Title
Effects of Mexico’s Seguro Popular Program on Health-Related Outcomes: Ten Years After its Implementation

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Effects of Mexico's Seguro Popular Program on Health-Related Outcomes: Ten Years After its Implementation

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by

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ABSTRACT OF THE DISSERTATION

Effects of Mexico's Seguro Popular Program on Health-Related Outcomes:
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by

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Doctor of Philosophy in Health Policy and Management
University of California, Los Angeles, 2017
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The launch of Seguro Popular by the Mexican government in the early 2000s has been one of the main highlights of Mexican health reform during this century. Essentially a voluntary health insurance program, Seguro Popular was implemented with the aim to expand health insurance coverage to the uninsured population, provide financial protection to families, and improve access to care. Gaining insight as to whether the program is meeting its proposed objectives and responding to the health needs of the Mexican population is crucial, given the adverse economic and social conditions imposed by the epidemiological and demographic transitions that are currently coexisting in the country. Numerous research studies have analyzed the impact of the program on different outcomes and sectors of Mexico's population. However, the majority of these studies have addressed the effects of the program at the individual level (rather than from a state or regional perspective), most of them have analyzed the impact of Seguro Popular on the short term, and very few have focused on the population of older Mexican adults with chronic

conditions, which represent one of the most vulnerable and fastest growing segments of Mexico's population.

This dissertation consists of three studies that analyze: (a) the effect of state-level Seguro Popular health-related resources on outpatient health care utilization (primarily); (b) the impact of Seguro Popular on health care utilization among the population of older Mexican adults with diabetes and/or hypertension at the individual level; and (c) the individual-level effect of Seguro Popular on out-of-pocket expenditures among older Mexican adults with diabetes and/or hypertension

While the first study makes use of a panel dataset on state-level characteristics that was compiled from publicly available data, the second and third studies use data from the first and third waves of the Mexican Health and Aging Study, a nationally representative longitudinal study of Mexican adults aged 50 or more. Different methodological approaches were used to address the research questions in each of the studies.

Findings from the first study indicate that greater availability of Seguro Popular health-related resources at the state level are associated with higher outpatient health care utilization rates. Moreover, results from the second and third study suggest that older Mexican adults who were enrolled in Seguro Popular were associated with higher utilization rates and lower out-of-pocket expenditures compared to those who were uninsured.

The dissertation of Ida Caterina García Appendini is approved.

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2017

To my Mom and Dad

To my Family

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LIST OF ACRONYMS

CAUSES	Ministry of Health’s catalog of universal health services (*Catálogo Universal de Servicios de Salud*)
CHE	Catastrophic Health Care expenditures
CONAPO	National Population Council (*Consejo Nacional de Población*)
CONEVAL	National Council for the Evaluation of Social Development Policy (*Consejo Nacional de Evaluación de la Política de Desarrollo Social*)
ENE	National Employment Survey (*Encuesta Nacional de Empleo*)
ENOE	National Employment and Occupation Survey (*Encuesta Nacional de Ocupación y Empleo*)
GEE	Generalized estimating equations
GDP	Gross Domestic Product
HRS	Health and Retirement Study
IMSS	Mexican Social Security Institute (*Instituto Mexicano del Seguro Social*)
INEGI	National Institute of Statistics and Geography (*Instituto Nacional de Estadística y Geografía*)
ISSSTE	Institute for Social Security and Services for State Workers (*Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado*)
LTFU	Loss to follow-up

MHAS	Mexican Health and Aging Study
MoH	Mexican Ministry of Health (*Secretaría de Salud*)
MXN	Mexican peso
NIA	National Institute on Aging
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary least squares
OOP	Out-of-pocket
PEMEX	Petróleos Mexicanos
PSM	Propensity Score Matching
PSMDID	Propensity score matching difference-in-differences
PSU	Primary sampling unit
REPSS	"State Regime for Social Protection in Health" (*Régimen de Protección Social en Salud*)
SD	Standard Deviation
SEDENA	Ministry of Defense (*Secretaría de la Defensa*)
SEGOB	Secretariat of the Interior (*Secretaría de Gobernación*)
SEMAR	Secretary of the Navy (*Secretaría de Marina*)
SEP	Ministry of Public Education (*Secretaría de Educación Pública*)
SES	Socioeconomic status

SESA	State Health Services (*Servicios Estatales de Salud*)

SP	*Seguro Popular*

SPSS	System of Social Protection in Health (*Sistema de Protección Social en Salud*)

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1. CHAPTER 1 – Introduction to the Dissertation

This dissertation focuses on Seguro Popular, a public voluntary health insurance program (in practice) that was officially launched by the Mexican government in the early 2000s. The main goal of Seguro Popular was to provide health coverage and services to mostly low-income, uninsured individuals, whom, at the time, represented almost half of Mexico's population. In addition, the program aimed to increase public heath expenditure, improve access to care, provide financial protection to families, ameliorate the distribution of expenditures to reduce inequities, and invest in new infrastructure and medical personnel. A number of important achievements of Seguro Popular have been reported throughout the years: the fraction of uninsured individuals has decreased considerably; public spending levels have increased and the Ministry of Health has claimed significant investments in infrastructure and in medical personnel. Despite these achievements, however, some critics have argued that significant disparities in health outcomes and health resources across Mexico's states persist and that critical issues still need to be addressed.

Numerous studies have examined the effects of being affiliated to Seguro Popular on health care utilization and out-of-pocket (and catastrophic) health expenditures. In general, findings from these research studies have suggested that the program is associated with higher rates of health care utilization as well as with lower out-of-pocket and catastrophic health expenditures among the population. However, as most of the existing literature has addressed research questions at the individual level, virtually no studies have focused on the effects of the program from a state-level perspective, even though scholars have documented a large heterogeneity in the implementation of Seguro Popular across Mexico's 32 states. Moreover, most studies have analyzed the impact of Seguro Popular on the short term and not much is known about the effects of Seguro Popular among older Mexican adults with chronic diseases, one of the most vulnerable and fastest growing segments of Mexico's population. Thus, this dissertation aims to fill this gaps in the literature.

Chapter Two examines the effect of levels of health-related resources (such as the availability of medical personnel) on outpatient health care utilization from a general, state-level perspective by taking Mexico's states' heterogeneity into account. In addition, this chapter analyzes the relationship between Seguro Popular state-level expenditures and (both) the number of program beneficiaries and the availability of health-related resources.

Chapter Three explores the effect of Seguro Popular on health care utilization among older Mexican adults aged 50 and more with diabetes and/or hypertension at the individual level. Finally, Chapter 4 focuses on the effect of the program on out-of-pocket expenses among the same population of adults with chronic diseases and also at the individual level.

2. CHAPTER 2 – State-Level Effects and Heterogeneity of Seguro Popular

2.1 Introduction

Encouraged by the World Health Organization and by the widespread acknowledgment that universal health coverage[1] is associated with improved access to health care, better health outcomes and lower out-of-pocket spending among populations, several developing countries have promoted expansions in health coverage in the last decades as a way to achieve universal coverage schemes. Although the evidence is somewhat mixed, the literature has documented that, among low- and middle-income countries, universal health coverage has improved access to care. Likewise, there is some evidence from developing countries that points towards the association of health coverage expansions with improved health outcomes and spending [1].

Prompted by the above and by the urgency to reorganize the Mexican Health System (because of its inability to effectively cope with the growing challenges posed by the (coexisting) demographic and epidemiological transitions in the country, and because of the large inequalities in public expenditure and health outcomes that prevailed across Mexico's 32 states [2]), the Mexican government approved a reform to the General Health Law in the early 2000s that gave rise to the System of Social Protection in Health (*Sistema de Protección Social en Salud*, SPSS) and its main insurance-based component: the Popular Health Insurance Program (*Seguro Popular*, SP). With the initial goal to obtain universal health coverage by 2010, SP was formally implemented as a nationwide policy in January 2004. Among its more specific objectives, SP intended to increase public health care expenditure, improve the distribution of those expenditures to reduce inequities, provide financial protection to families, build new infrastructure, and invest in health-related resources [2, 3].

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1 Universal health coverage, as defined by the World Health Organization, refers to health financing systems that provide access to health services and financial protection to all people in a country [1].

The literature has documented important achievements of SP throughout the years. In particular, public health expenditure has increased, the number of uninsured individuals has diminished considerably, and the Mexican Ministry of Health (MoH) has claimed significant investments in health infrastructure and human resources[2] since the program's implementation [4, 5]. Moreover, research has suggested that SP is associated with higher rates of health services utilization and lower catastrophic and out-of-pocket expenditures among the population.

Despite these achievements, however, critical issues still need to be addressed. In this regard, the National Council for the Evaluation of Social Development Policy (*Consejo Nacional de Evaluación de la Política de Desarrollo Social*, CONEVAL) estimated that more than 20% of the population was still uninsured by 2012. More importantly, different sources have indicated that the Mexican health care system is still highly fragmented and that significant disparities in health outcomes and health resources across Mexico's states persist [2, 6]. This state heterogeneity is particularly relevant, given the decentralized structure of Mexico's health system.[3] Surprisingly, little is known about the connection between SP and Mexico's decentralization process, the two main highlights of the Mexican health reform from the twentieth and twenty-first centuries [7]. In addition, there is a dearth in the literature with regards to the extent to which state-level expenditures and other health-related resources (e.g. health facilities and health personnel) are associated with better health outcomes. Because higher rates of health care utilization are presumably associated with improved health outcomes [8, 9], the present study aimed (primarily) to investigate whether higher levels of health-related resources in

[2] According to the MOH, the number of public outpatient consultation rooms increased by 75.3% between 2003 and 2012.In addition, the MOH claims that the number of physician and nurses in the public sector increased by 55.2% and 49.9% during that same period, respectively [5-6].

[3] Please refer to section 2.1.5 Seguro Popular's Design as a Decentralized "M-form" Organization

the states have translated into greater outpatient health services utilization rates, by taking into account Mexico's state-level heterogeneity and within the context of a decentralized health system. Additionally, and under the same context, this research study aimed to explore whether SP resources have been adequately used for the benefit of its beneficiaries. In particular, this paper aimed to explore whether higher state-level SP expenditures were associated with higher SP enrollment rates as well as with a greater availability of health-related resources in the states. In order to address the above goals, a panel dataset comprising the 2008-2012 period was constructed from annual, state-level information coming from several publicly available government data sources.

2.1.1 Overview of the Mexican Health Care System[4]

The Mexican health system comprises both the public and private sectors. The public sector includes social security institutions in addition to other organizations and programs that provide health care services to the population without social security. Social security is provided by the Mexican Social Security Institute (*Instituto Mexicano del Seguro Social*, IMSS), the Institute for Social Security and Services for State Workers (*Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado*, ISSSTE), Petróleos Mexicanos (PEMEX), the Ministry of Defense (*Secretaría de la Defensa*, SEDENA), and the Secretary of the Navy (*Secretaría de Marina*, SEMAR), whereas public organizations and programs that serve the population without social security (i.e. the self-employed, the unemployed, or workers within the informal sector of the econonomy) are mainly represented by the Mexican MoH (*Secretaría de Salud*, SS), State Health Services (*Servicios Estatales de Salud*, SESA),

[4] This section is heavily based on [3].

the IMSS-Prospera program (formerly IMSS-Oportunidades), and SP. The private sector includes insurance companies and health care providers who work in private offices, clinics and hospitals.

Social security institutions provide different services including health insurance and pensions to active and retired workers (and their dependents) within the formal sector of the economy. Health care services and medications are provided free of charge to its members, and affiliation to these institutions is mandatory for all salaried workers. All social security institutions deliver health care services in their own facilities and use their own health providers. These institutions are financed by payroll contributions from the federal and state governments, employers, and employees. By 2008, social security institutions provided coverage to 48.3 million people, about 45% of Mexico's total population. Of these, 80% were covered by IMSS and 18% were covered by ISSSTE.

Most of the population without social security, including individuals who are enrolled in SP, receive care in MoH and SESA facilities that are owned by the federal or state governments. These facilities have their own health providers and are financed primarily by the federal and/or state governments. However, users make a small contribution as well[5]. It is important to mention that although the SP program mostly contracts the delivery of health services in MoH or SESA facilities, it may also buy services from private providers.

Lastly, a small fraction of Mexico's population (approximately 3%) is covered (only) by private health insurance plans or through a fee-for-service basis. The private sector is mainly funded by users' contributions at the time of service and by the payment of insurance premiums. In this sector, private providers deliver health services in privately-owned consultation rooms, clinics, and hospitals

[5] Those who do not have social security and who are not affiliated with SP pay a small fee at the point of service. However, individuals without social security but who are covered by SP pay a fee at the time of enrollment to the SP program, but receive services without any co-pay (please refer to section 2.1.4).

It is worthwhile noting that both social security affiliates and those without social security may seek health care services within the private sector and pay for those services on an out-of-pocket (OOP) basis. In fact, this is a common practice in Mexico. According to a recent report by the Organization for Economic Cooperation and Development (OECD), OOP expenditures represented 45% of the Mexican health care system's revenue and 4% of household expenditures. In addition, Mexico has the highest ratio of private for-profit to public sector hospitals among OECD countries[6].

2.1.2 Demographic and Epidemiological Transitions in Mexico

For several decades, Mexico has been undergoing both a demographic and an epidemiological transition.

The demographic transition, mostly characterized by a rapid increase in the population's life expectancy and lower fertility rates, has resulted in a faster growth rate in the older population compared to that among the younger population. Mexico is currently going through the "demographic bonus" phase of this transition. As defined by the UN's Population Division, the demographic bonus, demographic dividend, or demographic window of opportunity is the period when the percentage of the population under 15 years of age is below 30% and the fraction of the population aged 65 and older has not yet reached 15% [10]. This is reinforced by data that have shown that there were 8.8 working age individuals for every person aged 65 or more in 2011, which reflected a low dependency ratio[6] compared to other OECD countries [6]. However, the literature suggests that some time near the year 2030 this "demographic window"

[6] The dependency ratio is defined as the number of people aged 65 and older per 100 working age people (age 15-64). The higher the ratio, the more elderly people there are to be supported by younger working adults.

will begin to close [11]. This implies that the old-age dependency ratio will be high enough to pose a considerable economic and social burden to the country.

Although recent studies point towards a slowdown in Mexico's life expectancy gains in the beginning of the 21st century [12, 13], the country has achieved an important increase in life expectancy at birth over the last six decades. In 1950, life expectancy at birth was estimated at 51 years for women and 47 years for men [14] and the OECD has estimated that life expectancy at birth increased from an average of 61 years in 1970 to an average of 74.6 years in 2012 [6]. Improvements in life expectancy and lower fertility rates have thus contributed to decreases in mortality which have, in turn, led to the aging of the Mexican population: in 2010, 6% of the population was 65 years and older and the percentage is expected to rise up to 21% by 2050 [15]. The epidemiological transition reflects the shift in population mortality from communicable diseases to chronic, non-communicable medical conditions such as diabetes and hypertension. The rising prevalence of these diseases, mainly driven by a dramatic increase in the prevalence of obesity among the population, has resulted in an increasing number of deaths among older adults [12] [16, 17]

2.1.3 Health Care Services Decentralization in Mexico[7]

Decentralization is mostly characterized by the transfer of decision authority (including fiscal, political and administrative tasks) from the central government to local entities [18]. In developing countries, decentralization of health care systems is viewed as an essential component of health reform that may enhance the delivery and financing of health care services [19, 20]. With the ultimate goal to achieve improved health outcomes, health services'

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[7] It is important to mention that only safety net health services provided by the SS and SESA facilities have been decentralized in Mexico (i.e. mainly those services for the uninsured and for SP members).

decentralization involves the transfer of decision autonomy from the federal government to local health authorities, and is seen as a way to promote better access to health care, equity, community engagement, and innovation among others [18, 21-26]. Compared to centralized systems, decentralized health services may provide more flexibility and can be better fit to address regional needs [19].

In Mexico, decentralization of health care has been envisioned as a means to improve state accountability as well as to reduce inequalities and motivate the participation of civil society [6, 27]. The first effort to decentralize the Mexican health care system, which involved setting up the framework for the transfer of (health care) responsibilities from the federal MoH to local health authorities in the states, took place in the 1980s. During this first decentralization wave (which also included the enactment of the General Health Law in 1983 and important amendments to the Mexican Constitution[8]), the federal government devolved health services to half of Mexico's 32 states; these services included the operation of outpatient primary health clinics and second level hospitals [6, 28]. However, due to adverse economic conditions and political issues, the decentralization process was interrupted. The second decentralization wave continued during the 1990s and was characterized by the decentralization of the remaining states and by the transfer of greater responsibility and decision autonomy to local health authorities [6].

[8] According to article 4 in the Mexican Constitution, every person is entitled to social protection in health and to receive health care services. The state is responsible for the provision of such protection and health services. This is regulated by the General Health Law.

2.1.4 Seguro Popular

In practice, SP is a voluntary program that provides health insurance coverage to uninsured families or individuals who do not benefit from social security, irrespective of pre-existing conditions[9]. Every Mexican citizen who is not covered by any social security institution may formally enroll in the program by providing his/her birth certificate or official ID. However, a large share of the population has duplicate and even triplicate insurance coverage. The program is mainly publicly funded (by both federal and state resources), with enrollees paying a small annual fee, based on their households' income level[10]. As of 2016, program beneficiaries are entitled to coverage for more than 280 interventions as well as to over 300 medications included in the SS's catalog of universal health services (*Catálogo Universal de Servicios de Salud*, CAUSES) without incurring any co-pay. Most of the services covered by CAUSES include primary and secondary cost-effective interventions that are provided by the state-managed by SESA facilities (mostly primary care) and by federal secondary and tertiary care SS facilities which are managed by the federal MoH.

As mentioned above, SP is funded by the federal and state governments and, to a lesser extent, by SP affiliates. As a result of the decentralization process, the MoH transfers federal funds to the states based on a capita payment per individual enrolled. States, in turn, make their own contribution to the program. Each of Mexico's 32 states has a "State Regime for Social Protection" (*Regimen de Protección Social en Salud*, REPSS) office that is in charge of pooling all the funds (including those coming from SP beneficiaries) and purchasing health care services from private and public health providers. With the

[9] As mentioned in section 2.1.1, SP affiliates mostly receive care in MoH and SESA facilities; however, because SP is allowed to contract the delivery of services with the private sector as well, sometimes SP members receive services from private providers.

[10] Households within the lowest two quintiles of the income distribution are not required to pay a fee [7, 22]. In practice, however, evidence has revealed that 97% of Mexican families did not pay fees by 2008 [23].

aim to improve efficiency and to allocate resources according to the needs of the population, the REPSS were originally designed as a way to separate financial allocation from provision of services [2, 7].

Federal resources may be used by the states to cover the medical workforce payroll (up to 40% of all federal funds), interventions and medications included in CAUSES (up to 30 %), promotion, prevention and disease screening activities (at least 20%), and some operation and administrative costs (up to 6%). Additional federal resources as well as funds coming from the states and from SP enrollees may be assigned to build new infrastructure and to hire new medical personnel. Because the amount of federal funds that each state receives is a function of the number of SP enrollees in that state, states may have perverse incentives to affiliate more individuals to SP in order to maximize federal transfers.

2.1.5 Seguro Popular's Design as a Decentralized "M-form" Organization

The design of Mexico's SP's system can be explained by organizational theory. Specifically, by transaction cost economics and the classification of firms as multidivisional (M-form organizations) or unitary (U-form organizations), depending on their organizational structure [29, 30]. While M-form organizations are usually defined as firms that consist of similar, self-contained, product-focused units, U-form organizations refer to firms composed of specialized, process-focused units [29]. This classification of organizations as multidivisional or unitary can be useful to understand decision-making authority [19]. In this respect, M-form organizations may provide (local) unit managers with more decision authority compared to unit managers in U-form organizations (the reason for this rests on the relative independence of the "self-contained" units within M-form organizations).

U-form organizations can be paralleled with the structure of centralized health systems in which the central government has full decision authority and is responsible for the delivery of health services by coordinating local managers who are only in charge of the operation of health care facilities. Conversely, systems with more decentralized arrangements (such as SP's) can be viewed as M-form organizations in which decision authority and responsibility for the delivery of services has been transferred to local health units that are in charge of both coordinating and operating health care facilities. In this case, the central government's role is to make sure that the population receives similar benefits across regions, to provide general guidelines to local authorities, to evaluate performance of local entities and (if applicable) to encourage the adoption of economies of scale [19]. **Figure 2.1** reflects the structure of SP's original decentralized design, in compliance with the definition of M-form organizations. In addition to highlighting the functions associated with both the federal and state-level health authorities, the figure shows how resources flow through the system and how funds are spent among REPSS' different activities in order to provide health care.

2.1.5.1 Origins of SP

Before the implementation of SP almost half of the Mexican population was uninsured; mostly those within the self-employed sector of the economy. This fraction of the population had access to publicly-subsidized services in SS, SESA, or IMSS-Prospera (IMSS-Oportunidades at that time) facilities by paying a small fee-for-service. However, the services offered by these facilities were limited by the lack of financial resources and unavailability of personnel (which resulted in high OOP costs at the household level because individuals preferred to receive services from private providers). In addition, it was unclear to which services the uninsured were entitled to. Moreover, there were large inequalities in public expenditure across states and also between individuals covered by social security institutions and the uninsured [2]. In addition to these problems, the Mexican health system faced the enormous challenges imposed by the coexistence of the demographic and epidemiological transitions in the country.

Confronted by all of these problems, and with the additional goal to generate a health insurance program that would help generate an insurance prepayment culture among the population [31], the Mexican government established SP in 2002 as a pilot program in five states (Aguascalientes, Campeche, Colima, Jalisco, and Tabasco). Then, it was rolled-out gradually to other states and by the end of 2005 the last three states had joined the program (Chihuahua, Distrito Federal, and Durango).

2.1.5.2 Achievements, Challenges and SP Heterogeneity

The number of SP affiliates has increased considerably over the past decade. According to the National Council for Evaluation of Social Development Policy [32] (*Consejo Nacional de Evaluación de la Política de Desarrollo* Social, CONEVAL), SP grew from 5 million individuals in late 2004 to around 50 million by 2014 (about 40% of Mexico's population), which represented an important milestone in the country's endeavor to achieve universal health care coverage. However, recent data have revealed that more than 20% of the population remains uninsured [6].

Although the literature has documented an increase in the country's public health expenditure[11], important reductions in catastrophic health care expenditures and some decreases in OOP expenditures among the population, and even if there is evidence of a shift from private to more affordable public health services use in the last decade[12], Mexico's health care OOP expenditures are still high when compared to most OECD countries [7]. In addition, disparities between SP affiliates and social security

[11] Public health expenditures increased from 2.4% to 3.2% of GDP during the last decade. This increase has been mostly associated with SP [7, 28].

[12] Mexico's 2010 census reported a decrease of almost 13 percentage points regarding the population of individuals 60 and more using private health services (and an increase in the proportion of usage of public health services provided by SS of almost 10 percentage points [29].

beneficiaries are still present, possibly because of differences in access to health care and in entitlement of benefits[13] [7].

Even though SP was designed in such a way as to take advantage of the system's decentralized structure to increase equity and efficiency as well as to improve the quality of health services, several critics have argued that the transfer of decision autonomy to the states has not yielded the expected benefits. On this matter, several sources have documented that the implementation of SP has been very different across states (e.g. in practice, many states have not collected fees from enrollees, some of the states have not made their own contributions to SP, expenditures vary considerably across states, and some states have enrolled more affiliates to receive more federal funding and have sometimes used SP's resources inappropriately). Furthermore, they contend that coordination between federal and state health entities is poor, that decision making is diffused throughout the system, and that resource allocation has not been entirely separated from provision of services. In sum, they have expressed concern that SP might have led to a more fragmented and inequitable health system [6, 7, 31, 33-40]. In addition, evidence provided by the Mexican auditor general shows that a considerable amount of funds has not been properly accounted for by the states [41]. All these problems have contributed to a large heterogeneity across states with regards to the implementation of SP.

2.2 Literature Review

Empirical evidence on the relationship between the availability of health-related resources (such as health infrastructure and human resources) and health care utilization or

[13] There are some important common high-cost health interventions that have been excluded from the CAUSES catalogue. For example, heart attacks in individuals over 60 years of age are not covered. Neither are strokes, dialysis following renal failure, multiple sclerosis, and lung cancer [7].

health outcomes in developing countries is limited. Likewise, not much is known about the association of public health expenditures with the availability of health-related resources.

Within the context of Tajikistan, a study aimed at analyzing the determinants of prenatal health utilization concluded that lack of health infrastructure was associated with a lower use of health care [42].

In a Peruvian study, Valdivia aimed to analyze whether expansions and improvements in Peru's infrastructure during the 1990s had favored greater equity in terms of outpatient health care utilization [43]. Using a probit model with random effects at the district level, he found that the expansion of network centers had led to greater equity in the use of health services, although the magnitude of the effect was rather small. In another research study, Valdivia examined the impact of health infrastructure expansions on child nutrition [44]. By using pooled cross-sectional data at the household level, the author developed a district fixed effects model. He concluded that infrastructure expansions (as proxied by the number of public health facilities and the number of physicians) yielded a positive effect in urban areas only, highlighting the need to reduce distance and waiting time barriers to improve child nutrition status.

