HOW DOES CURRENCY MISMATCH AFFECT RESILIENCE TO AN EXTERNAL SHOCK? EVIDENCE FROM THE 2007-2009 GLOBAL FINANCIAL CRISIS

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ABSTRACT

In the aftermath of the 1990s global financial crises, excessive foreign currency borrowing emerged as the common denominator in predicting the likelihood of a crisis as well as an economy’s capacity to withstand one. Expressed as the gap between foreign currency-denominated assets and liabilities, currency mismatch was shown to heighten foreign debt obligations in the event of a large devaluation, thereby triggering default, bankruptcies, and deep output contractions. Using panel data for 18 emerging economies from 1998-2011, this study estimates the contribution of currency mismatches to the behavior of real GDP growth before and during the recent 2007-2009 global financial crisis using country and year-level fixed effects. The main findings of the analysis suggest that increases in currency mismatch during the crises are associated with increases in real GDP growth. The paper also finds that for countries operating under a flexible exchange rate regime, changes in currency mismatch are associated with increases in economic growth.
To my friends and family

Many thanks,
KATHLEEN E. FAIRL
# TABLE OF CONTENTS

1. **INTRODUCTION** .................................................................................. 1  
   1.1. Motivation and Justification for Analysis ........................................... 4

2. **LITERATURE REVIEW** ..................................................................... 7  
   2.1. Determinants of Currency Mismatch ............................................... 8  
   2.2. Currency Mismatch and Economic Growth ..................................... 10  
   2.3. Policy Remedies ........................................................................... 10  
   2.4. Institutional Background ............................................................. 12  
   2.5. Contribution to the Literature ....................................................... 14

3. **METHODOLOGICAL APPROACH** .................................................. 14  
   3.1. Conceptual Model ......................................................................... 14  
   3.1.A. Mismatch and Systemic Risk ...................................................... 15  
   3.2. Empirical Model & Estimation Strategy ......................................... 17

4. **DATA** ................................................................................................. 20  
   4.1. Main Variables ............................................................................. 21  
   4.2. Explanatory Variables ................................................................... 22  
   4.2.A. Macroeconomic Stability Indicators ........................................... 22  
   4.2.B. Resilience Indicators ................................................................. 23

5. **RESULTS** ......................................................................................... 25  
   5.1. Preliminary Results ....................................................................... 25  
   5.2. Empirical Results ......................................................................... 30

6. **DISCUSSION** .................................................................................... 32  
   6.1. Policy Implications ....................................................................... 32  
   6.2. Caveats & Limitations .................................................................. 33

7. **CONCLUSION** .................................................................................. 33  
   7.1. Suggestions for Future Research ................................................... 33

APPENDIX A: Variable Descriptions ......................................................... 35  
APPENDIX B: Calculation of Currency Mismatch ..................................... 36  
APPENDIX C: Exchange Rate Regime Classification .................................. 36  
BIBLIOGRAPHY ...................................................................................... 37
TABLES AND FIGURES

TABLES

TABLE 1. COUNTRIES BY GEOGRAPHIC REGION AND INCOME.................................. 21
TABLE 2. DESCRIPTIVE STATISTICS................................................................. 27
TABLE 3. PAIRWISE CORRELATIONS............................................................... 29
TABLE 4. REGRESSION ANALYSIS OF THE EFFECT OF CURRENCY MISMATCH ON GROWTH...... 30
TABLE A1. VARIABLE DESCRIPTIONS............................................................... 35

FIGURES

FIGURE 1. CHANGE IN AVERAGE ANNUAL REAL GDP GROWTH, PRE-CRISIS TO CRISIS YEARS… 3
FIGURE 2. THEORETICAL MECHANISM............................................................. 16
FIGURE 3. ANNUAL REAL GDP GROWTH BY CURRENCY MISMATCH GROUP, 1998-2011........ 26
1. INTRODUCTION

The risks and vulnerabilities imposed by unhedged foreign liabilities in economic downturns have been well documented by a series of financial crisis in the 1990s. The experiences of the Mexican (1994), Russian (1998), and East Asian (1998) financial crises highlight the dangers associated with excessive foreign currency debts, particularly when an economy’s assets are denominated in domestic currency (Eichengreen and Hausmann, 1999). Currency mismatch, or the gap between foreign currency denominated assets and liabilities, is widely believed to exacerbate the severity of an emerging market crisis (Ranciere, Tornell, and Vamvakidis 2010).

In the years leading up to Mexico’s deepest recession in 50 years, both banks and local businesses saw a dramatic increase in foreign currency-denominated liabilities. For medium and large companies, the risks were particularly severe, with 60 percent of Mexican companies’ financial liabilities denominated in a foreign currency compared to only 10 percent of sales revenues (Goldstein and Turner, 2004). Similarly, prior to the 1998 East Asian currency crisis, Korea, Thailand, and the Philippines experienced rapid growth in the accumulation of foreign liabilities. For firms in Indonesia, unhedged foreign currency liabilities accounted for 65 percent of the consumer good sector and 95 percent of the agricultural, mining, and financial sectors. What followed after for both Mexico and East Asia was an unprecedented decline in economic growth. Now seen as a significant predictor of currency crises and economic shocks, many countries adopted large-scale efforts to diminish their exposure to unhedged foreign currency liabilities.

Reacting to the experiences of the 1990s, a large body of research emerged demonstrating the link between currency mismatches and output contractions following a large fluctuation in the real exchange rate. Indeed, high currency mismatches were found to increase both the
probability of a crisis and the subsequent output costs of falling into one (Goldstein and Turner, 2004). While prior research has been less consistent in producing measurements of mismatches, the results have largely pointed to the same conclusions. In effect, without access to an equal and offsetting stock of foreign currency-denominated assets, substantial foreign currency-denominated debt obligations coupled with a large devaluation have been shown to intensify output contractions and undermine years of domestic output growth (Cavallo et al. 2001). In other words, with a disproportionate amount of assets and liabilities denominated in a foreign currency, changes in the exchange rate can have severe implications for a country’s debt burden.

Evidence from the recent global recession suggests that subsequent efforts to reduce mismatches have had some success in increasing resilience to an external shock. For instance, maintaining a large stock of international reserves allowed economic growth to rebound fairly rapidly in several East Asian countries. Improved management of currency exposure and reforms to exchange rate policies also appear to have encouraged a more rapid recovery. However, while the recent recession highlights the effectiveness of reforms, it also underscores the uneven implementation and mixed progress of such efforts across the developing world.

As illustrated by Figure 1, the change in average annual GDP growth from the pre-crisis period (1998-2006) to the crisis period (2007-2009) varies substantially across countries with both high (positive) and low (negative) currency mismatches. Ranking countries by average currency mismatch in the years leading up to the crisis (1998-2006), theory would predict Uruguay to exhibit the largest economic contraction and for Brazil to demonstrate the smallest. Contrary to these expectations, Uruguay sees the largest increase in average annual growth from the pre-crisis to the crisis period while Brazil sees a comparatively modest gain in growth. The countries experiencing the largest growth reductions, Lithuania and Ukraine, exhibit only
modestly high or low average mismatches in the pre-crisis years. Thus, it would be a mistake to consider currency mismatches the sole factor explaining the behavior of real GDP growth during the crisis. Moreover, it would be equally hazardous to attribute weak resilience to an external shock solely to a country’s “developing” status. The fluctuations in GDP growth experienced during the crisis vary from roughly -7 percent in Eastern European countries to between 3 and 5 percent in Latin America and the Asia Pacific countries, which implies that other factors likely play a large role in explaining a country’s capacity to withstand an external shock. In effect, variation in the experiences from the recent global recession suggest the contribution of currency mismatches to economic crises is no longer as clear as it was in the 1990s. Further analysis of changes to domestic institutional arrangements, policies, and trends in the internal and external economy is required to better understanding the changing role of currency mismatches in shaping GDP growth.

