The Value of Health Insurance: A Household Job Search Approach

Gabriella Conti*

Rita Ginja†

Renata Narita‡

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Abstract

Do households value access to free health insurance when making labor supply decisions? We address this question by exploiting the introduction of universal health insurance in Mexico (Seguro Popular, SP), that broke the link between access to health care and the job contract. Exploiting its staggered rollout across municipalities, we first show that the introduction of SP increased informality among low-education households with children by 3.5%, but not among low-education households without children or high-education households. No impacts are detected on the salaries of those working in the formal or informal sectors. We then develop and estimate a household search model that incorporates the valuation of formal sector amenities relative to pre-reform alternatives and the value of health insurance. Model estimates show that low-education households with children value SP at 0.5 per peso spent by the government; we find even lower valuations among the other groups studied.

JEL Codes: J64, D10, I13, J46
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*University College London, Department of Economics and Social Research Institute, Drayton House, 30 Gordon St., London WC1H 0AX, United Kingdom. Tel.:+(0)2076794696, and Institute for Fiscal Studies. Email: gabriella.conti@ucl.ac.uk.

†University of Bergen, Department of Economics, Fosswinckelsgate 14, 5007 Bergen, Norway. Tel.: +47 55 58 92 00. Email: rita.ginja@uib.no.

‡University of São Paulo, Department of Economics, Av. Professor Luciano Gualberto 908, São Paulo, SP, Brazil 05508-010. Email: rnarita@usp.br.

1 Introduction

A central topic in the global health agenda is universal health care coverage. The World Health Organization 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. The primary goal of social health insurance schemes is to protect beneficiaries from the health and financial consequences of adverse health events. However, limited access to social health insurance programs by the poor and the informal sector workers has been a common problem in low-income countries, contributing to poor health outcomes (Bennett et al., 1998). While for this reason there is scope for government intervention in providing free or highly subsidized health insurance, the impacts of such policies on labor markets in developing countries are less clear. We study this issue in the context of a large health insurance expansion in Mexico.

The *Seguro Popular* (SP, hereafter) was introduced in 2002 in Mexico as a noncontributory health insurance program and it was directed to the half of the country's population uncovered by social protection or employer-provided health insurance (i.e., the informal sector workers and the nonemployed). Prior to the reform, 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 programme Oportunidades (now re-branded as Prospera, and called Progresa until 2002), which targets poor families with children; however it still left many disadvantaged poor families uncovered and without access to free health care services. Consequently, in 2002 half of the population of Mexico - uncovered by employer-provided health insurance - was eligible for SP.

Because uninsured individuals before SP could only access affordable health care through their employer, the introduction of a non-contributory public health insurance scheme such as SP 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 for 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 much households value free healthcare and how firms in each sector adjust wages given benefits.

In this paper, we analyze the effects of the introduction of SP on labor market outcomes and we provide an estimate for the value of this free health insurance scheme. We start by exploiting its staggered introduction across municipalities in Mexico in a difference-in-differences strategy.

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

Using data from the Mexican Labor Force Survey between 2000 and 2012, we show that the implementation of SP in a municipality is associated with an increase in informality among low educated households with children by 2.3 percentage points (3.5 percent), and no impacts for the other groups studied (i.e., low-educated households without children or high-educated households) or for the salaries in either the formal or the informal sector.

Although a reduced-form approach is crucial to measuring the impact of the reform, it does not allow to conduct counterfactual analysis. More importantly, it does not take into account endogenous labor market mobility when estimating parameters such as the value of job amenities and of free health care for uninsured individuals. Hence, in order to understand how access to such schemes is valued by households when their members (head and spouse) make labor market decisions, we develop and estimate a household search model that incorporates the value of free health care as well as the pre-reform valuations assigned to the amenities in each sector.

Our starting point is a model in which each member of a couple can be in one of three employment states: working in the formal sector, working in the informal sector, or not working at all. If one of the members joins the formal sector, the other spouse is automatically covered by employer-provided health insurance as well as other social security benefits, which are treated as public goods within the household. If none of the members work in the formal sector, the household is uninsured and, as such, becomes eligible to SP after its implementation. The model is designed to capture the main features of the introduction and expansion of free health care coverage to the uninsured population as well as existing amenities such as employer-provided health insurance and social protection.

The framework we use builds on the Burdett and Mortensen (1998) model, in which workers search randomly on and off the job, with the additional feature that they may receive offers from heterogeneous formal or informal firms. The non-employed and the informal sector workers are not entitled to any employment protection benefits, while the formal sector workers have access to employer-provided health insurance and other benefits secured by labor laws such as minimum wage and retirement pensions.

The main contribution of our paper is to combine four features: (i) a household search model with on-the-job search that provides significant heterogeneity, with (ii) two working states that have a one-to-one relationship with the introduction of free health care for the informal but not formal workers, (iii) a structure that accounts for pre-existing amenities across formal and informal/non-employment sectors, and (iv) the added worker effect (that is an alternative channel through which spousal labor supply can act as insurance and thus may potentially impact wages and the value of job amenities).

The model is estimated using indirect inference and data from the Mexican Labor Force Survey, separately for low- and high-education households, and conveys two main findings. First, we

estimate a marginal willingness to pay for SP between 0 and 5.8 percent of the mean household income, respectively, for high and low education households. These estimates show that the value of SP to families is always below the government's costs of providing it. For low education households, the value is around 51 cents per Peso spent in the program. These figures are similar to those found for subsidized health insurance in US; in particular, recipients value Medicaid at 0.5-1.2 per dollar spent in the program in Oregon (Finkelstein, Hendren and Luttmer, 2019) and less than 50 cents per dollar spent in a subsidized health insurance in Massachusetts also for low income adults (Finkelstein, Hendren and Shepard, 2019). Generally the free/subsidized systems are valued below their cost, suggesting that individuals/families would rather be uninsured than buy the insurance at its full cost.

Second, we take advantage of the estimated model to simulate counterfactual scenarios of changes in the valuation of SP on employment, labor informality and welfare. Our results show that the changes in employment are small, but these are consistent with an estimated valuation of SP below its cost. Household informality increases by 2.9 p.p. (5.9%) resulting mainly from men leaving the formal sector to informal sector jobs, and women taking more informal sector jobs which are less stable for them. As a consequence, we show that the welfare gains are limited (-4.7% to 1.7%): wages go down in the informal sector to compensate for the introduction of SP, as workers exit the formal sector where wages are higher and jobs are more productive (on average), to an extent depending on how the government taxes the economy to finance the program. Our findings constitute an upper bound of the welfare impacts of the program, as the simulations keep the pre-existing formal sector taxes and benefits fixed. However, changes in the current formal sector system, for example, if the government were to raise payroll taxes or decrease social security benefits, could result in welfare losses.

This paper contributes to three strands of literature. First, it contributes to work studying the impacts of SP. The evidence on the labor market effects of the reform is mixed (see the review in Bosch, Cobacho and Pages (2012)). The estimates range from no impact on informality (Gallardo-Garcia, 2006; Barros, 2008; Campos-Vazquez and Knox, 2013; Aguilera, 2011) to small increases in the share of informal workers with less than nine years of schooling, married women with children or caring for older adults (Azuara and Marinescu, 2013; Aterido, Hallward-Driemeier and Pages, 2011; Pérez-Estrada, 2011; Bosch and Campos-Vazquez, 2014). Aterido, Hallward-Driemeier and Pages (2011) find that SP reduces the flow out of unemployment and out of the labor force, and del Valle (2019) finds that women in families with disabled or dependent individuals move out of unemployment or inactivity to become informal workers. The evidence about the impact of SP on wages is even scarcer, and the findings range from no effects (Barros, 2008; Azuara and Marinescu, 2013) to negative impact on informal wages (Aterido, Hallward-Driemeier

and Pages, 2011; Pérez-Estrada, 2011).[2] Finally, evidence on the welfare effects of SP is only available indirectly: lower wages in the informal sector (Aterido, Hallward-Driemeier and Pages, 2011; Pérez-Estrada, 2011), and limited health impacts such as reduction in infant mortality and increase in the use of medical services in poor municipalities (Conti and Ginja, 2019), and decrease in miscarriages (Pfutze, 2014).

Second, we contribute to two theoretical lines of work. On the one hand, we contribute to the literature on household search. Dey and Flinn (2008), were the first to develop a household search framework to estimate the marginal willingness to pay for employer-provided health insurance in the US. The authors show the importance of considering the spouse's job status to recover unbiased estimates of the willingness to pay. More recently, Fang and Shephard (2019) study the recent reform in the US health system, building on Dey and Flinn (2008), adding health shocks (following Aizawa and Fang (2020)) and endogenous compensation packages comprising a wage and a menu of insurance offerings (premiums and coverage) that workers can select from.[3]

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 at least three papers are particularly relevant for our study. Albrecht, Navarro and Vroman (2009) model formal and informal sectors following Mortensen and Pissarides (1994). They use the model to simulate the impact of varying payroll taxes in the formal sector. A similar approach is taken in Bosch and Esteban-Pretel (2012) who calibrate the model to aggregate Brazilian data and use it to interpret the effects of various labor market policies. Meghir, Narita and Robin (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. A related recent contribution is Bobba, Flabbi and Levy (2018), which uses an individual search and matching environment with formal and informal sectors and schooling decision taken prior to entering the labor market; they estimate the model using a sample of males and data from municipalities with and without the

[2]Recent US reforms, which have relaxed the link between employment and the provision of health insurance, have produced 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, Gross and Notowidigdo (2014) estimate large increases in the labor supply associated with an abrupt reduction in the Medicaid coverage in Tennessee. While this recent evidence has significantly improved our understanding of the link between health insurance and employment, it all comes from a developed economy.

[3]Rendon and García-Pérez (2018) and Mankart and Oikonomou (2016) also introduce the added worker effect in a household search environment with one employment sector. Relative to their work, we have two sectors of employment: one that benefited from the free health insurance introduction (the informal sector) and one that did not (the formal sector).

program in 2005.

Finally, we contribute to the literature that uses structural methods to recover the welfare benefits of health programs. Finkelstein, Hendren and Luttmer (2019) compare alternative utility frameworks for valuing a Medicaid expansion for low-income, uninsured adults that occurred by lottery assignment in Oregon. They find that the welfare benefit to recipients per dollar of government spending is between \$0.5-\$1.2. Similarly, Finkelstein, Hendren and Shepard (2019) find that the willingness to pay is less than half of expected costs in the Massachusetts' subsidized insurance system.[4]

The paper proceeds as follows. In the next section, we describe the main features of SP and the context in which it was introduced. Section 3 describes the data and presents reduced-form estimates of the impact of implementing SP in a municipality on the labor market. In section 4 we present then model; the estimation procedure is described in section 5. In section 6 we present the model estimates and results from counterfactual experiments; section 7 concludes.

2 Background

2.1 The Mexican Health System and the Seguro Popular

Labor Relations Mexico is characterized by a dual system. Firms hire workers under salaried contractual relations which broadly include three main components. First, a salary at least equal to the minimum wage. Second, Social Security which includes access to the public health care system, of which the Mexican Social Security Institute (*Instituto Mexicano del Seguro Social*, IMSS) is the largest provider of services, with benefits including basic health care and medications, attention to occupational accidents and care for illnesses. Finally, retirement pensions.[5] However, many firms evade the payment of Social Security contributions and also hire workers without access to the benefits above (Antón, Hernández and Levy, 2013). Although firms can be monitored and fined if they do no comply with labor regulations, Kaplan and Sadka (2011) suggest that

[4]Other papers have estimated the value of job amenities using individual on-the-job search models. Search frictions can explain why workers with strong preference for amenities are paid higher wages, which is contrary to a conventional view of compensating wage differentials. Hwang, Mortensen and Reed (1998) estimate a general equilibrium on-the-job search model in which workers in each period may receive an offer that is characterized by a wage and by amenities. Firms have different cost of producing amenities and are, thus, differentiated by amenities, and workers select into jobs, trading lower wages for better amenities. Bonhomme and Jolivet (2009) estimate a partial equilibrium version of Hwang, Mortensen and Reed (1998) allowing two types of job-to-job mobility: voluntary and involuntary. Using data for several European countries and five different amenities (none related to health insurance), they generally find absence of compensating differentials because wages and amenities correlate in job offers and due to search frictions. Alternative approaches include survey-based methods such as contingent valuation (e.g. Ahmed et al., 2016).

[5]There is no unemployment insurance system in Mexico; e.g., workers insured by the IMSS who become unemployed may withdraw a maximum of 30 days' worth of pension savings every five years.

Mexico is characterized by low enforcement.

The Health Care System before *Seguro Popular* Up to 2002, the health care was characterized by a two-tiered system. About half of the population was covered through a contributory system guaranteed by the Social Security Institutions: the 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; 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 Expansion of Coverage Program (*Programa de Ampliacion de Copertura*, PAC), launched in 1996, with brigades visiting rural and marginalized areas; and, the basic health services provided by the Program for Education, Health and Nutrition (*Programa de Educacion, Salud y Alimentación*, Progresa). This was implemented 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, as it includes a health component offered in medical units managed by the IMSS-Oportunidades and *Secretaria de la Salud* (Ministry of Health).[6]

The uninsured population not covered by PAC or *Progresa* could seek health care either in public health units run by the Ministry of Health 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 were 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 and Colima) under the name Health for All (*Salud para Todos*), with the goal of a gradual expansion to the rest of the country. During 2002, 15 additional states implemented the program, and six more did it by the

[6] *Progresa* beneficiaries receive free of charge a basic package of health services. The nutrition of both children and pregnant women is monitored through monthly consultations and nutritional supplements are distributed in case of malnutrition. It is also includes information on preventive health behaviors through community workshops; emergency services related to pregnancy and childbirth. 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 3, 2020).

end of 2003.[7] The System of Social Protection in Health (*Sistema de Protección Social en Salud*, SPSS) was officially introduced in 2004 by the General Health Law that aim to extend health coverage to the eligible population. The expansion of SP prioritized states with low Social Security coverage; large number of uninsured in the first six deciles of income; ability to deliver the services covered; and, existence of sufficient budget for the program. In 2004, three more states introduced the program (Nayarit, Nuevo Leon and Querétaro) and the last three joined in 2005 (Chihuahua, Distrito Federal and Durango).

Individuals not beneficiaries of social security institutions are eligible to SP. Enrollment in the program is voluntary, and granted upon compliance with simple requirements; i.e., proof of residence in Mexico, lack of health insurance, ascertained with self-declaration, and the individual ID. Thus in 2012, 98% of the Mexican population was covered by some health insurance (Knaul et al., 2012).

Funding SP is funded by revenues from general taxes, based on a tripartite structure similar to that adopted by the two major social insurance agencies in Mexico, IMSS and ISSSTE. In particular, a social contribution from the federal government; solidarity contributions from both the federal government and the states; and a family contribution (in 2010, 96.1% of the enrolled families were exempted from paying it due to low self-reported income; 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. 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 increased steadily, from 1% to nearly 1.5% in 2009 (see Figure A.1).

