

Non-Contributory Health Insurance and Household Labor Supply: Evidence from Mexico

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Abstract

A central topic in the global health agenda is universal health coverage (UHC). The primary goal of social health insurance schemes is to protect beneficiaries from the health and financial consequences of adverse health events. While in this sense there is scope for government intervention in providing insurance, the impacts of UHC on labor markets in developing countries are less clear. We study this issue using the case of Mexico, which introduced in 2002 a non-contributory health insurance scheme directed to the half of the country's population uncovered by Social Security protection (the *Seguro Popular*, SP). Since before SP uninsured individuals could only access affordable health care through their employer, the introduction of

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a non-contributory public health insurance scheme could have resulted in large effects on the labor market. In practice, SP is a transfer(tax) to the informal(formal) sector workers and to the nonemployed. On the one hand, if the value placed on SP benefits is high, the introduction of fully subsidized health insurance can lead to negative impacts on employment and/or formality. On the other hand, wages in equilibrium might compensate the increase in benefits in the informal sector, in which case the impact on formality and employment is ambiguous. We start analyzing the effects of SP on labor market outcomes by exploiting its staggered introduction across municipalities using a difference-in-differences strategy on the Mexican Labor Force Survey data. We show that the implementation of SP in a municipality is associated with an increase in informality by 4% for low-education families with children. Then, to study why the policy change had limited impacts on the labor market, we develop and estimate a novel household search model which incorporates the value of SP as well as the pre-reform valuation assigned to the amenities in the formal sector relative to the alternatives (i.e., informal sector and non-employment), in order to understand whether access to free health services is valued by household members when they make their labor market decisions. Our structural model is able to replicate both the stocks of household types by Social Security coverage and the transitions in and out of employment and between formal and informal jobs in the pre-reform period. The results show that the steady-state marginal willingness to pay for the health insurance coverage provided by SP is very low, amounting to only 1.3% to 4.2% of the mean wage in the informal sector. Lastly, using the model to simulate counterfactual scenarios of employment and labor formality under different valuations of the new health system implemented in Mexico, we find that the willingness to pay for SP would have had to be significantly greater than it was to have substantial impacts on the economy.

JEL Codes: I13, J33, J42, O17

Keywords: Health Insurance, Social Security, Informality, Mexico.

1 Introduction

A central topic in the global health agenda is universal health care coverage. The World Health Organization (WHO) has defined universal coverage as access for all people to comprehensive health services at affordable cost and without financial hardship through protection against catastrophic health expenditures (WHO, 2010). The primary goal of social health insurance schemes is to protect beneficiaries from the health and financial consequences of adverse health events. Many households lack sufficient financial resources to purchase essential health care, resulting in poor health conditions. While in this sense there is scope for government intervention in providing insurance, the impacts of universal health coverage on labor markets in developing countries are less clear. We study this issue in the context of a big health insurance expansion in Mexico.

The *Seguro Popular* (SP) was introduced in 2002 in Mexico as a non-contributory health insurance program and it was directed to the half of the country's population, uncovered by social protection or employer provided health insurance (the informal sector workers and the nonemployed). Prior to 2002, health insurance in Mexico was tightly linked to employment. One of the few free health insurance services before SP was provided through the conditional cash transfer *Oportunidades* (now re-branded as *Prospera*, and called *Progresa* until 2002), which targets poor families with children; however most families without children would not have access to other free health care. After 2002, half of the population of Mexico who was uncovered by employer-provided health insurance was eligible for SP.

Since prior to SP uninsured individuals could only access affordable health care through their employer, the introduction of a non-contributory public health insurance scheme could have resulted in large effects on the labor market. In practice, the SP is a transfer(tax) to informal(formal) sector workers and to the nonemployed.¹ On the one hand, if the value placed on its benefits is high, SP can lead to a negative impact on employment and/or formality rates. On the other hand, wages in equilibrium might compensate the increase in benefits in the informal sector, and in this case, the impact on formality rates and employment is ambiguous. Thus, the labor supply and welfare impacts of a non-contributory health insurance program like SP depend on how firms in each sector adjust wages given benefits, on the allocation of workers and firms across sectors and on how the new free health services are valued by families.

In this paper, we analyze the effects of SP on labor market outcomes. We start by exploiting its staggered introduction across municipalities in Mexico in a difference-in-differences strategy. Using data from the Mexican Labor Force Survey between 2000 and 2012, we show that the implementation

¹This concern was voiced in the Mexican press (see, for example, <http://archivo.eluniversal.com.mx/finanzas/59102.html>).

of SP in a municipality is associated with an increase in informality among low educated households with children of 3.2 percentage points (4%).

Although reduced form estimates are crucial to understand whether the reform had significant impacts or not, they are not informative about the mechanisms through it worked, and they do not allow to perform counterfactual simulations or welfare analysis. Differently from the literature on developing countries, we consider household labour supply rather than individual choice, since both in the old and in the new system household members could be enrolled at small or zero costs. Thus, to understand how access to free-health services is valued by households members when they make their labor market decisions, we develop and estimate a household search model which incorporates the value of SP as well as the pre-reform valuation assigned to the amenities in the formal sector relative to the informal sector or non-employment. In the model, workers search randomly on and off the job and they may receive offers from formal or informal firms. The nonemployed and informal sector workers are not entitled to any employment protection benefits, whereas the formal sector workers receive employer-provided health insurance and other benefits secured by labor laws (for example, guaranteed minimum wage, retirement pensions and redundancy payment).

We model the choices of the members of the couple (heads and spouses) to capture the main features of social protection systems and labor markets like the Mexican. In particular, one further innovation of our model is that each of the members of the couple decides between three possibilities: working in the formal or informal sectors or not working at all. If one of the members decides to work in the formal sector, then the other spouse will automatically be covered by Social Security.² Children in the family are eligible to be covered by Social Security if they are under the age of 16. If none of the members works in the formal sector, the household is uninsured and, as such eligible to SP after its implementation.

The model is estimated using the Mexican Labor Force Survey data for the period before the introduction of SP in the municipality of residence of the household. The model is estimated for eight different groups based on demographic (education of the head and presence of children) and geographic (North versus South states) characteristics, to capture heterogeneity in health status/shocks and supply of health services.

The model is able to replicate the stocks of household types according to job status and the transitions in and out of employment and between formal and informal jobs for the period before the implementation of SP. The results show that the steady-state marginal willingness to pay for the health insurance coverage provided by SP is very low, amounting to only 1.3% to 4.2% of the mean wage in the informal sector. We then use the estimated model to simulate counterfactual scenarios of employment and labor formality in which we change the valuation of SP. We find that the willingness

²The spouse is entitled to coverage at a subsidized price.

to pay for SP would have had to be significantly greater than it was to have substantial impacts on the economy.

The paper proceeds as follows. In the next section, we describe the main features of SP and context in which it was introduced. In Section 3 we present a summary of the literature on the labor market effects of non-contributory health insurance schemes and economies with formal and informal sectors. Section 4 describes the data. In Section 5 we present reduced form estimates of the impact of implementing SP in a municipality on informality rates and on the distribution of wages in the formal and informal sectors. In Section 6 we present our model and in Section 7 we describe the estimation procedure used. The estimates from the structural model are presented in Section 8. Conclusions are in Section 9.

2 Background

We now describe the health system in Mexico and the context in which the health reform occurred.

2.1 The Mexican Health System and the Seguro Popular

The Health Care System before *Seguro Popular* Before SP, health care in Mexico was characterized by a two-tiered system. About half of the population was covered through a contributory system (still in place today) guaranteed by the Social Security Institutions: the Mexican Social Security Institute (*Instituto Mexicano del Seguro Social*, IMSS), covering the private sector workers; the Institute for Social Security and Services for State Workers (*Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado*, ISSSTE), covering the civil servants; and Mexican Petroleums (*Petroleos Mexicanos*, PEMEX), covering the employees in the oil industries. Health coverage was provided by these institutions in public hospitals; however, individuals could also pay for care in private hospitals, or buy private health insurance. In 2000, IMSS covered 40%, and ISSSTE 7% of the population, respectively (Frenk et al., 2006).

Health care was also available to the poor through two programs. The first one was the Expansion of Coverage Program (*Programa de Ampliacion de Copertura*, PAC), which started in 1996 and consisted of brigades visiting the more rural and marginalized areas of the country. Besides PAC, part of the uninsured population had access to basic health services through the Program for Education, Health and Nutrition (*Programa de Educacion, Salud y Alimentación*, Progresá). This was launched in 1997 in rural areas as the main anti-poverty program in Mexico; it was renamed *Oportunidades* in 2002 and expanded to urban areas. The program has some overlap with SP, since it includes a health component offered in medical units managed by the IMSS-Oportunidades and *Secretaria de*

la Salud (Ministry of Health).³

The uninsured population not covered by PAC or *Progresa* could seek health care either in public health units run by the Ministry of Health (*Secretaria de Salud*, SSA) or in private ones. In both cases, payment was at the point of use and patients had to buy their own medications. Hence, in 2000, approximately 50% of health expenditures was classified as “out-of-pocket expenses” (Frenk et al., 2009), and 50% of the Mexican population - about 50 million individuals - had no guaranteed health insurance coverage.

The Implementation of *Seguro Popular* SP was launched as a pilot program in 2002 in 26 municipalities (in 5 states: Campeche, Tabasco, Jalisco, Aguascalientes, Colima) under the name Health for All (*Salud para Todos*), with the aim to extend it gradually to the rest of the country. During 2002, 15 additional states⁴ implemented the program, and by the end of 2003, six additional states⁵ had joined, for a total of 613,938 families enrolled.

The System of Social Protection in Health (*Sistema de Protección Social en Salud*, SPSS) was officially introduced on January 1st 2004 by the General Health Law (*Ley General de Salud*, LGS), with the aim to extend health coverage to the eligible population. According to the rules of operation of SP, the expansion should prioritize states with: (1) low social security coverage; (2) large number of uninsured in the first six deciles of income; (3) ability to ensure the provision of services covered by the program; (4) potential demand for enrollment; (5) explicit request of the state authorities; (6) existence of sufficient budget for the program. In 2004, three more states introduced the program (Nayarit, Nuevo Leon and Querétaro). The last three states (Chihuahua, Distrito Federal and Durango) joined SP in 2005.

Eligibility and Enrolment Individuals not beneficiaries of social security institutions are eligible to SP. Enrollment in the program is voluntary, and granted upon compliance with simple requirements (proof of residence in the Mexico, lack of health insurance, ascertained with self-declaration, and the

³First, *Progresa* beneficiaries receive free of charge the Guaranteed Basic Health Package (*Paquete Básico Garantizado de Salud*), which includes a set of age-specific interventions; second, the nutrition of both children and pregnant women is monitored through monthly consultations (and nutritional supplements are distributed in case of malnutrition); third, information on preventive health behaviors is provided through community workshops; fourth, emergency services are secured by the Ministry of Health, IMSS-Oportunidades (the dedicated network of medical units for families enrolled in the program) and other state institutions (only in relation to pregnancy and child-birth); lastly, beneficiary families protected by Social Security have also access to second- and third-level care in the units administered by IMSS, while those unprotected have only limited access to second-level care. See <http://www.normateca.sedesol.gob.mx/es/NORMATECA/Historicas> (accessed May 10th 2015).

⁴Baja California, Chiapas, Coahuila, Guanajuato, Guerrero, Hidalgo, Mexico, Morelos, Oaxaca, Quintana Roo, San Luis Potosi, Sinaloa, Sonora, Tamaulipas and Zacatecas.

⁵Baja California Sur, Michoacán, Puebla, Tlaxcala, Veracruz and Yucatán.

individual ID). By April 2012, 98% of the Mexican population was covered by some health insurance (Knaul et al., 2012).

Coverage and Delivery of Health Services Once a family is enrolled in SP, it is assigned a health center (that is associated to a hospital) and a family doctor for primary care. The family has access to a package of health services with the number of interventions covered increasing yearly, from 78 in 2002 to 284 in 2012 (Knaul et al., 2012). A wide range of services were included, from prevention, family planning, prenatal, obstetric and perinatal care, to ambulatory, emergency and hospital care, including surgery. The basic coverage was complemented in 2004 with the introduction of the Fund for Protection against Catastrophic Expenses (*Fondo de Protección contra Gastos Catastróficos*, FPGC) to support the financing of care for high-cost diseases typically associated with premature death—such as breast and womb cancer, and child leukemia. A further expansion took place in 2006 with the introduction of Health Insurance for a New Generation (*Seguro Médico para una Nueva Generación*, SMNG), which offers a specific package of services for children under five.

The non-contributory and the contributory systems have separate networks of hospitals and health centers, each to serve its own affiliates and the health services covered by the SP are delivered in the hospitals and health centers run by the *Secretaría de la Salud* (Health Ministry).

Funding SP is funded by revenues from general taxes, on the basis of a tripartite structure similar to that adopted by the two major social insurance agencies in Mexico, IMSS and ISSSTE: (1) a social contribution from the federal government; (2) solidarity contributions from both the federal government and the states; (3) and a family contribution (in 2010, 96.1% of the enrolled families were exempted from paying it on the basis of scarce resources; own calculations from the registry of enrolled families, the *Padrón*).

Between 1999 and 2007, the ratio of the total public expenditure on health to GDP was stable at 2.6%. This was one of the lowest figures among OECD countries (the corresponding figures for Denmark – country with the highest share – and Brazil in 2004 were 8.2% and 3.4%, respectively). Between 1999 and 2004, the ratio of the total public expenditure on health to GDP for insured (not eligible) and uninsured (eligible) was 1.8% and 0.9%, respectively. After 2004, the ratio for the uninsured (eligible) experienced a steady increase, from 1% to nearly 1.5% in 2009 (see Figure A.1).

Supply of Health Care One of the goals of the health reform was to increase investment in health care infrastructure and to achieve a more equitable distribution of health care resources. Thus, the proportion of the Ministry of Health budget devoted to investment in health infrastructure increased from 3.8% in 2000 to 9.1% in 2006, with the construction of 2,284 outpatient clinics and

262 (community, general and specialized) hospitals between 2001 and 2006;⁶ as a consequence, the number of municipalities covered by each hospital declined from a 2000 average of 7 to a 2010 average of 5. Facilities providing services under the insurance scheme had to be accredited, which required the existence of enough resources to provide the covered interventions (Frenk et al., 2009). Thus, the gap between individuals covered and not by Social Security was reduced in terms of the availability of general and specialist doctors, nurses and beds (Knaul et al., 2012). Poor municipalities were prioritized in the allocation of resources (Conti and Ginja, 2016).

2.2 Other policy changes

The period studied (2000-2012) was relatively stable with respect to policy changes that could have affected the labor market choices of individuals. We briefly summarize here the reforms in the pension system, taxes and child care system (see Appendix B).

The current Mexican pension system is characterized by two parallel systems, where a contributory social security system with a package of defined benefits for formal workers in the private and public sectors coexists with a set of fragmented noncontributory services and benefits offered through diverse social protection programs to the population living in poverty, with low income, and in the informal sector. The largest reform on the Social Security took place in 1997, when the *IMSS* (the Social Security system for workers in the private workers) switched the pay-as-you-go (PAYG) system to a fully funded system with personal retirement accounts. The tax system also remained largely unchanged between 2000 and 2012.

Finally, the child care system underwent a reform which potentially may affect the relative value of the informal sector. Between 2007 and 2010, the government introduced the program *Estancias Infantiles para Apoyar a Madres Trabajadoras* (Child Care Centers to Support Working Mothers), which covers approximately 90 percent of the cost of enrolling a child under age four at a formal child care center and it targets women who are looking for work, in school, or working, that live in families without Social Security coverage (Calderon, 2012).

3 Literature Review

SP and informality in Mexico The evidence on the labor market effects of SP is mixed (see the review by Bosch et al. (2012)). The estimates range from no impact on the informality rates (Gallardo-Garcia, 2006; Barros, 2008; Campos-Vazquez and Knox, 2010; Aguilera, 2011) to small

⁶In the public sector as a whole, 1,054 outpatient clinics and 124 general hospitals were built in the same period (Frenk et al., 2009).

increases on the share of informal workers with less than 9 years of schooling, married women with children or caring for older adults ([Azuara and Marinescu, 2013](#); [Aterido et al., 2011](#); [Pérez-Estrada, 2011](#); [Bosch and Campos-Vazquez, 2014](#)). [Aterido et al. \(2011\)](#) find that SP is associated with a reduction on the flow out of unemployment and out of the labor force, but [del Valle \(2014\)](#) finds the women in families with disable or dependent individual reduce unemployment and inactivity to become informal workers.

Few papers analyze the effects of SP on wages, and the findings range from no effects ([Barros, 2008](#); [Azuara and Marinescu, 2013](#)) to negative impact on informal wages ([Aterido et al., 2011](#); [Pérez-Estrada, 2011](#)).

Finally, regarding the effects of SP on broader measures of welfare, there is some indirect evidence through lower wages in the informal sector ([Aterido et al., 2011](#); [Pérez-Estrada, 2011](#)), reduction in child mortality and increase in the use of medical services in poor municipalities ([Conti and Ginja, 2016](#)), a decrease in miscarriages ([Pfutze, 2014](#)), and no effect on health outcomes ([Knox, 2008](#); [King et al., 2009](#); [Barros, 2008](#)).

