DRUG SUBSIDY PROGRAMS IN THE DEVELOPING WORLD: THE IMPACT OF THE “FARMÁCIA POPULAR” PROGRAM ON HEALTH OUTCOMES IN BRAZIL

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ABSTRACT

Improved access to medications is associated with not only improved health status, but also with reduced expenditure in more complex medical procedures. This paper uses regression analysis to evaluate the impact of the Brazilian prescription drug reimbursement program “Farmácia Popular” (hereafter FP) on health outcomes, while controlling for other factors that affect health. To date, no existing studies have evaluated the program using multivariate regression. These findings can provide guidance as to the usefulness of future program expansion. Publicly available data at the state level over the 2003-2007 period are combined into a panel dataset, which allows the analysis of the period before and after the program was implemented. Data on hospitalizations due to hypertension diseases is used as the dependent variable, and fixed-effects and random-effects analysis is used to control for state-specific characteristics that may confound the relationship of interest. Results show that the program had a weak statistically significant impact on health outcomes (p>0.109) and indicate that a 1% increase in the number of FP pharmacies
is associated with a 0.02% decrease in hospitalizations, after controlling for other factors influencing hospitalization due to hypertension diseases. Among the control variables in the Fixed Effects model, only education was statistically significant (p>0.006), indicating that a 1% increase in illiteracy rates leads to a 0.51% increase in hospitalizations, holding all variables in the model constant. These finding on the importance of education levels for hypertension conditions are strongly supported by the literature.

Although there are a series of limitations regarding the variables used in the model and a lack of control variables for behavioral characteristics, results indicate that drug reimbursement programs can be an effective way to increase affordability and access to medications in developing countries. Nonetheless, policymakers should carefully analyze many other factors related to drug access and the effect of education on hypertension diseases.
ACKNOWLEDGEMENTS

I would like to thank everyone who helped me with this thesis, especially Dr. John Johnson, who has provided valuable guidance and insights and has been an extremely patient and encouraging advisor. I thank Dr. Fatima Marinho and Dr. Luiz Riani for their time and help with access to databases from Brazil. I would also like to thank my husband Steven, my baby daughter Giovanna and my mother Ivone for all their support, patience and love. Thank you!
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Introduction

To increase access to essential medications that treat high-incidence diseases such as hypertension, the Brazilian government recently implemented “Farmácia Popular” (FP), a nationwide reimbursement program for certain types of drugs. The FP program, first implemented in 2004 and expanded in 2006, covers 90% of drug costs. By substantially reducing drug costs to the end consumer, the FP has the potential to increase the population’s access to medications and improve health outcomes, while guaranteeing the pharmaceutical industry an increase in demand for drugs.\(^1\)

Using publicly available secondary data, this paper uses regression analysis to evaluate the impact of the FP program on health outcomes, while controlling for other socioeconomic factors that also affect health. Among the control variables included in the model are: percentage of the population covered by private health insurance, public expenditure on healthcare per capita, illiteracy levels, and income per capita. The number of hospital admissions due to hypertension is the outcome variable of interest. Data at the state level over the 2003-2007 period are combined into a panel dataset, which allows the analysis of the period before and after the program was implemented.

\(^1\) Economic theory predicts and empirical evidence suggests that a reduction in drug prices is associated with an increase in drug consumption, as people who could not otherwise afford their prescription drugs can then buy them at affordable prices (movement along the demand curve). In addition, there might be long run effects of the program that lead to a shift in the demand curve. This can be explained by the fact that the existence of the program itself may cause people to seek medical services to get their prescriptions, as they know they can now afford to buy them.
The analysis of this time frame is important to see how trends in hospitalization changed after the program was implemented.

Currently, no academic studies have used regression analysis to evaluate the FP program. A better understanding of the effects of the program on health status can contribute to better targeting and implementation of other drug subsidy programs in both Brazil and other developing countries looking to increase access to drugs. The present study aims at addressing this need. Its results can also guide ongoing discussions of expanding the scope of drugs reimbursed under the FP program.
Background

The Issue of Access

Policies to increase access to affordable prescription drugs are at the center of every government healthcare agenda, as access to medication has important implications for the health status of the population. Studies show that rational\(^2\) and effective use of drugs can improve health outcomes and reduce overall healthcare costs (e.g., through lower hospitalization rates) (Sokol, 2005 and Cremieux, 2007).

Research also shows that improved health status is positively correlated with economic growth (Hsiao, 1996; Bloom et al 2001). Life cycle models have explained how one’s health status can determine future income, wealth and consumption (Lilliard and Weiss 1997; Smith 1998; Smith 1999). Therefore, pharmaceutical policy is essential for countries’ development strategies.

However, rising prescription drug costs have prevented governments from providing universal access to medications in developing and developed countries alike.\(^3\) Many countries are confronted with the same dilemma: how to ensure that their

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\(^2\) According to the WHO, “Rational use of drugs requires that patients receive medications appropriate to their clinical needs, in doses that meet their own requirement, for an adequate period of time, and at lowest cost to them and their community”

\(^3\) The Global Humanitarian Assistance defines developing countries as “all countries and territories in Africa; all countries in the Americas except the US, Canada, Bahamas, Bermuda, Cayman Islands and Falkland Islands; all countries in Asia and the Middle East except Japan, Brunei, Hong Kong, Israel, Kuwait, Qatar, Singapore, Taiwan and United Arab Emirates; all countries in the Pacific apart from Australia and New Zealand; plus the European states of Albania, Armenia, Azerbaijan, Georgia, Gibraltar, Malta, Moldova, Turkey and ex-Yugoslavia
population has access to life-saving drugs while keeping public expenditures under control. Governments actively promote policies to reduce consumer’s drug costs, including: reimbursement and cost sharing schemes, reference pricing, price caps, and generic drug substitution. However, these policies require maintaining a delicate balance among conflicting goals: while price caps may keep drug prices low, they may reduce incentives for private investment in new drugs; while cost sharing mechanisms may alleviate the burden on government budgets, they may also affect drug affordability for price-sensitive consumers. As with most policy issues, there are inherent costs and benefits of each policy solution that must be carefully weighted.

Governments in most advanced economies provide coverage for healthcare and prescription drugs to their populations. However, governments in most developing countries cannot afford and/or do not have the institutional capacities to provide such benefits, and most people finance their prescription drug expenditures out-of-pocket. In addition, drug costs are only one of the barriers to access in these countries.

Although there is a wide variation of income per capita among the countries classified

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4 The US is an exception as it relies on private insurance markets for healthcare provision, with the government role essentially limited to the very poor (MEDICAID program) and the elderly (MEDICARE program). This has created major inequities in the access to health in the US. Nonetheless, other advanced countries also face equity and other issues and not everyone has access to prescription drugs in these countries (OECD 2008).

5 According to the Organization for Economic Co-Operation and Development (OECD), “household out-of-pocket expenditure on health comprise cost sharing, self-medication and other expenditure paid directly by private households, irrespective of whether the contact with the healthcare system was established on referral or on the patient’s own initiative”. See OECD’s Glossary of Statistical Terms for more information: [http://stats.oecd.org/glossary/index.htm](http://stats.oecd.org/glossary/index.htm).
as “developing”, they all tend to lack a well-functioning healthcare system that can effectively deliver health services to their populations. These countries lack well-trained doctors and nurses, medical equipment, capacity for preventive efforts, appropriately staffed and equipped hospitals, ambulatory services and health clinics. They usually have poor roads and other infrastructure barriers that limit population capabilities to access healthcare services. Poor countries also suffer from systematic corruption, burdensome red tape, poorly managed institutions, unsound macroeconomic conditions, large informal labor markets, and distortive and thin tax-bases that preclude effective healthcare financing and management.

As out-of-pocket expenditures on pharmaceuticals can be substantial, rising drug costs prevent adequate access to medications, with negative health consequences. In the developing world, out-of-pocket expenditures for drugs are the norm rather than the exception. A 1998 World Health Organization (WHO) study found that 50-90% of all expenditures on pharmaceuticals in developing countries are privately funded, considerably higher than in advanced countries (median is 34%). In addition, pharmaceuticals expenditures accounts for 30-50% of total health-care expenditure in developing countries, compared with less than 15% in established market economies (Velásquez, 1998).
According to the WHO, “an estimated one-third of the world population lacks regular access to essential medicines⁶, with this figure rising to over 50 percent in the poorest parts of Africa and Asia” (WHO, 2004) (see Figure I below). Millions of people, most in developing countries, lack access to essential drugs and millions die of preventable diseases every year.

Figure I: Percentage of WHO regions lacking access to essential medicines (WHO, 2004)

For many developing countries, especially the poorest ones, foreign aid and philanthropic activities led by foundations and pharmaceutical companies play an

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⁶ According to the WHO, “Essential medicines are those that satisfy the priority healthcare needs of the population (…) they are intended to be available within the context of functioning health systems at all times in adequate amounts, in the appropriate dosage forms, with assured quality and adequate information, and at a price the individual and the community can afford. The implementation of the concept of essential medicines is intended to be flexible and adaptable to many different situations; exactly which medicines are regarded as essential remains a national responsibility.”
important role in increasing the population’s access to affordable drugs. Their activities range from building healthcare infrastructure to contributing to global funds to fighting diseases specific to poor countries. Developing countries such as Brazil do not receive much investment from the development community because of their relative high income levels. However, as will be discussed below, Brazil has an extremely unequal income distribution, and millions of poor people cannot afford to buy needed medications. Therefore, drug subsidies programs that reduce costs to consumers can have an important impact on access and health status of the population.

Background on Brazil

Brazil offers an interesting case study for this analysis. It is a large emerging economy with vast natural resources and a growing middle class with immense potential for attracting investments that can spur economic growth and lift millions out of poverty.

Brazil ranks as the 5th most populous country in the world with a population of 194 million. According to the World Bank, Brazil’s Gross Domestic Product (GDP) was $1.3 trillion in 2007, the 10th largest in the world. The CIA Worldfactbook estimated a GDP of $1.665 trillion for Brazil in 2008.