Coverage and Delivery of Health Services Families enrolled in SP are assigned a health center (which in turn, is associated with 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). The services include preventive care, family planning, prenatal, obstetric and perinatal care, ambulatory, emergency and hospital care, including some surgeries. The basic coverage was complemented in 2004 with the introduction of the Fund for Protection against Catastrophic Expenses to support the financing of care for high-cost diseases associated with premature death, such as breast and cervical cancers and childhood

[7] Baja California, Chiapas, Coahuila, Guanajuato, Guerrero, Hidalgo, Mexico, Morelos, Oaxaca, Quintana Roo, San Luis Potosi, Sinaloa, Sonora, Tamaulipas and Zacatecas launches SP during 2002. In 2003, the program was introduced in Baja California Sur, Michoacán, Puebla, Tlaxcala, Veracruz and Yucatán.

leukemia. A further expansion took place in 2006 with the introduction of Health Insurance for a New Generation, which includes coverage for high cost conditions specific to children under five.

The non-contributory and the contributory systems have separate networks of hospitals and health centers, each serving its own affiliates and the health services covered by the SP are delivered in the hospitals and health centers run by the Health Ministry.

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. To do so, the Ministry of Health increased the proportion of the budget devoted to investment in health infrastructure from 3.8% in 2000 to 9.1% in 2006, with the construction of 2,284 outpatient clinics and 262 hospitals between 2001 and 2006; poor municipalities were prioritized in the allocation of resources (Conti and Ginja, 2019). Facilities providing services under SP had to be accredited, which required a sufficient amount of resources to be in place to provide the covered interventions (Frenk et al., 2009).

2.2 Other Policy Changes

The period studied (2000-2012) was relatively stable with respect to other policy changes that could have affected the labor market choices of households. We summarize here the main reforms (see Appendix D for details). The largest Social Security reform took place before the introduction of SP, in 1997, when the *IMSS* switched from a pay-as-you-go system to a fully funded system with personal retirement accounts. The tax system remained largely unchanged between 2000 and 2012. The child care system underwent a reform between 2007 and 2010, with the introduction of the program *Estancias Infantiles para Apoyar a Madres Trabajadoras* (Child Care Centers to Support Working Mothers), to cover approximately 90 percent of the cost of enrolling a child under age four at a formal child care center. This program targets women living in families without Social Security coverage, that are searching for work, enrolled in school, or working (Calderon, 2014).

3 Data and Empirical Facts

3.1 Data

We use data from two main sources. The first data source is the *Padrón*, which is the consolidated registry of all families with a valid enrollment in *Seguro Popular* by December 31 of each year between 2002 and 2010. These data are used by the Federal Government and States to decide the allocation of the funds to the program. It contains detailed demographic and socioeconomic characteristics of the enrolled families, including employment status, occupation and assets. It

also has the exact date of affiliation, residence and the identifiers of the health center and general hospital assigned to each family at the time of enrollment in the program. The date of affiliation of each family is used to construct the date of implementation of the program at the level of the municipality.[8]

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 three reasons. First, we prefer an absolute to a percentage measure 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 has been covered). Second, this definition has become relatively common in the SP-related literature (Bosch and Campos-Vazquez, 2014; del Valle, 2013; Conti and Ginja, 2019). Finally, Conti and Ginja (2019) show that the impacts of SP on health are not sensitive to the threshold number of families used to define program introduction.

Second, we use data from the labor force surveys of Mexico, the *Encuesta Nacional de Empleo* (ENE) 2000-2004 and the *Encuesta Nacional de Ocupación y Empleo* (ENOE) 2005-2012. These data have a quarterly frequency and are rotating panels at the individual and household level similar to the Current Population Survey in US. The data covers more than 11 million individuals between ages 18 and 59 from the second quarter of 2000 to the fourth quarter of 2012; it has information on the Social Security status of each individual across quarters, as well as his/her labor income when employed. All monetary values are deflated to the first quarter of 2011 using the CPI of Banco de Mexico.[9]

An individual is defined as an informal worker if he/she does not have access to the health services provided by his/her job through one of the Social Security institutions in the country. Because Social Security coverage is extended to the spouse and children in the household, a household is considered informal if neither the head nor the spouse have Social Security coverage through the job contract. We do not distinguish between self-employed and informal employees, as the definition of informality depends only on the Social Security coverage.

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 of analysis, we focus on the sample of municipalities surveyed since 2000. Thus, we restrict our

[8]For the years 2002 and 2003 (the pilot-phase), only information on the date of enrollment and on the state of residence was recorded. Because 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 that adopted SP in the pilot period.

[9]The choice of period spanning 2000 to 2012 should not be a concern. Despite recessionary episodes in 2001-02 and in particular in 2009 when the GDP growth was very negative, Mexico had similar average growth rates across the two pooled periods 2000-04 (pre-reform) and 2005-12 (post-reform), 2.1% and 2.3%, respectively (World Bank, 2020)

attention to the 640 municipalities present in both ENE and ENOE. Then, we impose the additional restriction that a municipality must be present in the data for at least eight quarters, which further reduces the sample to 628 municipalities. This results in a sample of 8 million observations for heads or spouses (corresponding to 2.2 million of individuals), from which we drop 37,100 observations without information on work and Social Security status. We, then, discard the 1% of the workers under a formal contract who earn less than the minimum wage and less than 900 observations with missing information on wage on the formal sector. We restrict the sample to households where the head is married and between 20 (when the chance of returning to full-time education upon leaving it is very low) and 59 years old (before age-eligibility for any non-contributory pension program for poor elderly); after imposing this restriction there are 640,000 couples in the sample.[10] We then drop about 20,000 households headed by women. Lastly, we trim the top of the wage distributions for the formal and informal sector to 36,000 pesos (95th percentile of the total sample) and the bottom 5% of the informal sector wages for each spouse. Our final sample includes just over 510,000 couples.

We follow individuals between the first and second quarters they are surveyed.[11] Within this time frame, we obtain the job-to-job, unemployment-to-job, and job-to-unemployment transitions for each individual in our sample (i.e., heads and their spouses), conditional on their state at the first interview. We also consider some "cross" conditional transition probabilities related to a positive added worker effect, i.e. the likelihood that the household head moves to the informal sector from nonemployment conditional to the spouse losing a job, and vice-versa. Finally, the proportion of households by employment status, and the distribution of earnings in the formal and informal sectors are obtained from the first interview.

We present results for two types of heterogeneity, which are related to different probabilities of facing health shocks, namely the education level of the head of the household and the presence of children aged 0-14 years. We define a family to be in the low education group if the head has at most 6 years of completed education, which corresponds to elementary education in Mexico (in 2001, just before the implementation of SP, 40% of the families in our data were in this group). We also allow for heterogeneity by the presence of children under age 15 in the household, for two reasons. First, the package of services covered by SP is especially generous for conditions prevalent among poor children (such as treatment of respiratory and intestinal infections; see Conti and Ginja (2019)). Second, the extension of coverage of Social Security to children depends on the age of the child: if the parent works in the private(public) sector the coverage is extended to

[10] In Mexico, 65 is the usual retirement age, but the participation rate among informal workers is 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).

[11] We only focus on transitions between the first and second interviews since about half of our sample of interest (households whose head is 20 to 59 years old) is not interviewed a third time.

children under 16(18). To keep the model treatable, we do not distinguish between parents working in private or public sectors, thus we use the most stringent definition, which also coincides with the minimum school leaving age in Mexico.[12]

3.2 Basic Descriptives

We start by presenting some basic facts regarding the labor market in Mexico, using the Mexican Labor Force Survey. Panel A of Table 1 presents basic statistics on the proportion of households by employment status and education, before and after the introduction of SP; 2007 is the year when the program reached all municipalities in our sample. The table shows that, before the introduction of SP, about 33%(57%) of households in the high(low)-education group did not have Social Security coverage. In 2007, while the proportion of households without Social Security coverage remained constant in the high-education group, it increased by almost 3p.p. among the low educated. The table also includes the nine possible types of households according to the labor market situation of each member of the couple (i.e., not working, which includes individuals unemployed or out of the labor force, working in the formal sector or working in the informal sector). Among the low educated, there is an increase in the proportion of households with members working in the informal sector, and a small decrease in the proportion of households where the head is a formal worker and the spouse is not working.

Panel B of Table 1 includes selected moments from the distribution of wages for the heads and spouses in both formal and informal households. The means of the salaries of both heads and spouses are lower in the informal sector than in the formal sector; the standard deviation for salaries of heads is higher in the informal than in the formal sector. These differences partly reflect unobserved productivity differences between the individuals who select into either sector within educational groups. Between 2001 and 2007, there is an increase in the salaries of the heads, regardless of the educational group and sector. In the informal sector, the salaries for spouses in high-education families working in the informal sector decreased.

Health Expenses Although the study of the impact of SP on out-of-pocket expenditures is beyond the scope of our paper, in Table A.1 in the Appendix we present basic descriptives of the amount of out-of-pocket health expenditures and its share in overall household expenditures. Because the Mexican Labor Force Survey does not have information on expenditures, we use data from the Household Income and Expenditure Survey (*Encuesta Nacional de Ingresos y Gastos de*

[12]We consider the presence of children under 15 in the household since the Labor Force Survey does not contain the date of birth and thus we do not know whether the child may be close to turn 16 at the survey date. If children are studying, coverage can be extended up to age 24. In 2001, 78% of the high educated and 69% of the low educated households in our data had children under 16.

los Hogares) for the years of 2002 (before SP) and 2008 (post SP). This table shows that over 99% of households do not report any expenditures on health insurance. The share of households with low education and children 0-14 years old that do not spend on health increased from 42% to 44% between 2002 and 2008, suggesting an improvement of health status and/or increased availability of free health services for these households. For those households in the high-education group with children 0-14 years old, this fraction remained stable at around 37% in the same period. Consistently with previous work, there is a decrease in the relative weight of health expenditures in overall expenditures for low-education households with children, but not for the other three groups in the table (i.e., household in the high education group and low-educated households without children; see King et al. (2009); Barros (2008); Grogger et al. (2015)).

3.3 Reduced-Form Analysis

To motivate the structural model we develop below, we analyze the causal impact of SP on the proportion of formal and informal households both overall and by type, and on the mean wages for husbands and spouses.

Empirical Strategy We present reduced-form evidence of the impact on informality of SP, exploiting the variation in the timing of implementation of the program at the municipality level. Figure A.2 in the Appendix displays the year of implementation of SP in each municipality in Mexico between 2002 and 2010. This map shows that there is considerable variation in the timing of adoption of SP by different municipalities. We use this variation in a difference-in-differences model, where we compare changes in outcomes for municipalities that introduced SP in different years between 2002 and 2007 (the last year a municipality implemented SP in our sample). We estimate the following model at the municipality-quarter level:

$$y_{msqt} = \beta SP_{msqt} + \gamma X_{msqt} + \mu_{ms} + \pi_{qt} + \varepsilon_{msqt} \tag{1}$$

where y_{msqt} is the share of households of a certain employment state, m indexes the municipality, s the state, q the quarter and t the year. SP_{msqt} is an indicator variable equal to one if municipality m of state s in quarter q of year t has implemented SP. We control for unrestricted municipality effects μ_{ms}, to account for unobserved determinants of y that are constant at municipality level and can also be correlated with the timing of implementation of SP; and for unrestricted quarter effects π_{qt} to account for common shocks. The parameter of interest is β, the effect of access to SP, which is identified from variation across municipalities and quarters. The standard errors are clustered at the municipality level to account for autocorrelation in the outcomes (Bertrand, Duflo and Mullainathan, 2004).

The determinants of the timing of the municipality-level implementation of SP have been studied in detail in Conti and Ginja (2019). They find that, after accounting for state fixed effects, earlier implementation of SP occurred in more populous and richer municipalities, with a smaller proportion of eligible individuals and of children 0-4 years old, with more hospitals, health centers and doctors per eligible, and with alignment between the party of the mayor and that of the governor of the state in the year in which the program was launched. These pre-existing differences in levels are accounted for by the municipality fixed effects. Conti and Ginja (2019) also show that the rollout of the program was unrelated with pre-existing municipality trends in the infant mortality rate and other health outcomes. Finally, earlier papers have also shown that the timing of SP implementation was not correlated with labor market characteristics (Azuara and Marinescu, 2013; Bosch and Campos-Vazquez, 2014). In our main specification, we also include in model (1) linear trends in the following characteristics of the municipality of residence measured in 2000: indicator for large city, index of deprivation, log of total population, number of hospitals and health centers in 2001, and total number of doctors and nurses in hospitals per 1,000 uninsured individuals in 2001.

Finally, as we study treatment effects on a relatively large number of outcomes, we also test which of the estimated impacts survive adjustment of inference for multiple hypotheses testing. We use the procedure in algorithms 4.1 and 4.2 of Romano and Wolf (2005), which accounts for testing several hypotheses simultaneously. Romano and Wolf (2005) propose an iterative rejection/acceptance procedure for a fixed level of significance. In the tables presented, we therefore indicate the coefficients that are still significant at a level of 10 percent. We use 1000 block-bootstrap replications to obtain the adjusted critical values (the block is the municipality).

Results Table 2 shows the impacts on informality rates and mean salaries of formal and informal workers. Column (1) shows that the implementation of SP in a municipality is associated with an increase in informality for low educated households with children of 2.3p.p. (Panel A), in line with the previous literature (Azuara and Marinescu, 2013; Aterido, Hallward-Driemeier and Pages, 2011; Pérez-Estrada, 2011; Bosch and Campos-Vazquez, 2014; del Valle, 2019). There are no impacts on any other groups. In Table A.2 in the Appendix we study households types according to the job market status of the head and the spouse. This table shows that, among the 36 hypotheses tested, the introduction of SP in a municipality had in general no impacts on the composition of households after accounting for multiple hypotheses testing.

Finally, columns (2)-(4) of Table 2 do not show any impacts on the salaries of low-educated individuals, which is the group mostly affected by the reform. Panel D, instead, shows that the salaries of the heads in high-educated households without children increase. There are no other impacts on salaries or informality among the 20 hypotheses tested in Table 2 that survive adjust-

ment of inference to multiple hypotheses testing.

We have also re-estimated the reduced form model using alternative specifications. In particular, (i) including a quadratic yearly state trend, and (ii) removing the linear trends in baseline municipality characteristics. The estimates for β for informality rate in low-educated households with children and for salaries of heads in high-educated households without children (ie, for the two main estimates that survive adjustment of inference to multiple hypotheses testing) are included in Table A.3 in the Appendix. We find that only the increase in informality rates among low-educated households with children is robust to alternative specifications.

In sum, applying a similar reduced-form approach as the one used in previous work, we find that the program introduction increased the informality rates among the most disadvantaged families but we are unable to detect any robust impacts on informality in any other group, or on salaries of different groups of individuals (Azuara and Marinescu, 2013; Aterido, Hallward-Driemeier and Pages, 2011; Pérez-Estrada, 2011; Bosch and Campos-Vazquez, 2014; del Valle, 2019). In particular, the RF results confirm that the main action is on the samples with children, in particular, when the household is less educated. These are the samples our model estimation will focus on.

