The Impact of Chile's 2008 Pension Reform on Labor Force Participation, Pension Savings, and Gender Equity

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1 Summary

In an individual-account based system and in the absence of state-provided non-contributory pensions, women can be particularly vulnerable to old-age poverty. This is due to their lower wages, interrupted careers, typically younger retirement ages and longer life spans. Reducing the pension gender gap was a significant objective of the 2008 pension reform of the Chilean Pension System, which significantly changed features of the existing contributory pension system.

The main objective of this study is to examine whether the reforms to the pension system promoted gender equity and also whether the insurance features of the new pension system, designed to guard against low pension accumulations, will generate unintended behavioral responses by altering incentives to work and save. These responses are captured by a dynamic model of labor supply and saving decisions estimated on longitudinal data from the *Encuesta de Proteccion Social* of the Microdata Center from the University of Chile and administrative data from the Superintendencia de Pensiones. The behavioral model takes into account dimensions of individual heterogeneity which allow us to capture distributional aspects of the impact of the reform.

We document that the fit of the model to the data is reasonable and use the model to simulate the differential, 5-year ahead impact of the reform on women's pension levels relative to men's, labor supply, poverty levels, contribution densities, participation in the formal sector and age of effective retirement.

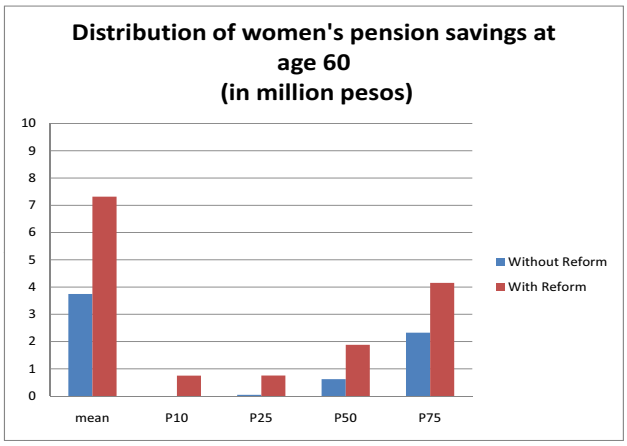
According to our simulations, the reform will dramatically improve pension saving levels for women (see figure 1), bridging a sizeable part of the gap between male and female pension benefits (see figure 2), and reduce poverty levels at older ages (see figure 3). This results from the very large coverage[1] and high level[2] of the basic solidarity pension ("Pension Basica Solidaria", or PBS) implemented by the reform.

We anticipate some negative behavioral responses in the form of lower labor force par-

[1]Households among the 60% poorest are eligible in the last phase of the reform's implementation

[2]more than 50% higher than the poverty line used in this report.

Figure 1: Predicted women pension saving levels, 5 years after the reform



ticipation at older ages and lower participation in the covered sector, resulting in lower contribution densities. In our simulations, attempts to make the reform more incentive-compatible by tapering-off non-contributory benefits do not offset income effects resulting from higher benefit levels. As retirement nears, incentives to contribute to the pension system are lower than before the reform due to higher expected income in retirement. This tends to reduce participation in the labor market, particularly in the covered sector and for women, relative to before the reform. These predictions are qualitatively consistent with the available post-reform (2009) data but the magnitude of these effects remains to be validated with more recent data that can capture the full impact of the reform.

The report develops as follows. Section 2 describes the Chilean Pension System, focusing on aspects that are relevant to gender equity. Section 3 provides an overview of the methodology which is then detailed in sections 4 to 9. Section 10 discusses model fit, section 11 reports model simulations with and without the reform and section 12 concludes.

Figure 2: Predicted ratio between male and female average pension benefits, 5 years after the reform

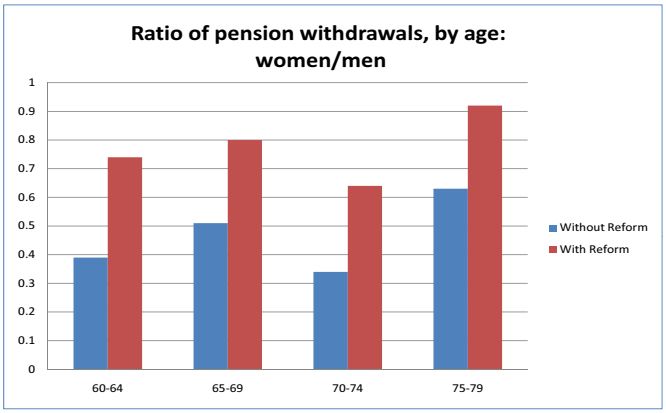
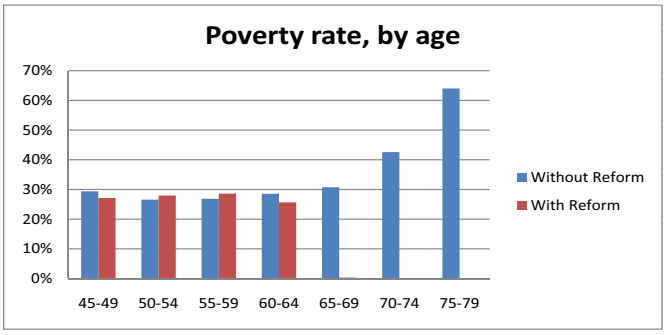


Figure 3: Predicted fraction of sampled households with annual income below 500,000 pesos, 5 years after the reform



2 Introduction

Many pay-as-you-go social security systems in the United States and Europe face impending insolvency as the number of pensioners per worker rises and are therefore in need of reform. The kinds of reforms being considered include, for example, increasing the required contribution per worker, raising the standard retirement age, or completely overhauling the pension system by transiting to a private accounts system. Chile has been at the forefront of pension reforms, having switched to a private retirement accounts system in 1980. The plans proposed in US and in Europe are in many ways similar to Chile's current pension system. They outline a system in which all workers are mandated to contribute part of their income to a pension account that is managed by a money manager, either a government owned company or a private firm. Under the proposed plans and also under the current Chilean system, the government serves as a last resort guarantor, supplementing pension income if pension accumulations are insufficient, either due to low income or unfavorable investment returns.