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7 See also Appendix II for additional graphs with trends on selected indicators in Brazil.
8 Source: U.S. Census Bureau, International Data Base: http://www.census.gov/cgi-bin/ipc/idbrank.pl (accessed on November 18, 2008).
Although per capita gross national income (international PPP $) was $8,700 in 2006,\(^{10}\) this indicator is not a good measure of general wellbeing, as income distribution in Brazil is highly unequal. Brazil’s Gini coefficient\(^{11}\) is 0.5703, one of the highest in the world. The wealthiest 10% of the population receives 46.1% of the per capita family income in Brazil, while the poorest 20% receives only 2.9% (Uga, 2007). About 22% of Brazil’s population lives below the national poverty line\(^{12}\).

Brazil ranks 70\(^{th}\) out of 179 countries in the United Nations’ Human Development Indicator (HDI). The HDI is a more comprehensive measure of wellbeing than the usual GDP measures as it includes measures of health status, educational achievement, and standards of living.\(^{13}\) Brazil’s HDI of 0.807 is lower than that of Chile and Argentina, but higher than most other countries in Latin America.

Table I below shows key socioeconomic indicators for Brazil, Chile, Mexico, and the US in 2006. Brazil performed worse than the other countries in all indicators. Brazil’s literacy rate was 88% in 2005 compared to 96% in Chile, even though Chile’s

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\(^{11}\) The Gini coefficient is a measure of inequality of income distribution, with 0 representing perfect equality and 1 perfect inequality.

\(^{12}\) World Bank, Brazil at a Glance, 9/24/08.

\(^{13}\) According to the Human Development Report 2008 of the United Nations Development Program (UNDP), “The HDI provides a composite measure of three dimensions of human development: living a long and healthy life (measured by life expectancy), being educated (measured by adult literacy and enrolment at the primary, secondary and tertiary level) and having a decent standard of living (measured by purchasing power parity, PPP, income)”. HDI tables can be accessed at: [http://hdrstats.undp.org/2008/countries/country_fact_sheets/cfy_fs_BRA.html](http://hdrstats.undp.org/2008/countries/country_fact_sheets/cfy_fs_BRA.html).
expenditure on education as a percentage of GDP was lower than that of Brazil’s (3.7 and 4.1 respectively).

Table I: Key health statistics for Brazil in 2006

<table>
<thead>
<tr>
<th></th>
<th>Brazil</th>
<th>Chile</th>
<th>Mexico</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per capita GDP (PPP)$^{14}$</td>
<td>10,298</td>
<td>14,688</td>
<td>14,581</td>
<td>47,025</td>
</tr>
<tr>
<td>Human Development Index - 2006$^{15}$</td>
<td>0.807</td>
<td>0.874</td>
<td>0.842</td>
<td>0.950</td>
</tr>
<tr>
<td>Life expectancy at birth (years) - 2006$^{16}$</td>
<td>72.00</td>
<td>78.40</td>
<td>75.80</td>
<td>78.00</td>
</tr>
<tr>
<td>Population suffering from malnutrition – 2002$^{17}$</td>
<td>7%</td>
<td>4%</td>
<td>5%</td>
<td>&lt; 2.5 %</td>
</tr>
<tr>
<td>Households with access to potable water - 2004$^{18}$</td>
<td>90%</td>
<td>95%</td>
<td>97%</td>
<td>100%</td>
</tr>
<tr>
<td>Households with access to sanitation - 2004$^{19}$</td>
<td>75%</td>
<td>91%</td>
<td>79%</td>
<td>100%</td>
</tr>
<tr>
<td>Literacy rate of persons 15 years of age or over - 2005$^{20}$</td>
<td>88%</td>
<td>96%</td>
<td>90%</td>
<td>99%</td>
</tr>
<tr>
<td>Public expenditure on education (% of GDP) - 2005$^{21}$</td>
<td>4.1</td>
<td>3.7</td>
<td>5.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Public expenditure on health services (% of GDP) – 2003$^{22}$</td>
<td>3.4</td>
<td>3.0</td>
<td>2.9</td>
<td>6.8</td>
</tr>
</tbody>
</table>

$^{16}$ Idem 14.
$^{19}$ Idem 17.
$^{22}$ Idem 20.
Brazil’s healthcare system is highly fragmented, with a public system coexisting alongside a private health insurance market. Brazil constitutionally guarantees the right to health through its publicly-funded universal healthcare system SUS (Sistema Único de Saúde)\(^23\) that provides health services and medications free of charge to the population. However, the system is systematically underfunded, plagued with flaws, and coverage is far from universal. As a result, a supplementary private system (SPS) financed with pre-payments by households and employers have been growing steadily over the years. Nonetheless, an estimated 70% of the population relies on SUS for medical care.

According to Brazil’s private health insurance regulator ANS (Agência Nacional de Seguros), about 45 million people (or about 23% of the population) have private insurance in Brazil (Gadelha et al, 2008), however some of them use the public system for procedures not covered by their private plans. There is also a share of the population that finances its medical expenses with out-of-pocket expenditures.

Private health plans are not required to offer comprehensive prescription drug coverage. Those with private insurance either pay the full cost of prescription drugs or receive some sort of discount (up to 30% for selected drugs) through their plans in associated pharmacy chains. Although the SUS provides some drugs free of charge through the “Pharmaceutical Assistance Program” for those using the public system, it

\(^23\) SUS was created by laws 8.080 and 8.142 in 1990.
does not have a comprehensive drug reimbursement program, leaving millions of people unable to pay for necessary prescription drugs.\(^{24}\)  

Studies show that prescription drugs expenditures are a substantial component of families’ budgets in Brazil, and it was the main out-of-pocket expenditure for all income levels in 2002. In a 2003 national household sample survey (PNAD)\(^ {25}\), more than 78% of the Brazilian population reported having trouble affording their prescription drugs. Another survey also found that in some states, drug expenses in 2003 accounted for more than 10% of families’ income for low income levels, compared to less than 1% for high income levels.\(^ {26}\)  

Based on the POF survey data and on ProGenéricos estimates, Figure II below illustrates the percentage of the population lacking access to drugs by income levels.

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\(^{24}\) However, it is important to recognize that the Brazilian government has been internationally praised for providing drugs free of charge for certain types of diseases. One example is the internationally recognized HIV/AIDS program, which provides antiretroviral drugs free of charge to anyone seeking treatment in the public system.  

\(^{25}\) PNAD is an annual national household survey conducted by IBGE (the Brazilian Census Bureau).  

\(^{26}\) POF (Household Budget Survey), IBGE, 2002-2003.
Figure II: Access to medications, by income level, 2002\(^{27}\)

As shown above, more than 65% of people in the lowest income bracket (those earning less than four times the minimum wage) lacked access to drugs due to income restrictions, and only 8% of this group had private insurance coverage. This means that 92% of the people in the lowest income group relied on SUS for medical care, and the fact that 65% of them did not have access to needed medication indicates that the current pharmaceutical assistance programs under SUS are not sufficiently covering

\(^{27}\) MW = Brazilian Minimum Wage
the most vulnerable portion of the population. In contrast, no one in the highest income bracket had problems buying their prescription drugs.

These trends only exacerbate the persistent income disparity that hinders social and economic development in Brazil. Properly designed, policies such as the FP program targeted at significantly reducing the costs of drugs to consumers have the potential to reduce these inequities in the Brazilian healthcare system by reducing the share of families’ income spent on drugs. However, inequities in health access are exacerbated by a complex interrelation of socioeconomic and policy factors.\(^28\) Although the FP can help reduce these inequities, a comprehensive approach\(^29\) is needed to make any serious dent on inequality indicators.

*The Brazilian Pharmaceutical Sector*

Brazil is the world’s 10\(^{th}\) largest market for pharmaceutical products. In 2007, total sales (excluding government purchases), amounted to approximately $10 billion, and sales are forecasted to reach $18 billion by 2012 (IMS Health).

The industry is dominated by multinational companies (about 70\% in 2002), but since the Brazilian generic drug law was approved, some key domestic players have been growing and gaining market share. As shown by Figure III below, among

\(^{28}\) These factors include: gender, race, ethnicity, culture, geography, income, education, to mention some.

\(^{29}\) A comprehensive approach must look at educational systems, welfare systems, progressive tax systems, and land reform issues, for instance.
the twelve largest companies in 2005, five were domestic: Aché, EMS Sigma Pharma, Medley, Eurofarma, and Group Castro Marques.

**Figure III**: Market share of 12 largest pharmaceutical companies in Brazil (in bold red)

The market for generic drugs was established by federal law 9.787/1999, with the first generic products put on market in February 2000. Under regulations of ANVISA, Brazil’s food and drug regulator, generic drugs are identical to brand name drugs whose patents have expired. This fact means that they are bioequivalent to a
brand name drug in effectiveness, safety, and quality. However, as generic drug manufactures do not have to make expensive R&D expenditures, generic drug prices are usually substantially lower than those of the brand-name drugs of reference. For certain drugs such as atelolol and metformina, designed to treat hypertension and diabetes respectively, prices can be 64% lower.

Generic drugs sales in Brazil grew by 39% in 2006 and 46% in 2007. Accumulated sales during the 12 month period from August 2007 to August 2008 were $1.97 billion, accounting for 14% of market share. As Figure IV below shows, sales and market share of generic drugs have been growing steadily since their introduction in 2000.

30 See technical notes at ANVISA website: [http://www.anvisa.gov.br/medicamentos/conceito.htm#2.4](http://www.anvisa.gov.br/medicamentos/conceito.htm#2.4).
31 By law a generic must be at least 35% cheaper than the reference drug.
32 Source: PróGenéricos, the trade association for generic drug manufacturers.
According to projections, generics are expected to account for 22.8% of the total market by 2011 (sales), making Brazil one of the largest generic markets in the world.

Sales of generic drugs for the treatment of cardiovascular diseases have been growing rapidly over the years, reflecting changes in the country’s epidemiology. As

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33 Projections from Research and Markets: Generic Drug Markets in Brazil 2007-2011.
income levels rise, chronic diseases such as cardiovascular conditions have become the number one cause of death in many states in the country.

