead>
<tr>
<th>Country</th>
<th>AGC index</th>
<th>Regional disparity of GDP per capita</th>
<th>Geographic concentration of population</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARG</td>
<td>0.2146</td>
<td>0.0743</td>
<td>0.1403</td>
</tr>
<tr>
<td>JAM</td>
<td>0.2612</td>
<td>0.0592</td>
<td>0.2020</td>
</tr>
<tr>
<td>COL</td>
<td>0.2637</td>
<td>0.1087</td>
<td>0.1550</td>
</tr>
<tr>
<td>BOL</td>
<td>0.3141</td>
<td>-0.0010</td>
<td>0.3151</td>
</tr>
<tr>
<td>BLZ</td>
<td>0.3301</td>
<td>0.1601</td>
<td>0.1700</td>
</tr>
<tr>
<td>SLV</td>
<td>0.4521</td>
<td>0.1679</td>
<td>0.2842</td>
</tr>
<tr>
<td>HND</td>
<td>0.4532</td>
<td>0.1109</td>
<td>0.3423</td>
</tr>
<tr>
<td>MEX</td>
<td>0.4630</td>
<td>0.0426</td>
<td>0.4204</td>
</tr>
<tr>
<td>DOM</td>
<td>0.4959</td>
<td>0.1442</td>
<td>0.3517</td>
</tr>
<tr>
<td>BRA</td>
<td>0.5066</td>
<td>0.0341</td>
<td>0.4724</td>
</tr>
<tr>
<td>ECU</td>
<td>0.5214</td>
<td>0.1780</td>
<td>0.3434</td>
</tr>
<tr>
<td>NIC</td>
<td>0.5362</td>
<td>0.1143</td>
<td>0.4219</td>
</tr>
<tr>
<td>VEN</td>
<td>0.5482</td>
<td>0.0130</td>
<td>0.5332</td>
</tr>
<tr>
<td>CRI</td>
<td>0.5609</td>
<td>0.1042</td>
<td>0.4627</td>
</tr>
<tr>
<td>CHL</td>
<td>0.5856</td>
<td>-0.0280</td>
<td>0.6135</td>
</tr>
<tr>
<td>PAN</td>
<td>0.6475</td>
<td>0.1691</td>
<td>0.4784</td>
</tr>
<tr>
<td>URY</td>
<td>0.7023</td>
<td>0.0939</td>
<td>0.6083</td>
</tr>
</tbody>
</table>

Table 2: Openness Summary Statistics

<table>
<thead>
<tr>
<th>Country</th>
<th>Openness in current prices</th>
<th>Openness in constant prices</th>
<th>WDI openness</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRA</td>
<td>19.7722</td>
<td>17.7108</td>
<td>10.9641</td>
</tr>
<tr>
<td>ARG</td>
<td>27.6697</td>
<td>38.5165</td>
<td>14.7945</td>
</tr>
<tr>
<td>COL</td>
<td>41.1626</td>
<td>38.9388</td>
<td>17.1117</td>
</tr>
<tr>
<td>URY</td>
<td>46.7904</td>
<td>51.0892</td>
<td>23.0613</td>
</tr>
<tr>
<td>BOL</td>
<td>50.4093</td>
<td>56.9931</td>
<td>22.2368</td>
</tr>
<tr>
<td>VEN</td>
<td>52.0957</td>
<td>56.0609</td>
<td>30.2624</td>
</tr>
<tr>
<td>MEX</td>
<td>54.5105</td>
<td>45.5420</td>
<td>25.6085</td>
</tr>
<tr>
<td>ECU</td>
<td>58.5978</td>
<td>57.1590</td>
<td>29.7221</td>
</tr>
<tr>
<td>CHL</td>
<td>60.8063</td>
<td>57.4109</td>
<td>32.1656</td>
</tr>
<tr>
<td>SLV</td>
<td>65.7787</td>
<td>61.9353</td>
<td>24.9221</td>
</tr>
<tr>
<td>NIC</td>
<td>67.4863</td>
<td>72.3360</td>
<td>23.7713</td>
</tr>
<tr>
<td>DOM</td>
<td>75.4143</td>
<td>66.4637</td>
<td>34.7240</td>
</tr>
<tr>
<td>CRI</td>
<td>86.6975</td>
<td>84.6449</td>
<td>41.7654</td>
</tr>
<tr>
<td>JAM</td>
<td>93.9686</td>
<td>94.2460</td>
<td>43.7863</td>
</tr>
<tr>
<td>BLZ</td>
<td>110.0891</td>
<td>104.3972</td>
<td>52.4585</td>
</tr>
<tr>
<td>HND</td>
<td>116.9658</td>
<td>122.2827</td>
<td>46.6754</td>
</tr>
<tr>
<td>PAN</td>
<td>143.5666</td>
<td>147.0366</td>
<td>73.9388</td>
</tr>
</tbody>
</table>

As expected, the island and coastal countries commit a larger fraction of their GDP to imports and exports than do predominantly continental countries. Surprisingly, in spite of our adherence to the Krugman and Livas (1996) theory, when we examine Table 2 in conjunction with Table 1, we find that Panama is both one of the most concentrated and
open countries in the sample. This may reflect, though, the country’s large percentage of uninhabitable terrain and its unique location on the Isthmus of Panama.

4.1 LSVD Results

Table 3 presents the LSDV estimates of $\beta$ in Equation 2 – the effect of openness on the spatial concentration of income. The LSDV estimates vary greatly depending on which measure of openness is used and to a lesser extent on whether year dummies are included. While openness, measured by the constant price ratio, generates no significant results, openness using current prices produces significant, negative estimates for $\beta$. The insignificance of constant-price openness can be attributed to the PWT 6.3’s definition of constant prices; in the PWT 6.3, “constant prices” and “real” are not synonymous. Openness in constant prices is the ratio of the sum of exports and imports to real GDP as calculated by the Laspeyres Index. Since we use current prices as a percentage of GDP, any cross-year difference in the price index is eliminated, giving us real prices.\(^5\)

To obtain the most accurate estimates, we altered the specification to that of a log-linear model and employed instrumental variables. Even though instrumenting openness appeared unnecessary since it is unlikely that concentration of income will independently generate changes in openness, the motivation behind running an IV regression was to ensure that no unobserved variable drove both openness and concentration of income. The log-log specification proved more robust than the log-linear model; hence, the log-log specification was carried throughout the subsequent regressions. Similarly, the IV specification generated no significant results, and the Durbin-Wu-Hausman test verified the superiority of the LSDV regression.\(^6\)

We also regressed openness separately on the regional disparity of GDP per capita and on the geographic concentration of the population to test the theories of interdependent and dependent urbanization, respectively.

\[
\begin{align*}
D \ln \text{regdisp}_{ct} &= D_c + D_t + b_{open} c_t + e_{2ct} \\
D \ln \text{conpop}_{ct} &= D_c + D_t + b_{open} c_t + e_{3ct}
\end{align*}
\]

No specification using the \text{regdisp} regressand and contemporaneous values of openness provided significant results. The concentration of the population, on the other hand, exhibits a negative relationship with openness. In fact, a one-percent increase in openness precipitates a 32-percent decrease in the population concentration of a country, which is significantly larger than the 20-percent decrease found in the aggregated AGC index regression. As is clear, the AGC results were driven predominantly by the concentration of population component.

---

\(^5\) To transform current into real prices, where $g_t$ is the GDP deflator for year $t$: $g_t(\text{imports + exports})/g_t(\text{GDP})$. $g_t$ would cancel out leaving us with our original value for current prices.

\(^6\) In the IV regression we assume that openness depends on market access. Developed country market access is reasonably exogenous to both openness and concentration of income in developing countries. Our IV model took the form: $D \ln open_{ct} = D_c + D_t + g_t + d_t \text{access}_t + e_{2ct}$. We proxied \text{access} with U.S. MFN tariffs.
Table 3: Summary of LSDV Regression Results of Openness on Income Concentration7
(Openness Measures as ln Trade/GDP)

<table>
<thead>
<tr>
<th>Income Concentration Measures</th>
<th>Current Price PWT (X+M)/GDP</th>
<th>Constant Price PWT (X+M)/GDP</th>
<th>Current Price WDI X/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With year dummies</td>
<td>Without year dummies</td>
<td>With year dummies</td>
</tr>
<tr>
<td>Δln AGC Index</td>
<td>-0.251*** (0.0809)</td>
<td>-0.202*** (0.0578)</td>
<td>0.055 (0.1048)</td>
</tr>
<tr>
<td>Δln Region Disparity</td>
<td>0.059 (0.3254)</td>
<td>-0.055 (0.2337)</td>
<td>0.284 (0.4119)</td>
</tr>
<tr>
<td>Δln Concentration of Population</td>
<td>-0.321*** (0.1136)</td>
<td>-0.321*** (0.0800)</td>
<td>0.090 (0.1462)</td>
</tr>
</tbody>
</table>

Even though we contest that the Herfindahl and Ellison-Glaeser Indices and Gini Coefficient are unsuitable for cross-country comparisons, we include these regressions for comparability with previous literature.

Table 4: Summary of LSDV Regression Results of Alternative Indices of Concentration8
(Openness Measures as ln Trade/GDP)

<table>
<thead>
<tr>
<th>Income Concentration Measures</th>
<th>Current Price PWT (X+M)/GDP</th>
<th>Constant Price PWT (X+M)/GDP</th>
<th>Current Price WDI X/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With year dummies</td>
<td>Without year dummies</td>
<td>With year dummies</td>
</tr>
<tr>
<td>Δln Herfindahl Index</td>
<td>-0.119*** (0.0424)</td>
<td>-0.097*** (0.0296)</td>
<td>0.048 (0.0545)</td>
</tr>
<tr>
<td>Δln Ellison-Glaeser Index</td>
<td>-0.522*** (0.1588)</td>
<td>-0.403*** (0.1132)</td>
<td>0.085 (0.2064)</td>
</tr>
<tr>
<td>Δln Gini Coefficient</td>
<td>-0.042 (0.0275)</td>
<td>-0.011 (0.0250)</td>
<td>-0.032 (0.0280)</td>
</tr>
</tbody>
</table>

As mentioned, the regdisp regressions do not appear robust. However, this could be due to a lagged relationship, or in other words, a delayed response by fixed capital to increases in openness. Thus, we lag openness up to eight periods on regdisp using the same log-log specification:

\[
D \ln \text{regdisp}_{ct} = D_c + D_t + b \text{openc}_{ct-g} + e_{4ct}
\]  

where g is the number of years lagged.

---

7 The table reports the coefficient on openness from the LSDV regressions. The concentration measure used in the regression is reported in the first column. The openness measure employed is indicated in the top row. Standard errors are reported in parentheses. ***, **, and * denote significance of at the 1, 5, and 10 percent levels, respectively. R^2 valued ranged between 0.6069 for the regional disparity regressions to 0.8704 for the concentration of population regressions.

8 The table reports the coefficient on openness from the LSDV regressions. The concentration measure used in the regression is reported in the first column. The openness measure employed is indicated in the top row. Standard errors are reported in parentheses. ***, **, and * denote significance of at the 1, 5, and 10 percent levels, respectively. The Gini regressions do not include Belize. R^2 valued ranged between 0.6686 for the Gini regressions to 0.9680 for Herfindahl regressions.
Table 5: Regression of Lagged Openness on Regional Disparity of GDP

<table>
<thead>
<tr>
<th>Income Concentration Measure</th>
<th>Openness Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current Price PWT (X+M)/GDP (-7)</td>
</tr>
<tr>
<td></td>
<td>With year dummies</td>
</tr>
<tr>
<td>In Region Disparity</td>
<td>-0.617**</td>
</tr>
<tr>
<td></td>
<td>(0.3072)</td>
</tr>
</tbody>
</table>

Table 5 presents the significant regression results. With a one-year lag, the results elicit that the change in openness last year has a negative and significant effect on the regional disparity of GDP. Surprisingly, however, the coefficient estimate becomes positive with a seven-year lag and, then, negative again after eight years.

Additional controls and different proxies were applied to the model, none of which contributed novel results. The included variables controlled for secondary market reforms, FDI inflows; stability of the urban-rural equilibrium, manufacturing wage premium; and population change due to factors other than migration, birth and death rates. A protection proxy was also substituted for openness but was insignificant. We changed the model specification to a GLS random effects model. However, the Hausman test was only robust for the AGC regressions, and we deemed ten-percent significance as an insufficient condition to favor random effects over fixed effects. Finally, a time trend was added but provided little insight.

4.2 Discussion

Almost all significant results, regardless of the measures of income concentration or openness, exhibit a negative relationship between the geographic concentration of income and openness. A one-percent increase in openness results in a about a 20-percent decrease in the geographic concentration of income in developing Latin American countries. These findings support the argument posited in Krugman and Livas (1996), which contended that urban primacy and industrial concentration will diminish as a result of trade liberalization.

Moreover, our results also support the findings of Henderson (2000). In his study of urbanization and economic growth, Henderson established that a one-standard deviation increase in openness decreased urban primacy of non-port cities by about 8 percent of a standard deviation of primacy, which is loosely in accordance with our estimates found in the conpop regressions; we conclude that a one-standard deviation increase in openness causes a 38-percent decrease in the concentration of the population. Even though the values of our estimates are significantly higher than those of Henderson, Puga (1996) provided reasons as to why Latin American migration patterns may be unique within the developing world context – mainly that Latin America will not experience the same inflow of urban migration to offset the drastic outflow. Puga argued that increasing concentration in cities after trade liberalization is contingent on a number of conditions, two of which are that the country has sufficiently low transport costs and an elastic supply of labor to the urban sector; few Latin American comply with these requisites.

Likewise, while openness has a contemporaneous effect on the concentration of.

---

9 Standard errors are reported in parentheses. ***, **, and * denote significance of at the 1, 5, and 10 percent levels, respectively. The Gini regressions do not include Belize. $R^2$ valued ranged between 0.81 and 0.92.
population, a number of reasons could explain its lagged relationship with the regional disparity in GDP per capita. First, the concentration of production, and hence regional GDP, may respond more slowly to adjustments in trade costs than does the population. This is a reasonable assumption since labor is naturally more mobile than fixed capital, and migrants, in turn, may not generate substantial incomes until a number of years after finding a permanent residence.

In fact, Kemper (1971) asserted that most Latin American domestic migration takes place within stages, and migrants often move in a somewhat random manner from their village or neighborhood to their ultimate destination. Hence, the migrant might spend years in transition from the poor rural settlement to the relatively rich urban area. Second, as mentioned in Puga (1996), urban-rural migration occurs to a greater degree in countries with ample unemployed rural labor. In such countries, labor can migrate from the countryside to cities without applying pressure on either urban or agricultural wages. If this were the case in Latin America, the persistence of relatively low urban wages would mute potential changes in regional income disparity.

4.3 Policy Implications

Theoretically, for a core-periphery orientation to be a stable equilibrium, the urban center must benefit from an inherent wage premium to offset the higher cost of living, otherwise, workers would move to the hinterland and firms would follow. Vast differences in wages, however, can have devastating effects on lagging regions. High concentration of industry, with limited growth and economic opportunities in the periphery and excessive urbanization in the core, is often a primary concern for policymakers (Deichmann, Lall, Redding, and Venables 2008).

However, policies to correct for regional inequalities have historically been a negative-sum game, where fiscal policies not only fail to influence business location decisions but also reduce tax revenue (Topalova 2007). The negative-sum game arises when the government institutes tax breaks for firms locating in peripheral regions. Yet, the fiscal incentives are rarely sufficient to alter the region’s economic base, resulting solely in a loss of tax revenue for the region. Accordingly, it is necessary to determine the types of incentives and public investments that influence firm location without compromising regional interests. What complicates policymaking is the inherent tradeoff between efficiency and equity in intervening in market-driven concentration processes. Nevertheless, some policy prescriptions have hastened greater income equality across regions: greater market access; enhanced infrastructure, especially ring roads that connect rural areas to each other; and a passive government role with consistent regional policies.

Our results have shown that trade liberalization, linked to passive market reforms in Latin America, has led to significant income dispersion across regions. While regional and individual income inequalities are not synonymous, mitigating the concentration of the former may have a positive impact on the latter. Therefore, we advocate passive liberalization, as opposed to active relocation policies, to assuage income inequality in the developing world.
5 Conclusion

Since the acceleration of multilateral trade agreements in the 1980s and 1990s, the hypothesized effect of openness on the concentration of production and population has been contentious. The debate has contrived two camps: Krugman and Livas (1996) in which trade liberalization garners dispersion of production and Paluzie (2001) which refutes the previous argument in favor of the contrary. The majority of studies that examine the effect of openness on individual developing countries have contributed support to Paluzie’s theory. Y, given the relative dearth of literature on multi-country analysis, we employed a model often used in growth economics to study the cross-country effects of trade liberalization on the geographic concentration of income.

We conclude that Krugman and Livas’s model, not that of Paluzie, provides an apt description of income concentration after liberalization in Latin America. However, given our regional focus and the consistency of secondary reforms – namely, privatization and monetary reform – across the observed countries, we are hesitant to generalize results to a wider breadth of countries.

A further understanding of the effect of openness on regional inequality could be gathered by repeating this study with a more global scope. However, because of the lack of data availability, we were inhibited from extending the study ourselves. We anticipate, though, that the persisting trends of globalization and trade liberalization will promote research, expand data, and, hence, shed greater light on the concentration of income in the developing world.

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AID, POLICIES, AND LONG-RUN GROWTH

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ABSTRACT

This paper analyzes the relationship between aid, policies, and growth over the long run. Specifically, it hypothesizes that if aid affects growth then it does so over a long period of time, i.e., past (as well as present) aid will have an impact on present growth. Furthermore, this paper investigates the logic that the extent to which this is true depends on an individual country’s policy environment. A dataset is compiled of 54 countries over 45 years with a variety of different specifications analyzed, including considering two definitions of "policy." The results of these models find no relationship between aid and growth. These results do find that good policies (mostly) have a considerable positive impact on growth but also that aid is no more effective in the presence of good policies than it is in the presence of poor policies. This paper therefore adds to the existing evidence showing that Burnside and Dollar’s (2000) result of aid effectiveness does not have external validity.

1 Introduction

For the first time in human history, the alleviation of global poverty and universal economic development is seen as an achievable and important goal (Millennium Development Goals). Aid (in all its many forms) is often cited as a crucial means to achieve this end (e.g., the UN’s long-standing target of 0.7% of rich countries’ GNP to be spent on aid). These aid disbursements continue to grow despite considerable academic ambiguity over the effectiveness of such transfers. Recently the logic that aid can have a considerable (and immediate) positive effect in the presence of developmental policies has received new life with the publishing of a paper by Burnside and Dollar (2000). My paper argues that the total effect of aid on growth can only be apparent in the long run, and this has implications for the analysis of the effect of aid in different policy environments.

This paper is going to broadly follow the logic of Burnside and Dollar in the assertion that aid may have a positive effect on growth in the presence of good policies. I will deviate from their paper by critiquing their definitions of aid and policy (but I acknowledge that my choices of variables are more symptomatic of ‘overall good governance’ than vitally important in their own right). More fundamentally, I note that macroeconomic studies of aid effectiveness have historically failed to consider the effect of aid over long periods of time (often due to data limitations), as it is necessary to fully identify the aid’s impact. Burnside
and Dollar (2000) argue that analysing the direct impact of a four year average of aid on the contemporaneous four year average of growth correctly identifies the effectiveness of aid. I dispute this and will analyse the data over a long period of time to account for the time taken to both invest the aid and for that investment to become productive.

2 Literature Review

Easterly (2006) estimates that, over the last fifty years, $2.3 trillion of aid has been disbursed and a considerable percentage of that over the last decade with the expressed intention of development. This has been recommended by leading economists (e.g., Sachs, 2005) who argue that aid can be crucial in enabling countries to break out from a "poverty trap". However critics of aid claim that there is little historical evidence of aid promoting growth, indeed, “the top quarter of aid recipients...received 17% of their GDP in aid over the last 42 years, yet also had near-zero per capita growth” (Easterly, 2007). These critics argue that those receiving aid have considerable incentives to renege on agreements and appropriate aid for private consumption with little threat of retribution (Bauer, 1976). Aid can even weaken a government’s developmental performance through reducing the incentives to adopt good policies and reform inefficient institutions (Heller and Gupta, 2002). Overall, “the debate about aid effectiveness is one where little is settled” (Rajan, 2005).

Given the critical stakes involved, much research has been undertaken into what makes aid more effective. It has long been theorised that ‘poor countries with sound economic policies benefit directly from the policies, and in this environment aid accelerates growth” (Burnside and Dollar, 2000). Burnside and Dollar (henceforth BD, 2000) authored a highly influential paper which aimed to empirically analyse the relationship between foreign aid, economic policies and growth of per capita GDP. They hypothesised that the extent to which aid would be effective depends on the extent to which it is invested. Because investment decisions and subsequent productivity are negatively affected by policy distortions, BD claimed that countries with ‘better’ policies would see more growth as a result of the aid. They robustly found that aid has had a "positive impact on growth in developing countries with good fiscal, monetary and trade policies but little effect in the presence of poor policies."

This paper has been seized upon by those involved in the aid industry as evidence that aid can be effective; indeed the paper has been cited by several development agencies as justification for selectively increasing aid flows (Easterly, 2003). However do the empirical results stand up to further scrutiny? Many economists have critiqued BD’s work, including Hansen and Tarp (2001), Dalgaard and Hansen (2001), Guillamont and Chauvet (2001), Collier and Dehn (2001), Lensink and White (2001), Collier and Dollar (2002) and Easterly et al (2004). These papers considered variants on the BD model with inconclusive results, some of these papers endorsed BD’s finding whilst others found contrary evidence, e.g. Easterly et al. (2004) who expanded the dataset to include more years and countries and saw the significance of the relationship disappear. Easterly (2003) makes the important
point that "choosing the appropriate specification often means there are more plausible right-hand side variables than there are data points in the sample." This has an implication for my work; rather than trying to exhaustively identify every relevant variable I should instead select those variables which are symptomatic of a broader concept (of commitment to development).

Although I re-evaluate the definitions of aid and policy, most fundamentally I argue that, if aid impacts growth, it will take time to do so. Aid given to build a road, or to buy textbooks for a school, or to equip a new hospital will not predominately have an immediate impact on growth. My model therefore allows for this by looking at the impact of past (and present) aid on present growth. A currently circulating IMF working paper (Minoiu and Reddy, 2009) addresses the impact of aid on growth over the long run, finding that development aid has a robust and strong impact on growth. Their work does briefly consider the interaction of policies over the long run (and finds no evidence that aid raises growth only in ‘good’ policy environments) but does not consider it in detail.

In conclusion, there is much academic ambiguity about the effectiveness of aid. Whilst it is commonly argued that the effectiveness of aid depends on a country’s policies there are no empirical specifications that seek to analyse the relationship between aid and policy and give particular attention to the time frame involved. It is this anomaly that my paper will seek to address.

3 The Model

I can investigate the long-run impact of aid on growth by estimating the following model:

$$g_{it} = g_t + \beta_y y_{it-1} + \beta_a a_{it-j} + \beta_p p'_{it} + \beta_{ap} a_{it-j} p'_{it} + \beta_z z'_{it} + \varepsilon_{it}^g$$  
$$a_{it} = a_t + \gamma_y y_{it-1} + \gamma_p p'_{it} + \gamma_x x'_{it} + \varepsilon_{it}^a$$  
$$p'_{it} = p_t + \theta_y y_{it-1} + \theta_p p'_{it-1} + \varepsilon_{it}^p$$

where i indexes countries, t indexes time, j indicates a time lag, $g_{it}$ is per capita real GDP growth, $y_{it}$ is the logarithm of real per capita GDP, $a_{it}$ is aid receipts relative to GDP, $p_{it}$ is a P x 1 vector of policies that affect growth, $z_{it}$ is a Z x 1 vector of other exogenous variables that might affect growth, $x_{it}$ is an X x 1 vector of other exogenous variables that might affect aid, $g_{it}$, $p_{it}$ and $a_{it}$ are fixed time effects, and $\varepsilon_{it}^{g}$, $\varepsilon_{it}^{a}$ and $\varepsilon_{it}^{p}$ are mean zero scalars.