**Figure 1. Change in Average Annual Real GDP Growth, Pre-Crisis to Crisis Years**

<table>
<thead>
<tr>
<th>Country</th>
<th>Average Mismatch</th>
<th>Figure Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uruguay</td>
<td>-8.00</td>
<td>-8.00</td>
</tr>
<tr>
<td>Philippines</td>
<td>-6.96</td>
<td>-6.96</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>-7.06</td>
<td>-7.06</td>
</tr>
<tr>
<td>Vietnam</td>
<td>-3.82</td>
<td>-3.82</td>
</tr>
<tr>
<td>Turkey</td>
<td>-3.82</td>
<td>-3.82</td>
</tr>
<tr>
<td>Indonesia</td>
<td>-3.82</td>
<td>-3.82</td>
</tr>
<tr>
<td>Lithuania</td>
<td>-3.67</td>
<td>-3.67</td>
</tr>
<tr>
<td>China</td>
<td>-2.82</td>
<td>-2.82</td>
</tr>
<tr>
<td>Egypt</td>
<td>-2.82</td>
<td>-2.82</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>-2.82</td>
<td>-2.82</td>
</tr>
<tr>
<td>Ukraine</td>
<td>-2.82</td>
<td>-2.82</td>
</tr>
<tr>
<td>Guatemala</td>
<td>-2.82</td>
<td>-2.82</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>-2.82</td>
<td>-2.82</td>
</tr>
<tr>
<td>Peru</td>
<td>-1.52</td>
<td>-1.52</td>
</tr>
<tr>
<td>Venezuela</td>
<td>-1.52</td>
<td>-1.52</td>
</tr>
<tr>
<td>Thailand</td>
<td>-1.52</td>
<td>-1.52</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>Brazil</td>
<td>1.16</td>
<td>1.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.63</td>
</tr>
</tbody>
</table>

*Note: Countries on the y-axis are ranked according to average currency mismatches in the pre-crisis years (1998-2006), with Uruguay having the highest average mismatch and Brazil having the lowest.*

*Source: World Bank, Global Development Finance Indicators and author’s calculations*
Recognizing a potential transition in the role played by currency mismatches, this research study seeks to uncover the implications of currency mismatches for a developing country’s ability to withstand an external financial shock in today’s increasingly globalized economy. In examining 18 emerging economies from 1998-2011, this analysis looks to identify the factors that contribute to the behavior of economic growth during the 2007-2009 global financial crisis. Due to the wealth effects associated with large-scale depreciations, it is expected that countries with a large imbalance between foreign currency assets and liabilities suffer greater economic contractions in the event of a financial crisis.

1.1. Motivation and Justification for Analysis
Increasing interconnectedness within the global economy has had mixed effects on developing countries. On one hand, research suggests that greater access to foreign financial markets is associated with higher foreign inflows and more opportunities for domestic investment. Ranciere, Tornell and Vamvakidis (2010) note that increasing access to foreign credit markets can serve as a catalyst for economic growth in countries with credit strapped firms. On the other hand, the subsequent increase in foreign currency liabilities associated with higher foreign borrowing can present significant threats to financial stability and enhance exposure to outside risks. These risks are particularly acute for countries with underdeveloped local currency markets. In those instances, without access to an equal and offsetting supply of foreign currency income, large increases in foreign currency denominated debt lead to a mismatch between foreign currency denominated assets and liabilities. As seen in the financial crises of the 1990s, developing countries are often more prone to accumulating foreign currency debt without sufficient foreign income to hedge against exchange rate fluctuations. As a result, rising foreign debt obligations in these countries can quickly transform into severe and destabilizing burdens in
the event of large currency depreciations. And as more domestic firms fail to service their debt, bankruptcy becomes widespread, triggering banking crisis and often deep economic contractions.

While many studies have identified the risks associated with high currency mismatch, few have paid particular attention to the underlying role of a country’s exchange rate regime. In incorporating a measure of exchange rate flexibility, this analysis looks to explore how incentives built into different regimes may shape the relationship between currency mismatch and economic growth. Countries operating under a fixed exchange rate regime are often more likely to exhibit greater mismatches because of the implicit guarantee built into a central bank’s commitment to defend a targeted rate. This guarantee biases borrowing towards foreign currency denominated debt by underscoring the risks associated with accumulating large amounts of unhedged foreign currency debt. Thus, by promising to keep currency volatility within a predefined range, the government effectively underwrites currency risk by insuring borrowers from any loss in the event of a devaluation. In comparison, a flexible exchange rate regime with is thought to have the opposite effect in that it provides incentives for more cautious management of currency exposure, thereby reducing the financial risks associated with currency mismatches.

In sum, drawing on evidence from the recent global financial crisis, this study seeks to further examine the role of currency mismatch in determining an emerging economy’s ability to withstand an external shock. In doing so, it hopes to address larger questions surrounding how developing countries can protect themselves from the vulnerabilities associated with foreign debt. Is abstinence the best option? Or is it possible for countries to adopt policies that prevent foreign debt obligations from becoming destabilizing? This analysis seeks to unearth the factors that contributed to the dynamic behavior of real GDP growth during the recent global financial
crisis, paying particular attention to how exchange rate regimes affect financial fragility through their underlying encouragement or discouragement of excessive foreign borrowing. In examining data from 1998-2011, this study further hopes to discern the potential for mismatches to encourage growth in times of global economic stability and significantly undermine it in the event of a global crisis.

In detecting the risks and vulnerabilities associated with excessive currency mismatches, the results from this study may have significant implications for policymakers by highlighting the importance of undergoing macro-prudential reforms. As emphasized by Ranciere, Tornell, and Vamvakidis (2010), it is also essential to note the potential benefits of foreign currency borrowing if pursued within a well-managed financial system. In incorporating variables reflective of foreign exchange management, external debt accumulation, and sources of financing, this analysis hopes to reveal the capacity for pre-emptive policies to reduce a country’s vulnerability to an external financial crisis. Policies that reduce currency mismatch may be key to reduce a country’s vulnerability to future crises. Examples of such policies may include the development of a local currency market or the adoption of a flexible exchange rate regime. In effect, evidence of a strong association between currency mismatches and growth during the crisis would encourage the adoption of such policies to reduce disruptions to global economic development. Alternatively, and consistent with the original sin hypothesis, evidence that such policies play a limited role would indicate that emerging economies cannot overcome this problem on their own, and a meaningful solution requires participation on behalf of the larger global economy (Eichengreen, Hausmann, and Panizza, 2002).
2. LITERATURE REVIEW

The contribution of currency mismatch and unhedged foreign currency debt to financial shocks has been well documented by analyses of the 1990s crises. In a close analysis of the East Asian and Latin American crises, Eichengreen and Hausmann (1999) find that external borrowing in foreign currency played a large role in exacerbating the severity of the crisis. Similarly, Gray (1999) concludes that rising currency mismatch in the years leading up to 1997 to 1998 Asian financial crisis led to larger subsequent currency depreciations and output losses. Evidence of the importance of currency mismatch also appears robust to changes in the data sources and methodologies used to measure its role in shaping economic outcomes.