Brazil first faced an epidemiological transition in 1960, when cardiovascular diseases became the leading cause of death in the south and southeast regions. In the 1980s, it became the leading cause in all regions. Nonetheless, the transition did not occur uniformly, and the incidence of infectious diseases remains in many parts of the country. These epidemiological characteristics are reflected in Table II below, which shows the proportion of deaths by cause and region in 2005.

**Table II:** Proportion of death by group of causes (ICD-10)\(^3\), by region, 2005

<table>
<thead>
<tr>
<th>Group of Causes</th>
<th>North</th>
<th>Northeast</th>
<th>Midwest</th>
<th>Southeast</th>
<th>South</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td>I - Infectious diseases</td>
<td>7.6</td>
<td>5.8</td>
<td>5.4</td>
<td>5</td>
<td>4</td>
<td>5.2</td>
</tr>
<tr>
<td>II - Neoplasm</td>
<td>13</td>
<td>13.4</td>
<td>14.6</td>
<td>17.1</td>
<td>20</td>
<td>16.3</td>
</tr>
<tr>
<td>IX - Diseases of the circulatory system</td>
<td>24.4</td>
<td>31.1</td>
<td>30.2</td>
<td>32.3</td>
<td>32.2</td>
<td>31.5</td>
</tr>
<tr>
<td>V - Diseases of the respiratory system</td>
<td>10.7</td>
<td>9.2</td>
<td>10.2</td>
<td>11.4</td>
<td>11.5</td>
<td>10.8</td>
</tr>
<tr>
<td>XX - External causes</td>
<td>19.3</td>
<td>15</td>
<td>17.9</td>
<td>13.2</td>
<td>12.8</td>
<td>14.1</td>
</tr>
</tbody>
</table>

Source: DATASUS/MS, July 2007

As the table indicates, infectious diseases are more prevalent in poorer regions in the North and Northeast, and diseases of the circulatory system are by far the

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\(^3\) ICD-10 is the International Statistical Classification of Diseases and related health problems, 10th revision. 2007 version can be accessed at: [http://www.who.int/classifications/apps/icd/icd10online](http://www.who.int/classifications/apps/icd/icd10online).
predominant cause of death in all regions. The government initiative to increase access to drugs for cardiovascular diseases can therefore have an important impact on the mortality rates in the country.

According to PróGenericos, sales of drugs for cardiovascular diseases accounted for the highest share of total sales in 2006 and 2007 (20.8% and 21.0%, respectively). Figure V below shows the sales evolution of drugs to treat diabetes and of beta-blockers, one of the drugs used to treat cardiovascular diseases.

**Figure V:** Sales evolution of selected drugs, 2007-2007

![Sales evolution of selected drugs](image)

<table>
<thead>
<tr>
<th>Year</th>
<th>Beta-blocker</th>
<th>Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>4.7</td>
<td>3.7</td>
</tr>
<tr>
<td>2004</td>
<td>6.4</td>
<td>5.1</td>
</tr>
<tr>
<td>2005</td>
<td>8.8</td>
<td>6.5</td>
</tr>
<tr>
<td>2006</td>
<td>10.5</td>
<td>7.4</td>
</tr>
<tr>
<td>2007</td>
<td>13.4</td>
<td>9.4</td>
</tr>
</tbody>
</table>

Source: IMS Health

If the FP program were expanded to cover drugs for a wider variety of diseases, the program could have a positive effect on the pharmaceutical industry in general and on generic manufacturers in particular, as most of the drugs covered under the program
are generics. As higher quantities of drugs are consumed under the program, this can give incentives for companies to expand investments, gain economies of scale and increase efficiencies and profitability.

**Pharmaceutical Assistance Programs**

The Brazilian government has implemented many different programs over the years to increase the population’s access to drugs. As shown in Figure VI below, between 2003 and 2007 the federal government increased its expenditures on drugs by 144%, amounting to a total of R$4.66 billion (Pinto, 2008). Federal government expenditures on pharmaceuticals is expected to reach 12.3% of the total government healthcare budget in 2008 (compared to 5.8% of the total healthcare budget in 2002).

**Figure VI**: Federal government expenditures on pharmaceuticals in Brazil

![Figure VI: Federal government expenditures on pharmaceuticals in Brazil](source: Brazilian Ministry of Health)
While these programs offer drugs free of charge to any citizen who seeks SUS services, there is no systematic evaluation of the impact, cost-effectiveness, and coverage of these programs. Appendix I provides a non-exhaustive list of these different programs. It is not the goal of this paper to analyze all of them, but they are listed here so they can be kept in mind throughout this analysis of the FP program as they could potentially be driving the results.

*Farmácia Popular (FP): the 2004 implementation*

The goal of the FP program is to increase access to prescription drugs through a cost sharing\textsuperscript{35} arrangement between the government and consumers. The program was conceptualized to target non-SUS users (mainly those with private health insurance) who have trouble affording their prescription drugs (as private health plans do not cover drugs). However, in reality the program is not targeted as it is not means-tested\textsuperscript{36} and it allows anyone (both SUS users and private health insurance holders) to buy their prescriptions through the program.

The 2004 FP implementation relies on state-owned production facilities and pharmacy chains to make the drugs available to the population at marginal cost. Prices are approximately 90% cheaper than similar drugs sold in private chains. These state-

\textsuperscript{35} In this case, cost sharing means that patients are responsible for covering a portion of the charges at the time a prescription is filled, with the federal government being responsible for the remaining portion.

\textsuperscript{36} Means-testing is an examination into the financial state of a person to determine eligibility for public assistance.
owned pharmacies are established in partnership with local governments to sell drugs produced and distributed by the Oswaldo Cruz Foundation (FIOCRUZ). The drugs under the FP program are targeted to treat the most common conditions among the Brazilian population including hypertension, diabetes, stomach ulcers, depression, asthma, and infections. As shown in Figure VII below, 60% of the drugs sold in the state-owned units are targeted at cardiovascular diseases. Due to the large concentration of drug sales for cardiovascular diseases under the FP program, the analysis will focus on this particular disease category.

\[37 \text{ FIOCRUZ is a government-related institution involved in healthcare policy and national production of essential drugs. When a specific drug is not produced by FIOCRUZ, FIOCRUZ will source it from private drug manufacturers.}\]
There are currently 451 state-owned pharmacies in 358 Brazilian municipalities and there are forecasts of expansion to 600 pharmacies by 2011. As of May 2008, the Brazilian Ministry of Health invested R$182 million in the program. Any municipality with a population level above 50 million that demonstrates interest can participate in the program. As shown in Figure VIII below, there is a concentration of state-owned pharmacies in the Northeast and Southeast regions.
These state-owned pharmacies under the 2004 FP implementation could be really important and effective in increasing access to medications if they are reaching poorer areas where the market has failed to attend due to the population’s low purchasing power.

*Farmácia Popular (FP): the 2006 expansion*

In 2006, the federal government decided to expand the FP program to include private pharmacy chains. Similar to the 2004 model, the 2006 expansion operates under a cost sharing arrangement where the government pays for up to 90% of the costs of certain drugs. Contrary to the 2004 model, the 2006 expansion relies on reimbursing private pharmacy chains for consumers’ purchases instead of relying on...
public production of drugs and state-owned pharmacies. By doing this, the government does not incur operational costs of the 2004 model which includes a lump sum for start-up plus a monthly payment for maintenance. Under the 2006 model, the government can also take advantage of an efficient and dynamic private sector which tends to be better suited to manage units and inventories through comprehensive knowledge of supply chain replenishment techniques.

The FP expansion covers mostly drugs targeted to treat cardiovascular diseases and diabetes but there are plans to expand the program to include additional drugs such as contraceptives and treatments for asthma and osteoporosis. As of May 2008, the government had reimbursed an average of R$24.7 million per month, counting 5,120 private pharmacies enrolled in the program in 810 municipalities. There are forecasts for expansion to 10,000 pharmacies by December 2008 and 19,700 pharmacies by 2011. As shown in Figure IX below, the 2006 expansion was very successful in increasing the number of pharmacies.
Figure IX: Comparison between 2004 implementation and 2006 expansion of the FP program

Source: Brazilian Ministry of Health
In a qualitative evaluation of the 2004 FP program, Claudia Pinto (2008) notes that patients from both the public (SUS) and private health insurance systems have been using the FP program. She also notes that most of the drugs covered in the FP program are also available free of charge to SUS patients under other pharmaceutical programs. The author concludes that SUS users are probably not getting adequate access to these medications through these other programs, as they are paying the copayments in the FP pharmacies instead of getting the drugs free of charge through SUS.
Literature Review

Because the FP program is fairly new, no studies use multivariate methods to analyze the impact of pharmaceuticals reimbursement programs on health outcomes in Brazil. However, most developed countries have some form of reimbursement and cost sharing scheme in place and there is a sizable body of literature evaluating the impact of such programs in these countries on the demand for drugs and on health outcomes.

Studies consistently find that increases (decreases) in reimbursement levels for prescription drugs by third party payers are associated with higher (lower) drug consumption. However, the empirical evidence of the impact of drug reimbursement on health outcomes is at best mixed.

Impact on drug demand

According to the extensive body of literature on this topic, the price elasticity of prescription drug demand ranges from -0.1 to -0.6. This means that a 10% reduction in cost sharing is associated with a 1-6% increase in drug consumption (Thomas, 2008). Other studies evaluating the impact of increased copayments on drug consumption show that drug use decreases substantially for the nonelderly (Blais et al., 1999a), while it decreases moderately for the elderly populations (Blais et al., 1999b).
**Impact on health outcomes**

A recent study by Kent (2008) focusing on the hypertension population in the US uses data from the Medicare Current Beneficiary Survey (MCBS) linked to Medicare claims data from 1995-1999 to estimate the relationship between insurance coverage for prescription drugs and health outcomes, measured by stroke rates. Using a Cox proportional hazards model and controlling for clinical risk adjustors and demographic and socioeconomic indicators, the author finds that insurance coverage has no effects on stroke rates for Medicare beneficiaries with hypertension. Other studies find similar results. Khan (2007) uses fixed-effects analysis to obtain the effects of prescription drug coverage on drug use, on other medical services use, and on health outcomes of the elderly. The author finds that prescription drug coverage, especially public coverage, significantly increased drug usage but had no effects on other health services usage or on health outcomes of the elderly.