Using impatient utilization data, Gruber et al. found that extending health insurance coverage through the Baht program in Thailand resulted in greater health care utilization rates for the previously uninsured [45]. Filmer and Pritchett conducted a cross-sectional study on the impact of public health spending on child and infant mortality [46]; their findings suggested that the effect was not statistically significant. Using an instrumental variables approach in a study on the effect of government health expenditures on child and maternal mortality, Bokhari et al. concluded that, in developing countries, government expenditure on health is an important factor determining health outcomes [47]. In an effort to explain the rural/urban divide in child nutrition in Peru, Gajate-Garrido analyzed the impact of total public expenditure on child nutrition [48]. Using an instrumental variables approach to account for the endogeneity associated with public expenditure at the regional level, results from the study revealed that public expenditures had a statistically significant, positive effect only in urban regions. These findings were in line with Valdivia's results. Using a panel dataset that included 153 countries and an instrumental variables approach, Moreno-Serra analyzed whether higher levels of public health spending were associated with lower mortality rates [49]. He concluded that country-level health spending was negatively associated with child and adult mortality.

In the Mexican context, a large body of the literature has looked at the effect of being affiliated to SP on health care utilization/health outcomes [50-61]. The unit of analysis in most of these studies has been the individual. Surprisingly, however, little is known about the relationship between health-related resources and health care utilization. Moreover, very few research studies have looked at SP's implementation from a state-level perspective and virtually none of them have accounted for heterogeneity across states. Lastly, although a research paper analyzed SP's financial transfer mechanisms (i.e. how financial resources are transferred to states) and the allocation process of funds for the purchase of medications and contracting of health personnel [7], I did not find empirical evidence on the association between SP expenditure and (both) the number of SP enrollees and the availability of health-related resources.

Thus, the present research study aims to fill these gaps in the literature. To my knowledge, this is the first study to take heterogeneity across Mexico's 32 states into account to explore the effect of *levels* of health-related resources on outpatient health utilization. Furthermore, this study contributes to the literature by being the first to examine the relationship between SP expenditure *levels* and (both) the number of SP beneficiaries and the availability of health-related resources at the state level.

2.3 Conceptual Model

Based on the above description of SP as a type of M-form organization and within the context of the program's heterogeneous implementation across states, the conceptual model for this research paper is shown in **Figure 2.2**[14]. All of the constructs in the figure are at the state level.

The present study had one *main* research question and two *additional* research questions[15].

The main research question **(RQ1)** aimed to investigate whether states with a greater availability of health-related resources (in particular, physical infrastructure and medical personnel) were associated with greater outpatient health services utilization rates, when compared to states with a lower availability of health-related resources (pathway A). In accordance with Habivov's and Valdivia's findings [42, 43], I hypothesized that states with greater infrastructure or higher levels of medical workforce would be associated with higher outpatient health care utilization rates than states with lower availability of health-related resources.

[14] It is important to mention that the "SP Expenditures" box in **Figure 2.2** refers to the same expenditures in **Figure 2.1**. In addition, the "health care utilization" box in **Figure 2.2** represents the "delivery of health services" box in **Figure 2.1** from the users' perspective (instead of from the providers' point of view).

[15] Because higher rates of health care utilization have been associated with better health outcomes, the main research question was the one in which the outcome of interest was represented by health care utilization.

The goals of the two additional research questions were to examine whether states with higher SP expenditures were associated with higher affiliation to SP **(Rq2)** and with a greater availability of health-related resources **(Rq3),** compared to states with lower levels of SP expenditures. These two additional research questions are represented in **Figure 2.2** by pathways B and C.

As part of the state's resources are used to enroll families and individuals to SP, and as evidenced by the significant growth in the number of SP beneficiaries during the last decade [32, 62], it was hypothesized that states with higher SP expenditures should be associated with higher SP affiliation rates, compared with other states that had lower expenditures (pathway B).

Pathway C in the figure suggests that states with a greater spending capacity were expected to invest more in health-related resources (especially in terms of the medical workforce) than states with lower SP expenditures.

Lastly, the double arrow connecting SP affiliation to the availability of health-related resources suggests that having a greater availability of health-related resources is associated with a greater capacity to provide services to more SP enrollees. In turn, higher levels of SP affiliation would require a greater number of health-related resources to satisfy demand.

As depicted in **Figure 2.2**, other factors affect the relationship between the constructs mentioned above. The amount that a state spends on SP depends on its wealth: the wealthier the state, the more resources it can devote to SP. In turn, state's wealth may influence unemployment rates, which is in agreement with Okun's law on the relationship between growth rate of the economy and unemployment at the country level. According to this law, there should be a negative association between a state's wealth and unemployment rates [63]. The connection that exists between states' wealth and educational attainment is in line with research that supports that educational attainment stimulates economic growth [64-67]. The reason for the double arrow relies on the fact that, compared to poorer states, wealthier states may devote more resources to education.

In addition, **Figure 2.2** suggests that the level of educational attainment in a state affects unemployment rates. The rationale for this rests upon evidence from country-level studies on the effect of education on unemployment rates [68]. The figure also illustrates that unemployment, in turn, may mediate the effect of educational attainment on SP affiliation. The link between unemployment and affiliation to SP can be explained by the fact that the unemployed do not have social security and thus are eligible to enroll in SP. Because higher educational attainment may be associated with better health knowledge, educational attainment is thought to influence health care utilization as well.

Finally, **Figure 2.2** illustrates that both affiliation to SP and population age affect outpatient health care utilization. While the former influences health care utilization because an individual should be enrolled in SP to receive health services, the latter has an effect on health care utilization because older individuals will tend to use health services more intensely than the younger population.

It is worthwhile noting that since the amount of SP resources that each state receives in a particular year is fixed and is determined by the number of SP enrollees in the state, the possibility of reverse causality between affiliation to SP and SP expenditure does not exist because a state will not get more resources from the government even if affiliates spend more than expected.

2.4 Methods

A 5-year panel dataset of Mexico's 32 states was constructed to address the above research questions.

2.4.1 Data

The panel dataset that was used in this study was built from (annualized) publicly available information on Mexico's 32 states for the time period comprising years 2008-2012. Data were drawn from a variety of government-based sources which included the MoH, the SPSS, the National Institute of Statistics and Geography (*Instituto Nacional de Estadística y Geografía*, INEGI), the National Population Council (*Consejo Nacional de Población,* CONAPO), the Ministry of Public Education (*Secretaría de Educación Pública*, SEP), and the Secretariat of the Interior (*Secretaría de Gobernación,* SEGOB). With 32 states and 5 years, the original dataset included 160 state-level observations on 12 variables that are described below.

2.4.2 Variables

The definition, type, name, and sources of the variables that were employed in this study to operationalize the constructs in the conceptual model described above are summarized in **Table 2.1**. As mentioned, all of the variables were measured at the state-level and on an annual basis. In addition, the relationship between the research questions of this study and the type of variables used to address each of the research questions are shown in **Table 2.2**.

2.4.2.1 Outcome Variables

Depending on the research question being analyzed, three state-level outcome variables were used in this study (please refer to **Table 2.2**). While the first of these represented a measure for health care utilization, the second and third variables operationalized enrollment to SP and health-related resources, respectively.[16]

As shown in **Table 2.1**, health care utilization was operationalized by a variable representing the total number of annual outpatient consultation services provided *by both public and private health institutions* per 1000 population in a state. Although a measure for state-level outpatient health care utilization among SP beneficiaries (only) would have been ideal, the variable that was used in this study was the only measure of outpatient utilization that was found within the sources that were consulted.

State-level affiliation to SP was measured by the number of SP enrollees in a state per 1000 population in a particular year. Lastly, health-related resources at the state-level were operationalized in terms of the availability of SS/SESA's (outpatient) physical infrastructure as well as by the availability of the medical workforce in contact with patients in those facilities. Infrastructure was proxied by the number of SS/SESA consultations rooms per 1000 population in a given year. Similarly, medical workforce availability was operationalized by (both) the number of SS/SESA physicians and nurses per year, per 1000 population. Analogous measures for health-related resources have been used in the literature [69, 70].

It is important to mention that affiliation to SP and the variables that operationalized health-related resources were used as control variables in some of the empirical specifications in this study (please refer to section 0).

[16] Depending on the type of health-related resource, three variables were actually used to operationalize this construct: availability of physicians, nurses, and outpatient consultation rooms per 1000 population.

2.4.2.2 Independent Variables

As shown in **Table 2.2**, SP expenditures were operationalized by states' annual total expenditure on SP per 1000 population. Similar measures have been used in the literature to account for country-level health expenditures [41-44]. This variable, representing annual spending by each of the states' REPSS, was used as the key independent variable in the empirical specifications aimed at addressing two of the three research questions in this study: Rq2 and Rq3. On the other hand, the availability of SP physicians, SP nurses and outpatient consultation rooms (as defined by the number of SS/SESA physicians/nurses/consultation rooms per 1000 population per year in a state) served as the key independent variable in regression models that aimed to answer research question RQ1.

In addition to the key independent variables described above, all the empirical analyses controlled for other state-level covariates that included measures for states' wealth, educational attainment, unemployment, and population demographics. Similar measures have been used previously in country-level studies [44]. While states' wealth was measured by each state's annual GDP per 1000 population in millions of 2008 Mexican pesos (MXN$, 2008), educational attainment was operationalized by the (annualized) percentage of the population in a state with elementary and/or middle school education. Unemployment was represented by a variable that measured the unemployment rate among the state's "economically active population"[17] and population demographics was operationalized by the share of the population aged 0-14 in a state.

[17] The economically active population is 15 and older. The unemployment rate refers to the percentage of that population who were unemployed in the second quarter of each year but who had been looking for a job during the previous month.

Finally, with the aim to control for time trends, all the empirical specifications in this study included year dummies for the 2008-2012 period.

2.4.3 Statistical Analyses

Stata version 14.2 was used to perform all of the analyses in this paper.

2.4.3.1 Descriptive Statistics & Main Empirical Strategy

After merging information from the different data sources and constructing the panel dataset, several descriptive analyses were carried out. The dataset was first examined to check for variables with missing data. Then, with the aim to determine skewness and to visualize outliers, distributions of the outcome variables (i.e. outpatient health care utilization, SP affiliation and the three variables associated with health-related resources) were analyzed. Subsequently, univariate frequency distributions for all relevant independent variables were obtained and bivariate statistics were conducted to analyze the crude associations between the key independent variables and the outcomes of interest in this study. Bivariate statistics included scatterplots and checking for statistical significance of Pearson correlation coefficients. In addition to the above, intra-class correlation coefficients were computed to analyze whether within-state observations were correlated.

In order to account for states' heterogeneity in the empirical models, state means for the key independent variables in **Table 2.2** were obtained and then states were divided into quintiles according to those means. For example, each state's mean expenditure on SP (per 1000 population) was first calculated and states were ordered from the lowest to highest mean spending levels. Then, states were divided into quintiles according to those spending levels. States in the fifth quintile had the highest (mean) SP spending levels while states in the first quintile had the lowest mean expenditures per 1000 population. A similar procedure was followed for the case of the availability of physicians, nurses and consultation rooms per 1000 population.

Cross-state heterogeneity in terms of mean SP expenditures and the mean number of nurses per 1000 population are shown in **Figure 2.3** and **Figure 2.4**.

2.4.3.2 Empirical Strategy

The strategy to test the hypotheses associated with each of the three research questions of this study involved the implementation of different regression specifications, all of which accounted for the possible non-independence of observations within states and for the panel structure of the data. These included fixed effects, random effects, and generalized estimating equations (GEE) empirical models.

For each of the research questions in **Table 2.2**, different regression models were implemented. Fixed and random effects models were first fit to analyze the overall effect of the key independent variable on the dependent variable in question and a Hausman test was performed to evaluate consistency of the random effects estimators. These models did not take into account cross-state heterogeneity in the independent variables and were implemented because unobservable, time-invariant characteristics at the state level were thought to influence both outpatient health care utilization and the availability of infrastructure and medical personnel. Failing to control for these factors could result in biased estimates.

In order to account for the state-level heterogeneity associated with the key independent variables in the study, a variety of GEE specifications were subsequently implemented. In particular, these included GEE formulations with independent, exchangeable and autoregressive (ar1, ar2, and ar3) working correlation matrices.[18] Finally, to check for robustness of results from the GEE specifications, an additional random-effects regression model that incorporated state-level heterogeneity was implemented.

The general form for the regression specifications described above was the following:

$$Y_{itm} = \beta_0 + x_{itm}^1\beta_1 + \boldsymbol{x_{itm}^k}\beta_k + \varepsilon_{itm}$$

for *i= 1, 2, …, 32; t= 2008, 2009, …, 2012; m=1, 2,3*[19]*; k= 2, 3, …n*

Where

$$Y_{itm} = outcome\ variable\ of\ interest\ in\ state\ i, at\ time\ t\ and\ in\ model\ m$$

$$x_{itm}^1 = key\ independent\ variable\ of\ interest\ in\ state\ i, at\ time\ t\ and\ in\ model\ m$$

$$\boldsymbol{x_{itm}^k} = vector\ of\ n-1\ covariates\ for\ state\ i, at\ time\ t\ and\ in\ model\ m$$

$$\varepsilon_{itm} = error\ term\ associated\ with\ state\ i\ , at\ time\ t\ and\ in\ model\ m$$

For the case of the random and fixed effects models, the error term in the above equation can be decomposed into unobserved time-invariant and time-varying factors. In all models that accounted for state-level heterogeneity, the key independent variable in question took the form of dummies: one for each of the quintiles.

[18] The autoregressive models aimed to account for serial correlation that may be present due to the longitudinal nature of the data. In addition, these lagged specifications were implemented because the value of the dependent variable in a particular year was thought to affect levels of that same variable in future years.

[19] Refers to the three models in **Table 2.2**

2.5 Results

2.5.1 Summary Statistics

Summary statistics for the analytical sample are shown in **Table 2.3**. As illustrated, all 160 observations (32 states, 5 years) were taken into account in the analyses. Therefore, missing data were not a concern in this study.

Histograms for the dependent variables in the present paper were mostly centered. However, the distributions of the outcome variables revealed that Tabasco, a state in the Southeastern part of Mexico, and the Federal District (represented by Mexico City) were consistently outliers. The latter was confirmed by bivariate relationships between the means of the main outcome variables and the means of the key independent variables. Tabasco was consistently associated (on average) with higher SP expenditures, higher utilization rates, and a greater availability of health-related resources per 1000 population, compared to other states. Conversely, Mexico City had lower SP expenditures but had higher utilization rates and a greater availability of medical personnel and infrastructure per 1000 population than other states. However, it is important to mention that higher levels of physical infrastructure (i.e. consultation rooms) in a state cannot be attributed to the SP program because much of this infrastructure was already in place before the launch of the program.

Finally, the analysis of intra-class correlation coefficients revealed that these coefficients were high for the three outcome variables in the study (i.e. 0.85, 0.55, and 0.90 for health care utilization, SP affiliation, and availability of nurses per 1000 population, respectively). Therefore, subsequent analyses took within-state correlations into account.

2.5.2 Results from Empirical Specifications

2.5.2.1 Effect of Health-Related Resources on Outpatient Health Care Utilization

Table 2.4 presents the coefficient estimates for the regression specifications modeling the effect of health-related resources on outpatient health care utilization (which corresponds to research question RQ1). Full results of the empirical models are presented in **Table 2.7** in the Appendix.

In this case, health-related resources were operationalized by the availability of nurses per 1000 population. However, similar results were obtained when implementing the same models for the case of physicians and consultation rooms. All the regression models in the table were adjusted for state-level SP expenditures in millions of 2008 MXN$, GDP per 1000 population, percentage of population with elementary/middle school education, share of population 0-14 years, unemployment rates, SP affiliation per 1000 population, and year dummies. As expected, the coefficients in **Table 2.4** were all positive, suggesting that the higher the availability of nurses per 1000 population in a state, the higher the outpatient health care utilization rates in that state.

Column 1 shows the results of the fixed effects specification on the *overall* effect of health-related resources on outpatient health care utilization (results from the analogous random effects model were not presented here because a Hausman test favored the fixed effects formulation). Without taking into account states' heterogeneity in terms of the availability of nurses, results from the fixed effects regression model suggested that, on average, state-level availability of nurses were positively associated with outpatient utilization rates. Moreover, this association was statistically significant.

Columns 2-7 in **Table 2.4** present the coefficient estimates for regression models that accounted for states' heterogeneity by dividing the states into quintiles according to levels of nurse availability. While columns 2-3 present the results of GEE models with independent and exchangeable working correlation matrices, columns 4-6 show the coefficients from autoregressive GEE models with 1, 2 and 3 year-lags, respectively (ar1, a42, and ar3). Finally, column 7 presents the coefficients for the random effects model that was implemented to check for robustness of results. As shown, all coefficients in columns 2-7 were positive and, in general, increased in magnitude as the quintile number increased. Therefore, compared to states with the fewest nurses per 1000 population, states in quintiles 2, 3, 4, and 5 were associated with greater health care utilization rates. However, only the coefficients for the fourth and fifth quintile were statistically significant.

2.5.2.2 Effect of SP Expenditures on the Number of SP affiliates

Coefficient estimates for the state-level regression specifications that aimed to address whether SP expenditures were associated with affiliation to SP (Rq2) are presented in **Table 2.5**. The models controlled for GDP per 1000 population, percentage of population with elementary/middle school education, share of population 0-14 years, unemployment rates, the number of nurses per 1000 population as well as for year dummies. Full results of these models are presented in **Table 2.8**.

As before, a Hausman test revealed that the coefficients from the random effects model on the *overall* effect of SP expenditures on affiliation to the program were not consistent with those of the fixed effects formulation. Therefore, column 1 shows the results from the latter specification. As shown, the coefficient for SP expenditures in the fixed effects model was positive and statistically significant. In addition, and as hypothesized, positive coefficients for all expenditure quintiles were also observed in the GEE models (columns 2-5) and in the random effects model that took state heterogeneity into account (column 6). In this case, almost all the coefficients for columns 2-6 were statistically significant and the magnitude of such coefficients increased from the lowest to the highest expenditure quintiles, strongly suggesting that higher state-level SP spending may have resulted in a greater number of SP affiliations per 1000 population. It is worthwhile noting that the GEE autoregressive model with three lags for the number of affiliates (i.e. the dependent variable) did not converge. Therefore, the table shows the results for the autoregressive specifications with one and two lags only.

2.5.2.3 Effect of SP Expenditures on Health-Related Resources

Table 2.6 shows the coefficients associated with the regression specifications that were implemented to model the effect of SP expenditures on health-related resources (Rq3). Full results are available in **Table 2.9**. Once again, health-related resources were measured by the availability of nurses in a state per 1000 population; however, similar results were obtained for models in which the dependent variable was operationalized by the number of physicians. In this case, all the models controlled for the number of SP affiliations per 1000 population and for health care utilization rates in addition to the usual covariates (i.e. states' GDP, percentage of population with elementary/middle school education, share of population 0-14 years, unemployment rates, and year dummies). As was the case for the other two research questions, a Hausman test revealed that the fixed effects model was preferred to the random effects specification to analyze the overall effect of SP expenditures on nurse availability.

As shown in **Table 2.6**, all coefficients were positive, which could imply that higher SP expenditures at the state level are associated with a greater availability of nurses (as was expected). However, the coefficient for the fixed effects model in column 1 was not statistically significant. For the case of the specifications that included cross-state spending heterogeneity (columns 2-7), only those states in spending quintiles 2 and 5 (and to a lesser extent those in spending quintiles 3 and 4) were consistently associated with greater levels of nurse availability, compared to states within spending quintile 1.

2.6 Discussion and Conclusions

By taking into account Mexico's state-level heterogeneity and within the context of a decentralized health system, this study made use of a state-level 2008-2012 panel dataset to assess whether higher levels of SP health-related resources have translated into greater outpatient health services utilization rates. In addition, this study aimed to explore whether higher state-level expenditures were associated with greater SP enrollment rates as well as with higher levels of health-related resources in the states. It is important to mention that because mediator variables were included in the empirical models presented in the previous section, the effects that were estimated were partial (i.e. marginal); hence, they should not be interpreted as total effects.

As hypothesized, empirical evidence from this study suggests that states with higher state-levels of health-related resources (as proxied by the number of nurses per 1000 population) are associated with greater outpatient health services utilization rates, compared to states with lower availability of such resources. Similarly, study findings provide support towards the hypotheses that states amongst the highest levels of SP expenditures per 1000 population are associated with higher SP enrollment rates and a greater availability of health-related resources than states with lower SP expenditure levels. The results were robust to empirical specifications from non-equivalent methodologies (i.e. based on different assumptions).

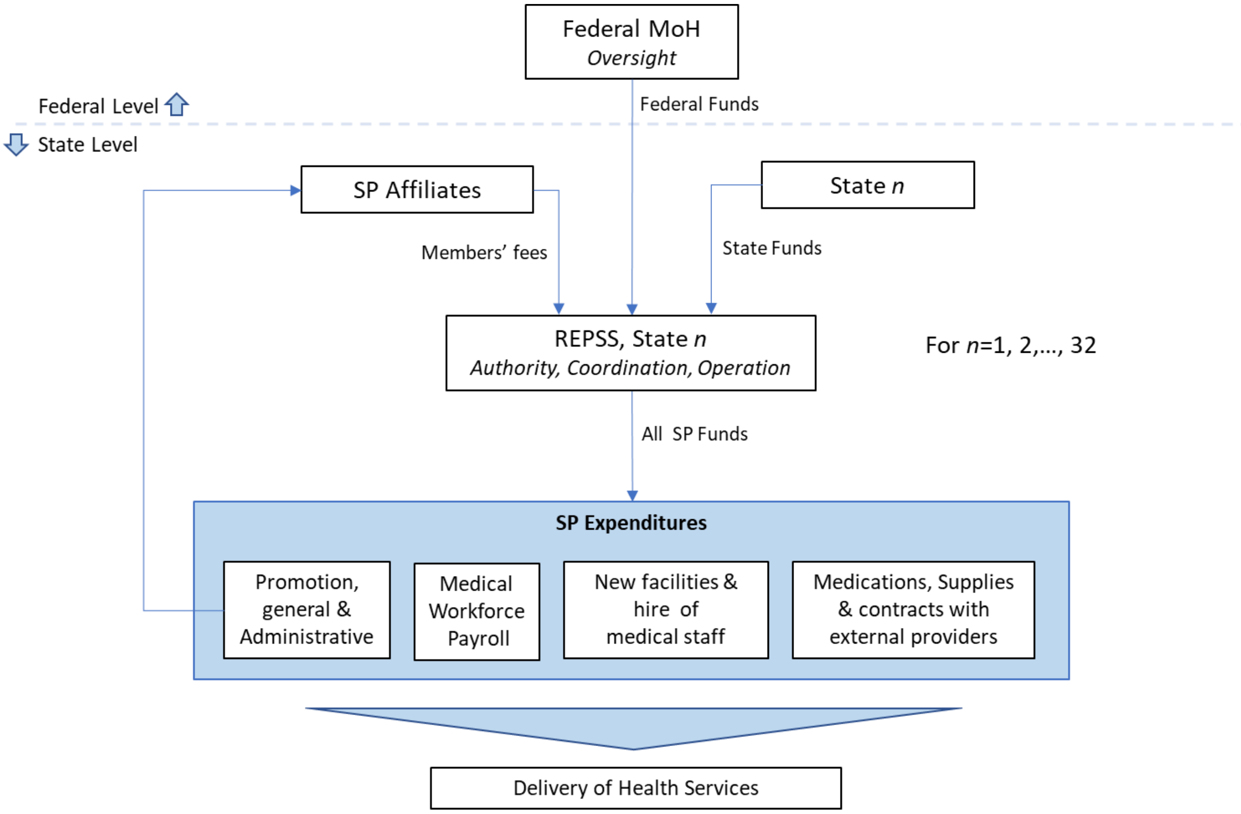
Findings from this study suggest that a greater availability of health-related resources has led to higher outpatient utilization rates in the states, which is highly encouraging given that one of SP's objectives was to improve access to health care. However, it seems that the positive effect of (annual) state-level SP spending on affiliation to SP is stronger than the effect of those expenditures on the availability of health-related resources. This could imply that some states have spent more of SP's resources on affiliating members rather than on investing in health-related resources, which would not be surprising given that states have an incentive to increase the number of affiliates in their state to receive more federal funds. Because higher utilization rates are generally linked to better health outcomes, and an increase in the number of beneficiaries does not necessarily lead to greater utilization, this could mean that the current performance of SP in terms of the health benefits provided to its intended recipients is suboptimal.