Kamil (2012), for instance, defines currency mismatch as dollar debt as a percentage of exports plus dollar assets. Montoro and Rojas-Suarez (2012) employ a similar measure, calculating currency mismatch as the ratio of the foreign currency share of debt to exports as a percent of gross domestic product (GDP). In contrast, Ranciere, Tornell, and Vamvakidis (2010) construct a new de facto measure of currency mismatch calculated as the ratio of net unhedged foreign currency denominated liabilities to assets. By controlling for foreign currency borrowers’ ability to hedge their debt, their measure encapsulates the systemic risk present in currency mismatches. In sum, while previous studies have utilized various measures of mismatches, their findings generally point to three main risks and concerns associated with high currency mismatches:

First, high currency mismatches are associated with both an increased likelihood of a financial crisis and a greater output loss in the event that a crisis occurs (Goldstein and Turner, 2004). Using several different measures of mismatches, Rodriguez (2002), Cavallo et al. (2001),
and Gupta, Mishra, and Sahay (2001) found that higher mismatches generally contributed to
deep recessions and output contractions in the 1990s crises.

Secondly, currency mismatches are thought to render monetary policies ineffective in the
event of a crisis. In the event of a large depreciation, countercyclical monetary policy would
direct policymakers to lower interest rates in an attempt to stimulate demand. For those with high
mismatches, however, lower interest rates risks triggering a large currency devaluation and
subsequent bank failures and bankruptcies. Raising rates to protect domestic currencies is
equally implausible, as higher rates would only heighten fiscal strains on local businesses and
further depress domestic demand (Goldstein and Turner, 2004).

Lastly, the accumulation of unhedged foreign currency-denominated liabilities is thought
to undermine the operation of a floating exchange rate regime in emerging economies. For those
that allow large mismatches to accumulate, efforts to gain monetary policy independence by
allowing rates to float quickly fade as intervention in the foreign exchange market to prevent
large-scale depreciations becomes increasingly important. Forced to protect domestic firms and
banks against exchange rate depreciations, these countries take on a “fear of floating” that
prevents them from acquiring the flexibility afforded by operating under a floating exchange rate
regime (Hausmann, Panizza, and Stein 2000). Furthermore, in devoting policies to maintaining
the exchange rate, inflation targeting is also rendered ineffective, further weakening an
economy’s capacity to absorb a financial shock.

2.1. Determinants of Currency Mismatch

While studies generally agree on the risks imposed by high mismatches, they remain largely
divided in their definition of the determinants of unhedged foreign currency liabilities, their
implications for economic growth, and the policy remedies necessary to discourage or manage them.

Previous analyses of the determinants of currency mismatch can be categorized as falling within one of two categories. The first group of academics argues that the strength of institutional arrangements and the depth of financial management policies can greatly impact a country’s capacity to withstand a shock. The main finding amongst these studies is that policies and institutions are critical to limiting dependence on foreign currency-denominated debt and reducing the risks associated with currency mismatch stated (Burger and Warnock, 2006). Bordo, Meissner, and Stuckler (2009) find that despite having large foreign debt obligations, many countries have been able to absorb previous crises due to the adoption sustainable fiscal positions and strong financial intermediation services. The recommendations that follow suggest that structural reforms, often in the form of flexible exchange rate policies and the accumulation international reserves- can effectively reduce the vulnerabilities associated with currency mismatch.

A second group of researchers, led by Eichengreen and Hausmann (2010), identifies currency mismatch as a symptom of underdeveloped bond markets and financial incompleteness in emerging economies. Known as the Original Sin Hypothesis (OSH), this theory suggests that the problem stems from emerging economies’ limited capacity to issue local currency debt in international markets. Moreover, OSH argues that reforms targeted at monetary or exchange rate policies are largely ineffective because central banks are forced to focus on maintaining exchange rates at the expense of encouraging long-term stability and growth.
2.2. **Currency Mismatch and Economic Growth**

In general, studies examining the relationship between unhedged foreign liabilities and economic growth emphasize the significant threats posed by high mismatches, both in terms of reducing output growth and in undermining the effectiveness of countercyclical policies. For instance, in analyzing the behavior of credit growth before and after the recent financial crisis, Montoro and Rojas-Suarez (2012) find that countries with smaller mismatches, lower dependence on external funding, and a higher capacity to implement countercyclical policies to provide liquidity performed better during the crisis and saw a more rapid recovery in the credit market. Similarly, in a study of the association between devaluations and growth for highly dollarized economies, Bebczuk et al. (2007) conclude that foreign currency-denominated contributes to depressed growth rates in the event of a depreciation in the real exchange rate. However, while many studies have focused exclusively on the negative implications of high mismatches for economic growth, others have pointed to the potential for mismatches to encourage growth in times of economic stability. Examining emerging economies in Europe from 1998-2008, Ranciere, Tornell, and Vamvakidis (2010) find that increases in currency mismatch are associated with higher growth in tranquil times, but also with more severe crises. On net, however, the authors find a positive link between currency mismatch and growth.

2.3. **Policy Remedies**

Conflicting views on the underlying determinants of currency mismatch have led to opposing recommendations for reducing mismatch and the associated currency risks. Proponents of monetary and exchange rate reforms point to three general policy prescriptions for lowering exposure to currency risks. One option, used widely among East Asian countries, calls for accumulating international reserves as a form of self-insurance against exchange rate volatility.
An alternative suggests expanding local currency markets through bonds or other forms of domestic debt. Others advocate for reforming exchange rate policies to reduce the moral hazard associated with fixed rate regimes. The fact that fixed exchange rate regimes were correlated with numerous crises in the 1990s, and that firms relied heavily on unhedged foreign currency debt in the years leading up to these crises, is often used as strong supporting evidence for this particular prescription (Kamil 2012). Several studies suggest that flexible exchange rate policies can encourage better management of foreign currency debt and reduce currency mismatches. In his study of corporate balance sheets in six Latin American countries, Kamil finds that allowing for higher exchange rate flexibility provides strong incentives for firms to reduce their currency exposure by matching foreign currency liabilities with stable sources of foreign currency-denominated export income or assets. Lastly, “socializing” mismatches, or moving mismatches from private to public sector balance sheets, has been shown to mitigate the adverse effects of high mismatches on economic growth during a crisis. In the case of Brazil, for instance, the central bank’s efforts to defend its then pegged exchange rate regime by selling dollar-indexed bonds to the private sector protected growth from the global recession. While the public sector was still heavily burdened by a depletion of reserves and large increases in public debt, Brazil’s economy fared far better than those in Asia where the 1998 crises translated into a spiral of private-sector insolvencies (Bevilaqua and Garcia, 2000).

Skeptics of policy reforms often argue that implementing such strategies is typically less feasible in developing countries. Accumulating foreign reserves to match foreign debt obligations is discouraged by the comparatively low return on reserves and the subsequent high opportunity cost of investing in reserves as opposed to other funds (Burger and Warnock, 2006). Calvo and Reinhart (2002) find that a floating regime is also a less viable option for small
developing economies that require more exchange rate stability. Emerging economies’ capacity to reduce their dependence on external financing can be weakened by their inability to issue hard currency (Montoro and Rojas-Suarez, 2012). Beyond implementation challenges, advocates of the OSH shed doubt on the ability of policy and monetary credibility to reduce the financial fragility associated with currency mismatch (Eichengreen, Hausmann, and Panizza, 2002). Those subscribing to this theory claim that because mismatch is not the product of local policies and institutions, efforts to reduce mismatch in developing countries require the participation of the larger global economy. In sum, the implications that follow suggest that emerging markets cannot overcome the problem on their own.

2.4. **Institutional Background**

Among other factors, a country’s exchange rate regime has been shown to carry significant weight in determining the likelihood of an external shock as well as a country’s capacity to withstand and respond. Referring back to the 1990s financial crises, many studies highlighted the ability for exchange rate regimes to shape economic growth patterns through their effect on currency mismatches. Goldstein and Turner (2004) and Schneider and Tornell (2004) argue that pegged or fixed exchange rate regimes are a significant precursor to currency mismatches. According to this theory, commitments to maintain a peg within a fixed regime offer an implicit guarantee against immediate, wide fluctuations in the exchange rate, leading to hazardous and often excessive foreign currency borrowing (Bordo, Meissner, and Stuckler, 2009). In other words, under fixed regimes, borrowers have the tendency to discount the risks of a sharp depreciation and assume unstable stocks of foreign currency liabilities. Moreover, domestic firms have been shown to overstate their government’s willingness and ability to uphold a fixed rate against shortages in capital inflows (Bordo, Meissner, and Stuckler, 2009). Thus, when
efforts to maintain fixed rates in several Asian and Latin American eventually collapsed, severe balance sheet effects quickly spiraled into bankruptcies, default, and deep credit crunches.