I construct my model by using the existing literature to select variables that belong in the policy and exogenous vectors. Some of the variables that belong in the growth equation do not belong in the policy or aid equations while the same is true for some variables in the aid and policy equations (these zero restrictions allow me to achieve identification of the model). The equations are estimated using data from 1960 to 2004 averaged over nine five-year periods, from 1960-1964 through to 2000-2004.
3.1 What determines growth?

I use the literature to develop a model of growth that depends on a variety of political and institutional variables. The aim of this is to control for a range of factors in order to identify the true impact of aid on growth. Firstly, lagged real per capita GDP is included in this regression because of convergence growth theory (Solow, 1957).

The exogenous variables include a measure of institutional quality (Knack and Keefer, 1995), ethnolinguistic fractionalisation (Easterly and Levine, 1997), lagged (to eliminate potential endogeneity) M2 as a percentage of GDP (Levine, 1997) and dummy variables for sub-Saharan Africa and East Asia. These variables have all been suggested by the literature as suitable exogenous variables (assassinations as a measure of political unrest was also considered but data was not available over the full time period).

I now consider which variables should be considered for the policy vector. Carroll and Carroll (1997) examine the successful case of Botswana and emphasise that the incentives were correctly aligned; that is, the "politicians had personal commitment to economic development." As I am trying to proxy a government’s commitment to development I have been guided by the literature to choose political variables that are symptomatic of this. Whilst BD utilise the highly subjective Sachs-Warner variable to proxy openness, I am going to use the black market premium, which is an effective way of showing trade distortions (Rodrik and Rodríguez, 2000). Fischer (1993) argues that inflation (GDP deflator) is negatively associated with growth (this can be controlled by monetary policy). Alogoskoufis and Ploeg (1991) show that running persistent budget deficits can lead to reduced savings and lower growth, hence I also include the budget surplus/deficit (% GDP). The degree to which the population is educated is also cited in the literature as being important for growth (e.g. Jamison, Jamison and Hanushek, 2007) and, as such, the percentage of children in primary education is included as a proxy for the degree of education in the larger population.

In order to consider the long-run impact of aid on growth I include lagged aid in the equation (two lagged variables are included: aid lagged one period and the average of aid lagged two periods and aid lagged three periods) and so that I can see the long-run impact of aid in different policy environments. I include lagged aid interacted with current policy (in a similar fashion). BD defines aid as "Effective Development Assistance" which is solely the grant element of aid. An expanded definition is "Official Development Assistance" (ODA), which includes loans targeted for development. I believe ODA to be a more accurate representation of true aid because the recipients are very often considerably liquidity-constrained (Easterly, 2003) and the loans are highly subsidised.

3.2 What determines aid?

The determinants of aid are a well researched topic in economics literature. The overarching consensus is that donors give a large amount of aid strategically (Maizels and Nissanka, 1984). In order to account for this, I include dummy variables for sub-Saharan Africa (much European aid is directed here), the Franc zone (which receives a disproportionate amount of French aid), Egypt (a strategic American ally) and Central American countries (also a favoured recipient of American aid). It has also been found that
aid is given to countries with small populations (Neumayer, 2002) and to countries with low incomes (Frey and Schneider, 1986), so population and lagged GDP per capita are also included in the exogenous vector. It is also conceivable that some aid is allocated to countries with good policies (Burnside and Dollar, 2000) so my policy variables are also included in the model.

3.3 What determines policies?

I hypothesise that policies are durable; that is, the policies in one period depends on policies in the previous period(s). For example the theory of adaptive expectations implies that inflation in one period is highly dependent on inflation in the previous period (Carlson and Parkin, 1975).

4 Constructing a policy index

Earlier, I identified four policy variables that impact growth to various extents. My results from Regression One will be difficult to isolate clearly if I am comparing the impact of differing policy variables; for instance, what weightings should I attach to the various policies? Because I postulate that the effectiveness of aid on growth depends crucially on the policy environment, it makes sense to weigh these policies according to their own impact on growth. Furthermore the creation of an index allows me to clearly distinguish between those countries with "good" policies and those with "bad" policies, a feature that will prove useful when I come to interpreting the results. I considered the logic that different regions may differ in their optimal combination of policies to impact growth and introduced interactive variables between regions and policies to test this. However, none of the different regions (Sub-Saharan Africa, Middle East and North Africa, and Asia) have significantly different combinations of optimal policy (relative to the default region, the Americas) at the 5% level, so I conclude that there is a global combination of policies that are optimal for growth. I compute this index by estimating the following regression:

\[ g_{it} = g_t + \mu_y y_{it-1} + \mu_p p'_{it} + \mu_z z'_{it} + \epsilon_{it}^{gp} \]  

(4)

and fixing the values of the coefficients that determine the policy index (i.e., \( p_{it} = b_p p'_{it} \)) where \( b_p \) is the OLS estimate of \( \beta_p \) in equation two. Then I can estimate the following main regression instead (with a similar alteration to equations 2 and 3):

\[ g_{it} = g_t + \delta_y y_{it-1} + \delta_a a_{it-j} + \delta_p p_{it} + \delta_{ap} a_{it-j} p_{it} + \beta_z z'_{it} + \epsilon_{it}^g \]  

(5)

I am conscious that these new equations are restricted versions of the originals, and this may lead to misspecification when I remove outliers. For this reason, I will re-evaluate the policy index at that point. Furthermore, if the policy variables are endogenous in the growth equation, I will have bias in these estimates. My specification tests (reported in detail later in the paper) demonstrate that I can assume policies to be exogenous in this instance.

I now summarize the main equations that I will estimate (with some variations) in Table
One. LHS indicates that the variable is dependent whereas RHS indicates the variable is independent. There are unique variables in each regression that can be used as instruments in (a hypothetical) 2SLS estimation. The assumption that some variables do not belong in all of the equations (which has been justified by the existing literature) allows me to achieve identification of the model. In practice the 2SLS estimator is overidentified.

| Table One |
|-----------|---|---|---|
|           | (1) | (2) | (3) |
| Growth    | LHS |     |     |
| Aid       | RHS | RHS | LHS |
| Policy index | RHS | RHS | RHS |
| Per capita income (Lag1) | RHS | RHS | RHS |
| Institutional quality | RHS | RHS | RHS |
| Ethnic fractionalisation | RHS | RHS | RHS |
| M2/GDP (Lag1) | RHS | RHS | RHS |
| Population (log) | RHS |     |     |
| Sub-Saharan Africa dummy | RHS | RHS | RHS |
| East Asia dummy | RHS |     |     |
| Egypt dummy | RHS |     |     |
| Franc zone dummy | RHS |     |     |
| Central America dummy | RHS |     |     |
| Aid (Lag1) | RHS |     |     |
| Aid [½(Lag2 + Lag3)] | RHS |     |     |
| Aid*Policy | RHS |     |     |
| Aid (Lag1)*Policy | RHS |     |     |
| Aid [½(Lag2+Lag3)]*Policy | RHS |     |     |
| Education (Lag1) | RHS |     |     |
| Black market premium (Lag1) | RHS |     |     |
| Budget surplus (Lag1) | RHS |     |     |
| Inflation (Lag1) | RHS |     |     |

5 Econometric Estimation

I am initially going to estimate this model using Ordinary Least Squares. I believe this is justified unless I can demonstrate that some of the assumptions underpinning OLS do not hold. Because my dataset is unbalanced it is prudent to use heteroscedasticity-consistent standard errors as suggested by White (1980) throughout. My Breusch-Godfrey tests for serial correlation reveal none in any of the regressions except the aid equation (so for these estimates I use the heteroscedasticity and auto-correlation-consistent standard errors as demonstrated by Newey and West (1987)). Computing Dickey-Fuller tests reveal no evidence of a unit root in any of the key variables. The major potential problem with OLS in this instance is endogeneity caused by simultaneity bias.

5.1 Endogeneity

Endogeneity could occur in this instance due to growth and policy or growth and aid being codetermined. I first consider potential endogeneity between policies and growth, that
is whether the error terms $\varepsilon_{gp}$ and $\varepsilon_{p}$ are correlated. I now need to decide whether estimation of these equations by OLS would result in bias (i.e., whether the use of instruments is necessary). Computing a Durbin-Wu-Hausman test reveals that the policy index can be assumed to be orthogonal at the 5% level to the error term in the growth equation, and I will therefore consider policy as exogenous in the growth equation.

The other potential source of endogeneity in my model is that between aid and growth, i.e., whether the error terms $\varepsilon_{g}$ and $\varepsilon_{a}$ are correlated. Computing the Durbin-Wu-Hausman test reveals that I can also consider aid as exogenous in the growth equation. This may be a surprising result, but it is not unique to my data (e.g., Hansen and Tarp, 2001) and inspection of the estimates generated by 2SLS reveals that they indeed do not deviate substantially from OLS.

5.2 Different specifications

Assuming that I have correctly specified my model, my OLS results (adjusted for heteroscedasticity and serial correlation where appropriate) should be consistent. I will initially consider a long-run relationship between growth and aid. Following this, I will then consider whether aid is more effective in different policy environments (over the long-run) by including aid*policy variables. Finally, I will investigate the removal of outliers, and this will highlight a possible need to change my definition of policy.

6 Data

Many previous analyses of the impact of aid on growth have been characterised by a lack of data over long periods of time and have therefore been unable to analyse long-run effects. I have attempted to get information for all countries that have received aid since 1960. I have been able to use a World Bank dataset to provide the majority of my data with information from 1960-2004 on GDP (both levels and growth rates), official development assistance, M2/GDP, budget surplus/deficit (which was supplemented by IMF data), primary education rates, population, and inflation. I have utilised data from Levine on the black market premium and ethnic fractionalization whilst institutional quality is measured in PRS Group’s IRIS III dataset, as described in Knack and Keefer (1995). The dataset is unbalanced and countries have been removed for which truly insufficient data (classified as data being available for fewer than three time periods) is available; in total there are 54 countries. The policy index can only be computed from 1970 onwards, which is satisfactory because the need to lag other variables means that policy variables before 1970 would not be included in the regression.

Furthermore, the countries for which I am missing data are not selected at random; it is almost certain that the reasons why I am missing this data are correlated with variables in my model. Finally I do not include countries such as Japan and Korea (due to a lack of data pre-1960), which have "graduated" from aid, as this is likely to negatively bias my effect of aid on growth. From a pragmatic perspective, there is little I can do about these issues except acknowledge that my results cannot be assumed to have external validity.
Logarithms were taken of population, inflation, black market premium, and GDP levels both in order to reduce the impact of outliers and because the theory suggests that a log-linear relationship is most appropriate in these cases (diminishing returns). Certain variables were assumed not to change over time, e.g., ethnic fractionalization and quality of education.

### Table Two

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Mean</th>
<th>Median</th>
<th>S.D.</th>
<th>Min</th>
<th>Max</th>
</tr>
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<tbody>
<tr>
<td>GDP Growth (%)</td>
<td>1.56</td>
<td>1.58</td>
<td>3.40</td>
<td>-11.84</td>
<td>32.01</td>
</tr>
<tr>
<td>Net Aid (% of GDP)</td>
<td>5.85</td>
<td>2.85</td>
<td>6.96</td>
<td>-0.02</td>
<td>35.99</td>
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<tr>
<td>Budget surplus (% of GDP)</td>
<td>-3.08</td>
<td>-2.27</td>
<td>3.79</td>
<td>-22.20</td>
<td>8.00</td>
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<tr>
<td>Black market premium (%)</td>
<td>55.08</td>
<td>11.27</td>
<td>215.12</td>
<td>-2.68</td>
<td>2792.36</td>
</tr>
<tr>
<td>Inflation (%)</td>
<td>15.10</td>
<td>8.01</td>
<td>29.17</td>
<td>-92.74</td>
<td>321.37</td>
</tr>
<tr>
<td>Education (% in primary education)</td>
<td>86.64</td>
<td>95.26</td>
<td>28.87</td>
<td>2.66</td>
<td>167.58</td>
</tr>
</tbody>
</table>

### Table Three

(A)

<table>
<thead>
<tr>
<th></th>
<th>Estimation Method: OLS</th>
<th>Number of Observations: 173</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R²: 0.45</td>
<td></td>
</tr>
<tr>
<td>Dependent Variable: GDP p.c. growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial GDP</td>
<td>-0.41</td>
<td>(0.35)</td>
</tr>
<tr>
<td>Ethnic fractionalization</td>
<td>-1.03</td>
<td>(0.99)</td>
</tr>
<tr>
<td>Institutional Quality</td>
<td>0.24</td>
<td>(0.15)</td>
</tr>
<tr>
<td>M2/GDP (lagged)</td>
<td>-0.001</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>-1.15</td>
<td>(0.80)</td>
</tr>
<tr>
<td>East Asia</td>
<td>0.83</td>
<td>(1.01)</td>
</tr>
<tr>
<td><strong>Budget Surplus</strong></td>
<td><strong>0.09</strong></td>
<td>(<strong>0.05</strong>)</td>
</tr>
<tr>
<td>Inflation</td>
<td><strong>-4.13</strong></td>
<td>(<strong>1.27</strong>)</td>
</tr>
<tr>
<td>Black Market Premium</td>
<td><strong>-0.28</strong></td>
<td>(<strong>0.14</strong>)</td>
</tr>
<tr>
<td>Education</td>
<td><strong>0.02</strong></td>
<td>(<strong>0.01</strong>)</td>
</tr>
</tbody>
</table>

* Significant at 10% level ** Significant at 5% level
institutions (information on these variables is not widely available over time, so I justified
these assumptions on the logic that institutions and ethnic fractionalization change slowly
over time). Averages over five-year periods (1960-1964, 1965-1969, etc.) were taken
to remove business cycle fluctuations from the analysis (i.e., only medium to long term
impacts should be observed).

Summary statistics for my dataset are available in Table Two. It is important to note
that aid is a net value (negative values are possible when the aid is being repaid) and the
education variable is calculated by looking at the number of students in primary education
and dividing it by the number of children of primary education "age" (i.e., figures of
over 100% are possible). Inflation, black market premium, and GDP per capita all have
considerable outliers, and this is one of the reasons why logarithms were taken.

7 Results

7.1 Constructing a policy index

In Table Three, I show the results of regression (4) in order to compute a policy index.
All of the exogenous variables have the expected sign and moderate explanatory power.
All of these variables will be retained throughout the analysis (irrelevant of significance in
individual regressions) in order to have a directly comparable base specification. Turning
to the policy variables, I can see that, as anticipated, an increase in the budget surplus, a
fall in inflation, a reduction in the black market premium, and an increase in education
all, ceteris paribus, lead to increased growth. The most significant determinants of growth
are the black market premium and inflation. Although the budget surplus and education
variables are not significant at the 5% level in this model, I have reason to believe that there
is considerable multicollinearity between these variables and the others in the regression
(indeed when I remove inflation from the regression, these variables becomes significant).
As the theoretical literature suggests these variables belong in this regression and the four
variables are jointly significant at the 5% significant level, I will include all four variables
in my policy index.

The policy index is computed using the regression coefficients:

\[
Policy = 3.65 - 0.28 \times \text{Log of black market premium} - 4.13 \times \text{Log inflation} \\
+ 0.09 \times \text{Budget Surplus} + 0.02 \times \text{Education Rate}
\]

The constant 3.65 was found by predicting the growth rate using the mean value of all
the other variables in the regression. In this way the policy index can be thought of as the
predicted growth rates of the country for that time period (assuming mean values of all
other variables).

7.2 Main Regression

The next stage is to look at the direct impact of aid on growth in regression (1). Because
lagged values of aid will display multicollinearity, it is important to do a joint test of
significance, and the aid variables are significant at the 5% level. From these results (B)
I can analyze the overall impact on growth of a permanent increase in aid. This will be $\delta_{a1}$ in the first period, $\delta_{a1} + \delta_{a2}$ in the second period, and $\delta_{a1} + \delta_{a2} + \delta_{a3}$ from the fourth period onwards. Taking partial derivatives of GDP growth with respect to aid over the long-run reveals:

$$\frac{\Delta \delta}{\Delta a} = \delta_{a1} + \delta_{a2} + \delta_{a3} = -0.11$$

So a sustained one percentage point increase in aid/GDP will, ceteris paribus, lead to a sustained fall in the growth rate of 0.11%. As discussed in the literature review, there are several reasons why aid may have a negative effect on growth, primarily due to reducing the accountability of the government to the electorate. However, this result is not significantly different from zero at the 5% significance level.

<table>
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<tr>
<th>Table Four</th>
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<tr>
<td></td>
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<tr>
<td>Dependent Variable: GDP</td>
</tr>
<tr>
<td>p.c. growth</td>
</tr>
<tr>
<td>Initial GDP</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Ethnic Fractionalization</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Institutions</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>East Asia</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Money (lagged)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Policy</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Aid</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Aid (lagged one period)</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Aid (lagged two/three periods)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Aid*Policy</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Aid (lagged one period)*Policy</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Aid (lagged two/three periods)*Policy</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Prob &gt; F (on results in bold)</td>
</tr>
</tbody>
</table>

* Significant at 10% level ** Significant at 5% level
The focus of this paper is on the impact of aid on growth in the presence of different policy environments, and the second result (C) shows me what happens when I have a permanent increase in aid in different policy environments. Because of multicollinearity between all the aid variables, it is necessary to do a significance check, and I can see that I am justified in including these variables at the 5% level.

Intuitively, this result makes sense: aid has a sharply negative impact on growth in a policy environment of zero (a relatively bad policy environment), whilst it can be seen that for countries with a particularly good policy environment, the impact of aid on growth can be positive. However neither the impact of aid on growth nor the impact of aid*policy on growth is statistically different from zero at the 5% significance level.

### 7.3 Different specifications

I am now going to investigate whether my results change when I remove outliers from my dataset and re-estimate the relationship. I use the Hadi test to identify and remove outliers. I feel comfortable removing outliers as, although these outliers are genuine results, they will not be representative of a "typical" relationship between aid, policies, and growth. I can justify this by observing that these outliers are all caused by unique cases, for instance, Bolivia, DRC, and Nicaragua all experienced hyperinflation, whilst Rwanda’s increase in aid followed genocide, and Oman’s extraordinary growth was caused by a short-run exploitation of oil reserves. Removing these outliers results in an interesting change to the significance of the policy variables. It transpires that the significance of the inflation variable (which was highly significant) and the education variable depends entirely on the outliers. As a robustness check I will therefore look at two scenarios; one where I consider all the policy variables (plausibly justified given the degree of multicollinearity between the variables) and one where I drop the inflation and education variables from the policy index.

### 7.4 Summary of results

I can summarize these results by looking at the long-run impact of aid (and aid*policy) in the six econometric specifications that I have outlined (see Table Five).

<table>
<thead>
<tr>
<th>Full dataset (original policy)</th>
<th>Outliers removed (original policy)</th>
<th>Outliers removed (different policy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(B) Table Four</td>
<td>(C) Table Four</td>
<td>(D) Table Twelve</td>
</tr>
<tr>
<td>Aid (F-value)</td>
<td>-0.11* (3.62)</td>
<td>-0.27 (1.14)</td>
</tr>
<tr>
<td>Aid*Policy (F-value)</td>
<td>-</td>
<td>0.04 (0.39)</td>
</tr>
</tbody>
</table>

* Significant at 10% level ** Significant at 5% level

The most interesting result here is that the impact of aid on growth is not dependent on the level of policy. The partial scatter graph, Diagram One from regression (C), plots the unexplained portion of aid*policy (unexplained by other right-hand side variables) against the unexplained portion of growth. A data point where growth controlling for other factors...
is high and aid*policy (also controlling for other factors) is high implies that aid is more effective in a good policy environment. However, there is no clear relationship between these residuals and, therefore, I cannot conclude that the impact of aid on growth is a function of the level of policy.

Looking at the pure aid-growth relationship, initially (regressions D and F) aid appears to have a negative effect on growth but this loses most of its significance once the additional aid-policy variables are added (regressions E and G). As a result, I cannot robustly conclude anything about the nature of the aid-growth relationship, which is in line with much of the empirical literature.

8 Extensions

Extensions to this paper would certainly touch on the impact of differing types of aid, for instance, looking at the differences between bilateral and multilateral aid, the latter of which is more often intended for developmental purposes. Minoiu and Reddy (2009) find that multilateral aid positively affects growth over the long run; it would be pertinent to fully explore the impact of different policy environments in this context. Secondly I would recommend developing a dataset with a sufficient quantity of data to allow lagging of the policy variable as it would be interesting to look at the impact of aid conditional on the policies in which the aid was given (as opposed to the current policy environment which was a necessary limitation of my dataset). Finally, further work would also focus on
looking in more detail at cross-country differences (e.g., what exactly is it about Botswana that enables aid to be effective in this instance?) in order to further understand and apply the lessons from aid disbursement over the last 45 years to ensure that aid is more successful at promoting growth over the next 45 years.

9 Conclusion

In this paper, I have considered two aspects of the aid debate: whether aid affects growth over the long run and whether aid is more effective in the presence of good policies. This paper adds to the growing literature that finds that Burnside and Dollar’s (2000) result is not robust to a change in specification, as I can find no evidence that aid is more effective in the presence of good policies. Overall, I cannot conclude whether aid’s effect on growth is positive or negative (or, indeed, whether there is an effect at all). This does not mean that I recommend an immediate cessation of aid but rather emphasize its current ineffectiveness in the majority of cases.

References


FDI AND THE DUTCH DISEASE

Katherine Donato
Georgetown University

ABSTRACT

Foreign Direct Investment is promoted as a tool for development because it brings capital inflows and intangible spillovers to recipient countries. This paper examines whether FDI, like other foreign capital inflows, leads to Dutch Disease effects, namely an exchange rate appreciation that reduces the competitiveness of the recipient country’s export industries. Using OLS regression with country fixed effects, we find that FDI does in fact lead to an exchange rate overvaluation, though the magnitude of this appreciation is significantly lower than that of other forms of capital inflows, including remittances and foreign aid. In order to maintain exporters’ competitiveness on the international market, recipient countries’ governments should take measures to maintain domestic non-tradable goods’ prices to prevent exchange rate misalignment following foreign capital inflows.

1 Introduction

FDI is often cited as a strong tool for development because of the direct and indirect benefits it brings to recipient countries. Most obviously, it provides a capital infusion to countries that are often capital deficient. The spillovers that come with FDI are perhaps just as important. In the process of receiving FDI, developing countries are exposed to advanced technology and processes, including the intangibles like managerial and marketing techniques. Foreign investment also often integrates domestic firms into global supply chains, further exposing these countries to valuable opportunities and forcing them to become competitive on the international level. Finally, FDI often increases employment opportunities in relatively high-paying jobs compared to other opportunities available within the host country.¹ As a result of these many numerous industry- and firm-wide advantages, many countries have invested considerable resources to attract these capital inflows.

In this paper, we test the hypothesis that while FDI does possess these strong attributes, it also leads to an adverse currency appreciation in recipient countries, as predicted by the Dutch Disease.² Given the reduction in FDI that has resulted from the recent financial

² The term “Dutch Disease” was coined when, after the discovery of natural gas in the Netherlands in the 1950s, the country experienced a decline in growth and international competitiveness
crisis, it is particularly relevant to consider how changes in levels of FDI inflows can affect recipient countries.

The basic theoretical framework leading to this deindustrialization is as follows: after domestic firms receive the influx of capital through foreign investment, household income is expected to increase through higher levels of better employment. As a result of this increase in income, domestic residents raise their consumption of both traded and non-traded goods. The increased demand for goods and services, as expected, leads to an increase in the price of non-tradable goods—the so called spending effect. Those firms producing traded goods, however, cannot raise the price of their product. The typical export-oriented firm in a developing nation is a price-taker and thus cannot increase its prices as domestic demand increases. It is in this way that the relative price of non-tradable to tradable goods increases, a real exchange rate appreciation. This exchange rate appreciation reduces the competitiveness of the export-oriented firms as it causes the relative price of their product on the international market to increase.