4 Joint Labor Search Model

4.1 The Basic Setup

We now present our household search model with two working sectors. We build on the model by Burdett and Mortensen (1998), in which workers search randomly on and off the job, with the additional feature of two searchers per household who may receive offers from formal or informal firms. In this continuous time model, the future discount rate is r and households seek to maximize their expected lifetime income. Individuals can be in one of three labor market states: nonemployed (n), formal (f), or informal (i). Conditional on their labor market state, the individual receives a new or alternative job offer that is characterized by a wage that is a random draw from a distribution of wage offers, F, specific to each sector and spouse. At each point in time, only one of the two household members – the head or the spouse – can receive a shock, i.e., spouse 1 (head) and spouse 2 (spouse) face mutually exclusive shocks in the labor market. However, a shock that destroys the job of the employed spouse may instantly create an opportunity for the nonemployed spouse to move to the informal sector. This opportunity is taken as exogenous and is interpreted as the rate at which an added worker effect may occur. The instant utility of the household is given by:

$$\mathtt{u}(w_1 + w_2) + a(1 - \mathbf{1}_{\{j \neq f, k \neq f\}}) + \gamma \mathbf{1}_{\{j \neq f, k \neq f\}}, \text{ if both spouse 1 and 2 work}$$

$$\mathtt{u}(w_1 + b_2) + a(1 - \mathbf{1}_{\{j \neq f\}}) + \gamma \mathbf{1}_{\{j \neq f\}}, \text{ if only spouse 1 works}$$

$\mathtt{u}(b_1 + w_2) + a(1 - \mathbf{1}_{\{k \neq f\}}) + \gamma \mathbf{1}_{\{k \neq f\}}$, if only spouse 2 works

$\mathtt{u}(b_1 + b_2) + \gamma$, if neither works

with $j, k =$ formal (f) or informal (i), $\mathbf{1}_{\{\cdot\}}$ is an indicator function for informal household (when no household member is in the formal sector), 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, the wage is after tax but before social security contributions; in the informal sector no taxes or contributions are made, so the wage is just the gross wage.

The parameter a captures all amenities in the formal sector relative to those in the informal sector in the pre-reform period. We define γ as the utility value of health insurance provided by SP, which is offered when no household member works in the formal sector, after its introduction. As it is modelled, γ includes not only the value directly assigned to the health services covered by SP, but also to its benefits, such as the value assigned to lower infant mortality (Conti and Ginja, 2019) and miscarriages (Pfutze, 2014) associated to SP. The function $\mathtt{u}$ takes a CARA form. For example, when spouse 1 and 2 work, $\mathtt{u}(w_1 + w_2) = \frac{1-\exp[-\theta(w_1+w_2)]}{\theta}$, where θ is the coefficient of absolute risk aversion.

4.2 Household's Value Functions

Let W_{jk} be the value function for a household where the head (spouse 1) is in status $j = f, i, n$ and the spouse (spouse 2) is in status $k = f, i, n$. There are nine value functions, and in the following we describe each of them.

4.2.1 Only one member works

In the formal sector We start with the case of a household with only one member working in the formal sector; this is a formal household, i.e., with Social Security coverage. The flow value is:

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

where $\delta_f^{s_1}$ is the rate at which spouse 1 faces formal job destruction, and p^{s_2} captures the added worker effect, i.e. the probability that spouse 2 moves from nonemployment to informality given that spouse 1 loses a formal job.[13] [14] $\lambda_{ff}^{s_1}$ and $\lambda_{fi}^{s_1}$ are the arrival rates of formal and informal job offers respectively for spouse 1, and $\lambda_{nf}^{s_2}$ and $\lambda_{ni}^{s_2}$ are the arrival rates of formal and informal job offers respectively for spouse 2. When the head loses a formal job by a $\delta_f^{s_1}$ shock, with probability p^{s_2} the spouse finds an opportunity to move to the informal sector. In this case, the household decides by considering the flow of gains which will accrue if the spouse takes the informal offer paying x, $W_{ni}(x) - W_{fn}(w_1)$, against the option of not taking it, $W_{nn} - W_{fn}(w_1)$. With probability $1 - p^{s_2}$ the spouse does not find an opportunity to work in 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 the rate $\lambda_{ff}^{s_1}$, and the household decides whether the head will take the offer. New offers from the informal sector to the head arrive at the rate $\lambda_{fi}^{s_1}$, and the household decides whether the head will take the offer. Job offers from the formal sector to the spouse arrive at rate $\lambda_{nf}^{s_2}$, and the spouse decides whether to take the formal offer or remain nonemployed. As Dey and Flinn (2008), we allow endogenous quitting in case the spouse finds a formal sector job since these jobs have the potential to replace the consumption lost if the head decides to quit. 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 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, the only difference is an exchange of the

[13] Spouses may find an opportunity to move immediately to job activities in the informal sector such as self-employment. We assume that, conditional to one spouse losing a job, there is no such opportunity for the other spouse to move to the formal sector since this would require more time, a formal application process, etc.

[14] As we show below in section 6.1 (Table 3), the likelihood of transition from nonemployment to an informal job for the spouse when the head loses his job is around 6% of the unconditional probability of moving from nonemployment to an informal job. For men, this is 3%. Given this, we opted to explicitly model this interesting feature, despite the fact that the standard household model allows for the exit rate hazard from nonemployment to the informal sector to vary discontinuously whenever their spouse loses a job with a wage greater than the reservation wage.

status between spouses 1 and 2 (see Appendix B).

In the informal sector In this case one member is working in the informal sector. This is an informal household, i.e., without Social Security coverage. The flow value is given by:

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

where $\delta_i^{s_1}$ is the rate at which spouse 1 faces informal job destruction, and q^{s_2} is the probability that spouse 2 moves from nonemployment to informality, given that spouse 1 loses his informal job, thus capturing the added worker effect in the case a job is lost in the informal sector. When the head loses the informal job by a $\delta_i^{s_1}$ shock, with probability q^{s_2} the spouse finds an opportunity to move to the informal sector. In this case, the household decides considering the flow of gains which will accrue if the spouse takes the informal offer paying x, $W_{ni}(x) - W_{in}(w_1)$, against the option of not taking it, $W_{nn} - W_{in}(w_1)$. With probability $1 - q^{s_2}$ the spouse does not find an opportunity to work in the informal sector. New offers from the informal (formal) sector to the head arrive at rate $\lambda_{ii}^{s_1}$ ($\lambda_{if}^{s_1}$), and the household decides whether the head will take the offer. Job offers from the formal sector to the spouse arrive at rate $\lambda_{nf}^{s_2}$, and the spouse decides whether to remain nonemployed or to take the formal offer and acquire the benefits of this sector for the household, in which case the head may quit. 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, the only difference is an exchange of the status between spouses 1 and 2 (see Appendix B).

4.2.2 Both members work

In the formal sector This is a household with Social Security coverage.

$$
\begin{aligned}
rW_{ff}(w_1,w_2) = \mathtt{u}(w_1+w_2) + a + \delta_f^{s_1}\left(W_{nf}(w_2) - W_{ff}(w_1,w_2)\right) + \\
\delta_f^{s_2}\left(W_{fn}(w_1) - W_{ff}(w_1,w_2)\right) + \\
\lambda_{ff}^{s_1}\int \max\left\{W_{ff}(x,w_2) - W_{ff}(w_1,w_2), 0\right\} dF_f^{s_1}(x) + \\
\lambda_{fi}^{s_1}\int \max\left\{W_{if}(x,w_2) - W_{ff}(w_1,w_2), 0\right\} dF_i^{s_1}(x) + \\
\lambda_{ff}^{s_2}\int \max\left\{W_{ff}(w_1,x) - W_{ff}(w_1,w_2), 0\right\} dF_f^{s_2}(x) + \\
\lambda_{fi}^{s_2}\int \max\left\{W_{fi}(w_1,x) - W_{ff}(w_1,w_2), 0\right\} dF_i^{s_2}(x).
\end{aligned}
$$

Jobs in the formal sector can be destroyed at the rate $\delta_f^{s_1}$ and $\delta_f^{s_2}$ 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), and the household will decide if either member will take the offer.

In the informal sector This is a household without Social Security coverage.

$$
\begin{aligned}
rW_{ii}(w_1,w_2) = \mathtt{u}(w_1+w_2) + \gamma + \delta_i^{s_1}\left(W_{ni}(w_2) - W_{ii}(w_1,w_2)\right) + \\
\delta_i^{s_2}\left(W_{in}(w_1) - W_{ii}(w_1,w_2)\right) + \\
\lambda_{ii}^{s_1}\int \max\left\{W_{ii}(x,w_2) - W_{ii}(w_1,w_2), 0\right\} dF_i^{s_1}(x) + \\
\lambda_{if}^{s_1}\int \max\left\{W_{fi}(x,w_2) - W_{ii}(w_1,w_2), W_{fn}(x) - W_{ii}(w_1,w_2), 0\right\} dF_f^{s_1}(x) + \\
\lambda_{ii}^{s_2}\int \max\left\{W_{ii}(w_1,x) - W_{ii}(w_1,w_2), 0\right\} dF_i^{s_2}(x) + \\
\lambda_{if}^{s_2}\int \max\left\{W_{if}(w_1,x) - W_{ii}(w_1,w_2), W_{nf}(x) - W_{ii}(w_1,w_2), 0\right\} dF_f^{s_2}(x).
\end{aligned}
$$

Each member of the couple may receive offers from either the formal or informal sector. In particular, when spouse 1 or spouse 2 receives an offer from the formal sector (at rate $\lambda_{if}^{s_1}$ and $\lambda_{if}^{s_2}$, respectively) the household decides whether to remain informal or to take the formal sector offer. In this latter case, the household will have Social Security coverage; however the other spouse (who did not receive the shock) may quit.

Households with a member working in the formal sector and the other in the informal sector These are households with Social Security coverage. For sake of brevity, the two value functions corresponding to this situation are presented in Appendix B given that the explanation is similar to the case where both spouses work in the same sector.

4.2.3 Neither member of the couple works

This is an informal household (i.e., without Social Security coverage).

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

Each member of the couple may receive offers either from the formal or the informal sector with arrival rates $\lambda_{nj}^{s_1}$ and $\lambda_{nj}^{s_2}, j = f, i$, respectively.

Households make their decisions based on reservation wages. Since 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 to take the offer if the resulting wage is higher than $\hat{w}_{ff->if}(w_1, w_2)$. This critical value is the solution of $W_{ff}(w_1, w_2) = W_{if}(\hat{w}_{ff->if}(w_1, w_2), w_2)$. Figure A.3 in the Appendix shows one possible scenario with the value function $W_{if}(w_1, w_2)$ dominating $W_{ff}(w_1, w_2)$ for lower wages of spouse 1 and given the wage of spouse 2 in the formal sector, w_2. Note that in this case, spouse 1 is willing to take a lower wage in the informal sector than his current wage in the formal sector. When households are faced with three options, the choice algorithm is a bit more complex because it will depend on the relative steepness and location of three instead of two curves. However, since the value functions are always non-decreasing in wages, there will be one or two cutoff wages that determine the choice made by each individual across three such options.

4.3 Firms and Equilibrium

A key difference between an individual and a household search model is that in the household context the reservation wage of one spouse depends on the job state and wage of the other spouse. In a standard wage posting model with single searchers, firms have to pay above a unique reservation wage. In this model, with two searching spouses, we assume that firms pay a wage that is higher than the minimum reservation wage of each spouse.

For simplicity, we assume that wages of spouses 1 and 2 in the formal (f) and in the informal (i) sectors are determined in separate markets. In each submarket, firms are ex-ante heterogeneous in their productivity (p) with continuous distributions: $\Gamma_f^{s_1}(p)$ for spouse 1 in the formal sector, $\Gamma_i^{s_1}(p)$ for spouse 1 in the informal sector, $\Gamma_f^{s_2}(p)$ for spouse 2 in the formal sector, and $\Gamma_i^{s_2}(p)$ for spouse 2 in the informal sector.[15] We denote as Γ the distribution of productivities of active

[15] By doing so, we assume that the labor markets are segmented by gender and sector, and they do not compete directly; this assumption can be seen as a limitation, however it is a way of controlling for these important observable

firms, and thus we assume that a firm does not offer a wage such that the total labor cost exceeds its revenue p because profits would be negative. Moreover, any wage offer is at least greater than the workers' minimum reservation wage denoted by $\underline{\hat{w}}_f^{s_h}$ and $\underline{\hat{w}}_i^{s_h}$ ($h = 1, 2$), for the formal and informal sectors, respectively.

In the formal sector, in addition to payroll taxes, τ, we also consider a legal minimum wage, mw, to capture the labor market institutions in the Mexican regulatory setting. In such sector, wage offers are greater than $\max\{\underline{\hat{w}}_f^{s_h}, \mathsf{mw}\}$. In the market for spouse $h = 1, 2$, a formal firm solves:

$$\max_w \quad (p - (1+\tau)w)\ell_f^{s_h}(w) \tag{2}$$

where $\ell_f^{s_h}(w)$ is the equilibrium size of a formal firm in the market of spouse h offering w, i.e. the steady-state measure of workers in firms paying w. Normalizing the number of formal firms to one in each market $h = 1, 2$, we have

$$\ell_f^{s_h}(w) = m_f^{s_h} \frac{dG_f^{s_h}(w)}{dF_f^{s_h}(w)} \tag{3}$$

where $m_f^{s_h}$ is the stationary measure of employment in the formal sector for spouse h. $G_f^{s_h}(w)$, $h = 1, 2$ is the stationary earnings distribution in the formal sector by spouse.[16]

In the informal sector, minimum wages are not enforced and firms do not pay taxes. However, they can be caught by enforcement authorities or face constraints such as having no access to credit markets. We assume that this imposes a cost on informal firms that is embedded in the level of productivity at which they operate in the labor market.

The informal sector firm solves:

$$\max_w \quad (p - w)\ell_i^{s_h}(w) \tag{4}$$

where $\ell_i^{s_h}(w)$ is analogous to function (3) defining the equilibrium size of an informal firm in the market of spouse h offering w.

Because the distributions of productivities of active firms in each submarket (by sector and spouse) are continuous, the solution to the maximization problem is unique (Bontemps, Robin and van den Berg, 1999, 2000). Furthermore, monotonicity of wages [$w = K_{j,s_h}(p)$] implies

differences, and it is better than mixing the groups and ignoring wage differences among them. Alternatively, Fang and Shephard (2019) propose an extension of Burdett and Mortensen (1998) motivated by the private health insurance system in the US by allowing firms to choose wages and whether to provide insurance. In their household setting, they aggregate marginal worker productivity and labor force size across the two spouses, and assume that firms of a given productivity p choose a wage that varies by the insurance option but does not vary by spouse (gender).

[16] As in an individual search environment with two employment sectors and direct transitions across the two of them (see e.g. Meghir, Narita and Robin, 2015; Narita, 2020), the stocks and earnings distributions in this context can be solved through a system of flow equations that are functions of the transition rates and wage offers distributions. In our estimation, this is simplified because we simulate the households' trajectories, so we do not need to use the flow equations to recover the stocks and earnings distributions.

$F_j^{s_h}(w) = \Gamma_j^{s_h}(K_{j,s_h}^{-1}(w))$; $j = f, i$ and $h = 1, 2$.[17]

4.4 Identification

As is well known in the literature of estimation of household search models (see e.g. Dey and Flinn, 2008; Flabbi and Mabli, 2018), it is difficult to solve analytically all structural parameters in terms of the data, thus a formal proof of identification cannot be provided. However, based on previous work on the identification of search models we can argue which are the main sources of identification for each parameter or set of parameters, and what additional information is required to identify additional parameters in our model.

Given r, identification of the productivity distributions $\Gamma_j^{s_1}(p)$ and $\Gamma_j^{s_2}(p)$, $j = i, f$, for spouse 1 and 2, respectively, comes *mainly* from the observed wage distribution in the formal and informal sectors by spouse at the first interview. The transition rates are *mainly* identified off the labor market transitions from longitudinal individual data between first and second interviews.