Health Insurance Reform in US and Labor Market Recent reforms in the US health insurance system which relaxed the link between employment and the provision of health insurance are associated to a stream of papers studying the effects of public health insurance on labor supply. [Baicker et al. \(2014\)](#) use a recent expansion in the eligibility to Medicaid in Oregon and find no effect on employment, but an increase in welfare dependence. [Kolstad and Kowalski \(2016\)](#) use the 2006-Massachusetts Health Reform and find compensating wage differentials due to employer provided health insurance, but no effects on employment or wages associated to the Reform. [Garthwaite et al. \(2014\)](#) estimate large increases in the labor supply associated to an abrupt reduction in the Medicaid coverage in Tennessee.

Theory Our approach relates to two lines of work. On the one hand, it relates to [Dey and Flinn \(2008\)](#), who use a household search framework to estimate the marginal willingness to pay for employer-provided health insurance for the US. The authors show the importance of taking into account the spouse’s job status to recover unbiased estimates of the WTP. [Aizawa and Fang \(2013\)](#) incorporates health shocks into a labor search model. [Fang and Shephard \(2014\)](#) estimate a household search model like [Dey and Flinn \(2008\)](#), but adding health shocks and endogenous compensation packages comprising a wage and a menu of insurance offerings (premiums and coverage) that workers select from.

On the other hand, our paper extends the literature on search with formal and informal sectors by allowing for intra-household dependency in labor market decisions. The literature of search

segmented into formal and informal sectors is recent, but two papers are particularly relevant for our study. [Albrecht et al. \(2009\)](#) model formal and informal sectors following [Mortensen and Pissarides \(1994\)](#) and they assume workers can only move to the formal sector from unemployment. Their model is used to simulate impact of tax policies in the formal sector. [Meghir et al. \(2015\)](#) model formal and informal sectors extending the [Burdett and Mortensen \(1998\)](#) approach. They estimate the model for Brazil and then simulate the impact of increasing the cost of informality. Our paper builds a bridge between these two lines of work by estimating a household search model with three sectors.

Finally, we also relate to [Finkelstein et al. \(2015\)](#) who recover the welfare benefit to recipients per each dollar spent in Medicaid. They find it varies between \$0.2-\$0.4. And we contribute to the health economics literature on computing the willingness to pay for health insurance using contingent valuation methods, especially in developing countries ([Ahmed et al., 2016](#)).

4 Data

In this paper we use data from two main sources.

Padrón This is the consolidated registry of all families with a valid enrolment in Seguro Popular by December 31st of each year between 2002 and 2010; it is used by the Federal Government and by the States to decide the funds to be allocate to the program. The data contains detailed demographic and socioeconomic characteristics of the enrolled families, including employment status, occupation and assets. It also contains information on the exact date of affiliation, residence and the identifiers of the health center and general hospital assigned to each family at the time of enrolment in the program. The exact date of affiliation of each family is used to construct the treatment indicator: the date of implementation of the program at the level of the municipality. For the years 2002 and 2003 (in which the program ran as a pilot), only information on the date of enrolment and on the state of residence was recorded. Since each family has a unique identifier, we are able to identify the exact date of implementation of SP in a given municipality by backtracking the relevant information from the subsequent years. We have then confirmed the accuracy of the implementation date obtained with this procedure by cross-checking it against the official list of municipalities which adopted SP in the pilot period.

In the absence of a formal definition, we consider that SP is introduced in a municipality when the number of families affiliated to the program is at least 10. We adopt this number for a variety of reasons. First, we prefer an absolute to a percentage measure since we want to capture the fact that the residents of a municipality can use the services provided by SP (and not the fact that a certain

proportion of the population had been covered). This low threshold aims to capture the exogenous rollout determined by the authorities, rather than endogenous individuals sign-ups which could arise if the threshold was set as a proportion of the population in the municipality. [Conti and Ginja \(2016\)](#) show that their estimated impacts on health are not sensitive to the choice of this definition.

Encuesta Nacional de Empleo (ENE) 2000-2004 and Encuesta Nacional de Ocupación y Empleo (ENOE) 2005-2012 We use quarterly data from the National Employment Surveys of Mexico, which is a rotating panel at the individual and household level and it covers more than 11 million individuals from the second quarter of 2000 to fourth quarter of 2012 between 18 and 65 years old. From this data set we observe the Social Security status of a specific individual across quarters, as well as his/hers labor income when employed.

An individual is an informal worker if he/she does not have access to health services provided by his/her job through one of the Social Security institutions in the country (IMSS, ISSSTE or PEMEX). Since Social Security coverage is extended to the spouse and children in the household, a household is considered informal if the head or the spouse do not have Social Security coverage through the job contract. We do not distinguish between self-employed and informal employees, as the definition of informality depends on the Social Security coverage.

All monetary values are deflated to the first quarter of 2011 using the CPI of Banco de Mexico.

Construction of the sample The ENE covers just over 640 municipalities every quarter, whereas the ENOE covers about 1000. To keep a consistent sample of municipalities throughout the period in analysis, we focus on the sample of municipalities surveyed since 2000. Thus, we restrict our attention to municipalities only in ENE and ENOE. That is, 640 municipalities. Then, we impose the additional restriction that a municipality must be present in the data at least for 2 years (8 quarters), which reduces the sample to 628 municipalities.

We restrict the sample to households where the head is married and between 20 (where the chance of returning to full-time education is very low among the low educated) and 59 years old, who are still not eligible for any non-contributory pension program for poor elderly.⁷ The restriction to married households individuals discards 22% (243,229) households. Finally, we drop 7% of households where the head of household is a female (60,005 households) and 2% of households with missing information about the gender of the spouse (21,604 households). Our final sample includes 748,181 households.

The minimum wage is binding in Mexico and it should be the minimum amount paid to all formal

⁷In Mexico 65 is the usual retirement age, but the participation rate among informal workers is very high among individuals between 65 and 70 years (47% and 6% of males in this age range report to be informal and formal workers, respectively); own calculations from the ENE/ENOE.

employees. After imposing the restrictions above, only 1% of the workers under a formal contract earns less than the minimum wage, and we drop these individuals.

We follow individuals for three months between their first and second surveys. We focus only on transitions between the first and second interviews since about half of the observations households-quarter whose head is 20 to 59 years old are observed only in the first and second interviews only. In the data, we identify job-to-job transitions, unemployment-to-job, or job-to-unemployment transitions during this period. For each individual in our sample (ie, heads and their spouses), we observe the employment status in the first and second interviews. From the second interview, we construct the transition indicators and we observe the wage among individuals (ie, heads and their spouses) who transitioned from non-employment to formal or informal work.

We present results for the sample of high and low educated families, where we define a family to be in the low education group if the head has at most 6 years of completed education. This corresponds to elementary education in Mexico and in 2001, just before the implementation of SP, 40% families in our data were in this group. We also allow for heterogeneity by the presence of children under 15 in the household for two reasons. First, the package of services covered by SP is specially generous for conditions prevalent among poor children (such as treatment of respiratory and intestinal infections). Second, the extension of coverage of Social Security to children depends on the age of the child. If the parent works in the private sector the coverage is extended to children under 16 (under 25 if they are studying) or if under 18, in case the parent works in the public sector. To keep the model treatable, we do not distinguish between parents working on private and public formal sectors, thus we use the most stringent definition, which also coincides with the age at which children terminate mandatory education in Mexico.⁸

The estimates for the structural model are also presented by region of residence, in particular, whether the family resides in the north and south of Mexico, which vary in the level of poverty, according to the index of marginalization of 2000. The Northern includes the states of: Baja California, Baja California Sur, Chihuahua, Durango, Sinaloa, Sonora, Coahuila, Nuevo Leon, Tamaulipas, Aguascalientes, Guanajuato, Querétaro, San Luis Potosí, Colima, Jalisco, Michoacán, Nayarit and Zacatecas. The Southern includes the following states: Distrito Federal, Mexico, Morelos, Hidalgo, Puebla, Tlaxcala, Veracruz, Campeche, Quintana Roo, Tabasco, Yucatán, Chiapas, Guerrero and Oaxaca.⁹

⁸We consider the presence of children under 15 in the household since the Labor Force Survey does not contain the data of birth and thus, the child may be close to turn 16 at the survey date at which she would lose eligibility to Social Security coverage if not enrolled in school.

⁹The index of marginalization is constructed by CONAPO (*Consejo Nacional de Población* - National Population Council) and it can take five possible values: Very High (marginalization), High, Medium, Low and Very Low. A map with the level of marginalization of states is available in the following provided by CONAPO: http://www.conapo.gob.mx/work/models/CONAPO/indices_margina/indices/pdfs/mapas/a_1.pdf.

5 Empirical Facts

Before moving to the behavioral model, we exploit the variation in the timing of implementation of SP at the municipality level. To motivate the model developed below, we analyze the impact of Seguro Popular on the proportion of informal families, on the situation of each member of the couple (head and spouse) and on the distribution of wages for males and females within a municipality.

5.1 Basic Descriptives

We start by presenting some basic facts regarding the labor market in Mexico, using the Mexican Labor Force Survey. We consider that in each moment an individual can be (1) unemployed or out-of-the-labor-force, (2) work in the formal sector or (3) work in the informal sector.

Table 1 includes basic statistics of the data. In the table we include the employment status and wages for both heads and their spouses taken just before the introduction of SP in 2001 and after the introduction of SP (we choose the year of 2007, this is year when the program reached all municipalities in our sample). The statistics are presented separately for two groups of education: high education households (where the head has more than 6 years of education) and low education (if the head has at most 6 years of education). The table shows that prior to the introduction of SP about 36% of households in the high education group did not have Social Security coverage, and this figure reached 61.5% among the low education group. The proportion of households without Social Security coverage remained constant in the high education group, but increased by almost 4p.p. among low educated families. The second panel of the table includes the nine possible types of households according to the labor market situation of each member of the couple. Interestingly, the increase in informality among low educated families is associated with an increase in the proportion of households where both members are informal, a decrease in the share of households where both members are formal workers and a decrease in the proportion of households where the head works in the formal sector and the spouse is not working.

Table 2 shows that the salaries of both heads and spouses are lower in the informal sector than in the formal sector among low educated households. This is generally the case also among high educated households, except for high educated heads in the period before SP. The standard deviation of salaries is also higher in the informal sector. These differences reflect unobserved productivity differences between the individuals who select into the informal sector within educational groups. Between 2001 and 2007, there is an increase in salaries in the formal sector, regardless of the educational group. In the informal sector, the salaries decrease in the high education group; for low educated families the growth in salaries is half than for those in the formal sector.

5.2 Empirical Strategy

We now present evidence on the causal impacts of the introduction of SP. Figure A.3 in Appendix displays the year of implementation of SP in each municipality in Mexico, between 2002 and 2010. This graph shows that there is considerable variation, across municipalities in the timing of adoption of SP by different municipalities. Thus, we use the staggered implementation of SP across Mexico in a difference-in-differences model, where we compare changes in outcomes for municipalities that introduced SP at different years between 2002 and 2007 (the municipality that last implemented SP in our sample did it in 2007). We estimate the following model at municipality-quarter level:

$$y_{ms,qt} = \beta SP_{ms,qt} + \gamma X_{ms,qt} + \mu_{ms} + \pi_{qt} + \varphi_s t + \varepsilon_{ms,qt} \quad (1)$$

where $y_{ms,qt}$ is one of the two outcomes we study: share of informal households in a municipality-quarter and log wages (of males and females). m indexes the municipality, s the state, q indexes the quarter and t the year. $SP_{ms,qt}$ is an indicator variable equal to one if municipality m in quarter q of year t has implemented SP. The municipality of residence is measured in quarter qt .

We allow for unrestricted municipality effects μ_{ms} , which control for unobserved determinants of $y_{ms,qt}$ that are constant at municipality level and which affect the outcome independently of SP; unrestricted quarter effects π_{qt} and state-year quadratic trends $\varphi_s t$ to account for state specific trends which may affect outcomes independently of SP (such as federal-state budget agreements in place and independent of SP). The parameter of interest is β , the effect of exposure to SP, which is identified from variation across municipalities and quarters.

Conti and Ginja (2016) study in detail the determinants of the timing of implementation of SP in a given municipality. They find that after accounting for state fixed effects, earlier implementation of SP occurred in more populous and less poor municipalities, with a smaller share of eligible individuals and of population working in the primary sector, and in municipalities with a greater share of children 0-4 years old. After these are accounted for, only the availability of health centers (but not of hospitals or doctors) and the political alignment between the mayor of the municipality and the governor of the state are associated with an earlier implementation of SP in a given municipality. Health conditions and mortality were unrelated to the timing of the implementation of SP. These findings justify our choice of controls. In addition to the controls mentioned above we also include the following demographic characteristics of municipalities: the share of households in each municipality-quarter by education group (in particular, we consider four categories: incomplete primary; complete primary; complete lower secondary education; and, complete upper secondary or higher education), and by age of the head (20-29; 30-39; 40-49 and 50-59), share of households by locality size. We control also for the following linear trends in socio-demographic characteristics of the municipality residence of

the household taken in 2000: quadratic in the index of deprivation, log of total population, share of population less than 5 years old, share of population over 15 that does not know how to read and write, share of occupied individuals working on the primary, secondary and tertiary sectors; and by municipality linear trends in characteristics of the Health Ministry/SSA health sector, which is the relevant sector for SP families (the number of hospitals and health centers in 2001, total number of doctors and nurses in hospitals per 1,000 uninsured individuals, all taken in 2001). $\varepsilon_{ims,qt}$ are idiosyncratic shocks. The standard errors are clustered at municipality level to account for autocorrelation in the outcome (Bertrand, Duflo and Mullainathan, 2004).

Impact on Social Security coverage The estimates in table 3 show that the implementation of SP in a municipality is associated with an increase in the probability of loss of Social Security protection by low educated households with children of 3.2p.p. (column 1, Panel A.2). This increase in informality is driven by an decrease in the proportion of households where both members work in the formal sector (households "FF") and where the head works on the formal sector and the spouse is not working (households "FN") and an increase in the proportion of households where both members are not working (households "NN"). Panel B shows that SP is not associated to changes in the informality rates of high educated families.

Impact on Salaries We now turn to the impacts on salaries on table 4. This table shows that SP is associated to decreases in the informal sector wages of spouses by 7.4% and 5.6%, in low and high education families, respectively. This is expected through compensating wage differentials.

6 Joint Labor Search Model

6.1 The Basic Setup

We now present a labor market model, which we use to compare our causal estimates to the predictions from the model. The model parameters are estimated in the pre-reform period.

Time in the model is continuous and households seek to maximize their expected lifetime income. We consider shocks and decisions taken by spouses 1 (the head) and 2 (the spouse) in a household. Individuals can be: nonemployed (n), formal (f), or informal (i). The household enjoys instant utility given by:

- $u = w_1(j) + w_2(j) + a(1 - \mathbb{H}_i) + \gamma\mathbb{H}_i$, if both spouse 1 and 2 work
- $u = w_1(j) + b_2 + a(1 - \mathbb{H}_i) + \gamma\mathbb{H}_i$, if only spouse 1 works

- $u = b_1 + w_2(j) + a(1 - \mathbb{H}_i) + \gamma\mathbb{H}_i$, if only spouse 2 works
- $u = b_1 + b_2 + \gamma$, if neither works

with $j = \text{formal or informal}$; and \mathbb{H}_i an indicator function for informal household (when both j are not formal). Throughout the exposition we consider a household to be informal if it does not have Social Security coverage. w_1 is the labor income of spouse 1, w_2 the labor income of spouse 2, b_1 the non-labor income of spouse 1, and b_2 the non-labor income of spouse 2. In the formal sector, w is after tax wage (but before social security contributions); w in the informal sector is the gross wage.

The parameter a captures all amenities in the formal sector relative to those in the informal sector, except the value of health insurance by SP. This parameter can be negative. We assume that γ is the value of health insurance provided by Seguro Popular, which is offered when no spouse works in the formal sector. We explain below how these two parameters are identified.¹⁰

Spouse 1 and spouse 2 who face mutually exclusive shocks in the labor market. There is one exception to this: when spouse 1 has a job and spouse 2 is nonemployed, a shock that destroys the job of spouse 1 may instantly create an opportunity for spouse 2 to move the informal sector.

We consider that when spouse 1 gets a formal job opportunity, spouse 2 may go into nonemployment. The same holds for spouse 2.

6.2 Household's Value Functions

Let W_{jk} be the value function for a household where the head (spouse 1) is in status $j = f, i$ and the spouse (spouse 2) is in status $k = f, i$. Further, for $j = f, i$ we use $W_{jj}(w_1, w_2) = W_{jn}(w_1)$ if $w_2 = 0$, $W_{jj}(w_1, w_2) = W_{nj}(w_2)$ if $w_1 = 0$, and equal to $W_{jj}(w_1, w_2) = W_{nn}$ if $w_1 = w_2 = 0$. There are nine value functions.

¹⁰In this version we assume that individuals are risk neutral. In future work we will allow for risk aversion.