As the economy adjusts, the higher price of non-tradable goods leads to an expansion of the non-tradable sector; labor is pulled out of the tradable sector to meet the growing demand. This resource movement effect increases the cost of labor for the tradable sector, further reducing its competitiveness. Finally, with the decline in labor employed in the tradable sector, tradable output falls. The tradable sector is therefore doubly harmed by the FDI inflows, through both an exchange rate appreciation and a more expensive labor supply. Since most foreign investment is in capital-intensive industries, however, the exchange rate appreciation is the largest concern.

The notion that an overvalued exchange rate impedes developing countries’ growth has been fairly well established in the literature. Rodrik (2008) provides evidence both that a currency undervaluation is beneficial to growth and that a currency overvaluation is harmful for growth. He suggests that the mechanism for this process is, indeed, the tradable sector, as is predicted in this model. He also finds that, in developing countries, reducing the level of overvaluation is just as effective as undervaluation in promoting growth. Dollar (1992) also finds that maintaining proper alignment is beneficial to growth, as any misalignment of the exchange rate, over- or undervaluation, is unsustainable and that maintaining proper alignment is beneficial to growth.

Since the Dutch Disease effects are part of an economy’s natural adjustment process, it could be argued that they should not be managed at the governmental level. This is problematic, however, because manufacturing is a “learning by doing” industry. Moreover, export-oriented industries experience faster technological growth than their protected non-traded counterparts. The majority of export-oriented firms in developing countries are in the manufacturing industry and are the main drivers of growth in their countries because they face a more competitive market. Countries that choose to abandon their because its exchange rate significantly appreciated. Its manufacturing sector declined immensely, leading many to declare the resource discovery a “disease.” The term “Dutch Disease” now refers to any case in which a country receives a large influx of foreign currency and the subsequent deindustrialization that often ensues.

3 Van Wijnbergen (1984)
manufacturing industry while enjoying the good fortune that has attracted huge inflows of capital relative to GDP, often find that after whatever is generating the capital inflows subsides, the manufacturing sector has deteriorated immensely and can no longer be relied upon as a driver of growth. Moreover, as has been pointed out on numerous occasions, virtually all countries experiencing strong growth in the post-war period have relied on their manufacturing base at some point.\textsuperscript{4} It could be particularly tempting for FDI recipient countries’ governments to ignore these potential effects because FDI is normally directed toward manufacturing and will therefore inherently boost the manufacturing sector. Ignoring potential Dutch Disease effects could, however, dampen the benefits FDI brings to recipient countries and subsequently slow their rate of development.

The concern about influxes of FDI generating Dutch Disease effects, namely a sustained real exchange rate overvaluation, is valid. From the initial argument posed in the context of natural resource discovery in the 1980s\textsuperscript{5}, to the more recent focus on remittances’ and bilateral aid’s potential Dutch Disease effects\textsuperscript{6}, it is clear that many developing countries struggle to absorb large inflows of foreign exchange, even when the capital inflows are altruistically motivated. Just as in van Wijnbergen’s (1984) analysis of Dutch Disease effects following the discovery of oil, FDI inflows are not altruistically motivated. Given developing countries’ demonstrated weakness in absorbing large inflows of foreign capital, it is also appropriate to analyze whether self-motivated FDI inflows lead to an adverse exchange rate overvaluation.\textsuperscript{7}

This paper looks at how FDI and host country exchange rates interact. The graphs in Figure 1 suggest that these Dutch Disease effects may indeed be present in the context of FDI. They show FDI as a percent of GDP and the log of the real effective exchange rate (REER)\textsuperscript{8} for Bolivia and Colombia, two of the countries we will use in this empirical study. The level of FDI and the real exchange rate follow quite closely, indicating that FDI inflows and currency appreciations often move together.

In this paper we will further explore the hypothesis that FDI is indeed a causal mechanism for REER movements. The remainder of the paper is organized as follows: Section 2 develops the theoretical model that is used as the basis for this analysis, Section 3 describes the data sources and empirical strategy that are employed to test the model, Section 4 describes the empirical results, Section 5 checks for robustness of the results, and Section 6 presents some limitations and conclusions of the analysis. It is ultimately determined that FDI inflows do induce a currency appreciation, though the magnitude of the appreciation is smaller than that associated with other foreign capital inflows.

\textsuperscript{4} For examples of this, see Jones & Olken (2005) and Johnson, Ostry, and Subramian (2006)

\textsuperscript{5} See Sweder van Wijnbergen (1984)

\textsuperscript{6} See Amuedo-Dorantes & Pozo (2004), Lopez, Molina, and Bussolo (2007), and Acosta, et al. (2007), Rajan & Subramanian (2009), among others.

\textsuperscript{7} Lartey (2008) develops a theoretical model that predicts that FDI causes the exchange rate to appreciate in the host country, but to the author’s knowledge, this is the first empirical study considering FDI and its potential Dutch Disease effects.

\textsuperscript{8} The real effective exchange rate is defined as the relative price of non-tradable to tradable goods, such that an increase corresponds to an appreciation.
2 Theoretical Model

In this section, we describe the theoretical model that explains the mechanisms by which FDI inflows are expected to lead to exchange rate appreciation.\footnote{This is based off of Corden and Neary’s (1982) model developed to describe how a technology boom in the energy sector works through an economy.}

2.1 Initial Equilibrium

Figure 2a shows the economy’s labor market. The economy’s entire labor supply is shown on the horizontal axis, with the distance from $0_N$ representing the labor employed in the non-tradable sector and the distance from $0_T$ representing the labor employed in the tradable sector. $L_N$ denotes the initial labor demand schedule for the non-tradable good sector and $L_D$ denotes the initial labor demand schedule for the portion of the tradable good sector that does not receive FDI. The economy’s entire labor demand schedule in the tradable sector is derived by laterally adding the labor demanded by those firms in the tradable sector who receive FDI to get $L_T$. Before the foreign investment, the economy is in equilibrium at point $A$, with wage $w_0$. Since the demand for labor in the non-traded sector is endogenously determined based on the relative price of non-traded goods (as opposed to the labor demand schedule for the traded sector where prices are assumed to be determined exogenously), Figure 2b must also be included in this analysis.

Figure 2b shows the production possibilities frontier (PPF) for the economy, with traded goods on the vertical axis and non-traded goods on the horizontal axis. Traded goods are aggregated (both those who are recipients of FDI and those who are not) because we are ultimately concerned with changes to the real exchange rate, or the relative price of non-traded to traded goods. The initial PPF is $TN$ and the equilibrium, composing the economy’s aggregate preferences with its production capabilities, is at $a$. The pre-FDI real exchange rate is then the slope of the line tangent to the production frontier at $a$, equal to the price of non-traded goods in terms of traded goods.

The following sections show the effects of foreign investment on the economy, first by breaking the outcome into the resource movement and spending effects.
2.2 Resource Movement Effect

In order to see the resource movement effect independently, we first assume that the real exchange rate remains constant. After foreign investment, recipient firms’ labor demand increases. This is shown in Figure 2a as an upward shift of the labor demand schedule for the tradable sector to from $L_T^1$ to $L_T'^1$. This new equilibrium at B has a higher wage rate $w_1$, and depicts a fall in the labor supply for firms in the tradable sector who do not receive FDI from $0_D$ to $0_D'$.

![Figure 2](image)

In Figure 2b, the FDI inflows are reflected as an outward shift of the production possibilities frontier. The economy’s production capacity of non-traded goods is unchanged, but the frontier shifts outward, biased toward the tradable sector, from $TN$ to $T'N$. Maintaining the constant real exchange rate, we see that the resource movement effect results in a movement from $a$ to $b$ such that non-tradable output falls and tradable output rises.

We now allow the exchange rate to adjust. Since we are dealing with the resource movement effect alone, we will assume that the elasticity of demand for non-traded goods is zero, or, in other words, that the demand for non-traded goods appears as a vertical line through $a$. This means that at the initial exchange rate, there is an excess demand for services and that the real exchange rate must appreciate.

2.3 Spending Effect

In order to see the spending effect apart from the resource movement effect, we now assume that the FDI recipients use no labor. This means that the FDI inflows cause no initial change in Figure 2a. The production frontier in 2b shifts out to $T'N$ as before.

At the initial real exchange rate, there is now excess demand for non-tradable goods. This means the exchange rate must appreciate in order to move from $b$ to equilibrium. Since non-tradable goods are assumed to be normal, this equilibrium will occur where non-tradable production has increased (to the right of $a$). Therefore, considering the spending effect alone, non-tradable production increases.

10 This is because the resource movement effect deals with the effects of labor movements.
2.4 Final Equilibrium

We see then that the resource movement and spending effects both result in a real exchange rate appreciation, and the final equilibrium combining both effects at \( g \) has a higher relative price of non-tradables. It is unclear, however, which way non-tradable production moves since the resource movement and spending effects predict it to move in opposite directions.

We can, however, clearly see the effects on the portion of the tradable sector not receiving FDI in Figure 2a. The higher non-tradable price (shown in Figure 2b) leads to an upward shift of the non-tradable labor demand schedule \( L^F_N \) to \( L^F_N' \), which raises the equilibrium to \( C \) with wage to \( w_2 \). This leads to a further reduction in labor supplied to the portion of the tradable sector not receiving FDI from \( OD' \) to \( OD'' \). In this way, this portion of the tradable sector’s output declines.\(^{11}\)

3 Data Sources and Empirical Strategy

The fourteen countries used in this analysis come from Asia and Latin America\(^ {12}\), the two regions of the world that have seen the greatest increase in FDI inflows over the past two decades. The data spans from 1990 to 2007, covering a relatively long period of time in which FDI has become profitable and attractive in a diverse group of countries.

Working off the empirical models developed by Amuedo-Dorantes & Pozo (2007) and Lopez, et al. (2004) who that determine the Dutch Disease effects associated with remittances, the following general model is developed:

\[
q_{it} = \beta FDI_{it} + \alpha x_{it} + v_i + \varepsilon_{it}
\]

where \( q_{it} \) is the exchange rate and \( FDI_{it} \) is the amount of FDI compared to the size of the economy for country \( i \) in time \( t \). \( x_{it} \) is a vector of controls of other factors predicted to influence the exchange rate, \( v_i \) is a vector of country dummies in order to account for any heterogeneity across countries but consistent over time, and \( \varepsilon_{it} \) is the error term.

The REER is defined as the relative price of domestic goods to foreign goods or non-tradable to tradable goods. As such, an increase in the REER indicates an exchange rate appreciation. The REER data published in the World Development Indicators is used.

We will first consider the case where the dependent variable is the log of the REER. FDI comes from the World Development Indicators and is measured as a percentage of GDP, so \( \beta \), the variable of interest, is interpreted as follows: \( 100* \beta \) is the percent change in the REER given a one percentage point increase in the level of FDI. We will then consider the case where

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\(^{11}\) It is worth noting, however, that this does not imply that the tradable sector as a whole declines. As discussed earlier, the harmful exchange rate effects associated with FDI may simply reduce FDI’s otherwise positive impact on the host country’s development.

\(^{12}\) The full sample of countries is: Belize, Bolivia, Chile, China, Colombia, Costa Rica, Ecuador, Japan, Malaysia, Nicaragua, Paraguay, Philippines, Singapore, and Venezuela. Other countries in Asia and Latin America were restricted because of extreme data restrictions.
the dependent variable is the deviation from trend of the log of the REER, as determined using an HP-filter. In this case, $\beta$ is similarly interpreted. A one percentage point increase in the level of FDI leads to a $100\% \beta\%$ increase in the over/undervaluation of the REER. This second round of regressions allows us to be more precise in determining whether changes in the exchange rate were due to long-run trends or actual over/undervaluation of the currency.

Besides the level of FDI, we expect several other factors to play a role in determining a country’s exchange rate. First, as discussed above, both remittances and foreign aid have been shown to be associated with Dutch Disease effects, so both will be included as regressors. Besides these two factors, we will use the standard determinants of exchange rates that have been established in the literature as controls, including the terms of trade, level of government expenditure, world interest rate, and GDP per capita.\(^{13}\) The terms of trade, defined as the country’s relative cost of exports to imports is expected to be positively associated with the exchange rate (where an upward movement corresponds to an appreciation). When the relative price of exports to imports increases, resources are pulled toward the export sector, and a real exchange rate appreciation occurs.\(^{14}\) Government expenditures have the potential to influence the real exchange rate, though the direction is theoretically uncertain unless the composition of government spending is known. For example, if the government’s purchases are biased toward domestic goods, fiscal spending will add to the spending effect and lead to a currency appreciation. The world interest rate acts as a proxy for external financial conditions, but its effect is theoretically unclear. A higher external interest rate may induce people to lend outside the country, improving the country’s credit position and ultimately resulting in a currency appreciation. However, the higher interest rate may also hold down domestic spending in the short run, reducing the spending effect and dampening a currency appreciation.\(^{15}\) Finally, GDP per capita is used as a proxy for productivity gains. As predicted by the Balassa-Samuelson theorem, richer countries are likely to have more appreciated currencies because their tradable sectors tend to be more productive because of technological advances. The greater productivity raises wages in the export sector, which also increases the price of non-tradable goods.\(^{16}\) Data sources for these control variables are available upon request.

### 4 Empirical Results

Table 1 shows the results of the first expression where the log of the REER is the dependent variable. Column I shows the results when only FDI as a percent of GDP, remittances received as a percent of GDP, and the log of aid are used as regressors. Based on this regression, only remittances and aid have a significant effect on the exchange rate and both are positive.

\(^{13}\) see Edwards & Savastano (1999), Froot & Rogoff (1995), and Montiel (1999), among others.

\(^{14}\) Amuedo-Dorantes & Pozo (2004)

\(^{15}\) Amuedo-Dorantes & Pozo (2004)

\(^{16}\) Amuedo-Dorantes & Pozo (2004)
Table 1.

Regression (Dependent Variable is the natural log of the REER)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDI % of GDP</td>
<td>0.008</td>
<td>0.010*</td>
<td>0.012**</td>
<td>0.002</td>
<td></td>
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<tr>
<td></td>
<td>(0.06)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.005)</td>
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<tr>
<td>Remittance % of GDP</td>
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<td>0.030**</td>
<td>0.032**</td>
<td>0.053**</td>
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<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.005)</td>
<td>(0.014)</td>
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<tr>
<td>ln(aid)</td>
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<td>-0.012</td>
<td>-0.006</td>
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<tr>
<td></td>
<td>(0.009)</td>
<td>(0.014)</td>
<td>(0.016)</td>
<td>(0.017)</td>
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<tr>
<td>Lag FDI % of GDP</td>
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<td>0.014**</td>
<td>0.016**</td>
<td>0.015**</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.006)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.005)</td>
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<tr>
<td>Lag ln(aid)</td>
<td>0.023*</td>
<td>-0.006</td>
<td>-0.018</td>
<td>-0.019</td>
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<td></td>
<td>(0.009)</td>
<td>(0.014)</td>
<td>(0.015)</td>
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<tr>
<td>Lag Remittance % of GDP</td>
<td>0.008+</td>
<td>0.031**</td>
<td>0.031**</td>
<td>0.019</td>
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<tr>
<td></td>
<td>(0.004)</td>
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<td>Terms of Trade</td>
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<td>0.002**</td>
<td>0.002**</td>
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<tr>
<td></td>
<td>(0.001)</td>
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<tr>
<td>ln(GDP per capita)</td>
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<td>-0.129</td>
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<tr>
<td></td>
<td>(0.095)</td>
<td>(0.096)</td>
<td>(0.099)</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>ln(government expenditures)</td>
<td>0.190**</td>
<td>0.118+</td>
<td>0.149*</td>
<td></td>
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<td></td>
<td>(0.069)</td>
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<td>(0.07)</td>
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<tr>
<td>World Int Rate-6mo</td>
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<tr>
<td>LIBOR</td>
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<td>Country Dummies</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>202</td>
<td>202</td>
<td>190</td>
<td>190</td>
<td>192</td>
<td>181</td>
<td>178</td>
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<tr>
<td>R-squared</td>
<td>0.08</td>
<td>0.67</td>
<td>0.07</td>
<td>0.68</td>
<td>0.71</td>
<td>0.72</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Source: author’s calculations

Column II considers the same regression, but includes country dummies to account for between-country heterogeneity. The jump in $R^2$ from 0.08 to 0.67 shows that country-specific factors play an important role in exchange rate values. The coefficient on FDI gains significance at the five percent level and suggests that a one percentage point increase in FDI as a percent of GDP leads to a one percent increase in the exchange rate.

Columns III and IV consider the same regression as columns I and II, respectively, but consider the one period lag of each factor instead of the current period factor. In this case, the coefficient on lag FDI jumps in significance and magnitude with the inclusion of
country dummies. Without country dummies (column III), all three coefficients are positive and significant at least at the ten percent level.

From that point forward, each column of Table 1 includes country dummies to account for characteristics specific to each country that influence their exchange rates. In column V, the additional factors hypothesized to influence the exchange rate are included with the current period capital inflows. The coefficient on FDI percentage of GDP is significant at the one percent level. Its value of 0.012 suggests that a one percentage point increase in FDI is associated with an increase in the exchange rate by 1.2 percent.

Column VI is the same as column V, with the exception that all current period capital inflow terms are converted into one period lag terms. Like in the previous regression, FDI maintains its significance at the one percent level.

It is clear from the first six columns of Table 1 that both the current and lag period capital inflows have an influence on the exchange rate. In Column VII when both the current and lag term variables are included, only the lag term of FDI continues to be significant.

Table 2 shows a similar analysis, but considers a different dependent variable. In this case, an HP-filter was employed to distinguish between the trend changes in exchange rates for each country and the deviations from the trend. By only considering the deviation from trend, it is possible to see whether an overvaluation of the currency results, rather than simply an increase in the exchange rate that have just been movement associated with a longer term trend. Column I shows the impact of the three types of capital inflows, FDI, remittances, and foreign aid on the deviation from trend of the exchange rate. Column II adds in country dummies. As can be seen from the relatively low R-squared value that remains in column II, however, the overvaluation of the exchange rate seems to have much less to do with country-specific factors. In both columns I and II, FDI is the only capital inflow with a significant coefficient in both cases, and as expected, both are positive.

As in Table 1, in columns III and IV the same expressions are considered as in columns I and II with the exception that lag terms are used. As in columns I and II, FDI is the only capital inflow variable that has a significant coefficient in both cases.

Columns V and VI consider the current and lagged foreign capital inflows individually while adding in the other factors that are hypothesized to influence exchange rates. In both cases FDI continues to maintain its significance once the additional controls are included. Column V suggests that a one percentage point increase in FDI in the current period increases the overvaluation of the exchange rate by 0.8 percent, while column VI suggests a similar increase in FDI in the previous period raises the current period exchange rate by one percent.

Finally, in Column VII, both current and lagged foreign capital inflows are included. As in Table 1, the coefficient on current period FDI loses its significance, though the lag term does maintain significance at the ten percent level. Again, it appears that both current and lagged foreign capital inflows, particularly FDI, influence the exchange rate. The drop in significance when both are included suggests that the two operate on the exchange rate very closely together.
Table 2.

Regression (Dependent Variable is the deviation from trend of the natural log of the REER)

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDI % of GDP</td>
<td>0.005+</td>
<td>0.009**</td>
<td>0.008*</td>
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<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
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<td>Remittance % of GDP</td>
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<td>0.015**</td>
<td>0.016**</td>
<td>0.041**</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.004)</td>
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<tr>
<td>ln(aid)</td>
<td>0.004</td>
<td>-0.011</td>
<td>-0.015</td>
<td>-0.008</td>
<td>(0.005)</td>
<td>(0.011)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Lag FDI % of GDP</td>
<td>0.006*</td>
<td>0.011**</td>
<td>0.010**</td>
<td>0.010*</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
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<tr>
<td>Lag ln(aid)</td>
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<td>0.019+</td>
<td>-0.016</td>
<td>-0.015</td>
<td>(0.005)</td>
<td>(0.011)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Lag Remittance % of GDP</td>
<td>-0.003</td>
<td>0.016**</td>
<td>0.016**</td>
<td>0.023*</td>
<td>(0.002)</td>
<td>(0.004)</td>
<td>(0.011)</td>
</tr>
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<td>Terms of Trade</td>
<td>0.001+</td>
<td>-0.001</td>
<td>-0.001</td>
<td>(0)</td>
<td>(0)</td>
<td>(0)</td>
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<tr>
<td>ln(GDP per capita)</td>
<td>-0.109</td>
<td>-0.033</td>
<td>-0.062</td>
<td>(0.075)</td>
<td>(0.078)</td>
<td>(0.081)</td>
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<tr>
<td>ln(government expenditures)</td>
<td>0.146**</td>
<td>0.087</td>
<td>0.114*</td>
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<td>World Int Rate-6mo LIBOR</td>
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<td>0.011*</td>
<td>0.012*</td>
<td>(0.004)</td>
<td>(0.005)</td>
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<tr>
<td>Country Dummies</td>
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<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Observations</td>
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<td>202</td>
<td>190</td>
<td>190</td>
<td>192</td>
<td>181</td>
<td>178</td>
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<tr>
<td>R-squared</td>
<td>0.03</td>
<td>0.13</td>
<td>0.03</td>
<td>0.16</td>
<td>0.18</td>
<td>0.21</td>
<td>0.27</td>
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</tbody>
</table>

Standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Source: author’s calculations
Finally, it is worth noting that the numbers observed here are significantly lower than those observed by Amuedo-Dorantes & Pozo (2004) who studied the effect of remittances on the exchange rate. They find that a doubling of per capita workers’ remittances increases the real exchange rate by 23 percent, compared to the very low single digit percentages observed here. There are a few potential reasons for this difference. First, the reason often cited for developing countries’ poor outcomes following large capital inflows is that the recipients simply could not absorb the capital. This problem is sure to be much alleviated by FDI’s directed flows into particular projects in the recipient country. Additionally, remittances are usually directed primarily toward consumption, aggravating the potential problems of large capital inflows. When remittances are directed toward investment, they are found to have a smaller effect on the exchange rate (Lopez, et al., 2007).

5 Robustness Checks

A potential reverse causality issue is present this analysis. Foreign companies’ decisions to invest in a country are likely to be influenced by the country’s exchange rate. If the country’s currency is overvalued, companies are less likely to invest there because they generally invest with the intention of producing export-oriented goods (particularly in recent decades since import substitution has been largely discredited). It therefore seems that there is likely a cycle from investment to currency appreciation to reduced investment to currency depreciation. Based on this predicted cycle, we expect that the coefficients found in the above analysis are actually prone to a downward bias. Despite the obvious endogeneity present in the analysis, the direction of the bias substantially reduces any concern this may cause.

In order to test the robustness of the results above, we use the average FDI received in each region, Asia and Latin America, as an instrument for the FDI received in the particular countries. In analysis available from the author, it can be seen that average FDI received in the entire region is a strong indicator of FDI received in a particular country. The amount of FDI received in an entire region has little conceivable impact on the exchange rate of individual countries. Together, these two aspects of average FDI to an entire region allow us to use it as an instrument in order to establish the robustness of the results. Using average FDI to the entire region as an instrument, we find that the results presented in Tables 1 and 2 and maintained, and that the coefficients are often higher in the IV regressions. As expected, the analysis presented in Section 4 (Tables 1 and 2) seems to suffer from a downward bias. More detailed analysis is available on request.

6 Conclusions & Limitations

In this paper we attempt to determine whether FDI inflows lead to Dutch Disease effects in recipient countries. We find that FDI inflows do in fact lead to some exchange rate appreciations. The results suggest that a one percent increase in FDI as a percentage of GDP leads approximately to a one percent increase (appreciation) in the exchange rate
and in its overvaluation.

Given this knowledge, prudent leaders of recipient countries may want to take some measures to alleviate these Dutch Disease effects. The most obvious policy proposal is to take measures to maintain stable prices of non-tradable goods, preventing the increases that induce the exchange rate appreciation. Leaders may want to address the labor mechanism in this process as well. Exporting firms are hurt by the increased labor prices and smaller labor force, so governments may wish to subsidize these export-oriented firms in order to better support them.