As mentioned earlier, advocates of decentralized health systems have argued that such systems are associated with positive outcomes among populations. In reality, however, there is mixed evidence with regard to the benefits and outcomes of health decentralization [19] and it is clear that sometimes the costs of decentralization outweigh its benefits. In the case of Mexico, the decentralized nature of the SP system may have helped create perverse incentives in some states to devote a significant proportion of SP's funds for the enrollment of more individuals instead of investing more of the program's resources on health-related resources. In addition, the federal authorities' lack of control on how SP funds are spent in the states, along with the poor coordination that exists between central and local health authorities under the current decentralized arrangements, may have led to a large heterogeneity across states with regards to the implementation of SP. This heterogeneity, in turn, is likely to have resulted in the mismanagement of resources and in the health outcomes and health care utilization inequalities that have been previously reported [33, 41]. Therefore, it is necessary to develop a more centralized system that includes mechanisms aimed at enhancing coordination between federal and state-level authorities and the establishment of regulations to improve states' accountability on the distribution of resources. In addition, the allocation of federal funds to states should be based on states' health needs (rather than on the number of affiliates per state) and on the quality of services provided by each of the states. In this regard, states could be evaluated on their performance according to certain health-related metrics and could be compensated through the allocation of more federal funds if their performance meets pre-specified standards or if they meet certain goals (such as reducing the incidence of chronic diseases in states).

To the best of my knowledge, this is the first study to incorporate heterogeneity across Mexico's 32 states in terms of SP's spending levels and the availability of SP health-related resources and one of the first to analyze issues regarding SP's implementation at the state level. An additional strength of this study was that it used longitudinal data. Compared to cross-sectional studies, the use of a panel dataset may allow researchers to draw inferences about a causal process such as the one presented in this paper. However, this study has some limitations. First, the study relied on a variety of publicly available data on characteristics of Mexico's 32 states. Therefore, the quality of data may not be verified. Second, the measure for outpatient health care utilization includes both public and private institutions and may therefore not be able to isolate the effect of utilization by SP beneficiaries. Third, it would have been desirable to control for a measure on the prevalence of chronic diseases to account for health status in states. Unfortunately, a variable of this sort was not found in the sources that were consulted. Lastly, this research study did not formally test for mediation effects that may exist between the constructs of this study. In particular, this study did not address whether both affiliation to SP and health-related resources in **Figure 2.2** act as mediators between SP expenditures and outpatient health care utilization. Future studies should incorporate longitudinal mediation models that address the role of time in addition to the analysis of the theoretical relationships that exist between study constructs. For example, a cross-lagged panel model with autoregressive effects could be performed with the aim to reflect the stability of the effects of one variable on another one over a certain lag.

2.7 Tables and Figures

Figure 2.1: *Seguro Popular as a (decentralized) M-form organization*



Source: Adapted from [12].

Figure 2.2: *Conceptual Model*

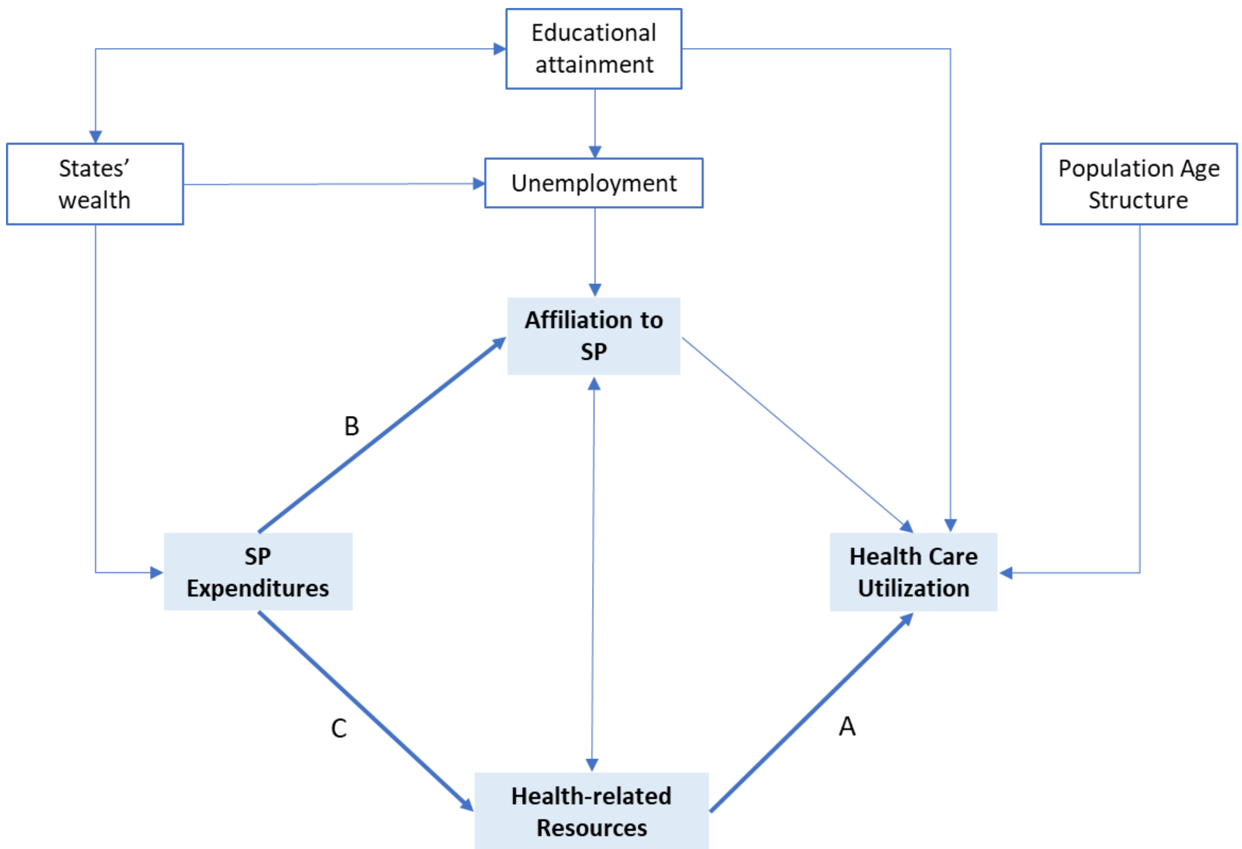
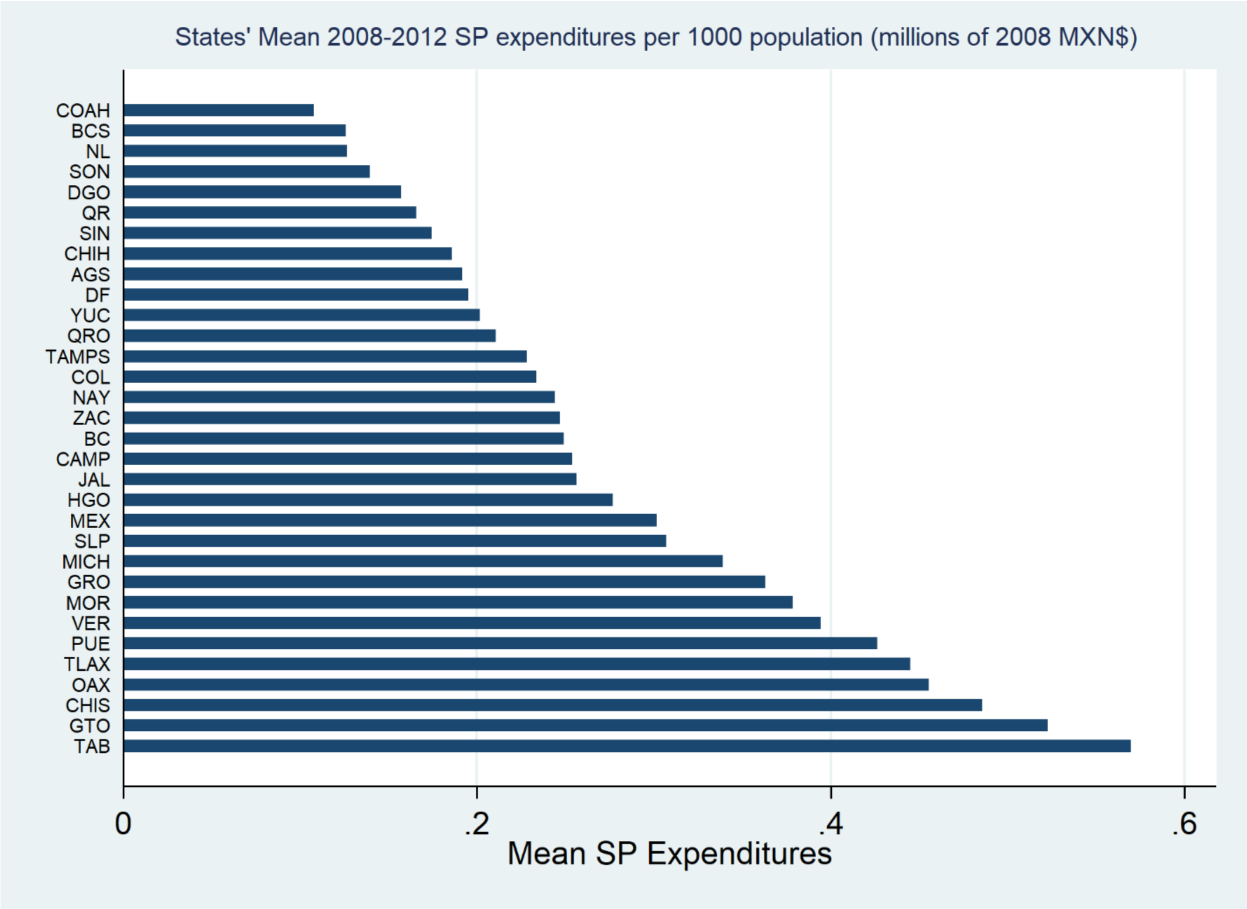


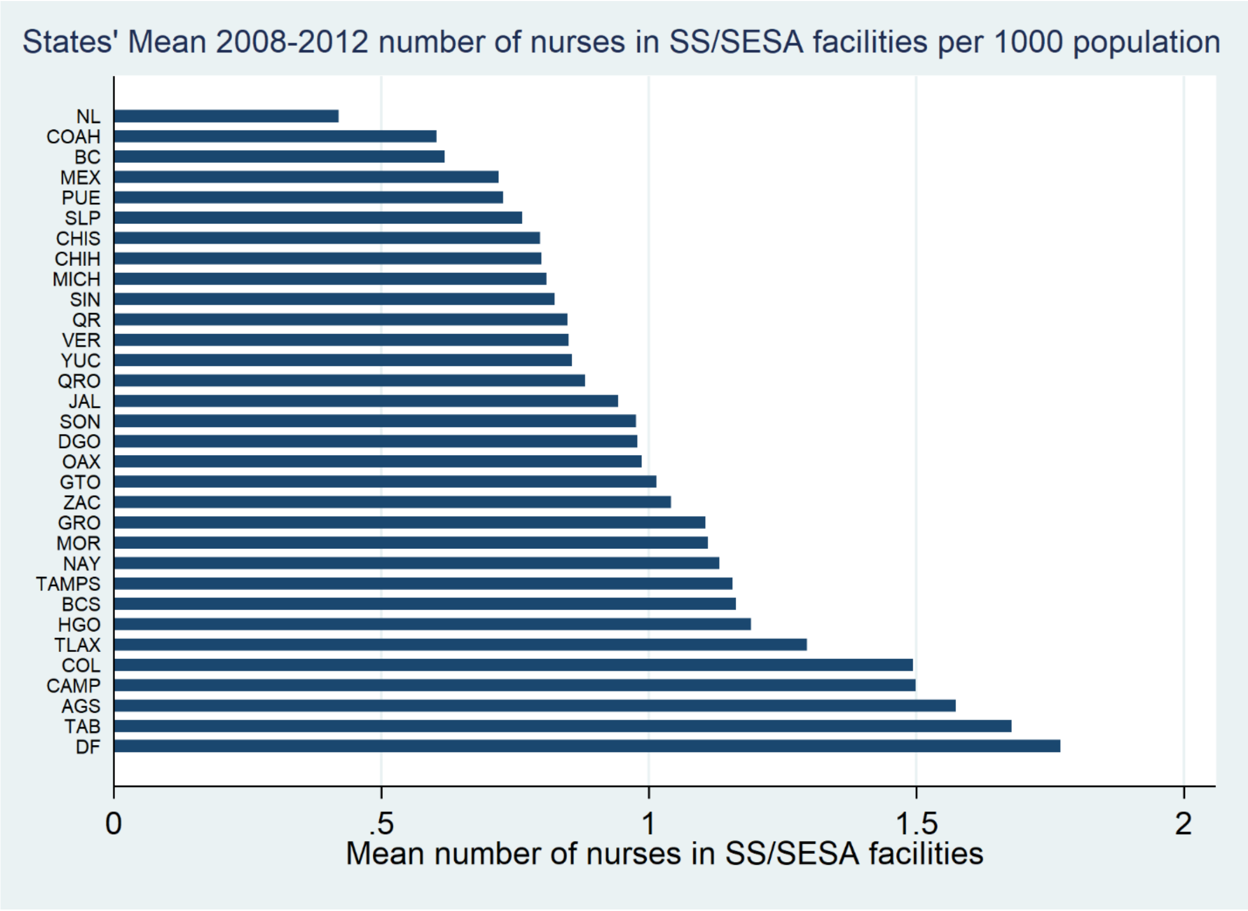
Figure 2.3: *States' mean 2008-2012 SP expenditures*



States by mean SP expenditure (quintiles)

Quintile 1 (lowest)	**Quintile 2**	**Quintile 3**	**Quintile 4**	**Quintile 5 (highest)**
Coahuila	Chihuahua	Colima	México	Puebla
Baja California Sur	Aguascalientes	Nayarit	San Luis Potosí	Tlaxcala
Nuevo León	Distrito Federal	Zacatecas	Michoacán	Oaxaca
Sonora	Yucatán	Baja California	Guerrero	Chiapas
Durango	Querétaro	Campeche	Morelos	Guanajuato
Quintana Roo	Tamaulipas	Jalisco	Veracruz	Tabasco
Sinaloa		Hidalgo		

Figure 2.4: *States' mean 2008-2012 number of nurses in SS/SESA facilities*



States by mean availability of nurses (quintiles)

Quintile 1 (lowest)	**Quintile 2**	**Quintile 3**	**Quintile 4**	**Quintile 5 (highest)**
Nuevo León	Chihuahua	Querétaro	Guerrero	Tlaxcala
Coahuila	Michoacán	Jalisco	Morelos	Colima
Baja California	Sinaloa	Sonora	Nayarit	Campeche
México	Quintana Roo	Durango	Tamaulipas	Aguascalientes
Puebla	Veracruz	Oaxaca	Baja California Sur	Tabasco
San Luis Potosí	Yucatán	Guanajuato	Hidalgo	Distrito Federal
Chiapas		Zacatecas		

Table 2.1: *Study Constructs and Measures*

Construct	Measure & Units	Name of Variable	Type of Variable (Research question)	Source(s)	Notes
Health care utilization	Number of outpatient consultations per year within the public and private sector, per 1000 population	Outpatient health care utilization	Dependent	SS, CONAPO	Includes both public and private sector outpatient consultations
Affiliation to SP	Number of SP affiliates per year, per 1000 population	SP affiliation	Dependent	SPSS	
Health-related resources	Number of physicians (in SS/SESA facilities) per year, per 1000 population	Availability of physicians	Dependent/Key Independent	SS, CONAPO	Includes information for public SS and SESA facilities only (i.e. Those that provide services to SP beneficiaries)
	Number of nurses (in SS/SESA facilities) per year, per 1000 population	Availability of nurses	Dependent/Key Independent	SS, CONAPO	Includes information for public SS and SESA facilities only
	Number of consultation rooms (SS/SESA facilities only) per year, per 1000 population	Availability of consultation rooms	Dependent/Key Independent	SS, CONAPO	Includes information for public SS and SESA facilities only
SP expenditures	State's total SP expenditure per year, per 1000 population, MXN$ (2008), millions	SP expenditures	Key Independent	SPSS	States' total annual expenditures on SP
States' wealth	State's GDP per year, per 1000 population, MXN$ (2008), millions		Independent	INEGI, CONAPO	
Educational attainment	Percentage of population in state with elementary and/or middle school education		Independent	SEP	Percentages might be greater than 100 because information was obtained from two different sources
Unemployment	States' yearly second quarter unemployment rate (in %)		Independent	INEGI	Percentage was calculated with respect to the states' economically active population
Population age	States' percentage of young population (0-14)		Independent	CONAPO	
Years	2008-2012		Independent		
State	1-32 (Mexico's states)		Independent		

Table 2.2: *Research Questions and Variables*

Research Question	Name of Key Independent Variable	Name of Dependent Variable
RQ1	Availability of physicians/ nurses/ consultation rooms	Outpatient health care utilization
Rq2	SP expenditures	SP affiliation
Rq3	SP expenditures	Availability of physicians/nurses/consultation rooms

Table 2.3: *Summary Statistics*

Variable	Obs	Mean	Std. Dev.	Min	Max
Outpatient utilization rates (number of consultations, *per 1000*)	160	2978.091	451.3475	2132.487	4046.677
Physicians in SS/SESA facilities (number of physicians, *per 1000*)	160	0.769849	0.255038	0.321988	1.488723
Nurses in SS/SESA facilities (number of nurses, *per 1000*)	160	1.019622	0.328486	0.357068	1.897737
SS/SESA consultation rooms (number of consultation rooms, *per 1000*)	160	0.320453	0.103565	0.132337	0.645909
Affiliation to SP (number of SP affiliates, *per 1000*)	160	381.7244	140.384	86.21504	698.2771
Expenditure in SP (millions of 2008 MXN$, *per 1000*)	160	0.279937	0.136112	0.074668	0.654163
GDP (millions of 2008 MXN$, *per 1000*)	160	122.4469	129.8183	42.27844	930.1899
Unemployment rate (population 15+ looking for a job, %)	160	4.555853	1.668092	1.126209	8.389726
Population with elementary or middle school education (%)	160	94.01595	3.161355	88.44593	105.4084
Population 0-14 years (%)	160	29.9475	2.1253	22.4055	36.1886

Note: *Includes state-level data for the 2008-2012 period. Outpatient utilization rates refer to consultations in both the public and private sectors*

Table 2.4: *Effect of Health-Related Resources on Outpatient Health Care Utilization*

VARIABLES	1 FE	2 GEE ind	3 GEE exch	4 GEE ar1	5 GEE ar2	6 GEE ar3	7 RE
Number of nurses	490.0**						
	(195.0)						
Quintile 2 (nurses)		121.2	167.3	236.6	229.2	266.4	167.2
		(176.4)	(199.0)	(201.6)	(198.4)	(199.8)	(208.4)
Quintile 3 (nurses)		182.0	259.2	192.9	211.6	164.0	259.3
		(135.7)	(179.2)	(176.8)	(176.5)	(176.9)	(187.7)
Quintile 4 (nurses)		261.3*	378.7**	335.5**	357.6**	328.1**	378.7*
		(149.2)	(188.7)	(168.9)	(172.5)	(163.7)	(197.7)
Quintile 5 (nurses)		514.4***	550.1***	500.5***	520.6***	499.6***	550.2**
		(146.6)	(204.4)	(171.1)	(177.2)	(169.2)	(214.1)
Observations	160	160	160	160	160	160	160
R-squared	0.550						
Number of states	32	32	32	32	32	32	32

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Note: *All models controlled for the following state-level covariates: SP expenditures (millions of 2008 MXN$), GDP per 1000, population with elementary/middle school rates, share of population 0-14 years, unemployment rates, SP affiliation per 1000, and for year dummies.*

Table 2.5: *Effect of SP expenditures on SP Affiliation*

VARIABLE	1 FE	2 GEE ind	3 GEE exch	4 GEE ar1	5 GEE ar2	6 RE
Expenditure	489.5***					
	(69.06)					
Quintile 2 (expenditure)		26.92	31.17	48.20*	60.20*	31.81
		(27.60)	(27.66)	(28.51)	(30.76)	(29.43)
Quintile 3 (expenditure)		88.84***	102.0***	119.4***	126.1***	105.1***
		(31.31)	(32.76)	(34.87)	(37.85)	(35.24)
Quintile 4 (expenditure)		92.97***	108.7***	117.7***	122.4***	113.2***
		(21.01)	(21.83)	(25.58)	(29.02)	(23.67)
Quintile 5 (expenditure)		141.9***	163.6***	187.4***	200.1***	173.3***
		(34.30)	(36.56)	(42.32)	(49.01)	(39.89)
Observations	160	160	160	160	160	160
R-squared	0.939					
Number of state	32	32	32	32	32	32

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Note: *All models controlled for the following state-level covariates: GDP per 1000, population with elementary/middle school rates, share of population 0-14 years, unemployment rates, number of nurses per 1000, and for year dummies.*

Table 2.6: *Effect of SP Expenditures on Health-Related Resources*

VARIABLE	1 FE	2 GEE ind	3 GEE exch	4 GEE ar1	5 GEE ar2	6 GEE ar3	7 RE
Expenditure	0.144						
	(0.200)						
Quintile 2 (expenditure)		0.274*	0.353**	0.347**	0.344**	0.358**	0.353**
		(0.161)	(0.153)	(0.159)	(0.158)	(0.153)	(0.161)
Quintile 3 (expenditure)		0.156	0.250**	0.266**	0.263**	0.256**	0.250**
		(0.130)	(0.108)	(0.128)	(0.124)	(0.111)	(0.113)
Quintile 4 (expenditure)		0.182	0.168	0.196*	0.183	0.197*	0.168
		(0.155)	(0.107)	(0.115)	(0.112)	(0.107)	(0.112)
Quintile 5 (expenditure)		0.270*	0.383***	0.442**	0.428**	0.411***	0.383***
		(0.157)	(0.142)	(0.177)	(0.170)	(0.146)	(0.148)
Observations	160	160	160	160	160	160	160
R-squared	0.525						
Number of state	32	32	32	32	32	32	32

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Note: *All models controlled for the following state-level covariates: GDP per 1000, population with elementary/middle school rates, share of population 0-14 years, unemployment rates, health care utilization, SP affiliation per 1000, and for year dummies.*

2.8 Appendix

Table 2.7: *Effect of Health-Related Resources on Outpatient Health Care Utilization (full results)*

VARIABLES	1 FE	2 GEE ind	3 GEE exch	4 GEE ar1	5 GEE ar2	6 GEE ar3	7 RE
Number of nurses	490.0**						
	(195.0)						
Quintile 2 (nurses)		121.2	167.3	236.6	229.2	266.4	167.2
		(176.4)	(199.0)	(201.6)	(198.4)	(199.8)	(208.4)
Quintile 3 (nurses)		182.0	259.2	192.9	211.6	164.0	259.3
		(135.7)	(179.2)	(176.8)	(176.5)	(176.9)	(187.7)
Quintile 4 (nurses)		261.3*	378.7**	335.5**	357.6**	328.1**	378.7*
		(149.2)	(188.7)	(168.9)	(172.5)	(163.7)	(197.7)
Quintile 5 (nurses)		514.4***	550.1***	500.5***	520.6***	499.6***	550.2**
		(146.6)	(204.4)	(171.1)	(177.2)	(169.2)	(214.1)
Expenditure	518.1	-1,976***	231.4	117.0	183.3	216.4	233.0
	(447.5)	(675.2)	(500.4)	(238.0)	(299.7)	(266.7)	(523.9)
GDP	-0.605*	-0.289	-0.335	0.0328	-0.0523	0.0500	-0.336
	(0.347)	(0.258)	(0.217)	(0.215)	(0.205)	(0.198)	(0.228)
Education	14.33	26.44*	16.01	23.26***	23.76***	29.07***	16.01
	(15.32)	(14.12)	(10.27)	(7.676)	(8.335)	(8.140)	(10.77)
Population 0-14	-29,900**	-4,325	-8,387***	-4,679**	-5,397**	-3,771	-8,399**
	(12,422)	(2,820)	(3,180)	(2,346)	(2,507)	(2,385)	(3,335)
Unemployment	-0.129	-10.20	-11.40	-9.960	-8.497	-7.696	-11.40
	(16.68)	(41.95)	(18.12)	(10.70)	(12.16)	(11.95)	(18.97)
Affiliation to SP	-0.0341	2.035***	0.596	0.311	0.309	0.0868	0.595
	(0.466)	(0.724)	(0.449)	(0.320)	(0.330)	(0.377)	(0.470)
2009	-38.19	124.0	93.25**	118.5***	110.2***	119.9***	93.17**
	(67.67)	(90.67)	(41.23)	(31.15)	(32.45)	(31.17)	(43.19)
2010	-192.6*	-26.50	3.464	74.33	61.27	98.29*	3.408
	(109.5)	(148.1)	(66.71)	(52.36)	(51.20)	(52.43)	(69.89)
2011	-275.5*	-32.49	3.066	108.7	90.32	145.5**	2.984
	(158.6)	(206.6)	(91.03)	(75.51)	(72.46)	(74.13)	(95.37)
2012	-386.8*	23.83	0.211	122.1	99.75	159.6*	0.0546
	(217.2)	(206.8)	(104.4)	(88.59)	(86.84)	(85.76)	(109.4)
Constant	10,207**	1,421	3,503***	1,755*	1,910**	963.5	3,507***
	(4,312)	(1,910)	(1,236)	(946.4)	(955.9)	(956.1)	(1,296)
Observations	160	160	160	160	160	160	160
R-squared	0.550						
Number of states	32	32	32	32	32	32	32