6.2.1 Only one member works

In the formal sector

$$\begin{aligned}
rW_{fn}(w_1) = & w_1 + b_2 + a + \delta_f^{s_1}(1 - p^{s_2})(W_{nn} - W_{fn}(w_1)) + \\
& \delta_f^{s_1} p^{s_2} \int \max \{W_{ni}(x) - W_{fn}(w_1), W_{nn} - W_{fn}(w_1)\} dF_i^{s_2}(x) + \\
& \lambda_{ff}^{s_1} \int \max \{W_{fn}(x) - W_{fn}(w_1), 0\} dF_f^{s_1}(x) + \\
& \lambda_{fi}^{s_1} \int \max \{W_{in}(x) - W_{fn}(w_1), 0\} dF_i^{s_1}(x) + \\
& \lambda_{nf}^{s_2} \int \max \{W_{ff}(w_1, x) - W_{fn}(w_1), W_{nf}(x) - W_{fn}(w_1), 0\} dF_f^{s_2}(x) + \\
& \lambda_{ni}^{s_2} \int \max \{W_{fi}(w_1, x) - W_{fn}(w_1), 0\} dF_i^{s_2}(x)
\end{aligned}$$

where p^{s_2} is the probability that spouse 2 moves from nonemployment to informal given that spouse 1 moves from a formal job to nonemployment. This is a formal household, with Social Security coverage. When the head loses the formal job, then with probability p^{s_2} the spouse gets an offer from the informal sector. In this case the household may re-evaluate its plan by considering the flow of gains if the spouse takes the informal offer ($W_{ni}(x)$) against the option of not taking it. With probability $1 - p^{s_2}$ the spouse does not get the offer from the informal sector, in which case there is no decision to be made by the household. New offers from the formal sector to the head arrive at rate $\lambda_{ff}^{s_1}$, and the household decides whether the head will take the offer or not. Empirically, we do not consider this hypothesis, since transitions within the same sector are not perfectly observed in our main data sets (ie, there is no information about whether the individual switched jobs with sector between the first and second interviews). New offers from the informal sector to the head arrive at rate $\lambda_{fi}^{s_1}$, and the household decides whether the head will take the offer or not. Job offers from the formal sector to the spouse arrive at rate $\lambda_{nf}^{s_2}$, and the household now faces 3 possibilities: (1) the spouse may take the new formal offer, (2) since the household will Social Security coverage if the spouse becomes a formal worker, then the head may quit his formal job, finally, (3) the household may do nothing (ie, the formal offer by the spouse is not accepted). Finally, job offers from the informal sector to the spouse arrive at rate $\lambda_{ni}^{s_2}$, in which case the household evaluates its current situation where the head is formal worker and the spouse non-employed against the situation where the spouse enters the informal sector.

The value function $W_{nf}(w_2)$ is similar to the above equation and its also a household with Social Security coverage. There is only an exchange of the status between spouses 1 and 2 (see Appendix

C).

In the informal sector

$$\begin{aligned}
rW_{in}(w_1) = & w_1 + b_2 + \gamma + \delta_i^{s_1}(1 - q^{s_2})(W_{nn} - W_{in}(w_1)) + \\
& \delta_i^{s_1}q^{s_2} \int \max \{W_{ni}(x) - W_{in}(w_1), W_{nn} - W_{in}(w_1)\} dF_i^{s_2}(x) + \\
& \lambda_{ii}^{s_1} \int \max \{W_{in}(x) - W_{in}(w_1), 0\} dF_i^{s_1}(x) + \\
& \lambda_{if}^{s_1} \int \max \{W_{fn}(x) - W_{in}(w_1), 0\} dF_f^{s_1}(x) + \\
& \lambda_{nf}^{s_2} \int \max \{W_{if}(w_1, x) - W_{in}(w_1), W_{nf}(x) - W_{in}(w_1), 0\} dF_f^{s_2}(x) + \\
& \lambda_{ni}^{s_2} \int \max \{W_{ii}(w_1, x) - W_{in}(w_1), 0\} dF_i^{s_2}(x)
\end{aligned}$$

where q^{s_2} is the probability that spouse 2 moves from nonemployment to informal given that spouse 1 moves from an informal job to nonemployment. This is an informal household, without Social Security coverage. When the head loses the informal job, with probability q^{s_2} the spouse has an offer from the informal sector. In this case the household may re-evaluate its plan by considering the flow of gains if the spouse takes the informal offer ($W_{ni}(x)$) against the option of not taking it. With probability $1 - q^{s_2}$ the spouse does not get the offer from the informal sector. New offers from the informal sector to the head arrive at rate $\lambda_{ii}^{s_1}$, and the household decides whether the head will take the offer or not. New offers from the formal sector to the head arrive at rate $\lambda_{if}^{s_1}$, and the household decides whether the head will take the offer or not. Job offers from the formal sector to the spouse arrive at rate $\lambda_{nf}^{s_2}$, and the household now faces 3 possibilities: (1) the spouse may take the new formal offer (conditional on the current wage of the head), (2) since the household will have Social Security coverage if the spouse becomes a formal worker, the head may quit his informal job, finally, (3) the household may do nothing (ie, the formal offer by the spouse is not accepted in which case the household remains informal). Finally, job offers from the informal sector to the spouse arrive at rate $\lambda_{ni}^{s_2}$.

The value function $W_{ni}(w_2)$ is similar to the above equation. There is only an exchange of the status between spouses 1 and 2 (see Appendix C).

6.2.2 Both members work

In the formal sector

$$\begin{aligned}
rW_{ff}(w_1, w_2) = & w_1 + w_2 + a + \delta_f^{s1} (W_{nf}(w_2) - W_{ff}(w_1, w_2)) + \\
& \delta_f^{s2} (W_{fn}(w_1) - W_{ff}(w_1, w_2)) + \\
& \lambda_{ff}^{s1} \int \max \{W_{ff}(x, w_2) - W_{ff}(w_1, w_2), 0\} dF_f^{s1}(x) + \\
& \lambda_{fi}^{s1} \int \max \{W_{if}(x, w_2) - W_{ff}(w_1, w_2), 0\} dF_i^{s1}(x) + \\
& \lambda_{ff}^{s2} \int \max \{W_{ff}(w_1, x) - W_{ff}(w_1, w_2), 0\} dF_f^{s2}(x) + \\
& \lambda_{fi}^{s2} \int \max \{W_{fi}(w_1, x) - W_{ff}(w_1, w_2), 0\} dF_i^{s2}(x).
\end{aligned}$$

This is a household with Social Security coverage. Jobs in the formal sector can be destroyed at the rate δ_f^{s1} and δ_f^{s2} for the head and spouse, respectively. Each member of the couple may receive offers from either the current sector of employment (formal), or from the other sector (informal).

In the informal sector

$$\begin{aligned}
rW_{ii}(w_1, w_2) = & w_1 + w_2 + \gamma + \delta_i^{s1} (W_{ni}(w_2) - W_{ii}(w_1, w_2)) + \\
& \delta_i^{s2} (W_{in}(w_1) - W_{ii}(w_1, w_2)) + \\
& \lambda_{ii}^{s1} \int \max \{W_{ii}(x, w_2) - W_{ii}(w_1, w_2), 0\} dF_i^{s1}(x) + \\
& \lambda_{if}^{s1} \int \max \{W_{fi}(x, w_2) - W_{ii}(w_1, w_2), W_{fn}(x) - W_{ii}(w_1, w_2), 0\} dF_f^{s1}(x) + \\
& \lambda_{ii}^{s2} \int \max \{W_{ii}(w_1, x) - W_{ii}(w_1, w_2), 0\} dF_i^{s2}(x) + \\
& \lambda_{if}^{s2} \int \max \{W_{if}(w_1, x) - W_{ii}(w_1, w_2), W_{nf}(x) - W_{ii}(w_1, w_2), 0\} dF_f^{s2}(x).
\end{aligned}$$

This is a household without Social Security coverage. Each member of the couple may receive offers from either the formal or informal sector. The head receives formal job offers at rate λ_{if}^{s1} then (1) the head may decide to take the formal offer and the household now has Social Security coverage, whereas the spouse remains informal worker, (2) the head may take the formal job offer, but the spouse may quit the informal job, or (3) do nothing. The same set of options hold if the spouse receives a formal job offer, which happens at rate λ_{if}^{s2} .

Spouse 1 works in the formal sector (and spouse 2 works in the informal sector)

$$\begin{aligned}
rW_{fi}(w_1, w_2) = & w_1 + w_2 + a + \delta_f^{s1} (W_{ni}(w_2) - W_{fi}(w_1, w_2)) + \\
& \delta_i^{s2} (W_{fn}(w_1) - W_{fi}(w_1, w_2)) + \\
& \lambda_{ff}^{s1} \int \max \{W_{fi}(x, w_2) - W_{fi}(w_1, w_2), 0\} dF_f^{s1}(x) + \\
& \lambda_{fi}^{s1} \int \max \{W_{ii}(x, w_2) - W_{fi}(w_1, w_2), 0\} dF_i^{s1}(x) + \\
& \lambda_{ii}^{s2} \int \max \{W_{fi}(w_1, x) - W_{fi}(w_1, w_2), 0\} dF_i^{s2}(x) + \\
& \lambda_{if}^{s2} \int \max \{W_{ff}(w_1, x) - W_{fi}(w_1, w_2), W_{nf}(x) - W_{fi}(w_1, w_2), 0\} dF_f^{s2}(x).
\end{aligned}$$

This is a household with Social Security coverage. Head and spouse may have his job destroyed at rate $\delta_j^{s1}, \delta_j^{s2}, j = i, f$, respectively. The head receives job offers from the formal or informal at rates λ_{ff}^{s1} or λ_{fi}^{s1} , respectively. Conditional on the wage of the spouse (w_2), the household re-evaluates its situation. The spouse receives job offers from the informal at rate λ_{ii}^{s2} ; and if she received an offer from the formal sector, which happens at rate λ_{if}^{s2} , the household decides between the following three possibilities: (1) the spouse takes the new formal offer; (2) given that the household still has Social Security coverage if the spouse takes the new offer, the head may decide to quit his formal job; or (3) do nothing (the spouse does not take the new offer).

Spouse 2 works in the formal sector (and spouse 1 works in the informal sector) The situation is symmetric to the previous one, but now the household faces three possibilities if the head (who is informal worker in the initial stage) receives a formal job offer.

$$\begin{aligned}
rW_{if}(w_1, w_2) = & w_1 + w_2 + a + \delta_i^{s1} (W_{nf}(w_2) - W_{if}(w_1, w_2)) + \\
& \delta_f^{s2} (W_{in}(w_1) - W_{if}(w_1, w_2)) + \\
& \lambda_{ii}^{s1} \int \max \{W_{if}(x, w_2) - W_{if}(w_1, w_2), 0\} dF_i^{s1}(x) + \\
& \lambda_{if}^{s1} \int \max \{W_{ff}(x, w_2) - W_{if}(w_1, w_2), W_{fn}(x) - W_{if}(w_1, w_2), 0\} dF_f^{s1}(x) + \\
& \lambda_{ff}^{s2} \int \max \{W_{if}(w_1, x) - W_{if}(w_1, w_2), 0\} dF_f^{s2}(x) + \\
& \lambda_{fi}^{s2} \int \max \{W_{ii}(w_1, x) - W_{if}(w_1, w_2), 0\} dF_i^{s2}(x)
\end{aligned}$$

6.2.3 Neither member of the couple works

$$\begin{aligned}
rW_{nn} = & b_1 + b_2 + \gamma + \\
& \lambda_{nf}^{s_1} \int \max \{W_{fn}(x) - W_{nn}, 0\} dF_f^{s_1}(x) + \\
& \lambda_{ni}^{s_1} \int \max \{W_{in}(x) - W_{nn}, 0\} dF_i^{s_1}(x) + \\
& \lambda_{nf}^{s_2} \int \max \{W_{nf}(x) - W_{nn}, 0\} dF_f^{s_2}(x) + \\
& \lambda_{ni}^{s_2} \int \max \{W_{ni}(x) - W_{nn}, 0\} dF_i^{s_2}(x).
\end{aligned}$$

In this case, the household is not covered by Social Security and each member of the couple receives offers from the formal or informal sector at rate $\lambda_{nj}^{s_1}, \lambda_{nj}^{s_2}, j = f, i$.

6.3 Reservation Wages

Households make their decisions based on reservation wages. Because the value functions are strictly increasing in wages, there exists a reservation wage for each pair of choices. For example, when a $\lambda_{fi}^{s_1}$ shock arrives to spouse 1 in the formal sector while spouse 2 is also formal, the household decides whether to take the offer if the wage in the informal sector is higher than $\hat{w}_{ff \rightarrow if}(w_1, w_2)$. This critical value is the solution of $W_{ff}(w_1, w_2) = W_{if}(\hat{w}_{ff \rightarrow if}(w_1, w_2), w_2)$. Figure 1 shows one possible scenario with the value function $W_{ff}(w_1, w_2)$ dominating $W_{if}(w_1, w_2)$ for higher w_1 , given w_2 .

When households are faced with 3 options, the choices are more complex, because they will depend on the relative steepness and location of 3 instead of 2 curves. Figures 2 and 3 exemplify the case where the household originally has spouse 1 in nonemployment and spouse 2 in the formal sector. When spouse 1 gets a formal job offer, the household may take it, not take it, and if they take it, spouse 2 may go into nonemployment. In Figure 2, the value function $W_{ff}(w_1, w_2)$ dominates $W_{fn}(w_1)$ for higher w_1 , given w_2 . In this case, the household decides to take the formal job offer for spouse 1 if the wage is higher than $\hat{w}_{fn \rightarrow ff}(w_2)$, or they take it and spouse 2 move into nonemployment if the wage is between $\hat{w}_{nf \rightarrow fn}(w_2)$ and $\hat{w}_{fn \rightarrow ff}(w_2)$. Finally, they reject this offer if the wage is below $\hat{w}_{nf \rightarrow fn}(w_2)$. In Figure 3, on the other hand, the value function $W_{fn}(w_1)$ dominates $W_{ff}(w_1, w_2)$ for higher w_1 , given w_2 . In such case, the decisions are reversed. The household now takes the formal job offer and spouse 2 does not move into nonemployment if the wage is between $\hat{w}_{nf \rightarrow ff}(w_2)$ and $\hat{w}_{ff \rightarrow fn}(w_2)$.

6.4 Flow Conditions

In steady state, the measure of couples where spouse 1 is in status j and spouse 2 is in status j' ($j, j' = f, i, n$) remains stable. For example, the measure of couples when both are in the formal sector earning up to w_1 (spouse 1) and w_2 (spouse 2) is balanced and it is given by the following equation:

$$\begin{aligned}
& m_{ff} G_{ff}(w_1, w_2) [\delta_f^{s_1} + \delta_f^{s_2} + \lambda_{ff}^{s_1} \bar{F}_f^{s_1}(w_1) + \lambda_{ff}^{s_2} \bar{F}_f^{s_2}(w_2)] + \\
& \lambda_{fi}^{s_1} m_{ff} \int^{w_2} \int^{w_1} \bar{F}_i^{s_1}(\hat{w}_{ff \rightarrow if}(x, w_2)) g_{ff}(x, w_2) dx dw_2 + \\
& \lambda_{fi}^{s_2} m_{ff} \int^{w_1} \int^{w_2} \bar{F}_i^{s_2}(\hat{w}_{ff \rightarrow fi}(w_1, x)) g_{ff}(w_1, x) dx dw_1 = \\
& \lambda_{nf}^{s_1} m_{nf} \int^{w_2} \max(F_f^{s_1}(w_1) - F_f^{s_1}(\max(\hat{w}_{nf \rightarrow ff}(w_2), \hat{w}_{fn \rightarrow ff}(w_2))), 0) g_{nf}(w_2) dw_2 + \\
& \lambda_{nf}^{s_2} m_{nf} \int^{w_1} \max(F_f^{s_2}(w_2) - F_f^{s_2}(\max(\hat{w}_{fn \rightarrow ff}(w_1), \hat{w}_{nf \rightarrow ff}(w_1))), 0) g_{fn}(w_1) dw_1 + \\
& \lambda_{if}^{s_1} m_{if} \int^{w_2} \int^{w_1} \max(F_f^{s_1}(w_1) - F_f^{s_1}(\max(\hat{w}_{if \rightarrow ff}(x, w_2), \hat{w}_{fn \rightarrow ff}(w_2))), 0) g_{if}(x, w_2) dx dw_2 + \\
& \lambda_{if}^{s_2} m_{fi} \int^{w_1} \int^{w_2} \max(F_f^{s_2}(w_2) - F_f^{s_2}(\max(\hat{w}_{fi \rightarrow ff}(w_1, x), \hat{w}_{nf \rightarrow ff}(w_1))), 0) g_{fi}(w_1, x) dx dw_1.
\end{aligned}$$

In this example, we assume that the value function $W_{ff}(w_1, w_2)$ dominates the other value options for higher values of wages. The outflow from the formal sector is given by the job separation to nonemployment, to other jobs paying higher than w in the formal sector and to other jobs in the informal sector while the inflow in the formal sector is given by the job acceptance by the nonemployed and by informal sector workers willing to take the formal sector job offering until w .

The balance equation is simpler when both spouses are in the informal sector because we assumed that moves of spouse 1 into this sector does not cause spouse 2 to move anywhere. Note, however, that when either agent leaves the informal sector to a formal sector job the other spouse may move into nonemployment. The balance condition is given by:

$$\begin{aligned}
& m_{ii} G_{ii}(w_1, w_2) [\delta_i^{s_1} + \delta_i^{s_2} + \lambda_{ii}^{s_1} \bar{F}_i^{s_1}(w_1) + \lambda_{ii}^{s_2} \bar{F}_i^{s_2}(w_2)] + \\
& \lambda_{if}^{s_1} m_{ii} \int^{w_2} \int^{w_1} \bar{F}_f^{s_1}(\min(\hat{w}_{ii->fi}(x, w_2), \hat{w}_{ii->fn}(x, w_2))) g_{ii}(x, w_2) dx dw_2 + \\
& \lambda_{if}^{s_2} m_{ii} \int^{w_1} \int^{w_2} \bar{F}_f^{s_2}(\min(\hat{w}_{ii->fi}(x, w_2), \hat{w}_{ii->fn}(x, w_2))) g_{ii}(w_1, x) dx dw_1 = \\
& \lambda_{ni}^{s_1} m_{ni} \int^{w_2} \max(F_i^{s_1}(w_1) - F_i^{s_1}(\hat{w}_{ni->ii}(w_2)), 0) g_{ni}(w_2) dw_2 + \\
& \lambda_{ni}^{s_2} m_{ni} \int^{w_1} \max(F_i^{s_2}(w_2) - F_i^{s_2}(\hat{w}_{ni->ii}(w_1)), 0) g_{ni}(w_1) dw_1 + \\
& \lambda_{fi}^{s_1} m_{fi} \int^{w_2} \int^{w_1} \max(F_i^{s_1}(w_1) - F_i^{s_1}(\hat{w}_{fi->ii}(x, w_2)), 0) g_{fi}(x, w_2) dx dw_2 + \\
& \lambda_{fi}^{s_2} m_{fi} \int^{w_1} \int^{w_2} \max(F_i^{s_2}(w_2) - F_i^{s_2}(\hat{w}_{fi->ii}(w_1, x)), 0) g_{fi}(w_1, x) dx dw_1.
\end{aligned}$$

In appendix, we show the remaining six flow equations where at least one spouse is working. We set the mass of couples in all joint states equal to one, and then we obtain m_{nn} .