It is also important to note that the numbers we observe here are much lower than those seen in studies of both remittances and aid and their affect on the exchange rate. This makes intuitive sense, as a large reason the exchange rate increases is because of the increased consumption that drives up the prices of non-tradable goods. Foreign investment does not directly deliver the money to households, so the opportunity for bidding up the prices of non-tradable goods is lower. The households are receiving the money indirectly, and presumably, in a more long-term timeframe.

While this study provides some evidence that FDI inflows lead to exchange rate appreciations, there are some other aspects for consideration. First, the magnitude of the numbers observed is not particularly large. A tradeoff from increasing FDI one percent of GDP to get a one percent appreciation in the exchange rate could be worthwhile. Moreover, compared to remittances and aid, the numbers are quite small. Particularly if the issue is viewed through a development lens, FDI can be viewed as a very strong tool with relatively minor side effects. Viewed in this way, this study’s value is that it establishes that exchange rate appreciations are a potential side effect of FDI and something of which recipient countries should be aware. If the exchange rate appreciations get so large that export-oriented firms cannot compete on the international market, leaders may choose to focus on measures to hold down domestic prices to limit the exchange rate appreciation.

References


THE EFFECTS OF INSTITUTIONAL QUALITY
ON FOREIGN OWNERSHIP:
AN INTERNATIONAL FIRM-LEVEL STUDY

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University of San Francisco

ABSTRACT

Recent developments in foreign direct investment (FDI) study emphasize the important role played by stable investment environment in host countries. For example, Alfaro, Kalemli-Ozcan and Volosoych (2008), shows that low institutional quality (IQ) is the major explanation for the lack of capital flows from rich to poor countries (Lucas Paradox). In this paper we attempt to shed some light on the relationship between IQ and FDI. Using the unique international firm-level data in 78 countries which covers the period of 2000-2005, we study how the quality of business and/or investment environment affects firms' foreign equity participation internationally. We measure the quality of business environment based on the following four indicators: (1) corruption, (2) legal protection, (3) crime protection, and (4) crime losses. We show that corruption is significantly negatively correlated with firm's foreign ownership while legal protection has a significantly positive effect on foreign ownership. We also consider different specifications including controlling fixed-effects of firm and country characteristics. The quality of business environment is still significant under these alternative specifications.

1 Introduction

During the past decades, every developing country has been trying to attract foreign direct investment into their country to increase their economic growth. Most countries create and use policy to attract the foreign direct investment (FDI) such as promoting and supporting small businesses, free trade agreement, subsidy, tax reduction, improve domestic consumption, and many others. But not many countries have looked into the government corruption and institutional quality, which we believe it plays a large role to attract FDI and increase economic growth.

Recent developments in FDI study emphasize the important role played by stable investment environment in host countries. For example, Alfaro, Kalemli-Ozcan and Volosoych (2008), shows that low institutional quality (IQ) is the major explanation for the lack of capital flows from rich to poor countries. This is also called the Lucas Paradox. Using international macroeconomic data between 1970 and 2000, the authors show that the measure of institutional quality is negatively correlated with the volume of FDI inflow internationally. However, at
least until recently, modern quantitative studies of the relationship between FDI and IQ are still limited on the macroeconomic level due to the lack of good-quality microeconomic firm-level data.

In this paper we attempt to shed some light on the relationship between IQ and FDI based on the firm-level analysis. Using the unique international firm-level data in 78 countries which covers the period of 2000-2005, we study how the quality of business and/or investment environment affects firms’ foreign equity participation internationally. We measure the quality of business environment based on the following four indicators: (1) corruption, (2) legal protection, (3) crime protection, and (4) crime losses. Our preliminary results show that corruption is significantly negatively correlated with firm’s foreign ownership while legal protection has a significantly positive effect on foreign ownership. We also consider different specifications including controlling fixed-effects of firm and country characteristics and control for potential endogeneity problems. The quality of business environment is still significant under these alternative specifications.

We believe that this research has an important policy implication as the existing literature generally suggests that FDI is one of the key factors for promoting economic growth in host countries. FDI is considered to be a vehicle transferring both physical capital and intangible assets, such as technology. Growth theories predict that capital accumulation and technological innovation are engines driving economic growth. As a result, we expect FDI to have a positive effect on host countries’ economic growth. For example, Choe (2003) and Mullen and Williams (2005) conclude that FDI has a positive effect on economic growth. Borensztein, De Gregorio and Lee (1998) and Alfaro, Chanda, Kalemli-Ozcan and Sayek (2004) find that FDI will promote economic growth when certain economic conditions are met in the host country, such as a threshold level of human capital (see also, Blonigen and Wang, 2005; Wang and Wong, 2008 and 2009).

Our research question gives us a better understanding how FDI can be attracted in order to promote economic growth in a host country. If the government is able to enforce a higher quality of business environment (in terms of the reduction of corruption or a better legal protection) in a country, more foreign participation will be encouraged in the domestic market. As a result, a higher economic growth would be expected in the country.

This paper is organized as follows. Section 2 describes the data we use and introduces the empirical specification in this study. We then discuss our general baseline results and the results with other robust specifications in section 3. Section 4 concludes.

2 Empirical Specification and Data Description

Following closely the empirical specification in Alfaro et al. (2008) with a set of country level data set, we estimate the impacts of institutional quality on the percentage of foreign ownership (FDI) for firm $i$ in country $j$ at time $t$ from 2000 to 2005:

$$ FDI_{ijt} = a + b \text{InstitutionalQuality}_{ijt} + g' Z_{ijt} + e_{ijt} $$
FDI in our study is defined as the foreign ownership of the firm $i$. The variable is obtained from the World Bank Productivity and the Investment Climate Private Enterprise Survey. Similar to Alfaro, et al. (2008), we expect that the institutional quality and business environment would have an important effect on firm’s foreign ownership. To measure different aspects of Institutional Quality, we include the following variables in our study: (1) corruption, (2) legal protection, (3) crime protection, and (4) crime losses. We construct four measures of corruption variables. Corruption 1 is the percentage of the corruption to the total sales; corruption 2 is the percentage of corruption to the average of total sales of 1 year ago and 2 years ago; corruption 3 is the percentage of expected corruption to the contract value; corruption 4 is the percentage of the costs of gifts and payments last year to the total sales of 1 year ago.

Legal protection is the firm level confidence of the judicial system; crime protection is the costs of providing security and protection payments as a percent of the total sales; crime loss is the losses of theft robbery, vandalism, or arson as a percent of the total sales. Wei (2000) showed that corruption in a country would significantly reduce the FDI of that country. Also, crime creates a strong disincentive for FDI which has been proven by Daniele and Marani (2008) with an Italian case. Other data also come from the World Bank’s Productivity and the Investment Climate Private Enterprise Survey. The vector of $Z$ represents the characteristics of firms. We included the sales to asset ratio, capital to asset ratio, and liabilities to asset ratio. We also construct different sets of dummy variables, which include: sectoral, time, and region dummy, into the regressions to control for industry, time and regional effects in our study.

The survey question is “What percentage of your firm is owned by foreign sector?” See Appendix A for details.

3 Empirical Results

3.1 The Baseline Results

3.1.1 The Impacts of Corruption

We also have different regressions referring to the regional sample and sizes of the firm about the impacts of corruption and business environment on foreign ownership in domestic firms, in which, corruption and business environment are our indicators of IQ.

We first investigate how different measures of corruption have effects on firm’s foreign ownership. Generally they all have negative sign of coefficients. However, a few coefficients for Corruption 1 appear to have positive signs. According to Table 1, we can see that corruption has a significant impact on FDI. Most of the coefficients met the expected negative sign and are significant at conventional levels. Corruption 2, measured as the percentage of corruption to the average of total sales of 1 year ago and 2 years ago, is consistently negative and significant in all regressions. Alternative measures of corruptions, such as Corruption 3 and Corruption 4, also show significantly negative impacts on firm’s foreign ownership. In regression models 1(c)-6(c), we see that the coefficient on Corruption 3, defined as the percentage of expected corruption to the contract value is in the range of -0.12 and -0.27. It implies that a 10 percentage points increase in the expected corruption to contract value tends to reduce the foreign ownership in a firm by around 1.2-2.7 percentage points, ceteris paribus. Similarly, gifts
and inform payments also play an important role in limiting firm-level foreign ownership as well. According the regressions 1(d)-6(d), if there is a 10 percentage points increase in the cost gifts and informal payments to the total sales, the percentage of foreign ownership can significantly go down by 0.01%-0.02%, controlling for firm’s productivity, time, industry and regional effects in our analysis.

The firm factors like sales to asset ratio, capital to asset ratio, and liabilities to asset ratio are also the important elements to explain the firm level of foreign ownership as we predict. We argue that higher the sale to the asset ratio the more likely to have higher returns which attract FDI because a higher sale to asset ratio means the company is using its asset efficiently to produce the sale. All results that are significant agree with our expectations. In contrast, the higher the capital to the asset ratio the more likely to decrease FDI, because the higher equity to the asset mean that the equity worth to asset is less, therefore the return of equity or investment will likely be predicted to have lower return, compared to the one with less capital to asset. All results that are significant agree with our expectation for Latin America. Our expectation of the liability is that the higher the liabilities to the asset ratio the less likely to attract FDI because higher liability with same amount of asset indicates that the net asset of the company is less and the borrowing is high. Again, all results that are significant agree with our expectations.

The factor that we want to point out is the number of years of business, which we believe to be one factor that significantly affecting FDI. In Table 1, the years of business are all negatively affecting FDI but not all are significant. For Table 2, are all negatively affect FDI and all are significant. Therefore, we can see that FDI is negatively effect from the years of business. We suggest that the earlier the business phase the higher expected return on investment and return on equity, relatively idea is that long establish business are likely to have less risk and lower return on investment. In which higher return expected by investor are likely to be invested more.

3.1.2 The Impacts of Business Environment

To measure the quality of business environment, we also consider other variables: legal protection, crime protection and crime losses. We argue that the well-established legal and crime protection and/or a lower level of crime losses can encourage more foreign investment in firms. In Table 2, we can see that business environment can affect the foreign ownership in domestic firms through the variable - legal protection. The coefficient on legal protection is positive and significant. It implies that foreign investors are more concerned with the quality of legal system in the host country when making investment decisions. If we look at the regression result of model 6d from Table 2, if there is a 1% increase in the firm level confidence of the judicial system, there will be 1.29365% increase in FDI. This is to say when the people have more confidence to the judicial system of the country (increase in IQ), so it could lead to increase in FDI. However, we find that both crime protection and crime losses are not quite significant in all regressions although both variables met the expected signs in most of the regressions.

3.2 Regional Impacts of Institutional Quality on Firms’ Foreign Ownership

According to Table 3, when we look at the impacts of corruption on foreign ownership in domestic firms by regional sample, Corruption 2 and Corruption 3 in Latin America and
Caribbean and South Asia are negatively related to FDI, which matches our assumption. The results are also significant and robust. In this table, we also see that Corruption 4 is negative and significant in Africa and South Asia. However, none of the corruption variables for East Asia and the Pacific are significant. This may be because the cheap cost of investing in those countries is a more important factor to those investing companies; therefore, corruption is not significant factor for them to determine investing at those countries. In addition, since corruption has been a common business strategy in East Asia and the Pacific, investors will see this as a business environment culture. Therefore, it is not a significant factor for them to decide investing or not.

According to table 4, the result met our expectation that three regions’ (Africa, East Asia and the Pacific, and South Asia) legal protection is positively related to the FDI. The result is also very robust and significant.

In Tables 3 and 4, by regional sample, we only see the significant and negatively affect FDI in East Asia and the Pacific. This is because in 4 regional samples, East Asia and the Pacific is the one invested with majority of business that involving Research and Development, which derive into phases of business and product life cycle stages.

3.3 Does the Size of the Firm Matter?

Looking at the firm size, referring to table 5, Corruption 2 is robust in model a, b, and c and it is negatively related to the FDI. However, when the regional dummy is added to model (d), the result became insignificant. We can see that corruption 2 is significant to all firm sizes from less than 20 employees to over 100 employees. In small size firms, Corruption 4 is also significant for models (a) and (b). We can see that corruption has more effect on small firms rather than large firms.

According to Table 6, we can see that legal protection is mostly significant and positive in all sizes of firms but not robust. In the small size firms category, we can see that crime losses is significant and robust in the regression result. It also met our expected sign which is negatively correlated with FDI. We can see that crime loss is a very important factor to the small size firms. Therefore, we can see that business environment (IQ) is an important to FDI. In Table 5 and 6, by firm size, we see that all sizes of firms negatively affect FDI. But only in medium and large size firm that is significant. We believe that in the small size firm, the data may fluctuate a lot due to the fact that well growing firm will move into medium size firm easily and no longer in the category. As well as small size firm life period is very short, so the data is not significant.

As we see from all tables, we believe that years of business are significantly affecting FDI. These can be supported by many recent articles about entrepreneurs are the driving force of new economic.
4 Concluding Remarks

In many countries especially developing countries, government concentrate to attract FDI by offering policy such as tax reduction or subsidy for export, but not many countries has put their effort into improving Institutional Quality. Our objective in this paper is to analyze the empirical role of Institutional Quality and stable investment environment to the increase in foreign ownership. While previous study has found that IQ could affect FDI incentive in the country level. We are specifically interested in how different firm-level business environment factors, such as corruption, legal protection, crime protection, etc., can affect the decisions of foreign firms in investing firms in the host country. Our empirical evidence shows that for the period 2000-2005, corruption 2, the delay with the use of giving gifts or informal payment with respective to the total sales, and legal protection play an important role on foreign firms’ investment decisions. Our results also generate implications for governments in developing country, business organization and international organization to focus and look into Institutional Quality as it has been proved by many recent papers (such as, Alfaro, et al., 2008) in a country level, and now with our result imply more into firm level that Institutional Quality can improve the flow of investment. But not only the developing country that should focus in to Institutional Quality of the developing country but developed country government and organization as well, because from the neoclassical theory and assumptions, people, individuals, and firms try to benefit themselves which cause the flow of money or capital to poor country to gain more advantage in production cost that the poor country can give (such as less regulation to environment, less cost of labor (this include wages and standard of living or health concern to be covered by the firm), and Government incentive for exporting). These will result in higher return on investment which is what individualand firm seeks to maximize.

From the neoclassical theory, we learned that more capital would increase the production of the companies. From our above empirical study, a higher IQ could lead to more foreign ownership. Foreign ownership could lead to the increase in technology since the investors would bring in new technology to the company. As the company is better of than other local company, it could have a spill over effect that the industry would acquire and look for the better technology, which could help their production. All in all, the production of the industry will increase, and the economy will also be better of.

Therefore, at the country level we should implement more ethic and regulation to prevent corruption of the country. The government should put more into academic and education, because this is the based and create culture and understanding of ethical and social responsibility in majority of the developing country especially east Asia, which will reduce corruption rate in the future. The government should have more stick system to monitor the government activities, such as E-Auction which is the system that reduces the time range after the government ofcer know the information to the making of decision. These will not eliminate the corruption but to reduce it and help to improve the institution quality. Also the government should increase the legal protection in their country since we have prove that higher legal protection will result in higher FDI, which can lead to spill over of the technology to local firms which increase economic growth to the country.
KATHERINE M.M. NG AND PONGRITH N. CHANTRAPORN

References


Appendix A: Questions from the survey

Corruption 1 (Q39): We’ve heard that establishments are sometimes required to make gifts or informal payments to public officials to “get things done” with regard to customs, taxes, licenses, regulations, services etc. On average, what percent of annual sales value would such expenses cost a typical firm like yours?
Corruption 2 (Q40): Based on the experience of your establishment over the last two years, what is the actual delay experienced (from the day you applied to the day you received the service or approval) and was a gift or informal payment asked for or expected to obtain each of the following?
Corruption 3 (Q43): When establishments in your industry do business with the govern-ment, how much of the contract value is typically expected in gifts or informal payments to secure the contract?
Corruption 4 (Q42): On average, how many days last year were spent in inspections and mandatory meetings with officials of each of the following agencies in the context of regulation of your business? And what were the costs associated with these interactions? (We got the total value from the following categories: tax inspectorate, labor and social security, fire and building safety, sanitation/ Epidemiology, municipal police, environmental)
Legal Protection (Q46): “I am confident that the judicial system will enforce my contractual and property rights in business disputes.” To what degree do you agree with this statement? 1. Fully disagree 2. Disagree in most cases 3. Tend to disagree 4. Tend to agree 5. Agree in most cases 6. Fully agree.
Crime Protection (Q48a+b): Please estimate your establishment’s costs (as a percent of its total sales) of providing: a) security (equipment, personnel, or professional security service)? b) protection payments (e.g. to organized crime to prevent violence)?
Crime Losses (Q49a): Please estimate the losses (as a percent of total sales) of theft, robbery, vandalism or arson against your establishment in the last year?

Table A: List of Countries

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How does Politician Quality relate to Governance Quality? Econometric Evidence From Indian State Legislatures

Siddharth E. George
Shamil Jobanputra
Xing C. Ong
Younil You

London School of Economics and Political Science

ABSTRACT

This paper empirically models the effectiveness of the monetary transmission mechanism in post-1996 China. A number of reforms demonstrate the government’s commitment to effective monetary policy, but limitations still exist within the financial system. Using a vector autoregression, this paper determines changes to the discount rate are effective at adjusting inflation rates and industrial output growth in the intended directions. However, the effects of monetary policy are small compared to other factors affecting the Chinese economy. The current system allows for effective monetary policy, but more reforms could give it a greater impact.

Acknowledgements

We thank numerous seminar participants and Anders Jensen, Markus Gstoettner, Daniel Stein, Dr Bernardo Guimaraes and, especially, Dr Judith Shapiro for comments. We thank Li Qing Lee and especially Guilherme Zagatti for their involvement in the creation of our dataset, particularly with the coding of politicians’ affidavits. We also thank Francesca Rossi, Professor Albert Marcet, Alexander Lembecke and Sanchari Roy for econometrics advice. The opinions in the paper are those of the authors and do not necessarily reflect the points of view of the London School of Economics and Political Science.

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1 Introduction

Good governance is widely acknowledged to be vital to achieving sustained economic growth and wider development goals. Several authors, including Kaufmann and Kraay
(2002), find a strong positive causal effect running from better governance to higher per capita incomes; and accounts of endemic state failure in low income countries, such as Acemoglu and Robinson (2004), demonstrate that long-run economic development is closely bound up with political development.

There is significantly less agreement, however, over what gives rise to good governance, or how governance can be improved. Nevertheless, it would seem reasonable to consider governance as the outcome of the game of politics, since effective political administration is a critical component of good governance, and most countries are now governed by some form of representative democracy. Viewed thus, governance is the outcome of a game that is played by politicians and whose ‘rules’ are those institutions – electoral, constitutional and others – which influence candidate selection and constrain in-office political behaviour.

Shaped in large part by the ideas of Anthony Downs and James Buchanan, economists’ thinking about governance in the last few decades has concentrated on the latter of those two issues, namely how ‘rules’ affect governance by restraining the self-serving behaviour of elected officials. Arguably the most important idea of the Downsian approach was its prediction that the policies of parties, modelled as competing ‘firms’, would converge to the median voter’s preferences. In assuming that citizens vote for policies, not politicians, the Downsian model had no room for the idea that politicians are heterogeneous – in competence and/or honesty – and have varied effects on governance.

The emphasis of the Public Choice literature, pioneered by James Buchanan, was also on ‘rules’, specifically on the role of elections and constitutions in disciplining politicians already in office. Buchanan saw the need for two kinds of constraints: procedural constraints, which limit acceptable political engagement, and fiscal constraints, which restrict policy choice. But he, too, neglected that political selection could affect governance. In fact, Buchanan was positively hostile to the idea: “To improve politics”, he said, “it is necessary to improve or reform rules, the framework within which the game of politics is played. There is no suggestion that improvement lies in the selection of morally superior agents who will use their powers in some ‘public interest’.” (1989)

By contrast, the founding fathers of American democracy thought one prerequisite of good governance was to get the right people making social decisions. James Madison, the primary author of the US Constitution, wrote in The Federalist Papers that “The aim of every political Constitution is, or ought to be, first to obtain for rulers men who possess most wisdom to discern, and most virtue to pursue, the common good of society; and, in the next place, to take the most effectual precautions for keeping them virtuous whilst they continue to hold their public trust.” (1788). The American political scientist, V.O. Key, expressed similar sentiments: “The nature of the workings of government depends ultimately on the men who run it. The men we elect to office and the circumstances we create that affect their work determine the nature of popular government. Let there be emphasis on those we elect to office.” (1956). Political selection is all the more important if elections – and other ‘rules’ – impose only limited constraints on political behaviour, in which case improving the quality of governance would entail raising the quality of elected officials.

A number of economists now incorporate selection into their models of politics. The
citizen-candidate model, developed by Osborne and Slivinski (1996) and Besley and Coate (1997), formalised the idea that institutional factors – like the electoral system – can affect governance by systematically influencing the composition of the political class. Caselli and Morelli (2002) construct a model in which the population comprises citizens of different levels of competence, and show that the formal returns to holding office affect policy outcomes through citizens’ candidacy decisions. In particular, their model predicts that low-quality citizens dominate the political class when formal returns to politics are poor. This prediction finds empirical support in the work of Ferraz and Finan (2008), who observe that Brazilian municipalities which offer higher salaries attract more educated politicians, and induce higher legislative productivity and better public good provision.

Like Caselli and Morelli (2002), Kotakorpi and Poutvaara (2009) argue that politics faces an adverse selection problem because asymmetric information obscures candidate quality, and because voters can elect only those citizens who choose to run for office. This informational view of politics is supported by Besley, Pande and Rao’s (2005) finding that Indian villages with better information flows elect more educated politicians. Besley, Pande and Rao (2005) also find that more educated village politicians exhibit less opportunism and better allocate public resources (here, Below Poverty Line cards). Their finding that educated politicians exhibit better actual and perceived performance suggests that focusing on factors that select better politicians is a valuable step towards improving governance.

Our paper builds on the work of Besley, Pande and Rao (2005) by studying how the characteristics of legislators in Indian state assemblies (henceforth, MLAs – Members of Legislative Assembly) relate to the quality of state-level governance. We construct a unique dataset on individual politicians, exploiting raw sources made available by the passing of India’s landmark Right to Information Act (RTI) in 2003, under which all candidates contesting parliamentary elections were mandated to submit affidavits declaring their educational qualifications, criminal history, and assets and liabilities. We construct our dataset from the information in such affidavits, and use the provisions of the RTI to obtain the same information for the pre-2003 period. We examine how particular attributes of MLAs (say, level of education or degree of criminality) vary with particular aspects of governance (say, change in Human Development Index or level of corruption). Our work differs from Besley, Pande and Rao (2005) and Ferraz and Finan (2008) in that we study a different tier of government. State governments have greater formal sanctions than municipality or village governments, and a key difference between politics at the village and state level could well be the kind of people who hold public office.

The next three sections discuss attempts in the recent literature to decipher the causes of good governance, and to measure politician and governance quality.

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1 We resist the temptation to attempt a cross-country study which, while exploiting rich variation, would face the difficulty of controlling for the many sources of cross-country heterogeneity in a convincing manner. We therefore restrict our investigation to sub-national data, and study India in part because it is one of the world’s most decentralised democracies: state legislatures are therefore largely responsible for state level governance, making a cross-state analysis viable. A second reason for choosing India is that there is substantial variation in the quality of politicians and governance across Indian states. This rich variation, which occurs within a very similar institutional setting, makes for an interesting study, and also mitigates the problem of multicollinearity.

2 See, for example, this affidavit submitted by Bala Nandgaonkar, MLA from Mumbai City, Maharashtra: http://myneta.info/mh2009/candidate.php?candidate_id=2407
1.1 What makes for good governance?