Utility parameters θ, b_1, b_2, a, and γ are identified using different data periods (as we will explain), because we cannot identify a and γ separately, using the same period of data.[18] As the preference parameters are common across spouses, it is reasonable to state that the main source of identification of such parameters is data on the household level such as household stocks. Furthermore, as Dey and Flinn (2008) show, the inclusion of cross-moments in the estimation of their household job search model significantly changed the estimate of the utility value of being in the insured sector. It is also reasonable to expect that cross-moments capture the extent of insurance within the household which enables a more credible estimation of common preference parameters.

To separately identify a (the utility value of amenities in the formal sector) and γ (the value of health insurance provided by SP), we use data on wages, employment shares and transitions exploiting the timing of the program introduction.[19] We do it in two steps:

1. by fixing $\gamma = 0$, we identify a and remaining parameters using data for the pre-Seguro Popular period;

2. conditional on a and other structural parameters, and keeping the assumption that $\gamma = 0$

[17] These equilibrium properties derived in (Bontemps, Robin and van den Berg, 1999, 2000) depend on the shape of the wage distributions. As we are unable to derive the admissible shapes of such distributions given the interdependence of different sectors and individuals in the current environment, in practice, we rely on the first-order condition to provide a unique solution to the firm's decision and then we check whether the second-order condition is satisfied. The latter is equivalent to $K'_{j,s_h}(p) > 0$.

[18] In previous versions of this paper, we imposed restrictions on the value functions by assuming strong monopsony power for the lowest paid to recover b_1 and b_2. While this was an alternative and probably more restrictive way, nonetheless the previous estimates do not differ much from the current ones.

[19] A slightly different identification strategy is implemented by Bobba, Flabbi and Levy (2018) to estimate the utility value of SP from an individual search and matching model. They use data for the year 2005.

in municipalities which did not have the program, we identify the value of γ from data on municipalities that implemented SP. [20]

Although we cannot establish a formal identification proof of the model, Appendix C provides formal identification arguments that can be achieved by imposing some behavioral restrictions. This is just illustrative and, as shown in the next section, we do not use such restrictions to estimate the model.

5 Estimation

As explained in the previous sections, we cannot estimate the distributions of productivity using the equilibrium steady-state relationships between the sampling distributions and the cross-sectional distributions of wages. The construction of such flow equations is problematic given that an individual exit hazard is not constant over the time period, i.e. it depends on the job state and wage of the spouse which may have changed over this time interval.

In addition, we cannot directly estimate the distributions of productivity from data on wages accepted by the nonemployed due to heterogeneity in reservation wages, so that the accepted wage distribution is not equal to the sampling distribution.

In this paper, we develop an estimation strategy suitable for this model with two searching spouses, two sectors of employment, and direct transitions that may occur between them. To keep it as simple as possible, we estimate the model using a simulated method of moments approach.

We use the equilibrium solution $F_j^{s_h}(w) = \Gamma_j^{s_h}(K^{-1}(w))$ for $j = f, i$ and $h = 1, 2$, and instead of estimating the distributions of productivity we estimate the wage offer distributions. We assume $F_j^{s_h}(w)$ to have a non-standard $\mathsf{Beta}(\underline{\mathsf{w}}, \overline{\mathsf{w}}, \alpha, \beta)$ CDF with α and β specific for each sector. The minimum and maximum support points for all distributions are obtained from the data by sector and spouse, then we interpolate using a uniformly spaced grid.

The model includes the wage offer distribution parameters in the formal and informal sectors ($\alpha_f, \beta_f, \alpha_i, \beta_i$), job offers arrival rates ($\boldsymbol{\lambda}$), job destruction rates ($\boldsymbol{\delta}$), and the added worker effect probabilities ($\boldsymbol{p}, \boldsymbol{q}$). The utility parameters are the measure of risk aversion (θ), the values of leisure (b_1 and b_2), the relative value of the amenities in the formal sector (a), and the value of Seguro Popular (γ). All are denoted by:

[20] We assume that the first-stage structural parameters are the same across the municipalities that implemented the program earlier or later. This assumption is supported by strong evidence that the timing of SP implementation was not correlated with labor market characteristics (Azuara and Marinescu, 2013; Bosch and Campos-Vazquez, 2014). There is also no evidence of other programs or reforms - such as payroll taxation, formal sector benefits or cash transfers - taking place in the same municipalities and with the same time frame, so that any changes in employment transitions and wages capture those changes that can be attributed to Seguro Popular.

$$\Theta = (\alpha_f, \beta_f, \alpha_i, \beta_i, \lambda_{if}^{s_1}, \lambda_{fi}^{s_1}, \lambda_{ni}^{s_1}, \lambda_{nf}^{s_1}, \delta_i^{s_1}, \delta_f^{s_1}, \lambda_{if}^{s_2},$$
$$\lambda_{fi}^{s_2}, \lambda_{ni}^{s_2}, \lambda_{nf}^{s_2}, \delta_i^{s_2}, \delta_f^{s_2}, q^{s_1}, p^{s_1}, q^{s_2}, p^{s_2}, \theta, b_1, b_2, a, \gamma).$$

Formally, in the first stage where we fix $\gamma = 0$, we search over the parameter vector Θ to find the combination that minimizes a distance criterion between the simulated and empirical moments using data from the pre-SP period. All 24 parameters are estimated jointly and again there are no analytic expressions for the targeted moments.[21] In the second stage, as explained, we keep all parameters constant and search over γ values to find the value that minimizes a distance criterion between the simulated and empirical moments using data from treated municipalities after the implementation of SP.[22]

We define our method by

$$\hat{\Theta}_{MSM} = \arg\min_{\Theta} \left(m(\Theta) - \tilde{m}\right)^T W \left(m(\Theta) - \tilde{m}\right)$$

with $\dim(m(\Theta)) = \dim(\tilde{m}) > \dim(\Theta)$ and W is a weighting matrix in which the diagonal elements are the inverses of the bootstrap variances.

From each sample, we use two groups of moments. The first contains individual moments: wages by sector and by spouse (mean, standard deviation, 10th, 25th, 50th, 75th, and 90th percentiles) and transition probabilities (variation in occupation status between interviews for the first and second quarters) by spouse and between any two labor market states. The second includes cross moments, i.e., moments that relate spouses 1 and 2 in any dimension. We have chosen to fit the joint employment proportions and some conditional transition probabilities such as the probability of the head finding a job in the informal sector conditional to the spouse losing a job, and vice versa.[23] In total, we use 53 moments to estimate 24 parameters in the first stage, and an additional 9 moments to estimate the utility value of health insurance γ in the second stage.[24] Finally, we obtain the bootstrap standard errors based on 100 replications.

Up to this point, we have showed how to estimate the distributions of wage offers, the transition and utility parameters. These estimates did not require computing the distributions of productivity.

[21] We set all the transition rates within the same sector (such as $\lambda_{ff}^{s_1}$) equal to zero because transitions within the same sector are not observed in our data.

[22] In the previous version of this paper we allowed for the wage offers distributions to vary in the second step as these are equilibrium objects and thus may vary with γ. However, the parameters of such distributions were not very different from those in the first step and, more importantly, the estimate of γ was similar to that of the current version.

[23] We could have also matched the joint distribution of wages from the data *in addition* to the moments we match, i.e., the marginal wage distributions and the transition probabilities. However, since the majority of women does not work and because wages are more imprecisely measured than stocks in the data, the results are unchanged when we take advantage of such extra moments.

[24] Given that the utility parameter γ is mostly identified from household stocks, we only use these moments for recovering it. However, we also estimated γ using additional moments such as wages and transitions and we found the results robust.

However, counterfactual policy experiments will use the estimated distributions of productivity to compute the new equilibrium.

In Appendix C we provide the details on how to solve the firm optimization problem; in particular, how we obtain the firm productivities.

6 Estimation Results

We now present the model estimates. As we already discussed, we focus the model estimation on households with children aged 0-14 years and present estimates separately for low and high education (recall a household is high educated if the head has more than 6 years of education).

We start by estimating all parameters using the period before the introduction of SP. To do so, we set the value of free health insurance in the informal sector and nonemployment, γ, to zero. In the sample of municipalities covered by the Labor Force Survey, SP was implemented in a staggered manner between 2004 and 2007. We, then, use the period after the introduction of SP to estimate γ as described in subsection 4.4, considering all other parameters fixed as estimated on data from the pre-reform period.

The time period in the model is one quarter. We set the discount rate to $r = 0.036$, which corresponds to the average for the Mexican benchmark interest rate in the period 2000-2004 and $\tau = 0.10$ for employer contributions to social security following Satchi and Temple (2009).

6.1 The Model Fit

Table 3 compares the stocks of households (where members are employed in formal or informal sectors or non-working) and the transitions predicted by the model and observed in the data, in the pre-SP period. The stocks are denoted by m_{jk}, which show the fraction of households where the head is in status $j = f, i, n$ and the spouse is in status $k = f, i, n$. The model closely reproduces the patterns observed in the data. The fractions of households where the head works in either the formal or informal sectors and the spouse is nonemployed are the largest. In aggregate, in the model, as in the data, the share of informal households is higher among low-education households. The estimated fractions are 49% and 41% for low and high-education households, respectively. Finally, the model reproduces remarkably well the share of heads and spouses in nonemployment, which is estimated at around 4.5% (5%) for heads and 73% (64%) for spouses in low-(high-)education households.

The transitions are less well fitted because our estimation method penalizes the moments that are less precise in the data. For example, the model underestimates the fraction of heads who move from formal to informal but also in the opposite direction between two consecutive quarters.

Among those with high education, it overestimates the fraction who enters the informal sector from nonemployment and particularly the share of spouses who leave the formal sector to nonemployment. It also underestimates the share who moves from nonemployment to an informal job when the other spouse loses his/her job, again a reflection that these transitions are more dispersed in the data.

Table 4 presents selected moments for the distribution of wages in the data and as predicted by the model. We assume that the F distributions follow a non-standard Beta distribution with parameters varying by sector and the support obtained from the data for each sector and spouse. Considering this, and given the flexibility of the Beta function, we replicate well the main patterns in distributions of accepted wages in the data. For instance, wages in the formal sector are on average higher than in the informal sector for both head and spouse. For low-education households, there is a large difference in the 10th percentile wage paid across formal and informal sectors, but the top wages paid across the sectors are much more similar. For high-education households, the gap between the lowest earners across formal and informal sectors remains large for spouses.

6.2 Model Estimates

Transition rates and Wage offers distributions Table 5 reports estimates of the transition parameters across sectors of employment and nonemployment by spouse. Both the job arrival and destruction rates originating from or exiting to formal and informal sectors are larger for heads than for spouses. The high informality stock as shown in Table 3 is associated with the following. First, the arrival rate from nonemployment to the informal sector i.e. λ_{ni} is higher than the exit to formal sector jobs denoted by λ_{nf}. Given that the destruction rates are larger for spouses, the difference between λ_{ni} and λ_{nf} is significantly more important for spouses in low-education households, for whom nonemployment is much higher. Second, the probabilities of transition from nonemployment to the informal sector when the spouse loses his/her job, p and q, are positive and around 0.2-0.8 indicating a significant added worker effect and, therefore, another important link to informality.

The market is more frictional for spouses (women) as the rate of job arrivals is lower than the rate of destruction in most cases. For men, the arrivals rates are 7-19 times larger than the destruction rates, depending on the destination and sample. Additionally, given the standard errors, it not clear whether search is more efficient on the job or out of the job.

In Table A.4 in Appendix we report the estimates for the Beta distribution parameters. The parameters vary by sector, formal (α_f and β_f) and informal (α_i and β_i) while the minimum and maximum support points vary by sector and spouse. The implied mean offered wage is higher for husbands than wives, showing that offered wages are 11% higher for men in the formal sector and

20% higher for men in the informal sector, among low-education households. The figures are a little higher for high-education households, at 12% and 25% respectively. We noticed that the mean wage offer is lower for high-education than for low-education households in the informal sector. A potential reason for this is that wage offers must be relatively more attractive in the informal sector to justify the high informality rate among low-education households.

Utility parameters The model allows for risk aversion and different values of leisure between heads and spouses. The first row of Table 6 shows that the coefficient of absolute risk aversion is not statistically different from zero, thus rejecting concavity for both the low- and high-education groups. The second and third rows show that the value of leisure is negative for both spouses, reflecting that job offers are more accepted by individuals out of work, in particular for the head of household because he is more likely to have a spouse who does not work. In this sense, as there is less household insurance for men, the value of leisure is lower for men than for women.

The fourth row of Table 6 includes the estimates for a, the value of pre-existing amenities in the formal sector relative to informality/nonemployment. This is negative and imprecise for low-education households, but positive for high-education households. To give a sense of what this represents in terms of earnings, we compute the willingness to pay, i.e. how much households would need to give up to be indifferent between being formal or outside the formal sector.

Our approach is to calculate the marginal willingness to pay, expressed as the ratio of the marginal utility of the job amenity in the formal sector over the marginal utility of the wage. This is reported in the sixth row of the table. Before the introduction of SP, less educated households (column 1) are willing to forgo 4% of their mean earnings to be in the informal sector or nonemployment rather than in the formal sector, however the estimate is not significant.[25]

For high-education households, column (2) shows that they are willing to pay 18% of the mean earnings to be in the formal sector, thus capturing that the formal sector indeed provides non-wage benefits for them. Antón, Hernández and Levy (2013)'s Table A2.1 shows that taxes amount to 22% (excluding pensions, housing and state taxes), hence our finding suggests that even those more likely to be formal workers do not seem to value enough formal health benefits. Hence our model is flexible enough to accommodate such low valuation, which is consistent with behavioral biases in which individuals are myopic and overweigh payment of taxes relative to expected pensions and benefits of the formal sector, in a similar way as Abaluck and Gruber (2011) find that a key reason consumers lose money on their plan choices under the Medicare Part D is that they overweigh

[25] Although even a negative value could be justified through (i) preferences for more flexible work schedules in the informal sector, (ii) access to welfare programs that exclude households covered through the formal sector such as *Oportunidades*, or (iii) the high informality rate among low education households as we observe in the data (53%). To fit such a high fraction, the proposed model needs differential frictions (higher for the formal sector), lower formal-informal offered wage gap, and/or a negative a.

premiums relative to expected out-of-pocket spending.

The value of Seguro Popular The estimate of γ in Table 6 (fifth and seventh rows) shows that the value added of SP is positive and significant, representing 5.8% of the mean earnings of low-education households. For high-education households, the utility parameter is negative and is not statistically significant. Although the SP program is not targeted to low-education workers only, it is perceived as having a higher value for them. Yet, even among low-education households, we show that the marginal willingness to pay for SP is low. Using information on government expenditures in SP, we can compare the marginal willingness to pay for SP to the total cost of funding the program per family. As the government spends per quarter MXP 1,306 (in 2010 pesos; about 100USD) per each family enrolled in the program (CNPSS, 2013), this is equivalent to saying that low-education households assign a value of 0.51 per each one MXP spent in the program.[26]

Summing up, the main message from the estimate of γ is that, conditional on all parameters fixed in the period before SP, only low-education households assign a positive value to the SP program: 5.8% of the mean household earnings. We also show that this value is below the average cost to the government per family.