6.5 Identification of parameters

The value of leisure To identify the value of leisure, b_1 and b_2 , we assume strong monopsony power for women that earn the lowest wages and that \underline{w} (from F_f and F_i) are the minimum wage offer accepted by nonemployed individuals. Thus, we identify b_1 by setting $W_{ni}(\underline{w}) = W_{nn}$ and b_2 by equating $W_{ii}(w_1, \underline{w}) = W_{in}(w_1)$. In the Appendix, we show these in detail. Thus, b_1 and b_2 can be interpreted as the value of home production.

The marginal willingness to pay for amenities in the formal sector (a) and the value of health insurance provided by Seguro Popular (γ) We recover the marginal willingness to pay parameters by equating the minimum values of job offers accepted in the informal and the formal sectors by nonemployed spouses, when the head of household is nonemployed. That is, $\min(W_{nf}) = \min(W_{ni})$. When the pool of nonemployed is large enough the reservation wage converges to the minimum wage in each sector. As the pool of nonemployed is relatively larger for spouse 2 (empirically, spouses 2 are women), we set $\min(W_{nf}) = \min(W_{ni})$, and we obtain the marginal willingness to pay parameters. To separately identify a and γ , we use data on wages and transitions before and after the Seguro Popular policy implementation.

1. Using data pre-Seguro Popular (under $\gamma = 0$), we identify a by $W_{ni}(\underline{w}^{t=0}) = W_{nf}(\underline{w}^{t=0})$,

2. Given a and using data after the implementation of Seguro Popular (when γ is possibly $\neq 0$), we identify γ setting $W_{ni}(\underline{w}^{t=1}) = W_{nf}(\underline{w}^{t=1})$.

We assess the empirical implications of this assumption, allowing for $\min(W_{ni}) < \min(W_{nf})$, and thus re-estimating the model at $W_{ni}(w_{Percentile2}^{t=0}) = W_{nf}(\underline{w}^{t=0})$ and $W_{ni}(w_{Percentile4}^{t=0}) = W_{nf}(\underline{w}^{t=0})$. The values of a and γ are robust to the three alternative values of w .

7 Estimation

Given the model specified in section 6, we need to estimate the wage offer distributions in the formal and informal sectors, the arrival rates (λ), the job destruction rates (δ), the instant reallocation shocks (p, q), the values of leisure (b_1, b_2), the relative value of the amenities in the formal sector (a), and the value of Seguro Popular ($gamma$), all denoted by

$$\Theta = (F_f^{s1}, F_i^{s1}, \lambda_{if}^{s1}, \lambda_{fi}^{s1}, \lambda_{ni}^{s1}, \lambda_{nf}^{s1}, \delta_i^{s1}, \delta_f^{s1}, q^{s1}, p^{s1}, b_1, F_f^{s2}, F_i^{s2}, \lambda_{if}^{s2}, \lambda_{fi}^{s2}, \lambda_{ni}^{s2}, \lambda_{nf}^{s2}, \delta_i^{s2}, \delta_f^{s2}, q^{s2}, p^{s2}, b_2, a, \gamma).$$

First, we obtain the wage offer distributions non-parametrically, that is F_f and F_i are obtained from the data from the wages accepted by the nonemployed. Then, we use a fixed point solution to solve for the remaining model parameters. Our procedure is the following. Given the F distributions and an initial guess for all unknowns: the transition parameters, the value of leisure, the marginal willingness to pay parameters, the measure of couples in any joint state $\frac{m_{jj'}}{m_{nn}} G_{jj'}(w_1, w_2)$, and the minimum and maximum support for each value function:

1. We interpolate the minimum and maximum support of the value functions.¹¹
2. We calculate the reservation wages using the value functions.
3. Given F_f and F_i distributions, transition rates, value of leisure, and marginal willingness to pay parameters, we solve $\frac{m_{jj'}}{m_{nn}} G_{jj'}(w_1, w_2)$ using the flow equations.
4. We then set w_1 and w_2 to infinity and set the mass of couples across all joint states to one to obtain the stocks and the joint $G_{jj'}$ distributions separately.
5. We update the value of leisure and marginal willingness to pay parameters using the restrictions we impose above.

¹¹We use Clenshaw-Curtis quadrature.

6. We update the value functions.
7. We update $\frac{m_{jj'}}{m_{nn}}G_{jj'}(w_1, w_2)$.
8. We update the transition parameters using the transition moments we construct and match to the data.

To assess the fit of the model we construct the model stocks $m_{jj'}$ ($j, j' = n, f, i$) and the marginal $G_j(w)$ distributions. We also obtain the transition probabilities calculated using the model parameters. These are checked against:

1. the empirical proportion of households in the situation jj' at the first interview date.
2. the empirical individual wage distributions at the first interview date.
3. the empirical transition probabilities.

The standard errors are obtained by bootstrap with 100 replications.

Transition rates Given F_f^s and F_i^s ($s = 1, 2$), we estimate the transition rates using method of moments. We follow the individual from the first interview to the next quarter, and we obtain the average transition from the data $\tilde{D}_{j\ell}$; $j, \ell = n, f, i$ for each sample used. The durations are exponentially distributed, and we construct the theoretical transitions by quarter, $D_{j\ell}$, as follows:

- Transitions to nonemployment:

$$D_{jn}^s = \int \frac{\delta_j^s}{d_j^s(x)} (1 - e^{-d_j^s(x) \times 1}) dG_j^s(x), \quad j = f, i$$

where $d_j^s(w_1) = \delta_j^s + \lambda_{jj}^s \bar{F}_j^s(w_1) + \lambda_{jk}^s \sum_{j'=n,f,i} \int \bar{F}_k^s(\hat{w}_{jj'->kj'}(w_1, w_2)) \frac{m_{jj'}}{m_j} g_{jj'}(w_2) dw_2$ is the total job separation rate. s indicates the spouse. $j, k = f, i$ and $j \neq k$.

- Transitions out-of nonemployment:

$$D_{nf}^s = \frac{\lambda_{nf}^s \sum_{j=n,f,i} \int \bar{F}_f(\hat{w}_{nj->fj}(w_2)) \frac{m_{nj}}{m_n} g_{nj}(w_2) dw_2}{a^s} (1 - e^{-a^s \times 1}),$$

$$D_{ni}^s = \frac{\lambda_{ni}^s \sum_{j=n,f,i} \int \bar{F}_i(\hat{w}_{nj->ij}(w_2)) \frac{m_{nj}}{m_n} g_{nj}(w_2) dw_2}{a^s} (1 - e^{-a^s \times 1}),$$

$$D_{ni|s' \text{ had a } \delta_f \text{ shock}}^s = \frac{\delta_f^{s'} p^s \int \bar{F}_i(\hat{w}_{nf->in}(w_2)) g_{nf}(w_2) dw_2}{a^s} (1 - e^{-a^s \times 1}),$$

$$D_{ni|s' \text{ had a } \delta_i \text{ shock}}^s = \frac{\delta_i^{s'} q^s \int \bar{F}_i(\hat{w}_{ni->in}(w_2)) g_{ni}(w_2) dw_2}{a^s} (1 - e^{-a^s \times 1}),$$

where $a^s = \lambda_{nf}^s \sum_{j=n,f,i} \int \bar{F}_f(\hat{w}_{nj->fj}(w_2)) \frac{m_{nj}}{m_n} g_{nj}(w_2) dw_2 + \lambda_{ni}^s \sum_{j=n,f,i} \int \bar{F}_i(\hat{w}_{nj->ij}(w_2)) \frac{m_{nj}}{m_n} g_{nj}(w_2) dw_2 + \delta_f^{s'} p^s \int \bar{F}_i(\hat{w}_{nf->in}(w_2)) g_{nf}(w_2) dw_2 + \delta_i^{s'} q^s \int \bar{F}_i(\hat{w}_{ni->in}(w_2)) g_{ni}(w_2) dw_2$ is the total job acceptance rate for the nonemployed (this holds for the head, spouse 1, since we are integrating over the distribution of the spouse 2).

- Transitions job-to-job:

$$D_{jj} = \int \frac{\lambda_{jj}^s \bar{F}_j(x)}{d_j^s(x)} (1 - e^{-d_j^s(x) \times 1}) dG_j^s(x), \quad j = f, i$$

$$D_{jk} = \int \frac{\lambda_{jk}^s \sum_{j'=n,f,i} \int \bar{F}_k^s(\hat{w}_{jj'->kj'}(x, w_2)) \frac{m_{jj'}}{m_j} g_{jj'}(x, w_2) dw_2}{d_j^s(x)} (1 - e^{-d_j^s(x) \times 1}) dG_j^s(x), \quad j = f, i$$

This a just-identified system of 20 non-linear equations for 20 parameters (two δ 's and eight λ 's for each spouse) and we obtain these transition rates by minimizing a distance between the model and the observed transition probabilities:

$$\sum_{s=1,2} \sum_{j,\ell=n,f,i} \left(D_{j\ell}^s - \tilde{D}_{j\ell}^s \right)^2.$$

8 Estimation Results

We present here the model estimates. We estimate the model separately by eight groups defined based on the following characteristics. Area of residence (North or South of Mexico); for 2 groups of education: high education households (where the head has more than 6 years of education) and low education (if the head has at most 6 years of education; for families with children ages 0-14 years and families family composition (with/out children 14 years old or under) and gender.

All parameters are estimated using the period before the introduction of SP in the municipality of residence. To do so, we set the value of health insurance in the informal sector and nonemployment, γ , to zero. We then use the period after the introduction of Seguro Popular to estimate γ as described in Section 6.5, taking a estimated from the pre-reform period.

8.1 The Model Fit

Table 5 compares the stocks of households across formal employment, informal employment and unemployment and the transitions predicted by the model and in the data. The model fits transitions and stocks remarkably well across all eight samples.

Table 6 presents selected moments for the distribution of wages in the data and predicted by the model. The mean wages for head of households in the informal sector is reasonably replicated by the model. The model performs less well to approximate the left hand side of the distribution of salaries for spouses in the informal sector.

The distribution of wages for spouses in the formal sector is well replicated from the 25th percentile to the top of the distribution and at the mean.

8.2 The value of leisure, the value of formal sector's amenities, and the value of health insurance by Seguro Popular

Table 7 shows the parameter estimates which are recovered from the model for the pre-reform period for the value of leisure for heads and spouses, b_1 and b_2 , respectively, and for the marginal willingness to pay to be outside the formal sector, $-a$. Both measures are presented in currency units divided by the mean wage in the informal sector. The table shows that before the introduction of SP, less educated households with children (column 1) are willing to forego a higher share of their wage to be in the informal sector rather than in formal sector. This could reflect for example other policies that were in place before SP, such as the Oportunidades cash transfers program. The estimate of γ shows that the value-added of SP program, given a , is positive but small (1.3-4.2 percent depending on the sample). This explains why the SP reform, as it was implemented, should not be expected to change significantly the economy.

8.3 Policy Experiments

In this subsection, we use the model to assess the impacts of changing the value of Seguro Popular, γ . In the simulations, we depart from the estimated wage distributions, stocks and transitions estimated from the data on the period prior to the implementation of SP.

Simulating changes in γ One major policy concern is to understand why most literature has found limited impacts of this new health policy in terms of employment and sector composition. Departing from the benchmark economy where γ is equal to zero, we simulate changes in the economy with γ equal to the value estimated from the model using the for the period after the implementation of

SP. Next, we consider increases of 5, 10 and 20 times higher than this estimate. We apply the same proportional increase across two extreme samples: (1) the poorest sample for households living in the South of Mexico with low educated and with children, and the (2) richest sample which includes families living in Northern states, with high educated heads and no children. The results of the simulations are presented in Table 9 which presents the results for the stocks of households, salaries and welfare, and in Table 10 which includes the impacts on transitions.

We first comment the results for the poorest households, which are Panel A of Table 9. Column (1) shows that if the pre-SP economy is simulated with the estimated value of SP, then the changes in employment and wages would very small, with wages changing by much less than 1%. Thus, there is not much effect on welfare. However, when we successively increase γ across columns (2) to (4), we start to observe that wages compensate in the expected direction, that is, wages increase in the formal sector and they decrease in the informal sector. This also occurs in Panel B for the sample of richest households. Consider the sample of poorest households, selection explains why wages of spouses do not decrease in the informal sector, where the relatively worst paid go into nonemployment. With a 10 times higher value of SP, about 3.5pp of households become informal-nonemployed, that is, with the head working in the informal sector and the spouse nonemployed. This effect appears to be monotonic once we simulate a 20 times higher value of SP there is an increase of 4.6pp in the stock of households informal-nonemployed. Table 10 shows that the increase in the stock of households informal-nonemployed is driven by an increase in transition of heads from the formal to the informal sector and a decline in the transition of spouses from nonemployment.

Figure 4 depicts the reservation wages of heads and spouses at the benchmark and after the simulation that applies a 10 times higher value of γ . These plots help to explain why the fraction of households informal-nonemployed increases. In Panel C shows that nonemployed heads of households become less reluctant to take an informal job with the simulated change. Whereas Panels A and B show that spouses in the same situation become more demanding, as their reservation wages go up particularly for those with lower wage heads.

The simulations show that despite an increase in the informal sector and nonemployment, the overall welfare increases by 2 and 5 percent in the simulations of 10 and 20 times higher value of γ , respectively. This is due to an increase in salaries in the formal sector and the value of health insurance by SP also raised the value of jobs in the informal sector.

Among the richest households (Panel B of Table 9), we found that the effects are similar for heads of households than for those in the poorest sample. They tend to go into the informal sector. However, richer spouses (women) tend to go less into nonemployment than poorer spouses. As a result, the increased value of SP for richer households increases both the fraction of those in the situation informal-informal and informal-nonemployment.

Figures 4 and 5 reveal the importance of considering the choices of the household rather than an individual isolated. First, the positively sloped function for the reservation wage of the spouse in Panels A and B relative to the head's, shows that she is more picky the as husband's wage increases. Second, Panel C shows that the wage of the wife is less important for the head, particularly if he is to take a job in the formal sector (see Panel C). Finally, the curves become flatter with higher γ (value of HI), so the wages of a spouse become less important for the head and vice-versa.

9 Conclusion

The data shows that significant transitions took place around the period of implementation of non-contributory health insurance in Mexico, with an increase in the share of informal households where heads are less educated and have younger children.

We estimate a household search model which allows us to understand to which extent the increase in informality is associated to the free access to health care associated to the non-contributory health insurance.

We recovered the value of health insurance by Seguro Popular from the model and by using data on wages and transitions before and after the implementation of Seguro Popular. We estimate the model for different segments of population separated by region, family composition and education. The model is well fitted to the data on stocks and transitions. The estimated value of Seguro Popular is between 1.3 to 4.2 percent of the mean informal sector wage, depending on the sample.

We use the model to simulate employment, wage and welfare effects from the introduction of health insurance by Seguro Popular by giving the households the value of health insurance as we estimated it. We then simulate counterfactual increases in the estimated value of health insurance. We find that the Seguro Popular system would have to be significantly more generous than it was to have impacts on the economy.

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10 Tables

Table 1: Description of the data: employment and transitions by education group.

	High Education		Low Education	
	Before	After	Before	After
	2001	2007	2001	2007
Number of Households-Quarters	76,445	49,420	49,972	24,999
Share of Households without Social Security coverage (informal hhlds.)	0.357	0.358	0.615	0.653
<i>Households by type</i>				
<i>With Social Security</i>				
Head Formal-Spouse Formal (FF)	0.156	0.163	0.044	0.037
Head Formal-Spouse Informal (FI)	0.075	0.103	0.054	0.067
Head Formal-Spouse Not Working (FN)	0.341	0.298	0.244	0.200
Head Informal-Spouse Formal (IF)	0.062	0.066	0.036	0.036
Head Not Working-Spouse Formal (NF)	0.008	0.011	0.006	0.007
<i>Without Social Security/Informal</i>				
Head Informal-Spouse Informal (II)	0.104	0.126	0.157	0.200
Head Informal-Spouse Not Working (IN)	0.221	0.196	0.395	0.386
Head Not Working-Spouse Informal (NI)	0.007	0.009	0.015	0.018
Head Not Working-Spouse Not Working (NN)	0.026	0.026	0.048	0.046
Share ages 20-39	0.605	0.513	0.410	0.375
Share with Children 0-14	0.777	0.727	0.692	0.648

Note: ENE-ENOE 2001 and 2007. Families whose head is 20-59 years old.