However, many other studies find different results from those above. Lichtenberg (1996) examines the impact of prescription drug use on health outcomes and on utilization of other medical services. The author finds that an increase in prescription drug use is associated with a decrease in hospitalization rates and in surgical procedures.

Recent studies show that increasing prescription drug cost sharing is associated with a reduction in the adherence to medical therapy for populations with hypertension.
A study by Cole et al., (2006) finds that increases in cost sharing have a strong impact on drug adherence and on health outcomes for those with chronic diseases. For patients taking beta-blockers, a $10 increase in copayment was associated with a 1.8% decrease in consumption. This decrease in consumption was in turn associated with a 2.8% decrease in medical costs and an 8.7% increase in the risk of hospitalization for congestive heart failure (CHF). Another study found that the underuse of beta-blockers among survivors of heart attacks (myocardial infarctions) was associated with adverse health outcomes (Soumerai, McLaughlin et al. 2007).

Similarly, in a prospective cohort study, Marieke et al. (2001) found that when cardiovascular drugs were given to patients who could not afford them, clinical outcomes improved during the six months of treatment and persisted throughout 24 months of follow-up, while hospitalizations decreased from 85 at baseline to 49 at six months (42%).

Other studies of populations with hypertension also suggest that increase cost sharing can have adverse effect on health. In a randomized controlled trial, Brook (1983) investigated if free care improves adult’s health. The author randomly assigned 3,958 people between the ages of 14 and 61 to either an insurance plan that requires cost sharing or to a plan that provides free care. As expected, the author finds that the former group made one third fewer visits to a physician, but found no effect on the
health status of the average participant. However, for low income people with hypertension, free care led to better control of blood pressure and reduced the risk of early death.

Tamblyn, R, et al., (2001) investigated the impact of cost sharing on the use of essential and non-essential drugs and on health outcomes. Using a random sample of elderly and welfare beneficiaries in Quebec in 1996, the authors apply an interrupted time-series analysis covering months before and after the introduction of a coinsurance and deductible for prescription drugs. The authors find a reduction in the use of essential drugs and an increase in adverse health events.

And finally, using data from the Rand Health Insurance Experiment, Keeler et al. (1985) analyzed the effect of free care and free prescription drugs on health outcomes. The author finds that low-income hypertensive patients receiving free care had better blood pressure control than those subjected to cost sharing, due to increased contact with physicians and increased use of prescription drugs.

The different findings encountered in the literature on the effect of cost sharing (and its resulting reduced drug use) on health outcomes indicate that the relationship between drug use and health outcomes varies across different types of diseases and across income levels.
Conceptual Framework and Hypothesis

Conceptual Framework

The FP program acts like prescription drug insurance by lowering the price of drugs to consumers and increasing access. Economic theory predicts that insurance motivates patients to consume more drugs than the economically optimal quantity, as the price perceived by the consumer is lower than the actual price. Cost sharing, by increasing costs to consumer, moves the quantity consumed closer to the optimum amount.\(^{38}\) The short-run effect of the FP program on drug consumption can be illustrated by Figure X below:

\(^{38}\) However as mentioned in the literature review section above, demand for drugs (as with healthcare services) tends to be inelastic. A 10% increase in cost sharing is usually associated with a much smaller decrease in drug consumption (1-6 % range).

31
Suppose the supply and demand for a drug is $P_0$ and $Q_0$. The FP program lowers the prices to end consumers all the way to $P_{fp}$, increasing drug consumption from $Q_0$ to $Q_{fp}$.\(^{39}\) If there were no cost sharing, then drug consumption would increase to $Q_t$ (where price = zero). While this movement along the demand curve is the immediate effect of the FP program, it is plausible that in the long run the program shifts the demand curve to the right, further increasing the quantity consumed and pressuring prices upwards. As mentioned earlier, this can be explained by the fact that the existence of the program can cause more people to seek medical services to get their prescriptions, as they know they can afford to buy them through the program.

However, it is important to note that there are many factors influencing the demand for drugs.\(^{40}\) For instance, generic drug policies allow the entry of cheaper generic drugs to the market and offer consumers the option to purchase their prescription drugs at substantially lower prices. Advertizing campaigns and other marketing techniques\(^{41}\) also influence consumption as these can affect patients, doctors and pharmacists’ behaviors and shift the demand curve to the right. The availability and affordability of quality public or private healthcare facilities and insurance

\(^{39}\) The magnitude of the increase will depend on the elasticity of demand.

\(^{40}\) Also note that these factors will affect the demand curve differently depending on the interrelation of the policy environment and specific demographic, cultural, and socio-economic circumstances of a particular country.

\(^{41}\) For instance, if a drug manufacturer gives pharmacists big discounts and offers bonuses or other benefits tied to the sales of their drugs, pharmacists will have incentives to offer those drugs to consumers.
schemes are also essential in determining demand as patients must be able to access their doctors in the first place before they can get their prescriptions. Individual behavior and characteristics such as income, education, and health status among other factors also influence the demand for medications.

To determine whether the FP, by reducing drug costs, has led to an increase in drug use and improved health outcomes, it is important to understand first what all the factors influencing health outcomes are. Figure XI below illustrates the relationship among all these factors and health status.

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42 For instance, even if prescription drugs are offered free of charge to the population, many people may still not be able to consume them if they live far from healthcare facilities and travel costs are too high.
As Figure XI shows, there are many individual characteristics affecting the health status of a population. For instance, the elderly are more susceptible to certain kinds to diseases (e.g., cardiovascular, cerebrovascular, dementia, diabetes, cancer, arthritis, and osteoporosis) than younger people. Studies show that gender plays a role in health status as men are more susceptible to certain kinds of diseases and die

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43 Source: [http://centeronaging.uams.edu/patients/diseases_common.asp](http://centeronaging.uams.edu/patients/diseases_common.asp).
earlier than woman in most countries. Rural populations may have higher disease prevalence than urban populations due to poor access to healthcare services in rural settings. Cultural aspects can also impact health status (e.g. not using condoms due to religion or belief in non-medical procedures for disease treatment). An extensive body of literature indicates the existence of a strong positive association between an individual’s education and health status. This can be explained by the fact that more educated people may make more informed decisions about their diet, lifestyle, and preventive care. Income is also important and positively associated with health status, as poor people are less likely to see a doctor than non-poor people due to income restrictions. And finally, an individual’s behavioral characteristics such as healthy eating habits, not smoking, consistently exercising, and low levels of stress are all associated with better health status, and these factors are particularly important for cardiovascular diseases.

The figure above also shows that there are resource factors impacting health status. These include, but are not limited to, a population’s access to appropriate sanitation, clean water, garbage collection and housing. The availability of these resources is positively associated with health status as they are essential to prevent infectious and communicable diseases. A proper set of standards and conformity assessment

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45 In addition, poor people are more likely to live in more hazardous environments, which can impact health negatively.
mechanisms that promote food safety and protect the health, safety and the
environment are also important for health status.

   Environmental factors such as pollution levels also play a role on health status. Studies show that high levels of air pollution can cause chronic respiratory disease, heart disease, lung cancer, and death (Mishra, 2003). It can also contaminate drinking water and impact the food chain.

   Finally, there are factors related to the availability of a healthcare system that are essential to keeping the population healthy. For instance, access to healthcare facilities, doctors, nurses, prescription drugs and related resources are associated with better health status. Access includes both the availability and affordability of these products and services and costs play an important role in patients’ access to treatments. Costs of travel time to healthcare units are also important as well as the effectiveness of prescription drugs. In order to improve health status, prescription drugs must be effective, be used rationally and treatments must be followed precisely. Finally, access to public or private insurance and prescription drug reimbursement schemes are essential to lower costs, increase access to healthcare, and improve health outcomes.
Hypothesis

This study predicts that the FP program increased usage of prescription drugs and improved health outcomes. This hypothesis can be specified as:

$H_0$: The FP program had no effect on health outcomes

$H_1$: The FP program had an effect on health outcomes

The best way to test this hypothesis and isolate the effects of the FP program from all the other factors influencing health mentioned above would be through a randomized experimental design. In such an experiment, a group of individuals is randomly assigned to the FP program (treatment group) and the health status of these individuals is then compared to the health status of an otherwise similar group who did not have access to the FP program (control group). If the selection of these groups is random, then all other factors affecting health outcomes and individual characteristics of the unit of analysis (states) would be automatically controlled for, and any changes in health outcomes would be due to the effects of the programs only. However, randomized experiments are rarely performed because in addition to being extremely costly, they can also raise ethical concerns (e.g., giving life saving drugs to some individuals but not to others).

A second option would be to use quasi-experimental designs. A common approach used in quasi-experiments is the difference-in-difference estimation. The model requires that health outcomes be observed for two groups for two time periods,
where one of the groups had access to the program (treatment group) in period two and the other group did not have access to the program in either period (control group). To find the effect of the program, the average effect of the control group is subtracted from the average effect of the treatment group and all the bias due to systematical differences between the two groups and bias due to time trends are eliminated.46

Although this type of research design has inferior internal validity than randomized experimental designs, they are commonly used in social science research. Figure XII below illustrates the difference-in-difference method:

**Figure XII**: Impact of the FP program in the diff-in-diff estimation

46 Assuming the units of observations are the same in both time periods (panel data).
Unfortunately, the FP program was established at the federal level, and the application of the diff-in-diff estimation is not possible because there is no control group to compare to (that is, all states received the “treatment”). A third approach could be to approximate a randomized experiment by using a simple regression model controlling for all other factors influencing health outcomes. The drawback of this approach is that it is extremely difficult to control for all the factors affecting health, due to data limitation, sample size, and imperfect measures. Certain methods such as Fixed Effects models can be a powerful tool, as they automatically control for all the factors influencing health outcomes that do not change over time. In this study I use this third approach using simple regressions and fixed and random effects models to determine the effects of the FP program on health outcomes.