In addition to creating the incentives often leading up to high mismatches, fixed or pegged exchange rate regimes are also significant in terms of the constraints they place on policymakers’ use of countercyclical tools. In a fixed or pegged exchange rate regime, countercyclical monetary policies are rendered obsolete by a country’s primary target of maintaining the exchange rate. By devoting all monetary policies to the goal of maintaining a fixed nominal exchange rate, countries with a fixed regime are prevented from utilizing interest rates to spur aggregate demand in a recession. Furthermore, unless capital flows are highly mobile, fiscal policy is similarly ineffective at encouraging stabilization during an external shock.

With an increasingly large body of research emphasizing the disadvantages of fixed exchange rate arrangements, many argue that reforms encouraging greater exchange rate flexibility are key to decreasing mismatches and introducing greater macroeconomic stability. In a study of six Latin American countries Kamil (2012) finds strong evidence of a decline in mismatch following the adoption of a flexible exchange rate regime. Eichengreen, Hausmann, and Panizza (2003) substantiate this claim by arguing that monetary authorities in countries with a high mismatch will pursue more aggressive intervention in the foreign exchange market to prevent a depreciation from aggravating external debt obligations. Thus, transition to a flexible regime would likely be indicative a successful reduction in currency mismatch that lowered an economy’s dependence on a fixed or pegged exchange rate. In contrast to these claims, Arteta (2005) concludes that floating exchange rate regimes are characteristic of higher currency
mismatches and that increased flexibility actually lowers incentives to hedge foreign currency debt.

2.5. Contribution to the Literature

This study seeks to contribute to the existing literature by examining the effect of currency mismatch on output volatility in the context of the recent global financial crisis. Similar to Montoro and Rojas-Suarez (2012), this paper will analyze an array of geographically diverse countries during the years surrounding the global recession. However, rather than real credit growth, this study uses GDP growth as a measure of a country’s capacity to withstand the crisis. Acknowledging that many variables likely factor into a country’s performance, measures related to financial soundness and macroeconomic stability will be included in the model, although it is expected that countries with greater mismatch will also score lower on other measures of financial stability and management. This study also departs from prior research in that it allows for the association between currency mismatches and economic growth to vary across crisis and non-crisis years. In essence, it relaxes the assumption that effect of currency mismatch on growth is constant during the pre-crisis and crisis years.

3. Methodological Approach

3.1. Conceptual Model

Constrained by limited access to credit, developing countries often turn to foreign currency borrowing as a source of financing (Ranciere, Tornell, and Vamvakidis, 2010). In times of economic stability, foreign currency debt has been shown to encourage domestic growth and development in emerging economies by lowering borrowing constrains and reducing interest costs. And when balanced by an offsetting stock of foreign currency assets, such borrowing poses few threats. However, in countries where cash flows intended to service the debt are
denominated in local currency, extensive foreign borrowing creates a mismatch between foreign
currency denominated assets and liabilities. In the absence of sound regulatory institutions and
effective management of currency mismatches, countries with large stocks of unhedged foreign
become vulnerable to contractionary depreciations and adverse balance sheet effects (Bebczuk et
al. 2007).

3.1.A. MISMATCH AND SYSTEMIC RISK

Economic theory supported by the popular Mundell-Fleming model traditionally points to the
expansionary effects of exchange rate depreciations. The arguments that follow demonstrate how
currency devaluation can improve a country’s trade balance by increasing the competitiveness of
domestic exports and reducing incentives to import comparatively expensive foreign goods and
services. While significant empirical evidence exists to corroborate these findings, the beneficial
effects of large devaluations have proven far less certain in dollarized economies, and in
particular, those with large stocks of net foreign currency-denominated debt.

Due to their limited ability to issue hard currency, emerging market economies are
especially prone to accumulating foreign currency-denominated debt. Although such debt poses
few risks in economically tranquil times, an external shock can quickly develop into a currency
crisis and a deep economic contraction for countries without an offsetting source of foreign
currency-denominated income. Figure 2 illustrates the mechanism through which currency
mismatch is thought to introduce systemic risk and increase the likelihood of a financial crisis.
The inclusion of exchange rate policies attempts to highlight the role played by pegged or fixed
regimes in lowering the perceived risk of foreign currency denominated-debt. In effect, the
central bank’s promise to maintain a certain rate in a fixed exchange rate regime becomes a
bailout guarantee against a sudden depreciation. The central bank’s failure to accurately price the
risks of foreign currency borrowing in this case often encourages unstable and excessive foreign currency borrowing (Dell’Ariccia, Laeven, and Marquez). However, while fixed regimes may underprice risk and contribute to higher mismatches, it is important to note that borrowing constraints can lead to similarly high mismatches even if the exchange rate is allowed to float. Moreover, examined in isolation from information on currency mismatches, exchange rate flexibility has little explanatory power in regards to an economy’s resilience to a crisis. The exchange rate regime is thus a contributing factor, rather than a determinant of currency mismatch or a significant predictor of fluctuations in economic growth.

**FIGURE 2. THEORETICAL MECHANISM**

![Diagram](image)

Source: Ranciere, Tornell, and Vamvakidis (2010)
In addition to illustrating the effects of an exchange rate regime on currency mismatches, Figure 2 demonstrates how mismatches can have both positive and negative implications for economic growth. In times of global economic stability, access to foreign capital flows has allowed for new investments and rapid growth. Only in times of economic recession or global financial crises do the risks associated with high mismatches come into fruition. In the event of a shock, emerging economies, especially those with liberalized capital accounts, are likely to see a significant reversal in foreign capital inflows (Bordo 2010). Unable to issue tradable and liquid external liabilities, these countries are often forced to deplete any reserve funds in order to service their debt payments. Simultaneously, speculation stemming from limited credibility or diminishing reserves frequently leads to sizable currency depreciations. Despite the positive effects such a devaluation may have on domestic exports, any benefits are likely to be outweighed by the escalating value of foreign debt in relation to the diminishing value of domestic currency-denominated assets and revenues. In sum, such a devaluation is likely to has trigger bankruptcies and default, deeper economic recessions, and prolonged credit contractions. Thus, the use of foreign currency-denominated debt to finance domestic investment and consumption exposes debtors to significant insolvency risks should the local currency depreciate unexpectedly.

### 3.2. Empirical Model and Estimation Strategy

This analysis uses fixed-effects models to test the hypothesis that higher mismatches contribute to greater economic contractions in the event of a financial crisis. The global recession is incorporated into the model using a dummy variable set equal to 1 for the years 2007-2009, when GDP growth rates turned negative or sharply declined in the countries sampled (Figure 3). In order to relax the assumption that the relationship between currency mismatch and economic
growth is the same during periods of economic stability and financial crisis, an interaction of the mismatch and crisis variables is incorporated into the model.

Rather than relying on a multiple regression model to control for all of the relevant determinants of GDP growth, country-level fixed effects are used to control for any country-specific, unobserved heterogeneity that remains fixed over time. In essence, the use of fixed effects eliminates the potential for time-invariant, omitted variables that are correlated with the dependent and independent variables of interest to bias the estimated effect of currency mismatch on economic growth. Examples of such variables may include geographic location, culture, or any other country-specific characteristic that remains constant over time. Country-specific time-variant characteristics that are likely correlated with economic growth and currency mismatch are included in the model as additional control variables (Table 2). While fixed-effects partial out and eliminate the effects of time-invariant country-specific characteristics, it does not do so for time-invariant variables that are constant across countries. In other words, any variables that are constant over time and across countries may still present a significant source of omitted variable bias.