Much of the recent literature has studied the role of institutional frameworks in improving in-office political behaviour and governance. Besley (2006) finds evidence that electoral rules affect policy outcomes through its effect on political competition. Gagliarducci, Nannicini and Naticchioni (2008) observe that allowing politicians to work in the private sector while being appointed in parliament results in a more competent candidate pool. Besley and Preston (2004) conclude that high pay and term limits appear to make governors more congruent – that is, more amenable to voter preferences.

Several papers have also ventured beyond institution design to link changes in governance to changes in politicians. Jones and Olken (2005) exploit the quasi-experimental variation produced by accidental or natural deaths of national leaders to study whether leader quality affects GDP growth. They conclude that national leaders do indeed influence growth, particularly in autocratic polities where there are few constraints on a leader’s power. However, very few papers have attempted to identify empirically which attributes of politicians tend to produce good governance, and those which have, such as Besley, Pande and Rao (2005), consider a limited range of politician attributes. The rich data on individual politicians afforded by the RTI in India allows us to study how factors not hitherto subject to empirical investigation (such as politicians’ criminal history) are correlated with governance.

1.2 Characteristics of politicians

The theoretical literature usefully divides the notion of politician quality into two broad, but distinct, categories: competence and honesty. As a measure of competence, Kotakorpi and Poutvaara (2009) and Besley, Pande and Rao (2005) use education level; Ferraz and Finan (2008) include both education level and political experience; and Matozzi (2007), Poutvaara and Takalo (2007), and Messner and Polborn (2003) use private sector wages, arguing that political ability is correlated to market ability. Authors have used rather more creative indicators of politician honesty. Gagliarducci et al (2008), for example, treat shirking as a proxy for dishonesty. Shirking is evinced by vote attendance, bill sponsorship and post-political-career earnings.

1.3 Quality of governance

Kaufmann, Kraay and Mastruzzi (2009) define governance as “the traditions and institutions by which authority in a country is exercised. This includes the process by which governments are selected, monitored and replaced; the capacity of the government to effectively formulate and implement sound policies; and the respect of citizens and the state for the institutions that govern economic and social interactions among them.” The authors use this definition to identify the following six dimensions of governance: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. They also argue for, and use, perceptions-based data to assess each of these dimensions.

Huther and Shah (1998) take a similar approach to measuring governance, but select
governance dimensions according to those cited in the World Bank’s (1992) booklet “Governance and Development.” Also, unlike Kaufmann et al (2009), their study is based on existing data.

Basu (2004) uses a similar approach to Kaufmann et al to create a governance index for individual Indian states. His governance dimensions are rule of law, public service, government functioning, workers’ and people’s participation, economic environment, social participation and press freedom. We follow in these authors’ footsteps by adopting a similar approach for measuring governance, even though data on governance at a sub-national level is typically less abundant.

It is important at this juncture to recognise that even the most comprehensive governance indicator is just that – an indicator. With a variable as all-encompassing as governance, it is simply impossible, even when including so many components, to count everything that counts.

2 Indicator Selection and Data Sources

We study how the following five characteristics of MLAs are correlated to state-level governance:

- **Education (COLLEGE):** Besley, Pande and Rao (2005) and Ferraz and Finan (2008) both provide empirical evidence that better educated village or municipality politicians allocate public resources more efficiently. We will be interested to see whether this prediction holds at the state level of government, which imposes greater formal sanctions on legislators than local government. Our data on the educational details of MLAs includes the duration of their education, and their highest qualification.

- **Age (AGE):** This is a proxy for political experience. Theoretical predictions about the effect of political experience on governance are ambiguous, perhaps because ‘career politicians’ face different incentive structures from those who merely have short stints in politics. Indeed Mattozzi and Merlo (2007) distinguish between both groups precisely for this reason. While a career politician is arguably more congruent because he is encouraged to formulate policies that will maximize voters’ long-run interest (and hence keep him in office), he also enjoys larger rent-seeking opportunities. Ferraz and Finan (2008) find evidence that more experienced legislatures exhibit greater legislative productivity; however, we are skeptical that this would necessarily lead to an improvement in most aspects of governance.

- **Criminality (CRIME):** India elects a distressing number of criminals into positions of political power. 23% of MPs in the Lok Sabha, the Lower House of India’s national parliament, have a criminal record, and this figure is significantly higher in some state assemblies. Chemin (2008) uses a regression discontinuity design to estimate that the election of criminal politicians leads to a 25% increase in offences
criminal politicians most often commit. We would like to investigate if the effects of politician criminality on governance are even more far reaching than crime rates.

- **Wealth (WEALTH)**: Besley, Pande and Rao (2005) find evidence that land ownership favours election to village government. It would be interesting to observe whether there existed significant differences in politician wealth across states, as well as to correlate Wealth with levels of corruption.

- **Gender (MALE)**: On the basis of evidence from a randomized policy experiment in Indian village governments, Duflo and Chattopadhyay (2004) conclude that reservation of political positions for women increases investment in those public goods most closely linked to women’s concerns, like drinking water. Also, Clots-Figueras (2007) finds that increasing female political representation by 10% increases the probability that an individual attains primary education in urban areas by 6%. We are keen to see if nearly other aspects of governance are related to politician gender.

While the RTI has made available to us data that was previously inaccessible, the task of compiling, coding and cleaning this dataset is very much ours. In the table on the following page, “1” indicates that the data has been located and “0” shows that, although we have been advised that the data exist, we have not been able to obtain it.

Constructing a dataset from thousands of pages of politicians’ affidavits was an arduous process with several complications. One of these was language barriers – in several states politicians filed their affidavits in languages other than English, such as Hindi, Gujarati or Kannada. Another was that some affidavits were incomplete or poorly scanned.

Overcoming language barriers has proved challenging; but we were able to assemble data for 33 unique state and election cycle pairings across 2 election cycles, representing a 16% loss ratio of currently available data.

To measure governance, we follow the general approach of Basu (2004) but also included data that addressed the dimensions of governance identified by Kaufmann, Kray and Mastruzzi (2009). Due to the shortage of data at state level, we are unable to use perceptions-based governance data, the benefits of which are explained by Kaufmann et al. We accept that this may be a limitation for our research.

Our governance indicators are described here, categorized by the component of governance we wish to gauge.

**Rule of Law:**

- **IPC Crime Rates (% per 100000 population)**

  *In India, the Criminal Procedure Code divides crimes into two heads: non-cognizable and cognizable. In the case of non-cognizable crimes, it is left to the affected parties to pursue action in Courts. In contrast, in the case of cognizable crimes, the police has the responsibility to take prompt action on receipt of a*
complaint or of credible information. Cognizable crimes are again sub-divided as those falling under either the Indian Penal Code (IPC), or under the Special and Local Laws (SLL). Following literature, we consider only IPC crimes. The reason is that the motivations and enforcement mechanism for SLL crimes are different from that of IPC crimes. Our data source is the National Crime Records Bureau’s annual publication, “Crime in India” which covers the period 1953-2009.

Public Service
- Educational Expenditure (per capita and also % of total local government expenditure)\(^3\)
- Health Expenditure (per capita and also % of total local government expenditure)\(^3\)

While we wish to measure the governance outcomes, we understand that investment in education and health are long-term and beneficial effects take years to appear in the data. This is why we have chosen to use expenditure levels of the state instead as a proxy measurement.

Social Equality
- Level of Poverty\(^4\)

While there may be debate over desired levels of relative income inequality, there is little doubt that society aims to eliminate absolute poverty. It is a desirable end-result outcome of development, regardless of political system. Our data is based on uniform recall period consumption surveys and indicates the percentage of the state population below the state poverty line.

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3 Statistics provided by the Reserve Bank of India.

4 Gini coefficient was also available for certain periods. Poverty ratios and poverty-line related data also available for certain periods. Press Information Bureau, Government of India and Rural Development Statistics, National Institute of Rural Development, Government of India.
HOW DOES POLITICIAN QUALITY RELATE TO GOVERNANCE QUALITY?

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| Meghalaya   | 0 | 1 | 0 | 1 |
| Mizoram     | 0 | 1 | 0 | 1 |
| Nagaland    | 0 | 1 | 0 | 1 |
| Orissa      | 1 | 1 | 0 | 2 |
| Punjab      | 0 | 1 | 0 | 1 |
| Rajasthan   | 0 | 1 | 0 | 1 |
| Sikkim      | 1 | 0 | 0 | 1 |
| Tamil Nadu  | 0 | 1 | 0 | 1 |
| Tripura     | 1 | 1 | 0 | 2 |
| Uttar Pradesh| 0 | 1 | 0 | 1 |
| Uttarakhand / Uttarakand | 0 | 1 | 0 | 1 |
| West Bengal | 0 | 1 | 0 | 1 |

Union Territories

| Andaman and Nicobar Islands | 0 | 0 | 0 | 0 |
| Chandigarh                | 0 | 0 | 0 | 0 |
| Dadra and Nagar Haveli    | 0 | 0 | 0 | 0 |
| Daman and Diu             | 0 | 0 | 0 | 0 |
| Lakshadweep               | 0 | 0 | 0 | 0 |
| National Capital Territory of Delhi | 0 | 1 | 0 | 1 |
| Puducherry / Pondicherry | 1 | 1 | 0 | 2 |

For the 2008/2009 election cycle, considerably less data was available from these primary sources as the affidavits are currently in the process of being digitized and have yet to be uploaded onto the websites of our the above primary sources.

3 Preliminary Analysis of Data

We proceed by first conducting a preliminary analysis of the data, analyzing the relationships between our governance indicators and each politician characteristic. Our approach involves inspecting scatter graphs for each pair of variables as well as calculating correlation coefficients. A summary of our findings is presented below.

3.1 Politicians’ Education (COLLEGE: percentage of legislators with at least college education)

There appears to be a positive and significant relationship between COLLEGE and the percentage of state budget spent on health. A state with 10% more college-educated legislators is associated with a 0.42% increase in the proportion of state budget channelled to health. We found this particularly peculiar as we expected to find a stronger correlation between COLLEGE and education spending than between COLLEGE and health spending. We investigate whether this finding holds up in a full regression specification.

3.2 Age

There appears to be no significant relationship between age and any of our governance indicators.
3.3 Crime (CRIME: average number of criminal charges per legislator)

We observe a significant negative relationship between CRIME and both education and health spending per capita. However, our results were confounded by the strong finding (with a p-value of 0.001) that budget share allocated to education was higher in states with higher CRIME. We posit the following explanation for this result: by regressing per capita state budget against CRIME, we find that states with smaller per capita budgets are associated with higher levels of politician criminality. Each additional Rs. 100 of state budget per capita was associated with 0.78 fewer criminal convictions per legislator (P-value of 0.018). We suspect that smaller per capita budgets constrain legislators to a greater extent, pushing them to channel a larger percentage of the tighter budget to a ‘protected’ area like education.

Perhaps most surprisingly, however, we do not find a significant relationship between overall state-level crime rates and the number of criminal convictions per legislator.

3.4 Wealth (in Rs Lakhs)

We find a negative relationship between wealth and the spending on health and education, with statistically significant negative coefficients for health spending as a percentage of state budget and education spending per capita. We also find that states with wealthier politicians had lower poverty, a result that is statistically significant but perhaps only serves to reflect the overall wealth of the state.

3.5 Male

Male politicians seem to be associated with higher expenditure on health, and less on education. We closely examine whether these results hold up in a full regression framework as they contradict the findings of Chattopadhyay and Duflo (2004), who studied village governments in the Indian state of West Bengal. A full regression framework would allow us to make a stronger conclusion on whether it is fundamentally being male that has led to this – or if our results have arisen due to other characteristics of politicians that are highly correlated with being male.

4 Econometric Strategy

Our preliminary goal is to test for correlations, so that we might gain some insight into the complex relationships between politician attributes and governance outcomes. We see this as an initial step towards establishing causation. A description of the difficulties we faced in trying to establish causation may be found in Appendix 1.

Our econometric strategy, then, is to run variants of the following basic equation:

\[
\text{GOV}(i, t) = a + \text{COLLEGE}(i, t) \beta_1 \text{ (college)} + \text{AGE}(i, t) \beta_1 \text{ (age)} + \text{CRIME}(i, t) \beta_1 \text{ (crime)} + \text{WEALTH}(i, t) \beta_1 \text{ (wealth)} + \text{MALE}(i, t) \beta_1 \text{ (male)} + \text{TIME}(t) \beta_1 \text{ (time)} + X(i, t) \beta_1 (x) + \varepsilon \text{ (GOV)}(i, t),
\]
where \( i \) and \( t \) are indexes for state and time respectively. Further,

\[
\begin{array}{|c|l|}
\hline
\text{GOV} (i, t) & \text{is an indicator of governance. Rather than using an aggregated index of indicators to measure governance, we intend to run the regression equation separately using each of the different governance indicators, as identified above, in turn.} \\
\hline
\text{COLLEGE} (i, t) & \text{is the proportion of MLAs with college level education or higher} \\
\hline
\text{AGE} (i, t) & \text{is the average age of MLAs} \\
\hline
\text{CRIME} (i, t) & \text{is the average number of criminal accusations against MLAs} \\
\hline
\text{WEALTH} (i, t) & \text{is the average of the differences between MLAs’ personal asset and liabilities (Rs Lakhs).} \\
\hline
\text{MALE} (i, t) & \text{is the proportion of MLAs who are male} \\
\hline
\text{TIME} (t) & \text{is a dummy to capture exogenous effects that affect all states which occur at time } t \\
\hline
\text{X} (i, t) & \text{is a } 4 \times 1 \text{ vector of other control variables that might affect governance:} \\
& \bullet \text{MAJ} (i,t), \text{the proportion of seats held by the majority party} \\
& \bullet \text{MAJRATIO} (i,t), \text{the number of seats held by the majority party as a fraction of the seats held by the second largest party} \\
& \bullet \text{POPN} (i,t), \text{the population of state } i \text{ at time } t \\
& \bullet \text{GDP1980} (i), \text{the state’s GDP in 1980} \\
\hline
\varepsilon (\text{GOV})(i, t) & \text{is an error term} \\
\end{array}
\]

This equation allows us to establish how each indicator is related to politician attributes, as opposed to some overall measure of governance – thus, we will be able to pick up the relationship between politicians and individual governance components even if there is no overall relationship between politicians and a combined measure of governance. Furthermore, using each indicator in turn allows us to avoid arbitrarily assigning weights, and thus relative values, to various governance indicators.

As GDP1980 data is not available for 6 of our data points, we consider specifications both with and without GDP1980 as a control variable. For comparison, we also run a separate specification which excludes all controls.

4.1 Limitations of our current strategy

Our strategy faces at least two limitations.

First, complex group interactions between members of a legislature are likely to constrain the ability of each parliamentarian to influence policy-making. Intra- and inter-party dynamics may restrict the extent to which a capable, clean legislator can improve governance; and network externalities are embedded in the policy-making process: for example, a qualified politician might raise the productivity of his fellow legislators by boosting the standard of debate.

A second concern is measurement error. Because our data on politician characteristics comes from self-sworn affidavits, false declarations may have taken place. For instance, politicians might have under-declared their assets to evade taxes. We have two reasons not to be unduly perturbed by this problem: first, widespread falsehoods are unlikely, since all affidavits were signed in a court of law and verified by a notary public, and because this information was made public, sometimes published by national newspapers. Secondly, when misstatements do occur, it is reasonable to expect the same pattern of deviations across all politicians. For instance, we do not expect any politicians to over-declare their assets. This should preserve the structure of the relationship between politician attributes (as we measure it) and governance.
5 Results
Here we present an overview of the findings; relevant tables are in Appendix 2.

5.1 Politician criminality has an ambiguous relationship with governance. We find that, conditional on our other controls, an increase in average number of criminal charges per legislator by 1.0 is associated with a larger share of the public budget devoted to education (10.8% larger, significant at the 10% level), but with smaller per capita education spending (Rs 91.9 less, significant at the 10% level). As explained on page 10, we suspect that the latter relation is driven by states with small budgets having disproportionately more criminal politicians.

In the full regression framework, the link between criminality and health expenditure observed previously breaks down. Our results in Table 6 supported our preliminary finding that politician criminality shows no strong relationship with aggregate state-level crime rates. We believe this points to the importance of disaggregating crime rates into types of crime – like Chemin (2008), who uses a regression discontinuity framework to estimate that the election of a criminal politician increases by 25% the incidence of those crimes most commonly committed by criminal politicians (like assault).

5.2 Politician wealth appears to have a negative relationship with governance. The coefficients on wealth for all four of the governance indicators relating to health and education spending (Tables 1 – 4) are negative, although they are only significant (but very strongly so) for the budget share allocated to health care. We postulate that wealthy politicians seem to be associated with worse governance, even though our study of related literature has not uncovered any existing theories explaining why this might be true.

5.3 Gender also seems to have a significant relationship with governance. Per capita health care expenditure was found to increase with the proportion of males in government (10% more male parliamentarians are associated with Rs 298 higher expenditure, a statistically significant result). Yet, we also found that an increase in the proportion of males is associated with a lower budget share for education (10% more male legislators are associated with 3.9% greater expenditure, a statistically significant result). Our results on education are in line with the findings of Clots-Figueras (2007), but run counter to those of Chattopadhyay and Duflo (2004). Again, the distinction between village and state level governments arises: Chattopadhyay and Duflo (2004) study village-level governments, while Clots-Figueras (2007) studies state level governments. This suggests that there is evidence that there are important differences between the ways in which politician characteristics relate to state-level governance and to village-level governance.

5.4 Age was not observed to possess any relationship found with all our governance indicators, just as our preliminary analysis had suggested.
5.5 Politician education level shows no strong relationship with any governance indicator. In particular, the positive association we had observed earlier between politician education level and the proportion of state budget channelled to health is in the full regression specification. That we found no relationship between politician education level and any governance indicator is surprising, as it runs counter to the work of Besley et al (2005) – though, admittedly, their paper studied village-level governments, an altogether different beast whose political processes may impose far fewer constraints on sitting politicians.

A possible reason we considered for the lack of results for both education and age across governance indicators is multicollinearity. AGE and COLLEGE are strongly positively correlated, a relationship that is significant at the 1% level as can be seen in the following scatter chart and regression output.

To deal with this possibility, we conducted an F-test on COLLEGE and AGE, using the full regression specification which includes all control variables. The results, as presented below, do not allow us to reject the hypothesis that both the coefficients on COLLEGE and AGE are equal to zero.

Another interesting finding, although outside the scope of our question, is that an increase in the proportion of seats held by the majority party is also associated with a higher level of per capita health care expenditure, but a lower budget share for education.
### Governance Indicator

<table>
<thead>
<tr>
<th>Governance Indicator</th>
<th>P-value of F-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health spending per capita</td>
<td>0.6860</td>
</tr>
<tr>
<td>Health expenditure as percentage of budget</td>
<td>0.7143</td>
</tr>
<tr>
<td>Education spending per capita</td>
<td>0.2071</td>
</tr>
<tr>
<td>Education expenditure as percentage of budget</td>
<td>0.2822</td>
</tr>
<tr>
<td>Proportion of population below poverty line</td>
<td>0.5629</td>
</tr>
<tr>
<td>Incidence of IPC Crime</td>
<td>0.3109</td>
</tr>
</tbody>
</table>

### References


Besley, Timothy, Marta Reynal-Querol. 2009. “Do Democracies Select more educated leaders?”


Wrasai, Phongthorn. 2005. “Politicians’ Motivation, Role of Elections and Policy Choices” Tinbergen Institute, Tinbergen Institute Discussion Papers: 05-050/1

Appendix 1: Difficulties with Establishing Causality

In arriving at our econometric strategy, there are several concerns which we have identified and attempted to overcome. The main econometric difficulty in this sort of study is, as ever, in empirically establishing the direction of causation, if it exists at all.

The first approach we considered was the use of instrumental variables (IV). This required us to identify variables that are correlated with politician attributes and only affect governance through them. There has not been a great deal of previous work in measuring
politicians’ attributes so we do not have the benefit of other authors’ ideas for suitable IVs. Nevertheless, we attempted to identify a suitable IV by examining legislative changes which may produce an exogenous variation in politician characteristics which do not affect our indicators of governance directly.

Initially, we felt that the amendment to the People’s Representation of the People Act (R.P Act) in 1951, prohibiting those with convictions of more than 2 years from contesting an election, would be a suitable legislative change. This clearly fit the criteria for our IV. However, this IV suffered from 2 problems which eventually deemed it unsuitable. Firstly, India only gained independence in 1947, which meant that we would not have sufficient data pre-implementation. Secondly, it is also public knowledge that the act is rather poorly enforced in India, with appeals and reprieves common place.

We also tried using the Right to Information (RTI) Act (2005), as a source of discontinuity since its introduction and the subsequent release of personal data on political candidates would have improved the degree to which voters would discern candidate quality. However, this method was subject to the problem that the RTI Act made information on so many other facets available that it could have improved governance without affecting political selection, rendering it unworkable as an IV.

Another strategy we considered was to adopt a method used by Clots-Figueras (2007). She avoids the possibility of governance affecting the selection of female politicians by limiting observations to politicians that won elections by very small majorities (over male politicians), arguing that in close elections, the winner is essentially randomly selected. Unfortunately, we soon realised we are unable to implement this technique in our study, simply because India has too few states to include only those in which most MLAs were elected by small margins.

We also considered running a specification as follows:

\[
\Delta \text{GOV}(i, t) = \text{COLLEGE}(i, t) \beta(\text{college}) + \text{AGE}(i, t) \beta(\text{age}) + \text{CRIME}(i, t) \beta(\text{crime}) \\
+ \text{WEALTH}(i, t) \beta(\text{wealth}) + \text{MALE}(i, t) \beta(\text{male}) \\
+ \text{FIXEDSTATE}(i) \beta(\text{fixedstate}) + \text{TIME}(t) \beta(\text{time}) \\
+ X(i, t) \beta(x) + \varepsilon(\text{GOV})(i, t)
\]

where \(i\) indexes states, \(t\) indexes time, and

<table>
<thead>
<tr>
<th>GOV ((i, t))</th>
<th>is an indicator of governance. Rather than using an aggregated index of indicators to measure governance, we intend to run the regression equation separately using each of the different governance indicators, as identified above, in turn.</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLLEGE ((i, t))</td>
<td>is the proportion of MLAs with college and above education</td>
</tr>
<tr>
<td>AGE ((i, t))</td>
<td>is the average age of MLAs</td>
</tr>
<tr>
<td>CRIME ((i, t))</td>
<td>is the average number of criminal accusations against MLAs</td>
</tr>
<tr>
<td>WEALTH ((i, t))</td>
<td>is the average of the differences between the personal asset and liabilities of MLAs</td>
</tr>
<tr>
<td>MALE ((i, t))</td>
<td>is the proportion of MLAs who are male</td>
</tr>
<tr>
<td>TIME ((t))</td>
<td>is a dummy to capture exogenous effects that affect all states which occur at time (t)</td>
</tr>
<tr>
<td>FIXEDSTATE ((i))</td>
<td>is a dummy to capture the state fixed effects</td>
</tr>
<tr>
<td>(X(i, t))</td>
<td>is a (P \times 1) vector of other control variables that might affect governance</td>
</tr>
<tr>
<td>(\varepsilon(\text{GOV})(i, t))</td>
<td>is an error term</td>
</tr>
</tbody>
</table>

The intuition behind such a specification was that the regressors that we have deployed as indicators of politician quality (crime rate, education, experience etc.) are long-term attributes that have been established prior to the realisation of our measurements of
governance as modelled by the first differences. In other words, while the level of our governance variable might be correlated with past levels of the governance variable (and is thus an endogenous variable), one might reasonably expect that the changes in the governance variable have no causal link to our indicators of politician quality. This then allows us to argue for causality.

For instance, it is unlikely that an increase in the level of state education spending in any given year would have any immediate impact on the education level of politicians in that year or that the changes in the quality of life (proxied by HDI) in any given year would have any immediate impact on politician wealth in that year.

However, despite this approach being tempting, it has a major failing: One might argue that it is unfair to judge the performance of politicians in terms of the changes in our governance variable. Effectively, we would be comparing the performance of current MLAs to the previous MLA in their state. If the transition was from a “outstanding” MLA (for instance, one which decided to invest heavily in education), the next MLA that comes after them is likely to be judged as a “poor” MLA (as it might not have invested as much on education) even though it might be just as good (in fact, it could even be the same MLA which simply kept the same “good” decisions it had made before). The converse is also true for “poor” MLAs which might be incorrectly judged to be “good”.