47 For instance, it is difficult if not impossible to measure certain factors such as cultural characteristics or individual’s behavior or motivation.
Data and Methods

Data

The dataset used in this study comes from the Brazilian Ministry of Health and the Institute for the Research of Applied Economics (IPEA) website. The dataset contains information at the state level with information for all 27 Brazilian states. The data were grouped in a panel data format with 27 different observations for each year being analyzed.

Hospital morbidity by cause is the dependent variable. This indicator is classified according to the ICD-10, which allows for the analysis of specific causes. The morbidity indicator selected to measure the impact of the implementation of the FP program in 2004 and its expansion in 2006 is the number of hospital admissions due to hypertension. Ranging from 2003 through 2007, these data were generated by the SUS Hospital Information System (SIH/SUS) and were downloaded from the Brazilian Ministry of Health DATASUS website.48

The number of FP pharmacies open per year in each state is the independent variable of interest and it was obtained from the Department of Pharmaceutical Assistance (DPA) at the Ministry of Health.49 These data cover the periods 2004 through 2007.

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49 Data was supplied by Ms. Odete Gialdi from the DPA and by Mr. Dirceu Barbana, former Director of the DPA and recently appointed Director of ANVISA.
The model includes a set of control variables that affect morbidity indicators. Data for the education, income, and inequality indicators range from 2003 through 2007 and were downloaded from the IPEA website.\textsuperscript{50} Data on alcohol abuse and on hypertension care from 2003 through 2007 were generated by the Basic Attention Information System and were downloaded from the Ministry of Health DATASUS website.\textsuperscript{51} Data on per capita expenditures in health from 2003 through 2005 were generated by IDB-2007 (Indicators and Basic Data, Brazil, 2007) and downloaded from the Ministry of Health DATASUS website.\textsuperscript{52} Data on private insurance coverage from 2003 through 2007 were downloaded from the ANS website (Brazilian National Agency for Supplemental Health), a federal agency that regulates the private health insurance market.\textsuperscript{53}

**Analysis**

Two sets of regressions were used to analyze the impact of the FP program in health outcomes: one set for the 2004 implementation and another set for the 2006 expansion. The unit of analysis for both sets is each of the 27 states of the Federal Republic of Brazil. The time frame for the 2004 implementation ranges from 2003 through 2005, and from 2003 through 2007 for the 2006 expansion. This time frame

\textsuperscript{50} Data can be accessed at: [www.ipeadata.gov.br](http://www.ipeadata.gov.br).
\textsuperscript{51} Data can be accessed at: [http://tabnet.datasus.gov.br/cgi/deftohtm.exe?siab/cnv/SIABSbr.def](http://tabnet.datasus.gov.br/cgi/deftohtm.exe?siab/cnv/SIABSbr.def).
\textsuperscript{52} Data can be accessed at: [http://tabnet.datasus.gov.br/cgi/idb2007/matriz.htm](http://tabnet.datasus.gov.br/cgi/idb2007/matriz.htm).
allows for the comparison of before and after the program was first implemented and later expanded.

For each of the regression sets, I run an ordinary least square model pooling the data across the years selected. Then, to take advantage of the panel data aspect, I test both Fixed Effects (FE) and Random Effects (RE) models. FE allows us to control for all the time invariant (constant) unobservable variables that may be biasing the model such as race, gender, culture, genetic endowment, climate, geography, quality of institutions, eating habits, and levels of physical activity. This constant can be removed from the data by subtracting each individual's means from each of his observations before estimating the model. One critical assumption is that the error term is uncorrelated with each explanatory variable in each time period. If this assumption is not met, the results will be biased. One issue with FE transformation is that it is not very efficient, as it increases standard errors by reducing the variation on the independent variables.

The RE model allows us to control for some omitted variables that are constant over time but that vary between cases and for others that are fixed between cases but vary over time. All assumptions of FE applies to RE. In addition, a critical assumption of RE is that unobserved effects are uncorrelated with all explanatory variables in all time periods. If we believe that this assumption holds, we should use
RE as it is more efficient. A commonly accepted way of choosing between RE and FE is to perform a Hausman test. FE always gives consistent estimators but may not be the most efficient model (gives high standard errors). RE is more efficient and gives better P-values, but it can give inconsistent estimators if the model is not well specified. The Hausman test verifies if a more efficient model (RE) also gives consistent results. If the test results are significant (Prob>chi2 smaller than 0.05), then RE does not give consistent results and it is more appropriate to use FE.

We will also include time period dummies in all models to control for factors that are constant across states but differ across time. Finally, we will take the log of the dependent and independent variables to get a percentage change effect.

**Model**

The following model was used to estimate the effects of the implementation of the FP program in 2004 on health outcomes:

\[
H_{it} = (X_{it} + F_{it} + a_i + u_{it})
\]

where \(H_{it}\) is the natural log of the number of hospitalizations due to hypertension diseases (Log(morbhyper)), \(F_{it}\) is the natural log of the number of FP pharmacies (Log(fpexpan)), \(a_i\) is the time invariant state effects such as race, gender, culture, genetic

\[54\] As mentioned above, this indicator was chosen as the main outcome variable because most of the drugs sold under the FP program (about 60%) are targeted at treating hypertension. The lack of treatment of hypertension diseases is associated with increased risks for strokes and heart attacks which lead to hospitalizations.
endowment, climate, geography, quality of institutions, eating habits, and levels of physical activity, $u_{it}$ is the error term, and $X_{it}$ is the natural log of a vector of covariates. The covariates include time dummies to control for time effects, the natural log of the number of people with hypertension registered with a government program who received at least one visit from the community worker in the month of reference ($Log(hypertreat)$), the natural log of the percentage of the population covered by private health insurance ($Log(insurancepriv)$), the natural log of the household income per capita in 2002 Brazilian Reais ($Log(incpercapita)$), the natural log of the illiteracy rate, defined as the percentage of the population age 15 or older that cannot read or write a simple sentence ($Log(illiter15y)$), the natural log of the number of hospitalizations due to alcohol abuse ($Log(hospalcoh)$), and the natural log of the per capita public expenditure in healthcare ($Log(expcapita)$). The same model was used in the analysis of the 2006 expansion except that the covariate on income per capita could not be included in the 2006 model due to data availability. See Appendix III for a list of variable definitions.
Results

Descriptive Results

The data in Table II below shows a consistent drop in the average number of hospitalizations due to hypertension in the period analyzed: from 6,280 in 2003 to 5,822 in 2007, a 7.30% reduction. There was a 0.48% reduction in 2005 in relation to 2004, when the program was first expanded. At the time the expansion took place in 2006, the data indicated a 3.30% drop in relation to the previous year. The median has decreased across the five year period from 4,261 to 3,126, which means that some states that previously had high numbers of hospitalizations were able to decrease them over the period analyzed. The difference between the mean and median increased from 2,019 in 2003 to 2,696 in 2007, indicating an increase in the concentration of hospitalization in some states.

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>6,280.93</td>
<td>6,910.20</td>
<td>4,261</td>
<td>73</td>
<td>30,348</td>
</tr>
<tr>
<td>2004</td>
<td>6,149.26</td>
<td>6,809.40</td>
<td>4,345</td>
<td>115</td>
<td>32,360</td>
</tr>
<tr>
<td>2005</td>
<td>6,119.59</td>
<td>6,802.52</td>
<td>4,047</td>
<td>167</td>
<td>32,790</td>
</tr>
<tr>
<td>2006</td>
<td>5,914.93</td>
<td>6,570.60</td>
<td>3,366</td>
<td>181</td>
<td>31,046</td>
</tr>
<tr>
<td>2007</td>
<td>5,822.07</td>
<td>6,324.25</td>
<td>3,126</td>
<td>205</td>
<td>29,237</td>
</tr>
</tbody>
</table>

As shown by Table III below, the average number of state-owned pharmacies increased from one in 2004 to 15 in 2007. The number of state-owned pharmacies ranged from one to 67 in 2007, with an average of 15 pharmacies per state. The table also shows the dramatic increase in the number of pharmacies due to the 2006
expansion when the program partnered with private pharmacy chains: an increase from an average of 2.89 pharmacies in 2005 to an average of 148.41 pharmacies in 2007. The median and standard deviation show that the pharmacies are quite concentrated in some states.

**Table III: Independent Variables**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2003</strong></td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>2004</strong></td>
<td>1.00</td>
<td>3.31</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td><strong>2005</strong></td>
<td>2.89</td>
<td>5.75</td>
<td>1</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td><strong>2006</strong></td>
<td>9.41</td>
<td>11.70</td>
<td>7</td>
<td>0</td>
<td>58</td>
</tr>
<tr>
<td><strong>2007</strong></td>
<td>15.04</td>
<td>16.13</td>
<td>9</td>
<td>1</td>
<td>67</td>
</tr>
</tbody>
</table>

Without going much into detail, Table IV below provides some interesting statistics for the control variables. Average government expenditure on health increased 22% from 2003 to 2005, and average hospitalizations due to alcohol abuse increased 23% from 2003 to 2007. From 2003 through 2007, the average number of people receiving treatment for hypertension increased 69%, the average illiteracy rate dropped 12%, average per capita income increased 25%, and average number of people with private health insurance increased 17%. It is important to note that these averages
hide important distinctions among the states in each of these indicators, as shown by the wide range and high standard deviations.