The Chilean pension fund system, known as the *Administradoras de Fondos de Pensiones* or *AFP* system, has already served as a model for pension reform in several Latin American countries (for example, Mexico, Peru, and Uruguay). When it was introduced in 1980, the AFP system replaced a heterogeneous pay-as-you-go system composed of many different institutions (called "Cajas de Prevision") that covered different professions and subsets of the population. At its inception, individuals participating in the old pension system were given the option to transfer to the new system based on individual capitalization or to remain in the pay-as-you-go system, which was partially standardized and renamed INP.[3] To encourage transfers, workers who opted for the new system received a 12.6% increase in net income (which corresponds to the new contribution rate plus commissions or fees) and the benefits they had accrued under the old system were recognized through the issuing of a "recognition bond," payable upon retirement. Labor force entrants after 1980 were required

[3] *Instituto de Normalizacion Previsional*

to affiliate to the new system.[4]

The AFP Pension system is a savings program based on defined-contribution individual accounts. The program is mandatory for salaried workers and voluntary for self-employed workers. Affiliated workers pay a 10% contribution of their monthly wages into a tax-deferred pension account, which is for the most part inaccessible until retirement.[5]. The restrictions on withdrawal of funds are more stringent in Chile than they are for US 401K plans. In addition to this mandatory contribution, workers must pay a contribution of 7% for health services, 0.8% for a disability and survivorship insurance, and an average of 2.6% to the pension fund manager as a commission or fee.[6]

A pension system affiliate can choose to invest his/her pension funds in one of a number of pension fund administrators (the AFP firms) who manage the savings and invest them in the financial markets. [7] Initially, AFPs were required to invest all of the funds in government bonds, but investment restrictions have been relaxed and they now offer a broad array of investment choices, including foreign assets and stocks.[8]

Workers can access their pension savings at 65 years old for men and 60 years old for women. They have three withdrawal options: Programmed Withdrawals (Retiro Programado), purchase an annuity from an insurance company (Renta Vitalicia), or a mix of phased withdrawals for a period of time and a deferred lifetime annuity. The law also allows for early retirement, provided that the worker has pension funds sufficient to generate a pension amount equal to or greater than 110% of the minimum pension guaranteed by the State.[9]

The state provided retirement income transfers through two mechanisms. First, a welfare

[4]Government and military workers are exempted and have separate pension systems.

[5]The contributions are capped at 66 UFs. UFs or Unidades de Fomento are indexed on inflation. The value of the UF as of December 2004 was $17,317 pesos (US$31)

[6]The commissions charged differ by fund manager.

[7]The number of AFPs has changed over the years, reaching a high of 32 in 1997 and a low of 5 in 2008.

[8]Since 2002, each AFP must offer 5 portfolio options, called multifunds, to their affiliates. The funds are labeled A to E with an increasing weight on fixed-income assets. By default, older workers are assigned to a more conservative portfolio (D or E).

[9]The pension must also be equal to or greater than 50% of the average taxable income for the last 10 working years

or assistance pension (known as *pension asistencial* or *PASIS*), equal a little less than a third of the minimum wage[10] was made available for program applicants above 65 years of age, irrespective of their contribution history, provided that their earnings and their household's per capita earnings were both below that level. [11] The second transfer was a minimum pension guarantee (MPG) equal to about twice the PASIS pension; individuals with more than 20 years of contribution received the MPG if their accumulated contributions could not finance a higher pension. Both of these benefits took the form of a top-up, that is, the benefit was equal to the difference between the guaranteed level and the pension financed by the worker's account.

In 2008, the Chilean pension system underwent significant reforms aimed at alleviating old age poverty and reducing observed gender gaps in pension accumulations. Arenas de Mesa and Montecinos (1999) argue that the direct link between lifetime earnings and pensions in the AFP system largely accounts for the lower average pensions for women, who tend to retire at earlier ages, participate less often in the labor-force and earn lower salaries. James et al. (2003) note that the new system ameliorates the gender disparity in self-financed pensions through state-financed minimum pension benefits, which are targeted toward low earners and thus often benefit women. More recently, an analysis of pension contribution histories at the micro level under the pre-2008 system (e.g. Arenas de Mesa et. al. (2007)) showed that most individuals are expected to have low pension accumulations upon retirement.[12] The situation is especially troublesome for women, for whom only 37% were projected to have a pension above the MPG level, in comparison with 67% for men. Moreover, very few women are projected to reach the 20 years of contributions necessary to qualify for the minimum pension guarantee. The average projected replacement rate for women under the pre-reform pension system was 28% of the last wage in comparison to 51% for men.

[10] In August 2007, the minimum wage was 159,000 pesos per month, while the PASIS was 44,186 pesos for retirees between 65 and 70 years of age, 47,103 pesos between 70 and 75 and 51,503 pesos if older than 75

[11] The PASIS pensions were allocated at the regional level based on an index of economic vulnerability, called "ficha CAS".

[12] The micro-level data on pension contribution histories were obtained from a database of the *Superintendency of Pensions* or SP.

An analysis of employment histories indicates that an important factor underlying the gender gap in projected pension levels is that labor force participation is lower and more sporadic among women. A statistic that is sometimes used as a measure of pension program participation is the so-called *density of contributions*, which is the number of years the individual makes pension contributions divided by the number of potential working-age years. The density of contribution for women is 41% in comparison with 61% for men. In addition to lower participation levels, lower wages, earlier retirement ages and projected longer life spans, which affect annuity pay-outs, all serve to reduce the level of women's pensions relative to men's.