6.3 Policy Experiments

To evaluate the impact of SP on welfare, employment and informality, we use the model to generate counterfactual simulations that vary the parameter of interest, γ, from zero to the estimated value as reported in Table 6. We take as benchmark the model estimated in the period before the implementation of the program, when γ is set to zero. We assume that the economy is in a steady state, represented by the situation in the pre-program period and moves to a new steady state, after the policy change. We present the simulations for low-education households only as we find a non-zero value of γ only for this sample.

The reform implemented by SP expanded health care to about 50% of the population not covered by the contributory health insurance. We should expect that the reform increased the incentives for households to be outside the formal sector, i.e. when spouses are either working in the informal sector or nonemployed. In general equilibrium, as workers move out of the formal sector, formal sector firms may raise the wage offer to keep them while firms in the informal sector may lower the wage offer instead. This should counteract at least some of the positive impact of the reform on the value of being informal.[27] If we consider that the government funds the SP system

[26] Across different approaches, Finkelstein, Hendren and Luttmer (2019) find that the willingness to pay for Medicaid by recipients per dollar of net cost is between 0.5 and 1.2; Finkelstein, Hendren and Shepard (2019) estimate a willingness to pay which is always less than 0.5 for enrollees in the Massachusetts' subsidized insurance exchange.

[27] General equilibrium effects are expected to be smaller because they may result only from changes in labor supply

out of a lump-sum tax paid by all households in every period, then this may further reduce the incentives to become informal because the tax hits more heavily the nonemployed and informal sector workers.

Table 7 reports the results on household stocks, mean wages and welfare. Table A.5 and Table A.6 in Appendix present the results on transitions, firm size, and profits. Column (1) in these tables shows partial equilibrium results, in which we do not consider endogenous changes in wages. They show that if the pre-SP economy is simulated with the estimated value of SP, all household stocks in the formal sector fall leading to an increase in household informality by 3.8 p.p. (7.7%) in aggregate. This is mainly due to an increase by 3.3 p.p. (8%) in the stock of households where the head is informal and the spouse nonemployed, and a fall by 2.3 p.p. (7.5%) in the fraction where the head is formal and the spouse is nonemployed. There is also a decline by about 10% in the shares of households where the head is formal and the spouse is working, which corresponds to our reduced-form evidence. Exits from the formal sector to the informal sector increase for both heads and spouses. However, employment in an informal sector job is much less stable for spouses so many of them end up nonemployed.

The increase in the health insurance transfer also appears to increase nonemployment of heads by 0.4 p.p. (8%), which is negligible in aggregate terms given the frequency of heads in nonemployment, and also of spouses, by a small 0.8 p.p.(1.1%).

The partial equilibrium results also show that the formal sector wages go up as workers become more reluctant to take formal sector job offers. Informal sector wages go down for heads of households because they are now more willing to take a job offer in this sector after the introduction of SP. Together, the introduction of SP corresponding to a value of 5.8% of the mean household income and a reduction in overall wages imply an increase in the average welfare of workers of 1.7%. Welfare goes up for informal and nonemployed individuals because they get SP. The gains are much higher for households with very low instant utility, particularly nonemployed males because they have a very negative value of leisure, however this is a small fraction of individuals. Welfare goes up in the formal sector, as wages are higher due to an increase in the reservation wage to work in that sector. The remaining part of the increase in welfare depends on the values of outside options that increase everywhere.

As we allow for endogenous wages in column (2), we observe a clear compensating differential for working in the informal sector, as we would expect. The decline in informal wages is stronger for both head and spouse while formal sector wages go up and above the partial equilibrium result (column 1) for spouses. General equilibrium effects through changes in the wage offers are non-negligible but are not very large compared with the partial equilibrium results. They show that the impact on household informality is attenuated at 2.9 p.p. (5.9%) and that workers' welfare still

given that firms bear no cost related to the health insurance provided by SP.

increases by 1.2%.

In column (3) we report the results that we obtain when we consider a revenue-neutral implementation of SP. We assume that the government expenditure for SP is paid by all households through a lump-sum tax in the form of dividends. The tax penalizes the lowest earners more in general and the informal/nonemployed, in particular. In relation to the general equilibrium results of column (2), wages offers compensate by increasing in the formal sector, as workers attempt leaving this sector. This is clearly seen for men. Women are more reluctant to take informal sector jobs but less so to take formal sector jobs. As a result, overall wages go down by more than in the non-neutral analysis in column (2). Despite the SP transfer, workers' welfare goes down by 4.7%. The revenue-neutral results also show a lower impact on informality at 2.75 p.p. (5.6%) than in relation to benchmark levels, and closer to our reduced-form estimates (3.5%) reported in Table 2.

We now turn to firms. Table A.6 in Appendix shows that the introduction of SP increases profit (per worker) of formal firms across most simulations due to a decrease in the fraction of formal sector workers, despite a higher wage in the formal sector (Table 7) and a lower firm size. In the non-neutral general equilibrium simulation (column (2)), a lower firm size and a smaller reduction in the share of formal sector male workers explain why profit per worker is reduced for formal sector firms hiring males. The mean profit of informal firms employing heads or spouses increases mostly because wages go down in this sector, but also due to an increase in firm size, which is the case for the heads.

All results point to one direction: SP generates incentives for household informality. It increases it by 5.6-7.7% across different model simulations. In our view, given that the reform implied coverage of 53% of households with low education, the impact is low and consistent with the reduced-form evidence. We are able to rationalize this result with our estimate of the marginal willingness to pay for SP, which is less than the government expenditure per household in the program. We also find limited scope for increasing workers' welfare through introducing free health insurance by SP, as the effect is negative when the government budget is taken into account.

Reservation Wages Figure 1 depicts the reservation wages of heads and spouses at the benchmark economy and after simulating the introduction of SP. We show two main reservation wage functions for each spouse when they are deciding on moving from nonemployment to the formal (lighter lines) or informal sectors (darker lines), conditional on the other spouse working in the informal sector and on the wage. Many facts stand out from these plots: (i) the head of household (men) reacts much less to the spouse's wage, except when she has higher wages within a more educated household; (ii) the introduction of SP makes the low-education heads more reluctant to take a formal job offer if the spouse earns a high wage, which explains why nonemployment of the head goes up; (iii) spouses' reservation wages are increasing on heads' wages as they become more

demanding; and (iv) SP makes spouses more (less) demanding if the job offer arrives from the formal (informal) sector, a conclusion that is consistent with more women going into informality after SP.

These figures also show the importance of studying labor supply decisions at the household rather than at the individual level (see also Guler, Guvenen and Violante, 2012; Flabbi and Mabli, 2018). By ignoring the dependency of an individual's behavior on the state and wage of his/her spouse one would miss an important mechanism. Married individuals share benefits with their spouses such as their earnings, and thus individuals with a high income spouse typically find it optimal to remain nonemployed or working for the informal sector. This incentive increases when a welfare system such as SP is positively valued, which is the case for low education households.

7 Conclusion

In this paper we study how access to universal health coverage affects the labor market decisions of households. To do so, we develop and estimate for the first time a household-level model of job search for a developing/middle-income country. In particular, we use the case of Mexico, which introduced in 2002 a non-contributory health insurance scheme (Seguro Popular) directed to the half of the country's population not covered by Social Security protection. Before SP, individuals could only access affordable health care through their employer, hence the introduction of 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 change to compensate the increase in benefits in the informal sector, in which case the impact on formality and employment is ambiguous.

Difference-in-differences estimates using the staggered introduction of SP across municipalities show that the program is associated with an increase in informality by 3.5% for low-education households with children, with no impacts for the other groups studied (i.e., low-educated households without children or high-educated households).

Then, to study why the policy change had limited impacts on the labor market, we develop and estimate a household search model that incorporates the value of free health care by 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) to recover the value of SP by households.

Our results show that the marginal willingness to pay for health insurance coverage provided by SP is low, ranging from zero to 5.8% of the mean household income, with the largest valuation coming from the poorest group of households (low-education families with children). Our esti-

mates also indicate that the value is generally below the government's average cost of providing it, about half of it for low-education households. Not surprisingly, when we use the estimated model to simulate the introduction of the SP program, we find that it increases household informality by 5.9%, which is less than expected given that the SP reform expanded health care to more than 50% of the population. Welfare gains are limited (the increases are at most by 1.7%) since workers exit the formal sector and wages go down in the informal sector to compensate for the introduction of SP. Welfare losses occur if the government uses a lump-sum tax paid by households out of their income in every period to finance the program. These results keep the pre-existing formal sector contributions and benefits system fixed, so it may still be the case that changes in the current formal sector system (for example, if the government were to raise payroll taxes or decrease social security benefits) may result in further welfare losses.

Our results have important policy implications for those countries introducing and/or expanding schemes that cut the link between the job contract and access to health services, such as Medicaid expansions for low-income uninsured individuals or the 2010 Affordable Care Act in the USA.

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8 Tables and Figures

Table 1: Employment and wages in the formal and informal sector.

	High Education		Low Education	
	Before 2001	After 2007	Before 2001	After 2007
Panel A: Proportion of households, by employment type				
Number of Households-Quarters	20,480	11,544	18,122	7,584
Share of Households without Social Security coverage (informal hhlds.)	0.334	0.340	0.570	0.602
Households by type				
With Social Security				
Head Formal-Spouse Formal (FF)	0.142	0.139	0.047	0.041
Head Formal-Spouse Informal (FI)	0.074	0.108	0.055	0.073
Head Formal-Spouse Not Working (FN)	0.391	0.353	0.286	0.243
Head Informal-Spouse Formal (IF)	0.049	0.050	0.036	0.033
Head Not Working-Spouse Formal (NF)	0.010	0.012	0.006	0.008
Without Social Security/Informal				
Head Informal-Spouse Informal (II)	0.058	0.078	0.097	0.132
Head Informal-Spouse Not Working (IN)	0.228	0.209	0.399	0.389
Head Not Working-Spouse Informal (NI)	0.008	0.010	0.016	0.018
Head Not Working-Spouse Not Working (NN)	0.040	0.043	0.060	0.062
Panel B: Wages in the formal and informal sectors				
Wages: Formal Sector				
Head				
Mean	17,907	18,837	14,542	15,919
SD	6,993	6,833	5,764	5,773
Observations	12,442	6,913	7,025	2,709
Spouse				
Mean	16,085	16,824	12,291	13,208
SD	6,839	7,565	5,196	5,636
Observations	4,109	3,882	1,606	623
Wages: Informal Sector				
Head				
Mean	15,849	16,998	12,990	14,213
SD	7,369	7,036	6,437	6,549
Observations	6,860	2,311	9,619	4,210
Spouse				
Mean	9,519	9,356	7,115	7,778
SD	6,809	6,313	4,927	4,875
Observations	2,862	2,254	3,029	1,696
Wage Growth (2007-2001): Formal Sector				
Head	0.052		0.095	
Spouse	0.046		0.075	
Wage Growth (2007-2001): Informal Sector				
Head	0.073		0.094	
Spouse	-0.017		0.093	

NOTE: ENE-ENOE 2001 and 2007, sample of families whose head is 20-59 years old. A household belongs to the "high education" group if the head has more than six years of education. Wages in the formal and informal sector by education group are measured by quarter.

Table 2: Reduced-Form Estimates: Impact of SP on Salaries and Informality Rate.

	(1)	(2)	(3)	(4)	(5)
	Informal	Head		Spouse	
	Households	Ln(w) Formal	Ln(w) Informal	Ln(w) Formal	Ln(w) Informal
Panel A: Low Education - With Children					
SP	0.023*	-0.011	0.005	-0.030	-0.003
	(0.010)	(0.013)	(0.013)	(0.025)	(0.027)
Mean in 2001	.657	9.45	9.27	9.32	8.61
N	13036	7376	11455	3194	6855
Panel B: Low Education - Without Children					
SP	0.006	-0.010	-0.002	0.013	0.038
	(0.015)	(0.018)	(0.021)	(0.030)	(0.036)
Mean in 2001	.674	9.47	9.24	9.34	8.71
N	9780	5026	7736	2175	4358
Panel C: High Education - With Children					
SP	-0.002	-0.036	0.002	-0.012	-0.071
	(0.011)	(0.011)	(0.014)	(0.016)	(0.029)
Mean in 2001	.415	9.66	9.46	9.6	8.85
N	13698	10893	10979	6403	7378
Panel D: High Education - Without Children					
SP	-0.004	-0.004	0.054*	-0.037	0.008
	(0.019)	(0.017)	(0.025)	(0.023)	(0.043)
Mean in 2001	.409	9.72	9.52	9.59	9.06
N	8365	5966	5231	3762	3649

NOTE: OLS estimates obtained using the ENE/ENEO data aggregated at the municipality-quarter level. Estimates are weighted by the population of the municipality in 2000. Controls excluded from table are: 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); municipality of residence fixed effects, quarter fixed effects, and a linear trend in the characteristics of the municipality of residence taken in 2000 (indicator for large city, index of deprivation, log of total population, number of hospitals and health centers in 2001, total number of doctors and nurses in hospitals per 1,000 uninsured individuals in 2001). The pre-SP mean is measured in 2001. Standard errors clustered by municipality. * significant after adjusting for multiple hypothesis testing using the Romano and Wolf (2005) method.

Table 3: Model Fit: Stocks and Transitions.

	(1)	(2)	(3)	(4)
Education	Low		High	
	Data	Model	Data	Model
Employment				
m_{ff}	0.041	0.078	0.127	0.110
m_{fi}	0.054	0.074	0.077	0.085
m_{fn}	0.282	0.305	0.412	0.296
m_{if}	0.031	0.044	0.045	0.083
m_{nf}	0.005	0.008	0.008	0.013
m_{ii}	0.098	0.038	0.060	0.056
m_{in}	0.434	0.417	0.239	0.321
m_{ni}	0.013	0.026	0.007	0.015
m_{nn}	0.043	0.012	0.025	0.022
Transitions: Head				
Nonemployment-Formal	0.111	0.218	0.234	0.167
Nonemployment-Informal	0.496	0.413	0.351	0.468
Formal-Nonemployment	0.024	0.023	0.018	0.041
Formal-Informal	0.155	0.057	0.087	0.041
Informal-Nonemployment	0.052	0.039	0.039	0.027
Informal-Formal	0.099	0.055	0.146	0.066
Nonemp.-Inf., if spouse loses formal job	0.046	0.007	0.014	0.018
Nonemp.-Inf., if spouse loses informal job	0.038	0.087	0.023	0.034
Transitions: Spouse				
Nonemployment-Formal	0.015	0.027	0.025	0.079
Nonemployment-Informal	0.081	0.074	0.073	0.096
Formal-Nonemployment	0.149	0.198	0.111	0.355
Formal-Informal	0.081	0.020	0.044	0.033
Informal-Nonemployment	0.382	0.379	0.357	0.269
Informal-Formal	0.037	0.065	0.069	0.130
Nonemp.-Inf., if head loses formal job	0.087	0.006	0.082	0.006
Nonemp.-Inf., if head loses informal job	0.101	0.017	0.079	0.004

NOTE: All estimates presented in the table are obtained using data from the period before the introduction of SP. We define high education as households where the head has at least primary education. Sample of households with children 0-14.

Table 4: Model Fit: Log-wages.