### Table IV: Control Variables

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of people treated for hypertension</strong></td>
<td>2003</td>
<td>1,990,090</td>
<td>2,037,028</td>
<td>1,462,829</td>
<td>72,558</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>2,321,913</td>
<td>2,391,505</td>
<td>1,631,639</td>
<td>84,414</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>2,683,588</td>
<td>2,814,274</td>
<td>1,861,965</td>
<td>86,994</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>3,125,866</td>
<td>3,360,478</td>
<td>2,040,605</td>
<td>121,984</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>3,363,149</td>
<td>3,689,880</td>
<td>2,196,486</td>
<td>131,664</td>
</tr>
<tr>
<td></td>
<td>2003</td>
<td>14.14</td>
<td>8.02</td>
<td>10.71</td>
<td>4.51</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>13.89</td>
<td>7.79</td>
<td>10.23</td>
<td>4.68</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>12.92</td>
<td>7.30</td>
<td>9.63</td>
<td>3.76</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>12.45</td>
<td>6.73</td>
<td>10.08</td>
<td>3.73</td>
</tr>
<tr>
<td><strong>Illiteracy rate &gt;15y</strong></td>
<td>2003</td>
<td>277.15</td>
<td>110.34</td>
<td>261.05</td>
<td>150.99</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>282.78</td>
<td>112.43</td>
<td>233.17</td>
<td>153.19</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>300.01</td>
<td>120.84</td>
<td>248.27</td>
<td>148.49</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>331.72</td>
<td>128.43</td>
<td>286.35</td>
<td>199.59</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>345.00</td>
<td>139.56</td>
<td>283.72</td>
<td>197.07</td>
</tr>
<tr>
<td><strong>Household percapita income (Brazilian Reais)</strong></td>
<td>2003</td>
<td>1,317.37</td>
<td>1,466.64</td>
<td>770</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1,563.52</td>
<td>2,441.09</td>
<td>777</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>1,551.96</td>
<td>2,158.27</td>
<td>683</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>1,548.04</td>
<td>2,239.18</td>
<td>714</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>1,625.26</td>
<td>2,548.40</td>
<td>719</td>
<td>21</td>
</tr>
<tr>
<td><strong>Hospitalizations due to alcohol abuse</strong></td>
<td>2003</td>
<td>10.89</td>
<td>8.28</td>
<td>7.70</td>
<td>2.30</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>11.29</td>
<td>8.32</td>
<td>7.80</td>
<td>2.30</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>11.67</td>
<td>8.37</td>
<td>8.20</td>
<td>2.30</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>12.24</td>
<td>8.69</td>
<td>8.90</td>
<td>2.20</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>12.72</td>
<td>8.93</td>
<td>9.30</td>
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</tr>
<tr>
<td><strong>Private insurance coverage rate</strong></td>
<td>2003</td>
<td>289.27</td>
<td>76.42</td>
<td>278.44</td>
<td>175.02</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>308.49</td>
<td>71.02</td>
<td>298.28</td>
<td>174.20</td>
</tr>
<tr>
<td><strong>Percapita pub expenditure in</strong></td>
<td>2003</td>
<td>289.27</td>
<td>76.42</td>
<td>278.44</td>
<td>175.02</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>308.49</td>
<td>71.02</td>
<td>298.28</td>
<td>174.20</td>
</tr>
</tbody>
</table>
As Figure XIII below shows, the average number of hospitalizations due to hypertension has been falling in all regions except for the North and Northeast during the period analyzed, with the largest drops in the South and Southeast. Interestingly, as the Figure XIV shows, the South and Southeast are also the two regions with the highest growth in the number of pharmacies, which could indicate a positive association between the program and improvements in health status.

Figure XIII: Trends on hospitalizations due to hypertension for 2003, 2005, and 2007, by region

Source: Brazilian Ministry of Health
Figure XIV: Trends of average number of FP pharmacies in 2005, 2006, and 2007, by region

Source: Brazilian Ministry of Health

Regression Results

Table V below shows the results for the 2006 expansion using data from 2003 through 2007. Starting with a simple pooled OLS (model 1), I regressed the log of the number of pharmacies on the log of the number of hospitalizations. Results indicate that a 1% increase in the number of pharmacies is associated with a 0.27%

55 Results for the 2004 implementation will not be reported as the results were not meaningful due to the small sample size and limited degrees of freedom in the model.
increase in the number of hospitalizations (p>0.000). This counter-intuitive result is due to misspecification problems (omitted variable bias from other factors influencing hospitalization rates). Next, I add a set of covariates in model 2 to control for omitted variable bias. While I found the expected negative association between the program expansion and hospitalizations, this relationship is not statistically significantly different from zero (p>0.266). Among the covariates included in the model, only hospitalizations due to alcohol abuse and visits from healthcare agents to treat hypertension are statistically significant: on average, a 1% increase in alcohol abuse is associated with a 0.33% increase in hospitalizations due to hypertension (p>0.068), while a 1% increase in the number of people visited by healthcare agents is associated with a 0.53% increase in the number of hospitalizations due to hypertension (p>0.040), holding all other variables in the model constant. The incorrect sign in the latter case is due to selection bias, as states with the highest number of visits by healthcare agents are those with the highest incidence of hypertension. The positive relationship in the former case supports the evidence that hypertension is strongly affected by alcohol consumption.

To verify if there are time effects, I add a set of time dummy variables on model 3 and find a strong positive effect of the FP expansion on hospitalization rates, indicating that on average, a 1% increase in the number of pharmacies is associated
with a 0.19% increase in the number of hospitalizations (p>0.002), holding all other variables constant. Coefficients on the 2004 and 2005 time dummies are statistically significant indicating a positive effect of 1.46% and 0.96% on hospitalizations, respectively. While the effect of the number of visits by healthcare agents on hospitalizations remained positive and statistically significant\(^{56}\) (p>0.009), the effect of alcohol abuse is no longer significant. The coefficients on insurance and per capita income became significant: on average, a 1% increase in private insurance coverage is associated with a 0.30% decrease in hospitalizations (p>0.099) while a 1% increase in per capita income is associated with 0.59% increase in hospitalizations (p>0.109), holding all other variables constant.

As the OLS results above are likely to be biased due to state effects that are not being controlled for, FE estimation is used in model 4. The coefficient on the FP program has the expected negative sign and is statistically significant at the 0.114 level, indicating that on average, a 1% increase in the number of FP pharmacies is associated with a 0.017% decrease in the number of hospitalizations due to hypertension, holding all the other variables constant. Coefficients on all covariates are insignificant, except on the education variable, indicating that on average, a 1% increase in illiteracy rates is associated with a 0.51% increase in hospitalizations due to hypertension (p>0.005), holding all other variables constant. Next, I add a set off

\(^{56}\) In fact, it increased from 0.53% in model 2 to 0.60% in model 3.
dummy variable to control for time effects on model 5. Although none of the dummy variables are significant, the precision of the estimation and the size of the effect of the pharmacy coefficient increased. Results indicate that on average, a 1% increase in the number of FP pharmacies is associated with a 0.023% decrease in the number of hospitalizations due to hypertension (p>0.109), holding all the other variables constant. Similar to results in model 4, coefficients on all covariates are insignificant, except on the education variable. This finding is in line with the existing literature that finds a strong positive association between education levels and hypertension diseases (Ishitani et al, 2006 and Barros et al, 2006).

As expected, standard errors on the FE models are much higher than those of the OLS models due to the reduction in variation, and a larger sample size would help increase the precision of the estimates. Nonetheless, FE is a fairly reliable model and gives the appropriate sign on the estimators as it controls for time invariant variables.

Next I turn to RE estimates on model 6. Coefficients are statistically significant on all variables except for that on the per capita income variable. The coefficient on the pharmacy variable is highly significant with twice the magnitude of that in the FE estimation, indicating that a 1% increase in the number of FP pharmacies is associated with a 0.043% decrease in the number of hospitalizations due to hypertension (p>0.000), holding all the other variables constant. The coefficient on the
A hypertension treatment variable is significant (p > 0.000) but with an unexpected positive sign. As mentioned above, the incorrect sign can be explained by selection bias. The coefficients on illiteracy rates and alcohol abuse variables are significant and with the expected positive sign (p > 0.008 and p > 0.041, respectively). The positive sign on the private insurance variable seems counter-intuitive, as we would expect higher rates of private insurance to be negatively associated with hospitalizations rates in the public healthcare system. It is possible that the private insurance variable is endogenous. For instance, if the number of hospitalizations in the public healthcare system increases and reaches capacity, many people may have to purchase private insurance to be able to receive treatment, leading to the positive association observed in the test.

Finally, I add a set of time dummies to the RE estimation on model 7 and find that the time dummies are statistically significant. The magnitude of the coefficient on the FP pharmacy variable dropped 37%, from -0.043 in model 6 to -0.027 in model 7, reflecting that the coefficient on that variable in model 6 was carrying some of these time effects. Because of this drop, the coefficient on the FP program became significant at the 10% level only (p > 0.095), compared to the highly significant levels in model 6 (p > 0.000). The coefficients on the covariates remained fairly similar to those
from model 6, except that the magnitude of all but one coefficient\textsuperscript{57} increased in model 7 and the alcohol abuse variable became insignificant.

Considering that both the FE and RE models presented significant results, I ran a Hausman test to determine if both models also give consistent results. Results from the Hausman test indicate that the RE results are not consistent, and therefore the FE models 4 and 5 presented above are more reliable models.