Reducing the pension gender gap was a significant objective of the 2008 pension reform. The reform replaced the PASIS pension and the minimum pension guarantee (MPG) with a so-called "New Solidarity Pillar" that augments pension levels of workers with relatively few years of contributions, among which women are over-represented. The new safety net implements a means-tested welfare pension, which will eventually guarantee to all individuals in the 60% least affluent households in the population a pension of 75,000 pesos per month called the Basic Solidarity Pension or PBS.[13] The PBS represents an increase of nearly 50% with respect to the former PASIS pension. In addition to providing for a minimum pension level, the new system augments low contributory pensions through the Solidarity Pension Supplement or APS.[14] The APS benefit corresponds to a fraction of the PBS which is gradually reduced for workers with relatively larger contributory pensions according to the formula:[15]

$$APS = PBS * (1 - \frac{Contributory\ Pension}{Maximum\ Supplemented\ Pension})$$

[13] *Pension Basica Solidaria*. This feature of the reform will be introduced gradually over July 2008-July 2011. The level of the PBS was initially 60,000 pesos and reached 75,000 pesos in July 2009. The coverage of the MPG was started at 40% with eligibility being based on an existing poverty index, the Social Protection Index (*Ficha de Proteccion Social)*. Coverage is expected to reach 60% in July 2011 and eligibility will be based on the household's income from September 2009 onwards.

[14] *Aporte Previsional Solidario*

[15] The Maximum Supplemented Pension (PMAS or *Pension Maxima con Aporte Solidario*) was gradually increased through the phased implementation from 70,000 pesos per month to 255,000 pesos per month in July 2011

In effect, this means that the APS tapers off at a rate which will reach 0.3 in July 2011. For example, a worker who can finance a pension of 100,000 pesos per month with the funds accumulated in her individual account will receive a supplement equal to $75,000 - (100,000 * 0.3) = 45,000$. His/her total pension will then be 145,000 pesos per month.[16]

Another important aspect of the 2008 pension reform with regard to gender equity is the introduction of a pension subsidy for mothers that depends on their number of children. This feature of the reform seeks to recognize and compensate for interruptions in contribution histories due to pregnancy and infant care. The subsidy will retroactively take into account children who were born even before the reform. When the woman turns 65, the state will augment her pension savings with a benefit equal to a year and a half of pension contributions at the minimum wage (the benefit amounted to about 280,000 pesos in 2008), plus interests accrued since the birth of the child, minus commissions paid to the pension fund administrator.

A third feature of the pension reform is a change in the rules for dividing pension balances in the case of divorce or annulment. Before the reform, an individual would lose access to their spouse's pension upon divorce.[17] A judge can now rule that up to 50% of one of the spouse's pension balance be transferred to the other spouse's account after a divorce or annulment as a form of alimony.

A fourth feature of the pension reform is a change in the premium for disability and survivorship benefits. Prior to 2008, women and men both paid about 1% of their wages towards disability and survivorship benefits. This was deemed unfair to women, because they live longer and are less likely to become invalid and should arguably pay a lower premium. Starting in July of 2009, both men and women pay contributions that correspond to men's premium level, but the difference in premiums is added to a woman's pension account.

Lastly, the pension reform made it possible for someone who is not working (for example

[16]Before the reform, eligible workers effectively faced an implicit marginal tax rate of 100% on contributions over some range, in that additional contributions would not increase the level of pension upon retirement. The new system ensures that an additional contribution always increase the level of the retirement pension, and it maintains a constant implicit marginal tax rate of about 37% on additional contributions.

[17]However, divorce only became legal in Chile in 2004.

a stay-at-home mother) to make pension contributions. The status of "voluntary affiliate" was created in October 2008, allowing individuals without an employer and not registered as self-employed to make contributions. Those can be deducted from the taxable income of a third party who can contribute towards the voluntary affiliate's account. In addition, the amount contributed is not determined by the law, since there is no base wage on which to apply a 10% rate. These provisions are expected to create incentives, for example, for a husband to transfer income to his wife by paying contributions towards her pension account during times when she is not working.

3 Overview of the methodology

This study develops and estimates a dynamic structural model to examine the effects of the 2008 pension reform in Chile on labor supply, private savings, pension accumulations, and early retirement behavior of women and men five years after the reform (in 2014). In the model, households, which can be either singles or couples, make choices over their lifetime with regard to labor supply, private savings and retirement in an environment with uncertainty about future wages, asset returns on pension savings, fertility, future divorce or widowhood and own survival. Men and women also have the choice about whether to work in the formal sector where pension contributions are mandatory, in the informal sector or of not working.

We use the estimated dynamic behavioral model to study how labor supply and savings behavior changes with the introduction of the 2008 pension reform in comparison with the previous pension system rules. Specifically, we estimate the model parameters by the method of simulated moments using pre-reform data from the 2004 and 2006 EPS Surveys.[18] We use the estimated model to forecast behavior in 2004 and 2006 (within sample) and in 2009 and 2014 (out-of-sample). The simulations for the year 2009 are then compared to the post-reform data of 2009. Our model describes the behavior of both men and women, but our analysis focuses on how the reform affects women's pension accumulations and labor supply

[18]See below for more detailed description of the data sources

behavior relative to men's.

We analyze how the changes in the pension system affect the following primary indicators of interest:

- level (average and distribution) of women's and men's pensions upon retirement
- contribution densities for men and women at different ages
- the coverage rate (or fraction of employed workers who make contributions) of men and women at different ages
- pension savings accumulation of men and women at different ages
- the fraction of men and women participating in the labor force and in the covered sector at different ages
- how working decisions vary with number of children
- the ages of retirement
- private savings levels of the couple

These indicators are projected out to year 2014 to analyze the medium-term (five year) impacts of the reform.