Appendix 2: Tables of Results

Table 1

<table>
<thead>
<tr>
<th>Per capita Health spending (Rs)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-10.0814 (0.435)</td>
<td>-5.23532 (0.747)</td>
<td>6.694163 (0.731)</td>
</tr>
<tr>
<td>Crime</td>
<td>-41.41114 (0.259)</td>
<td>-20.8902 (0.637)</td>
<td>-116.1455 (0.023**)</td>
</tr>
<tr>
<td>Wealth</td>
<td>-0.4602007 (0.127)</td>
<td>-0.2185476 (0.513)</td>
<td>-0.2682208 (0.478)</td>
</tr>
<tr>
<td>College</td>
<td>-23.45498 (0.964)</td>
<td>153.3681 (0.798)</td>
<td>-68.16704 (0.926)</td>
</tr>
<tr>
<td>Male</td>
<td>2978.882 (0.005***)</td>
<td>3916.91 (0.001***)</td>
<td>4011.094 (0.002***)</td>
</tr>
<tr>
<td>Controls excludingGDPT1980</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>GDP1980</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Size of sample</td>
<td>27</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.8183</td>
<td>0.7073</td>
<td>0.4408</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.7047</td>
<td>0.5928</td>
<td>0.3373</td>
</tr>
</tbody>
</table>

* = significant at 10% level ** = significant at 5% level *** = significant at 1% level

Table 2

<table>
<thead>
<tr>
<th>Health spending as a percentage of state budget</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.0171257 (0.801)</td>
<td>0.008262 (0.908)</td>
<td>0.0693196 (0.349)</td>
</tr>
<tr>
<td>Crime</td>
<td>0.0115378 (0.952)</td>
<td>0.1597401 (0.414)</td>
<td>0.0443543 (0.810)</td>
</tr>
<tr>
<td>Wealth</td>
<td>-0.0033873 (0.040**)</td>
<td>-0.003477 (0.025**)</td>
<td>-0.001913 (0.185)</td>
</tr>
<tr>
<td>College</td>
<td>1.744413 (0.531)</td>
<td>-0.1744587 (0.947)</td>
<td>1.614 (0.562)</td>
</tr>
<tr>
<td>Male</td>
<td>5.123542 (0.308)</td>
<td>2.741721 (0.529)</td>
<td>4.262557 (0.336)</td>
</tr>
<tr>
<td>Controls excludingGDPT1980</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>GDP1980</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Size of sample</td>
<td>27</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.6098</td>
<td>0.4373</td>
<td>0.2090</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.3660</td>
<td>0.2171</td>
<td>0.0625</td>
</tr>
</tbody>
</table>

* = significant at 10% level ** = significant at 5% level *** = significant at 1% level
### Table 3
Per capita Education spending (Rs)

<table>
<thead>
<tr>
<th></th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-30.50952 (0.105)</td>
<td>-8.679998 (0.794)</td>
<td>-17.61001 (0.648)</td>
</tr>
<tr>
<td>Crime</td>
<td>-91.97575 (0.083*)</td>
<td>-137.1652 (0.794)</td>
<td>-230.8126 (0.648)</td>
</tr>
<tr>
<td>Wealth</td>
<td>-0.3842451 (0.354)</td>
<td>-0.2882068 (0.673)</td>
<td>-1.33502 (0.081*)</td>
</tr>
<tr>
<td>College</td>
<td>-33.86139 (0.963)</td>
<td>153.3681 (0.777)</td>
<td>-1304.818 (0.374)</td>
</tr>
<tr>
<td>Male</td>
<td>1780.354 (0.188)</td>
<td>3916.91 (0.725)</td>
<td>644.6759 (0.780)</td>
</tr>
</tbody>
</table>

Controls excluding GDP1980
- Yes
- Yes
- No

GDP1980
- Yes
- No
- No

Size of sample
- 27
- 33
- 33

R²
- 0.8880
- 0.5886
- 0.2661

Adjusted R²
- 0.8180
- 0.4276
- 0.1302

* = significant at 10% level
** = significant at 5% level
*** = significant at 1% level

### Table 4
Education spending as a percentage of state budget

<table>
<thead>
<tr>
<th></th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.3552719 (0.129)</td>
<td>0.3162521 (0.131)</td>
<td>0.203006 (0.361)</td>
</tr>
<tr>
<td>Crime</td>
<td>1.08135 (0.100*)</td>
<td>1.204225 (0.039**)</td>
<td>1.746039 (0.004****)</td>
</tr>
<tr>
<td>Wealth</td>
<td>-0.0080347 (0.130)</td>
<td>-0.0068675 (0.111)</td>
<td>-0.0088031 (0.047***)</td>
</tr>
<tr>
<td>College</td>
<td>-8.853405 (0.343)</td>
<td>-51.44996 (0.499)</td>
<td>-3.308819 (0.692)</td>
</tr>
<tr>
<td>Male</td>
<td>-39.18386 (0.028**)</td>
<td>-27.74695 (0.034**)</td>
<td>-22.27367 (0.100*)</td>
</tr>
</tbody>
</table>

Controls excluding GDP1980
- Yes
- Yes
- No

GDP1980
- Yes
- No
- No

Size of sample
- 27
- 33
- 33

R²
- 0.7160
- 0.6569
- 0.4708

Adjusted R²
- 0.5385
- 0.5226
- 0.3727

* = significant at 10% level
** = significant at 5% level
*** = significant at 1% level

### Table 5
Percentage of Population below Poverty Line

<table>
<thead>
<tr>
<th></th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.4624265 (0.500)</td>
<td>0.3694997 (0.614)</td>
<td>-17.61001 (0.648)</td>
</tr>
<tr>
<td>Crime</td>
<td>1.389922 (0.471)</td>
<td>0.750653 (0.706)</td>
<td>-230.8126 (0.023***)</td>
</tr>
<tr>
<td>Wealth</td>
<td>-0.0068974 (0.656)</td>
<td>-0.0159892 (0.338)</td>
<td>-1.33502 (0.081*)</td>
</tr>
<tr>
<td>College</td>
<td>14.65676 (0.599)</td>
<td>15.40038 (0.600)</td>
<td>-1304.818 (0.374)</td>
</tr>
<tr>
<td>Male</td>
<td>55.12243 (0.276)</td>
<td>49.92232 (0.327)</td>
<td>644.6759 (0.780)</td>
</tr>
</tbody>
</table>

Controls excluding GDP1980
- Yes
- Yes
- No

GDP1980
- Yes
- No
- No

Size of sample
- 27
- 33
- 33

R²
- 0.5050
- 0.3395
- 0.2204

Adjusted R²
- 0.1957
- 0.0423
- 0.0880

* = significant at 10% level
** = significant at 5% level
*** = significant at 1% level

### Table 6
Incidence of IPC crime (per 100,000)

<table>
<thead>
<tr>
<th></th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-7.47597 (0.211)</td>
<td>-5.757994 (0.320)</td>
<td>-3.145555 (0.577)</td>
</tr>
<tr>
<td>Crime</td>
<td>2.950496 (0.857)</td>
<td>11.23014 (0.474)</td>
<td>7.385633 (0.601)</td>
</tr>
<tr>
<td>Wealth</td>
<td>-0.0057097 (0.966)</td>
<td>-0.1023258 (0.387)</td>
<td>0.0812939 (0.456)</td>
</tr>
<tr>
<td>College</td>
<td>-85.70852 (0.719)</td>
<td>-10.4576 (0.961)</td>
<td>70.09148 (0.742)</td>
</tr>
<tr>
<td>Male</td>
<td>-425.48884 (0.324)</td>
<td>-241.0749 (0.491)</td>
<td>-198.6847 (0.556)</td>
</tr>
</tbody>
</table>

Controls excluding GDP1980
- Yes
- Yes
- No

GDP1980
- Yes
- No
- No

Size of sample
- 27
- 33
- 33

R²
- 0.4574
- 0.2571
- 0.0454

Adjusted R²
- 0.1183
- 0.0418
- 0.1374

* = significant at 10% level
** = significant at 5% level
*** = significant at 1% level
IMF Precautionary Arrangements: Determinants of Entry

Michael Karno
Georgetown University

Abstract

Despite a vast body of literature on the motivation for entry into IMF programs and the effects of these programs, surprisingly little empirical research has been conducted distinguishing programs by designation as either precautionary or non-precautionary. This paper addresses a gap in the literature by using a dynamic logit model over a panel of middle- and upper-income countries over the period 1992-2005 to identify political and economic variables significant to the decision to enter into either a precautionary or non-precautionary IMF program. Entry determinants for precautionary and non-precautionary arrangements are found to be different, with results for non-precautionary mirroring results of an all-arrangement sample. Political and economic variables are only found to be significant in explaining entry into precautionary arrangements when conditioned on directly succeeding participation in another IMF program. This provides some evidence for their use by executives facing divided legislatures to continue momentum for fiscal and monetary reform after completion of a successful IMF program.

Acknowledgements

I would also like to offer special thanks to Professor James Raymond Vreeland of Georgetown University, whose own work motivated this paper and who assisted me at key points in developing its methodology and focus.

1 Introduction

Why do governments approach the International Monetary Fund (“IMF” or “the Fund”) for assistance, and what factors, in turn, influence the IMF to offer assistance programs to its member nations? These questions have recently been the focus of an emerging body of literature because their answers address fundamental questions. These include the influence of individuals and states on the design of programs managed by international organizations; how the legislative-executive relationship plays out at the international level in two-level games (Putnam 1988); and whether programs implemented by international organizations are successful.

This paper seeks to enhance understanding of these more general points of inquiry by examining the motivation for entry into IMF programs based on their classification.
as precautionary or non-precautionary. Previous literature attempting to achieve a more nuanced approach to understanding IMF program entry motivation has focused on disaggregating results by program structure (Mody and Savaria, 2003; Bird and Rowlands, 2005a). These papers answer why countries and the IMF choose a traditional Stand-By Arrangement (SBA) as opposed to an Extended Funds Facility (EFF) or other programs. This research has improved strategic knowledge for countries and the Fund. The lack of separation by the country’s drawing intention (i.e. whether the country intends to draw funds from the facility immediately), however, leaves unanswered questions about how the country views the arrangement. Yet most research makes no attempt to disaggregate programs by drawing intention, casually assuming the standard IMF relationship where funds are immediately dispersed in exchange for promises of future compliance with a package of monetary and fiscal policy conditions (\textit{ex ante} conditionality).

Under a precautionary arrangement, a country accepts IMF conditionality (usually fiscal and monetary conditions) in exchange for a non-drawing facility. A non-precautionary arrangement, on the contrary, is defined as a program where the country declares its initial intention to draw IMF funds \textit{and} follows through on this intention.\footnote{If a country never draws, it is considered precautionary.} A precautionary facility is intended only for emergency purposes, similar to a line of credit that a firm uses for liquidity purposes. Given the rather stark difference in program intention for precautionary arrangements, compounded with superior policies and initial macroeconomic conditions associated with these programs, it is surprising how little empirical research has been conducted to discern the motivation for the IMF to offer such agreements and countries to enter them (IMF 2006), as well as differences in their economic (Diaz-Cassou et al., 2006) or political effects.

By separately testing entry motivation for precautionary and non-precautionary IMF programs using a dynamic logit model with time-series data, this work begins to address this gap in the literature. The results show entry into non-precautionary arrangements to be similar to the all-arrangement sample. For precautionary arrangements, entry motivation is not explained by selected variables when no IMF program precedes it, but can be explained by both political and economic factors when preceded by an IMF program. The significance of these variables depends on the preceding program type (precautionary or non-precautionary).

The answers to the questions posed in the paper are important for the IMF. As the Fund seeks to enhance its toolbox, examining the logic for why countries would opt for an agreement involving conditionality without receiving funds is crucial to comprehending how executives might seek to use the Fund in the future.

The paper will proceed as follows: Section 2 will review the literature on why countries and the IMF enter into programs. Section 3 provides background on precautionary arrangements. Section 4 explains the methodology and discusses the variables used in the empirical analysis. Section 5 presents and discusses the results. Section 6 offers concluding remarks.
2 Literature review

Diverging interests motivate IMF program entry for both governments and the Fund. This has inspired research to discern organization-specific objectives and those shared by both sides. This latter line of research has centered on the attainment of specific economic outcomes for nations who sign IMF agreements. The official purposes of IMF programs are made explicit in the IMF Articles of Agreement. Chief among these is “To give confidence to members by making the general resources of the Fund temporarily available to them under adequate safeguards” (IMF Articles of Agreement, Article I.i). This goal is crucial in justifying the existence of the Fund, whose credibility depends on its successful execution. Governments also have the responsibility to promote the economic welfare of their citizens. When they turn to an IMF program, they too are risking their credibility upon its success. Therefore, a primary motivation for entering into such programs is clearly the attainment of beneficial economic outcomes. There is, however, a body of evidence suggesting IMF programs have adverse consequences for participants (Bird, 2001).

One area where IMF involvement does appear to be successful is the prevention of capital account crises. The IMF has played a prominent role in a number of emerging currency crises, including the Mexican peso crisis of 1994 and the Russian ruble crisis of 1998. Many critics of the Fund have claimed its programs have failed to abate currency crises and, in fact, may have made them worse (Stiglitz, 2002). On the contrary, after controlling for currency reserves, Ramakrishnan and Zalduendo (2006) find funds disbursed under IMF programs have a positive effect in averting capital account crises in member nations facing reserve shortfalls. Further, the effects of stronger policies and the IMF “seal-of-approval” are significant after controlling for total reserves.

An IMF agreement can also be sought as a signal of commitment to sound fiscal and monetary policies to other economic participants. In the case of developing countries, this could be an attempt to attract foreign aid from wealthy donor nations. Bird and Rowlands (2007) suggest IMF programs can help developing countries receive additional foreign aid.

Another purpose of an IMF program is to signal a credible commitment to addressing fiscal and monetary policy concerns to foreign investors, who are expected to increase private capital flows in response. Unfortunately, this effect does not appear to work in practice. Evidence implies IMF programs are not very successful as commitment devices (Mody and Saravia, 2003). Some studies show IMF programs have no effect on private capital inflows (Bird and Rowlands, 2002). Others indicate catalysis is possible only under certain circumstances, depending on factors like program type (Bird and Rowlands, 2005) or whether the program is precautionary (Diaz-Cassou, et al., 2006). Further research shows IMF programs may actually reduce FDI flows (Jensen, 2004) or that negative effects of program austerity outweigh any positive signaling effect (Edwards, 2006). The evidence is thus ambiguous at best as to whether countries are able to effectively signal a credible commitment to policy reform by signing an IMF agreement.

Governments and the IMF are ultimately rationalizing these programs as an attempt to promote economic growth.2 While some early results suggested Fund programs are 2 In 1990, the former Managing Director of the IMF, Michael Camdessus remarked, “Our primary objec-
success in meeting this goal (Conway, 1994), more recent studies do not lend support to this conjecture (Dreher, 2005). Przeworski and Vreeland (2000) find this could be because of the inability of countries to compensate for the austerity inherent in implementing the IMF’s conditions, while Barro and Lee (2005) suggest reduction in democracy and rule of law resulting from IMF programs might also contribute. These findings are consistent with the claims of some of the IMF’s most vociferous critics (Klein, 2007). This lack of unambiguous evidence supporting the supposed program motivation suggests non-economic reasons likely influence participation.

Putnam’s (1998) two-level game framework can assist in understanding why governments choose to enter IMF programs. In contrast to trade agreements, where conflicting priorities between the legislative and executive branches of government can reduce the likelihood of achieving an agreement (Milner and Rosendorff, 1997), disagreement can actually enhance the probability of an IMF agreement being signed. This is because IMF programs are signed directly between a country’s executive branch and the Fund. They are not considered treaties, which would require ratification by one or more houses in the legislature.

The number of veto players in a political system (Tsebelis, 1995) may be one reason why executives sign IMF agreements. Drazen (2002) models how executives can use IMF programs to circumvent opposition to economic reform packages from domestic legislatures by accepting conditionality. The findings of Vreeland (2005) demonstrate the validity of this model, showing an increase in the number of veto players enhances the likelihood of an executive signing an IMF agreement. The success of this strategy is contingent upon the presence of high costs of noncompliance with IMF-imposed conditions. Edwards (2005) finds failed implementation of IMF agreements leads to significant capital flight (although there is no indication that compliance with conditions actually enhances capital flows). Because of these high costs, executives are acting rationally when they choose to sign agreements to push through economic policies unpopular with their legislatures.

While success in attaining preferred monetary and fiscal policy changes is one motivating factor, a more fundamental question for executives (whose primary goal is to remain in power as long as possible) is how IMF agreements affect their re-election prospects. Executives could use IMF agreements to identify a scapegoat for poor economic conditions within their country; however, Smith and Vreeland (2003) find that only leaders who inherit IMF programs from their predecessor are able to successfully use this argument to enhance their re-election probabilities. In contrast to the domestic political aims of executives who sign IMF agreements, the IMF’s own motivations are quite different. Initial macroeconomic conditions do appear to play a role (Knight and Santaella, 1997), but these do not fully account for all variation. The IMF is not a monolithic entity with homogeneous preferences and interests. It is an international organization controlled by its shareholders (i.e. the major world global economies), which serves as their agent. This does not, however, guarantee it will act perfectly in accordance with their preferences (Vaubel 1986).

It has been suggested vested interests of international organizations (like the IMF) active is growth.” (Przeworski and Vreeland 2000)
make it impossible for governments (the principals) to effectively exercise control over the organization’s actions because of high costs of information, distorted incentives, and a tendency among the organization’s staff to prioritize institutional goals over national interests (Vaubel 2006). In the case of the IMF, this could mean offering loans in excess of the needs of member nations in order to justify staffing levels or possibly even the existence of the Fund itself.

Research on the IMF demonstrates the influence of the bureaucracy in IMF decision-making to be rather limited. Fratianni and Pattison (2005) find the IMF staff’s influence is relegated to less important decisions, while the crucial decisions are made in accordance with the preferences of the G7 countries (the IMF’s largest shareholders). In a similar vein, Copelovitch (2007) finds the role of IMF staff, as measured by loan size, is reduced when the preferences of the G5 countries are unified but is enhanced when the largest shareholders are in disagreement.

Because the IMF’s largest shareholders do exercise effective control over key decisions, it is useful to examine how this influence has manifested in agreements offered by the IMF to member nations. A number of studies identify a country’s alignment with US foreign policy as a major contributing factor to lending decisions (Oatley and Yackee, 2004, Anderson et al., 2005). Thacker (1999) shows countries that vote with the US at the United Nations General Assembly are more likely to receive a loan than those who do not. Other studies have indicated IMF conditionality could be lowered or not enforced for countries with a closer political and economic relationship to the US (Woods, 2002 and 2004, Dreher and Jensen, 2007, Vreeland 2005). However, this view is not universal. Dreher and Sturm (2006) suggests voting with G7 countries in the General Assembly increases the chance of receiving an IMF loan, but voting with the US has no effect by itself. The results of Dreher, Sturm, and Vreeland (2009) demonstrate countries with a rotating seat on the United Nations Security Council (UNSC) to be more likely to receive an IMF package. They do not indicate whether the US or a coalition of the US, UK and France holds the preponderance of influence, but they do provide another channel through which the Fund’s largest shareholders influence lending decisions.

3 Precautionary arrangements

Before testing the differences of entry determinants for non-precautionary and precautionary arrangements, it is useful to provide some background on precautionary arrangements. The IMF has offered precautionary arrangements since 1987 as a means of improving investor confidence in participating countries to help resolve near-term capital account pressure. A facility is put in place for use by the member nation if conditions deteriorate and they are unable to borrow from the international capital markets to meet a reserve shortfall. This almost always comes in the form of a Stand-By Arrangement (SBA). The country is not supposed to immediately draw the funds. In fact, this agreement category is defined by a country’s declaration to not draw on their facility unless absolutely necessary.
Over the period 1992-2005, 24 countries signed 52 precautionary arrangements. In most cases, the member nations never drew funds from the facility; however, there were 6 cases where the government did draw. This was mostly due to the emergence of capital account crises after the country had already entered into the agreement. Three of these six cases (Argentina in 2000, Brazil in 2001, and the Philippines in 1998) were unusual because the facility size was more than 100% of the country’s IMF quota. While this is relatively normal for non-precautionary arrangements, only six precautionary agreements since 1987 had facility sizes in excess of the member state’s quota (see Table 7).

An important feature of precautionary arrangements is the presence of conditionality. The IMF stated in a 2003 report (IMF 2003) that conditionality for precautionary arrangements is exactly the same as non-precautionary arrangements. However, its own 2006 study indicated the number of quantitative performance criteria to be identical between categories, but that structural conditionality was lower for precautionary arrangements, ascribing this difference to superior initial macroeconomic conditions and policies in countries requesting such arrangements.

Despite lower conditionality for precautionary arrangements, countries are still accepting the external imposition of IMF conditions without receiving funds in return. Thus, the prevention of near-term currency crises, the only success of IMF programs discovered in the literature, is clearly not a goal of these programs. As mentioned earlier, precautionary programs appear to be more successful at mobilizing private capital flows, including FDI (Diaz-Cassou, et al., 2006), but there is little evidence of other beneficial economic effects.

In the wake of the global financial crisis in 2009, the IMF decided to reform the Precautionary SBA program, renaming it the High-Access Precautionary Arrangement (HAPA). HAPAs feature reduced conditionality and greater flexibility (they are signed for shorter periods). To date, three countries (Costa Rica, El Salvador, and Guatemala) have entered into these modified agreements. The IMF’s decision to reform precautionary programs may be based on faulty assumptions. What if countries are seeking precautionary arrangements because of the strong conditionality, rather than in spite of it? If so, the IMF would be better served by reverting back to the stronger conditionality implied in the previous Precautionary SBA program.

Earlier, it was shown despite a primarily economic mission for the IMF, the decision by the government to request assistance from the IMF and the Fund’s lending decision are often driven by factors completely unrelated to the economic position or desired economic outcomes of participating countries. Does this hold true for precautionary arrangements as well? To date, only one empirical study has been conducted regarding the government’s decision to enter precautionary arrangements (IMF, 2006) and none have been conducted to evaluate why the IMF has offered such programs. This particular IMF study found the International Country Risk Guide (ICRG) bureaucracy quality index, prior Fund involvement, and countries whose executives were in the latter half of their term as statistically significant political factors in explaining motivation for entry into precautionary arrangements. Yet, the study did not employ regression analysis, inspiring the statistical work contained within this paper. As such, there is not much empirical basis
for understanding how the motivation behind precautionary arrangements may differ from other IMF arrangements. This has hindered development of a more nuanced understanding of a country’s motivation to turn to the IMF and vice versa.

In the regression analysis presented below, I expect entry into precautionary arrangements to be motivated by current account balance and political variables indicating a weak political position of the executive. For non-precautionary arrangements, I expect entry motivation to be the same as in previous literature: significance of both capital and current account variables, as well as variables indicating political division. Because of previous findings that IMF programs can signal the incompetence of leadership in middle income countries (Dreher, 2003), I would expect, however, that executives require a longer tenure in order to successfully enter into drawing programs without insurmountable political consequences. The results for the non-precautionary arrangement are expected to be similar to the all-arrangement sample because of their relatively large share (105 of 157 agreements are non-precautionary).

I also predict to discover differences in the motivation for entry based on the type of previous IMF agreement (precautionary or non-precautionary) because of the differential effects caused by each type of arrangements (as established in Diaz-Cassou, et al., 2006). The next section expands on these hypotheses and explains the methodology by which they are tested.