\textsuperscript{57} The coefficient on illiteracy rates actually decreased from 0.40 in model 6 to 0.35 in model 7.
Table V: Coefficient Estimates on log (morbhyper) for 2006 expansion

<table>
<thead>
<tr>
<th>Independent variable (log)</th>
<th>Pooled OLS (1)</th>
<th>Pooled OLS (2)</th>
<th>Pooled OLS (3)</th>
<th>Pooled OLS (4)</th>
<th>FE (5)</th>
<th>FE (6)</th>
<th>RE (7)</th>
<th>RE (8)</th>
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<tr>
<td>fplexpan</td>
<td>0.267</td>
<td>-0.041</td>
<td>0.189</td>
<td>-0.017</td>
<td>-0.023</td>
<td>-0.043</td>
<td>-0.027</td>
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<tr>
<td>(4.78)***</td>
<td>(3.30)***</td>
<td>(1.64)*</td>
<td>(4.53)***</td>
<td>(1.67)*</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>hypertreat</td>
<td>0.527</td>
<td>0.597</td>
<td>0.179</td>
<td>0.053</td>
<td>0.493</td>
<td>0.639</td>
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<td></td>
</tr>
<tr>
<td>(2.10)**</td>
<td>(2.70)***</td>
<td>(1.64)*</td>
<td>(3.60)***</td>
<td>(4.24)***</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>insurancepriv</td>
<td>-0.008</td>
<td>-0.04</td>
<td>(1.67)*</td>
<td>-0.049</td>
<td>0.211</td>
<td>0.224</td>
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</tr>
<tr>
<td>(1.62)*</td>
<td>(1.78)*</td>
<td>(1.86)*</td>
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<td></td>
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<td></td>
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<tr>
<td>incpercapita</td>
<td>0.376</td>
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<tr>
<td>(1.67)*</td>
<td>(1.86)*</td>
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<td>illiter15y</td>
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<td>0.025</td>
<td>0.509</td>
<td>0.506</td>
<td>0.405</td>
<td>0.347</td>
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<tr>
<td>(2.95)***</td>
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<td>(2.22)***</td>
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<td>hospalcoh</td>
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<td>0.103</td>
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<tr>
<td>(1.86)*</td>
<td>-0.64</td>
<td>-1.07</td>
<td>-1.18</td>
<td>(2.04)**</td>
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<tr>
<td>d2004</td>
<td>1.464</td>
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<tr>
<td>(4.81)***</td>
<td>-1</td>
<td>(2.20)**</td>
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<td></td>
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<tr>
<td>d2005</td>
<td>0.956</td>
<td>-0.065</td>
<td>0.134</td>
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<td></td>
<td></td>
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<tr>
<td>(4.33)***</td>
<td>-0.86</td>
<td>(1.96)**</td>
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<tr>
<td>d2006</td>
<td>0.123</td>
<td>-0.012</td>
<td>0.049</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Constant</td>
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<td>-3.499</td>
<td>-4.637</td>
<td>3.2</td>
<td>5.555</td>
<td>-2.206</td>
<td>-4.851</td>
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<tr>
<td>(39.84)***</td>
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<td>-1.4</td>
<td>-1.3</td>
<td>-1.53</td>
<td>-1.26</td>
<td>(2.43)***</td>
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</tr>
<tr>
<td>(.)</td>
<td>(.)</td>
<td>(.)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Observations</td>
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<td>79</td>
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<td>79</td>
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</tr>
<tr>
<td>R-squared</td>
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<td>0.85</td>
<td>0.89</td>
<td>0.29</td>
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</table>

Absolute value of t statistics in parentheses; all variables are logged

* significant at 10%; ** significant at 5%; *** significant at 1%
Discussion

Limitations:

The results above indicate that there is a somewhat weak impact of the FP program on health outcomes. After running different models and testing for consistency of estimators, the results show that the FE models gave consistent and weak statistically significant results of small magnitude, indicating that a 1% increase in the number of FP pharmacies is associated with a 0.02% decrease in hospitalizations, after controlling for other factors influencing hospitalization due to hypertension diseases.

However, there are a series of limitations in this study that could be affecting the precision of the results. First, obesity rates, levels of physical activity, and dietary habits are important factors that could not be controlled for and that are likely to have a strong effect on hypertension diseases. In the FE analysis, the assumption that these factors did not change over time and would therefore drop out of the model may not hold, as these factors may have suffered variation over the past years in response to changes in income levels and other government policies.\textsuperscript{58} These three variable are themselves highly correlated (unhealthy diet and lack of physical activity are strongly

\textsuperscript{58} Some studies show that Brazil has suffered a nutritional transition during the past decades to diets rich in fats, sugars, and processed foods that have contributed to increasing obesity rates in the country (Monteiro et al 2001, 2003, 2007). It is unclear, however, that these changes have occurred in the short period analyzed in this study (2003-2007), and it is plausible that these changes are reflected in the morbidity indicators over longer periods of time.
associated with obesity), and the data on obesity could have been sufficient to proxy the effects of the other two variables. It is clear that obesity is positively associated with the dependent variable (hypertension diseases), as obesity is one of the leading causes of hypertension. However, the direction of the relationship between obesity and the independent variable (number of FP pharmacies) is not so clear. There are three possibilities: positive relationship, negative relationship, or no relationship. Obese people tend to need medication to control various chronic conditions that hit this population, and it is possible that pharmacies will pop up in areas with the highest demand (positive relationship). However, we could also expect that the obesity incidence is highest in poorer areas, where the availability of pharmacies is scarcer due to the lower purchasing power of that population (negative relationship). If this assumption that obesity hits the poorest areas hold, then it is likely that there is a downward bias, and the actual effect of the PF program on hospitalization is actually greater than the one stated in the regression results. It is also plausible that there is no relationship between obesity rates and the FP program. In this case, adding data on obesity rates would reduce standard errors and increase the precision of the estimations, but it would not bias the results. Although the social and economic determinants of obesity are complex, it is plausible that the obesity effects are being proxied by the illiteracy rates variable, as studies in Brazil have suggested a positive
association between illiteracy and obesity rates after controlling for other socio-economic factors (Monteiro et al, 2001). If this is the case, we captured the obesity effects through the illiteracy variable and the results are not biased.

Second, the use of the variable “hospitalizations due to alcohol abuse” to proxy for the effects of alcohol consumption on hypertension diseases does not offer a precise measure of alcohol consumption. The issue with this variable is that it only captures extreme cases of abuse that lead to hospitalizations, while it fails to capture those who drink enough to harm their health but not to the point where it leads to hospitalization. Nonetheless, it is not unrealistic to assume that states with a high incidence of hospitalizations due to alcohol abuse also have high levels of alcohol consumption.

Third, the results could have been more precise if we had data on the number of drugs sold per type of drug for each state, as pharmacies in each state sell different volumes and types of drugs under the program (e.g. state X has more FP pharmacies than state Y, but pharmacies in state Y sell more medication under the FP program than pharmacies in state X).

Fourth, the fact that the FP program is relatively new may underestimate the results of this analysis. Although there are signs in each FP pharmacy advertising the discounts that consumers may get, consumers may not know about the program and not go to the pharmacy because they know they can’t afford the full costs of the drugs.
As this educational/awareness factor might vary by location, it would be interesting to see future studies assess the impact of the program over longer time-frames.

Fifth, another limitation is the fact that the dependent variable measures the number of hospital admissions in the public healthcare system only (i.e. in the SUS). Although the FP program is used by both SUS and non-SUS users, the results would be more precise if we could measure the number of hospital admissions in the private healthcare system as well. If for some reason non-SUS users tend to use more the FP program than SUS-users, than the results are underestimated (the drop in hospitalizations occurring in the private health insurance system due to the FP program is not being captured by the data in this study).

Finally, state policies might have changed non-uniformly during the time period analyzed. For instance, even though the model controls for some of the effects of the “Family Health program” for hypertension treatment (which includes monthly visits by health community workers who keep track of individuals’ blood pressure and tend to educate patients about hypertension causes and treatments), states might have engaged in additional efforts. These initiatives could have included: increased efforts to raise awareness and improve treatment of hypertension diseases, increased education on eating habits and physical activities, and increased distribution of anti-hypertensive...
drugs. If these initiatives occurred at different rates in each state, than the results are likely to be biased, as they could be driving the results.

Conclusion and future research

Given the results and limitations discussed above, this study suggests that the present model cannot estimate with high precision the effects of the FP program on health outcomes. Nonetheless, despite these limitations, the model finds a statistically significant (albeit weak) association between the program and hospitalization rates. Even though the null hypothesis was barely rejected at the 10% level (p>0.109), these positive results are nonetheless encouraging and important for future pharmaceutical policies. This study’s findings have some implications. First, as economic theory predicts and as the empirical literature supports, cost has an important effect on prescription drug usage and on health outcomes. The FP program substantially lowers the costs of the drugs, and its potential benefits are somewhat represented in the results above through lower hospitalization rates. These lower hospitalization rates also translate into overall lower healthcare costs, as it is much cheaper to subsidize the medications than to pay for hospitalization expenses. Future research should apply cost-benefit analysis to verify the potential savings the FP brings to the healthcare system.
Second, as shown in the literature review section, cost sharing schemes can have a negative effect on drug consumption and on health outcomes, especially for chronic diseases affecting the most disadvantaged. These results suggest some equity concerns about a cost sharing program such as the FP. If the poor are not having access to drugs free of charge via SUS and are deciding to buy their medications in the pharmacy, then the copayments associated with the FP (although small) may pose a barrier to access for this population. This means that the program could be somewhat regressive, as taxpayer money is financing a program that benefits medium to high income families while the poor continue without the needed drugs (especially if the poorest are not accessing healthcare units in the first place due to travel costs, for instance). Futures studies accessing the impact of this cost sharing on the poor would be extremely helpful. This equity concern could be addressed by voiding the copayment for all the prescriptions coming from SUS, as most SUS-users are low income patients. In any case, a systematic cost-effectiveness and impact evaluation of healthcare policies in general, and of all different pharmaceutical assistance programs in particular, should be performed in order to allocate resources effectively and equitably.

Third, future research using individual or household level data would allow the analysis to be broken down by different income levels, which would be interesting to
examine given that the literature found that the impact of such programs tends to have
a greater effect on the health of low income individuals.

Fourth, education has shown to be extremely important for improved health
status, especially for hypertension diseases that requires changes in behavior and
lifestyle. In addition, education is also extremely important for long term economic
growth and development, and policies to enhance education attainment and quality
should be a priority in the policy agenda of every developing country.