4 Aspects of the reform that are examined

Our evaluation of the 2008 pension reform focuses on the features of the reform that are most likely to produce large impacts on the disparity in pension levels between men and women. We introduce the following key features of the reform into the model:
(i) The New Solidarity Pillar. The NSP is most beneficial to workers with low pension savings accumulations who would not otherwise contribute long enough to qualify for the MPG. Before the 2008 reform, these workers would be likely to rely solely on the PASIS or on a meagre self-financed pension for consumption in old age. Women find themselves

disproportionately in that situation, as they are much more likely to interrupt their careers to have children and contribute to their accounts less then 20 years. Under the NSP, they instead will receive at least the PBS, which is already about 50% more generous than PASIS, possibly augmented based on the level of their self-financed pension. Thus, though that aspect of the reform isn't solely targeted towards women, it is likely to benefit more women than men and improve gender equity. We also examine whether the state financed minimum pension benefits induce disincentive effects on women's labor supply or incentives to work in the informal rather than formal sector.

(ii) The bonus per child. This bonus is intended to fill those gaps in a woman's contribution history that are due to pregnancy and infant care. As the bonus is only provided to women, it is expected to affect gender gaps in pensions. The bonus is not targeted to women who actually incurred long career interruptions upon giving birth, and thus does not directly encourage women to stop working in order to receive the benefit. Still, the bonus could have disincentive effects on women's labor supply either through a wealth effect (the benefit increases pension savings, so the household doesn't need to work and save as much) or by encouraging greater fertility which in turn could lead to more career interruptions.

(iii) The possible allocation of up to 50% of the husband's pension savings to his wife upon divorce.

Two aspects of the reform that speak to gender equity cannot be evaluated given our methodology. The first is the change in the premium paid by women per the Survivorship and Disability insurance, since the model does not incorporate health status (other than death). The second is the ability to make voluntary contributions. Under the current system, the percentage of the population making voluntary contributions to their pension account above the mandatory 10% level is very small. Given the additional complexity required and given the relative infrequency of voluntary contributions in the data, we did not incorporate this aspect into the model. The model does, however, incorporate decisions about private savings, but not the decision of whether to place the private savings into a tax-deferred pension account.

5 Previous literature

Thus far, there has been only one study of the short term effects of the 2008 Chilean pension reform by Jere R. Behrman, Maria Cecilia Calderon, Olivia S. Mitchell, Javiera Vasquez, and David Bravo (2011). They analyze the effects of the PBS (Basic Solidary Pension) aspect of the reform on household income as well as on outcomes related to household work, health status, expenditures on alcohol and cigarettes, health insurance and ownership of consumer durables. Their main estimation strategy uses a difference-in-difference approach that compares the change in income/outcomes over time for treated families that qualify for the PBS (by virtue of being poor and having a family member age 65+) and households that are poor but otherwise do not qualify. The pre-treatment year is 2006, two years before the reform, and the post-treatment year is 2009, one year after the reform. Behrman et. al.s (2011) study finds that PBS targeted households received an increase of 2.4% more in household annual income relative to non-targeted households, with little evidence of crowding out of private transfers. In addition, targeted households report higher expenditures on health care, report more leisure hours and have improved self-reported health, indicative of positive effects of the program on welfare.

The Behrman et. al. (2011) analysis does not explicitly model the mechanisms through which the PBS or the APS (Aporte Previsional Solidario) influence outcomes and therefore does not provide a framework for doing long-term program impact predictions nor for studying the effects of programs that differ significantly from the one that was actually implemented. The analysis also does not incorporate possible interaction effects the PBS and APS programs, which is one of the aims of this study. Nevertheless, the Behrman et. al. (2011) study is the first to analyze the short-term effects of the reform. Although the estimated effects are modest and statistically significantly different from zero only for a few of the outcomes analyzed, they appear to be positive.

Lastly, an implicit assumption of the difference-in-difference approach is that households who do not qualify for the program at a point in time can be considered untreated. In a

dynamic setting, however, this assumption could be problematic. With forward-looking behavior, even households who do not qualify for a program but anticipate that they will qualify at some future time period may change their behavior and might therefore be considered as being affected by the reform, regardless of whether they are actively receiving benefits. The dynamic framework used in this study explicitly incorporates such anticipatory effects.

6 Description of the Model

The dynamic behavioral model that we develop and estimate describes how households make decisions with regard to work and savings. A household may consist of either a couple or a single individual. In each period, couples face an exogenous probability of separation (further described below) or of one member of the couple dying, in which case the couples' problem changes to that of a single-headed household.

6.1 Timing and Initial conditions

The superscript $j \in \{m, f\}$ denotes gender, and the superscript 2 denotes a couple.[19] Periods in the singles' problem are indexed by the individual's age ($t = a_t^j$), while the couples' problem is indexed by the age of the female ($t = a_t^f$). For singles, the decision problem begins at ages $t_0^m = t_0^f = 35$.[20] For couples, the decision problem begins when the wife turns t_0^f. Thus, the age of the husband in the first period, $a_{t_0}^m$ is part of the initial conditions. Any household assets (A_{t_0}), work experience ($X_{t_0}^m, X_{t_0}^f$) accumulated prior to the first model period, as well as any children born prior to female age 35 (N_{t_0}) are also taken as initial conditions. The initial conditions also include pension savings ($B_{t_0}^m, B_{t_0}^f$), pension rights accumulated by the two spouses under the earlier INP retirement system prior to age $a_{t_0}^j$ ("Bonos de reconocimiento") or under the new AFP system. Finally, the initial conditions include two permanent characteristics: completed schooling levels of men and women (e^j),

[19] We use the terms husband and wife, but the model could apply to non-married couples

[20] Singles at age 35 are assumed to remain single. Married couples are able to transition to being divorced or widowed, as further described below. We estimate the model for singles on people who remain single after age t_0^j.

and birth cohorts (bc^j).