Autocorrelation across successive values of the error term is corrected for using clustered standard errors. In this case, the use of clustered standard errors allows for heteroskedasticity and autocorrelation to be present within countries without violating the assumption that the unobserved determinants of real GDP growth are identically and independently distributed across countries.
The basic fixed-effects regression model used to test the impact of currency mismatches on economic growth during the crisis for low and high-mismatch countries appears as follows:

\[ y_{it} = \alpha_i + \gamma(X_1)_{it} + \theta(X_2)_{it} + \delta(X_1 * X_2)_{it} + Z_{it} + \mu_{it} \]  

(1)

where the subscript \( i \) denotes individual countries and \( t \) denotes years. Here, \( \alpha_i \) refers to country-level fixed-effects, or essentially the effect of being in each individual country. and \( y \) represents the dependent variable of interest, real GDP growth. The main independently variables of interest, currency mismatch and the financial crisis, are represented by \( X_1 \) and \( X_2 \) respectively. In turn, the interaction of \( X_1 \) and \( X_2 \) is used to estimate whether the effect of currency mismatch on growth varies significantly across crisis and non-crisis years. Alternatively, \( \delta \) serves as a measure of the additional impact currency mismatches have on growth during the crisis relative to stable economic times. Lastly, \( Z \) represents several time-varying characteristics that differ across countries and are assumed to be correlated with currency mismatch and economic growth, including:

- Current account balance (%)
- Inflation
- Short-term debt-to-exports
- National Savings
- FOREX
- Capital Investment

The identifying assumption for this identification strategy is that there are no variables omitted from the model which are correlated with GDP growth and currency mismatch and which vary across time and countries. The estimation strategy proceeds by testing the model separately for two groups, low and high-mismatch countries, where “low” mismatch countries are defined as those with a mismatch less than or equal to 0 and “high” mismatch countries are defined as those with a mismatch greater than 1.
In order to analyze all countries in the sample simultaneously, a second specification is tested using a first-differences approach to estimate the effect of a change in currency mismatch on GDP growth during the crisis (equation 2).

\[ y_{lt} - y_{lt-1} = \alpha_i + \lambda_t + Y(X_{1lt} - X_{1lt-1}) + \delta(X_{1lt} - X_{1lt-1}) + (Z_{lt} - Z_{lt-1}) + (\mu_{lt} - \mu_{lt-1}) \]  

(2)

In addition to country-level fixed effects, this model specification incorporates time fixed effects, represented by \( \lambda_t \). Year fixed-effects add to the model by controlling for all factors that evolve over time but are fixed across entities. Examples are likely to include macroeconomic changes occurring at the global level that subsequently affect all countries included in the sample over time.

4. DATA

The panel data used to conduct this analysis covers 18 developing and emerging economies for the years 1998 to 2011. The selection of countries was largely dictated by the availability of data on currency mismatches for the time period of interest. Despite these limitations, the group of chosen consists of economically and regionally diverse countries, which serves to strengthen any significant empirical results.

The main independent variable, currency mismatch, is taken from Ranicere, Tornell, and Vamvakidis (2010). The majority of the other variables are taken from the World Bank’s dataset of Global Development Finance Indicators. Table A1 in the Appendix provides descriptions and sources of the main dependent and independent variables. The specific countries under examination are as follows:
### Table 1. Countries by Geographic Region and Income

<table>
<thead>
<tr>
<th>Latin America</th>
<th>Europe</th>
<th>Asia Pacific</th>
<th>Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>Upper-Middle</td>
<td>Upper-Middle</td>
<td>China</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>Upper-Middle</td>
<td>Upper-Middle</td>
<td>Indonesia</td>
</tr>
<tr>
<td>Guatemala</td>
<td>Low-Middle</td>
<td>Upper-Middle</td>
<td>Kazakhstan</td>
</tr>
<tr>
<td>Mexico</td>
<td>Upper-Middle</td>
<td>Low-Middle</td>
<td>Philippines</td>
</tr>
<tr>
<td>Peru</td>
<td>Upper-Middle</td>
<td></td>
<td>Thailand</td>
</tr>
<tr>
<td>Uruguay</td>
<td>Upper-Middle</td>
<td></td>
<td>Vietnam</td>
</tr>
<tr>
<td>Venezuela</td>
<td>Upper-Middle</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Income classifications are defined by the World Bank (2012) with lower-middle income = $1,026 to $4,035 and upper-middle income = $4,036 to $12,475.*

### 4.1. Main Variables

For this analysis, the dependent variable used to measure resilience to the global financial crisis is the rate of annual real GDP growth.

**Currency Mismatch:** The key independent variable used is this analysis is currency mismatch, measured as the gap between foreign currency assets and liabilities. Due to limited data availability, a more comprehensive measure of currency mismatch is taken from Ranciere, Tornell, and Vamvakidis (2010) to adjust for unhedged foreign currency lending. Using this measure, a positive number indicates an excess of foreign currency-denominated liabilities over foreign currency-denominated assets. Alternatively, a negative number suggests a country possesses more foreign currency-denominated assets than liabilities, which is unlikely to increase vulnerability to an external shock. A more detailed description of the calculation used to measure currency mismatch is provided in Appendix B.
**Crisis:** In order to examine the impact of currency mismatches during the crisis, a crisis dummy variable is constructed and set equal to 1 for the years 2007-2009 and 0 for all other years.

**Exchange Rate Arrangement:** A binary variable is constructed to represent a country’s choice of exchange rate arrangement. Based on the annual fine classification system, taken from Reinhart and Rogoff (2010), the variable takes on the value of 0 for fixed exchange rate regimes and 1 for flexible regimes. Given the implications of an exchange rate regime for determining both the size of a mismatch and a country’s capacity to mitigate an external shock through countercyclical policies, this variable is of particular importance to the analysis (see Appendix C for a description of the annual fine classification system). Moreover, a country’s exchange rate regime may also influence their ability to absorb a shock through countercyclical fiscal and monetary policies.

**4.2. Explanatory Variables**

In order to isolate the contribution of currency mismatch to fluctuations in GDP growth during the crisis, a number of relevant explanatory variables are included in the model. Those variables categorized as macroeconomic stability indicators and resiliency indicators are described further below.

**4.2.A. Macroeconomic Stability and Performance Indicators**

Acknowledging that the risks posed by unhedged foreign currency liabilities likely depend on a country’s overall economy, a number of variables used to measure macroeconomic stability are included in the model.
**CURRENT ACCOUNT BALANCE:** Measured as a percent of GDP, the current account balance provides a flow indicator for a country’s external financing needs. A higher value suggests heavy reliance on foreign credit or investment flows and thus greater vulnerability to an external shock.

**SAVINGS:** Also measured as a percent of GDP, the rate of national savings serves as an additional measure of economic stability in indicating the availability of domestic savings for investment. Low national savings suggests greater reliance on external sources of financing and subsequently greater exposure to an external crisis.

**CAPITAL:** The average annual growth of gross fixed capital is included as an additional proxy for economic growth and development. Fixed capital formation represents domestic fixed investment in land improvements, plant and equipment, infrastructure, and in the construction of schools, residential buildings, commercial and industrial offices. Including a measure of domestic investment may provide further insights into the effects of currency mismatches on economic growth, as larger mismatches are generally thought to be associated with greater cuts to investment in the event of a devaluation (Rodriguez 2002).