Table 2: Description of the data: wages in the formal and informal sector by education group.

	High Education		Low Education	
	Before	After	Before	After
	2001	2007	2001	2007
<hr/>				
<i>Wages: Formal Sector</i>				
Head				
Mean	28412	28786	15886	17385
SD	33510	27656	9592	11081
Observations	39,604	23,686	16,021	6,876
Spouse				
Mean	21688	23577	13258	14370
SD	14521	16626	7914	8412
Observations	15,280	10,001	4,006	1,786
 <i>Wages: Informal Sector</i>				
Head				
Mean	30080	27171	14872	15507
SD	34993	35000	15435	19615
Observations	26,398	15,327	27,162	12,942
Spouse				
Mean	15393	13721	7604	8425
SD	22255	19397	8531	9310
Observations	10,501	8,659	8,548	5,405
 Change in W (2007-2001)				
<i>Formal Sector</i>				
Head	0.013		0.090	
Spouse	0.083		0.081	
 <i>Informal Sector</i>				
Head	-0.102		0.042	
Spouse	-0.115		0.103	
<hr/>				

Note: ENE-ENOE 2001 and 2007. Families whose head is 20-59 years old.

Table 3: Reduced Form Estimates: the dependent variable is the share of informal households (ie, without Social Security coverage) in a municipality in a given quarter.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Informal Household	FF	Formal (with SS) Households				Informal Household (Without SS)			
			FI	FN	IF	NF	II	IN	NI	NN
Panel A: Low Education										
A.1: Without Children										
SP	-0.048 (0.040)	0.008 (0.014)	0.027 (0.019)	0.014 (0.032)	-0.008 (0.013)	0.007 (0.004)	0.004 (0.022)	-0.008 (0.028)	-0.007 (0.010)	-0.037* (0.020)
Mean Pre-SP	0.741	0.058	0.043	0.141	0.017	0.000	0.165	0.451	0.0128	0.113
A.2: With Children										
SP	0.032* (0.017)	-0.010* (0.006)	0.006 (0.008)	-0.034** (0.015)	0.007 (0.005)	-0.002 (0.003)	-0.002 (0.013)	0.007 (0.018)	0.0002 (0.004)	0.027*** (0.009)
Mean Pre-SP	0.781	0.018	0.045	0.151	0.003	0.001	0.166	0.552	0.015	0.048
Observations	20,411									
Panel B: High Education										
B.1: Without Children										
SP	-0.052 (0.033)	0.003 (0.020)	-0.008 (0.014)	0.031 (0.030)	0.026* (0.016)	0.001 (0.006)	-0.026 (0.021)	-0.021 (0.029)	-0.004 (0.007)	-0.001 (0.020)
Mean Pre-SP	0.568	0.027	0.041	0.189	0.176	0.000	0.149	0.311	0.000	0.108
B.2: With Children										
SP	0.005 (0.015)	0.012 (0.009)	0.014*** (0.005)	-0.019 (0.012)	-0.008 (0.006)	-0.003 (0.002)	0.015** (0.007)	-0.009 (0.013)	0.002 (0.002)	-0.002 (0.006)
Mean Pre-SP	0.562	0.075	0.064	0.262	0.035	0.003	0.099	0.428	0.010	0.026
Observations	19,915									

Note: OLS estimates obtained using the ENE/ENEO data at municipality-quarter level. Estimates are weighted by the population of the municipality in 2000. Controls excluded from table include: the share of households in each municipality-quarter by education group (incomplete primary, complete primary, complete lower secondary education or complete upper secondary and higher education), and by age of the head (20-29; 30-39; 40-49 and 50-59), share of households by locality size, municipality of residence fixed effects, state-year quadratic trend, quarter fixed effects, and a linear trend in characteristics of the municipality of residence taken in 2000 (quadratic in the index of deprivation, log of total population, share of population less than 5 years old, share of population over 15 that does not know how to read and write, share of occupied individuals working on the primary, secondary and tertiary sectors; the number of hospitals and health centers in 2001, total number of doctors and nurses in hospitals per 1,000 uninsured individuals in 2001). Control mean is taken the year before the implementation of SP in a municipality.

Standard errors clustered by municipality. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Table 4: Reduced Form Estimates: the dependent variable is the log salary.

	(1)	(2)	(3)	(4)
	Head		Spouse	
	Formal	Informal	Formal	Informal
Panel A: Low Education				
SP	-0.023 (0.016)	-0.001 (0.016)	0.004 (0.058)	-0.074* (0.041)
Observations	12,682	19,122	5,005	8,366
Mean Pre-SP	15304	12729	15074	13681
Panel B: High Education				
SP	-0.007 (0.013)	0.007 (0.017)	-0.005 (0.031)	-0.056* (0.034)
Observations	16,567	17,598	8,934	8,126
Mean Pre-SP	22996	19406	25329	23550

Note: Note: OLS estimates obtained using the ENE/ENEO data at municipality-quarter level. Estimates are weighted by the population of the municipality in 2000. Controls excluded from table include: the share of households in each municipality-quarter by education group (incomplete primary, complete primary, complete lower secondary education or complete upper secondary and higher education), and by age of the head (20-29; 30-39; 40-49 and 50-59), share of households by locality size, municipality of residence fixed effects, state-year quadratic trend, quarter fixed effects, and a linear trend in characteristics of the municipality of residence taken in 2000 (quadratic in the index of deprivation, log of total population, share of population less than 5 years old, share of population over 15 that does not know how to read and write, share of occupied individuals working on the primary, secondary and tertiary sectors; the number of hospitals and health centers in 2001, total number of doctors and nurses in hospitals per 1,000 uninsured individuals in 2001). Control mean is taken the year before the implementation of SP in a municipality. Standard errors clustered by municipality. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Table 5: Model Fit: Stocks and Transitions.

Region	North															
	Low								High							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Education	South															
	Low								High							
	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Children 0-14	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
<u>Employment</u>																
m_{ff}	0.017	0.010	0.020	0.009	0.119	0.103	0.129	0.072	0.052	0.044	0.035	0.012	0.159	0.148	0.160	0.086
m_{fi}	0.041	0.019	0.038	0.021	0.074	0.063	0.073	0.052	0.056	0.046	0.043	0.023	0.080	0.071	0.071	0.050
m_{fn}	0.157	0.126	0.153	0.134	0.321	0.289	0.274	0.280	0.270	0.240	0.209	0.208	0.371	0.336	0.294	0.325
m_{if}	0.021	0.075	0.023	0.047	0.057	0.120	0.066	0.096	0.040	0.091	0.028	0.045	0.061	0.104	0.066	0.095
m_{nf}	0.003	0.020	0.006	0.033	0.007	0.016	0.015	0.075	0.006	0.031	0.009	0.027	0.008	0.017	0.016	0.049
m_{ii}	0.207	0.184	0.185	0.138	0.125	0.095	0.131	0.080	0.133	0.114	0.139	0.099	0.092	0.065	0.104	0.060
m_{in}	0.507	0.474	0.438	0.406	0.272	0.240	0.232	0.209	0.389	0.343	0.358	0.347	0.204	0.187	0.201	0.173
m_{ni}	0.015	0.042	0.028	0.106	0.007	0.020	0.015	0.050	0.013	0.038	0.027	0.075	0.006	0.014	0.012	0.041
m_{nn}	0.031	0.049	0.108	0.106	0.018	0.054	0.066	0.086	0.042	0.054	0.152	0.163	0.018	0.057	0.077	0.121
<u>Transitions: Head</u>																
Nonemployment-Formal	0.081	0.081	0.036	0.036	0.203	0.203	0.091	0.091	0.119	0.119	0.054	0.054	0.260	0.260	0.105	0.105
Nonemployment-Inf	0.552	0.552	0.332	0.332	0.423	0.423	0.231	0.231	0.490	0.490	0.280	0.280	0.374	0.374	0.218	0.218
Formal-Nonemployment	0.021	0.021	0.036	0.036	0.016	0.016	0.022	0.022	0.025	0.025	0.046	0.046	0.016	0.016	0.025	0.025
Formal-Inf	0.185	0.185	0.158	0.158	0.111	0.111	0.110	0.110	0.156	0.156	0.142	0.142	0.089	0.089	0.094	0.094
Informal-Nonemployment	0.035	0.035	0.080	0.080	0.027	0.027	0.059	0.059	0.053	0.053	0.104	0.104	0.032	0.032	0.067	0.067
Informal-Formal	0.050	0.050	0.048	0.048	0.116	0.116	0.116	0.116	0.102	0.102	0.075	0.075	0.147	0.147	0.137	0.137
Nonemp.-Inf., if spouse loses formal job	0.055	0.044	0.023	0.023	0.012	0.012	0.034	0.025	0.032	0.032	0.042	0.041	0.011	0.011	0.018	0.018
Nonemp.-Inf., if spouse loses informal job	0.030	0.030	0.046	0.046	0.014	0.014	0.021	0.021	0.028	0.028	0.043	0.043	0.014	0.014	0.018	0.018
<u>Transitions: Spouse</u>																
Nonemployment-Formal	0.008	0.008	0.009	0.009	0.022	0.022	0.024	0.024	0.018	0.018	0.011	0.011	0.030	0.030	0.031	0.031
Nonemployment-Inf	0.137	0.137	0.123	0.123	0.106	0.106	0.102	0.102	0.108	0.108	0.094	0.094	0.094	0.094	0.084	0.084
Formal-Nonemployment	0.117	0.117	0.121	0.121	0.088	0.088	0.090	0.090	0.153	0.153	0.130	0.130	0.096	0.096	0.103	0.103
Formal-Inf	0.122	0.122	0.114	0.114	0.064	0.064	0.075	0.075	0.080	0.080	0.081	0.081	0.048	0.048	0.057	0.057
Informal-Nonemployment	0.358	0.358	0.346	0.346	0.309	0.309	0.290	0.290	0.368	0.368	0.333	0.333	0.316	0.316	0.289	0.289
Informal-Formal	0.023	0.023	0.021	0.021	0.063	0.063	0.075	0.075	0.032	0.032	0.031	0.031	0.070	0.070	0.075	0.075
Nonemp.-Inf., if head loses formal job	0.115	0.000	0.108	0.000	0.101	0.000	0.035	0.000	0.091	0.000	0.040	0.000	0.071	0.000	0.023	0.000
Nonemp.-Inf., if head loses informal job	0.130	0.033	0.083	0.075	0.081	0.025	0.053	0.053	0.078	0.051	0.056	0.056	0.069	0.031	0.035	0.035

Table 6: Model Fit for Households: Log-wages.

Region	Low			South			High			Low			North			High		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)		
Education	Yes			No			Yes			No			Yes			No		
Children 0-14	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
Formal wage: head																		
P10	8.778	9.652	8.859	9.161	9.098	9.398	9.173	9.568	9.043	9.260	9.025	9.277	9.282	9.399	9.284	9.590		
P25	9.069	10.040	9.086	9.464	9.398	9.798	9.437	9.964	9.260	9.585	9.277	9.528	9.516	9.633	9.590	9.998		
P50	9.361	10.526	9.388	10.069	9.798	10.198	9.964	10.491	9.476	9.910	9.528	9.864	9.867	10.102	9.998	10.407		
P75	9.652	10.720	9.691	10.826	10.198	10.698	10.359	11.414	9.801	10.559	9.780	10.284	10.336	10.570	10.509	10.917		
P90	9.943	11.109	10.069	10.977	10.698	11.298	10.887	11.678	10.018	10.992	10.116	10.787	10.804	11.156	11.019	11.529		
Mean	9.544	10.559	9.608	10.434	10.147	10.634	10.331	11.026	9.675	10.331	9.698	10.144	10.224	10.470	10.380	10.870		
Informal wage: head																		
P10	7.498	8.474	7.824	8.238	8.734	8.991	8.806	8.933	8.573	8.842	8.512	8.643	9.136	9.136	9.148	9.148		
P25	8.474	9.032	8.513	8.789	9.119	9.376	9.187	9.441	8.977	9.111	9.036	9.167	9.472	9.472	9.457	9.664		
P50	9.032	9.450	9.064	9.202	9.633	9.762	9.695	10.076	9.380	9.514	9.430	9.692	9.921	9.921	9.974	10.283		
P75	9.450	9.729	9.477	9.615	10.147	10.276	10.330	10.584	9.783	9.783	9.823	10.216	10.481	10.481	10.593	10.696		
P90	9.868	10.426	9.891	9.891	10.661	11.047	10.965	11.219	10.186	10.320	10.216	10.740	11.041	11.041	11.212	11.315		
Mean	9.276	9.781	9.407	9.498	10.061	10.272	10.258	10.463	9.679	9.808	9.737	10.048	10.366	10.340	10.476	10.601		
Formal wage: spouse																		
P10	8.762	8.822	8.715	8.834	9.021	9.109	9.008	9.232	8.863	8.926	8.886	8.961	9.073	9.073	9.111	9.281		
P25	8.943	9.063	8.893	9.071	9.374	9.374	9.381	9.530	9.054	9.118	9.111	9.111	9.407	9.324	9.451	9.535		
P50	9.184	9.304	9.250	9.309	9.727	9.815	9.829	9.903	9.309	9.309	9.336	9.336	9.741	9.657	9.790	9.875		
P75	9.546	9.666	9.606	9.665	10.079	10.168	10.202	10.426	9.564	9.564	9.561	9.561	10.158	10.074	10.214	10.299		
P90	9.968	9.968	9.962	10.378	10.520	10.608	10.575	10.874	9.883	9.819	9.935	9.935	10.491	10.491	10.638	10.723		
Mean	9.429	9.473	9.457	9.649	9.971	10.028	10.060	10.184	9.470	9.437	9.524	9.558	9.974	9.931	10.072	10.159		
Informal wage: spouse																		
P10	6.949	7.083	7.281	6.933	7.783	7.920	8.134	7.795	7.569	7.457	7.641	7.531	7.948	8.113	8.240	8.240		
P25	7.755	7.889	7.975	7.859	8.330	8.467	8.587	8.474	8.132	8.244	8.298	8.188	8.443	8.607	8.748	8.875		
P50	8.427	8.561	8.554	8.554	8.878	9.152	9.153	9.153	8.694	8.807	8.735	8.845	9.102	9.267	9.256	9.510		
P75	8.830	9.234	9.017	9.133	9.562	9.836	9.833	9.946	9.144	9.369	9.173	9.283	9.596	9.926	9.891	10.145		
P90	9.234	9.771	9.480	9.827	10.109	10.383	10.398	10.625	9.482	9.932	9.720	9.830	10.255	10.585	10.526	10.653		
Mean	8.722	9.065	8.877	9.089	9.468	9.656	9.663	9.825	8.984	9.251	9.138	9.226	9.594	9.795	9.844	9.969		

Table 7: Model Estimates: marginal willingness to pay to be in formal and informal sectors and value of leisure.

	(1)	(2)	(3)	(4)
Education	Low		High	
Children 0-14	Yes	No	Yes	No
Panel A: South				
$\frac{b_1}{w_i^{head}}$	0.025 (0.003)	0.036 (0.004)	0.087 (0.012)	0.089 (0.012)
$\frac{b_2}{w_i^{spouse}}$	0.036 (0.004)	0.046 (0.006)	0.059 (0.005)	0.067 (0.009)
$\frac{a}{w_i^{spouse}}$	-0.544 (0.033)	-0.497 (0.039)	-0.253 (0.023)	-0.195 (0.017)
$\frac{\gamma}{w_i^{spouse}}$	0.013 (0.007)	0.035 (0.020)	0.029 (0.007)	0.027 (0.013)
Panel B: North				
$\frac{b_1}{w_i^{head}}$	0.066 (0.009)	0.058 (0.010)	0.171 (0.009)	0.126 (0.010)
$\frac{b_2}{w_i^{spouse}}$	0.067 (0.007)	0.069 (0.008)	0.069 (0.004)	0.073 (0.009)
$\frac{a}{w_i^{spouse}}$	-0.395 (0.033)	-0.421 (0.033)	-0.202 (0.016)	-0.162 (0.024)
$\frac{\gamma}{w_i^{spouse}}$	0.030 (0.013)	0.042 (0.011)	0.029 (0.009)	0.021 (0.014)

Note: All parameters estimates presented in the table are obtained using data from the period before the introduction of SP in the municipality of residence of individuals. The exception is γ , which, conditional on the estimate for a , is obtained from the period after the introduction of SP. The bootstrap standard errors in parenthesis are computed from 100 replications.