We denote the set of initial conditions for a couple by $\Omega^2_{t_0}$ and for a single household by $\Omega^j_{t_0}$:

$$\Omega^2_{t_0} = \{a^m_{t_0}, A_{t_0}, B^m_{t_0}, B^f_{t_0}, X^m_{t_0}, X^f_{t_0}, N_{t_0}; e^m, e^f, bc^m, bc^f\}$$

$$\Omega^j_{t_0} = \{A^j_{t_0}, B^j_{t_0}, X^j_{t_0}, N_{t_0}; e^j, bc^j\}$$

6.2 Decisions

In each period such that $a^m_t < t_R$ and $a^f_t < t_R$, a two-person household makes a saving decision for the household (s_t), a labor force participation decision for each individual (d^m_t, d^f_t) and a part-time work decision for the woman (p^f_t). The income that is not saved is split evenly into the two spouses' consumptions c^m_t, c^f_t. s_t is the fraction of income that is saved and not consumed in period t. The three employment options available to both men and women are to work in the covered sector ($d^j_t = 1$), to work in the uncovered sector ($d^j_t = 2$), or to stay home ($d^j_t = 3$) for $j \in \{m, f\}$. In addition, female workers can chose to work part-time ($p^j_t = 1$) or full-time ($p^j_t = 0$).[21]

6.3 Preferences

Individuals derive utility from consumption and from leisure, if not working or working part-time. The per period utility function of a couple is the weighted sum of the utility of a single male and the utility of a single female, where the weights represent bargaining power (the weight is set to 0.5 in the simulations reported below):

$$U(c^m_t, c^f_t, d^m_t, d^f_t, p^f_t, N_t, \epsilon^m_t, \epsilon^f_t) =$$
$$\theta u^m(c^m_t, d^m_t, N_t, \epsilon^m_t) + (1-\theta)u^f(c^f_t, d^f_t, p^f_t, N_t, \epsilon^f_t).$$

[21] Part-time work (p_t) is only an option for females.[22] It is assumed that individuals cannot work after age $t_R = 70$.[23] Once spouse j reaches age t_R (age 70), the only option is leisure ($d^j_t = 3$) for the remaining periods. Both single and married households make savings, labor participation and labor force sector (formal or informal) decisions.

The terms $u^m(c_t^m, d_t^m, N_t, \epsilon_t^m)$ and $u^f(c_t^f, d_t^f, p_t^f, N_t, \epsilon_t^f)$ represent the utility from consumption, leisure, and number of children for a single household formed by a male and a female respectively. Part-time work (p_t) is only an option for females. The leisure preference shocks are assumed to be jointly distributed normally and to be uncorrelated over time:

$$(\epsilon_t^m, \epsilon_t^f) \sim iidN(0, \Sigma)$$

The period utility function is specified as:

$$u^j(c_t^j, d_t^j, p_t^j, N_t, \epsilon_t^j) =$$
$$\left(\frac{c_t^j}{1-\sigma}\right)^{1-\sigma} (1 + \exp\{\nu_0^j N_t + \nu_1^j I_{\{d_t^j=3\}}\}) + (I_{\{d_t^j=3\}} + \delta_p^j I_{\{p_t^j=1\}})(\delta_l^j + \epsilon_t^j).$$

This formulation allows the marginal utility of consumption to depend on the number of children and on labor market status. The utility from not being employed is $\delta_l^j + \epsilon_t^j$, with δ_p^j capturing the fraction of the utility of leisure received if employed part-time (an option for women).

6.4 Household Income

As previously noted, we assume that the labor market consists of two sectors, a covered and an uncovered sector. Each working age individual (whether part of a couple or single) receives an earnings offer from the uncovered sector in every period with probability one. In addition, with a probability Γ_t^j, individuals may receive an offer from the covered sector. The probability depends on his/her gender, level of schooling, age, and whether employed in the covered sector in the previous period.

$$\forall j \in \{m, f\}, t \in \{t_0, t_R\},$$
$$\Gamma_t^j = (1 + exp\{-(\gamma_0^j + \gamma_1^j I_{\{d_{t-1}^j=1\}} + \gamma_2^j e^j + \gamma_3^j X^j)\})^{-1}$$

The log-earnings offers (for spouse $j \in \{m, f\}$, in sector $s \in \{C, U\}$, with completed schooling e) are given by:

$$w_{s,t}^j = \theta_{0s}^j + \theta_{1s}^j \cdot e^j + \theta_{2s}^j \cdot X^j + \theta_{3s}^j \cdot (X^j)^2 + \epsilon_{s,t}^j$$

where $\theta^j_{0,s}$ is a gender- and sector-specific constant, θ^j_{1es} a gender-, sector-, schooling-specific cohort effect, θ^j_{2s} the sector-specific returns to schooling, and θ^j_{3es} and θ^j_{4es} the sector- and schooling-specific returns to experience. $\epsilon^j_{s,t}$ ($j \in \{m, w\}, s \in \{C, U\}$) are i.i.d. sector-specific earnings offer shocks that are uncorrelated across time-periods but potentially correlated between two members of the same household. Our earnings offer specification (described below) allows returns to experience to differ in both sectors.

The total household disposable labor income y^2_t is the sum of accepted earnings offers, net of income taxes and mandatory pension contributions:

$$y^2_t = \sum_{i \in \{H,W\}} \frac{(1-\tau) \cdot w^i_{C,t} \cdot I_{\{d^i_t=1\}} + w^i_{U,t} \cdot I_{\{d^i_t=2\}}}{1+p^j_t} - T(A_t, w^m_{C,t}, w^f_{C,t}, d^m_t, d^f_t)$$

where τ is the pension contribution rate (10%). The household income for a single household, y^j_t, is defined similarly. Covered labor earnings net of pension contributions and private savings returns are subject to a progressive income tax. Taxes due at period t are denoted $T(A_t, w^m_{C,t}, w^f_{C,t}, d^m_t, d^f_t)$, and depend on the household's stock of private savings, covered sector earnings offers and labor force participation decisions. Net borrowing and borrowing against pension savings are not allowed. It is assumed that individuals working in the uncovered sector do not pay taxes on their labor income.