	(1)	(2)	(3)	(4)
Education	Low		High	
	Data	Model	Data	Model
Formal wage: head				
P10	8.990	8.889	9.175	9.194
P25	9.222	9.194	9.435	9.478
P50	9.487	9.527	9.710	9.847
P75	9.744	9.738	10.007	10.089
P90	9.991	9.913	10.240	10.261
Mean	9.564	9.529	9.779	9.848
Informal wage: head				
P10	8.633	8.600	8.883	7.895
P25	8.990	9.010	9.212	8.719
P50	9.347	9.360	9.567	9.573
P75	9.672	9.573	9.895	9.931
P90	9.949	9.787	10.200	10.141
Mean	9.439	9.365	9.658	9.549
Formal wage: spouse				
P10	8.879	8.651	9.039	8.889
P25	9.051	8.947	9.312	9.194
P50	9.290	9.303	9.589	9.573
P75	9.539	9.518	9.917	9.880
P90	9.825	9.734	10.183	10.115
Mean	9.396	9.304	9.692	9.624
Informal wage: spouse				
P10	7.692	7.145	7.868	7.145
P25	8.199	8.136	8.372	7.593
P50	8.669	8.853	8.896	8.853
P75	9.051	9.196	9.353	9.506
P90	9.397	9.506	9.825	9.898
Mean	8.827	8.882	9.110	9.087

NOTE: All estimates presented in the table are obtained using data from the period before the introduction of SP. We define high education as households where the head has at least primary education. Sample of households with children 0-14.

Table 5: Model Estimates: Transition Rates

	(1)	(2)
Education	Low	High
Head		
δ_f	0.045	0.067
	(0.018)	(0.012)
δ_i	0.067	0.047
	(0.032)	(0.010)
λ_{nf}	0.503	0.472
	(0.046)	(0.051)
λ_{ni}	0.673	0.902
	(0.095)	(0.083)
λ_{fi}	0.686	0.558
	(0.098)	(0.065)
λ_{if}	0.646	0.657
	(0.107)	(0.046)
p_1	0.220	0.415
	(0.133)	(0.070)
q_1	0.648	0.651
	(0.140)	(0.073)
Spouse		
δ_f	0.277	0.649
	(0.129)	(0.070)
δ_i	0.716	0.487
	(0.081)	(0.044)
λ_{nf}	0.317	0.297
	(0.159)	(0.067)
λ_{ni}	0.666	0.533
	(0.142)	(0.068)
λ_{fi}	0.147	0.417
	(0.124)	(0.073)
λ_{if}	0.320	0.481
	(0.145)	(0.059)
p_2	0.712	0.555
	(0.138)	(0.064)
q_2	0.809	0.573
	(0.092)	(0.072)

NOTE: All parameters estimates presented in the table are obtained using data from the period before the introduction of SP. We define high education as households where the head has at least primary education. The bootstrap standard errors in parenthesis are computed using 100 replications. Sample of households with children 0-14.

Table 6: Model Estimates: utility parameters including the value of Seguro Popular.

	(1)	(2)
Education	Low	High
θ	1.24E-08	5.85E-07
	(3.21E-06)	(3.22E-06)
b_1	-5,575.11	-6,207.16
	(1,640.88)	(801.30)
b_2	-1,016.45	-4,476.21
	(1,221.88)	(727.96)
a	-421.57	2,572.37
	(633.03)	(1,101.86)
γ	663.96	-697.64
	(235.73)	(676.99)
$MWP(a) = a \times (1/u'_I)$	-421.62	2,587.31
	(649.44)	(1,174.63)
$MWP(\gamma) = \gamma \times (1/u'_I)$	664.05	-701.69
	(239.05)	(713.00)

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. The exception is γ, which, conditional on the estimate of all other parameters, is obtained from the period after the introduction of SP. We define high education as households where the head has at least primary education. The bootstrap standard errors in parenthesis are computed from 100 replications. I is the quarterly mean household income, MXP 11,461 and MXP 14,283 for low and high education, respectively. Sample of households with children 0-14.

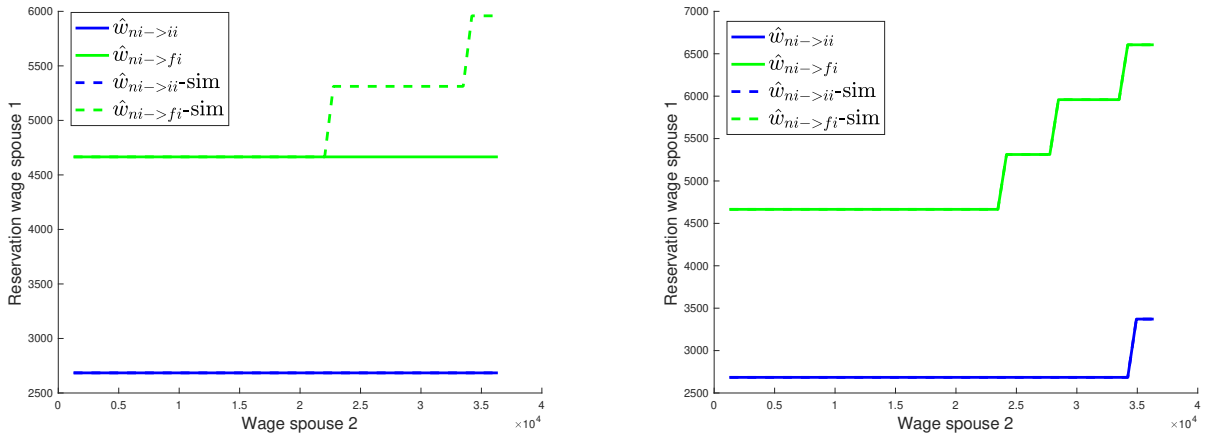
Table 7: Counterfactual Experiments: Effects of changing the utility value of having HI outside the formal sector (γ) on stocks, wages and welfare.

	(1)	(2)	(3)
	Partial Eq.	General Eq.	General Eq. (revenue neutral)
Stocks (p.p)			
m_{ff}	-0.810	-0.840	-0.350
m_{fi}	-0.730	-0.350	-0.150
m_{fn}	-2.280	-1.720	-2.250
m_{if}	-0.280	-0.080	-0.200
m_{nf}	0.300	0.090	0.200
m_{ii}	0.420	0.040	0.060
m_{in}	3.310	2.900	2.380
m_{ni}	0.290	0.060	0.270
m_{nn}	-0.220	-0.100	0.040
Household informality (p.p.)	3.800	2.900	2.750
Nonemployment head (p.p.)	0.370	0.050	0.510
Nonemployment spouse (p.p.)	0.810	1.080	0.170
Mean Wage:			
Head: Formal Sector (%)	1.405	1.344	2.019
Head: Informal Sector (%)	-4.088	-4.776	-5.310
Spouse: Formal Sector (%)	1.506	1.886	1.317
Spouse: Informal Sector (%)	-0.134	-1.642	-0.380
Welfare workers: average (%)	1.722	1.234	-4.715
Welfare per sector - head (%)			
formal sector	2.051	1.689	-3.636
informal sector	1.580	0.563	-4.814
nonemployment	24.695	21.782	-8.363
Welfare per sector - spouse (%)			
formal sector	-0.806	1.224	-5.419
informal sector	0.066	2.090	-5.997
nonemployment	2.241	0.941	-4.406

NOTE: We simulate the model using the estimate of γ reported in Table 6. The table shows changes in relation to benchmark levels (pre-SP period, where γ is set to 0). The General Equilibrium (column 2) is computed allowing endogenous wages implied by the wage posting structure as explained in section 4.3. Column 3 considers that the Seguro Popular program is financed out of dividends, paid equally by all workers in every period. Sample of households with children 0-14.

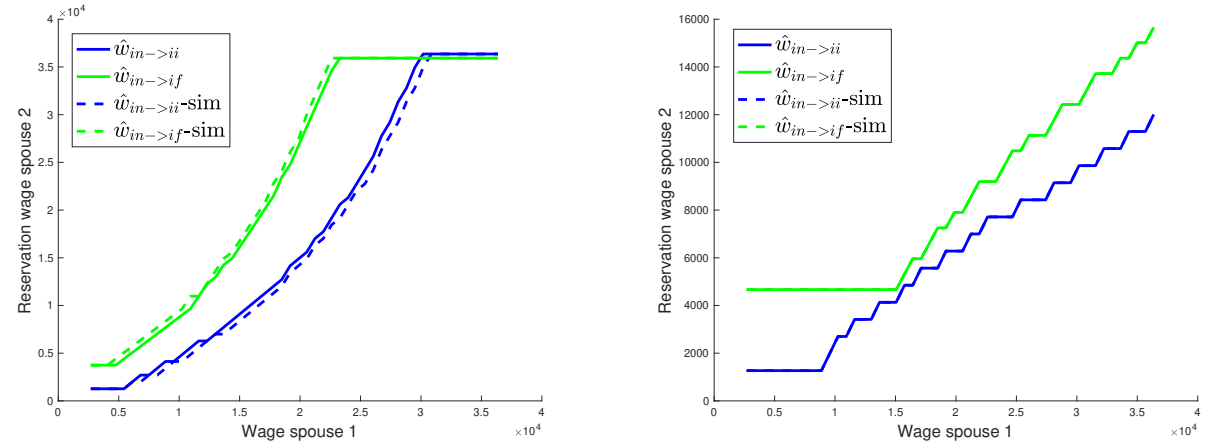
Figure 1: Reservation wages in a household search model

(a) Reservation wage of spouse 1 (*head*)



(a.1) Low education **(a.2) High education**

(b) Reservation wage of spouse 2 (*spouse*)



(b.1) Low education **(b.2) High education**

NOTE: Panel (a) plots the reservation wage of spouse 1 for each wage in the informal sector of spouse 2. The dark line plots the reservation wage for the informal sector (denoted $\hat{w}_{ni\to ii}$)); the lighter line plots the reservation wage for the formal sector (denoted $\hat{w}_{ni\to fi}$). Panel (b) plots the reservation wage of spouse 2 for each wage in the informal sector of spouse 1. The dark line plots the reservation wage for the informal sector (denoted $\hat{w}_{in\to ii}$), whereas the lighter line plots the reservation wage for the formal sector (denoted $\hat{w}_{in\to if}$). In both panels, the solid lines are the reservation wages resulting from estimating the model on the baseline economy, with $\gamma = 0$. The dashed lines are the reservation wages from simulating the baseline economy with γ equal the estimate as reported on Table 6.

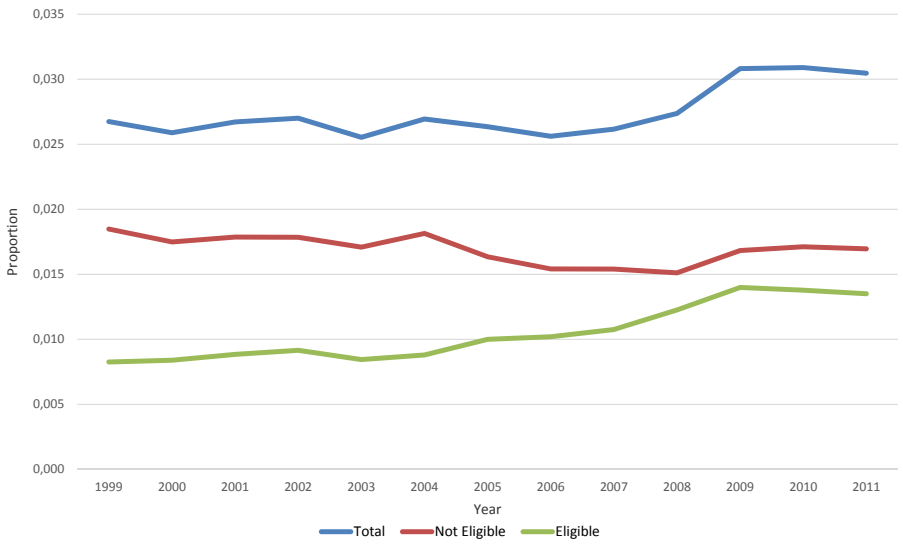
The Value of Health Insurance: A Household Job Search Approach

Gabriella Conti, Rita Ginja, & Renata Narita

ONLINE APPENDIX

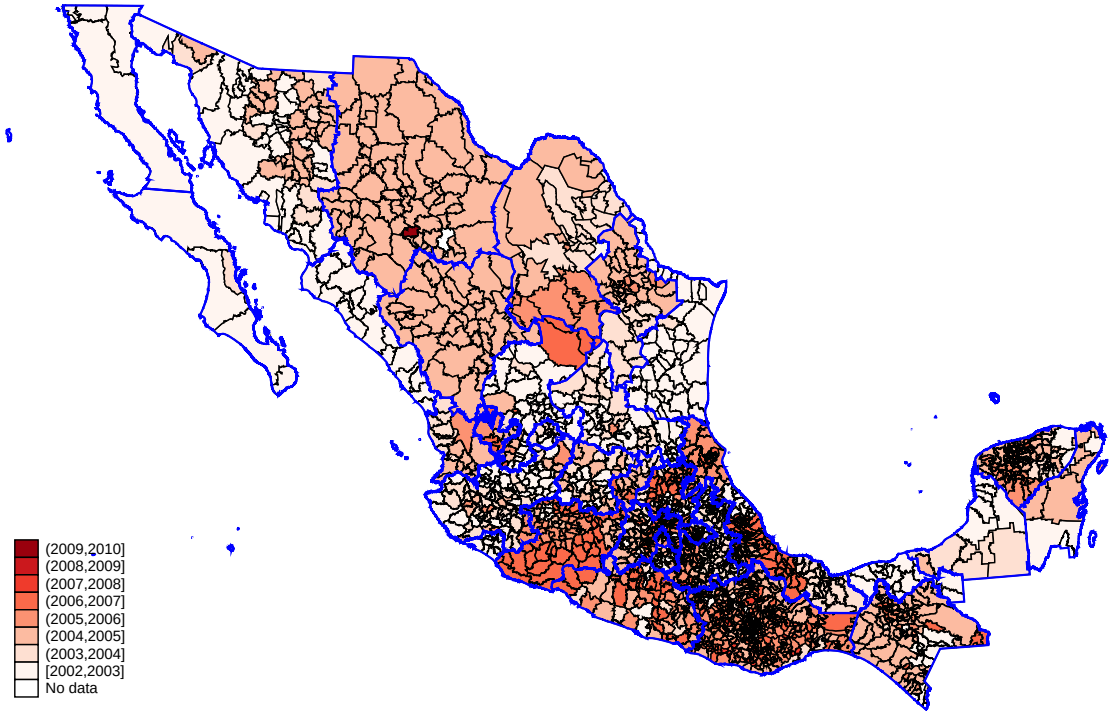
A Additional Figures and Tables

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



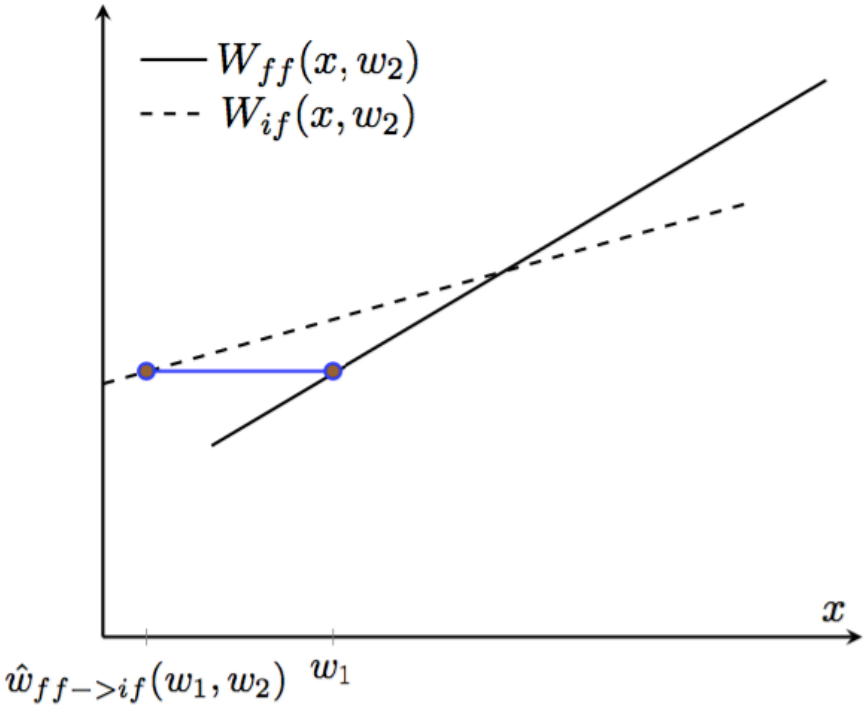
NOTE: The figure shows the ratio of public expenditure on health to GDP, overall and by SP eligibility group. The total public expenditure on health is the sum of the public expenditure for the insured population (not eligible to SP), i.e. those affiliated with IMSS, ISSSTE and PEMEX, and for the uninsured 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: Year of implementation of SP by municipality.