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 2.8: *Effect of SP expenditures on SP Affiliation (full results)*

VARIABLE	1 FE	2 GEE ind	3 GEE exch	4 GEE ar1	5 GEE ar2	6 RE
Expenditure	489.5***					
	(69.06)					
Quintile 2 (expenditure)		26.92	31.17	48.20*	60.20*	31.81
		(27.60)	(27.66)	(28.51)	(30.76)	(29.43)
Quintile 3 (expenditure)		88.84***	102.0***	119.4***	126.1***	105.1***
		(31.31)	(32.76)	(34.87)	(37.85)	(35.24)
Quintile 4 (expenditure)		92.97***	108.7***	117.7***	122.4***	113.2***
		(21.01)	(21.83)	(25.58)	(29.02)	(23.67)
Quintile 5 (expenditure)		141.9***	163.6***	187.4***	200.1***	173.3***
		(34.30)	(36.56)	(42.32)	(49.01)	(39.89)
GDP	0.0349	0.0164	0.0498	0.0847*	0.0928**	0.0581
	(0.0889)	(0.0405)	(0.0607)	(0.0502)	(0.0467)	(0.0731)
Education	-3.595	2.922	3.941	2.135	0.476	4.009
	(2.734)	(3.011)	(2.967)	(2.148)	(2.010)	(3.269)
Population 0-14	-6,531**	2,206***	1,833***	1,739***	1,718***	1,581**
	(2,709)	(627.9)	(640.4)	(528.8)	(490.5)	(719.7)
Unemployment	1.028	-13.11**	-7.498*	-2.472	-0.686	-6.756
	(3.397)	(5.746)	(4.093)	(2.699)	(2.893)	(4.534)
2009	-15.07	51.53***	42.08***	37.02***	36.21***	40.19***
	(11.66)	(10.98)	(8.503)	(6.563)	(6.347)	(9.251)
2010	38.49*	153.4***	142.9***	138.8***	138.8***	140.1***
	(22.51)	(13.80)	(14.19)	(12.44)	(12.33)	(15.33)
2011	56.73*	221.9***	209.7***	206.6***	207.7***	205.9***
	(32.88)	(16.87)	(17.63)	(15.64)	(15.44)	(19.08)
2012	25.16	222.7***	212.7***	215.1***	219.2***	208.7***
	(43.63)	(17.73)	(19.14)	(17.37)	(17.17)	(20.77)
Number of nurses	4.949	119.3***	88.65***	40.05	12.23	80.37**
	(21.85)	(33.56)	(32.55)	(31.72)	(37.64)	(35.59)
Constant	2,504***	-816.0***	-800.7***	-591.5**	-418.1	-728.4**
	(912.4)	(314.0)	(294.1)	(235.9)	(254.8)	(331.5)
Observations	160	160	160	160	160	160
R-squared	0.939					
Number of state	32	32	32	32	32	32

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 2.9: *Effect of SP Expenditures on Health-Related Resources (full results)*

VARIABLE	1 FE	2 GEE ind	3 GEE exch	4 GEE ar1	5 GEE ar2	6 GEE ar3	7 RE
Expenditure	0.144						
	(0.200)						
Quintile 2 (expenditure)		0.274*	0.353**	0.347**	0.344**	0.358**	0.353**
		(0.161)	(0.153)	(0.159)	(0.158)	(0.153)	(0.161)
Quintile 3 (expenditure)		0.156	0.250**	0.266**	0.263**	0.256**	0.250**
		(0.130)	(0.108)	(0.128)	(0.124)	(0.111)	(0.113)
Quintile 4 (expenditure)		0.182	0.168	0.196*	0.183	0.197*	0.168
		(0.155)	(0.107)	(0.115)	(0.112)	(0.107)	(0.112)
Quintile 5 (expenditure)		0.270*	0.383***	0.442**	0.428**	0.411***	0.383***
		(0.157)	(0.142)	(0.177)	(0.170)	(0.146)	(0.148)
GDP	-0.000394**	0.000519***	0.000313**	0.000265	0.000214	0.000501***	0.000310*
	(0.000185)	(0.000182)	(0.000153)	(0.000166)	(0.000165)	(0.000152)	(0.000160)
Education	-0.0195	-0.00856	-0.0171	-0.0121	-0.0126	-0.0154	-0.0171
	(0.0121)	(0.0150)	(0.0111)	(0.00961)	(0.00959)	(0.0103)	(0.0116)
Population 0-14	7.049	-3.716	-2.240	-3.499	-3.523	-2.135	-2.228
	(6.626)	(3.340)	(3.390)	(3.412)	(3.421)	(3.314)	(3.550)
Unemployment	-0.0132*	0.0320	-0.00981	-0.00430	-0.00544	-0.00755	-0.00986
	(0.00746)	(0.0304)	(0.00723)	(0.00535)	(0.00541)	(0.00661)	(0.00756)
Affiliation to SP	5.08e-05	0.000924*	0.000107	-2.90e-05	2.01e-05	2.96e-06	0.000107
	(0.000187)	(0.000497)	(0.000191)	(0.000237)	(0.000202)	(0.000190)	(0.000199)
2009	0.0760**	-0.0876**	0.0300	0.0227	0.0232	0.0298	0.0302
	(0.0331)	(0.0442)	(0.0225)	(0.0223)	(0.0219)	(0.0226)	(0.0235)
2010	0.145**	-0.155**	0.0543	0.0543	0.0503	0.0638	0.0546
	(0.0608)	(0.0715)	(0.0435)	(0.0470)	(0.0445)	(0.0429)	(0.0456)
2011	0.195**	-0.227**	0.0581	0.0625	0.0559	0.0730	0.0586
	(0.0853)	(0.0886)	(0.0579)	(0.0700)	(0.0646)	(0.0603)	(0.0607)
2012	0.261**	-0.200**	0.0856	0.0885	0.0814	0.101	0.0862
	(0.110)	(0.0954)	(0.0650)	(0.0765)	(0.0715)	(0.0659)	(0.0680)
Health care utilization	0.000179***	0.000350***	0.000220***	0.000177***	0.000174***	0.000225***	0.000219***
	(4.69e-05)	(0.000108)	(4.98e-05)	(5.52e-05)	(5.13e-05)	(5.12e-05)	(5.21e-05)
Constant	0.117	1.297	2.336	2.392*	2.451*	2.121	2.338
	(2.443)	(1.762)	(1.501)	(1.351)	(1.359)	(1.408)	(1.572)
Observations	160	160	160	160	160	160	160
R-squared	0.525						
Number of state	32	32	32	32	32	32	32

Robust standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

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3. CHAPTER 3 – Effect of Seguro Popular on Health Care Utilization Among Older Mexican Adults with Diabetes and/or Hypertension

3.1 Introduction and Background

During the last decades, Mexico has been experiencing both a demographic and an epidemiological transition. While the former has led to a significant increase in the growth rate of the country's older population, the latter reflects a shift in population mortality from communicable diseases to chronic, non-communicable medical conditions such as diabetes, hypertension-related complications, and obesity. With more than 15% of adults affected by diabetes type 2, this disease has been the leading cause of adult mortality since 2000 [1, 2]. Moreover, it has been estimated that 25.5% of adults have hypertension[20] [3], and according to a recent report, Mexico has been rated as the second most obese country amongst OECD nations [1]. If the status quo is maintained, these transitions could result in an increasing proportion of overweight/obese older adults with chronic diseases, thus imposing a heavy health and economic load to Mexico's Health Care System and to Mexican society [4].

It is well known that providing timely preventive care and an adequate management of chronic conditions can reduce the health and economic consequences associated with chronic diseases. In addition, increasing empirical evidence has suggested that health insurance is associated with higher rates of health care utilization and better health outcomes [5-16]. This evidence has encouraged the development of health insurance expansion programs in several countries, including Mexico.

With the main goal to provide public health care coverage to uninsured Mexicans (i.e. mainly those in the self-employed sector of the economy who previously did not have access to

[20] Hypertension-related conditions such as ischemic heart disease and stroke represent the second and third causes of death in Mexico, respectively [2].

social security[21]), the Mexican government formally launched Seguro Popular (SP) in January 2004. Among its more specific objectives, SP intended to improve access to preventive screening, increase public health care expenditure, improve the distribution of public expenditures to reduce inequities, protect families against catastrophic health expenditures, build new infrastructure, and improve the delivery of public health care services by investing in health-related resources [18, 19]. Largely as a result of the program's introduction, the number of adults 50 years and older without health insurance decreased from nearly 50% in 2001 to an average of 15% by 2012 [20]. Furthermore, results from a recent study have shown that diabetes mortality decreased in 2005-2010 when compared to 2000-2005. As the authors explain, this could be due in part to SP which has provided greater health care coverage, particularly in preventive care among the poor [21].

Some studies have analyzed the impact of health insurance on health care utilization among the Mexican population in general and also among older Mexican adults [13, 16, 22, 23]. However, not much is known about the effect of SP on health care utilization among the population of Mexican adults 50 years and older (50+) with either diabetes or hypertension. Knowing how SP has affected this segment of the population has important policy implications, given the high prevalence of these conditions in this population cohort[22] and the demographic transition that Mexico is currently undergoing. Since the population of older adults will represent a higher proportion of Mexico's total population in the future, it is crucial to understand whether SP has been addressing the needs of aging adults. This study contributes to the literature by

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[21] By 2002 about half of Mexico's population was uninsured [17].

[22] Wong et al. [20] estimated that in 2012, 19.6% of those 50 years and older reported having being diagnosed with diabetes while 19.11% reported having been diagnosed with hypertension. However, prevalence of these conditions is probably higher due to undiagnosed cases.

analyzing whether SP is associated with higher health care utilization rates among older Mexican adults 50+ with diabetes/hypertension, by using longitudinal data from the 2001 and 2012 waves of the Mexican Health and Aging Study (MHAS). It is hypothesized that SP has led to higher rates of health care utilization among SP enrollees compared to uninsured individuals.

3.2 Literature Review

Several studies have addressed the impact of SP on health care utilization since the launch of the program's pilot phase in 2003. Although results are mixed, most of them have suggested that SP is associated with an increase in the utilization of health services.

One of the first formal evaluations of SP was conducted by Gakidou et al. Using multiple datasets, the authors examined the effect of SP on a number of outcomes including outpatient and inpatient health care use [24]. Results from their study suggested that, compared to uninsured individuals, SP-enrollees were associated with greater utilization of both inpatient and outpatient health services (conditional on self-perceived need). However, the study is cross-sectional in nature and it spans just a couple of years after the inception of the program.

A study by Scott presented preliminary evidence of the effect of SP on several issues, including health care services utilization [25]. His main results suggested that health care services utilization rates were higher for SP beneficiaries compared to those of the uninsured. However, as noted by the author, results should be interpreted with care especially because of the lack of appropriate control groups [25].

By using an experimental design, King et al. also attempted to evaluate SP on a number of different outcomes, including health services utilization [26]. They concluded that SP had a negligible effect on the use of medical services and they attributed this to the short-term nature of their evaluation (i.e. only 10 months of treatment).

More recently, a cross-sectional study by Sosa-Rubi looked at the impact of SP on obstetrical health services utilization. Among its findings, the authors concluded that SP had increased pregnant women's access to obstetrical services. The empirical strategy in this study included a multinomial probit model that accounted explicitly for the endogeneity of the household's decision to participate in SP [27].

Using longitudinal data for households between 2002 and 2004 from the urban Oportunidades conditional cash-transfer program survey, Knox conducted a difference-in-differences analysis to assess the effect of SP on both individual and household-level health care utilization [28]. Her results point towards a positive association between SP and health care use. However, the results were again preliminary since the study spanned just three years.

Among studies analyzing the effect of SP on adults with chronic diseases, Bleich et al. conducted a population-based, cross-sectional study targeting the effect of SP on the Mexican adult population with hypertension by implementing propensity score matching. Among its main objectives, the authors aimed to determine whether SP was associated with a greater use of antihypertensive treatment and control of blood pressure, compared to uninsured adults with hypertension [29]. They found that compared to uninsured adults with hypertension, SP enrollees were 50% more likely to receive antihypertension treatment and 35% more likely than uninsured individuals to have good blood pressure control. In addition, their results indicated that supply of health care professionals moderated the relationship between SP and both treatment coverage and blood pressure control (i.e. the effects of SP were greater in areas with a higher supply of health care professionals). Although the authors attempted to control for selection bias by matching treated individuals with controls through propensity score matching, they still did not account for unobservable characteristics that could have explained the association between SP and the outcomes in their study.

Sosa-Rubi et al.'s cross-sectional study on poor Mexican adults with diabetes (20-80 years of age) is an example of another paper that analyzed whether enrollment in SP led to an increase in access to health care services and treatment and control of diabetes, compared to the uninsured. By implementing propensity score matching to balance characteristics between the treatment and control group, the authors found that SP had improved health care access and blood glucose control among adults with diabetes [30]. Again, the study did not account for unobservable factors.

Fewer studies have attempted to examine the effect of health insurance SP on health care utilization among older Mexican adults. In a recent cross-sectional study, Rivera-Hernandez & Galárraga [31] examined the differences in preventive services utilization (e.g. diabetes, hypertension, and cholesterol screenings) between SP and other types of health insurance. Their results suggest that, compared to the uninsured, SP affiliates were more likely to use screening services for diabetes, cholesterol, and hypertension. However, those who had social security benefits or private health insurance were more likely than SP affiliates to use those types of services. Doubova et al performed another cross-sectional study looking at the population of older Mexicans. In this paper, the authors estimated the impact of SP on health care access and concluded that being affiliated to SP provided a protective effect against lack of access, compared to the uninsured [32].

To my knowledge, only two studies have used data from MHAS' 2001 and 2012 waves to assess the effects of SP on health care utilization: the one by Salinas and the one by Parker et al.[22-23] Within a pre-post approach, Salinas used logistic regression and ordinary least squares to identify changes in preventive screening (e.g. diabetes, blood pressure, cholesterol, and vaccination) due to the implementation of SP [23]. According to her results, older adults who had been uninsured in 2001 but had SP by 2012 had higher rates of health care utilization than those who were uninsured in both time periods. However, the results of this study may be biased because it does not address the selection issue related to enrollment in SP. In addition, the author did not conduct any sensitivity analyses to rule out competing explanations for her results.

Parker et al.'s working paper aimed to estimate the effect of SP on a number of health indicators, including health services utilization [22]. One of the main contributions of this study is that it accounted for selection on observables and time-invariant unobservable characteristics at the individual level by implementing a before and after program difference-in-differences approach coupled with propensity score matching. The authors found that compared to those who did not have SP, those with SP were associated with a greater use of health care services, especially in rural areas with access to more health resources and equipped health care facilities. One limitation of this study was that the definition of the treatment and control groups may not be appropriate because those with SP (i.e. the treated) could have other types of health insurance and those without SP could be uninsured or have other types of health insurance excluding SP. Therefore, comparisons between the treatment and control groups are not "clean" and thus, the estimated effect of SP on the outcome variables may not be accurate. Additionally, this study does not focus exclusively on the population of older adults with chronic disease and uses a different outcome measures compared to the ones proposed in this study.

In summary, almost all of the studies described above are cross-sectional, very few of them focus on Mexico's population of older adults with chronic diseases, the majority have analyzed the effect of SP on health care utilization in the short-run (i.e. 2-3 years after the program's implementation), and only a few have addressed the issue of self-selection that may arise due to the voluntary nature of SP. In addition, none of the studies has focused exclusively in assessing the effect of SP on health care utilization among older adults with previously diagnosed diabetes/hypertension, despite the health consequences and high financial burden associated with complications of these chronic conditions among the elderly. By solely focusing on the population of older Mexican adults 50+ with chronic disease, the present study will fill-in this gap in the literature.

3.3 Conceptual Framework

The conceptual framework in **Figure 3.1** builds upon the Andersen's behavioral model, which posits that predisposing, enabling, and need characteristics at both the individual and contextual levels determine health care utilization [33-35].In this study, individual predisposing characteristics includes age, gender, marital status, educational attainment, occupation/work status, whether the individual spoke an indigenous language (as a measure for ethnicity), and health beliefs. All these have been widely used in the literature to analyze the impact of health insurance on health care utilization [35].

Individual-level enabling characteristics are usually represented by measures of income and wealth, health insurance, travel time to health care facilities, waiting times for service, social support, etc. [35]. As shown in **Figure 3.1**, this research project incorporated two of these constructs: namely, socioeconomic status (SES, as measured by respondents' household assets) and health insurance status. It is worth noting that although health insurance is an individual enabling characteristic, it was removed from the "enabling box" because increasing theoretical and empirical evidence points to a positive, direct effect of health insurance status on health care utilization [12].

Need characteristics at the individual level are represented in the conceptual framework by health status, disease burden, and lifestyle behaviors. These have been previously used in other studies to assess the effect of health insurance on health utilization and health spending [36, 37]. In the empirical models, measures for these constructs included self-reported health status, whether individuals had been diagnosed with diabetes or with respiratory disease, whether they had ever smoked, whether they would seek private care, and a measure for individuals' internal locus of control (as a measure for health belief).

Finally, contextual characteristics included measures for frequently used enabling factors at the community-level such as health care infrastructure, supply of human resources, and place of residence [36]. These were measured by the per-capita number of medical units per 1000 population, per-capita number of primary care physicians per 1000 population, and by the type of place of residence (urban/rural), respectively.

Figure 3.1 illustrates that both individual and contextual characteristics may confound the effect of health insurance on health care utilization. Therefore, to estimate the impact of health insurance on utilization, it was necessary to control for these characteristics in the empirical specifications. Pathway A in **Figure 3.1** represents the direct effect of health insurance status on health care utilization.

3.4 Methods

3.4.1 Data

Data for this study were drawn primarily from MHAS and from additional restricted-use databases that were linked to this dataset. These included the National Institute of Statistics and Geography's (INEGI) 2000 Mexican Population Census, the Mexican Ministry of Health's (MoH's) 2002 Directory of Public Health Sector Facilities, and state-level population projections for 2002-2012 from the National Population Council (CONAPO).

MHAS is a nationally representative longitudinal study of Mexicans 50+ who residing in urban and rural communities throughout the country. It is based on the United States Health and Retirement Study (HRS) and is partly sponsored by the US' National Institute on Aging (NIA). Among its main objectives, MHAS aims to understand the aging process among Mexicans and the impact of disease from a wide socioeconomic viewpoint [38]. As of today, four waves of the MHAS have been fielded (2001, 2003, 2012, and 2015). In the baseline 2001 survey, a total of 15,186 individuals were interviewed. These included subjects who were born before 1951 (i.e. those who were 50 or more at that time) as well as their spouses/partners regardless of age.

The baseline sample was selected from INEGI's Mexican National Employment Survey (*Encuesta Nacional de Empleo,* ENE). All households in ENE with at least one person aged 50 or older were eligible to participate in MHAS's first wave. In households with more than one individual meeting the age criterion, one of them was randomly selected to participate in the study.

In 2003, new spouses/partners of those interviewed in 2001 were added to the study. In this second wave, the questionnaire was administered to 14,250 individuals, which included surviving respondents, the new spouses/partners, and 546 next-of-kin interviews to follow-up on individuals who died between the first and second waves. To maintain representativeness, the sample was updated (from the then called *Encuesta Nacional de Ocupación y Empleo,* ENOE) for the 2012 wave to include individuals who were born between 1952 and 1962 plus their spouses/partners regardless of age. In that year, 18,465 people were interviewed, including 2,742 next-of-kin interviews for those who died between 2003 and 2012. The response rates for the baseline, 2003 and 2012 waves were 91.8%, 93%, and 88.1% respectively. Response rates for the 2015 waves were not available at this time.

As MHAS includes a rich set of socio-demographic and socioeconomic variables and individuals' labor history, health insurance status, use of health care services, health care expenditures, general health status, disease burden, life-style behaviors and type of community of residence (i.e. urban or rural), the use of this dataset (coupled with the restricted-use datasets mentioned above) was ideal because it provided information on a large set of variables that were used to measure the constructs in the conceptual model in **Figure 3.1**.

3.4.2 Study Design

In this study, a nonequivalent control group quasi-experimental design (often referred to as a "difference-in-differences" approach) was adopted to estimate the effect of SP on health care utilization. As the MHAS's 2001 round (i.e. wave 1) collected information on individuals before SP was implemented and the 2012 round (i.e. wave 3) captured the characteristics of individuals after the program's implementation, the use of these two MHAS waves was convenient for the purposes of this study. The unit of all the analyses was at the individual level.

3.4.3 Sample Definition

The treatment group in this study was derived from an initial subsample of MHAS respondents who reported in 2001 to be 50 years or older, uninsured, and to have been diagnosed with diabetes, hypertension, or both. Individuals from this initial subsample who claimed to be insured only by SP when directly re-interviewed in the MHAS' 2012 wave composed the treatment group. This group was compared with a control group, which included individuals from the initial 2001 subsample who reported to be uninsured when re-interviewed in MHAS' 2012 wave (i.e. those who were uninsured in both time periods). The derivation process for the treatment and the control group is shown in **Figure 3.4** in the appendix. In addition, **Table 3.6** in the appendix presents the original sample sizes that were obtained from MHAS' baseline 2001 survey. As shown in the table, from the 3,440 older adults with diabetes and/or hypertension who were followed-up in 2012, only 2,947 were directly interviewed in both waves. Of these, only 649 individuals reported no health insurance in 2001: 458 were enrolled in SP (only) by 2012 and the other 191 reported no health insurance in 2012.

3.4.4 Variables

3.4.4.1 Health Care Utilization Variables

The MHAS questionnaire asked respondents in both waves whether they had taken different health tests over the previous two years. Specifically, they were asked whether they had undertaken blood work tests for diabetes and cholesterol and whether they had taken hypertension, tetanus, and sex-specific tests (pap smear and prostate tests). Similar to Wong et al. [16], Wagstaff et al. [39], Macinko & Lima-Costa [40] and to Cho et al., [41], health care utilization was measured by a binary variable indicating whether MHAS's respondents had received at least one of these health tests during the previous two years. The variable was coded as one if the individual had taken one or more tests and zero otherwise. In addition to this binary indicator, the total number of tests was also considered in the analyses. Although the number of visits to a physician is frequently used in the literature as a measure for health care utilization [6, 12, 42-44], the use of this variable is somewhat controversial because it may not necessarily result in positive health outcomes. However, it was taken into account as an additional outcome variable when conducting sensitivity analyses.

3.4.4.2 Independent Variables

Health insurance status, the key independent variable in the study, was measured by a binary variable equal to one if an individual reported to be uninsured in 2001 and who then stated to be affiliated only to SP by 2012 (i.e. if the individual was part of the treatment group). In the case that the individual was uninsured in both periods (i.e. if the individual belonged to the control group), the variable took a value of zero. In addition to this variable, a dichotomous "before-after" indicator referring to the timing of SP implementation was used. It was equal to one for data in MHAS's 2012 wave and zero for the 2001 wave.

In agreement with the conceptual model in **Figure 3.1**, the analyses incorporated individual-level as well as household and community-level variables.

Individual-level demographic and socioeconomic variables at baseline included age, gender, number of years of formal education, marital status, occupation, smoking history, and whether the person spoke an indigenous language. These variables have been frequently used in the literature to analyze the effect of health insurance on health care utilization [22, 36, 45]. Other individual-level variables were measured in both waves. These included self-reported health status, employment status, whether the respondent had been diagnosed with chronic disease (diabetes or respiratory disease), whether they would be willing to seek private care, and a measure for individuals' internal locus of control. The first three of these variables were included in the model because they have also been found to be associated with health care utilization [22, 45]. Internal locus of control was selected as a covariate because there is some evidence of an association between such construct and health care utilization [46, 47]. In addition, locus of control was found to be significantly associated with SP enrollment in a logistic model aiming to identify the main predictors of enrollment to the program (self-analysis). The construction of the internal locus of control index was similar to Angel et al.'s [48] and based on Rotter's construct of locus of control [49]. The scale ranges from 0.25 to 4; the higher the score, the greater internal locus of control (i.e. the more in control a person is of the events in his/her life, including her health). Finally, willingness to seek private health care was chosen as a covariate because it was also a significant predictor of enrollment to SP and because there is a link between willingness to pay and health care use [50] in Nemet et al. [51].

Household-level assets and variables at the community-level such as place of residence (i.e. whether urban or rural), per capita medical units and per capita primary care physicians were also accounted for in the analyses. These last variables were incorporated in the empirical formulations because some of them have also been found to be associated with health care utilization and because they were also associated with the propensity to enroll in SP in the logistic regression described above.