**4.2.B. RESILIENCE INDICATORS**

**SHORT-TERM DEBT-TO-EXPORTS:** The ratio of short-term debt (debt with a maturity of less than one year) to exports of goods, services, and income is included in the analysis as a measure of an economy’s ability to survive an external shocks. In this context, the ratio demonstrates the size of a country’s external debt obligations relative to its export income, thereby illustrating its ability to service its debt with foreign capital flows. A higher ratio indicates that the negative effect on net worth from a large devaluation would overwhelm any positive effects on exports profits from more competitive pricing. As such, the higher the ratio the less prepared an economy appears to
services its debt obligations with export income, and therefore is more vulnerable it is to an external shock (Bleakley and Cowan, 2002).

**Foreign Exchange Reserves:** This measure of foreign exchange reserves is calculated as the annual percentage change in a country’s stock of official foreign assets (including gold and foreign currency reserves). Measuring the change in foreign exchange reserves attempts to capture a country’s efforts to hedge against a financial crisis. Particularly for those with high foreign liabilities, accumulating a stock of foreign exchange reserves is often argued as a safeguard against a large exchange rate depreciation or a sudden stop in foreign capital inflows. As such, growth in an economy’s stock of foreign exchange reserves in the pre-crisis period may predict greater resilience to the global financial crisis. In addition to measuring resilience, the change in foreign exchange reserves is intended to control for some of the heterogeneity of exchange rate policies obscured by the 0-1 measure of the exchange rate arrangement. In this sense, it is meant to capture the degree of central bank intervention in the foreign exchange market.

**Inflation:** Inflation rates are used as an indicator of pre-crisis resilience because poor inflation performance is often linked to higher mismatches and more volatile patterns of economic growth. High inflation in developing countries may reflect artificial price increases induced by monetary authorities in order to lower a country’s debt obligations. As a result, inflation swings often reduce foreign investors’ willingness to lend in domestic currency, particularly in the long term. In turn, countries with high inflation generally take on more foreign currency-denominated debt.
5. RESULTS

5.1. PRELIMINARY FINDINGS

The results of this study are expected to coincide with the finding from previous research on currency risk and economic growth. In particular, stable output growth during the crisis is expected to be associated with lower levels of currency mismatch. In the period before the crisis, however, greater currency mismatch is expected to coincide with higher rates of economic growth. Consistent with Bordo, Meissner, and Stuckler (2009), unhedged foreign currency debt is expected to emerge as a significant indicator of reductions in economic growth during and after the crisis. Similar to the findings in Montoro and Rojas-Suarez (2012), countries with a lower ratio of short-term external debt-to-exports and smaller current account deficits as a percent of GDP are expected to perform better during the crisis.

Figure 3 provides a basic illustration of the behavior of real GDP growth before and during the financial crisis for countries with low and high-mismatches. Surprisingly, countries with low currency mismatches appear to exhibit greater fluctuations in GDP growth in the pre-crisis period than do countries with high mismatches. During the crisis, both groups of countries clearly experienced sharp economic contractions with GDP growth for the high-mismatch group dipping slightly below the low-mismatch group. Despite having seen a deep economic decline during the crisis years, growth rates for 2010 and 2011 indicate that high-mismatch countries actually made a greater recovery than the low-mismatch countries. While Figure 3 suggests some connection between currency mismatch and GDP growth, it remains to be seen whether other factors are potentially obscuring the true association between currency mismatch and economic growth during the recent financial crisis.
A closer look at the descriptive statistics for the variables of interest reveals several important trends about the data. Table 2 provides the means and standard deviations of each of the variables of interest for the low and high mismatch countries in the years before and during the financial crisis. As expected, average GDP growth is higher for both low and high mismatch countries in the years before the crisis. Moreover, high mismatch countries appear to see a greater drop in average growth during the crisis with a 1.32 percentage point decrease compared to a 0.31 percentage point decrease amongst low-mismatch countries. This comparatively larger economic contraction may be partially explained by the higher current account deficits and lower national savings present amongst high-mismatch countries in the years before the crisis.
Table 2: Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Low Mismatch (Mismatch&lt;=0)</th>
<th>High Mismatch (Mismatch&gt;0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP Growth</td>
<td>4.06</td>
<td>3.75</td>
</tr>
<tr>
<td></td>
<td>(4.60)</td>
<td>(4.06)</td>
</tr>
<tr>
<td>Current Account Balance&lt;sup&gt;A&lt;/sup&gt;</td>
<td>0.35</td>
<td>-0.10</td>
</tr>
<tr>
<td></td>
<td>(6.17)</td>
<td>(4.58)</td>
</tr>
<tr>
<td>Short-term Debt-to-Exports</td>
<td>23.17</td>
<td>15.73</td>
</tr>
<tr>
<td></td>
<td>(12.83)</td>
<td>(7.02)</td>
</tr>
<tr>
<td>Foreign Exchange Reserves&lt;sup&gt;B&lt;/sup&gt;</td>
<td>0.21</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>(0.34)</td>
<td>(0.29)</td>
</tr>
<tr>
<td>Inflation</td>
<td>9.34</td>
<td>8.58</td>
</tr>
<tr>
<td></td>
<td>(14.68)</td>
<td>(7.21)</td>
</tr>
<tr>
<td>National Savings&lt;sup&gt;A&lt;/sup&gt;</td>
<td>22.93</td>
<td>24.00</td>
</tr>
<tr>
<td></td>
<td>(9.43)</td>
<td>(11.35)</td>
</tr>
<tr>
<td>Fixed Capital Formation&lt;sup&gt;B&lt;/sup&gt;</td>
<td>7.46</td>
<td>5.52</td>
</tr>
<tr>
<td></td>
<td>(15.26)</td>
<td>(13.45)</td>
</tr>
</tbody>
</table>

Binary Variables (Frequencies)

| Crisis                                        |               |               |               |               |
|                                               | 0=Non-Crisis  | 1=Crisis      | 0=Non-Crisis  | 1=Crisis      |
|                                               | 67            | 0             | 95            | 0             |
|                                               | 0             | 26            | 0             | 28            |

| Exchange Rate                                 |               |               |               |               |
|                                               | 0=Fixed       | 1=Flexible    | 0=Fixed       | 1=Flexible    |
|                                               | 31            | 13            | 45            | 13            |
|                                               | 36            | 13            | 50            | 15            |

Total Observations: 705 230 985 252

(A) Variable is express as a percent of GDP
(B) Represents average annual rate of growth
Quantities in parentheses are standard deviations.

However, the larger debt-to-exports ratio and higher rate of inflation in low-mismatch countries before the crisis appears to contradict their seemingly greater resilience to the shock. In effect, the descriptive statistics in Table 2 do not fully explain why low-mismatch countries might
perform better during the crisis than high-mismatch countries. Moreover, the question of whether mismatches can in fact explain the behavior of real GDP growth during the crisis also remains unanswered.