NOTE: Own calculations from the *Padron*.

Figure A.3: Two Value Functions and the Reservation Wage



NOTE: The graph displays the value functions for the case in which both spouses initially work in the formal sector.

Table A.1: Expenditures in Health and Health Insurance.

	High Education		**Low Education**	
	Before 2002	After 2008	Before 2002	After 2008
Households without children 0-14	1,678	4,124	1,809	2,640
Health Insurance (HI) Expenditure	27.83	106.56	9.37	19.41
Health Expenditure	906.30	1067.98	561.87	402.98
Proportion without Expenditures on HI	0.99	0.97	0.99	0.99
Proportion without Expenditures on Health	0.46	0.42	0.47	0.47
Ratio (Expenditures HI/Total Expenditures)	0.00	0.00	0.00	0.00
Ratio (Expenditures Health/Total Expenditures)	0.02	0.02	0.03	0.02
Total Expenditures	38130.11	33166.34	16297.85	15622.73
Households with children 0-14	4,634	9,121	5,256	6,433
Health Insurance (HI) Expenditure	20.62	74.19	1.29	7.32
Health Expenditure	879.05	855.96	485.45	437.10
Proportion without Expenditures on HI	0.99	0.99	1.00	0.99
Proportion without Expenditures on Health	0.37	0.37	0.42	0.44
Ratio (Expenditures HI/Total Expenditures)	0.00	0.00	0.00	0.00
Ratio (Expenditures Health/Total Expenditures)	0.02	0.02	0.03	0.02
Total Expenditures	30769.35	28473.93	15806.98	16745.68

NOTE: The table is constructed using data from the Household Income and Expenditure Survey (*Encuesta Nacional de Ingresos y Gastos de los Hogares*) for the years of 2002 (before SP) and 2008 (post SP). This survey is available biannually. A household belongs to the "high education" group if the head has more than six years of education. All monetary values are deflated to the first quarter of 2011 using the CPI of Banco de Mexico.

Table A.2: Reduced Form Estimates: Impact of SP on stocks of households.

	(1) m_{ff}	(2) m_{fi}	(3) m_{fn}	(4) m_{if}	(5) m_{nf}	(6) m_{ii}	(7) m_{in}	(8) m_{ni}	(9) m_{nn}
Panel A: Low Education - With Children									
SP	-0.007	-0.009	-0.009	0.003	-0.001	0.009	0.010	-0.003	0.008
	(0.004)	(0.005)	(0.009)	(0.003)	(0.001)	(0.009)	(0.012)	(0.003)	(0.006)
Mean in 2001	.027	.049	.237	.028	.003	.099	.502	.013	.043
N	13036	13036	13036	13036	13036	13036	13036	13036	13036
Panel B: Low Education - Without Children									
SP	0.000	-0.004	-0.007	0.001	0.003	-0.005	0.019	-0.003	-0.005
	(0.005)	(0.007)	(0.012)	(0.006)	(0.003)	(0.010)	(0.017)	(0.005)	(0.010)
Mean in 2001	.034	.047	.211	.029	.005	.103	.447	.023	.102
N	9780	9780	9780	9780	9780	9780	9780	9780	9780
Panel C: High Education - With Children									
SP	0.003	-0.002	0.001	0.001	-0.000	0.004	-0.005	-0.004	0.003
	(0.006)	(0.006)	(0.011)	(0.005)	(0.002)	(0.007)	(0.011)	(0.002)	(0.004)
Mean in 2001	.103	.063	.375	.040	.007	.066	.317	.007	.026
N	13698	13698	13698	13698	13698	13698	13698	13698	13698
Panel D: High Education - Without Children									
SP	0.010	-0.004	-0.005	0.002	0.000	-0.004	0.002	-0.001	-0.000
	(0.013)	(0.011)	(0.018)	(0.008)	(0.004)	(0.011)	(0.016)	(0.005)	(0.011)
Mean in 2001	.136	.069	.309	.063	.014	.079	.233	.012	.086
N	8365	8365	8365	8365	8365	8365	8365	8365	8365

NOTE: OLS estimates obtained using the ENE/ENEO data aggregated at the municipality-quarter level. Estimates are weighted by the population of the municipality in 2000. Controls excluded from table are: 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); municipality of residence fixed effects, quarter fixed effects, and a linear trend in the characteristics of the municipality of residence taken in 2000 (indicator for large city, index of deprivation, log of total population, number of hospitals and health centers in 2001, total number of doctors and nurses in hospitals per 1,000 uninsured individuals in 2001). The pre-SP mean is measured in 2001. Standard errors clustered by municipality.

Table A.3: Reduced Form Estimates: Sensitivity to functional form.

	(1) State Trends	(2) Reduced set of controls
Panel A: Informality among low educated with children		
SP	0.024	0.023
	(0.011)	(0.010)
Panel B: Salary of Head among high educated without children		
SP	0.043	0.051
	(0.027)	(0.025)

NOTE: OLS estimates obtained using the ENE/ENEO data aggregated at the municipality-quarter level. Estimates are weighted by the population of the municipality in 2000. Controls excluded from table are: 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); municipality of residence fixed effects, quarter fixed effects, and a linear trend in the characteristics of the municipality of residence taken in 2000 (indicator for large city, index of deprivation, log of total population, number of hospitals and health centers in 2001, total number of doctors and nurses in hospitals per 1,000 uninsured individuals in 2001). The pre-SP mean is measured in 2001. Standard errors clustered by municipality.

Table A.4: Model Estimates: Wage Offer Parameters and Mean

	(1)	(2)
Education	Low	High
α_f	0.857	1.026
	(0.455)	(0.270)
β_f	6.576	2.917
	(1.503)	(0.538)
α_i	0.966	0.197
	(0.267)	(0.093)
β_i	7.802	2.384
	(1.302)	(0.468)
Head:		
$E_{F^f}(w)$	9.066	9.491
$E_{F^i}(w)$	8.817	8.656
Spouse:		
$E_{F^f}(w)$	8.961	9.371
$E_{F^i}(w)$	8.613	8.402

NOTE: All parameters estimates presented in the table are obtained using data from the period before the introduction of SP. We define high education as households where the head has at least primary education. Sample of households with children 0-14. $E_{F^f}(\log(w))$ ($E_{F^i}(\log(w))$) is the mean of log wage offer in the formal (informal) sector. The bootstrap standard errors in parenthesis are computed from 100 replications.

Table A.5: Counterfactual Experiments: Effects of changing the utility value of having HI outside the formal sector (γ) on transitions.

	(1)	(2)	(3)
	Partial Eq.	General Eq.	General Eq. (revenue neutral)
Transitions: Head (p.p.)			
Nonemployment-Formal	2.452	2.618	0.178
Nonemployment-Informal	4.047	1.304	3.776
Formal-Nonemployment	0.309	0.252	0.616
Formal-Informal	0.141	0.649	0.625
Informal-Nonemployment	0.308	-0.440	0.004
Informal-Formal	0.020	-0.600	-0.216
Nonemp.-Inf., if spouse loses formal job	0.155	-0.667	-0.267
Nonemp.-Inf., if spouse loses informal job	3.448	4.520	3.709
Transitions: Spouse (p.p.)			
Nonemployment-Formal	0.335	0.149	-0.129
Nonemployment-Informal	-0.149	0.067	0.418
Formal-Nonemployment	-1.753	0.038	0.471
Formal-Informal	0.870	0.714	0.294
Informal-Nonemployment	-0.968	3.455	1.022
Informal-Formal	-1.233	-0.846	-0.805
Nonemp.-Inf., if head loses formal job	-0.088	0.085	0.107
Nonemp.-Inf., if head loses informal job	0.238	-0.011	0.146

NOTE: We simulate the model using the estimate of γ reported in Table 6. The table shows changes in relation to benchmark levels (pre-SP period, where γ is set to 0). The General Equilibrium (column 2) is computed allowing endogenous wages implied by the wage posting structure as explained in section 4.3. Column 3 considers that the Seguro Popular program is financed out of dividends, paid equally by all workers in every period.

Table A.6: Counterfactual Experiments: Effects of changing the utility value of having HI outside the formal sector (γ) on firm profit per worker and size.

	(1)	(2)	(3)
	Partial Eq.	General Eq.	General Eq. (revenue neutral)
Profit per worker - head (%)			
Formal sector	1.008	-5.207	1.758
Informal sector	1.469	3.416	4.395
Profit per worker - spouse (%)			
Formal sector	160.497	46.323	153.215
Informal sector	24.070	35.432	34.500
Mean size (%)			
Head: Formal Sector	-8.383	-6.386	-6.035
Head: Informal Sector	6.910	5.728	4.486
Spouse: Formal Sector	-6.096	-6.404	-2.701
Spouse: Informal Sector	-0.146	-1.825	1.314

NOTE: We simulate the model using the estimate of γ reported in Table 6. The table shows changes in relation to benchmark levels (pre-SP period, where γ is set to 0). The General Equilibrium (column 2) is computed allowing endogenous wages implied by the wage posting structure as explained in section 4.3. Column 3 considers that the Seguro Popular program is financed out of dividends, paid equally by all workers in every period.

B Other Value Functions

Spouse 2 works in the formal sector and spouse 1 does not work The value function $W_{nf}(w_2)$ is similar to 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:

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

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

Spouse 2 works in the informal sector and spouse 1 does not work 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:

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

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.

Spouse 1 works in the formal sector and spouse 2 works in the informal sector This is a household with Social Security coverage.

$$
\begin{aligned}
rW_{fi}(w_1,w_2) = {} & \mathtt{u}(w_1+w_2) + a + \delta_f^{s_1}\left(W_{ni}(w_2) - W_{fi}(w_1,w_2)\right) + \\
& \delta_i^{s_2}\left(W_{fn}(w_1) - W_{fi}(w_1,w_2)\right) + \\
& \lambda_{ff}^{s_1}\int \max\left\{W_{fi}(x,w_2) - W_{fi}(w_1,w_2), 0\right\} dF_f^{s_1}(x) + \\
& \lambda_{fi}^{s_1}\int \max\left\{W_{ii}(x,w_2) - W_{fi}(w_1,w_2), 0\right\} dF_i^{s_1}(x) + \\
& \lambda_{ii}^{s_2}\int \max\left\{W_{fi}(w_1,x) - W_{fi}(w_1,w_2), 0\right\} dF_i^{s_2}(x) + \\
& \lambda_{if}^{s_2}\int \max\left\{W_{ff}(w_1,x) - W_{fi}(w_1,w_2), W_{nf}(x) - W_{fi}(w_1,w_2), 0\right\} dF_f^{s_2}(x).
\end{aligned}
$$

Head and spouse may have his/her job destroyed at rate $\delta_f^{s_1}$ and $\delta_i^{s_2}$, respectively. The head receives job offers from the formal or informal sector at rates $\lambda_{ff}^{s_1}$ or $\lambda_{fi}^{s_1}$, respectively; the spouse receives job offers from the informal sector or formal sector at rates $\lambda_{ii}^{s_2}$ or $\lambda_{if}^{s_2}$, respectively.

Spouse 1 works in the informal sector and spouse 2 works in the formal sector The value function for a household where spouse 2 works in the formal sector and spouse 1 works in the informal sector is given by:

$$
\begin{aligned}
rW_{if}(w_1,w_2) = {} & \mathtt{u}(w_1+w_2) + a + \delta_i^{s_1}\left(W_{nf}(w_2) - W_{if}(w_1,w_2)\right) + \\
& \delta_f^{s_2}\left(W_{in}(w_1) - W_{if}(w_1,w_2)\right) + \\
& \lambda_{ii}^{s_1}\int \max\left\{W_{if}(x,w_2) - W_{if}(w_1,w_2), 0\right\} dF_i^{s_1}(x) + \\
& \lambda_{if}^{s_1}\int \max\left\{W_{ff}(x,w_2) - W_{if}(w_1,w_2), W_{fn}(x) - W_{if}(w_1,w_2), 0\right\} dF_f^{s_1}(x) + \\
& \lambda_{ff}^{s_2}\int \max\left\{W_{if}(w_1,x) - W_{if}(w_1,w_2), 0\right\} dF_f^{s_2}(x) + \\
& \lambda_{fi}^{s_2}\int \max\left\{W_{ii}(w_1,x) - W_{if}(w_1,w_2), 0\right\} dF_i^{s_2}(x).
\end{aligned}
$$

C Formal identification arguments under the reservation wages stability assumption

In this section, we show that if we condition on the spouse's job state and wage at a given point in time, we can provide a formal discussion on identification of the model parameters and distributions. Note that heterogeneity of reservation wages for an individual of a given state and wage is still present in the model, however the assumption implies that the reservation wages are stable over the interval of time within which the individual receives a shock, which is crucial for the derivations that will follow.

Sampling distribution of wage offers Conditional on the transition parameters, we can use the equilibrium steady-state relationships between the sampling distributions, $F_j^{s_h}$, and the observed joint earnings distributions, $G_{jj'}$, to estimate the sampling distributions.