Table 8: Transition rates to unemployment and between jobs (quarterly).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education high Children 0-14	Low		High		Low		High	
	Yes	No	Yes	No	Yes	No	Yes	No
	Panel A: South				Panel B: North			
Head								
δ_f	0.024 (0.003)	0.040 (0.004)	0.027 (0.002)	0.051 (0.003)	0.017 (0.001)	0.024 (0.002)	0.017 (0.001)	0.027 (0.002)
δ_i	0.037 (0.002)	0.086 (0.003)	0.058 (0.002)	0.115 (0.004)	0.029 (0.002)	0.065 (0.003)	0.036 (0.002)	0.075 (0.004)
λ_{nf}	0.146 (0.024)	0.048 (0.012)	0.198 (0.016)	0.071 (0.010)	0.337 (0.031)	0.139 (0.025)	0.457 (0.030)	0.139 (0.014)
λ_{ni}	1.033 (0.063)	0.445 (0.052)	0.821 (0.037)	0.369 (0.029)	0.702 (0.065)	0.375 (0.057)	0.630 (0.037)	0.289 (0.024)
λ_{fi}	4.878 (4.525)	1.001 (2.238)	0.718 (0.104)	1.878 (0.214)	0.510 (0.106)	0.693 (0.239)	0.285 (0.023)	0.788 (0.210)
λ_{if}	0.066 (0.005)	0.063 (0.006)	0.148 (0.010)	0.096 (0.009)	0.180 (0.010)	0.182 (0.010)	0.245 (0.014)	0.209 (0.013)
p_1	1.000 (0.200)	0.251 (0.333)	0.326 (0.064)	0.504 (0.209)	0.257 (0.265)	1.000 (0.297)	0.235 (0.112)	0.360 (0.140)
q_1	0.123 (0.016)	0.148 (0.030)	0.103 (0.016)	0.143 (0.016)	0.062 (0.013)	0.081 (0.018)	0.066 (0.009)	0.077 (0.016)
Spouse								
δ_f	0.134 (0.011)	0.138 (0.015)	0.174 (0.011)	0.147 (0.012)	0.095 (0.007)	0.098 (0.008)	0.104 (0.009)	0.113 (0.010)
δ_i	0.450 (0.015)	0.431 (0.016)	0.470 (0.014)	0.413 (0.013)	0.387 (0.016)	0.361 (0.014)	0.399 (0.015)	0.359 (0.019)
λ_{nf}	0.031 (0.007)	0.033 (0.007)	0.083 (0.006)	0.024 (0.008)	0.050 (0.004)	0.053 (0.008)	0.059 (0.005)	0.062 (0.011)
λ_{ni}	1.067 (0.136)	0.621 (0.115)	0.720 (0.075)	0.275 (0.057)	0.430 (0.054)	0.425 (0.057)	0.269 (0.019)	0.234 (0.033)
λ_{fi}	0.644 (0.131)	0.401 (0.208)	0.226 (0.022)	0.503 (0.141)	0.335 (0.059)	0.531 (0.123)	0.217 (0.022)	0.348 (0.075)
λ_{if}	0.059 (0.010)	0.055 (0.009)	0.105 (0.008)	0.061 (0.016)	0.155 (0.015)	0.143 (0.024)	0.167 (0.018)	0.161 (0.029)
p_2	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
q_2	1.000 (0.000)	1.000 (0.024)	1.000 (0.000)	0.554 (0.117)	1.000 (0.000)	0.943 (0.107)	1.000 (0.000)	0.535 (0.175)

Note: All parameters estimates presented in the table are obtained using data from the period before the introduction of SP. The bootstrap standard errors in parenthesis are computed from 100 replications.

Table 9: Counterfactual Experiment: Effects of changing willingness to pay to have HI outside the formal sector (γ).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A				Panel B			
	South, Low Educ, Children		North, High Educ, No Children					
	$\hat{\gamma}$	$5 \times \hat{\gamma}$	$10 \times \hat{\gamma}$	$20 \times \hat{\gamma}$	$\hat{\gamma}$	$5 \times \hat{\gamma}$	$10 \times \hat{\gamma}$	$20 \times \hat{\gamma}$
Stocks (p.p.)								
m_{ff}	-0.01	-0.08	-0.15	-0.23	-0.07	-0.36	-0.78	-1.48
m_{fi}	0.00	-0.07	-0.31	-0.37	-0.04	-0.15	-0.30	-0.58
m_{fn}	0.00	-0.60	-0.85	-0.95	0.06	0.12	-0.15	-0.26
m_{if}	-0.09	-0.41	-0.83	-1.54	-0.08	-0.36	-0.72	-1.61
m_{nf}	-0.01	-0.03	-0.03	-0.10	-0.03	-0.12	-0.14	-0.19
m_{ii}	0.06	0.46	-0.79	-0.77	0.08	0.33	0.62	1.23
m_{in}	0.05	0.66	3.53	4.64	0.08	0.56	1.58	3.01
m_{ni}	0.00	0.03	-0.18	-0.21	0.01	0.04	0.09	0.22
m_{nn}	0.00	0.03	-0.39	-0.48	-0.01	-0.06	-0.18	-0.33
Mean Wage of Head: Formal Sector (%)	0.05	2.89	4.46	5.52	0.17	1.33	3.88	7.28
Mean Wage of Head: Informal Sector (%)	-0.07	-2.93	-3.97	-6.02	-0.29	-1.93	-4.69	-8.41
Mean Wage of Spouse: Formal Sector (%)	0.35	1.66	3.09	5.40	0.43	1.99	3.90	7.63
Mean Wage of Spouse: Informal Sector (%)	-0.01	0.00	0.93	2.25	-0.06	-0.41	-1.27	-2.78
Avg. Welfare (%)	0.37	0.21	2.12	5.16	0.21	1.17	2.69	5.32
Welfare per sector: head (%)								
formal sector	0.06	3.29	5.13	6.43	0.17	1.35	4.02	7.62
informal sector	0.51	0.03	1.91	5.72	0.43	1.78	2.92	6.77
nonemployment	0.17	-0.03	3.52	3.15	0.06	0.22	0.62	1.50
Welfare per sector: spouse (%)								
formal sector	0.46	1.68	3.77	7.56	0.23	1.03	1.93	3.99
informal sector	0.59	2.25	4.52	10.92	0.26	1.20	2.19	4.52
nonemployment	0.30	-0.28	-0.09	1.73	0.13	0.87	2.28	4.47

Note: Changes are in relation to benchmark levels.

Table 10: Counterfactual Experiment: Effects of changing willingness to pay to have HI outside the formal sector (γ).

	(1)	(2)	(3)	(4)
	Panel A		Panel B	
	South, Low Educ, Children $10 \times \hat{\gamma}$	South, Low Educ, Children $20 \times \hat{\gamma}$	North, High Educ, No Children $10 \times \hat{\gamma}$	North, High Educ, No Children $20 \times \hat{\gamma}$
Transitions: Head (pp)				
Nonemployment-Formal	-0.06	-0.11	-0.05	-0.13
Nonemployment-Informal	0.09	0.25	0.26	0.33
Formal-Nonemployment	-0.02	-0.01	-0.01	-0.02
Formal-Informal	0.89	0.48	0.88	1.60
Informal-Nonemployment	0.00	0.00	0.00	0.00
Informal-Formal	0.04	0.06	0.04	0.03
Nonemployment-Informal, if spouse loses formal job	0.43	0.83	0.36	0.61
Nonemployment-Informal, if spouse loses informal job	0.05	0.04	0.13	0.16
Transitions: Spouse (pp)				
Nonemployment-Formal	-0.10	-0.16	-0.24	-0.49
Nonemployment-Informal	-1.64	-2.05	-0.28	-0.49
Formal-Nonemployment	-0.10	-0.19	-0.04	-0.09
Formal-Informal	1.39	2.64	0.74	1.55
Informal-Nonemployment	0.06	0.11	0.14	0.27
Informal-Formal	-0.29	-0.54	-0.78	-1.56
Nonemployment-Informal, if head loses formal job	0.00	0.00	0.01	0.01
Nonemployment-Informal, if head loses informal job	0.03	0.04	0.01	0.02

Note: Changes are in relation to benchmark levels.

11 Figures

Figure 1: Two Value Functions and the Reservation Wage

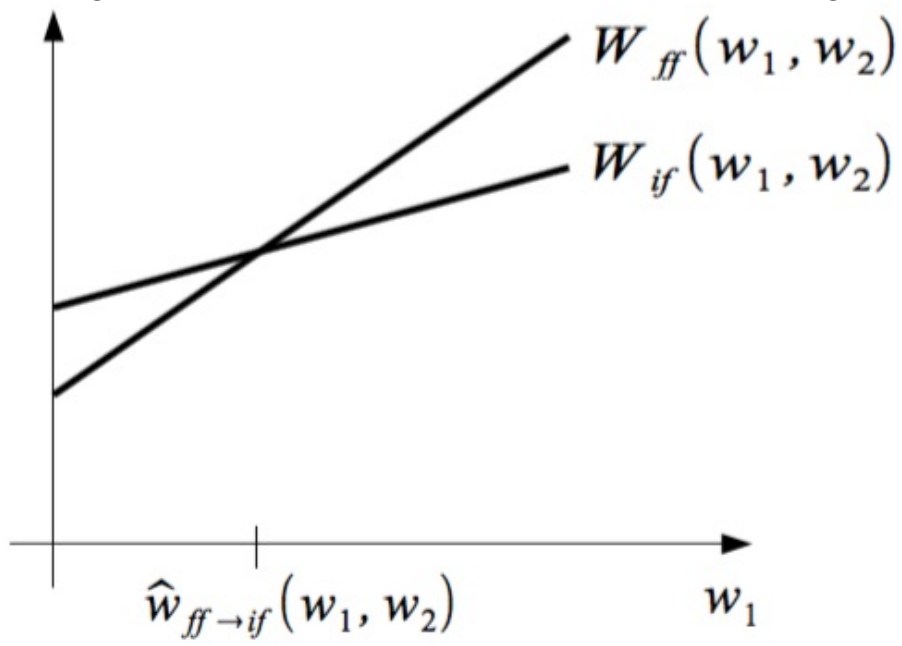


Figure 2: Three Value Functions and the Reservation Wages (1)

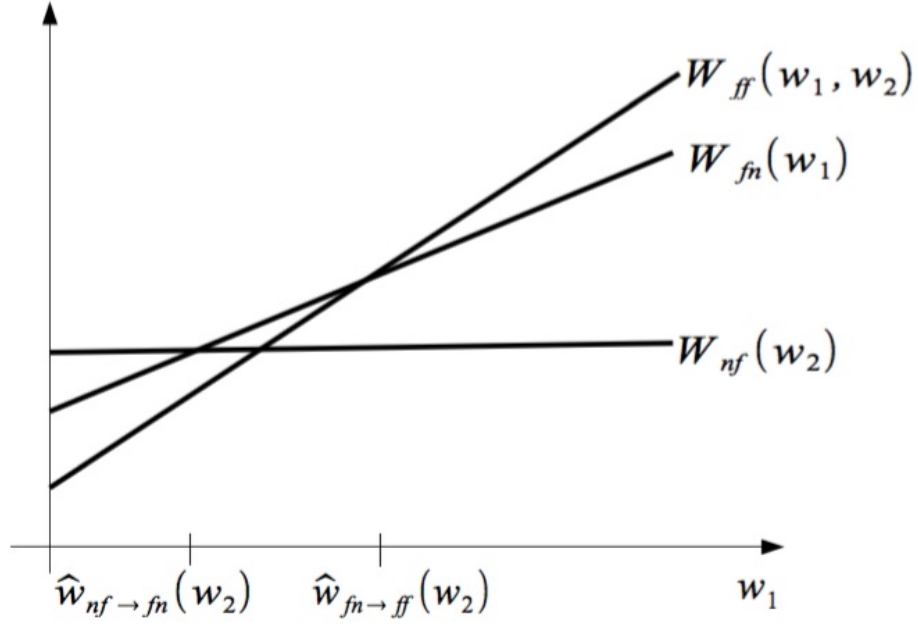


Figure 3: Three Value Functions and the Reservation Wages (2)

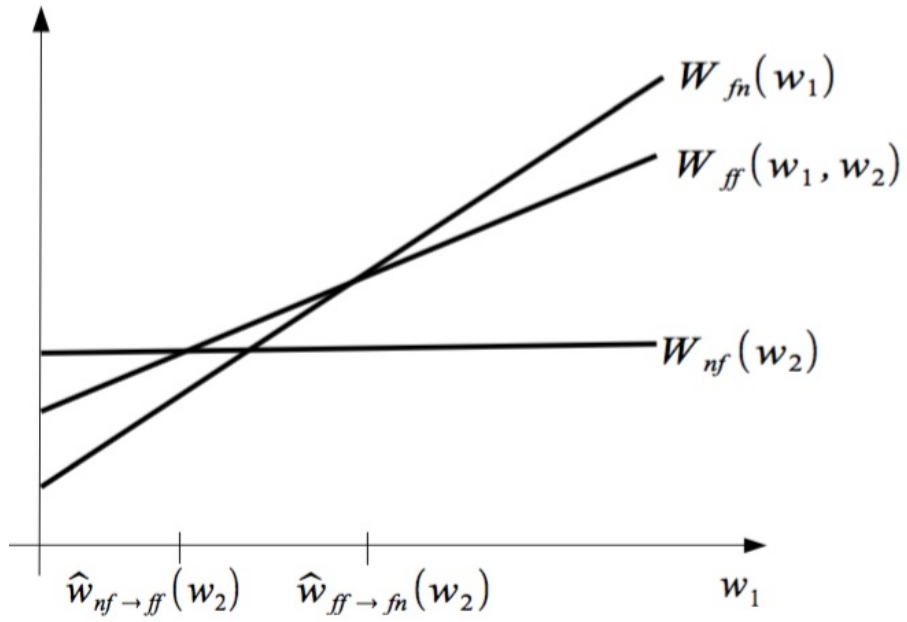
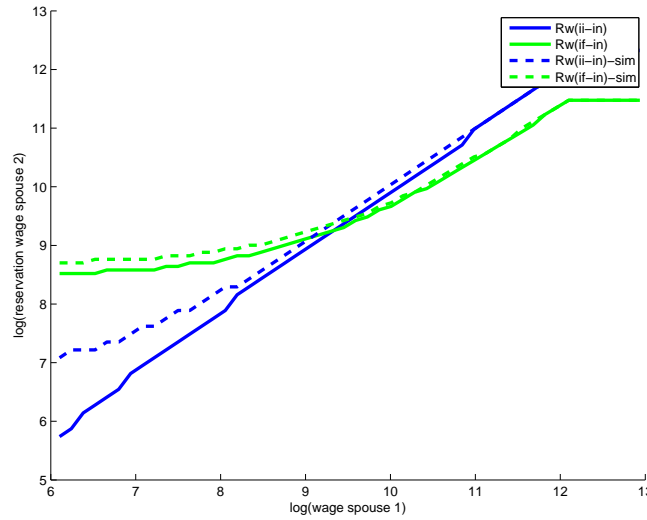
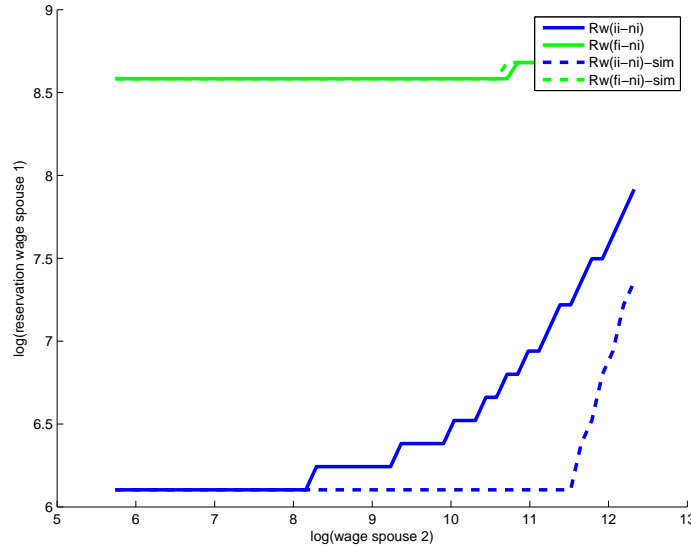


Figure 4: Simulated changes in γ (sample: Southern states, low educated households with children).



Panel A: Reservation wage of the spouse 2 (spouse) for each level of wage in the informal sector wage of the spouse 1 (head)



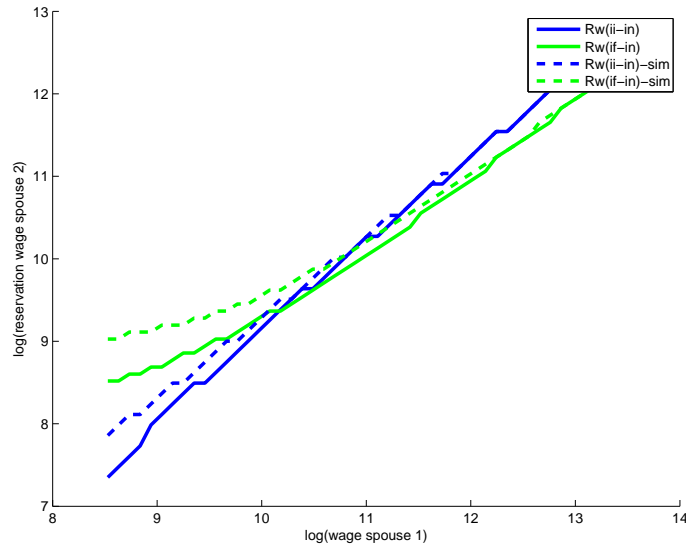
Panel B: Reservation wage of the spouse 1 (head) for each level of wage in the informal sector wage of the spouse 2 (spouse)

Note: The lines in Panel A plot the reservation wage of the spouse 2 (spouse) for each level of wage in the informal sector wage of the spouse 1 (head). The dark line plots the reservation wage for the informal sector (denoted in the legend to graph as $Rw(ii-in)$), whereas the lighter line plots the reservation wage for the formal sector (denoted in the legend to graph as $Rw(fi-in)$).