3.4.5 Statistical Analyses

3.4.5.1 Descriptive Analyses & Empirical Strategy[23]

Several descriptive analyses were performed. First, the distribution of the outcome variable (i.e. one or more tests) was inspected to determine skewness. Then, univariate frequency distributions were obtained for all other relevant variables. Missing data patterns were also examined to determine whether data were missing not at random. Furthermore, pairwise t-tests

[23] Stata IC version 14.0 was used to carry-out all the analyses in this study.

were carried out to compare characteristics between the treatment and control group both at baseline and in 2012.

As the MHAS is longitudinal in nature and the final sample included individuals who were interviewed in both waves, results of the study could be biased if the loss to follow-up (LTFU) of individuals between 2001 and 2012 were not random. As shown in **Table 3.6** in the appendix, out of the 5,987 individuals who were 50+ and had either diabetes or hypertension in 2001, 29% died and 13% were LTFU before MHAS' 2012 survey. Therefore, as attrition represented a concern in this study, it was analyzed by conducting two-sample t-tests to compare characteristics between those in the final sample and those who died or were LTFU during 2001-2012.

Finally, as the difference-in-differences approach is valid only if the "parallel trends" assumption holds, paired t-tests on health-unrelated individual characteristics were conducted to check whether both the treatment and control group had changed over time. An alternative to check for differences in secular time trends between the treatment and control groups would have been to compare characteristics of the same treatment and control groups in a period prior to 2001 [52, 53]. However, this was not possible because the first wave of the MHAS corresponds to 2001. Another alternative would have been to implement an additional difference-in-differences model in which the treatment group would be compared to another control group that had not been affected by SP. This was unfeasible because, although SP's rollout was gradual among states (i.e. some states implemented SP before others), the MHAS does not provide information on respondents' state of residence.

The main empirical strategy to address whether SP was associated with higher rates of health care utilization comprised the implementation of a series of difference-in-differences fixed and random-effects regression models: naive ordinary least squares (OLS) and linear probability models, logistic and multilevel logistic models. To check for robustness of results, other regression models were run. These analyses included propensity score matching difference-in-differences (PSMDID) formulations to address the problem of self-selection into SP (please refer to results of empirical models in the results section), other regression specifications (e.g. Poisson and negative binomial models) and the implementation of a model using the larger sample of older Mexican adults 50+ which included individuals with or without chronic conditions.

The general specification of the models described above is as follows:

$$One\ or\ more\ health\ tests = \beta_0 + \beta_1 \cdot treatment + \beta_2 \cdot post_{SPimplementation} + \beta_3 \cdot treatment \cdot post_{SPimplementation} + \beta_4 \cdot covariates + \varepsilon$$

It is important to mention that all the analyses were unweighted because MHAS did not provide either the primary sampling unit (PSU) or the strata. Therefore, results might not be generalizable to all the population of Mexican older adults with diabetes and/or hypertension.

3.5 Results

3.5.1 Summary statistics

Table 3.1 presents summary statistics for the analytical sample of older Mexicans 50+ with diabetes and/or hypertension both at baseline and at follow-up.

As shown, characteristics of the treatment and control groups at baseline were similar in terms of the number of health tests, age, gender, percentage of individuals having blue collar-related occupations, marital status, self-reported health and smoking status, percentage of people speaking an indigenous language, employment status, proportion of people with diabetes and respiratory disease, and in the (per-capita) number of physicians in their communities. However, individuals in the treatment group were more likely to reside in rural areas, had less years of formal education, less assets, a lower internal locus of control, were less likely to seek private care and had fewer (per-capita) medical units in their communities compared to those in the control group. In addition, individuals in the treatment group were less likely to have white-collar jobs and more likely to have an agriculture-related occupation compared with those in the control group. In summary, those in the treatment group tended to be more disadvantaged than individuals in the control group. This would have been expected since the SP program initially focused on affiliating underserved individuals within rural communities.

At follow-up, individuals in the treated group were sicker, more likely to have taken at least one health test in the previous two years, and less likely to have a job, compared to those in the control group. Except for the case of the occupation and work status variables (which had approximately 27% of missing values), missing data were mainly not a concern in this study. However, since not including any of these two variables in the analyses did not alter the main results of the study, I decided that multiple imputation was not worthwhile (because my results were similar in both cases) and opted to leave them in the analyses due to conceptual considerations.

3.5.2 Attrition Analyses

Table 3.2 shows the results of two-sample t-tests with unequal variances that were performed to compare baseline characteristics of the 649 uninsured older Mexicans in the original sample[24] who were followed-up in 2012 (please refer to Sample Definition) to those who died or were LTFU between waves 1 and 3 of the MHAS. In total, 795 uninsured people 50+ with either diabetes or hypertension died or were LTFU in between waves (573 and 222, respectively).

Results in the table suggest that, -at baseline-, those who were followed-up in 2012 were younger, healthier, more likely to live in rural areas, to be working, to have taken at least one health test in the previous two years, to have a lower number of physician visits, lower health care expenses, and lived in communities with more per-capita medical units, compared to those who died or were LTFU.

3.5.3 Parallel Trends Assumption

To test whether the parallel trends assumption held, I investigated whether health status unrelated characteristics of the treatment and control groups had changed between 2001 and 2012. As expected, results of paired t-tests among those in the analytical sample (**Table 3.3**) suggested that both groups experienced a reduction in the proportion of married individuals and in the proportion of people that were working. The control group remained stable in all other characteristics. Namely, in the proportion of people having had one or more medical tests during the previous two years, percentage of individuals living in urban areas, assets, annual health

[24] Individuals in the final sample were 50 or more in 2001, uninsured, and had diabetes and/or hypertension; they were successfully re-interviewed in 2012.

expenditures, internal locus of control and willingness to seek private care. However, the only characteristics that remained unchanged among individuals in the treatment group were the proportion of people living in urban areas and the amount they spent annually on health. Instead, those in the treatment group were associated with an increase in the proportion of individuals who had taken one or more medical tests during the previous two years, in the amount of household assets, and in their internal locus of control score. In addition, the proportion of individuals in the treatment group who were willing to seek private care decreased (this was expected because, by 2012, these individuals reported being enrolled only in SP).

3.5.4 Analytical Models

3.5.4.1 Empirical Strategy

Table 3.4 presents the coefficient estimates for the regression specifications modeling the effect of SP on health care utilization.[25] As shown, all models yielded a positive coefficient for the interaction between the treatment and the post-SP implementation variables. That is, individuals who were uninsured in 2001 and who reported having SP (only) in 2012 were associated with higher levels of health care utilization compared to those who claimed to be uninsured in both time points. As the random-effects logistic formulation yielded similar results to the ones obtained in the mixed effects logistic regression models, the outputs of the former, simpler model are described below.[26]

[25] Full results of the main random effects logistic regression model are presented in Table 3.7 in the Appendix.

[26] It is worth mentioning that the fixed effects logistic model produced no results because of collinearity (i.e. many observations were dropped because the value of the outcome variable was time invariant for some individuals).

The main results of this model indicate that the association between SP and having taken at least one medical test in the past two years was positive and statistically significant.[27] In addition, plotting the predictive margins for both the treatment and control groups before and after SP's implementation revealed that the proportion of people in the control group that had received one or more medical tests within the previous two years decreased over time (**Figure 3.2** and **Table 3.5**). However, the proportion of individuals in the treatment group who received one or more tests during the previous two years increased **more** than the decrease experienced by those in the control group. This same trend was observed in most of the other regression specifications. It is important to note that standard errors associated with the interaction term were adjusted by Norton's correction.

3.5.4.2 Sensitivity Analyses

As PSMDID models are often used to conduct impact evaluations of social programs [39, 45, 54-60], two PSMDID regression specifications were implemented both to address the possibility of self-selection to SP and to assess robustness of results among the population of adults 50+ with either diabetes or hypertension. Results from these two models are also shown in **Table 3.4** and the histogram for the propensity scores is presented in **Figure 3.3**. The first of these PSMDID models incorporated the weight variable that was generated by the propensity score algorithm as an extra regressor, while the second one used that weight as an importance weight ("iweight" in Stata). The interaction terms in the two models were positive, statistically significant and similar, in terms of magnitude, to those obtained in the random effects logistic model specification. The baseline variables that were used to match individuals in the treatment

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[27] Another interpretation of this result is: the log-odds of having taken at least one medical test in the past two years were 1.43 times higher for the individuals in the treatment group than those in the control group.

group with those in the control groups based on the propensity scores were gender, marital status, education, occupation, type of place or residence, employment status, total household assets, and whether individuals had been diagnosed with diabetes or hypertension.

As described in the Statistical Analyses section, a random effects logistic regression on the larger sample of older Mexican adults 50+ was also implemented. In this case, the coefficient of the interaction between the treatment group and the indicator for post implementation of SP was also positive and statistically significant. However, the treatment effect was smaller compared to the interaction coefficient in the random effects logistic model. Other regression models among the population of older Mexicans 50+ with diabetes and/or hypertension were run to check for robustness of results. Results are shown in **Table 3.8** in the appendix.

3.6 Discussion and Conclusions

Overall, the results of this study support the hypothesis that those enrolled in SP (only) were associated with higher levels of health care utilization compared to the uninsured. In particular, the implementation of a random effects logistic regression revealed that older Mexican adults 50+ with diabetes/hypertension who switched from having no insurance in 2001 to having SP (only) in 2012 were significantly more likely to receive one or more medical tests during the previous two years than those who reported to be uninsured in both MHAS waves. This was true after adjusting for several individual and community-level characteristics. The findings of this work are in line with those from other studies that have analyzed the impact of SP on health care utilization [13, 22, 23, 61]. Since the main results were robust to the implementation of PSMDID models, this might suggest that self-selection to SP does not play a critical role when assessing the effect of the program on health care utilization because even when controlling for observable and unobservable characteristics by implementing the PSMDID specifications, results were the same. However, results must be interpreted with caution because there might still be unobserved, time-varying factors that may confound the effect of Seguro Popular on health care utilization.

To my knowledge, this is the first study that uses longitudinal data from a nationally representative sample of older Mexican adults to assess the effect of SP on health care utilization among the population of older Mexicans 50+ with either diabetes or hypertension, the two most prevalent conditions (and among the first risk factors or causes of adult mortality in Mexico) in this fraction of the population. In addition, this work contributes to the literature by testing whether selection to SP enrollment could be a concern when addressing the impact of SP on health-related outcomes in general. Although the study proved to be robust for additional specifications, it has several limitations that could lead to bias of results. First, there is concern for reverse causality between enrollment in SP and health care utilization. That is, affiliation to SP might be endogenous. In fact, descriptive analyses suggest that endogeneity might be an issue. Second, not employing weights in the analyses might imply that the results may not be generalizable to all the population of older Mexicans 50+ with diabetes/hypertension. However, due to ethical reasons, MHAS provides neither a primary sampling unit (PSU) nor strata (i.e. MHAS did not supply information with regards to place of residence). Third, the study relied mostly on self-reported data. Fourth, it cannot be determined from the data whether those who reported to be enrolled in SP by 2012 had any other type of health insurance in the period between 2001-2012. Similarly, it is impossible to determine whether those who reported to be uninsured in 2012 were uninsured for the entire period. Fifth, both MHAS waves asked individuals whether they had taken the preventive tests within the last two years. However, it is not possible to tell whether respondents were continuously uninsured (or enrolled in SP) for the whole 2-year period. This may also be a source of bias. Sixth, confronted by limitations to test for the parallel trends assumption more formally, results from analyses aimed at testing the assumption of parallel trends between the treatment and control group provided no evidence that such assumption holds. Seventh, attrition analyses at baseline revealed that those Mexican adults 50+ with diabetes/hypertension who died or were LTFU between 2001 and 2012 were somewhat different from the 649 individuals who survived and were successfully re-interviewed in 2012. These limitations suggest that results from the study should be interpreted with caution.

In summary, results from this paper suggest that -in the medium-term-, expansion of health insurance coverage through SP has provided better access and has increased health care utilization rates among the population of older adults 50+ with diabetes and/or hypertension.[28] These findings have important policy implications in light of Mexico’s 2003 health reform and in the midst of the demographic and epidemiological transitions that the country is going through because they suggest that people are using the system which could eventually lead to a decrease in the incidence of diabetes and hypertension. However, although results point to an increase in the number of tests taken, future studies should analyze whether this increase in utilization rates has translated into better management of chronic diseases and, ultimately, into better health outcomes. Also, since there was an expansion of SP enrollment in 2010, it would be interesting to know whether health care utilization levels remained constant, diminished or continued to rise after 2012. Results from MHAS’s 2015 wave may give further insight into this.

[28] This is especially true in the case of the underserved, rural population of older Mexican adults which characterizes the treatment group. However, this is not surprising given that SP originally targeted rural communities with a high proportion of low-income, uninsured individuals.

3.7 Tables and Figures

Figure 3.1: *Conceptual framework*

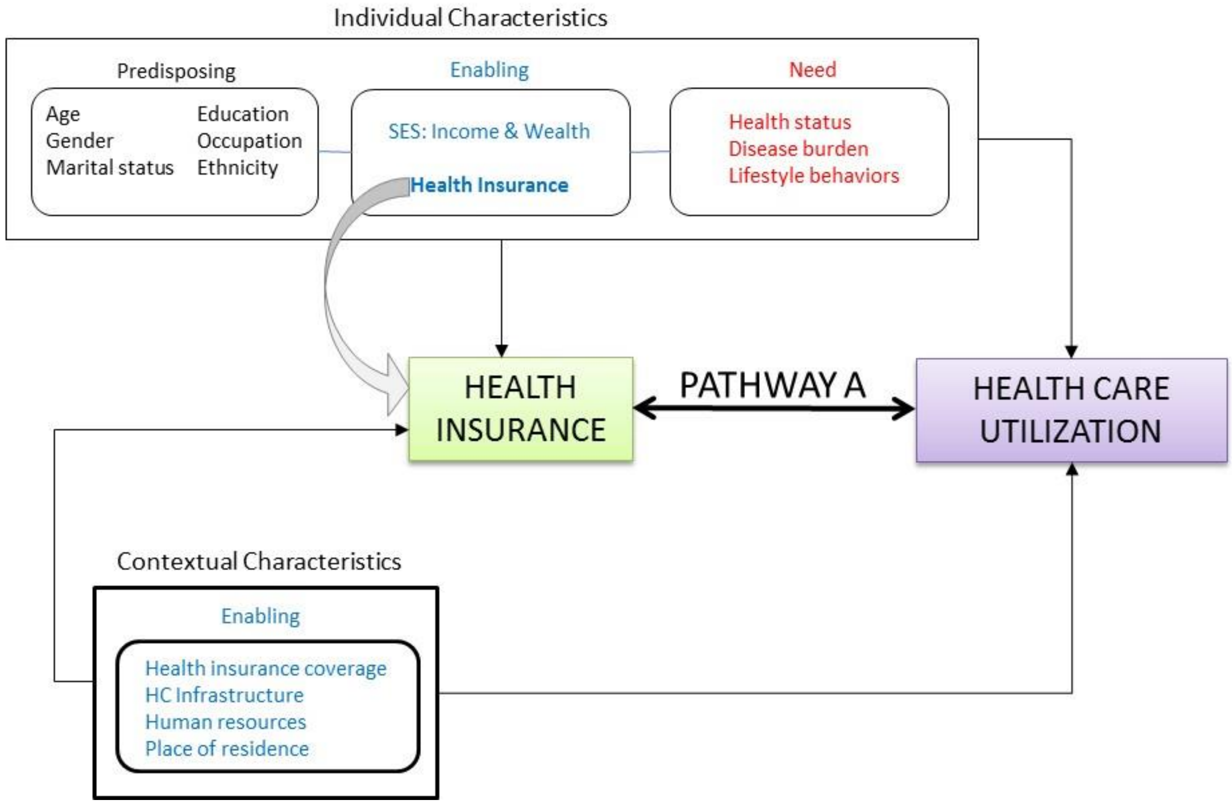


Table 3.1: *Summary statistics for sample of adults 50+ with diabetes and/or hypertension by wave and treatment status*

	Full sample, 2001		Full sample, 2012		Treatment group, 2001		Control group, 2001		Treatment group, 2012		Control group, 2012	
VARIABLE	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
One or more tests	0.92	0.27	0.93	0.26	0.92	0.26	0.91	0.28	0.96***	0.2	0.85	0.35
Age (yrs)	59.72	7.83	71.47	7.59	59.63	7.92	59.95	7.67	71.38	7.53	71.67	7.72
Female	0.61	0.49	0.6	0.49	0.62	0.49	0.61	0.49	0.6	0.49	0.59	0.49
Urban	0.36	0.48	0.35	0.48	0.33**	0.47	0.44	0.5	0.32**	0.47	0.43	0.5
Formal education (yrs)	2.73	3.32	2.73	3.29	2.47*	2.8	3.31	4.24	2.4***	2.73	3.41	4.16
Occupation												
White collar	0.05	0.23	0.05	0.21	0.03***	0.16	0.12	0.33	0.02***	0.15	0.1	0.3
Blue collar	0.63	0.48	0.63	0.48	0.62	0.48	0.64	0.48	0.62	0.49	0.64	0.48
Agriculture/fisheries/forestry	0.31	0.46	0.32	0.47	0.35**	0.48	0.24	0.43	0.35**	0.48	0.26	0.44
Married	0.61	0.49	0.53	0.5	0.62	0.48	0.58	0.5	0.55	0.5	0.48	0.5
Health status												
Good +	0.22	0.41	0.2	0.4	0.2	0.4	0.26	0.44	0.17**	0.37	0.26	0.44
Fair	0.53	0.5	0.55	0.5	0.55	0.5	0.48	0.5	0.56	0.5	0.53	0.5
Poor	0.25	0.43	0.25	0.44	0.25	0.43	0.26	0.44	0.28	0.45	0.21	0.41
Ever smoked	0.4	0.49	0.4	0.49	0.41	0.49	0.38	0.49	0.4	0.49	0.4	..49
Indigenous language	0.09	0.28	0.09	0.29	0.09	0.29	0.08	0.27	0.1	0.3	0.07	0.25
Assets (1000 MXN$, 2012)	507	895	654.1	1183.2	434.43**	799.44	672.45	1068.4	595.81	1175..84	775.83	1193.2
Currently working	0.59	0.49	0.26	0.44	0.58	0.49	0.62	0.49	0.22**	0.42	0.33	0.47
Internal locus of control	2.9	0.48	2.96	0.46	2.87**	0.51	2.98	0.37	2.94	0.47	2.98	0.44
Would seek private care	0.24	0.42	0.15	0.36	0.18***	0.39	0.37	0.48	0.08***	0.27	0.31	0.46
Diagnosed with diabetes	0.22	0.41	0.33	0.47	0.24	0.43	0.17	0.38	0.35*	0.48	0.27	0.45
Diagnosed with respiratory disease	0.07	0.26	0.06	0.24	0.07	0.26	0.08	0.27	0.07	0.25	0.05	0.22
Per capita medical units*1000	0.49	0.97	na	na	0.56***	1.1	0.3	0.52	na	na	na	na
Per capita primary care physicians*1000	1.8	1.53	na	na	1.8	1.6	1.78	1.36	na	na	na	na
Number of observations		**384**		**445**		**267**		**117**		**301**		**144**

*t-tests: pairwise comparisons between treatment and control group in each wave. *** p<0.01, ** p<0.05, * p<0.1*

Table 3.2: *Attrition Analysis: Baseline differences between analytical sample and LTFU/died*

	Mean	
VARIABLE	**Analytical**	**LTFU or Died**
Female	0.61	0.59
Age (yrs.)	59.56***	66.91
Married	0.62	0.57
Formal education (yrs.)	2.74	2.97
Indigenous language	0.09	0.07
Urban	0.37***	0.45
Occupation		
White collar	0.05	0.07
Blue collar	0.63	0.64
Agriculture/fisheries/forestry	0.32	0.29
Currently working	0.6***	0.42
Assets (1000 MXN$, 2001)	509	511
One or more tests	0.92***	0.81
Number of physician visits last year	3.98***	5.96
Number of medical tests last year	2.54	2.43
Diagnosed with respiratory disease	0.07	0.09
Diagnosed with diabetes	0.22***	0.4
Health status		
Good +	0.22	0.19
Fair	0.52**	0.45
Poor	0.25***	0.37
Ever smoked	0.4	0.44
Total health expenses last year (MXN$, 2001)	3113**	4741
Internal locus of control	2.9	2.86
Would seek private care	0.24	0.28
Per capita medical units	0.49**	0.35
Per capita primary care physicians	1.79	1.7

*Two-sample t-tests with unequal variances. *** p<0.01; ** p<0.05; *p<0.1*

Table 3.3: *Test for parallel trends assumption: Changes in the treatment and control groups during 2001-2012.*

	Treatment group, 2001		Treatment group, 2012		Control group, 2001		Control group, 2012	
VARIABLE	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
One or more tests	0.92*	0.02	0.96	0.01	0.91	0.03	0.85	0.03
Urban	0.33	0.03	0.32	0.02	0.44	0.05	0.43	0.04
Married	0.62*	0.03	0.55	0.03	0.58	0.05	0.48	0.04
Assets (1000 MXN$, 2012)	434.43*	48.92	595.81	67.77	672.46	98.77	775.83	99.43
Currently working	0.58***	0.03	0.22	0.02	0.62***	0.04	0.33	0.04
Internal locus of control	2.87*	0.03	2.94	0.03	2.98	0.03	2.98	0.04
Would seek private care	0.18***	0.02	0.08	0.02	0.37	0.04	0.31	0.04
Number of observations	**267**	**267**	**301**	**301**	**117**	**117**	**144**	**144**

*t-tests: Pairwise comparisons for each of the treatment groups and waves. *** p<0.01, ** p<0.05, * p<0.1*

Table 3.4: *Coefficient estimates for main regression specifications*

MODELS (among sample of adults 50+ with diab|hyp)	**Stata Command**	**Difference-in-differences Coefficient (log(odds))**	**p-value**
Naive linear prob w/bootrstrap	diff (user defined)	0.091	0.009
Naive linear prob, robust, bootstrap	diff (user defined)	0.091	0.037
Naive linear prob PSM w/robust	diff (user defined)	0.08	0.154
Logistic regression, fixed effects	xtlogit	na	na
Logistic regression, random effects	xtlogit	1.43	0.023
Mixed effects (Multilevel model, 3 levels)	melogit ||household: ||id:	1.43	0.021
Mixed effects (Multilevel model, 2 levels)	melogit ||id:	1.43	0.021
PSMDID logistic regression estimator, _weight as extra covariate	xtlogit	1.37	0.043
PSMDID logistic regression estimator, _weight as an iweight	xtlogit	1.49	0.009
SENSITIVITY ANALYSES (among sample of adults 50+)			
Logistic regression, random effects	xtlogit	1.26	0.000

Table 3.5: *Adjusted Probabilities for random-effects logistic regression*

Predictive margins	**Delta-method**		
	Margin	Std.Err.	P>|z|
Treatment/Control#Pre-SP/Post-SP			
Control#Pre-SP	2.893543	0.434	0
Control#Post-SP	2.283537	0.3575	0
Treatment#Pre-SP	3.142352	0.4525	0
Treatment#Post-SP	3.963911	0.5757	0

Figure 3.2: *Plot of predictive margins for random-effects logistic regression*

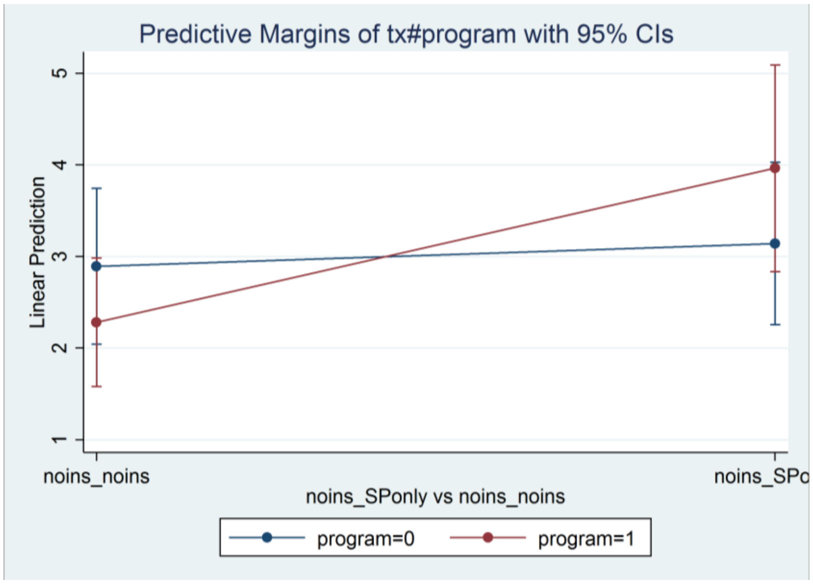
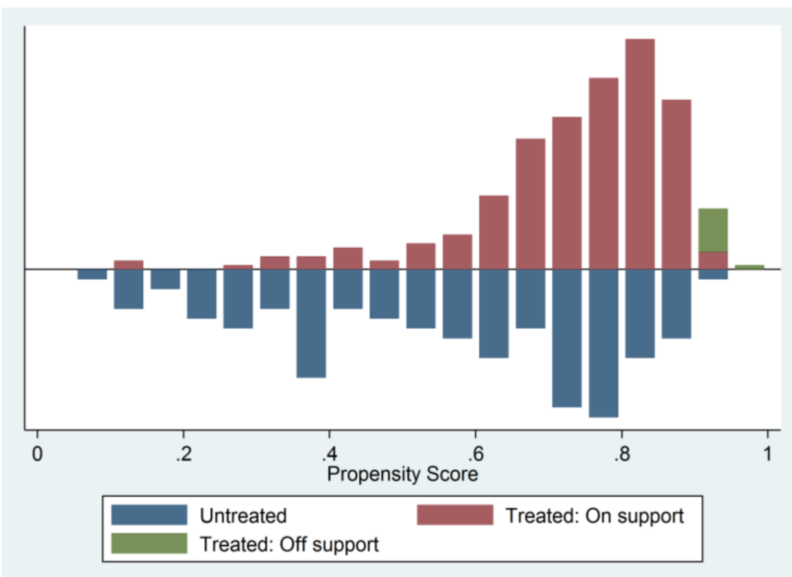