6.5 Separation and mortality

Each period, there is a probability of the man or woman (whether in a couple or single) dying, which is assumed exogenous with respect to the other aspects of the model.[24] Denote the probability of surviving to the next period as $\pi^{sj} = \pi^{sj}(a_t)$ for $j \in \{m, f\}$. Our model assume that widows inherit their former spouses pension funds.

Household separation (for reasons other than widowhood) is modeled as an exogenous event. Conditional on both spouses surviving, the probability of becoming separated in

[24] We obtain these probabilities from life tables that are specific to Chile and are conditional on age and gender (RV-2004, from Circular 1314, published by the Superintendencia de Pensiones).

period t is assumed to depend on the man and woman's level of education (e^m, e^f), their ages $(a_t^m, a_t^f = t)$, and the number of children (N_t).[25] The separation probability is given by a logistic model,

$\pi_t^d = \pi^d(e^m, e^f, N_t, a_t^m, t)$.

Upon separation, a couple's non-pension assets A_t are split evenly between the two individuals who then become single households.

Recall that one feature of the pension reform was a change in the rules governing pensions upon divorce. Prior to the reform, divorce could lead to a loss of rights to a spouse's pension benefits. After the reform, in the event of a divorce or annulment, a judge can rule that up to 50% of one of the spouse's pension balance be transferred to the other spouse's account as a form of alimony. In our model, we assume that before the reform, divorced individuals only have access to their own pension funds and do not get to keep any of their former spouse's pension. After the reform, we assume the spouse that is followed in the model gets the maximum of either their own pension or one-half of the pooled pension savings of the wife and husband.

To reduce computational complexity and because separation in old age is relatively rare, we assume that no separation occurs after the woman turns age 60 ($t = t_s$).

6.6 Retirement

At ages $t_C^f = 60$ and $t_C^m = 65$ years old respectively, males and females are allowed to withdraw money from their pension savings accounts. For tractability, we did not incorporate the choice about whether to take retirement savings as an annuity or as phased withdrawal. Rather, we assume phased withdrawal because the formula is a simple function of age. The level of pension benefits is calculated according to the rules of the pension system in place, including the minimum pension guaranty (MPG) when applicable. In addition, after age 65, either spouse may receive the pension benefits (PASIS, PBS, APS) for which they qualify ,

[25] Until 2004, divorce did not exist in Chile. For simplicity we treat divorce, marriage, annulment and de facto separation as equivalent in the model.

given their individual and family incomes, and the according to the rules to which they are subject at that time (pre-reform until 2008, phased implementation of the reform from 2009 to 2011, post-reform after 2011).

By age t_R=70, it is assumed that individuals stop working, at which point they take leisure ($d_t^j = 3$) for all remaining periods, up until age 90, the last period in the model. When both spouses turn 70 and no longer have the option of working, the model assumes that households run down their accumulated savings by optimally consuming until they die or reach the last period (age 90). We assume that bequests are involuntary and do not generate utility.

6.7 Fertility

The number of children N_t is assumed to evolve stochastically, because of pregnancies. The probability of having another child is modeled as a logistic model, that depends on the woman's age, marital status, schooling level and and number of children in the previous period.

$$\pi^N j_t(N_t|N_{t-1}, a_t^j, e^f, marital\ status)$$

There are assumed to be no births after the woman turns age 40 (t=t_C).

6.8 Evolution of other state variables

The model's other time-varying state variables, A_t, B_t^m, B_t^f, X_t^m, X_t^f are determined by the saving, labor supply decisions and asset return shocks. Private savings are assumed to earn the risk-free rate r, assumed to be 5%. The balances on each spouse's pension account accrue interests stochastically and are augmented by the current period's contribution. Returns on the pension accounts are modeled as an iid process: $r_B \sim iidN(\bar{r_B}, \sigma_B^2)$.[26]

[26] Allowing for serial correlation in the returns would require adding past returns as additional continuous state variables, which would significantly complicate the numerical solution of the problem.

6.9 Recursive formulation of the Household's Problem

The optimization problem faced by a single individual of gender j has the following recursive formulation:

$$V_t^j(\Omega_t^j; \tilde{\epsilon}_t^j) = \max_{s_t, d_t^j, p_t^j} \left[u^j(c_t^j, d_t^j, p_t^j, N_t, \epsilon_t^j) + \beta \pi^{sj}(t) E V_{t+1}^j(\Omega_{t+1}^j; \tilde{\epsilon}_{t+1}^j) \right]$$

s.t.

$$\begin{aligned} c_t^j &= (1 - s_t) \cdot (y_t^j + A_t \cdot (1 + r)) \\ A_{t+1} &= s_t \cdot (y_t^j + A_t \cdot (1 + r)) \\ A_{t+1} &\geq 0 \\ B_{t+1}^j &= B_t^j \cdot (1 + r_B) + \tau \cdot \frac{w_{C,t}^j}{1 + p_t^j} \cdot I_{\{d_t^j = 1\}} \end{aligned}$$

where $\tau \cdot w_{C,t}^j \cdot I_{\{d_t^j=1\}}$ is the pension contribution made by workers in the covered sector. y_t^j is the household's income defined earlier, and $\tilde{\epsilon}_t^j$ is a vector of shocks to wage offers, preferences for leisure, and pension asset returns.[27]

For couples the continuation value imbeds five possible events:

- Both spouses die (the continuation value is 0 in this case)
- The husband dies and the maximization problem continues with the wife
- The wife dies and the maximization problem continues with the husband
- Both spouses survive and remain together
- Both spouses survive and separate and the problem continues with the sampled individual (either male or female)

[27] Non-pension assets are assumed to earn a rate of return of 5%.