4 Methodology and data

Previous works offer a few options for testing the hypotheses. Vreeland (2003) examines IMF agreements signed 1951-1990 using yearly panel data from each IMF member nation, employing a “dynamic bivariate probit with partial observability” model (Przeworski and Vreeland, 2002). This approach incorporates a number of crucial assumptions. First, it examines both the decision to enter and the decision to remain under an IMF agreement. This is because agreements differ in their lengths and many countries choose to sign consecutive arrangements. Additionally, bivariate implies an emphasis on the joint decision made between the Fund and the country in producing an arrangement. There are therefore separate equations for the government and the IMF. Finally, the model only has partial observability because observations are only produced when both sides desire a program and agree on the terms.

IMF (2006) represents the only empirical work conducted to date on the differential entry logic between precautionary and non-precautionary arrangements, examining agreements signed by middle-income countries over the period 1992-2005. The study takes countries entering into an IMF arrangement during the period and separates the country-year observations into three categories: periods with no Fund-supported programs, periods under precautionary arrangements, and periods under non-precautionary arrangements. For the periods with no IMF programs, the average of a number of economic and political variables across years and countries is calculated. In the other two categories, observations for the variables are taken from the year prior to the program’s enactment and averaged
across countries. The differences are tested to determine whether they are statically significant.

The approach employed by Vreeland (2003) would be preferable because it allows for separate examination of the independent variables motivating the entry decision from the perspective of both the government and the IMF. Yet, because of difficulties of interpreting the coefficients for bivariate probit regressions with partial observability, as well as other methodological constraints, this paper instead uses a dynamic logit model. Despite some drawbacks, the methodology is also superior to that in the IMF (2006) report in the use of logit regressions instead of the difference in differences approach.

This paper uses a panel of middle- and upper income IMF member nations during the period 1992-2005. A country is defined as middle- or upper-income based on its exclusion from the list of Poverty Reduction and Growth Facility (PGRF)-eligible countries. The dependent variable is a binomial variable indicating participation in the referenced IMF program. Data on country participation comes from the IMF’s Monitoring of Fund Arrangements (MONA) database, which includes all non-PGRF programs over the period. Countries were coded as participating in an agreement in a particular year if they were participating for at least one day in the calendar year. It may be preferable to only code countries as under an agreement if the agreement exceeds a certain time threshold. For instance, if a country enters an agreement in December, it would not make much sense to consider the country as participating in the IMF program for the entire year. However, this method can also lead to missing observations when programs are shorter.4

There are a few differences of note between the general approach used here and Vreeland (2003). First, separate regressions are run for both precautionary and non-precautionary arrangements. Regressions for the all-arrangement sample are also run to compare results of this study to previous research on IMF program entry determinants. Second, Vreeland (2003) examines both the decision to enter an agreement and the decision to remain under all types of IMF agreements. In this paper, the decision to remain is disaggregated by type of previous IMF arrangement for each sample. This is done in order to examine how each category of agreement affects the motivation for entry into a subsequent agreement.

The independent variables in this survey generally fall into the category of economic and political, in order to test the hypothesis that both sets of variables have an important influence on the decision to enter any type of IMF arrangement (regardless of the expected order of magnitude). All of the non-dummy independent variables were lagged one year to reflect lending decisions being made based upon conditions pervasive in the previous year.

The first independent variable is a measure of the percent change in reserves. The IMF traditionally has been most needed when countries experience a dramatic deterioration of their capital account (represented by their reserve position), so one would expect this to be among the more important causes of a government’s decision to turn to the IMF for a non-precautionary arrangement. Unlike other studies using reserve level, the change in reserves is used here to more accurately represent capital account deterioration.

3 As of May 2, 2001. Source: IMF. There were 77 PGRF-eligible countries at this time.
4 This approach is also followed in (Dreher, Sturm, and Vreeland 2009)
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debt service as a percentage of Gross National Income (GNI). Countries facing high debt service payments are more in need of fiscal policy readjustment to reduce their borrowing costs and total amount of sovereign debt. This variable is expected to be significant for both types of agreements because a precautionary arrangement may be sought to reduce fiscal imbalances, reducing sovereign borrowing costs. This variable was dropped in regressions including political variables because of data availability.

The government’s current account is measured using its current account balance as a percentage of Gross Domestic Product (GDP). Executives are predicted to be more likely to sign either type of arrangement when facing large budgetary shortfalls. The logic behind signing the agreement from the executive’s perspective is to force the legislative branch to accept the conditions imposed under the IMF agreements, thus increasing the costs of rejecting the IMF and leading to a fiscal deficit contraction. On the other hand, the IMF is likely to be motivated by the need to improve investor confidence by correcting the current account.

Net official development assistance (ODA) as a percentage of GNI is included in order to proxy for the availability of substitutes. For instance, a country may be less likely to enter into a non-precautionary IMF program if they have large quantities of concessional ODA available. A number of other economic variables are entered into the regression, including inflation (using a GDP deflator), annual growth in gross capital formation (dropped in regressions with political variables due to data availability), and per capita GDP (using constant 2000 SUS). Data for these independent variables comes from the World Bank’s World Development Indicators (WDI).

The total number of member nations under an IMF agreement in a given year is also included, undifferentiated between precautionary and non-precautionary arrangements. It is hypothesized executives are less likely to face domestic backlash for signing such agreements when there are other nations under similar agreements, leading to a positive coefficient. This may also proxy for the state of the global economy at a given time (i.e. more countries will be under IMF agreements during an economic downturn). From the perspective of the IMF, however, this represents the budget constraint of the Fund. Data on the total number of IMF agreements comes from the IMF’s MONA database.

The four political variables employed in the government regressions come from the World Bank’s Database of Political Institutions (DPI; Keefer, 2009). The first is an index of checks and balances in the political system. This represents a measure of both the systemic amount of diffusion in decision-making within a country and the decentralization of power among the various houses and the executive in any given year resulting from election outcomes. For instance, if one party controls the executive branch and both houses, the checks and balances index is lower. When the checks and balances index is higher, an executive should be more likely to enter into an agreement, leading to a positive coefficient. This relationship is expected because an IMF agreement can serve as the force necessary to bring together dispersed power within a government to fulfill the conditions stipulated by an IMF agreement. On the other hand, the index may proxy for negotiation costs for the IMF.

Also included is the share of vote held in the legislature by all opposition parties. When
higher, an executive has greater difficulty in passing his legislative agenda, preventing the enactment of fiscal and monetary policies preferred by international investors. The number of years the executive has been in office is also included. Executives in office longer are predicted to have greater willingness to enter into non-precautionary IMF agreements because of their relative popularity and a less credible threat to lose an election (if the possibility exists at all). This effect is expected to be negative for precautionary arrangements, where a stronger executive may have no need for IMF conditionality in order to enact policy changes. The final political variable included is a lagged dummy variable with a value of 1 if a legislative election had occurred in the previous year. Executives are expected to be more likely to enter IMF agreements when elections are distant.

Dummy variables for countries in Latin America and East Asia were also included. In the case of Latin America, this is because a very large proportion of precautionary arrangements (27 out of 52 total agreements in the sample) came from the continent. It is also telling that of the three countries that have entered the IMF’s new HAPA program, all of them are located in Latin America (Costa Rica, El Salvador, and Guatemala). East Asia had a notably difficult experience with the IMF during this time period (the Asian Financial Crisis of 1997-1999), which possibly may have discouraged entry into IMF agreements later in the sample. The East Asian dummy is omitted from some regressions due to multicollinearity.

5 Results and discussion

5.1 All-arrangement sample

Tables 1 and 2 report the results for the logit regressions for the all-arrangement sample. The reserves dummy is significant at the 10% level for all regressions for entry into IMF programs when not preceded by another program (Table 1 columns 1-3). This appears to be consistent with the mandate of the IMF to provide programs to countries witnessing a weakening capital account. Per capita GDP becomes highly significant after debt service and fixed capital formation are dropped from the regression, indicating poorer countries are more likely to join such agreements. The checks and balances index is also significant at the 5% level in these regressions, providing evidence for the hypothesis that an IMF arrangement may represent an attempt by executives to subvert their legislatures to adopt the policies inherent in IMF conditionality. Yet, the lack of significance of other political independent variables tempers this finding. The Latin America dummy is significant and positive in column 3, indicating location in this region made entry into an IMF program without previous participation more likely. The large size of the coefficient\(^5\) indicates the magnitude of this regional influence, which may be driven by the precautionary subset, as predicted earlier.

For the decision to remain under any IMF agreement (columns 4-6), there are surprisingly

\(^5\) Logit coefficients can be interpreted as the likelihood ratio of the event. For example, if the event had a .25% chance of happening for each incremental increase of the independent variable, the ratio would be .25/.75, or a coefficient of .33. Negative coefficients imply the independent variable decreasing the likelihood of the event.
few variables of significance. Only gross fixed capital formation is negative and significant at the 1% level in column 4. The fairly low pseudo $R^2$ figures on the regression (0.03 to 0.08) indicate that variables other than those included in the model may be driving the decision to remain.

The decision to remain in any IMF program after a precautionary arrangement (Table 2 columns 1-3) provides a more interesting picture. Although no variables are significant in the first two regressions, the inclusion of regional dummies leads to greater significance of the model. The dummies themselves are negative and significant, with large coefficients. Countries from these regions under precautionary arrangements were far less likely to continue an IMF program. This may also be reflective of agreements signed after crises in the respective regions (Asian Financial Crisis and the Argentina crisis).

Current account balance is positive and significant, possibly indicating the success of precautionary arrangements in correcting the current account balance and the use of subsequent arrangements to lock in those gains. Years in office is also significant, with negative coefficient, suggesting executives in weaker electoral positions may be using these agreements to ensure the continuation of fiscal and monetary austerity.

The results for entry into IMF programs from non-precautionary arrangement are nearly identical to those for the decision to remain under any program. Only gross fixed capital formation is significant. This again is likely the result of the non-precautionary sub-sample driving the results for the all-arrangement sample.

5.2 Precautionary arrangements

For precautionary arrangements, the regressions on the decision to enter from no previous IMF program (columns 1-3) show no variables to be significant. Because the pseudo $R^2$ on the regressions is high (0.29 once regional dummies are added), it is fair to conclude that, while the model well explains variation in signing arrangements, there is no identifiable pattern of political and economic variables among nations signing such arrangements without already having one.

The decision to remain under a consecutive precautionary arrangement (columns 4-6) shows very similar results to entry into all arrangements from a precautionary arrangement in Table 2. In this case, the reserves dummy is weakly significant after political variables are added in column 5. Again, the addition of regional dummy variables leads to a number of variables gaining significance (generally the same as in the all-arrangement regressions). Additionally, the overall significance of the model is greatly assisted by the addition of these variables (the pseudo $R^2$ rises from 0.14 to 0.25 with their addition). This suggests reentry into an IMF program may be more influenced by the characteristics of the preceding IMF agreement than other factors. The most notable difference between the two regressions is the significance of the variable for the total number of countries under a non-PGRF IMF program. Because precautionary arrangements do not draw on the IMF’s resources, the IMF and the governments are both more likely to enter into a precautionary arrangement when the total number of agreements is higher. This is in contrast to non-precautionary arrangements, where the IMF would be less willing to support such a program.
For governments deciding whether to switch from a non-precautionary to a precautionary program (columns 7-9), economic factors appear to best explain this decision. The current account balance is negative and weakly significant across all three regressions, while inflation is negative and is significant at the 5% and 10% levels. This could indicate countries that decide to switch into precautionary arrangements have benefitted from the crisis-averting nature of non-precautionary arrangements (as reflected in lower inflation) but still have some longer-term current account concerns that were not fixed. The accompanying IMF “seal of approval” is thus desired in order to ensure the country does not return to a crisis.

5.3 Non-precautionary arrangements

The results for entry into a non-precautionary arrangement without a preceding IMF program bear major resemblance to the all-arrangement sample (Table 4 column 1-3). In the regression with only economic variables, only the reserves dummy is significant with a negative coefficient, demonstrating the dominance of the deteriorating reserve position on a country’s decision to turn to the IMF for a loan. The addition of political variables improves the significance of percent change in reserves to the 1% level. For political variables, the checks and balances index is highly significant, suggesting that results in the all-arrangement sample are driven by non-precautionary arrangements.

The regressions for the decision to switch from a precautionary arrangement to a non-precautionary arrangement (columns 4-5) feature no variables of significance. This may simply be due to special circumstances associated with the few instances of this switch. The pseudo $R^2$ is significantly higher for these regressions (0.77 and 0.63) than for any of the other specifications tested, making it difficult to determine whether adding other independent variables would help explain this decision. Entry into an additional non-precautionary arrangement (columns 7-9) does not appear to be well explained by the independent variables selected.

5.4 Robustness

To test the robustness of the results for precautionary arrangements, two additional sets of regressions were performed. First, results were rerun without the four agreements that were initially non-precautionary. The results are shown in Table 5. As can be seen in comparing the two tables, dropping these four agreements has little effect on the form of the results but yield somewhat fewer significant variables.

As mentioned earlier, there were six agreements over the sample period in which countries were given facilities in excess of 100% of their IMF quota. This was atypical of precautionary arrangements, and in three of the cases, the countries drew on the facility. This could indicate the intent behind the program was substantially different than the vast majority of precautionary arrangements. These six agreements (Table 7) were dropped from the previous specification and the precautionary arrangement regressions were run again, leading to few significant variables.

The results after the inclusion of the Latin American dummy variable (column 6) are in

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some ways similar to those from the initial precautionary regressions in Table 3. Percent change in reserves is significant and positive, while the Latin America dummy itself is negative and significant. In this regression, however, ODA as a percentage of GDP is positive and weakly significant. This provides partial confirmation of the proposition that countries with access to cheap substitute funding from international donors may be more willing to accept a precautionary arrangement when they desire conditionality but not the accompanying funds. IMF loans are cheap but not cost-free to governments. Additionally, executive years in office is negative and significant. The sign on this coefficient is the opposite of earlier results for non-precautionary arrangements.

In switching from a non-precautionary to a precautionary arrangement (columns 7-9), the results differ depending on the independent variables included in the model. In the specification without political variables (column 7), the results are similar to those prior to dropping the six arrangements. The inclusion of political variables in column 8 largely changes the results. Current account balance and inflation lose significance entirely, while GDP per capita becomes weakly significant. Interestingly, opposition vote share also becomes weakly significant and positive. This finding is robust to the inclusion of the Latin America dummy in column 9. It may be that executives use precautionary arrangements to continue IMF conditionality from a non-precautionary arrangement when facing legislatures that do not wish to continue the fiscal and monetary conditions. The IMF and executives may be jointly seeking to continue these reforms to reassure investors of the government’s commitment to sound policies. It is possible this did not appear in the baseline precautionary regression because the dropped six arrangements were biasing the results. In any case, it is clear that entry motivation for the agreements with access limits over 100% of a country’s IMF quota differs from other precautionary arrangements.

5.5 Summary of findings and discussion

A number of conclusions may be drawn from the results. First, entry motivation between precautionary and non-precautionary arrangements is obviously different. This is important because nearly all previous studies on IMF program entry motivation or economic outcomes have failed to disaggregate the two types of arrangements. The findings here should lead researchers focused on the IMF to reexamine their results. This is also important because it appears non-precautionary arrangements are driving the results for studies including all arrangements. As far as intended purpose is concerned, precautionary arrangements appear to be a special breed of IMF program. Unlike non-precautionary arrangements, whose entry motivation was driven by a mix of capital account, current account, and political factors, precautionary arrangement entry is more difficult to explain.

Yet the findings did provide interesting explanations for the decision to remain under an IMF program. Remaining in consecutive precautionary arrangements appears to be well explained by not being located in East Asia or Latin America. This may be mostly the result of our sample being fairly split between the period before and after the Asian financial crisis.

For countries switching from non-precautionary to precautionary arrangements, the
results were greatly impacted by dropping agreements with access limits over 100% of a member nation’s IMF quota. After doing this, evidence for a political motivation for signing precautionary arrangements appeared in the results for the first time. Governments and the IMF may be seeking the survival of monetary and fiscal reforms without an obvious need for capital account correction. This latter finding is one of the more interesting results of this study, although its robustness is not very strong. As a consequence, we cannot necessarily conclude the IMF’s reduction of conditionality in the new HAPAs is misguided.

6 Concluding remarks

This study represented one of the first empirical examinations of the differences in entry motivation for precautionary and non-precautionary IMF arrangements. Precautionary arrangements are not determined by the same variables as non-precautionary arrangements, while the latter group bears numerous similarities to the all-arrangement sample. While there appears to be no consistency in determining entry motivation into precautionary arrangements for countries not previously under an IMF arrangement, evidence presented here suggests executives may use such agreements to continue fiscal and monetary policy reform after completion of an IMF program. These findings should motivate additional research to better understanding the differences driving governments and the IMF to enter into one of these two types of programs.

Future studies could enhance our understanding of these phenomena in a number of ways. First, it would be better to test the hypotheses using the dynamic bivariate probit with partial observability model. By using this model, a better sense of the specific variables separately influencing the IMF and the government could be gained, especially the inclusion of variables more specific to the IMF’s motivation for offering agreements. It would also have been helpful to include variables present in other similar studies on IMF program entry motivation, such as investment levels (Vreeland, 2003) and percentage of the time previously under an IMF agreement (IMF, 2006). Expanding the dataset to include arrangements beginning in 1987 and concluding with the conversion of the Precautionary SBA into the HAPA in 2009 would also improve the robustness of the results. It would also be beneficial to conduct case studies on the six instances where access levels were larger than 100% of the country’s IMF quota. Finally, this paper has also not examined the question of how the effects of precautionary and non-precautionary arrangements differ. While Diaz-Cassou et al. (2006) finds precautionary arrangements to be more successful at catalyzing private capital flows (FDI especially), no other empirical work has been conducted to date on this topic. While differential determinants of entry have been established, an effort to determine differences of both economic and political outcomes of precautionary arrangements is outside the scope of this study and should be made in future work.
References


Social Science Quarterly 86(4): 857-873.


Ramakrishnan, Uma and Juan Zalduendo. 2006. The Role of IMF Support in Crisis Prevention. IMF Working


World Bank. 2010. Data retrieved March 6, 2010, from World Development Indicators Online (WDI) database.
## Tables 1 & 2: Dependent Variable: Under all arrangements

### Variables

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>% change in reserves</td>
<td>-1.86  **</td>
<td>-2.56  *</td>
<td>-1.79  *</td>
<td>-0.05 04</td>
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<td>-0.0392</td>
<td>-0.0381</td>
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<td>Per Capita GDP</td>
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<td>2.90E-06</td>
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<td>ODA as % of GDP</td>
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<td>-0.153</td>
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<td>-0.157</td>
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<td>Debt Service</td>
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<td>East Asia Dummy</td>
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### Observations

<table>
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<td>0.207</td>
<td>0.238</td>
<td>0.08</td>
<td>0.0258</td>
<td>0.0272</td>
</tr>
</tbody>
</table>

### Notes

- ** indicates p < 0.01
- *** indicates p < 0.001
- * indicates p < 0.1

Standard errors in parentheses

All non-dummy independent variables are lagged one year.

---

## Appendix: Entry from Precautionary Arrangements

### Variables

<table>
<thead>
<tr>
<th>VARIABLES</th>
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<tbody>
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<td>% change in reserves</td>
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<td>Per Capita GDP</td>
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<td>ODA as % of GDP</td>
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<td>East Asia Dummy</td>
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### Observations

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<td>0.0366</td>
<td>0.0384</td>
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### Notes

- ** indicates p < 0.01
- *** indicates p < 0.001
- * indicates p < 0.1

Standard errors in parentheses

All non-dummy independent variables are lagged one year.
### Tables 3 & 4: Dependent Variable: Under precautionary and non-precautionary arrangements

#### No preceding IMF Program

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>1</th>
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<th>5</th>
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<th>7</th>
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</thead>
<tbody>
<tr>
<td>% change in reserves</td>
<td>0.245</td>
<td>0.962</td>
<td>0.952</td>
<td>3.348</td>
<td>3.498*</td>
<td>5.439**</td>
<td>0.0167</td>
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<tr>
<td>Current account balance</td>
<td>-1.67</td>
<td>-1.312</td>
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<td>-3.183</td>
<td>-3.054</td>
<td>-2.4</td>
<td>-0.282</td>
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<td>Inflation</td>
<td>-0.109</td>
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<td>-0.134</td>
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<tr>
<td>Per Capita GDP</td>
<td>-0.229</td>
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<td>-0.02119</td>
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<td>-0.0019</td>
<td>-0.0499***</td>
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<tr>
<td>Debt Service</td>
<td>-0.013</td>
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<td>-0.0228</td>
<td>-0.0626</td>
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<tr>
<td>ODA as % of GDP</td>
<td>-0.03036</td>
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<td>-0.000203</td>
<td>0.000148</td>
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#### Entry from Precautionary Arrangement

<table>
<thead>
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<th>5</th>
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<tbody>
<tr>
<td>% change in reserves</td>
<td>5.089</td>
<td>5.099</td>
<td>5.106</td>
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<tr>
<td>Current account balance</td>
<td>-1.151</td>
<td>-1.286</td>
<td>-1.269</td>
<td>-1.515</td>
<td>-3.773</td>
<td>-0.8055</td>
<td>-0.8019</td>
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<tr>
<td>Inflation</td>
<td>-0.0426</td>
<td>-0.0447</td>
<td>-0.0436</td>
<td>-0.209</td>
<td>-0.182</td>
<td>-0.0369</td>
<td>-0.0362</td>
<td>-0.0377</td>
</tr>
<tr>
<td>Per Capita GDP</td>
<td>5.986*</td>
<td>0.000204</td>
<td>5.965</td>
<td>0.578</td>
<td>0.259</td>
<td>-0.0101</td>
<td>-0.00792</td>
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<tr>
<td>Debt Service</td>
<td>-0.152</td>
<td>-0.162</td>
<td>-0.129</td>
<td>-0.523</td>
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<td>-0.094</td>
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<td>-0.104</td>
</tr>
<tr>
<td>Total Under IMF</td>
<td>0.209</td>
<td>0.0126</td>
<td>0.00145</td>
<td>-1.027</td>
<td>-0.407</td>
<td>0.0251</td>
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#### Entry from Non-Precautionary

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<th>5</th>
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</thead>
<tbody>
<tr>
<td>% change in reserves</td>
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<td>-3.336***</td>
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<tr>
<td>Current account balance</td>
<td>-1.151</td>
<td>-1.286</td>
<td>-1.269</td>
<td>-1.515</td>
<td>-3.773</td>
<td>-0.8055</td>
<td>-0.8019</td>
<td>-0.0811</td>
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<tr>
<td>Inflation</td>
<td>-0.0426</td>
<td>-0.0447</td>
<td>-0.0436</td>
<td>-0.209</td>
<td>-0.182</td>
<td>-0.0369</td>
<td>-0.0362</td>
<td>-0.0377</td>
</tr>
<tr>
<td>Per Capita GDP</td>
<td>5.986*</td>
<td>0.000204</td>
<td>5.965</td>
<td>0.578</td>
<td>0.259</td>
<td>-0.0101</td>
<td>-0.00792</td>
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<tr>
<td>Debt Service</td>
<td>-0.152</td>
<td>-0.162</td>
<td>-0.129</td>
<td>-0.523</td>
<td>-11.49</td>
<td>-0.094</td>
<td>-0.102</td>
<td>-0.104</td>
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<tr>
<td>Total Under IMF</td>
<td>0.209</td>
<td>0.0126</td>
<td>0.00145</td>
<td>-1.027</td>
<td>-0.407</td>
<td>0.0251</td>
<td>0.0209</td>
<td>0.0153</td>
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</tbody>
</table>

#### Observations

- No preceding IMF program: 263
- Entry from precautionary arrangement: 755
- Entry from non-precautionary: 755

#### Standard errors in parentheses

- *** p<0.01, ** p<0.05, * p<0.1
- All non-dummy independent variables are lagged one year.
Tables 5 & 6: Precautionary robustness checks (originally non-precautionary arrangements dropped and agreements with access limits over 100% dropped)

Table 7: Precautionary arrangements with access over 100% of member nation access limits

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<tr>
<th>Country</th>
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</tr>
<tr>
<td>Colombia</td>
<td>12/20/1999–12/19/2002</td>
</tr>
<tr>
<td>Colombia</td>
<td>1/15/2003–5/2/2005</td>
</tr>
</tbody>
</table>