Figure 3.3: *Histogram of Propensity Scores*



3.8 Appendix

Figure 3.4: *Derivation of treatment and control group*

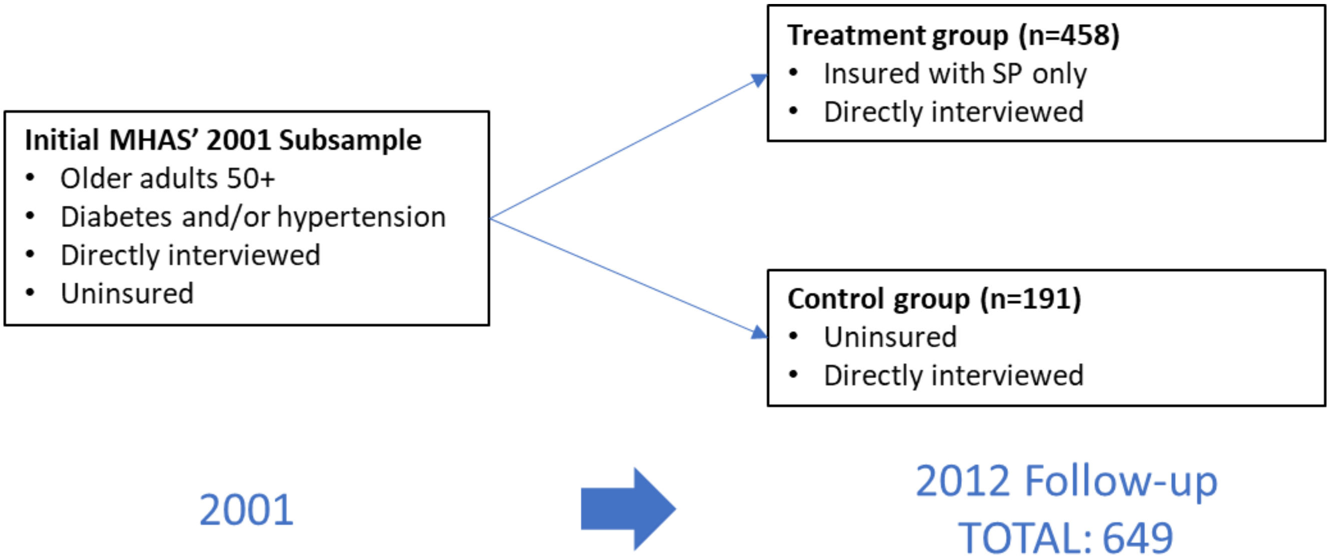


Table 3.6: *Original Study Sample.*

	Number of respondents excluded	Number remaining
MHAS 2001		15,186
Restricting to those 50+ with diabetes and/or hypertension	9,199	5,987
Deceased 2001-2003	296	5,691
Deceased 2003-2012	1,473	4,218
LTFU 2001-2012	778	3,440
Proxy-interviewed in 2001 or 2012	493	2,947
Original treatment group: No insurance 2001- SP (only) in 2012*	na	458
Original control group: No insurance in either year*	na	191

**Note: Both the treatment and control groups include MHAS respondents who were interviewed directly in each of the two waves.*

Table 3.7: *Full results from random-effects logistic regression*

VARIABLES	Coefficient (Std. Error)
One or more tests (Dependent variable)	
Treatment	0.249
	(0.451)
Post-SP	-0.61
	(0.424)
Control#Pre-SP	0
	(0)
Treatment #Post-SP	1.432**
	(0.630)
Female	1.085**
	(0.424)
Married	0.297
	(0.349)
Formal Education	0.188**
	(0.0775)
Occupation	
Blue collar	1.401**
	(0.665)
Agriculture	1.545**
	(0.757)
Urban	0.0378
	(0.445)
Would seek private care	0.688
	(0.432)
Internal locus of control	0.706**
	(0.293)
Currently working	0.241
	(0.381)
Diagnosed with respiratory disease	1.611
	(1.158)
Diagnosed with diabetes	0.784*
	(0.424)
Assets (1000 MXN$, 2012)	-0.0000902
	(8.84e-05)
Age (yrs)	-0.00674
	(0.0204)
Indigenous language	0.689
	(0.676)
Health status	
Fair	1.022***
	(0.356)
Poor	1.040**
	(0.405)
Per capita medical units * 1000	-0.121

VARIABLES	Coefficient (Std. Error)
One or more tests (Dependent variable)	
	(0.184)
Per capita primary care physicians*1000	0.196
	(0.151)
Constant	-3.287*
	(1.937)
lnsig2u	-0.784
	(1.609)
Observations	829
Number of clusters	450
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Table 3.8: *DID coefficients for other sensitivity analyses models*

OTHER SENSITIVITY ANALYSES (other dependent variables / model specifications)	**Stata Command**	**Difference-in-differences Coefficient (log(odds))**	**p-value**
poisson, re, *number of visits*, among 50+ diab|hyp	xtpoisson	0.008	0.965
negative binomial, re, number of visits, among 50+ diab|hyp	xtnbreg	0.27	0.098
OLS, re, number of visits, among 50+ diab|hyp	xtreg	0.8	0.261
poisson, re, *number of tests*, among 50+ diab|hyp	xtpoisson	na	na
OLS, re, number of tests, among 50+ diab|hyp	xtreg	0.33	0.096

Table 3.9: *Comparison between* ***main*** *model specifications*

	RE, logistic b/(se)	**MLM, 2 levels b/(se)**	**MLM, 1 level b/(se)**	**PSMDID 1 b/(se)**	**PSMDID 2 b/(se)**
One or more tests					
Control	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Treatment	0.249	0.249	0.249	0.311	0.305
	(0.45)	(0.45)	(0.45)	(0.55)	(0.37)
Pre-SP	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Post-SP	-0.61	-0.61	-0.61	-0.559	-0.604+
	(0.42)	(0.46)	(0.46)	(0.42)	(0.34)
Control # Pre-SP	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Control # Post-SP	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Treatment#Pre-SP	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Treatment#Post-SP	1.432*	1.432*	1.432*	1.428*	1.524**
	(0.63)	(0.62)	(0.62)	(0.68)	(0.55)
Female	1.085*	1.085*	1.085*	0.957*	0.492
	(0.42)	(0.43)	(0.43)	(0.41)	(0.36)
Married	0.297	0.297	0.297	0.208	-0.201
	(0.35)	(0.34)	(0.34)	(0.36)	(0.30)
Formal education	0.188*	0.188**	0.188**	0.191*	0.201**
	(0.08)	(0.07)	(0.07)	(0.08)	(0.07)
Occupation					
White Collar	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Blue Collar	1.401*	1.401+	1.401+	1.467*	1.134
	(0.67)	(0.79)	(0.79)	(0.68)	(0.94)
Agriculture	1.545*	1.545+	1.545+	1.553*	0.913
	(0.76)	(0.87)	(0.87)	(0.78)	(0.99)
Urban	0.038	0.038	0.038	-0.023	0.321
	(0.44)	(0.43)	(0.43)	(0.47)	(0.41)
Would seek private care	0.688	0.688+	0.688+	0.573	0.401
	(0.43)	(0.41)	(0.41)	(0.48)	(0.39)
Internal locus of control	0.706*	0.706*	0.706*	0.875**	1.072**
	(0.29)	(0.33)	(0.33)	(0.30)	(0.34)
Currently working	0.241	0.241	0.241	0.477	0.826*
	(0.38)	(0.36)	(0.36)	(0.42)	(0.36)
Diagnosed with respiratory disease	1.611	1.611	1.611	1.495	1.682
	(1.16)	(1.10)	(1.10)	(1.18)	(1.08)
Diagnosed with diabetes	0.784+	0.784+	0.784+	0.642	0.485

	RE, logistic b/(se)	MLM, 2 levels b/(se)	MLM, 1 level b/(se)	PSMDID 1 b/(se)	PSMDID 2 b/(se)
	(0.42)	(0.45)	(0.45)	(0.45)	(0.39)
Assets (1000 MXN$, 2012)	0	0	0	0	0
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age (yrs)	-0.007	-0.007	-0.007	0.005	-0.011
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Indigenous language	0.689	0.689	0.689	0.531	2.087*
	(0.68)	(0.66)	(0.66)	(0.71)	(0.86)
Health status					
Good +	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Fair	1.022**	1.022**	1.022**	0.968**	1.226***
	(0.36)	(0.34)	(0.34)	(0.37)	(0.31)
Poor	1.040*	1.040*	1.040*	1.403**	2.128***
	(0.40)	(0.43)	(0.43)	(0.45)	(0.42)
Ever smoked	0.309	0.309	0.309	0.094	-0.091
	(0.32)	(0.34)	(0.34)	(0.33)	(0.28)
Per capita medical units *1000	-0.121	-0.121	-0.121	-0.15	-0.068
	(0.18)	(0.19)	(0.19)	(0.18)	(0.22)
Per capita primary care physicians *1000	0.196	0.196	0.196	0.202	0.298*
	(0.15)	(0.15)	(0.15)	(0.16)	(0.15)
weight				0	
				(0.18)	
Constant	-3.287+	-3.287+	-3.287+	-4.446*	-3.780*
	(1.94)	(1.97)	(1.97)	(2.05)	(1.91)
lnsig2u					
constant	-0.784			-0.931	-2.894
	(1.61)			(1.89)	(11.58)
var(_cons[~)					
_cons		0			
		(0.00)			
var(_cons [~)					
_cons		0.457			
		(0.89)			
var(_cons[~)					
_cons			0.457		
			(0.89)		
No. of Obs.	829	829	829	736	736

Table 3.10: *Comparison between* ***sensitivity analysis*** *specifications*

	RE logistic 50+ b/se	Poisson, number visits b/se	Negative binomial, number visits b/se	RE OLS, number visits b/se	RE OLS, number tests b/se
Control	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Treatment	0.253	0.375*	0.202	1.391*	0.27
	(0.19)	(0.17)	(0.13)	(0.58)	(0.17)
Pre-SP	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Post-SP	-0.125	0.371*	0.139	0.895+	0.244
	(0.19)	(0.16)	(0.15)	(0.53)	(0.17)
Control#Pre-SP	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Control#Post-SP	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Treatment#Pre-SP	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Treatment#Post-SP	1.266***	0.008	0.273+	0.796	0.327+
	(0.26)	(0.18)	(0.16)	(0.71)	(0.20)
Female	1.145***	0.297*	0.264**	1.521*	0.291*
	(0.19)	(0.13)	(0.10)	(0.65)	(0.14)
Married	0.169	0.325*	0.179*	1.346*	0.241*
	(0.17)	(0.14)	(0.08)	(0.65)	(0.11)
Formal education	0.052*	0.012	0.014	0.033	0.054*
	(0.02)	(0.02)	(0.02)	(0.10)	(0.02)
Occupation					
White collar	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Blue Collar	-0.326	0.353	0.393	1.335+	0.352
	(0.37)	(0.30)	(0.25)	(0.78)	(0.28)
Agriculture	-0.282	0.495	0.506+	2.063*	0.298
	(0.40)	(0.33)	(0.27)	(0.99)	(0.33)
Urban	-0.063	0.104	-0.003	0.631	-0.005
	(0.18)	(0.13)	(0.09)	(0.81)	(0.14)
Would seek private care	0.523**	-0.002	-0.045	-0.164	0.128
	(0.17)	(0.17)	(0.10)	(0.57)	(0.14)
Internal locus of control	0.144	0.138	0.087	0.687	0.15
	(0.14)	(0.11)	(0.08)	(0.45)	(0.11)
Currently working	0.021	0.037	0.037	-0.119	-0.013
	(0.15)	(0.14)	(0.09)	(0.49)	(0.12)
Diagnosed with respiratory disease	0.919*	0.326*	0.186	1.483	0.286+
	(0.40)	(0.16)	(0.14)	(0.93)	(0.17)
Diagnosed with diabetes	1.483***	0.274*	0.409***	2.163***	0.615***

	RE logistic 50+ b/se	Poisson, number visits b/se	Negative binomial, number visits b/se	RE OLS, number visits b/se	RE OLS, number tests b/se
	(0.30)	(0.13)	(0.09)	(0.57)	(0.12)
Assets (1000 MXN$, 2012)	0	-0.000+	0	0	0
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age (yrs)	0.011	0.014+	0.011*	0.026	0.001
	(0.01)	(0.01)	(0.01)	(0.04)	(0.01)
Indigenous language	0.141	-0.352*	-0.093	-1.497*	0.022
	(0.22)	(0.14)	(0.13)	(0.59)	(0.17)
Health status					
Good +	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
Fair	0.626***	0.384**	0.356**	0.998*	0.356**
	(0.14)	(0.13)	(0.11)	(0.42)	(0.13)
Poor	0.673***	0.732***	0.665***	3.239***	0.337*
	(0.20)	(0.16)	(0.12)	(0.74)	(0.15)
Ever smoker	-0.034	-0.067	-0.056	-0.455	0.138
	(0.14)	(0.11)	(0.09)	(0.54)	(0.12)
Per capita medical units*1000	0.006	0.084	0.063	0.415	0.077
	(0.06)	(0.06)	(0.04)	(0.28)	(0.06)
Per capita primary care physicians *1000	-0.004	-0.028	-0.005	-0.071	0.029
	(0.05)	(0.03)	(0.03)	(0.16)	(0.03)
_cons	-0.676	-1.427+	-2.620***	-5.697*	0.455
	(0.91)	(0.74)	(0.55)	(2.87)	(0.77)
lnsig2u					
_cons	-0.011				
	(0.37)				
lnalpha					
_cons		-0.107			
		(0.17)			
ln_r					
_cons			1.976***		
			(0.30)		
ln_s					
_cons			3.466***		
			(0.40)		
No. of Obs.	2572	828	828	828	829

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4. **CHAPTER 4 –** **Impact of Seguro Popular on Out-Of-Pocket Health Expenditures among Older Mexican Adults with Diabetes and/ or Hypertension**

4.1 Introduction and Background

Over the past decades, governments from several developing countries have encouraged the expansion and development of health insurance programs with the goal of transitioning into universal health coverage schemes that can ultimately provide better access to health care, help improve health outcomes, and offer financial protection (primarily) to the more disadvantaged segments of the population.

Under this framework, and with more than 50% of Mexico's population lacking health insurance in the early 2000s, the Mexican government established *Seguro Popular* (SP) as part of a comprehensive health reform that would pave the way towards universal health coverage[29]. In addition to providing health insurance coverage to the uninsured, SP aimed to increase public health expenditure, improve access to preventive care facilities, build new infrastructure, improve the delivery of health care services by investing in the health workforce, and protect families against both out-of-pocket (OOP) and catastrophic health expenditures [1, 2]. The latter goals of SP are particularly relevant, given that Mexico's OOP health expenditures -along with those of other Latin American countries- are characterized as being disproportionately high (in 2002, individuals' OOP expenses represented 52% of Mexico's total expenditure in health [3].)

More than ten years after the program's official implementation, enrollment to SP has increased rapidly: from 5 million individuals in late 2004 to approximately 50 million by 2014 (about 40% of Mexico's population at the time) [4]. Even though this signals an important

[29] SP is a voluntary public health insurance program targeting Mexicans in the informal sector of the economy who do not benefit from social security, irrespective of pre-existing condition. The program is mainly publicly funded by both the federal and state resources, although affiliates pay a small annual fee at the time of enrollment (according to their households' income level). Program beneficiaries are entitled to more than 280 medical conditions/services as well as to over 300 medications included in the Ministry of Health's Catalogue of Universal Health Services (*Catalogo Universal de Servicios de Salud*, CAUSES), without incurring in any co-pay.

milestone in the country's effort to attain universal coverage, recent data suggest that around 20% of the population is still uninsured [5] and various reports and studies have indicated that there are additional challenges that should be addressed by SP. Among these challenges is the need to reduce OOP health expenditures. Even though the literature has documented important reductions in catastrophic health care expenditures and some decrease in OOP spending, and although there is evidence of a shift from private to public health services use in the last decade, individuals' health care OOP expenses in Mexico are still high compared to most OECD countries [5]. Tackling this problem is further complicated by the demographic and epidemiological transitions that the country is currentlly facing. While the former has translated into a rapidly growing population of older adults, the latter has led to a significant increase in the prevalence of chronic, non-communicable diseases such as diabetes, hypertension and obesity, especially among older adults 50 years and above (50+). If the current trends continue, the economic and social consequences associated with these transitions could be devastating to both Mexico's Health Care System and to Mexican society in general.

While a relatively large body of literature has examined the effect of SP on OOP health expenditures on the short term and on the general population, not many studies have assessed the impact of the program on OOP expenses in the longer term and very few of them (if any) have focused on the population of older Mexican adults afflicted with diabetes and/or hypertension, the two most prevalent chronic conditions among this segment of the population. Examining whether SP is associated with a longer-term reduction in OOP health expenditures among this population is essential, given the high degree of vulnerability experienced by individuals in this group[30] (especially because these individuals are usually low-income, they would most likely have to pay out-of-pocket for medications in the private sector if they did not have access to SP).

Therefore, the purpose of this paper was to estimate the effect of SP on OOP health spending among the population of older Mexican adults 50+ with diabetes and/or hypertension by using longitudinal data from the 2001 and 2012 waves of the Mexican Health and Aging Study (MHAS). It was hypothesized that, compared to the uninsured, affiliation to SP is associated with a reduction in OOP health expenditures.

4.2 Literature Review

As one of the main goals of SP was to reduce catastrophic health care expenditures (CHE) among the poorest sector of the population [8], several studies have explored the effect of SP on these types of expenditures. In addition, other studies have analyzed the effect of SP in OOP health expenditures in general [9, 14-15]. Most of the empirical evidence has suggested that SP is associated with a reduction in both CHE and OOP expenses.

Gakidou et al. were one of the first to conclude that SP was associated with a reduction in CHEs and OOP expenditures [9]. The authors claimed that, compared to the uninsured, OOP expenditures were significantly lower among SP beneficiaries. The cross-sectional nature of this study and the fact that it covered just a couple of years after SP's implementation were the major limitations of this study.

Another preliminary study providing some evidence of SP's impact on CHE was the one by Scott [10]. His results showed that, on average, SP enrollees spent less on health (per

[30] Data from 2010 revealed that 28.8% of individuals 65 and over did not have access to social security and almost 46% of this same population lived in poverty [6-7].

household) than the uninsured. Similarly, the article showed that the incidence of CHE was lower among households that were affiliated to SP, compared to those in which all household members were uninsured. The author, however, cautioned on the interpretation of the results because of the lack of appropriate controls.

In a working paper, Barros compared households in the formal sector to those in the informal sector (the latter of whom were eligible for SP), taking advantage of the "variation in program intensity over time and space induced by the roll-out of SP". Results from his triple-differences analyses showed that SP significantly reduced beneficiaries' OOP expenditures in SP-affiliated households, as evidenced by the shift from private, fee-for-service providers to free public providers [11]. The main limitation of his study, however, was that it is cross-sectional.

Using a matched-pair cluster-randomized experimental design, King et al. focused on evaluating whether SP had reduced the percentage of households with CHE, as well as OOP health expenditures. To do so, they measured the outcomes of interest through a baseline and a follow-up survey which was administered 10 months later [12]. They included self-reported measures of OOP health expenditures for inpatient and outpatient care, medication, and medical devices. Their main findings revealed that, especially among the poorest households, SP was associated with a reduction in both catastrophic and OOP expenditures for the case of inpatient and outpatient health care services only. The fact that SP had no effect on medication expenditures came as a surprise to the authors because previous evidence indicated a reduction in such expenditures. Although the design of this study was experimental, it is very preliminary because it spanned just 10 months after the launch of SP.

Galárraga et al. estimated the effect of SP on both CHE and OOP by using both a longitudinal and a cross-sectional dataset [13]. In order to address the endogeneity of the treatment variable (i.e. health insurance status), they used an instrumental variables approach and found that SP beneficiaries were associated with a significant reduction in CHE and lower OOP spending in outpatient and medication expenditures. The main contribution of this study was that it attempted to reduce selection bias through the use of an instrument for health insurance status. However, the longitudinal dataset that they used (i.e. SP Impact evaluation survey) spanned less than 2 years after the formal implementation of the SP program.

In a recent paper based on both experimental and cross-sectional data, Grogger et al. concluded that SP reduced CHE in urban settings. In rural communities, however, SP was associated with reductions in CHE only in areas with larger health facilities [14]. The findings of this study are interesting, especially because they included urban households in their analyses. However, the authors used King et al.'s experimental data [12], and thus represented a short-term evaluation of SP. Moreover, the issue of selection bias was not addressed in this study.

By using cross-sectional data, and a propensity score matching approach, a household-based study analyzing the effect of SP on CHEs and OOP expenditures, concluded that SP had a beneficial effect in terms of OOP spending and CHE among households with patients who had diabetes and/or hypertension [15] and that the positive effect was greater among those households that had been exposed to SP for a longer time. The main drawback of this study was that it was based on cross-sectional data.

To my knowledge, there is a single study that has addressed the effect of SP on CHE and OOP health expenditures among older Mexican adults. One of the main goals of this study was to estimate the impact of SP on financial risk protection at the household level [16]. However, the study was cross-sectional and its results suggested that SP was not associated with a protective effect against financial burden, compared to those with social security and to those without health insurance.

As described above, most of the studies analyzing the effect of SP on CHEs and OOP health expenditures are cross-sectional, focus on the short-term after SP's implementation, and very few of them address the issue of selection bias. In addition, literature regarding the effect of SP on CHEs and OOP health expenditures among older Mexican adults with chronic diseases is virtually nonexistent.

The present study aimed to fill-in this dearth in the literature by using longitudinal data and examining the effect of the SP program among older Mexican adults 50+ with diabetes and/or hypertension, the two most prevalent chronic conditions that affect this segment of the population.

4.3 Conceptual Framework

Based on Andersen's behavioral model for health services use, the conceptual framework for this study is shown in **Figure 4.1**. Andersen postulates that health care utilization is determined by predisposing, enabling, and need characteristics acting at both the individual and contextual levels [17, 18]. In addition, there is evidence that suggests that OOP health care expenditures are determined by the amount of health care services utilized as well as by health insurance coverage [19, 20]. Since health care utilization is presumably a mediator between health insurance coverage and health outcomes [21], it is reasonable to assume that it also mediates the impact of health insurance on OOP expenditures (as there would be no OOP expenses in the absence of health services utilization). Therefore, the same factors that determine health care utilization (including health insurance coverage) are expected to determine OOP expenditures. The pathway of interest in this study, that is, the one connecting health insurance to OOP expenses, is depicted in the figure by the two thick arrows. The arrow from OOP health expenditures to health insurance represents the possibility of reverse causality. In this regard, people with high OOP health expenditures might opt to join SP to reduce spending.

Individual predisposing characteristics are represented in **Figure 4.1** by biological sociodemographic factors such as age and gender and by social structure-related characteristics that include marital status, health beliefs, educational attainment, occupation, work status, and ethnicity. Measures for these characteristics have been thoroughly used in the literature in studies analyzing the effect of health insurance on health utilization and on health expenditures [22].

In this study, socioeconomic status (SES) and health insurance represent enabling resources at the individual level. Along with travel time to health facilities, waiting times for service and social support, measures for SES and health insurance have been widely used in the health services literature as determinants of health care utilization [22]. It is important to mention that although health insurance is indeed an enabling factor, it was removed from the "enabling characteristics box" to highlight the increasing evidence that points towards a positive, direct effect of health insurance on health care utilization [23] and potentially on OOP health expenditures.

As shown in **Figure 4.1**, health status, disease burden, and lifestyle behaviors represent individuals' need characteristics. Measures for these constructs have been used in previous research to examine the impact of health insurance on health care utilization and health care expenditures [24, 25].