Incorporating greater detail about the different possible next period options, the recursive formulation of the couple's problem can be written as:

$$
\begin{aligned}
V_t^2(\Omega_t^2;\tilde{\epsilon}_t^2) = \max_{s_t,d_t^m,d_t^f,p_t^m,p_t^f} \quad & \Bigg[\\
U(c_t^m,c_t^f,d_t^m,d_t^f,p_t^m,p_t^f,N_t,\epsilon_t^m,\epsilon_t^f) \quad + \quad & \beta\cdot\Big(\\
& \pi^{sf}(1-\pi^{sm})\cdot(1-\theta)EV_t^f(\Omega_{t+1}^f;\tilde{\epsilon}_{t+1}^2) \\
+ \quad & \pi^{sm}(1-\pi^{sf})\cdot\theta EV_t^m(\Omega_{t+1}^m;\tilde{\epsilon}_{t+1}^2) \\
+ \quad & \pi^{sm}\pi^{sf}(1-\pi^d)\cdot EV_{t+1}^2(\Omega_t^2;\tilde{\epsilon}_{t+1}^2) \\
+ \quad & \pi^{sm}\pi^{sf}\pi^d\cdot\Big[\theta EV_{t+1}^m(\Omega_{t+1}^m;\tilde{\epsilon}_{t+1}^2)+(1-\theta)V_t^f(\Omega_{t+1}^f;\tilde{\epsilon}_{t+1}^2)\Big]\Big) \\
& \Bigg]
\end{aligned}
$$

s.t.

$$
\begin{aligned}
c_t &= (1-s_t)\cdot(y_t^2+A_t\cdot(1+r)-\eta N_t) \\
A_{t+1} &= s_t\cdot(y_t^2+A_t\cdot(1+r)-\eta N_t) \\
A_{t+1} &\geq 0 \\
B_{t+1}^j &= B_t^j\cdot(1+r_B)+\tau\cdot w_{C,t}^j\cdot I_{\{d_t^j=1\}}
\end{aligned}
$$

The variables on which the separation and divorce probabilities depend were omitted above to make the notation less burdensome.

7 Discussion of the Model

The above described model is dynamic and explicitly incorporates forward-looking behavior under a rational expectations assumption. The model also incorporates uncertainty and incomplete information. In particular, individuals are assumed to be uncertain about future wage shocks, future fertility, future divorce or widowhood, future survival and investment returns at the time of making labor supply and savings decisions. In solving the model, we

assume that the 2008 pension reform came as a surprise and was not anticipated. Thus, decisions up until 2008 are governed by a pre pension reform decision model and decisions after 2009 are governed by a post pension reform model. This requires solving two different versions of the model. The model is estimated solely on pre pension reform data and then, fixing the parameters of the structural parameters, the model is then resolved under the post pension reform scenario.

To a limited extent, the model incorporates business cycle effects in that returns on pension investments vary over time. Two limitations of the model are that investment returns are assumed to be i.i.d. and that there are otherwise no aggregate shocks to earnings.

Aggregate demographic changes in the economy are taken into account in a few ways. First, the initial conditions include the education levels of the husband and wife and rising levels of education with successive birth cohorts will lead to different decision-making with regard to labor force participation and fertility. We expect, for example, that more recent cohorts of women will tend to have fewer children and will participate more in the labor force. Also, the model takes marital sorting patterns as a given initial condition, so changes in marital sorting that may have occurred over time (for example, the sorting patterns of husbands and wives) are also taken into account.

The model also incorporates some important labor market regulations. For example, the progressive tax structure is taken into account in computing after-tax income. Fees that workers pay for health and disability insurance are also incorporated. Lastly, the model incorporates the fact that informal sector workers typically do not pay these taxes and fees.[28]

The effects of the 2008 pension reform on decision-making and on the indicators described in section two can be assessed by simulating household behavior using the pre-reform pension model and the simulating the same households under the post-reform rules. For purposes of this simulation, we use as a starting point the initial conditions in the year 2004 and the simulate their choices in years 2005-2014. Our tables report values in 2014, but of course

[28]We use information on reported earnings and will not explicitly incorporate minimum wage regulation. However, we will trim out a small fraction of the lowest and highest earnings that are likely to be reported with error.

pension values in 2014 reflect choices made in prior years. A comparison of the choices and outcomes under the pre-reform and post-reform regimes is informative about the impact of the reform.

7.1 Unobservable heterogeneity

It is important to recognize the existence of unobservable differences across households that may affect their decisions. The model incorporates permanent unobservable sources of heterogeneity in the form of two permanent types of households. The utility of leisure is allowed to vary by type, as well as the constant terms in the wage offer equations (for the informal and formal sector wage offers). Along with these type-specific parameters, we estimate a logistic type probability function, where the type probability depends on a constant term and the man and woman's education levels.

8 Solution and Estimation Method

8.1 Solution Method

The model does not have an analytic solution and is therefore solved numerically by backwards recursion.

The model solution proceeds as follows. At age $t_R - 1$, a household decides on labor force participation and consumption (which together imply a level of savings) to maximize the weighted sum of current and future period utilities, denoted by $V_{t_R-1}(\overline{S_{t_R-1}}, \{\epsilon^i_{j,t_R-1}\})$, where the state space, S_{t_R-1} , is divided into a deterministic component containing the elements that are not random at the beginning of period $t_R - 1$, $\overline{S_{t_R-1}}$, and a shock component containing the vector of random earnings and preference shocks drawn at $t_R - 1$, $\{\epsilon^i_{j,t_R-1}\}$.

For any given value of the deterministic and shock components of the state space, optimal consumption is obtained by comparing utility on a grid of possible consumption levels, for each of the possible choices of husbands' and wives' labor sectors and for the different possible savings choices. The labor decision and associated optimal consumption that maximizes total utility is chosen for that value of the state space. At any deterministic state point,

the expected value of V_{t_R-1} is obtained by Monte Carlo integration, that is, by taking draws from the shock vector distribution and averaging to obtain $EV_{t_R-1}(\overline{S_{t_R-1}})$. This expectation is calculated at a subset of the deterministic state points and the function is approximated for all other state points by a polynomial regression following an approximation method developed by Keane and Wolpin (1994, 1997). We denote this function as $Emax(t_R - 1)$.