Fifth, as discussed earlier, pharmaceutical costs are important but not the only
determinant of access to medications. For instance, access to drugs and access to other
healthcare services cannot be considered in isolation, as one cannot be effective
without the other. It is important that investments to increase access to healthcare
facilities and infrastructure be made in order for the FP program to have its full
potential effects. The government’s investment in the Family Health program
(focusing on access to medical care and preventive efforts) and in pharmaceutical
assistance programs such as the FP program (focusing on increasing access to essential
drugs) is a step in the right direction, and more empirical evaluation of the impact of
such programs will be helpful to guide future health policies.59

59 For instance, Macinko et al, 2006 found that the Family Health program is associated with reduced
infant mortality rates in Brazil which demonstrates the importance of such programs for Brazil’s
healthcare policies.
Sixth, an interesting area for future research would be to look at the effects of various price control mechanisms that the Brazilian government employs (such as price caps) on health outcomes and on industry’s performance. There is not much data available for Brazil, but some studies suggest that price control mechanisms in some of the OECD countries can affect the timing and quantity of new drugs introduced in markets that apply such regulations (Danzon, 2003) and reduce incentives for R&D (Aldonas, 2005). However, other studies suggest that such controls have no negative impact on health outcomes (Sturm, 2007) while being effective tools to reduce healthcare costs (Menon, 2001).

Seventh, another important consideration to be explored is the fact that policies targeting the development of national industries can sometimes conflict with health policy goals of supplying drugs at affordable prices. That can be the case if the domestic or state-owned firms do not have the technological and productive capacity to produce drugs competitively and the government imposes tariffs on imported drugs and inputs in order to protect the local industry. This inflates drug costs and reduces access to drugs, but at the same time might have some positive impacts on trade balance, employment, and economic growth, especially in the pharmaceutical industry which has backward (e.g. plastic manufacturers) and forward (e.g. shipping industry)
linkages. Future research could explore Brazil’s industrial policy for the sector and analyze its impact on health outcomes and on economic growth.

Eighth, another interesting area for future research is the impact of the enabling environment for innovation and strategies to increase the diffusion of existing technologies on productivity, economic growth, and health outcomes. Brazil’s innovation policy is linked to the industrial policies mentioned above, and it is a particularly challenging topic given the many constraints Brazil faces that preclude progress in this area. For instance, competition pressures and acquisition of high-end technology from openness to trade can be an important driver of innovation. Brazil has remained relatively closed in the past and was unable to reap the benefits of high economic growth such as in the East Asian economies. Openness to trade is not by itself the driver of growth, as many other factors play an important role such as stable macroeconomic conditions (low inflation, stable currency, fiscal austerity, etc), high levels of savings that enable productive investments, the presence of human capital through an educated workforce that allows for the adoption and dissemination of knowledge, access to consumer and capital markets, presence of information technology infrastructure, presence of local supplies and cluster industries, strong and efficient institutions and regulatory frameworks, and the enforcement of property rights, among other factors. Brazil faces challenges with all of these items, particularly
with its low quality education system. In addition, there is a weak link between Brazilian universities and the private sector which weakens the capability of turning research into innovative commercial products. These issues are particularly important for Brazil’s long term economic growth, which in turn allows for the provision of public goods such as healthcare to the population.

Ninth, the tax system in Brazil is notoriously cumbersome and tax rates on medications are much higher than on many other less-essential goods, averaging 35% (compared to 18.9% for flowers and 14.3% for agriculture inputs, for instance).60 It would be interesting to analyze the impact of this regressive tax system on access to drugs, on inequality, and on health outcomes.

Finally, even though the results indicate that drug reimbursement programs can be an effective way to increase affordability and access to medications in developing countries, each country’s particular level of social and economic development, institutional capacity, and policy environment have to be taken into consideration in analyzing the most effective approach to any particular policy or program. Nonetheless, Brazil’s case illustrates that a big developing country with large economic and regional disparities and imperfect healthcare delivery system can put in place programs that have the potential to alleviate the burden of medications on families’ budgets and improve health conditions in the country.

60 Source: FEBRAFARMA, 2006
References


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Uga, Maria A. D. and Isabela Soares Santos. 2007. An analysis of Equity in the Brazilian Health System Financing. *Health Affairs*, Volume 26, Number 4

### Appendices

**Appendix I:** Non-exhaustive list of pharmaceutical programs implemented by the Brazilian government

<table>
<thead>
<tr>
<th>Year</th>
<th>Key government programs for pharmaceutical assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>Creation of the National List of Essential Medicines (RENAME)</td>
</tr>
<tr>
<td>1987</td>
<td>Implementation of the Basic Pharmacy program, with free drug for SUS's basic attention.</td>
</tr>
<tr>
<td>1995</td>
<td>Decentralization of the Pharmaceutical Assistance programs</td>
</tr>
<tr>
<td>1997</td>
<td>Re-launch of the Basic Pharmacy program</td>
</tr>
<tr>
<td>1998</td>
<td>Establishment of a National Drug Policy</td>
</tr>
<tr>
<td>1999</td>
<td>Enactment of the Generic Drug law</td>
</tr>
<tr>
<td>2004</td>
<td>Implementation of the Farmacia Popular program</td>
</tr>
<tr>
<td>2005</td>
<td>Reorientation of the Pharmaceutical Assistance programs (changes in the financing)</td>
</tr>
<tr>
<td>2006</td>
<td>Expansion of the Farmacia Popular program</td>
</tr>
</tbody>
</table>
Reorientation of some strategic programs that provide free drugs to the users:

- HIPERDIA, targeted at treating hypertension and diabetes
- Insulin
- Woman's health, with birth control methods
- Smoking control
- Food and nutrition, providing vitamins
- Drugs for Asthma
- Mental health
- HIV/AIDS
- Tuberculoses control
- Hanseniasis
- Endemic diseases such as malaria, Chagas, Dengue, etc
- Blood for the treatment of anemic diseases
- Drugs used in hospitals for SUS patients are reimbursed by the government
- Drugs for rare diseases

Source: Brazilian Ministry of Health and Pinto, 2008
Appendix II: Trends for selected indicators

Average number of people who received at least one monthly visit of community workers for hypertension treatment, 2003 – 2007, by region:
Average per capita expenditure in health (in Brazilian Reais) from 2003 – 2006, by region:

Average public per capita expenditure on health, 2003-2006

Average rate of private health insurance coverage, from 2003-2007, by region:

Average private insurance coverage rate 2003-2007
Average percentage of the Brazilian population below the national poverty line, from 2003-2007, by region:

**Average proportion of poor people 2003-2007**

Average income per capita (in 2002 Brazilian Reais), from 2003-2007, by region:

**Average per capita income 2003-2007**
Average illiteracy rates from 2003-2007, by region:

![Average Illiteracy rates >15y 2003-2007](image)

Average hospitalizations due to alcohol abuse, 2003-2007, by region:

![Average hospitalizations due to alcohol abuse 2003-2007](image)
Average number of state owned FP pharmacies, from 2004-2007, by region:

Average number of private pharmacies participating in the 2006 FP expansion, from 2006-2007, by region:
**Appendix III: Variables Definition**

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Variable description</th>
<th>Rational / Expected effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>morbhyper</strong></td>
<td>The number of hospitalizations due to hypertension diseases, 2003-2007</td>
<td>Most of the drugs sold under the FP program (about 60%) are targeted at treating hypertension. The lack of treatment of hypertension diseases is associated with increased risks for strokes and heart attacks, which lead to hospitalizations.</td>
</tr>
<tr>
<td><strong>fppub</strong></td>
<td>The number of state-owned pharmacies enrolled in the FP program, 2004-2007</td>
<td>It is expected that an increase in the number of FP pharmacies is associated with a decrease in the number of hospitalization due to hypertension, all else being equal.</td>
</tr>
<tr>
<td><strong>fpexpan</strong></td>
<td>The number of state-owned (2004-2007) + private owned (2006-2007) pharmacies enrolled in the FP program</td>
<td>It is expected that an increase in the number of FP pharmacies is associated with a decrease in the number of hospitalization due to hypertension, all else being equal.</td>
</tr>
<tr>
<td><strong>hypertreat</strong></td>
<td>The number of people with hypertension registered with a government program who received at least one visit from the community worker in the month of reference, 2004-2007</td>
<td>It is expected that states with large number of visits by health community workers will be likely to have low number of hospitalizations due to hypertension, as these visits include consistent checkups of blood pressure, and diet and physical activity guidance.</td>
</tr>
<tr>
<td><strong>hospalcoh</strong></td>
<td>The number of hospitalizations due to alcohol abuse, 2004-2007</td>
<td>It is expected that states with a high number of hospitalizations due to alcohol abuse are likely to have high number of hospitalizations due to hypertension, as alcohol consumption has an important effect on hypertension.</td>
</tr>
<tr>
<td><strong>insurancepriv</strong></td>
<td>The percentage of the Brazilian population covered by private health insurance, 2004-2007</td>
<td>It is expected that states with large proportions of the population covered by private insurance are likely to have a low number of hospitalizations due to hypertension, as people with insurance tend to visit their doctors more often and do more preventive work, instead of only seeing a doctor when there is an emergency.</td>
</tr>
<tr>
<td><strong>expcapita</strong></td>
<td>Public expenditure with healthcare, per capita, 2004-2005</td>
<td>It is expected that states with high expenditures per capita on healthcare services are likely to have a low number of hospitalizations due to hypertension, as all states designate part of their resources to preventive care and control of chronic diseases such as hypertension.</td>
</tr>
<tr>
<td>Variable name</td>
<td>Variable description</td>
<td>Rational / Expected effects</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>illiter15y</td>
<td>The illiteracy rate, defined as the percentage of the population 15 or more years of age that cannot read or write a simple sentence, 2004-2007</td>
<td>It is expected that states with high illiteracy rates are likely to have a high number of hospitalizations due to hypertension, as more educated people can make more informed decisions about their diets, lifestyle, and treatments.</td>
</tr>
<tr>
<td>incpercapita</td>
<td>The household income per capita, in 2002 Brazilian Reais, 2004-2007</td>
<td>It is expected that states with high household income per capita are likely to have a low number of hospitalizations due to hypertension, as there are more resources to better control hypertension (with medications, for instance).</td>
</tr>
</tbody>
</table>