Contextual-level characteristics that affect health care utilization and OOP health spending include the degree of health insurance coverage and health care infrastructure within the community, supply of health-related human resources, and the type of place of residence.

As illustrated in the figure, both individual and contextual level characteristics may confound the effect of health insurance on OOP expenditures. Therefore, all the empirical models in this study controlled for these factors. However, it is worthwhile noting that the models did not control for health care utilization because, as mentioned earlier, it functions as a mediator between health insurance and OOP expenditures.

4.4 Methods

4.4.1 Data

Data for this study were extracted from MHAS and from other restricted-use databases that were linked to this dataset. These included the National Institute of Statistics and Geography's (INEGI) 2000 Mexican Population Census, the Mexican Ministry of Health's 2002 Directory of Public Health Sector Facilities, and state-level population projections for 2002-2012 from the National Population Council (CONAPO).

MHAS is a nationally representative longitudinal study of Mexicans 50+ who reside in urban and rural communities throughout the country. It is based on the United States Health and Retirement Study (HRS) and is partly sponsored by the US' National Institute on Aging (NIA). Among its main objectives, it aims to understand the aging process among Mexicans and the impact of disease from a wide socioeconomic viewpoint [26]. As of today, four waves of the MHAS have been fielded (2001, 2003, 2012, and 2015). In the baseline 2001 survey, a total of

15,186 individuals were interviewed. These included subjects who were born before 1951 (i.e. those who were 50 or more at that time) as well as their spouses/partners regardless of age.

The baseline sample was selected from INEGI's Mexican National Employment Survey (*Encuesta Nacional de Empleo,* ENE). All households in ENE with at least one person aged 50 or older were eligible to participate in MHAS's first wave. In households with more than one individual meeting the age criterion, one of them was randomly selected to participate in the study.

In 2003, new spouses/partners of those interviewed in 2001 were added to the study. In this second wave, the questionnaire was administered to 14,250 individuals, which included surviving respondents, the new spouses/partners, and 546 next-of-kin interviews to follow-up on individuals who died between the first and second waves. To maintain representativeness, the sample was updated (from the then called *Encuesta Nacional de Ocupación y Empleo,* ENOE) for the 2012 wave to include individuals who were born between 1952 and 1962 plus their spouses/partners regardless of age. In that year, 18,465 people were interviewed, including 2,742 next-of-kin interviews for those who died between 2003 and 2012. The response rates for the baseline, 2003 and 2012 waves were 91.8%, 93%, and 88.1% respectively. Response rates for the 2015 waves were not available at this time.

As MHAS includes a rich set of socio-demographic and socioeconomic variables and individuals' labor history, health insurance status, use of health care services, health care expenditures, general health status, disease burden, life-style behaviors and type of community of residence (i.e. urban or rural), the use of this dataset (coupled with the restricted-use datasets mentioned above) provided information on a large set of variables that were used to measure the constructs in the conceptual model in **Figure 4.1**.

4.4.2 Study Design

Since MHAS's initial 2001 wave collected information on individuals before the launch of SP and MHAS's third round included characteristics of individuals after eight years of the program's formal implementation, the use of these two waves provided a convenient setting for the adoption of a nonequivalent control group quasi-experimental design (also known as the "difference-in-differences" approach). Therefore, this study made use of the difference-in-differences methodology to estimate the impact of SP on OOP health expenditures. All analyses were performed at the individual level.

4.4.3 Sample Definition

Both the treatment and control groups for this study were derived from an original subsample of MHAS respondents who reported in 2001 to be 50 years or older, *uninsured*, and to have been diagnosed with diabetes, hypertension, or both. The treatment group was composed of those individuals in the initial 2001 subsample who reported to be insured *only* by SP when they were re-interviewed in the MHAS' 2012 wave. This group was compared with a control group that included individuals from the same initial 2001 subsample but who reported to be *uninsured* in MHAS' 2012 wave (i.e. those who were uninsured in both time periods). The derivation process for the treatment and the control groups is illustrated in **Figure 4.2** in the appendix. In addition, **Table 4.5** in the appendix presents the original sample sizes that were obtained from MHAS' baseline 2001 survey. As shown, from the 3,440 older adults with diabetes and/or hypertension who were followed-up in 2012, only 2,947 were directly interviewed[31] in both

[31] Information for the rest of the individuals was provided by proxies.

waves. Of these, only 649 individuals reported no health insurance in 2001: 458 were enrolled in SP (only) by 2012 and the other 191 reported no health insurance in 2012.

4.4.4 Variables

All the variables described in this section represent measures of the constructs in **Figure 4.1**

4.4.4.1 Outcome Variables

Both waves of the MHAS asked individuals: "Including all visits and consultations to physicians and/or other medical personnel during the last 12 months, how much did you pay out-of-pocket for these services?" Responses were coded as: amount (in Mexican pesos, MXN$)/nothing/paid in-kind/refused/don't know). In addition to physician visits, interviewees were asked similar questions for the case of other OOP spending categories such as outpatient procedures, dental care, and health care services provided by folk-healers or homeopaths. If individuals answered "don't know" to any of these, then they were asked: "Would you say that it was more than $x (yes/no/don't know)? $y(yes/no/don't know)? $z(yes/no/don't know)?, where x>z>y[32].

In this study, OOP health expenditures were operationalized by variables representing individuals' *total annual OOP health expenses* in 2001 and 2012[33]. Similar measures have been used in previous studies [29-32]. All expenditure data were transformed to constant 2012 MXN$.

[32] As in the US' Health and Retirement Study, this second question with unfolding brackets was included in MHAS's questionnaires to minimize non-response. Answers to this question were later imputed by MHAS staff to recover monetary amounts.

[33] These outcome variables (which included all OOP categories described above) were constructed from individuals' self-reported expenditures in MXN$ and from MHAS' imputed non-response amounts. The imputation methodology employed by MHAS is reported elsewhere [27].

As is often the case with cost data, the distributions of total annual OOP expenditures in both 2001 and 2012 were positively skewed, mainly because more than 30% of individuals reported no annual OOP expenditures (please refer to the results section). Therefore, to help minimize the possibility of biased regression coefficient estimates, the natural log of the original variables for total annual OOP expenditures was taken. This log-transformed version of total OOP health expenditures was used as the dependent variable in several of the regression model specifications in this study.

Finally, to implement the first stage of the two-part model described in section 4.4.5, an additional dichotomous variable for total OOP health expenditures was constructed. This binary indicator equaled one if the respondent had a positive expenditure in at least one of the time periods (i.e. had "some" expenditure) and took the value of zero if the individual in question reported no expenditures in neither of the two MHAS waves (i.e. had "no" expenditure).

4.4.4.2 Independent Variables

Health insurance status, the main independent variable in this study, was used as a measure for the health insurance construct in **Figure 4.1**. It was defined by a binary variable that took the value of one if the respondent belonged to the treatment group and was equal to zero if the individual was from the control group. In addition to this "treatment" variable, a dichotomous "before-after" indicator referring to the timing of SP implementation was employed. This indicator was equal to one for data coming from MHAS's 2012 wave (i.e. post SP implementation) and was zero for data extracted from MHAS's 2001 baseline wave (i.e. before SP was implemented).

While some individual-level independent variables in the present study were obtained from MHAS's 2001 baseline wave only, others were taken from both the baseline and the 2012 follow-up waves. Variables from the baseline wave included gender, number of years of formal education, occupation (operationalized by a person's main lifetime job: white-collar / blue-collar / agriculture-related), smoking history (as a measure of an individual's lifestyle behaviors: ever smoker/never smoker), and a variable indicating whether the person spoke an indigenous language to operationalize ethnicity. These have been frequently used in studies assessing the effect of health insurance on levels of health care utilization and OOP health spending [19, 24, 30, 33]. Individual demographic and socioeconomic variables extracted from both waves comprised age (in years), marital status (married/not married), employment status (currently working/not working), health status (good/fair/poor), whether an individual had been diagnosed with diabetes, whether a person mentioned that she had been diagnosed with respiratory disease, individuals' willingness to seek private care, and a measure for respondents' internal locus of control. The first six of these variables were included in the study because of evidence indicating its association with OOP health expenditures and/or with health care utilization [19, 30, 33]. Individuals' willingness to seek private care was chosen as a measure for health beliefs because it was a strong predictor of enrollment to SP. This was suggested by a logistic regression aimed at identifying predictors of SP enrollment (self-analysis, results not reported in this study). It was also incorporated in the models because there is some evidence of an association between willingness to pay and health care utilization [34]. Finally, the internal locus of control index was selected as an additional measure for health beliefs mainly because it was a significant predictor of enrollment to SP in the logistic model mentioned above and because previous research suggests that there is a link between internal locus of control and health care utilization [35, 36]. The scale for the internal locus of control index, which ranges from 0.25 to 4, is similar to Angel et al.'s [37] and is based on Rotter's conceptualization of internal locus of control [38]. The higher the score on internal locus of control, the more in control a person is of the events in his/her life, including health.

Contextual-level characteristics in **Figure 4.1** are represented by individuals' 2001 and 2012 household-level assets (in thousands of 2012 MXN$) and by variables at the community level such as place of residence (urban/rural), number of medical units per 1000 population, and the number of primary care physicians per 1000 population. These were all accounted for in the study since some of them were associated with the propensity to enroll in SP and because it has been suggested that they are associated with health care utilization [17].

4.4.5 Statistical Analyses

Stata IC, version 14.2 was used to carry-out the analyses in this study. It is worth mentioning that all the analyses were unweighted because MHAS data did not provide neither a primary sampling unit (PSU) nor survey strata.

4.4.5.1 Descriptive Analyses

A series of descriptive analyses were performed before proceeding with the implementation of econometric models. The distributions of total OOP expenditures for both 2001 and 2012 were first checked to determine skewness and to identify outliers. Then, with the main goal to examine missing data patterns, frequency distributions for all the independent variables in the study were obtained. Subsequently, pairwise t-tests were conducted to assess the comparability of individuals' characteristics in the treatment and control groups, both at the 2001 baseline and at the 2012 follow-up.

Given that MHAS is a longitudinal survey and that the final sample of this study included individuals who were (directly) interviewed in both 2001 and 2012, the results of this study could be biased if individuals who died or were lost to follow-up (LTFU) between the two

MHAS waves were different from those who were re-interviewed in 2012. According to **Table 4.5** in the appendix, in 2001 there were 5,987 individuals 50+ who reported having been diagnosed with diabetes, hypertension, or both. By 2012, 29% of those had died and 13% were LTFU. This suggested that attrition could definitely be a concern in the study. Therefore, two sample t-tests were performed to compare the characteristics of those who remained in the sample by 2012 with the characteristics of those who were interviewed in 2001 but who had died or were LTFU by 2012.

As the main empirical strategy in this study involved a difference-in-differences approach, it was necessary to assess whether the "parallel-trends" assumption held. Ideally, differences in secular time trends between the treatment and control groups could have been inspected by comparing the characteristics of these two groups in a period prior to 2001 [39, 40]. However, this was not possible because MHAS's first wave was precisely the one fielded in 2001. Another alternative would have been to implement an additional difference-in-differences model in which the treatment group would have been compared to another group that had not been affected by SP. Unfortunately, this was also unfeasible: even though SP was rolled out gradually across states in Mexico, MHAS does not provide information on respondents' state of residence. Therefore, the validity of the parallel trends assumption was analyzed through a series of paired t-tests on health-unrelated individual observed characteristics. The purpose of these tests was to determine whether the treatment and control groups had changed over time in terms of those characteristics.

4.4.5.2 Empirical Strategy

A two-part difference-in-differences model was implemented as the main empirical strategy to assess whether SP was associated with lower OOP health spending. However, to check for the robustness of results, other difference-in-differences regression model specifications were conducted. These included a naive ordinary least squares (OLS) model, fixed and random effects, multilevel, and propensity score matching difference-in-differences (PSMDID) formulations[34], as well as models involving a larger sample of older adults 50+ with or without chronic conditions. Except for the naive OLS specification, these last models all accounted for the longitudinal nature of the data.

The two-part difference-in-differences model[35]:

The first part of the two-part model (i.e. the binary choice model) was estimated by a logistic regression specification modeling the probability of having some (positive) total annual OOP health expenditure. This model took the form:

$$Prob(positive\ annual\ total\ OOP\ health\ spending\ in\ 2001\ or\ 2012) =$$
$$\alpha_0 + \alpha_1 \cdot treatment + \alpha_2 \cdot post - SP_{implementation} + \alpha_3 \cdot treatment \cdot post -$$
$$SP_{implementation} + \boldsymbol{\alpha_j} \cdot \boldsymbol{cov_j} + \varepsilon_1, \text{ for } j=4 \text{ to } 16$$

where *positive annual total OOP health spending in 2001 or 2012* was defined according to the binary variable described at the end of the outcome variables section, $\boldsymbol{cov_j}$ is a vector of the additional thirteen covariates mentioned in the independent variables section, and $\boldsymbol{\alpha_j}$ is the set of estimated parameters associated with such covariates.

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[34] In addition to modeling the possibility of self-selection to SP (given the voluntary nature of the program), the PSMDID models provided an alternative approach to assess the effect of SP on OOP expenditures. This methodology has been widely used in the social program evaluation literature [30, 41-48].

[35] In addition to the two-part model specification described in this section, other cross-sectional two-part models as well as an additional specification that took the longitudinal nature of the data into account were fit. Please refer to the results section for more details.

The second component of the two-part model (i.e. the model conditional on positive OOP health expenditures) included an OLS regression model given by:

$$ln(total\ annual\ OOP\ health\ expenditures | total\ annual\ OOP\ health\ expenditures > 0)$$
$$=$$
$$\beta_0 + \beta_1 \cdot treatment + \beta_2 \cdot post - SP_{implementation} + \beta_3 \cdot treatment \cdot post$$
$$- SP_{implementation} + \boldsymbol{\beta_j} \cdot \boldsymbol{cov_j} + \varepsilon_2, \text{for } j = 4\ to\ 1$$

Other difference-in-differences models

The additional models mentioned above had the following general regression specification:

$$ln(total\ annual\ OOP\ health\ expenditures) =$$
$$\gamma_0 + \gamma_1 \cdot treatment + \gamma_2 \cdot post - SP_{implementation} + \gamma_3 \cdot treatment \cdot post$$
$$- SP_{implementation} + \boldsymbol{\gamma_j} \cdot \boldsymbol{cov_j} + \varepsilon_3, \text{for } j = 4\ to\ 16$$

Again, the natural logarithm of *total annual OOP expenditures* was taken to account for the skewness of the original outcome variable [49]. However, the same regressions were implemented with the dependent variable in its raw scale.

4.5 Results

4.5.1 Descriptive & Summary Statistics

As is common with cost data, the distributions of total annual OOP health expenditures for both 2001 and 2012 were positively skewed and had a significant mass of zeroes (more than 30% of individuals in both waves reported no OOP expenses during the12 months previous to the interview).

Missing data were mainly not a concern in this study except for the case of the occupation and current work status variables (approximately, 27% of data for these variables were missing). Although the results of the main empirical specifications did not change much when these two variables were not included in the models, they remained as covariates in the regression models because, as mentioned in the conceptual model section, they have been associated with health care utilization and OOP health expenditures.

Summary statistics for the analytical sample of older Mexicans 50+ with diabetes and/or hypertension both at baseline and at follow-up are shown in **Table 4.1**.

As illustrated, characteristics of the treatment and control groups at baseline were similar in terms of total annual OOP health spending (including the log-transformed version of this variable), age, gender, percentage of individuals having blue collar-related occupations, marital status, self-reported health and smoking status, percentage of people speaking an indigenous language, employment status, proportion of people with diabetes and respiratory disease, and in the (per-capita) number of physicians in their communities. However, individuals in the treatment group were more likely to reside in rural areas, had less years of formal education, fewer assets, a lower internal locus of control, were less likely to seek private care and had more (per-capita) medical units in their communities compared to those in the control group. In addition, individuals in the treatment group were less likely to have white-collar jobs and were more likely to have an agriculture-related occupation compared with those in the control group. In summary, those in the treatment group tended to be more disadvantaged than individuals in the control group at baseline. This was not surprising since the SP program initially focused on affiliating underserved individuals within rural communities. At follow-up, individuals in the treated group were sicker, more likely to have lower annual OOP health expenditures and to have been diagnosed with diabetes, less likely to have a job, and less likely to seek private care, compared to those in the control group.

4.5.2 Attrition Analyses

Table 4.2 shows the results of two-sample t-tests with unequal variances that were performed to compare baseline characteristics of the 649 uninsured older Mexicans in the original sample who were followed-up in 2012[36] to those who died or were LTFU between 2001 and 2012. In total, 795 uninsured people 50+ with either diabetes or hypertension died or were LTFU in between waves (573 and 222, respectively). Results in the table suggest that, -at baseline-, those who were followed-up in 2012 were younger, healthier, more likely to live in rural areas, to be working, to have taken at least one health test in the previous two years, to have fewer physician visits and lower total OOP health expenditures in the previous year, and to live in communities with more per-capita medical units, than those who died or were LTFU.

[36] Individuals in the final sample were 50 or more in 2001, uninsured, had diabetes and/or hypertension, and were re-interviewed in 2012.

4.5.3 Parallel Trends Assumption

To test for the validity of the parallel trends assumption, I investigated whether health-unrelated characteristics of both the treatment and control groups had changed between 2001 and 2012. As expected, results of paired t-tests among those in the analytical sample **Table 4.3**, revealed that both groups experienced a reduction in the proportion of individuals that were working. Except for experiencing an increase in OOP expenditures (in terms of the log-transformed OOP variable only), the control group remained basically stable in all other characteristics[37]. Namely, in the percentage of individuals living in urban areas, marital status, assets, and also in the amount of annual total OOP expenses (in its raw scale), internal locus of control, and willingness to seek private care. However, the only characteristics that remained unchanged among individuals in the treatment group were the proportion of people living in urban areas and the OOP amount they spent annually on health (in both the raw and log-transformed scales). Instead, those in the treatment group were associated with an increase in the amount of household assets and in their internal locus of control score. In addition, the proportion of individuals in the treatment group who were willing to seek private care decreased. The latter was expected because, by 2012, these individuals reported being enrolled only in SP.

[37] Except for ln(OOP expenditures +1). In this case, the control group experienced higher log-transformed OOP expenditures in 2012, compared to 2001.

4.5.4 Analytical Models

Table 4.4, presents the difference-in differences coefficient estimates for the regression specifications modeling the effect of SP on total annual OOP health expenditures. All of the models controlled for the covariates mentioned in the variables section.

Panel A in **Table 4.4** displays the results of the two-part model[38]. Since total annual health OOP expenditures were log-transformed in the second part of the two-part model specification, it was necessary to retransform back from the logged scale to the outcome variable's raw scale in order to obtain estimates for the overall mean of total annual OOP health expenditures and marginal effects of the interaction term. This was done through the use of Duan's nonparametric smearing estimator, assuming non-normally distributed, homoscedastic error terms *[51]*. Finally, standard errors for overall predictions and marginal effects were bootstrapped to obtain appropriate standard errors.

As shown in Panel A, individuals in the treatment group were associated with an average of MXN$ 2,852 less total annual OOP expenditures compared to those in the control group. This difference was statistically significant at the $p<0.05$ significance level. Since average total annual OOP expenditures for both groups were estimated at MXN$3,563, this represents approximately an 80% average reduction in OOP health expenditures. The full results of this model are shown in the appendix in **Table 4.6**.

Because of the possibility of different sets of unobservable characteristics acting in 2001 and 2012, two extra two-part model specifications were implemented within the cross-sectional

[38] It is important to note that Stata's *twopm* user-written command was used to implement the two-part model [50]. Since this command does not support Stata's *xt* series of commands for the analysis of panel data, both parts of the two-part model were adjusted for clustering in order to account for the non-independence of observations. Moreover, heteroscedasticity was controlled for by including robust standard errors in both parts of the model.

realm (one for 2001 and another one for 2012). Results from these models were mostly in agreement with those shown in Panel A (results not shown here). Furthermore, to check for robustness of results and to account for time invariant unobservable characteristics that might have influenced total annual OOP health expenditures, two additional *panel* models were estimated: a logit regression modeling the probability of having some positive OOP health expenditure and a panel OLS regression in which the natural log of positive total annual OOP expenditures was used as the outcome variable. Both fixed and random effects versions of these two panel models were estimated. Results from these model specifications were also in line with those in Panel A.

The coefficients of the interaction term in the models in which the outcome was represented by ln(*total annual OOP expenditures*) are shown in Panel B. All the models in this panel (which included the following regressions: naive OLS, fixed effects,[39] random effects, multilevel, and PSMDID) produced negative and statistically significant coefficients for the interaction between the treatment and the post-SP implementation variables, confirming that those in the treatment group experienced less total OOP health expenses compared to individuals in the control group. The percentage reductions in annual OOP expenditures ranged (roughly) between 88 and 94% among the sample of older Mexican adults 50+ with diabetes and/or hypertension and by a reduction of around 63% for older Mexican adults 50+ with or without chronic conditions. The baseline variables that were included in the propensity score matching stage for the implementation of the PSMDID model were gender, marital status, education,

[39] Although the fixed effects regression model dropped several observations because the value of the outcome variable was time invariant for some individuals, the model produced a negative, statistically significant coefficient for the interaction term (shown in **Table 4.4**, Panel B) However, results from a Hausman test gave preference to the random effects model.

occupation, type of place of residence, employment status, total household assets, and whether the individuals had been diagnosed with diabetes or hypertension.

The difference-in-differences coefficients for regression models in which the dependent variable was expressed in its raw scale (i.e. total annual OOP health expenditures) were also negative. However, none of them were statistically significant. (results for these regressions are not displayed here).

Although all models in **Table 4.4**, yielded negative and statistically significant difference-in-differences coefficient estimates, the two-part model was preferred because, unlike the other regression specifications, it accounts for the outcome variable's mixed discrete-continuous nature and for its considerable mass of true zeroes. In addition, the two-part model approach has been thoroughly used by health services researchers to model health care cost data [50, 52].

4.6 Discussion and Conclusions

Using a two-part difference-in-differences regression model to account for the mixed discrete-continuous character of health expenditure data, this study contributes to the literature by providing strong empirical evidence on the longer-term effect of SP on total annual OOP health expenditures among the population of Mexican older adults with chronic diseases. To the best of my knowledge, this study also adds to the literature by being the first to analyze the effect of SP on OOP health expenditures through the implementation of a two-part model.

As expected, study results suggest that older Mexican adults with diabetes and/or hypertension who were uninsured in 2001 and were enrolled in SP (only) by 2012 had significantly lower total annual OOP health expenditures compared to similar individuals who reported to be uninsured in both time periods. These results held true even after adjusting for individual and community-level factors and were robust to different, non-equivalent, model specifications that included additional two-part model regression specifications, fixed and random effects, multilevel, and PSMDID regression models. Furthermore, the magnitude and sign of the interaction coefficient (in the dependent's variable raw scale) from the main two-part model is fairly consistent with the one obtained by doing a simple difference-in-difference calculation from the unadjusted values in the summary statistics table (i.e. **Table 4.1**).[40] The findings of this study are consistent with those reported by others [13, 15, 53, 54].

Although study findings from the two-part model were robust to several alternative empirical specifications, results might still be liable to bias due to some limitations. One of the main concerns in the study is that enrollment to SP might be endogenous; specifically, the possibility of reverse causality between SP affiliation and total OOP health expenditures cannot be discarded. Future studies should address this limitation by using an instrumental variables approach. A second reason for concern is that most of the measures, including OOP health expenditures, health status, and diagnosis of chronic diseases were self-reported. In addition, survey weights were not included in the analyses. Thus, results might not be generalizable to the population of Mexican older adults 50+ with diabetes, hypertension, or with both of these chronic conditions. Future studies should address this limitation. Moreover, the definition of the outcome variable (i.e. total OOP health expenditures) variable might not be that appropriate; having data on medication OOP expenses would have been highly desirable. The absence of data on the timing of SP enrollment might also be a matter of concern. In this regard, MHAS does not report when an individual enrolled in SP and it is also impossible to determine from the data

[40] Because results from the PSMDID were similar to those of other models, this might suggest that self-selection to SP does not play an important role when analyzing the effect of SP on OOP health expenditures. However, the possibility of non-observable characteristics affecting enrollment to SP still exists.

whether those who reported to be enrolled in SP by 2012 (i.e. those in the treatment group) had another type of health insurance during the 2001-2012 period. Likewise, individuals who reported to be uninsured in both time points (i.e. the ones in the control group) might have been enrolled in another health insurance program between 2001 and 2012. This could lead to misclassification of individuals in the treatment and control groups. Another possible source of bias is related to the parallel trends assumption. The tests that aimed to determine whether this assumption held provided no conclusive evidence as to whether the assumption is valid in this setting. However, because of the timing of the MHAS waves and the lack of information on the place of residence, it was not possible to conduct more formal tests. Finally, attrition analyses at baseline showed that the 649 Mexican older adults 50+ with diabetes and/or hypertension who were interviewed in both the 2001 and 2012 MHAS waves (and were thus included in the study) were somewhat different from those who died or were LTFU between 2001 and 2012. The limitations described above imply that the results of the study should be interpreted with caution.