In order to further examine the roles played by currency mismatch and each of the resilience indicators in shaping GDP growth, Table 3 provides estimates of each of the relevant pairwise correlations for low and high-mismatch countries during the crisis. Interestingly, the correlations seem to suggest that while the correlation between mismatch and GDP during the crisis was negative for low-mismatch countries, the same correlation amongst high-mismatch countries was actually positive during the crisis. In other words, the results from Table 4 indicate that the association between currency mismatch and economic growth may take on opposite signs for low and high-mismatch countries during the crisis. Contrary to expectations, the correlation between the choice of exchange rate regime and currency mismatch was positive and statistically significant for low-mismatch countries. The positive sign suggests that high mismatch is associated with a flexible rather than a fixed exchange rate regime. For high-mismatch countries, there appears to be a positive and statistically significant correlation between foreign exchange reserves and GDP growth. For those countries, a positive correlation indicates an accumulation of foreign exchange reserves may be associated with greater resilience to the financial crisis.
### Table 3. Pairwise Correlations

#### Mismatch <= 0

<table>
<thead>
<tr>
<th></th>
<th>GDP</th>
<th>Mismatch</th>
<th>Exchange Rate</th>
<th>Current Acct. Bal.</th>
<th>Debt/Exports</th>
<th>FOREX</th>
<th>Inflation</th>
<th>Savings</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mismatch</td>
<td>-0.29</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>-0.28</td>
<td>0.40*</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Acct. Bal.</td>
<td>-0.13</td>
<td>0.23</td>
<td>0.14</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt/Exports</td>
<td>0.06</td>
<td>0.18</td>
<td>-0.31</td>
<td>-0.17</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOREX</td>
<td>0.30</td>
<td>0.11</td>
<td>0.35+</td>
<td>0.16</td>
<td>0.03</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>-0.01</td>
<td>-0.16</td>
<td>-0.75**</td>
<td>-0.30</td>
<td>0.31</td>
<td>-0.48*</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Savings</td>
<td>0.10</td>
<td>0.11</td>
<td>0.00</td>
<td>0.40+</td>
<td>-0.02</td>
<td>0.06</td>
<td>-0.02</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>0.85**</td>
<td>-0.15</td>
<td>-0.17</td>
<td>-0.11</td>
<td>0.12</td>
<td>0.33</td>
<td>-0.01</td>
<td>0.32</td>
<td>1.00</td>
</tr>
</tbody>
</table>

#### Mismatch > 0

<table>
<thead>
<tr>
<th></th>
<th>GDP</th>
<th>Mismatch</th>
<th>Exchange Rate</th>
<th>Current Acct. Bal.</th>
<th>Debt/Exports</th>
<th>FOREX</th>
<th>Inflation</th>
<th>Savings</th>
<th>Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mismatch</td>
<td>0.07</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>0.02</td>
<td>0.28</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Acct. Bal.</td>
<td>-0.06</td>
<td>0.07</td>
<td>0.64**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt/Exports</td>
<td>-0.36+</td>
<td>-0.51**</td>
<td>-0.41*</td>
<td>-0.57**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOREX</td>
<td>0.51**</td>
<td>0.11</td>
<td>0.21</td>
<td>0.08</td>
<td>-0.22</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>-0.11</td>
<td>0.10</td>
<td>-0.33+</td>
<td>-0.46*</td>
<td>-0.02</td>
<td>-0.35+</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Savings</td>
<td>0.55**</td>
<td>-0.34+</td>
<td>0.08</td>
<td>0.46*</td>
<td>-0.33+</td>
<td>0.23</td>
<td>-0.31</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>0.94**</td>
<td>0.08</td>
<td>-0.11</td>
<td>-0.22</td>
<td>-0.25</td>
<td>0.49**</td>
<td>-0.12</td>
<td>0.41*</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Correlation is significant at the +10%, *5%, or **1% level.
5.2. **Empirical Results**

Table 4 presents the results from the fixed-effects regression models. Columns 1 and 2 estimate model 1 for low and high-mismatch countries respectively.

**Table 4. Regression Analysis of the Effect of Currency Mismatch on Growth**

<table>
<thead>
<tr>
<th>Model</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mismatch Group</strong></td>
<td>Mismatch&lt;=0</td>
<td>Mismatch&gt;0</td>
<td>First Differences</td>
</tr>
<tr>
<td>Mismatch</td>
<td>0.05+ (0.02)</td>
<td>0.033 (0.09)</td>
<td>-0.14* (0.05)</td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>-0.001 (1.58)</td>
<td>0.93 (1.28)</td>
<td>-0.45 (1.06)</td>
</tr>
<tr>
<td>Crisis</td>
<td>-1.87** (0.65)</td>
<td>-2.44** (0.85)</td>
<td>-3.97** (1.15)</td>
</tr>
<tr>
<td>Mismatch x Crisis</td>
<td>-0.18** (0.07)</td>
<td>0.09+ (0.05)</td>
<td>0.25* (0.11)</td>
</tr>
<tr>
<td>Mismatch x Exchange Rate</td>
<td>0.02 (0.09)</td>
<td>-0.03 (0.09)</td>
<td>0.14* (0.06)</td>
</tr>
<tr>
<td>Current Account Balance</td>
<td>0.09 (0.08)</td>
<td>-0.15* (0.07)</td>
<td>-0.14+ (0.04)</td>
</tr>
<tr>
<td>Short-Term Debt-to-Exports</td>
<td>0.03 (0.03)</td>
<td>-0.04 (0.03)</td>
<td>-0.04 (0.04)</td>
</tr>
<tr>
<td>Foreign Exchange Reserves</td>
<td>-0.02 (0.68)</td>
<td>1.53* (0.74)</td>
<td>0.26 (0.44)</td>
</tr>
<tr>
<td>Inflation</td>
<td>0.02 (0.07)</td>
<td>-0.01 (0.03)</td>
<td>0.06 (0.06)</td>
</tr>
<tr>
<td>National Savings</td>
<td>0.10 (0.09)</td>
<td>0.20* (0.09)</td>
<td>0.42** (0.11)</td>
</tr>
<tr>
<td>Capital Investment</td>
<td>0.22** (0.03)</td>
<td>0.22** (0.02)</td>
<td>0.19** (0.02)</td>
</tr>
</tbody>
</table>

*The individual coefficient is significant at the +10%, *5%, or **1% level.*

Column 3 presents the estimates for model 2, the impact of a change in currency mismatch on the change in GDP, for all countries in the sample.
MODEL 1.

The coefficient on the interaction term (mismatch x crisis) estimates the difference in the effect of currency mismatch on growth during the crisis versus non-crisis years. Comparing columns 1 and 2, both indicate that an increase in mismatch during the crisis is associated with an increase in GDP, relative to the non-crisis years. For low-mismatch countries, the coefficient on the interaction term (mismatch x crisis) is negative and statistically significant at the 1% level. However, because mismatch is negative for these countries, the results are suggesting that negative mismatches are associated with an increase in economic growth during the crisis, relative to the non-crisis years. For high or positive mismatch countries, the coefficient on the interaction term (mismatch x crisis) is positive and statistically significant at the 10% level. The sign and significance level suggest that an increase in currency mismatch is associated with an increase in growth during the crisis. In sum, estimates from columns 1 and 2 suggest that neither low nor high-mismatch countries experienced the expected economic effect of changes in currency mismatches during the crisis.

MODEL 2.

In order to analyze high and low mismatch countries simultaneously, column 3 estimates the association between a change in each of the relevant variables and a change in GDP growth. For simplification, the change in mismatch is defined to indicate whether the magnitude of the mismatch is increasing or decreasing. Here, a positive coefficient indicates an increase in mismatch for a high mismatch country or a further decrease in mismatch for a low mismatch country. The results in column 3 suggest that a 1-unit change (in either direction) in mismatch was associated with a decrease in economic growth during the non-crisis years and an increase in GDP growth during the crisis years. A country’s choice of exchange rate regime also becomes
relevant in column 3, where a 1-unit increase in mismatch within a flexible regime appears to be consistent with an increase in GDP growth. The rate of national savings also appears to be positively associated with growth, and is statistically significant at the 1% level.

6. DISCUSSION

The results from all three fixed effects regressions appear to contradict the theory that the adverse effects of mismatches for growth are exacerbated in the event of an external crisis. Rather, the main finding consistent across columns 1-3 suggests that the effect of a change in mismatch in either direction on growth was amplified by the crisis. As discussed below, such conclusions may have significant implications for policies and reform efforts in emerging economies.