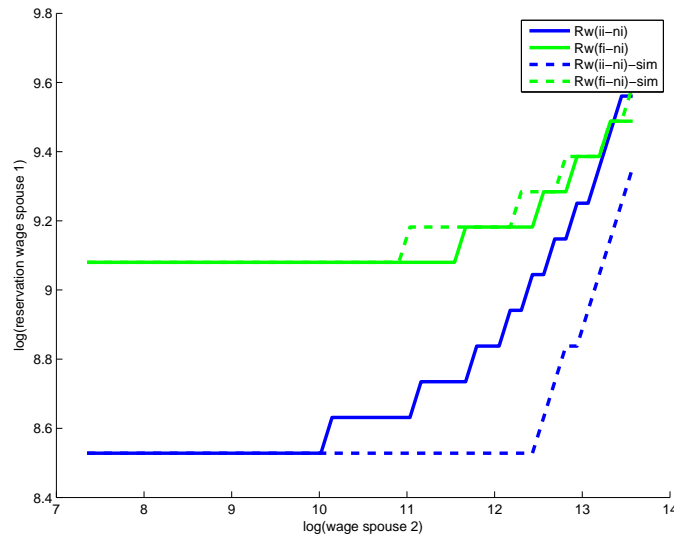
The lines in Panel B plot the reservation wage of the spouse 1 (head) for each level of wage in the informal sector wage of the spouse 2 (spouse). The dark line plots the reservation wage for the informal sector (denoted in the legend to graph as $Rw(ii-ni)$), whereas the lighter line plots the reservation wage for the formal sector (denoted in the legend to graph as $Rw(fi-ni)$).

In both panels, the solid lines are the reservation wages from the estimation of the model on the pre-SP period (baseline economy, where γ is set to 0). The dashed line represent the reservation wages which result from simulating the baseline economy with a value of γ 10 times the value which is obtained by estimating the model on the post-introduction of SP period.

Figure 5: Simulated changes in γ (sample: Northern states, high educated households without children).



Panel A: Reservation wage of the spouse 2 (spouse) for each level of wage in the informal sector wage of the spouse 1 (head)



Panel B: Reservation wage of the spouse 1 (head) for each level of wage in the informal sector wage of the spouse 2 (spouse)

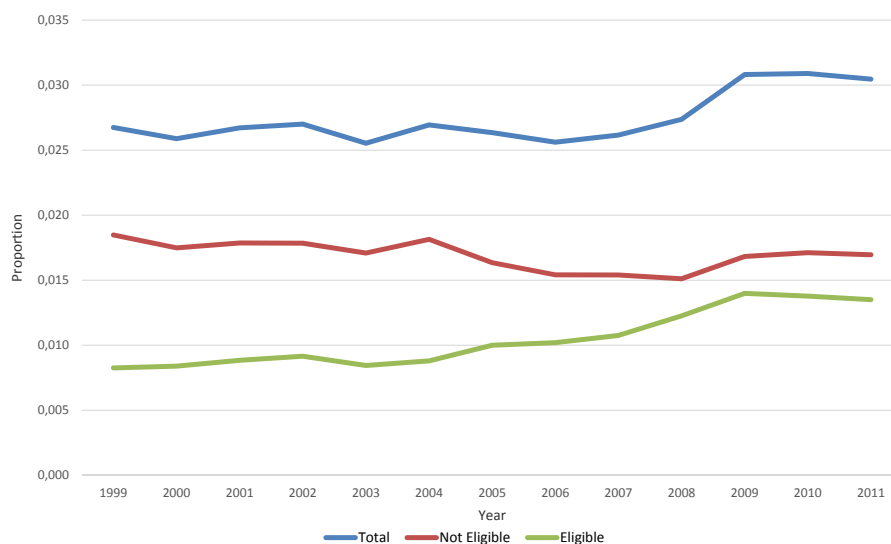
Note: The lines in Panel A plot the reservation wage of the spouse 2 (spouse) for each level of wage in the informal sector wage of the spouse 1 (head). The dark line plots the reservation wage for the informal sector (denoted in the legend to graph as $Rw(ii-in)$), whereas the lighter line plots the reservation wage for the formal sector (denoted in the legend to graph as $Rw(fi-in)$).

The lines in Panel B plot the reservation wage of the spouse 1 (head) for each level of wage in the informal sector wage of the spouse 2 (spouse). The dark line plots the reservation wage for the informal sector (denoted in the legend to graph as $Rw(ii-ni)$), whereas the lighter line plots the reservation wage for the formal sector (denoted in the legend to graph as $Rw(fi-ni)$).

In both panels, the solid lines are the reservation wages from the estimation of the model on the pre-SP period (baseline economy, where γ is set to 0). The dashed line represent the reservation wages which result from simulating the baseline economy with a value of γ 10 times the value which is obtained by estimating the model on the post-introduction of SP period.

A Appendix: Figures

Figure A.1: Public Expenditure on Health, Overall and by SP Eligibility Group



Note: The figure shows the ratio of public expenditure on health to GDP, overall and by SP eligibility group. The total public expenditure on health is the sum of the public expenditure for the insured population (not eligible to SP), i.e. those affiliated with IMSS (*Instituto Mexicano del Seguro Social*), ISSSTE (*Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado*) and PEMEX (*Petrleos Mexicanos*), and for the uninsured population (eligible to SP). This latter includes both federal and state expenditures, where the former combines resources assigned to (1) the Ministry of Health (*Ramo 12*), (2) the FASSA (*Fondo de Aportaciones para los Servicios de Salud, Ramo 33*) - these two constitute the *Aportaciones Federales* - or other health services funds; and (3) the IMSS-Oportunidades (*Ramo 19*). Source: own calculations from the official budget.

Figure A.2: Municipalities that implemented SP, per month.

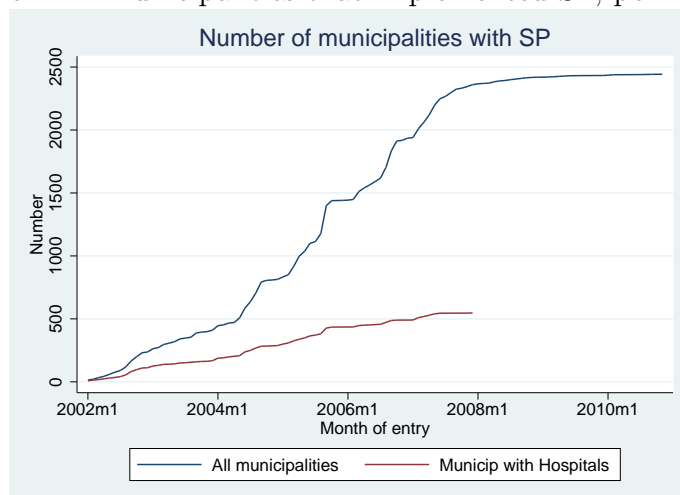
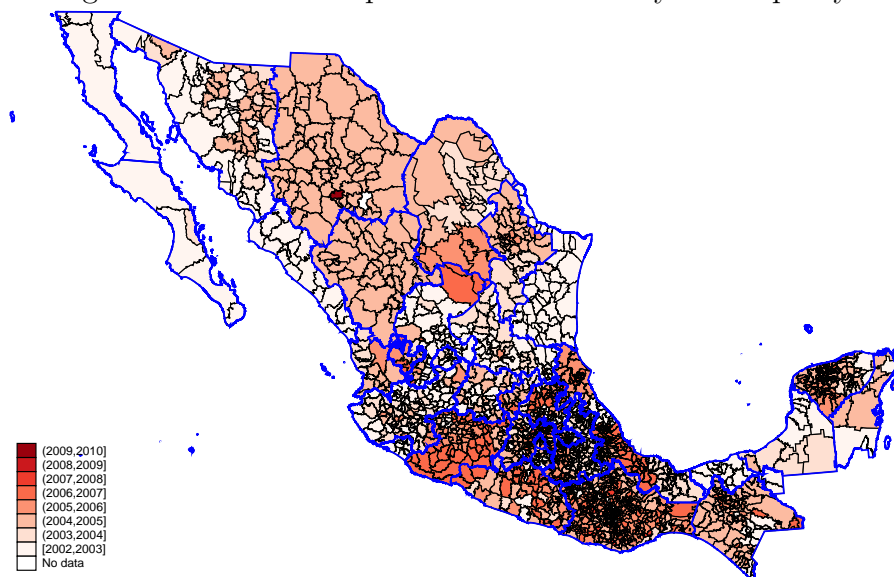


Figure A.3: Year of implementation of SP by municipality.



B Institutional Setup: Mexican pension system, taxes and child care

B.1 The Pension System

The current pension system is characterized by two parallel systems, where a contributory social security system, with a package of defined benefits for formal workers in the private and public sectors, coexists with a set of fragmented noncontributory services and benefits offered through diverse social protection programs to the population living in poverty, with low income, and in the informal sector of the economy.

The largest reform on the Social Security took place in 1997, when the IMSS (the Social Security system for workers in the private workers) switched the pay-as-you-go (PAYG) system to a fully funded system with personal retirement accounts (PRAs). The pension benefit depends on the amount accumulated and capitalized in an individual account (Aguila, 2014). Under the PAYG system the benefits can be claimed through normal or early retirement. There is no mandatory retirement age, but the normal retirement age is 65, and the IMSS requires at least 10 years (500 weeks) of contributions to retire under PAYG rules. Social security benefits are then computed as a proportion of the average wage in the 5 years before retirement, and benefits increase for each year of contribution beyond the required 10 years. There is also a minimum payment guarantee, which is equal to the minimum wage in Mexico City (to be entitled to this benefit, the worker must contribute for at least 1,250 weeks over his work life). The ISSSTE underwent a similar reform in 2007, however, the change to a fully funded scheme was voluntary for workers who were already active (Villagómez and Ramírez, 2015).

Since 2001 there are also several non-contributory programs for poor elderly over 60. In 2001 the government of the Federal District implemented the Nutritional Support, Medical Attention, and Free Medicines Program for the Elderly (*Programa de Apoyo Alimentario, Atención Médica y Medicamentos Gratuitos para Adultos Mayores*), covering elderly residents older than 70 in the poorest areas of the Distrito Federal (Villagómez and Ramírez, 2015). In 2003 the government introduced the program *Attention to the Elderly in Rural Areas* for individuals nonparticipants in any other social protection program like the *Opportunities*. The program targeted adults older than 60 living in nutritional poverty and resident poor rural communities with less than 2,500 inhabitants. Finally, the *Oportunidades* created in 2006 a complement to beneficiary families with adults older than 70.

B.2 Taxes

During most of the period in analysis there were no changes in the income or corporation taxes in Mexico. The exception was 2010, when a tax reform increased the marginal income tax rates for some workers but not others. Mexico operated a dual income tax system for business income where the taxpayer is liable to the higher of either the standard income tax (ISR) or a cashflow business tax called the *Impuesto Empresarial de Tasa Única* (IETU) from 2008 to 2013. The flat tax under IETU was not increased as part of the 2010 tax reform, whilst the top rates of ISR were (see Abramovsky and Philips, 2015).

B.3 Child Care for Children of Mother in the Formal and Informal Sectors

The government introduced in 2007 the program *Estancias Infantiles para Apoyar a Madres Trabajadoras*, which covers approximately 90 percent of the cost of enrolling a child under age four at a formal child care center and is intended to benefit women who are looking for work, in school, or working, that live in families without Social Security coverage. This program was expanded between 2007 and 2010.

C Other Value Functions

The value function $W_{nf}(w_2)$ is similar to the that for a household where the head works in the formal sector and the spouse is non-employed ($W_{fn}(w_1)$). There is only an exchange in the status between spouses 1 and 2:

$$\begin{aligned}
rW_{nf}(w_2) = & w_2 + b_1 + a + \delta_f^{s_2}(1 - p^{s_1})(W_{nn} - W_{nf}(w_2)) + \\
& \delta_f^{s_2}p^{s_1} \int \max\{W_{in}(x) - W_{nf}(w_2), W_{nn} - W_{nf}(w_2)\} dF_i^{s_1}(x) + \\
& \lambda_{ff}^{s_2} \int \max\{W_{nf}(x) - W_{nf}(w_2), 0\} dF_f^{s_2}(x) + \\
& \lambda_{fi}^{s_2} \int \max\{W_{ni}(x) - W_{nf}(w_2), 0\} dF_i^{s_2}(x) + \\
& \lambda_{nf}^{s_1} \int \max\{W_{ff}(x, w_2) - W_{nf}(w_2), W_{fn}(x) - W_{nf}(w_2), 0\} dF_f^{s_1}(x) + \\
& \lambda_{ni}^{s_1} \int \max\{W_{if}(x, w_2) - W_{nf}(w_2), 0\} dF_i^{s_1}(x)
\end{aligned}$$

and p^{s_1} is the probability that spouse 1 moves from nonemployment to informal given that spouse 2 moves from a formal job to nonemployment.

The value function $W_{ni}(w_2)$ is similar to that for a household where the head works in the informal sector and the spouse is non-employed ($W_{in}(w_1)$). There is only an exchange in the status between spouses 1 and 2:

$$\begin{aligned}
rW_{ni}(w_2) = & w_2 + b_1 + \gamma + \delta_i^{s_2}(1 - q^{s_1})(W_{nn} - W_{ni}(w_2)) + \\
& \delta_i^{s_2}q^{s_1} \int \max\{W_{in}(x) - W_{ni}(w_2), W_{nn} - W_{ni}(w_2)\} dF_i^{s_1}(x) + \\
& \lambda_{ii}^{s_2} \int \max\{W_{ni}(x) - W_{ni}(w_2), 0\} dF_i^{s_2}(x) + \\
& \lambda_{if}^{s_2} \int \max\{W_{nf}(x) - W_{ni}(w_2), 0\} dF_f^{s_2}(x) + \\
& \lambda_{nf}^{s_1} \int \max\{W_{fi}(x, w_2) - W_{ni}(w_2), W_{fn}(x) - W_{ni}(w_2), 0\} dF_f^{s_1}(x) + \\
& \lambda_{ni}^{s_1} \int \max\{W_{ii}(x, w_2) - W_{ni}(w_2), 0\} dF_i^{s_1}(x)
\end{aligned}$$

where q^{s_1} is the probability that spouse 1 moves from nonemployment to informal given that spouse 2 moves from an informal job to nonemployment.

D Identification and Estimation Issues

D.1 Flow Conditions

Spouse 1 in formal sector and spouse 2 in informal sector

$$\begin{aligned}
& m_{fi}G_{fi}(w_1, w_2)[\delta_f^{s1} + \delta_i^{s2} + \lambda_{ff}^{s1}\bar{F}_f^{s1}(w_1) + \lambda_{ii}^{s2}\bar{F}_i^{s2}(w_2)] + \\
& \lambda_{fi}^{s1}m_{fi} \int^{w_2} \int^{w_1} \bar{F}_i^{s1}(\hat{w}_{fi->ii}(x, w_2))g_{fi}(x, w_2)dx dw_2 + \\
& \lambda_{if}^{s2}m_{fi} \int^{w_1} \int^{w_2} \bar{F}_f^{s2}(\min(\hat{w}_{fi->ff}(w_1, x), \hat{w}_{fi->nf}(w_1, x)))g_{fi}(w_1, x)dx dw_1 = \\
& \lambda_{if}^{s1}m_{ii} \int^{w_2} \int^{w_1} \max(F_f^{s1}(w_1) - F_f^{s1}(\max(\hat{w}_{ii->fi}(x, w_2), \hat{w}_{fn->fi}(x, w_2))), 0) g_{ii}(x, w_2)dx dw_2 + \\
& \lambda_{fi}^{s2}m_{ff} \int^{w_1} \int^{w_2} \max(F_i^{s2}(w_2) - F_i^{s2}(\hat{w}_{ff->fi}(w_1, x)), 0)g_{ff}(w_1, x)dx dw_1 + \\
& \lambda_{nf}^{s1}m_{ni} \int^{w_2} \max(F_f^{s1}(w_1) - F_f^{s1}(\max(\hat{w}_{ni->fi}(w_2), \hat{w}_{fn->fi}(w_2))), 0)g_{ni}(w_2)dw_2 + \\
& \lambda_{ni}^{s2}m_{fn} \int^{w_1} \max(F_i^{s2}(w_2) - F_i^{s2}(\hat{w}_{fn->fi}(w_1)), 0)g_{fn}(w_1)dw_1.
\end{aligned}$$

where $W_{fi}(\bar{w}_1, w_2)$ is higher than $W_{ii}(\bar{w}_1, w_2)$ and $W_{fn}(\bar{w}_1)$.

Spouse 1 in formal sector and spouse 2 in nonemployment

$$\begin{aligned}
& m_{fn}G_{fn}(w_1)[\delta_f^{s1} + \lambda_{ff}^{s1}\bar{F}_f^{s1}(w_1)] + \\
& \lambda_{fi}^{s1}m_{fn} \int^{w_1} \bar{F}_i^{s1}(\hat{w}_{fn->in}(x))g_{fn}(x)dx + \\
& \lambda_{nf}^{s2}m_{fn} \int^{w_1} \bar{F}_f^{s2}(\min(\hat{w}_{fn->ff}(w_1), \hat{w}_{fn->nf}(w_1)))g_{fn}(w_1)dw_1 + \\
& \lambda_{ni}^{s2}m_{fn} \int^{w_1} \bar{F}_i^{s2}(\hat{w}_{fn->fi}(w_1))g_{fn}(w_1)dw_1 = \\
& \delta_f^{s2}m_{ff}G_{ff}(w_1, \bar{w}_2) + \delta_i^{s2}m_{fi}G_{fi}(w_1, \bar{w}_2) + \\
& \lambda_{nf}^{s1}m_{nn} \max(F_f^{s1}(w_1) - F_f^{s1}(\hat{w}_{nn->fn}), 0) + \\
& \lambda_{nf}^{s1}m_{ni} \int^{w_2} \max(F_f^{s1}(w_1) - F_f^{s1}(\max(\hat{w}_{ni->fn}(w_2), \hat{w}_{fi->fn}(w_2))), 0)g_{ni}(w_2)dw_2 + \\
& \lambda_{nf}^{s1}m_{nf} \int^{w_2} \max(F_f^{s1}(w_1) - F_f^{s1}(\max(\hat{w}_{nf->fn}(w_2), \hat{w}_{ff->fn}(w_2))), 0)g_{nf}(w_2)dw_2 + \\
& \lambda_{if}^{s1}m_{in} \int^{w_1} \max(F_f^{s1}(w_1) - F_f^{s1}(\hat{w}_{in->fn}(x)), 0)g_{in}(x)dx.
\end{aligned}$$

where $W_{fn}(\bar{w}_1)$ is higher than $W_{ff}(\bar{w}_1, w_2)$ and $W_{fi}(\bar{w}_1, w_2)$.