Despite these limitations, however, the present study has considerable strengths. These include the use of MHAS's longitudinal data, the implementation of a two-part model to account for skewness in the dependent variable's distribution, and the use of propensity score matching in the PSMDID specifications to address self-selection to SP.

In conclusion, overall results from the current study suggest that, in the longer term, health insurance coverage through the SP program has had a protective financial effect among the population of older Mexican adults 50+ with chronic conditions, by reducing individuals' total OOP health expenditures (compared to total OOP health expenses of uninsured individuals). The fact that SP is associated with a reduction in total OOP health expenditures among the population of older Mexican adults with chronic conditions is encouraging from a policy perspective, given that one of the goals of the SP program was to reduce out-of-pocket health expenditures, especially among vulnerable populations such as the population under study.

4.7 Tables and Figures

Figure 4.1: *Conceptual Framework*

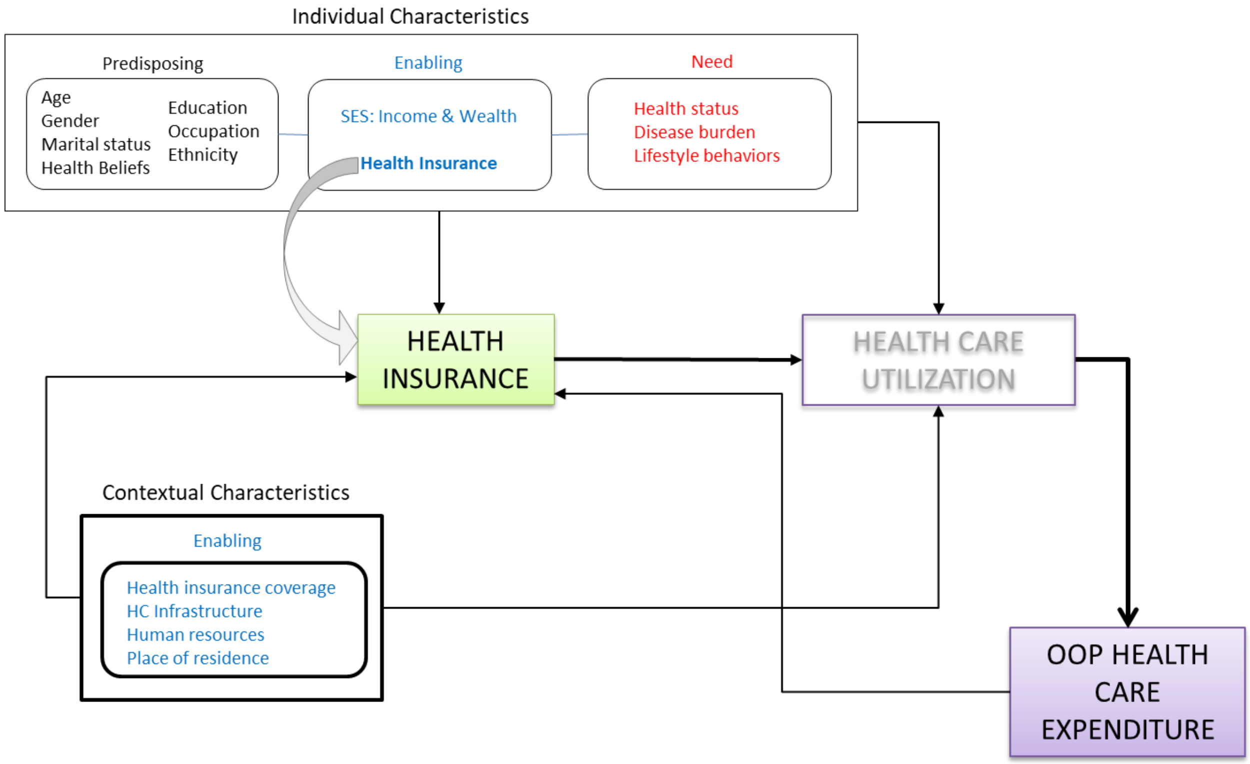

Table 4.1: *Summary statistics for sample of adults 50+ with diabetes and/or hypertension by wave and treatment status*

	Full sample, 2001		**Full sample, 2012**		**Treatment group, 2001**		**Control group, 2001**		**Treatment group, 2012**		**Control group, 2012**	
VARIABLE	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Total out-of-pocket expenditures, MXN$, 2012	3097.6	9100.7	3167	11349	3177	9651.4	2916.5	7733.6	2544.31*	11211	4467.6	11562
ln(Total out-of-pocket expenditures +1) in MXN$, 2012)	4.59	3.61	4.79	3.47	4.71	3.55	4.32	3.77	4.24***	3.5	5.93	3.14
Age (yrs)	59.72	7.83	71.47	7.59	59.63	7.92	59.95	7.67	71.38	7.53	71.67	7.72
Female	0.61	0.49	0.6	0.49	0.62	0.49	0.61	0.49	0.6	0.49	0.59	0.49
Urban	0.36	0.48	0.35	0.48	0.33**	0.47	0.44	0.5	0.32**	0.47	0.43	0.5
Formal education (yrs)	2.73	3.32	2.73	3.29	2.47*	2.8	3.31	4.24	2.4***	2.73	3.41	4.16
Occupation												
White collar	0.05	0.23	0.05	0.21	0.03***	0.16	0.12	0.33	0.02***	0.15	0.1	0.3
Blue collar	0.63	0.48	0.63	0.48	0.62	0.48	0.64	0.48	0.62	0.49	0.64	0.48
Agriculture/fisheries/forestry	0.31	0.46	0.32	0.47	0.35**	0.48	0.24	0.43	0.35**	0.48	0.26	0.44
Married	0.61	0.49	0.53	0.5	0.62	0.48	0.58	0.5	0.55	0.5	0.48	0.5
Health status												
Good +	0.22	0.41	0.2	0.4	0.2	0.4	0.26	0.44	0.17**	0.37	0.26	0.44
Fair	0.53	0.5	0.55	0.5	0.55	0.5	0.48	0.5	0.56	0.5	0.53	0.5
Poor	0.25	0.43	0.25	0.44	0.25	0.43	0.26	0.44	0.28	0.45	0.21	0.41
Ever smoked	0.4	0.49	0.4	0.49	0.41	0.49	0.38	0.49	0.4	0.49	0.4	..49
Indigenous language	0.09	0.28	0.09	0.29	0.09	0.29	0.08	0.27	0.1	0.3	0.07	0.25
Assets (1000 MXN$, 2012)	507	895	654.1	1183.2	434.43**	799.44	672.45	1068.4	595.81	1175..84	775.83	1193.2
Currently working	0.59	0.49	0.26	0.44	0.58	0.49	0.62	0.49	0.22**	0.42	0.33	0.47
Internal locus of control	2.9	0.48	2.96	0.46	2.87**	0.51	2.98	0.37	2.94	0.47	2.98	0.44
Would seek private care	0.24	0.42	0.15	0.36	0.18***	0.39	0.37	0.48	0.08***	0.27	0.31	0.46
Diagnosed with diabetes	0.22	0.41	0.33	0.47	0.24	0.43	0.17	0.38	0.35*	0.48	0.27	0.45
Diagnosed with respiratory disease	0.07	0.26	0.06	0.24	0.07	0.26	0.08	0.27	0.07	0.25	0.05	0.22
Per capita medical units*1000	0.49	0.97	na	na	0.56***	1.1	0.3	0.52	na	na	na	na
Per capita primary care physicians*1000	1.8	1.53	na	na	1.8	1.6	1.78	1.36	na	na	na	na
Number of observations		**384**		**445**		**267**		**117**		**301**		**144**

*t-tests: pairwise comparisons between treatment and control group in each wave *** p<0.01, ** p<0.05, * p<0.1*

Table 4.2: *Attrition Analysis: Baseline differences between analytical sample and LTFU/died*

VARIABLE	Analytical	LTFU or Died
Female	0.61	0.59
Age (yrs)	59.56***	66.91
Married	0.62	0.57
Formal education (yrs)	2.74	2.97
Indigenous language	0.09	0.07
Urban	0.37***	0.45
Occupation		
White collar	0.05	0.07
Blue collar	0.63	0.64
Agriculture/fisheries/forestry	0.32	0.29
Currently working	0.6***	0.42
Assets (1000 MXN$, 2001)	509	511
One or more tests	0.92***	0.81
Number of physician visits last year	3.98***	5.96
Number of medical tests last year	2.54	2.43
Diagnosed with respiratory disease	0.07	0.09
Diagnosed with diabetes	0.22***	0.4
Health status		
Good +	0.22	0.19
Fair	0.52**	0.45
Poor	0.25***	0.37
Ever smoked	0.4	0.44
Total health expenses last year (MXN$, 2001)	3113**	4741
Internal locus of control	2.9	2.86
Would seek private care	0.24	0.28
Per capita medical units	0.49**	0.35
Per capita primary care physicians	1.79	1.7

*Two-sample t-tests with unequal variances *** $p<0.01$; ** $p<0.05$; *$p<0.1$*

Table 4.3: *Parallel trends assumption: Changes in the treatment and control groups during 2001-2012*

	Treatment group, 2001		**Treatment group, 2012**		**Control group, 2001**		**Control group, 2012**	
VARIABLE	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Total out-of-pocket expenditures in MXN$, 2012	3176.97	590.65	2544.31	646.2	2916.54	714.97	4467.57	963.5
ln(Total out-of-pocket expenditures +1 in MXN$, 2012)	4.71	0.22	4.24	0.2	4.31***	0.35	5.93	0.26
Urban	0.33	0.03	0.32	0.02	0.44	0.05	0.43	0.04
Married	0.62*	0.03	0.55	0.03	0.58	0.05	0.48	0.04
Assets (1000 MXN$, 2012)	434.43*	48.92	595.81	67.77	672.46	98.77	775.83	99.43
Currently working	0.58***	0.03	0.22	0.02	0.62***	0.04	0.33	0.04
Internal locus of control	2.87*	0.03	2.94	0.03	2.98	0.03	2.98	0.04
Would seek private care	0.18***	0.02	0.08	0.02	0.37	0.04	0.31	0.04
Number of observations	**267**	**267**	**301**	**301**	**117**	**117**	**144**	**144**

*t-tests: Pairwise comparisons for each of the treatment groups and waves *** p<0.01, ** p<0.05, *p<0.1*

Table 4.4: *Difference-in differences coefficient estimates for the regression specifications modeling the effect of SP on total annual OOP health expenditures*

Panel A: *Difference-in-differences coefficients for main two-part model specification*

TWO PART MODEL	**Stata Command**	**Difference-in-differences Coefficient (MXN$, 2012)**	**p-value**
First part logit (some oop expense); second part OLS ln(total OOP|total OOP>0), w/bootstrap, cluster robust	twopm (user defined)	-2852	0.034

Panel B: *Difference-in-differences coefficients for model specifications with ln(total OOP expenditures +1) as outcome variable*

MODELS (among sample of adults 50+ with diab and/or |hyperte)	**Stata Command**	**Difference-in-differences Coefficient ln(MXN$)**	**p-value**
Naive OLS, w/bootstrap, robust	diff (user defined)	-2.175	0.0000
Fixed effects	xtreg	-2.2	0.0000
Random effects, robust	xtreg	-2.15	0.0000
Mixed effects (multilevel model, 3 levels: observations, individual, household)	mixed ||household: ||id:	-2.15	0.0000
PSMDID regression estimator, _weight as extra covariate (based on xtreg, re robust)	xtreg	-2.192	0.0000
SENSITIVITY ANALYSES (among sample of adults 50+)			
Random effects, robust	xtreg	-0.989	0.0000

4.8 Appendix

Figure 4.2: *Derivation of Treatment and Control Groups*

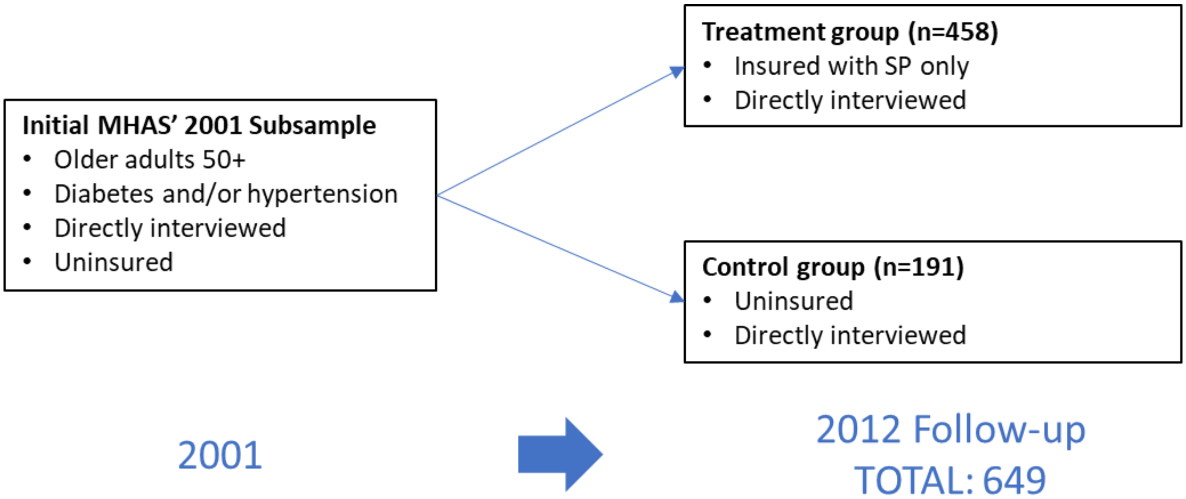

Table 4.5: *Original Study Sample*

	Number of respondents excluded	Number remaining
MHAS 2001		15,186
Restricting to those aged 50+ with diabetes and/or hypertension	9,199	5,987
Deceased 2001-2003	296	5,691
Deceased 2003-2012	1,473	4,218
LTFU 2001-2012	778	3,440
Proxy-interviewed in 2001 or 2012	493	2,947
Original treatment group: No insurance 2001- SP (only) in 2012*	na	458
Original control group 1: No insurance in either year*	na	191

** Note: Both the treatment and control groups include MHAS respondents who were interviewed directly in each of the two waves.*

Table 4.6: *Full results of Two-Part Model*

(6a) First part: logit

Total OOP expenditure	Coef.	Robust Std. Err.	P>|z|
Treatment/Control Group			
Treatment	0.500616	0.2486777	0.044
Pre-SP/Post-SP			
Post-SP	1.32606	0.2770362	0.0000
Treatment/Control#Pre-SP/Post-SP			
Treatment#Post-SP	-1.45891	0.3262819	0.0000
Female	-0.19089	0.217285	0.38
Married	0.187766	0.1719319	0.275
Formal education	0.024281	0.0329501	0.461
Occupation			
Blue-collar	0.807391	0.4351728	0.064
Agriculture	0.899453	0.4933154	0.068
Urban	0.321771	0.207493	0.121
Would seek private care	0.489608	0.2261145	0.03
Internal locus of control	0.007523	0.1833326	0.967
Currently working	0.16313	0.1800293	0.365
Diagnosed with respiratory disease	0.902538	0.3707269	0.015
Diagnosed with diabetes	0.099584	0.1882768	0.597
Assets (1000 MXN$, 2012)	7.11E-05	0.0000792	0.369
Age (yrs)	-0.01858	0.0114344	0.104
Indigenous language	-0.31645	0.257335	0.219
Health Status			
fair+	0.670744	0.2006936	0.001
poor	0.977211	0.2415853	0
Ever smoker	-0.29653	0.1775617	0.095
Per capita medical units*1000	-0.21364	0.0884708	0.016
Per capita primary physicians*1000	0.001562	0.0575705	0.978
Constant	-0.22142	1.103945	0.841

450 clusters in id for the first part

(6b) Second Part: regress_log

Total OOP Expenditures	Coef.	Robust Std. Err.	P>|z|
Treatment/Control			
Treatment	-0.07167	0.2293499	0.755
Pre-SP/Post-SP			
Post	-0.02643	0.2287543	0.9080
Treatment/Control#Pre-SP/Post-SP			
Treatment#Post-SP	-0.44719	0.2861683	0.118
Female	0.058804	0.2057542	0.775
Married	0.214636	0.1610132	0.183
Formal education	0.094562	0.0285782	0.001
Occupation			
Blue-collar	0.63959	0.4108378	0.12
Agriculture	0.96517	0.4678364	0.039
Urban	-0.00271	0.1688737	0.987
Would seek private care	0.590849	0.201493	0.003
Internal locus of control	0.132737	0.1581807	0.401
Currently working	-0.39731	0.1673769	0.018
Diagnosed with respiratory disease	0.566617	0.2770236	0.041
Diagnosed with diabetes	0.061597	0.1573854	0.696
Assets (MXN$, 2012)	0.000263	0.0000616	0
Age (yrs)	0.017978	0.010599	0.09
Indigenous language	-0.51087	0.2586894	0.048
Health status			
Fair+	0.275726	0.2134936	0.197
Poor	0.682431	0.2428924	0.005
Ever smoker	-0.27231	0.1660417	0.101
Per capita medical units*1000	0.122229	0.1010136	0.226
Per capita primary care physicians*1000	-0.00323	0.0441959	0.942

389 clusters in id for the second part

(6c) Margins for interaction:

	Delta-method		
	Margin	Std. Err.	P>|z|
Treatment/Control#Pre-SP/Post-SP			
Control#Pre-SP	3670.49	829.0932	0.00000
Control#Post-SP	4928.747	802.2252	0.00000
Treatment#Pre-SP	3989.064	641.8974	0.00000
Treatment#Post-SP	2394.802	387.9811	0.00000

Number of obs = 829

(6d) Bootstrapped standard errors for margins (overall conditional mean)

	Observed Coef.	Bootstrap Std. Err.	P>|z|
_cons	3563.489	508.5133	0

Number of obs = 829
Replications=1000

(6e) Bootstrapped marginal effects (marginal effects, averaged over the sample)

	Observed Coef.	Bootstrap Std. Err.	P>|z|
Treatment/Control#Pre-SP/Post-SP			
Control#Pre-SP	3670.49	1006.465	0.00000
Control#Post-SP	4928.747	970.4377	0.00000
Treatment#Pre-SP	3989.064	742.8475	0.00000
Treatment#Post-SP	2394.802	443.5178	0.00000

Number of obs = 829
Replications=1000

(6f) Statistical significance of interaction term coefficient

	Coef.	Std. Err.	P>|z|
-1	-2852.52	1347.979	0.034

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5. `CHAPTER 5 – Conclusion to the Dissertation

This dissertation focused on analyzing the medium-term effects of Seguro Popular on health-related outcomes both from a general, state-level perspective and from an individual-level point of view (in particular, among older Mexican adults with chronic diseases). In general, results from the three research studies presented in Chapters two, three and four of this dissertation suggest that SP is positively associated with health care utilization and negatively associated with out-of-pocket expenditures. This is encouraging from a policy standpoint, given that the launch of Seguro Popular has been one of the highlights of Mexican health reform during the present century, and especially because increasing access and providing affordable health care services to the population were among the program's core objectives. In addition, addressing whether Seguro Popular is meeting the health needs of older Mexican adults with chronic conditions, one of the most vulnerable sectors of the population, is essential in light of the current demographic and epidemiologic transitions that are currently imposing a considerable economic and social burden on the country.

By taking into account Mexico's state-level heterogeneity and within the context of a decentralized system, in the first study (presented in Chapter two of this dissertation), I used a 2008-20012 panel dataset at the state level with the main aim to analyze whether higher levels of Seguro Popular health-related resources have translated into greater outpatient health care utilization in the states. In addition, I explored whether higher state-level expenditures were associated with higher Seguro Popular enrollment rates and with a greater availability of health-related resources in the states. Results, which were robust to the implementation of several non-equivalent empirical specifications accounting for the non-independence of observations, suggested that a greater availability of medical personnel at the state level was associated with higher outpatient utilization. Similarly, although results indicated that higher (annual) state-level Seguro Popular expenditures were positively associated with the availability of medical personnel, higher expenditures were *strongly* associated with greater enrollment rates in the states. Given that states have incentives to increase the number of Seguro Popular affiliates to receive more federal funds, these results might imply that instead of investing on additional health-related resources (which could translate into greater outpatient health care utilization rates and eventually into improved health outcomes), some states would choose to enroll more individuals in SP. This decision could therefore undermine the beneficial effects of Seguro Popular among its recipients and could potentially lead to problems in the implementation of the program. In this respect, I argue that Seguro Popular's current decentralized structure, which involves a lack of control from federal authorities on how Seguro Popular funds are spent by the states and a poor of coordination between the central and local health authorities, may have led to a large heterogeneity across states with regards to the implementation of Seguro Popular. This heterogeneity, in turn, is likely to have resulted in the mismanagement of resources and in the health outcomes and health care utilization inequalities that have been documented in the literature. Therefore, I recommended the development of a more centralized system that includes mechanisms that give more control to federal health authorities, enhance coordination between the federal and state levels and establish additional regulations to improve states' accountability of resources. Finally, to avoid states' perverse incentives to enroll SP members with the aim to receive additional federal funds, I argue that the allocation of federal funds to states should be based on states' health needs and according to states' performance on meeting pre-specified goals and quality standards instead of on the number of affiliates. This study was the first to incorporate heterogeneity across Mexico's states (in terms of spending and availability of health-related resources) and one of the first to analyze the implementation of SP from a state-level perspective. Moreover, an additional strength of this research study was that it relied on longitudinal data. However, this study was not exempt from some limitations. In particular, the paper had data limitations because it relied only on publicly available information on Mexico's states. Additional data on the operation of Seguro Popular at the state level, as well as health characteristics in each of the states could help shed more light on the relationship between SP expenditures, availability of health-related resources, health care utilization and other outcome measures. Furthermore, future studies should formally test for mediation effects that may exist between SP expenditures and outpatient health care utilization.

Chapters three and four of this dissertation focused on analyzing the medium-term effects of Seguro Popular among the population of older Mexican adults with diabetes and/or hypertension. The analyses in both of these chapters were at the individual level and employed data from the 2001 and 2012 waves of the Mexican Health and Aging Study, a longitudinal, nationally representative survey of Mexican adults aged 50 and more.

In Chapter three, I implemented several difference-in-differences empirical specifications to examine the impact of Seguro Popular on health care utilization. In line with the results from Chapter two, I found that expansion of health insurance coverage through Seguro Popular has resulted in increased health care utilization rates. In particular, individuals who were enrolled in Seguro Popular were associated with higher levels of health care utilization, compared to those who were uninsured and results proved robust to the implementation of alternative panel regression models. One of the great strengths of research study was related to the use of longitudinal data from a nationally representative sample of older Mexican adults. In addition, the study controlled for the potential self-selection to SP by implementing propensity score matching difference-in-differences (PSMDID) models. However, one of the main drawbacks of this study was that it did not address reverse causality that might exist between health care utilization and affiliation to SP. Furthermore, the analyses did not incorporate sampling weights; thus, results might not be generalizable to the population of older Mexican adults with diabetes and/or hypertension in Mexico. Confronted by limitations to test the validity of the parallel trends assumption more formally, this research study did not provide evidence that such an assumption is valid. Future studies should address these limitations by taking sampling weights into account, using alternative methodologies (such as instrumental variables approach to analyze the possibility of reverse causality), other nationally representative surveys to check for robustness of results.

In Chapter four, I used a two-part difference-in-differences regression model as the main empirical strategy to address whether older Mexican adults with diabetes and/or hypertension who were enrolled in Seguro Popular had lower out-of-pocket expenditures compared to individuals with similar characteristics but who were uninsured. As was hypothesized, I concluded that, in the medium-term, health insurance coverage through Seguro Popular has led to a protective financial effect among the population of older Mexican adults with diabetes and/or hypertension and these results were robust to alternative difference-in differences regression specifications, including the implementation of a PSMDID approach that accounted for self-selection to SP. Along with the use of longitudinal data from a nationally representative sample of older Mexican adults, the implementation of the two-part model was one of the main strengths of this study because it accounted for the dependent variable's skewed distribution. However, this study had some limitations. As in Chapter three, analyses did not use survey weights which might preclude the generalizability of results to the population of older Mexican adults with chronic conditions. Similarly, results from analyses attempting to check for the validity of the parallel trends assumption were not conclusive and attrition analyses suggested that individuals in the treatment group were somewhat different from those in the control group. Future studies should address these limitations.

In summary, results from the three studies in this dissertation suggest that the Seguro Popular program is associated with increased outpatient health care utilization rates and with a reduction in out-of-pocket expenditures, in line with existing evidence from studies analyzing the effect of the program on health-related outcomes. Therefore, extending health insurance coverage to the previously uninsured individuals through Seguro Popular may be an effective strategy that might help towards the achievement of improved health outcomes amongst Mexicans.