6.1. POLICY IMPLICATIONS

The ability for mismatches to encourage growth during the crisis may in part be due to increased capacity to mitigate the effects with countercyclical monetary policies. Indeed, Hausmann and Panizza (2010) find that in comparison to the 1990s crises, many emerging economies responded to the recent global recession by lowering policy interest rates. Consistent with this increase in capacity, trends toward the adoption of increasingly flexible exchange rate regimes may have afforded countries with greater flexibility to counter output contractions resulting from the financial crisis. Moreover, domestic bond market development and hence redemption from original sin may be underlying the positive association between mismatches and growth during the crisis. Thus, assuming that anti-cyclical policies were effective in reducing output contractions, financial and institutional development in many emerging economies may have weakened or even solved the problems associated with high mismatches, providing new support of the effectiveness of institutional reforms in mitigating mismatches.
6.2. **Caveats and Limitations**

One drawback to using a fixed effects identification strategy is that it cannot be used to explore the effects of time-invariant variables that differ across individual entities. Such variables would be perfectly collinear with the country fixed-effects, and are thus necessarily excluded from the model. For the purposes of this analysis, the use of fixed effects limits the ability to estimate the impacts of time-invariant characteristics on GDP growth.

**Endogeneity**

Endogeneity and potential omitted variable bias represent two of the larger threats to estimating the effect of currency mismatch on economic growth. While fixed effects controls for factors invariant across time or by country, it is likely that there are still some unobserved characteristics that affect the choice of currency mismatch and are correlated with economic growth. For example, a country’s capacity to set countercyclical monetary and fiscal policies during the crisis is likely to be correlated with its observed resilience and the level of currency mismatch.

**Reverse Causality**

An additional challenge is presented by the possibility of reverse causality. As previously mentioned, sustained periods of high economic growth may contribute to lower currency mismatch. For instance, to the extent that growth is correlated with development of local currency markets, countries experiencing periods of high growth rates may be less dependent on foreign financing sources.

7. **Conclusion**

In conclusion, evidence from the recent global financial crisis provides a departure from the traditional theory that high mismatches significantly undermine growth in the event of an external shock. On the contrary, the results from fixed effects regression analysis points to a positive
association between mismatch and growth during the crisis (2007-2009). Whether driven by
domestic financial development, the adoption of flexible exchange rate regimes, or abstinence
from borrowing in the foreign exchange market, currency mismatches no longer appear to be
significantly linked to economic contractions during a financial crisis.

**7.1. Suggestions for Future Research**

In order to assess the robustness of this study’s findings, future research should substitute various
measures of both currency mismatch and resilience to an external shock. If the results from the
analyses hold, it’s likely that the estimates are effectively capturing the association between
mismatch and growth. One alternative variable for measuring mismatch is the ratio of foreign
currency-denominated liabilities to export revenue as a percent of GDP. This method of
calculating currency mismatch highlights the importance of openness to trade. By virtue of the
calculation, countries that are more open will also have lower currency mismatch. In addition to
including additional measures of the main variables, re-estimation of the model using firm-level
data would reveal whether the results hold from a micro-economic perspective.

Similar to previous studies including Bordo, Meissner, and Stuckler (2010), future
research might adjust the empirical model to capture the effect of high mismatches on the
probability of a crisis. Logit or probit analysis may provide additional insights into how
mismatches effect growth through their impact on the probability of experiencing a crisis.

Lastly, future research should also incorporate measures of institutional strength,
government effectiveness, and capacity to enact countercyclical policies. While the choice of
exchange rate regime provides some insights into capacity, data on policy interest rates and
direct intervention in the foreign exchange market would further clarify the role of government
institutions in both mitigating crises and encouraging resilience in the pre-crisis period.
## APPENDIX A: Variable Descriptions

### Table A1. Variable Descriptions

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP Growth</td>
<td>Annual rate of real GDP growth (%)</td>
<td>WB GDF Indicators</td>
</tr>
<tr>
<td>Currency Mismatch</td>
<td>Net foreign currency denominated liabilities-to-total banks reserves</td>
<td>Ranciere, Tornell, and Vamvakidis (2010)</td>
</tr>
<tr>
<td>Crisis</td>
<td>1= crisis years (2007-2009), 0= all other years</td>
<td>Author’s calculations</td>
</tr>
<tr>
<td>Exchange Rate Arrangement</td>
<td>1= flexible regime, 0= fixed or pegged regime</td>
<td>Reinhart and Rogoff (2010) and author’s calculations</td>
</tr>
</tbody>
</table>

### Macroeconomic Stability Indicators

- **Current Account Balance**: Current account surplus/deficit as a percent of GDP (%)  
  - Source: WB GDF Indicators
- **National Savings**: Annual rate of savings as a percent of GDP (%)  
  - Source: WB GDF Indicators
- **Fixed Capital Formation**: Annual growth in fixed capital formation (%)  
  - Source: WB GDF Indicators

### Resiliency Indicators

- **Short-term debt-to-Exports**: Ratio of short-term debt (<1 year maturity) to total exports  
  - Source: WB GDF Indicators
- **Foreign Exchange Reserves**: Annual percent change in foreign exchange reserves (%)  
  - Source: IMF-IFS
- **Inflation**: Annual change in the Consumer Price Index (CPI); (%)  
  - Source: WB GDF Indicators

*Note: Table presents definitions and sources for all variables used in the analysis. WB GDF Indicators are the World Bank’s Global Development Finance Indicators. IMF IFS are the International Monetary Fund’s International Financial Statistics.*
APPENDIX B: Calculation of Currency Mismatch

The measure for currency mismatch is calculated using the following formula:

\[
\text{Foreign currency denominated net liabilities} = \frac{\text{foreign currency foreign liabilities} + \text{foreign currency domestic liabilities} - \text{foreign currency foreign assets} - \text{foreign currency domestic assets} + \text{foreign currency lending to unhedged households} + \text{foreign currency lending to unhedged nonfinancial firms}}{\text{total bank assets}}
\]

APPENDIX C: Exchange Rate Regime Classification

The annual fine classification used to measure a country’s choice of exchange rate regime categorizes regimes according to the degree of flexibility allowed by monetary authorities. Using a scale of 1-15, lower values represent strict controls and higher values signal greater flexibility. In contrast to Kamil (2012), this analysis classifies classifications 9 and above as floating, and all others as fixed.

The specific codes are as follows:

<table>
<thead>
<tr>
<th>CODE</th>
<th>CLASSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No separate legal tender</td>
</tr>
<tr>
<td>2</td>
<td>Pre announced peg or currency board arrangement</td>
</tr>
<tr>
<td>3</td>
<td>Pre announced horizontal band that is narrower than or equal to +/-2%</td>
</tr>
<tr>
<td>4</td>
<td>De facto peg</td>
</tr>
<tr>
<td>5</td>
<td>Pre announced crawling peg</td>
</tr>
<tr>
<td>6</td>
<td>Pre announced crawling band that is narrower than or equal to +/-2%</td>
</tr>
<tr>
<td>7</td>
<td>De factor crawling peg</td>
</tr>
<tr>
<td>8</td>
<td>De facto crawling band that is narrower than or equal to +/-2%</td>
</tr>
<tr>
<td>9</td>
<td>Pre announced crawling band that is wider than or equal to +/-2%</td>
</tr>
<tr>
<td>10</td>
<td>De facto crawling band that is narrower than or equal to +/-5%</td>
</tr>
<tr>
<td>11</td>
<td>Moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time)</td>
</tr>
<tr>
<td>12</td>
<td>Managed floating</td>
</tr>
<tr>
<td>13</td>
<td>Freely floating</td>
</tr>
<tr>
<td>14</td>
<td>Freely falling</td>
</tr>
<tr>
<td>15</td>
<td>Dual market in which parallel market data is missing.</td>
</tr>
</tbody>
</table>

Source: Reinhart and Rogoff (2010)
BIBLIOGRAPHY