The stock of households where spouse 1 is in status j and spouse 2 is in status j' is $m_{jj'}$, $(j, j' = f, i, n)$. We assume that the mass of households is equal to 1, so that the stocks across all types of households add up to 1. $G_{jj'}$ is the joint earnings CDF, and $g_{jj'}$ is the PDF. In steady state, the measure of couples in which 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 individuals are in the formal sector earning up to w_1 (spouse 1) and w_2 (spouse 2) is balanced when the flows in are equal to the flows out; this is given by the following equation:

$$
\begin{aligned}
m_{ff} G_{ff}(w_1, w_2) \left[\delta_f^{s_1} + \delta_f^{s_2} + \lambda_{ff}^{s_1} \overline{F}_f^{s_1}(w_1) + \lambda_{ff}^{s_2} \overline{F}_f^{s_2}(w_2)\right] + \\
\lambda_{fi}^{s_1} m_{ff} \int^{w_2} \int^{w_1} \overline{F}_i^{s_1}(\hat{w}_{ff->if}(x, w_2)) g_{ff}(x, w_2) dx dw_2 + \\
\lambda_{fi}^{s_2} m_{ff} \int^{w_1} \int^{w_2} \overline{F}_i^{s_2}(\hat{w}_{ff->fi}(w_1, x)) g_{ff}(w_1, x) dx dw_1 = \\
\lambda_{nf}^{s_1} m_{nf} \int^{w_2} \max\left(F_f^{s_1}(w_1) - F_f^{s_1}\left(\hat{w}_{nf->ff}(w_2)\right), 0\right) g_{nf}(w_2)\, dw_2 + \\
\lambda_{nf}^{s_2} m_{fn} \int^{w_1} \max\left(F_f^{s_2}(w_2) - F_f^{s_2}\left(\hat{w}_{fn->ff}(w_1)\right), 0\right) g_{fn}(w_1)\, dw_1 + \\
\lambda_{if}^{s_1} m_{if} \int^{w_2} \int^{w_1} \max\left(F_f^{s_1}(w_1) - F_f^{s_1}\left(\hat{w}_{if->ff}(x, w_2)\right), 0\right) g_{if}(x, w_2)\, dx dw_2 + \\
\lambda_{if}^{s_2} m_{fi} \int^{w1} \int^{w_2} \max\left(F_f^{s_2}(w_2) - F_f^{s_2}\left(\hat{w}_{fi->ff}(w_1, x)\right), 0\right) g_{fi}(w_1, x)\, dx dw_1.
\end{aligned}
$$

The outflow from the formal sector (LHS) is given by the job separation to nonemployment, to other jobs paying higher than w_1 (spouse 1) or w_2 (spouse 2) in the formal sector and to other jobs in the informal sector paying above the reservation wages. The inflow in the formal sector (RHS) is given by the job acceptance by the nonemployed and by informal sector workers willing to take the formal sector job offering until w_1 (spouse 1) or w_2 (spouse 2). For ease of exposition, notice we shut down the possibility of endogenous quitting by the spouse that could occur when a nonemployed household member receives an arrival shock from the "superior" (formal) sector.

The balance equation is similar when both spouses are in the informal sector, and it is given by:

$$
\begin{aligned}
m_{ii}G_{ii}(w_1,w_2)\left[\delta_i^{s_1}+\delta_i^{s_2}+\lambda_{ii}^{s_1}\overline{F}_i^{s_1}(w_1)+\lambda_{ii}^{s_2}\overline{F}_i^{s_2}(w_2)\right]+ \\
\lambda_{if}^{s_1}m_{ii}\int^{w2}\int^{w1}\overline{F}_f^{s_1}\left(\hat{w}_{ii->fi}(x,w_2)\right)g_{ii}(x,w_2)dxdw_2+ \\
\lambda_{if}^{s_2}m_{ii}\int^{w1}\int^{w2}\overline{F}_f^{s_2}\left(\hat{w}_{ii->if}(x,w_2)\right)g_{ii}(w_1,x)dxdw_1= \\
\lambda_{ni}^{s_1}m_{ni}\int^{w2}\max\left(F_i^{s_1}(w_1)-F_i^{s_1}(\hat{w}_{ni->ii}(w_2)),0\right)g_{ni}(w_2)dw_2+ \\
\lambda_{ni}^{s_2}m_{in}\int^{w1}\max\left(F_i^{s_2}(w_2)-F_i^{s_2}(\hat{w}_{in->ii}(w_1)),0\right)g_{in}(w_1)dw_1+ \\
\lambda_{fi}^{s_1}m_{fi}\int^{w2}\int^{w1}\max\left(F_i^{s_1}(w_1)-F_i^{s_1}(\hat{w}_{fi->ii}(x,w_2)),0\right)g_{fi}(x,w_2)dxdw_2+ \\
\lambda_{fi}^{s_2}m_{if}\int^{w1}\int^{w2}\max\left(F_i^{s_2}(w_2)-F_i^{s_2}(\hat{w}_{if->ii}(w_1,x)),0\right)g_{if}(w_1,x)dxdw_1.
\end{aligned}
$$

The remaining seven flow equations are available from the authors upon request. The stocks $m_{jj'}$ can be estimated from proportions we observe in the data. We can also estimate the earnings CDF by $\hat{G}_{jj'}(w_1,w_2)=\frac{1}{2N}\sum_{k=1}^{N}\sum_{\mathrm{k'=1}}^{\mathrm{N}}\mathbf{1}(\mathrm{w_{1k}}<\mathrm{w_1})\mathbf{1}(\mathrm{w_{2k'}}<\mathrm{w_2})$, where N is the number of couples in the cross sectional sample. Then we obtain $\hat{g}_{jj'}$ by differentiation of $\hat{G}_{jj'}$.

However, as we notice in all flow equations, $F_j^{s_h}$ is not an obvious function of the earnings distributions such that we cannot implement a nonparametric estimation, for instance, as in (Bontemps, Robin and van den Berg, 2000). Conditional on the Poisson rates and assuming a parametric form for $F_j^{s_h}$, an iterative method for finding the the parameter values of such distributions using the stationary relationships can be implemented.

Transition rates As argued earlier, if reservation wages were stable, i.e. if the state and wage of an individual's spouse is stable over an interval of time, then we could use the following theoretical moments to recover the transition rates.

Given $F_j^{s_h}$, we would estimate the transition rates using minimum distance. We follow the individual from the first interview to the next quarter (second interview), and we obtain a measure for average transition from the data $\hat{D}_{j\ell};\ j,\ell=n,f,i$, which is the probability of transition conditional to status j at the first interview. We assume that remaining durations can be exponentially distributed, and we construct the theoretical counterpart for this measure, $D_{j\ell}$, as follows:

- Transitions to nonemployment:

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

where $d_j^h(w_1)=\delta_j^h+\lambda_{jj}^h\overline{F}_j^{s_h}(w_1)+\lambda_{jk}^h\sum_{j'=n,f,i}\int\overline{F}_k^{s_h}(\hat{w}_{jj'->kj'}(w_1,w_2))\frac{m_{jj'}}{m_j^h}g_{jj'}(w_1,w_2)dw_2$ is the total job separation rate. $h=1,2$ indicates the spouse. $j,k=f,i$ with $j\neq k$, $m_j^1=\sum_{j'=n,f,i}m_{jj'}$ and $m_j^2=\sum_{j'=n,f,i}m_{j'j}$.

- Transitions out-of nonemployment:

$$D^h_{nf} = \frac{\lambda^h_{nf} \sum\limits_{j=n,f,i} \int \overline{F}^{s_h}_f(\hat{w}_{nj->fj}(w_2)) \frac{m_{nj}}{m_n} g_{nj}(w_2) dw_2}{a^h} (1 - e^{-a^h \times 1}),$$

$$D^h_{ni} = \frac{\lambda^h_{ni} \sum\limits_{j=n,f,i} \int \overline{F}^{s_h}_i(\hat{w}_{nj->ij}(w_2)) \frac{m_{nj}}{m_n} g_{nj}(w_2) dw_2}{a^h} (1 - e^{-a^h \times 1}),$$

$$D^h_{ni|h' \, had \, a \, \delta_f \, shock} = \frac{\delta^{h'}_f p^h \int \overline{F}^{s_h}_i(\hat{w}_{nf->in}(w_2)) g_{nf}(w_2) dw_2}{a^h} (1 - e^{-a^h \times 1}),$$

$$D^h_{ni|h' \, had \, a \, \delta_i \, shock} = \frac{\delta^{h'}_i q^h \int \overline{F}^{s_h}_i(\hat{w}_{ni->in}(w_2)) g_{ni}(w_2) dw_2}{a^h} (1 - e^{-a^h \times 1}),$$

where $a^h = \lambda^h_{nf} \sum\limits_{j=n,f,i} \int \overline{F}^{s_h}_f(\hat{w}_{nj->fj}(w_2)) \frac{m_{nj}}{m_n} g_{nj}(w_2) dw_2 + \lambda^h_{ni} \sum\limits_{j=n,f,i} \int \overline{F}^{s_h}_i(\hat{w}_{nj->ij}(w_2)) \frac{m_{nj}}{m_n} g_{nj}(w_2) dw_2 + \delta^{h'}_f p^h \int \overline{F}^{s_h}_i(\hat{w}_{nf->in}(w_2)) g_{nf}(w_2) dw_2 + \delta^{h'}_i q^h \int \overline{F}^{s_h}_i(\hat{w}_{ni->in}(w_2)) g_{ni}(w_2) dw_2$ is the total job acceptance rate for the nonemployed (this holds for the either household member since we are integrating over the distribution of their spouse).

- Job-to-job transitions:

$$D^h_{jj} = \int \frac{\lambda^h_{jj} \overline{F}^{s_h}_j(x)}{d^h_j(x)} (1 - e^{-d^h_j(x) \times 1}) dG^h_j(x), \; j = f, i,$$

$$D^h_{jk} = \int \frac{\lambda^h_{jk} \sum\limits_{j'=n,f,i} \int \overline{F}^{s_h}_k(\hat{w}_{jj'->kj'}(x, w_2)) \frac{m_{jj'}}{m_j} g_{jj'}(x, w_2) dw_2}{d^h_j(x)} (1 - e^{-d^h_j(x) \times 1}) dG^h_j(x), \; j, k = f, i \, \text{and} \, j \neq k$$

This generates a just-identified system of 16 non-linear equations for 16 parameters. The transition rates can be estimated by minimizing the distance between the model and the observed transition probabilities using fixed point iteration.

Preference parameters Even in absence of the stability of reservation wages assumption, we could have imposed some model restrictions that would enable us to pin down all preference parameters.

We could have assumed for instance strong monopsony power for the lowest wage earners in both formal and informal sectors. This would justify at least the following model restrictions: $W_{ni}(\underline{w}^i_2) = W_{nn}$, $W_{in}(\underline{w}^i_1) = W_{ii}(\underline{w}^i_1, \underline{w}^i_2)$, and $W_{in}(\underline{w}^i_1) = W_{fn}(\underline{w}^f_1)$, with which we obtain b_1, b_2, a and γ, respectively. Assume linear utility ($\theta = 0$), so that the calculations are more transparent. Conditional on the transition parameters and wage offers distributions we could estimate a, b_1 and b_2 under the restriction $\gamma = 0$, i.e using data before SP:

$$\hat{b}_1 = rW_{nn} - \underline{w}^i_2 - A$$

$$\hat{b}_2 = rW_{ii}(\underline{w}^i_1, \underline{w}^i_2) - \underline{w}^i_1 - B$$

$$\hat{a} = rW_{in}(\underline{w}^i_1) - b_2 - \underline{w}^f_1 - C$$

where

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

$$
\begin{aligned}
B = {} & \delta_i^{s_1} (1 - q^{s_2}) \left(W_{nn} - W_{in}(\underline{w}_1)\right) + \\
& \delta_i^{s_1} q^{s_2} \int \max\left\{W_{ni}(x) - W_{in}(\underline{w}_1), W_{nn} - W_{in}(\underline{w}_1)\right\} dF_i^{s_2}(x) + \\
& \lambda_{ii}^{s_1} \int \max\left\{W_{in}(x) - W_{in}(\underline{w}_1), 0\right\} dF_i^{s_1}(x) + \\
& \lambda_{if}^{s_1} \int \max\left\{W_{fn}(x) - W_{in}(\underline{w}_1), 0\right\} dF_f^{s_1}(x) + \\
& \lambda_{nf}^{s_2} \int \max\left\{W_{if}(\underline{w}_1, x) - W_{in}(\underline{w}_1), W_{nf}(x) - W_{in}(\underline{w}_1), 0\right\} dF_f^{s_2}(x) + \\
& \lambda_{ni}^{s_2} \int \max\left\{W_{ii}(\underline{w}_1, x) - W_{in}(\underline{w}_1), 0\right\} dF_i^{s_2}(x)
\end{aligned}
$$

$$
\begin{aligned}
C = {} & \delta_f^{s_1} (1 - p^{s_2}) \left(W_{nn} - W_{fn}(\underline{w}_1)\right) + \\
& \delta_f^{s_1} p^{s_2} \int \max\left\{W_{ni}(x) - W_{fn}(\underline{w}_1), W_{nn} - W_{fn}(\underline{w}_1)\right\} dF_i^{s_2}(x) + \\
& \lambda_{ff}^{s_1} \int \max\left\{W_{fn}(x) - W_{fn}(\underline{w}_1), 0\right\} dF_f^{s_1}(x) + \\
& \lambda_{fi}^{s_1} \int \max\left\{W_{in}(x) - W_{fn}(\underline{w}_1), 0\right\} dF_i^{s_1}(x) + \\
& \lambda_{nf}^{s_2} \int \max\left\{W_{ff}(\underline{w}_1, x) - W_{fn}(\underline{w}_1), W_{nf}(x) - W_{fn}(\underline{w}_1), 0\right\} dF_f^{s_2}(x) + \\
& \lambda_{ni}^{s_2} \int \max\left\{W_{fi}(\underline{w}_1, x) - W_{fn}(\underline{w}_1), 0\right\} dF_i^{s_2}(x)
\end{aligned}
$$

Given $\hat{a}$, $\hat{b}_1$ and $\hat{b}_2$ estimated using data before SP, γ can be obtained using data from a period after the SP implementation, and using the same restriction as the that used to calculate a:

$$\gamma = rW_{fn}(\underline{w}_1^f) - \hat{b}_2 - \underline{w}_1^i - B$$

Productivity distributions The distributions of firm productivities can be identified based on the restrictions from profit-maximization (see (2), (4)). Here, we do not need to impose the assumption on stability of reservation wages.

Given the distributions of wage offers $F_j^{s_h}$ ($j = f, i$ and $h = 1, 2$) and the transition parameters, we can recover the uniquely associated productivity distributions $\Gamma_j^{s_h}$ if we have strict monotonicity of $K_{j,s_h}(p)$.

We derive the support of the productivity distributions using the first-order conditions of the firm's optimization problem. We then check whether the second-order condition is satisfied which is equivalent to $K'_{j,s_h}(p) > 0$. For each spouse ($h = 1, 2$) and sector ($j = f, i$), we estimate the productivity support using

$$K_{f,s_h}^{-1}(w) = (1+\tau)\left[w + \frac{\ell_f^{s_h}(w)}{\ell'_f{}^{s_h}(w)}\right]$$

$$K_{i,s_h}^{-1}(w) = \left[w + \frac{\ell_i^{s_h}(w)}{\ell'_i{}^{s_h}(w)}\right]$$

where $\ell_f^{s_h}(w)$ is the labor force size in the formal sector (equation (3)) with first derivative $\ell'_f{}^{s_h}(w)$. $\ell_i^{s_h}(w)$ and $\ell'_i{}^{s_h}(w)$ are analogously obtained for the informal sector.[28]

For each point of the wage grid, w, we can calculate a corresponding point on the productivity grid $p = K_{f,s_h}^{-1}(w)$.

[28] We are aware that using a simulation procedure to obtain the g distributions and thus calculate the labor supply functions does not guarantee that such functions are differentiable. An alternative procedure to solve the firm productivities without relying on differentiability of the labor supply functions is to use the envelope theorem and solve through a fixed point algorithm.

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

D.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.

D.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).

D.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.