Spouse 1 in nonemployment and spouse 2 in informal sector

$$\begin{aligned}
& m_{ni}G_{ni}(w_2)[\delta_i^{s2} + \lambda_{ii}^{s2}\bar{F}_i^{s2}(w_2)] + \\
& \lambda_{if}^{s2}m_{ni} \int^{w_2} \bar{F}_f^{s2}(\hat{w}_{ni->nf}(x))g_{ni}(x)dx + \\
& \lambda_{nf}^{s1}m_{ni} \int^{w_2} \bar{F}_f^{s1}(\min(\hat{w}_{ni->fi}(w_2), \hat{w}_{ni->fn}(w_2))g_{ni}(w_2))dw_2 + \\
& \lambda_{ni}^{s1}m_{ni} \int^{w_2} \bar{F}_i^{s1}(\hat{w}_{ni->ii}(w_2))g_{ni}(w_2)dw_2 = \\
& \delta_f^{s1}m_{fi}G_{fi}(\bar{w}_1, w_2) + \delta_i^{s1}m_{ii}G_{ii}(\bar{w}_1, w_2) + \\
& \lambda_{fi}^{s2}m_{nf} \int^{w_2} \max(F_i^{s2}(w_2) - F_i^{s2}(\hat{w}_{nf->ni}(x)), 0)g_{nf}(x)dx + \\
& \lambda_{ni}^{s2}m_{nn} \max(F_i^{s1}(w_2) - F_i^{s1}(\hat{w}_{nn->ni}), 0) + \\
& \delta_f^{s1}p_{s2}m_{fn} \int^{w_1} \max(F_i^{s2}(w_2) - F_i^{s2}(\max(\hat{w}_{fn->ni}(w_1), \hat{w}_{nn->ni})), 0)g_{fn}(w_1)dw_1 + \\
& \delta_i^{s1}q_{s2}m_{in} \int^{w_1} \max(F_i^{s2}(w_2) - F_i^{s2}(\max(\hat{w}_{in->ni}(w_1), \hat{w}_{nn->ni})), 0)g_{in}(w_1)dw_1.
\end{aligned}$$

Spouse 1 in informal sector and spouse 2 in nonemployment

$$\begin{aligned}
& m_{in}G_{in}(w_1)[\delta_i^{s1} + \lambda_{ii}^{s1}\bar{F}_i^{s1}(w_1)] + \\
& \lambda_{if}^{s1}m_{in} \int^{w_1} \bar{F}_f^{s1}(\hat{w}_{in->fn}(x))g_{in}(x)dx + \\
& \lambda_{nf}^{s2}m_{in} \int^{w_1} \bar{F}_f^{s2}(\min(\hat{w}_{in->if}(w_1), \hat{w}_{in->nf}(w_1))g_{in}(w_1)dw_1 + \\
& \lambda_{ni}^{s2}m_{in} \int^{w_1} \bar{F}_i^{s2}(\hat{w}_{in->ii}(w_1))g_{in}(w_1)dw_1 = \\
& \delta_f^{s2}m_{if}G_{if}(w_1, \bar{w}_2) + \delta_i^{s2}m_{ii}G_{ii}(w_1, \bar{w}_2) + \\
& \lambda_{ni}^{s1}m_{nn} \max(F_i^{s1}(w_1) - F_i^{s1}(\hat{w}_{nn->in}), 0) + \\
& \delta_f^{s2}p_{s1}m_{nf} \int^{w_2} \max(F_i^{s1}(w_1) - F_i^{s1}(\max(\hat{w}_{nf->in}(w_2), \hat{w}_{nn->in})), 0)g_{nf}(w_2)dw_2 + \\
& \delta_i^{s2}q_{s1}m_{ni} \int^{w_2} \max(F_i^{s1}(w_1) - F_i^{s1}(\max(\hat{w}_{ni->in}(w_2), \hat{w}_{nn->in})), 0)g_{ni}(w_2)dw_2 + \\
& \lambda_{fi}^{s1}m_{fn} \int^{w_1} \max(F_i^{s1}(w_1) - F_i^{s1}(\hat{w}_{fn->in}(x)), 0)g_{fn}(x)dx.
\end{aligned}$$

Spouse 1 in informal sector and spouse 2 in formal sector

$$\begin{aligned}
& m_{if}G_{if}(w_1, w_2)[\delta_i^{s1} + \delta_f^{s2} + \lambda_{ii}^{s1}\bar{F}_i^{s1}(w_1) + \lambda_{ff}^{s2}\bar{F}_f^{s2}(w_2)] + \\
& \lambda_{if}^{s1}m_{if} \int^{w_2} \int^{w_1} \bar{F}_f^{s1}(\min(\hat{w}_{if->ff}(x, w_2), \hat{w}_{if->fn}(x, w_2)))g_{if}(x, w_2)dx dw_2 + \\
& \lambda_{fi}^{s2}m_{if} \int^{w_1} \int^{w_2} \bar{F}_i^{s2}(\hat{w}_{if->ii}(w_1, x))g_{if}(w_1, x)dx dw_1 = \\
& \lambda_{ni}^{s1}m_{nf} \int^{w_2} \max(F_i^{s1}(w_1) - F_i^{s1}(\hat{w}_{nf->if}(w_2)), 0)g_{nf}(w_2)dw_2 + \\
& \lambda_{nf}^{s2}m_{in} \int^{w_1} \max(F_f^{s2}(w_2) - F_f^{s2}(\max(\hat{w}_{in->if}(w_1), \hat{w}_{nf->if}(w_1))), 0)g_{in}(w_1)dw_1 + \\
& \lambda_{fi}^{s1}m_{ff} \int^{w_2} \int^{w_1} \max(F_i^{s1}(w_1) - F_i^{s1}(\hat{w}_{ff->if}(x, w_2)), 0)g_{ff}(x, w_2)dx dw_2 + \\
& \lambda_{if}^{s2}m_{ii} \int^{w_1} \int^{w_2} \max(F_f^{s2}(w_2) - F_f^{s2}(\max(\hat{w}_{ii->if}(w_1, x), \hat{w}_{nf->if}(w_1))), 0)g_{ii}(w_1, x)dx dw_1.
\end{aligned}$$

where $W_{if}(w_1, \bar{w}_2)$ is higher than $W_{ii}(w_1, \bar{w}_2)$ and $W_{nf}(\bar{w}_2)$.

Spouse 1 is nonemployed and spouse 2 in formal sector

$$\begin{aligned}
& m_{nf}G_{nf}(w_2)[\delta_f^{s2} + \lambda_{ff}^{s2}\bar{F}_f^{s2}(w_2)] + \\
& \lambda_{ni}^{s1}m_{nf} \int^{w_2} \bar{F}_i^{s1}(\hat{w}_{nf->if}(w_2))g_{nf}(w_2)dw_2 + \\
& \lambda_{nf}^{s1}m_{nf} \int^{w_2} \bar{F}_f^{s1}(\min(\hat{w}_{nf->ff}(w_2), \hat{w}_{nf->fn}(w_2)))g_{nf}(w_2)dw_2 + \\
& \lambda_{fi}^{s2}m_{nf} \int^{w_2} \bar{F}_i^{s2}(\hat{w}_{nf->ni}(x))g_{nf}(x)dx = \\
& \delta_f^{s1}m_{ff}G_{ff}(\bar{w}_1, w_2) + \delta_i^{s1}m_{if}G_{if}(\bar{w}_1, w_2) + \\
& \lambda_{nf}^{s2}m_{nn} \max(F_f^{s2}(w_2) - F_f^{s2}(\hat{w}_{nn->nf}), 0) + \\
& \lambda_{nf}^{s2}m_{in} \int^{w_1} \max(F_f^{s2}(w_2) - F_f^{s2}(\max(\hat{w}_{in->nf}(w_1), \hat{w}_{if->nf}(w_1))), 0)g_{in}(w_1)dw_1 + \\
& \lambda_{nf}^{s2}m_{fn} \int^{w_1} \max(F_f^{s2}(w_2) - F_f^{s2}(\max(\hat{w}_{fn->nf}(w_1), \hat{w}_{ff->nf}(w_1))), 0)g_{fn}(w_1)dw_1 + \\
& \lambda_{if}^{s2}m_{ni} \int^{w_2} \max(F_f^{s2}(w_2) - F_f^{s2}(\hat{w}_{ni->nf}(x)), 0)g_{ni}(x)dx.
\end{aligned}$$

where $W_{nf}(\bar{w}_2)$ is higher than $W_{ff}(w_1, \bar{w}_2)$ and $W_{if}(w_1, \bar{w}_2)$.

D.2 Identification in the Household Model: the value of leisure, the value of amenities in the formal sector, and the value of health insurance by SP

From the restrictions imposed in the model $W_{in}(\underline{w}_1^i) = W_{ii}(\underline{w}_1^i, \underline{w}_2^i)$, $W_{ni}(\underline{w}_2^i) = W_{nn}$, and $W_{ni}(\underline{w}_2^i) = W_{nf}(\underline{w}_2^f)$, we obtain b_1 , b_2 , a and γ , respectively.

Under the restriction $\gamma = 0$, i.e before SP, the parameters a , b_1 and b_2 are:

$$b_1 = rW_{nn} - \underline{w}_2^i - \gamma - B$$

$$b_2 = rW_{ii}(\underline{w}_1^i, \underline{w}_2^i) - \underline{w}_1^i - \gamma - C$$

$$a = rW_{ni}(\underline{w}_2^i) - b_1 - \underline{w}_2^f - D$$

where

$$\begin{aligned} B = & \delta_i^{s_2} q^{s_1} \int (W_{in}(x) - W_{ni}(\underline{w}_2)) dF_i^{s_1}(x) - \\ & \lambda_{ii}^{s_2} \int (W_{ni}(x) - W_{ni}(\underline{w}_2)) dF_i^{s_2}(x) - \\ & \lambda_{if}^{s_2} \int (W_{nf}(x) - W_{ni}(\underline{w}_2)) dF_f^{s_2}(x) - \\ & \lambda_{nf}^{s_1} \int \max \{W_{fi}(x, \underline{w}_2) - W_{ni}(\underline{w}_2), W_{fn}(x) - W_{ni}(\underline{w}_2), 0\} dF_f^{s_1}(x) - \\ & \lambda_{ni}^{s_1} \int (W_{ii}(x, \underline{w}_2) - W_{ni}(\underline{w}_2)) dF_i^{s_1}(x) \end{aligned}$$

$$\begin{aligned} C = & \delta_i^{s_1} q^{s_2} \int (W_{ni}(x) - W_{in}(\underline{w}_1)) dF_i^{s_2}(x) - \\ & \lambda_{ii}^{s_1} \int (W_{in}(x) - W_{in}(\underline{w}_1)) dF_i^{s_1}(x) - \\ & \lambda_{if}^{s_1} \int \max \{W_{fn}(x) - W_{in}(\underline{w}_1), 0\} dF_f^{s_1}(x) - \\ & \lambda_{nf}^{s_2} \int \max \{W_{if}(\underline{w}_1, x) - W_{in}(\underline{w}_1), W_{nf}(x) - W_{in}(\underline{w}_1)\} dF_f^{s_2}(x) - \\ & \lambda_{ni}^{s_2} \int (W_{ii}(\underline{w}_1, x) - W_{in}(\underline{w}_1)) dF_i^{s_2}(x) \end{aligned}$$

$$\begin{aligned}
D = & \delta_f^{s_2} p^{s_1} \int (W_{in}(x) - W_{nf}(\underline{w}_2)) dF_i^{s_1}(x) + \\
& \lambda_{ff}^{s_2} \int (W_{nf}(x) - W_{nf}(\underline{w}_2)) dF_f^{s_2}(x) + \\
& \lambda_{fi}^{s_2} \int (W_{ni}(x) - W_{nf}(\underline{w}_2)) dF_i^{s_2}(x) + \\
& \lambda_{nf}^{s_1} \int \max \{W_{ff}(x, \underline{w}_2) - W_{nf}(\underline{w}_2), W_{fn}(x) - W_{nf}(\underline{w}_2), 0\} dF_f^{s_1}(x) + \\
& \lambda_{ni}^{s_1} \int \max \{W_{if}(x, \underline{w}_2) - W_{nf}(\underline{w}_2), 0\} dF_i^{s_1}(x)
\end{aligned}$$

Given a , b_1 and b_2 estimated using data before SP, γ is obtained using data from a period after the SP implementation:

$$\gamma = rW_{nf}(\underline{w}_2) - b_1 - \underline{w}_2^i - B$$

D.3 Implementation of the value functions

We use integration by parts to obtain the Emax functions in terms of the F distributions and the transition parameters. We first re-write the integrals to eliminate the max function. For example:

$$\int \max \{W_{in}(x) - W_{fn}(w_1), 0\} dF_i^{s_1}(x) = \int_{\hat{w}_{fn->in}(w_1)}^{\infty} (W_{in}(x) - W_{fn}(w_1)) dF_i^{s_1}(x)$$

Then we use the definition of reservation wage so that $W_{in}(\hat{w}_{fn->in}(w_1)) = W_{fn}(w_1)$. We also differentiate the value function $W_{in}(w_1)$ with respect to w_1 . In the case where $W_{if}(w_1, \bar{w}_2) > W_{nf}(\bar{w}_2)$,

$$\begin{aligned}
W'_{in}(w_1) = & [r + \delta_i^{s_1}(1 - q^{s_2}) + \delta_i^{s_1} q^{s_2} \bar{F}_i^{s_2}(\hat{w}_{in->ni}(w_1)) + \lambda_{ii}^{s_1} \bar{F}_i^{s_1}(w_1) + \\
& \lambda_{if}^{s_1} \bar{F}_f^{s_1}(\hat{w}_{in->fn}(w_1)) + \lambda_{nf}^{s_2} \bar{F}_f^{s_2}(\hat{w}_{in->if}(w_1)) + \lambda_{ni}^{s_2} \bar{F}_i^{s_2}(\hat{w}_{in->ii}(w_1))]^{-1}
\end{aligned}$$

The above integral becomes:

$$\int_{\hat{w}_{fn->in}(w_1)}^{\infty} (W_{in}(x) - W_{fn}(w_1)) dF_i^{s_1}(x) = \int_{\hat{w}_{fn->in}(w_1)}^{\infty} \bar{F}_i^{s_1}(x) W'_{in}(x) dx$$

Other Emax functions have three elements instead of two. We also solve them in terms of F distributions and the transition parameters. For example:

$$\int \max \{W_{ff}(w_1, x) - W_{fn}(w_1), W_{nf}(x) - W_{fn}(w_1), 0\} dF_f^{s_2}(x) =$$

$$\int_{\hat{w}_{fn->ff}(w_1)}^{\infty} \overline{F}_f^{s_2}(x) W'_{ff}(w_1, x) dx \quad \text{if} \quad \begin{aligned} &\hat{w}_{fn->nf}(w_1) \geq \hat{w}_{nf->ff}(w_1) \\ &\& W_{ff}(w_1, \bar{w}_2) \geq W_{nf}(\bar{w}_2) \end{aligned}$$

$$\int_{\hat{w}_{fn->nf}(w_1)}^{\infty} \overline{F}_f^{s_2}(x) W'_{nf}(x) dx \quad \text{if} \quad \begin{aligned} &\hat{w}_{fn->nf}(w_1) \geq \hat{w}_{ff->nf}(w_1) \\ &\& W_{ff}(w_1, \bar{w}_2) < W_{nf}(\bar{w}_2) \end{aligned}$$

$$\begin{aligned} &\int_{\hat{w}_{fn->nf}(w_1)}^{\hat{w}_{nf->ff}(w_1)} \overline{F}_f^{s_2}(x) W'_{nf}(x) dx \\ + \int_{\hat{w}_{nf->ff}(w_1)}^{\infty} \overline{F}_f^{s_2}(x) W'_{ff}(w_1, x) dx \end{aligned} \quad \text{if} \quad \begin{aligned} &\hat{w}_{fn->nf}(w_1) < \hat{w}_{nf->ff}(w_1) \\ &\& W_{ff}(w_1, \bar{w}_2) \geq W_{nf}(\bar{w}_2) \end{aligned}$$

$$\begin{aligned} &\int_{\hat{w}_{fn->ff}(w_1)}^{\hat{w}_{ff->nf}(w_1)} \overline{F}_f^{s_2}(x) W'_{ff}(w_1, x) dx \\ + \int_{\hat{w}_{ff->nf}(w_1)}^{\infty} \overline{F}_f^{s_2}(x) W'_{nf}(x) dx \end{aligned} \quad \text{if} \quad \begin{aligned} &\hat{w}_{fn->nf}(w_1) < \hat{w}_{ff->nf}(w_1) \\ &\& W_{ff}(w_1, \bar{w}_2) < W_{nf}(\bar{w}_2) \end{aligned}$$

0

else