APPENDICES
Carroll Round Proceedings
APPENDICES

APPENDIX A:
Eighth Annual Carroll Round Presentation Schedule

**Session 1A**
Chair: Rodney Ludema (Associate Professor, Georgetown University)

Daniel Lim (Georgetown University)
*Does Participation in Export Markets Increase TFP? Evaluating the Learning By Exporting Hypothesis Using Firm-Level Data*
Discussant: Rob Harris (University of Warwick)

Rob Harris (University of Warwick)
*The Effect of News Media on UK Inflation Assessment*
Discussant: Flora Ng (Dartmouth College)

Flora Ng (Dartmouth College)
*Determinants of Asylum Migration to Germany 1980-2008*
Discussant: Daniel Lim (Georgetown University)

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**Session 1B**
Chair: Robert Cumby (Professor, Georgetown University)

Ariell Zimran (Georgetown University)
*Export-Country GDP Growth, Market Openness, and Antidumping Filings*
Discussant: Yang Du (Williams College)

Yang Du (Williams College)
*The Credit Channel in the Monetary Transmission Mechanism in China*
Discussant: Takuma Habu (University of Warwick)

Takuma Habu (University of Warwick)
*Money Illusion and its Implication on Unemployment*
Discussant: Ariell Zimran (Georgetown University)

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**Session 1C**
Chair: Behzad Diba (Professor, Georgetown University)

Tom Han (Georgetown University)
*Determinants of Cost of Credit Across Firms in Central Asia and Eastern Europe*
Discussant: Antonina Davydenko (American University in Bulgaria)

Antonina Davydenko (American University in Bulgaria)
*The Profitability and the Fragility of the Banking Sector in Ukraine*
Discussant: Vera Chau (New York University)

Vera Chau (New York University)
*Stock Exchanges and the Monopoly Bank Model*
Discussant: Tom Han (Georgetown University)

---

**Session 2A**
Chair: Raj Desai (Associate Professor, Georgetown University)

Ahmad Wahdat (Oberlin College)
*Consulting Services and Clustering: A Study of Egypt and Turkey*
Discussant: Peter Hull (Wesleyan University)

Peter Hull (Wesleyan University)
*Economic Shocks and Civil Conflict: Evidence from the Constraints of the Open Economy Trilemma*
Discussant: Todd Kawakita (Dartmouth College)

Todd Kawakita (Dartmouth College)
*How Do Capital Losses Affect Investment Following Natural Disasters?*
Discussant: Ahmad Wahdat (Oberlin College)

---

**Session 2B**
Chair: Jose Cuesta (Affiliated Professor, Georgetown University)

Jorge Aponte (Georgetown University)
*Project Size as a Determinant of Outcome for Private Investment in the Electricity Sector of Developing Economies*

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APPENDICES

Discussant: Sarah Hinkfuss (Harvard College)
Sarah Hinkfuss (Harvard College)
The Role of the Informal Sector in Equitable Water Distribution: A Case Study of the Tanker Market in Ayn al-Basha, Jordan
Discussant: Birgit Leimer (New York University)
Birgit Leimer (New York University)
Changes in the Distribution of Actual Demand and Predicted Demand of Medical Care Services in Chile since 2000
Discussant: Jorge Aponte (Georgetown University)

Session 2C
Chair: Charles Udomsaph (Visiting Assistant Professor, Georgetown University)
Anna Klis (Georgetown University)
Early Participants of Multilateral Environmental Agreements and Their Effect on Later Membership
Discussants: Benjamin Arnold (University of Michigan)
Benjamin Arnold (University of Michigan)
Parental Death: Effects on Intelligence
Discussant: Kelsey Hample (Illinois Wesleyan University)
Kelsey Hample (Illinois Wesleyan University)
Comparing Intergenerational Transfer of Human Capital Among Immigrant and Native Families
Discussant: Anna Klis (Georgetown University)

Session 3A
Chair: Matthew Canzoneri (Professor, Georgetown University)
Hang Qian (Dartmouth College)
The Undervaluation of Renminbi and the Role of People’s Bank of China in the Misalignment
Discussant: Paul Unanue (Princeton University)
Paul Unanue (Princeton University)
A Common Currency for Mercosur: Trade and Foreign Direct Investment Implications
Discussant: Allison Kern (Georgetown University)

Allison Kern (Georgetown University)
Trade Liberalization and the Geographic Concentration of Income in Developing Countries
Discussant: Hang Qian (Dartmouth College)

Session 3B
Chair: Francis Vella (Professor, Department Chair, and Villani Chair in Economics, Georgetown University)
Courtney Blair (Harvard College)
Commodity Prices, Agricultural Policy, and Food Security in Developing Countries: 1970 – Present
Discussant: Benjamin Morley (University of Warwick)
Benjamin Morley (University of Warwick)
Aid, policies and long-run growth
Discussant: Katherine Donato (Georgetown University)
Katherine Donato (Georgetown University)
Foreign Direct Investment and the Dutch Disease
Discussant: Courtney Blair (Harvard College)

Session 3C
Chair: James Vreeland (Associate Professor, Georgetown University)
Katharine Ng and Pongrith Chantraporn (University of San Francisco)
The Effects of Institutional Quality on Foreign Ownership
Discussant: Siddharth George and Xing Cong Ong (London School of Economics)
Siddharth George and Xing Cong Ong (London School of Economics)
How do the Characteristics of Politicians Relate to Governance Quality? Evidence from Indian States
Discussant: Michael Karno (Georgetown University)
Michael Karno (Georgetown University)
IMF Precautionary Arrangements: Determinants of Entry
Discussant: Katharine Ng and Pongrith Chantraporn (University of San Francisco)
APPENDIX B:
Past Speakers

First Annual Carroll Round (April 5-7, 2002)
Roger W. Ferguson, Federal Reserve Board of Governors
Donald L. Kohn, Federal Reserve Board of Governors
Lawrence B. Lindsey, Assistant to the President and National Economic Council
Edwin M. Truman, Institute for International Economics
John Williamson, Institute for International Economics

Second Annual Carroll Round (April 11-13, 2003)
R. Glenn Hubbard, Council of Economic Advisers and Columbia University
Donald L. Kohn, Federal Reserve Board of Governors
John Williamson, Institute for International Economics

Third Annual Carroll Round (April 15-18, 2004)
Donald L. Kohn, Federal Reserve Board of Governors
John F. Nash, Jr., Princeton University (1994 Nobel Laureate)
Peter R. Orszag, The Brookings Institute

Fourth Annual Carroll Round (April 22-24, 2005)
Ben S. Bernanke, Federal Reserve Board of Governors
William Easterly, New York University
Maurice Obstfeld, University of California at Berkeley
Edwin M. Truman, Institute for International Economics

Fifth Annual Carroll Round (April 28-30, 2006)
Kemal Dervis, United Nations Development Programme
Thomas C. Schelling, University of Maryland (2005 Nobel Laureate)

Sixth Annual Carroll Round (April 19-22, 2007)
Grant D. Aldonas, Center for Strategic and International Studies
François Bourguignon, Chief Economist and Senior Vice President of the World Bank
Randall Kroszner, Federal Reserve Board of Governors

Seventh Annual Carroll Round (April 17-20, 2008)
Susan C. Athey, Harvard University
Philip I. Levy, American Enterprise Institute
Steven Radelet, Senior Fellow at the Center for Global Development

Eighth Annual Carroll Round (April 16-19, 2009)
Eric S. Maskin, Princeton University (2007 Nobel Laureate)
Nassim Nicholas Taleb, Universa Investments and New York University

Ninth Annual Carroll Round (April 22-25, 2010)
Philip I. Levy, American Enterprise Institute
Lant Pritchett, Harvard Kennedy School
APPENDIX C:  
Former Carroll Round Steering Committees

First Annual Carroll Round  
(April 5-7, 2002)  
Christopher L. Griffin Jr., chair (SFS ’02)  
William B. Brady (SFS ’02)  
Cullen A. Drescher (COL’04)  
Meredith L. Gilbert (COL’04)  
Joshua M. Harris (SFS ’02)  
Andrew T. Hayashi (SFS ’02)  
Mark R. Longstreth (SFS ’04)  
Kathryn E. Magee (SFS ’02)  
Ryan F. Michaels (SFS ’02)  
J. Brendan Mullen (SFS ’02)  
Scott E. Pedowitz (SFS ’02)  
Waheed A. Sheikh (SFS ’04)  

Second Annual Carroll Round  
(April 11-13, 2003)  
Seth M. Kundrot, chair (SFS ’03)  
Nada M. Abdelnour (SFS ’03)  
Maria M. Arhancet (SFS ’04)  
Victoria E. Bembenista (SFS ’03)  
Michael J. Callen (SFS ’05)  
Eric M. Fischer (SFS ’03)  
Daphney Francois (SFS/GRD ’04)  
Meredith L. Gilbert (COL’04)  
Jeffrey M. Harris (COL’03)  
Robert S. Katz (COL’04)  
Marina Lafferriere (SFS ’06)  
Lu Shi (SFS ’03)  
Stacey H. Tsai (SFS ’03)  
Robert T. Wrobel (SFS ’03)  
Erica C. Yu (COL’05)  

Third Annual Carroll Round  
(April 15-18, 2004)  
Meredith L. Gilbert, chair (COL’04)  
Héber M. Delgado-Medrano (SFS ’06)  
Ryan V. Fraser (SFS ’04)  
Tetyana V. Gaponenko (SFS ’07)  
Yunjung Cindy Jin (SFS ’05)  
Sarah H. Knupp (SFS ’04)  
Robert S. Katz (COL’04)  
Marina Lafferriere (SFS ’06)  

Fourth Annual Carroll Round  
(April 22-24, 2005)  
Erica C. Yu, chair (COL’05)  
Jasmina Beganovic (SFS ’05)  
Lucia Franzese (SFS ’07)  
Dennis L. Huggins (SFS ’05)  
Yunjung Cindy Jin (SFS ’05)  
Jonathan W. Kirschner (SFS ’05)  
Susan C. Kleiman (SFS ’05)  
Yousif H. Mohammed (SFS ’06)  
Amy M. Osekowsky (SFS ’07)  
Daniel P. Schier (SFS ’05)  

Fifth Annual Carroll Round  
(April 27-30, 2006)  
Marina Lafferriere, chair (SFS ’06)  
Irmak Bademli (SFS ’06)  
Stephen Brinkmann (SFS ’07)  
Heber Delgado (SFS ’06)  
Lucia Franzese (SFS ’07)  
Yasmine Fulena (SFS ’08)  
Jen Hardy (SFS ’06)  
Michael Kunkel (SFS ’08)  
Yousif Mohammed (SFS ’06)  
Emy Reimao (SFS ’06)  
Tamar Tashjian (SFS ’06)  

Sixth Annual Carroll Round  
(April 19-22, 2007)  
Stephen A. Brinkmann, chair (SFS ’07)  
Lucia Franzese (SFS ’07)  
Nicholas A. Hartman (SFS ’07)  
Ian P. Hinsdale (COL’09)  
Alexander P. Kostura (SFS ’09)  
Jennifer M. Noh (SFS ’07)  
Amy M. Osekowsky (SFS ’07)  
Allison E. Phillips (SFS ’07)  
Sun Yi (SFS ’07)  

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APPENDICES

Seventh Annual Carroll Round
(April 17-20, 2008)
Yasmine Fulena, chair (SFS '08)
Sue Bai (SFS '08)
Stacey Droms (COL '08)
Brandon Feldman (COL '08)
LiJia Gong (SFS '08)
Kory Katenga (SFS '10)
Sung Kim (SFS '08)
Michael Kunkel (SFS '08)
Fuyang Zhang (SFS '10)

Eighth Annual Carroll Round
(April 16-19, 2009)
Rebecca A. Heide, chair (SFS '09)
James O. Arnold (SFS '11)
Amanda B. Delp (SFS '12)
Henry T. Gillam (SFS '10)
Tom J. Han (SFS '10)
Anna A. Klis (SFS '10)
Daniel T. Leonard (SFS '09)
Daniel Y. Lim (SFS '11)
Arjun B. Pant (SFS '09)
Benjamin D. Simmons (COL '09)
Ariell E. Zimran (SFS '10)

Ninth Annual Carroll Round
(April 22-25, 2010)
Ariell E. Zimran, chair (SFS '10)
Michael A. Counihan (SFS '11)
Amanda B. Delp (SFS '12)
Katherine E. Donato (SFS '10)
Tom J. Han (SFS '10)
Michael R. Korno (SFS '10)
Allison T. Kern (SFS '10)
Anna A. Klis (SFS '10)
Daniel Y. Lim (SFS '11)
H. Jess Seok (SFS '12)
Matthew H. Shapiro (SFS '11)

APPENDIX D:
Members of the Advisory Panel
Meredith L. Gilbert, The Chartis Group
Christopher L. Griffin, Duke University
Andrew T. Hayashi, Davis Polk & Wardwell
Mitch Kaneda, Georgetown University
Robert S. Katz, Acumen Fund
J. Brendan Mullen, American College of Cardiology
Scott E. Pedowitz, Corporate Executive Board
Erica C. Yu, University of Maryland
APPENDICES

APPENDIX E:
Past Participants

First Annual Carroll Round (April 5-7, 2002)

Azhar Adbul-Quader          Columbia University
Santosh Anagol              Stanford University
William Brady               Georgetown University
Daniel Braun                Oberlin College
Jacqueline Bueso            University of Pennsylvania
Karla Campbell              University of Virginia
Benn Eifert                 Stanford University
Courtney Fretz              University of Pennsylvania
Carlos Galvez               Stanford University
Aniruddha Gopalakrishnan   Duke University
Christopher Griffin         Georgetown University
Casey Hanson                Lehigh University
Joshua Harris               Georgetown University
Andrew Hayashi              Georgetown University
Marco Hernandez             Massachusetts Institute of Technology
Katia Hristova              Illinois-Wesleyan University
Maria Jelescu               Massachusetts Institute of Technology
Fadi Kanaan                 Yale University
Avinash Kaza                Stanford University
Vinay Kumar                 Duke University
Anisha Madan                Illinois-Wesleyan University
Kathryn Magee               Georgetown University
Ryan Michaels               Georgetown University
Jack Moore                  Stanford University
Brendan Mullen              Georgetown University
Andrei Muresianu            Brown University
Scott Orleck                Duke University
Scott Pedowitz              Georgetown University
Jonathan Prin               University of Pennsylvania
Jeremy Sandford             Illinois-Wesleyan University
Deborah Slezak              Illinois-Wesleyan University
Conan Wong                  Brown University

Second Annual Carroll Round (April 11-13, 2003)

Nada Abdelnour              Georgetown University
Amanda Barnett              Emory University
Andrea Bell                 Wellesley College
Patrick Byrne               University of Colorado
David Chao                  Cornell University
Sylvia Ciesluk              Lehigh University
Adam Doverspike             Georgetown University
Benn Eifert                 Stanford University
Adam Engberg                Georgetown University
APPENDICES

Alexandra Fiorillo    Connecticut College
Eric Fischer     Georgetown University
Zlata Hajro     Wellesley College
Samina Jain     Georgetown University
Avinash Kaza     Stanford University
Eric Kim     The George Washington University
Seth Kundrot     Georgetown University
Lada Kyi     Rice University
Lee Lockwood     Northwestern University
Sunil Mulani     New York University
Holly Presley     Vanderbilt University
Duncan Roberts     University of California at Berkeley
Lu Shi     Georgetown University
Shanaz Taber     Barnard College
Jiang Wei     University of Michigan

Third Annual Carroll Round (April 15-18, 2004)

Jeffrey Arnold     Dartmouth College
Julia Berazneva     Mt. Holyoke College
Mehmet Cangul     Georgetown University
Richard Carew     University of Virginia
Ashley Coleman     Vanderbilt University
Dilyana Dimova     Stanford University
Fernando Galeana     Stanford University
M. Blair Garvey     Emory University
Meredith Gilbert     Georgetown University
Adam Greeney     Oberlin College
Asim Gunduz     University of Virginia
Marc Hafstead     Northwestern University
Andrew Hayashi     University of California at Berkeley
Katherine Howitt     McGill University
Sohini Kar     Columbia University
Josh Lewis     McGill University
Satish Lohani     Illinois-Wesleyan University
Alexis Manning     Illinois-Wesleyan University
Sara Menker     Mt. Holyoke College
Elizabeth Mielke     Vanderbilt University
Stratos Pahis     Dartmouth College
Alicja Pluta     Georgetown University
Adam Raymakers     Dalhousie University
Caroline Schmutte     Dartmouth College
Matt Sekerke     Johns Hopkins University
John Soleanicov     Columbia University
Kai Szakmary     Columbia University
Brandon Wall     Yale University
Kenneth Ward     University of Chicago
Susan Work     Georgetown University
APPENDICES

Fourth Annual Carroll Round (April 22-24, 2005)

Lidia Barabash     Dartmouth College
Jasmina Beganovic  Georgetown University
Xun Bian     Illinois-Wesleyan University
Michael Furchtgott   Columbia University
Michael Gechter     Pomona College
Kevin B. Goldstein Dartmouth College
Michael Haase     University of Copenhagen
Dennis Huggins    Georgetown University
Michael Insel    Claremont McKenna College
Jonathan Kirschner Georgetown University
Shiy ing Lee Duke University
James Liao     Dartmouth College
Brian Lichter Washington University
Wee Lee Loh     Cornell University
Alice Luo     Duke University
Katharine Mullock University of Western Ontario
Jose Mustre del Rio The Ohio State University
Leah Nelson    Georgetown University
Ee Cheng Ong Wellesley College
Matthew Phan Columbia University
Nina Rendelstein Washington University
David Rogier Washington University
Ana Maria Romero Illinois-Wesleyan University
Nathan Saperia Dartmouth College
Bogdan Tereshchenko Georgetown University
Olga Timoshenko University of Western Ontario
Tom Vogl Princeton University
Kenneth Ward University of Chicago
Jonathan Wolfson Washington University
Suzanne Zurkiya Emory University

Fifth Annual Carroll Round (April 28-30, 2006)

Sarah Carroll Stanford University
Ruth Coffman     Georgetown University
Dubravka Colic Wellesley College
Pratik Dattani University of Warwick
Jennifer Dawson Illinois-Wesleyan University
Héber Delgado-Medrano Georgetown University
Sherri Haas     Illinois-Wesleyan University
Jen Hardy     Georgetown University
Lauren Iacocca University of California at Los Angeles
Salifou Issoufou University of Wisconsin at Madison
Stella Klemperer Brown University
Daniel Kurland Dartmouth College
Corinne Low Duke University
Shanthi Manian Georgetown University
Michael Monteleone University of Chicago
APPENDICES

John Nesbitt     Georgetown University
Natasha Nguyen     University of California at Berkeley
Oyebanke Oyeyinka    Carleton College
Evgeniya Petrova    Dartmouth College
Emy Reimao     Georgetown University
Svetoslav Roussanov    Columbia University
Vikram Shankar     Georgetown University
Juan Carlos Suarez    Trinity University
Austin Vedder     Dartmouth College
David Wiczer     Carleton College
Geoffrey Yu     Carleton College
Xiaoti Zhang     University of Warwick

Sixth Annual Carroll Round (April 19-22, 2007)

Matthew Adler     Oberlin College
Marion Aouad     Princeton University
Stephen Brinkmann    Georgetown University
Erik Eggum     University of Warwick
Lucia Franzese    Georgetown University
Tanja Groth     University of St. Andrews
Ashley Halpin     Dartmouth College
Nicholas Hartman    Georgetown University
Adrienna Huffman    Washington University
Abdulla Humaidan    University of Warwick
Mohammad Huq     Georgetown University
Nedko Kyuchukov    Dartmouth College
Zachary Mahone    New York University
R. Priya Mathew     Washington University
Yana Morgulis     University of Chicago
Jennifer Noh     Georgetown University
Andrew O’Brien Penney    Georgetown University
Jessica Oliveri    Monash University
Matthew Pech     Dartmouth College
Allison Phillips    Georgetown University
Angelica da Rocha    University of Warwick
Sören Radde     University of Bayreuth
Helendi Rande    New York University
Elena Spatoulas    University of Michigan
Yi Sun     Georgetown University
Bennett Surajat    Carleton College
Freddy Tsai     University of British Columbia
David Wolff     Dartmouth College
Jennifer Xi     Dartmouth College
Cynthia Yim     Princeton University
Seventh Annual Carroll Round (April 17-20, 2008)

Karl Andres    University of Warwick
Cecil Ang     University of Virginia
Alaina Antonucci    The Pennsylvania State University
Sue Bai     Georgetown University
Marinella Boyadzhiev   Oberlin College
Quentin Brummet    Illinois-Wesleyan University
Brendan Cooper    Carleton College
Gerard DiPippo    Dartmouth College
Stacey Droms    Georgetown University
Varun Dutt    Macalaster College
Yasmine Fulena    Georgetown University
Amish Gandhi    University of Warwick
Katherine Gordon    Mt. Holyoke College
Yi Kang     Wesleyan College
Michael Kunkel    Georgetown University
Han Youp Lee    Georgetown University
Claudio LoCascio    Dartmouth College
Olivia Lynch    Georgetown University
Amr Moubarak    The George Washington University
Simone Nitsch    University of Warwick
Saurabh Pant    New York University
Carson Sherwood    University of Western Ontario
Tadashi Shirai    University of Warwick
Dominique Shure    Georgetown University
William Slater    Vanderbilt University
Shyam Sundaram    Brown University
Poh Lin Tan    Princeton University
Dorothy Voorhees    Georgetown University
Kris Walsh    Georgetown University
Monica Yu     Dartmouth College

Eighth Annual Carroll Round (April 16-19, 2009)

Jennifer Cairns     Calvin College
David Childers    Georgetown University
Vaska Dimitrova    American University in Bulgaria
Rebecca Freeman    Smith College
Georg Graetz    London School of Economics and Political Science
Markus Gstoettner    London School of Economics and Political Science
Arpit Gupta    University of Chicago
Frederick Haney    New York University
Rebecca Heide    Georgetown University
Gregory Howard    The University of North Carolina at Chapel Hill
Jacqueline Iwata    The George Washington University
Anders Jensen    London School of Economics and Political Science
William Kafoure    The George Washington University
Elira Kuka    Wellesley College
Daniel Leonard    Georgetown University

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APPENDICES

Chris Lim Dartmouth College
Juan Ignacio Elorrieta Maira University of Chile
Nick Marchio Macalester College
Hekuran Neziri American University in Bulgaria
Casey Oswald Georgetown University
Arjun Pant Georgetown University
Caitlin Pierce Dartmouth College
Isra Salim Macalester College
Keval Sangani University of Warwick
Pronita Saxena University of California, Berkeley
Benjamin Simmons Georgetown University
Maximilian Sirianni Macalester College
Seitaro Takarabe Wesleyan University
Fabien Thayamballi Georgetown University
Rachel Winograd Dartmouth College
Woan Foong Wong Oberlin College

Ninth Annual Carroll Round (April 22-25, 2010)

Jorge Aponte Georgetown University
Benjamin Arnold University of Michigan
Courtney Blair Harvard University
Vera Chau New York University
Nick Chantraporn University of San Francisco
Antonina Davydenko American University in Bulgaria
Katherine Donato Georgetown University
Yang Du Dartmouth College
Siddharth George London School of Economics and Political Science
Takuma Habu University of Warwick
Kelsey Hample Illinois Wesleyan University
Tom Han Georgetown University
Rob Harris University of Warwick
Sarah Hinkfuss Harvard University
Peter Hull Wesleyan University
Michael Karno Georgetown University
Todd Kawakita Dartmouth College
Allison Kern Georgetown University
Anna Klis Georgetown University
Birgit Leimer New York University
Daniel Lim Georgetown University
Benjamin Morley University of Warwick
In Un Flora Ng Dartmouth College
Katherine Ng University of San Francisco
Hang Qian Dartmouth College
Paul Unanue Princeton University
Ahmad Wahdat Oberlin College
Ariell Zimran Georgetown University