This procedure is repeated at age t_R-2. Using the recursive formulation of the value function, substituting the $Emax(t_R-1)$ function for the future component, the optimal decision is computed. Monte Carlo integration over the shock vector at t_R-2 provides $EV_{t_R-2}(\overline{S_{t_R-2}})$ for a given deterministic state point. A polynomial regression over a subset of the state points again provides an approximation to the function, denoted by $Emax(t_R - 2)$. Repeating the procedure back to the initial age provides the $Emax$ polynomial approximation at each age. The set of $Emax(t)$ functions fully describe the solution to the optimization problem.

8.2 Estimation Method

The parameters of the previously described model are estimated by the Method of Simulated Moments (MSM)[29] with the exception of the discount factor which calibrated at 0.95. The fertility logit parameters were estimated separately on the estimation data and are presented in table C.1.[30] Our approach uses information from the 2004 survey to construct the initial conditions and state variables, simulates two periods ahead to get 2006 outcomes, and minimizes the distance between the actual and the simulated 2006 outcomes, where some of the outcomes include 2004-2006 transitions.

Appendix A lists the complete set of data moments used in the estimation. There are 157 moments (M) used in the estimation and 47 model parameters to be estimated (K). The estimated parameters are reported in table C.2 with standard errors in italics. Some details on the computation of the standard errors are reported below.

[29]This method more easily accommodates missing state variables than does simulated maximum likelihood, which would require integrating over possible values of missing state variables.

[30]The standard errors of the MSM parameters were not adjusted for the fact that the fertility parameters are estimates rather than the true values.

8.2.1 Standard Errors

Below is the description of how standard errors are obtained for the parameter estimates. Denote by x_i^m the contribution of observation i to moment m, $i \in 1..N, m \in 1...M$. Denote S^m the set, and N^m the number, of observations that contribute to moment m. Finally, the theoretical model predicts a value for each moment, denoted $\mu^m(\theta)$, where $\theta = [\theta_1, ... \theta_K]$ is the vector of estimated parameters.

The Method of Simulated Moments estimator is defined as:

$$\hat{\theta}_N = \arg\max_{\theta \in \Theta} \left[\frac{1}{N^m} \sum_{i \in S^m} (x_i^m - \mu^m(\theta)) \right]'_{m=1...M} W^{-1} \left[\frac{1}{N^m} \sum_{i \in S^m} (x_i^m - \mu^m(\theta)) \right]_{m=1...M}.$$

The inverse of the weighting matrix W is an M by M diagonal matrix with the m^{th} diagonal elements equal to the sample variance of x_i^m.

Given the moments chosen above, not all observations contribute to all moments. To derive the asymptotic properties of the estimator it is convenient to note that:

$$\hat{\theta}_N = \arg\max_{\theta \in \Theta} \left[\frac{1}{N} \sum_{i \in S} (x_i^m - \mu^m(\theta)) \cdot D_i^m \cdot \frac{1}{N^m} \right]' W^{-1} \left[\frac{1}{N} \sum_{i \in S} (x_i^m - \mu^m(\theta)) \cdot D_i^m \cdot \frac{1}{N^m} \right]$$

where D_i^m is a dummy that is equal to one if observation i contributes to moment m, and S is the union of all S^ms.

Taking first order conditions with respect to θ yields:

$$\left[\frac{1}{N} \frac{\delta \mu^m}{\delta \theta} |_{\hat{\theta}_N} \right]' W^{-1} \left[\frac{1}{N} \sum_{i \in S} (x_i^m - \mu^m(\theta)) \cdot D_i^m \cdot \frac{1}{N^m} \right] = 0 \tag{1}$$

A Taylor expansion of μ^m around the true parameter vector θ_0 yields:

$$\mu^m(\hat{\theta}_N) = \mu^m(\theta_0) + \frac{\delta \mu^m}{\delta \theta} |_{\theta *} \cdot (\hat{\theta}_N - \theta_0) \tag{2}$$

for some $\theta*$ between $\hat{\theta}_N$ and θ_0. Combining (1) and (2), we obtain after rearranging:

$$\sqrt{N}(\hat{\theta}_N - \theta_0) = \left[\left[\frac{\delta \mu^m}{\delta \theta} |_{\hat{\theta}_N} \right]' W^{-1} \left[\frac{\delta \mu^m}{\delta \theta} |_{\hat{\theta}*} \right] \right]^{-1} \left[\frac{\delta \mu^m}{\delta \theta} |_{\hat{\theta}_N} \right]' W^{-1} \left[\frac{1}{\sqrt{N}} \sum_{i \in S} (x_i^m - \mu^m(\theta_0)) \cdot D_i^m \cdot \frac{N}{N^m} \right].$$

A central limit theorem can be applied after redefining

$$\tilde{x}_i^m \equiv x_i^m \cdot D_i^m \cdot \left(\frac{N}{N^m}\right)$$

and

$$\tilde{\mu}_i^m(\theta_0) \equiv \mu_i^m(\theta_0) \cdot D_i^m \cdot \left(\frac{N}{N^m}\right).$$

The estimator's asymptotic variance-covariance matrix is given by:

$$Asy.Var(\hat{\theta}_N) = \left(D_0' W^{-1} D_0\right)^{-1} D_0' W^{-1} W_0^{-1} W^{-1} D_0 \left(D_0' W^{-1} D_0\right)^{-1\prime},$$

where $D_0 = E\left[\frac{\delta \mu^m}{\delta \theta}|_{\theta_0}\right]$, $W_0 = E\left([\tilde{x}_i^m - \tilde{\mu}_i^m(\theta_0)]' \left[\tilde{x}_j^m - \tilde{\mu}_j^m(\theta_0)\right]\right)$.

In computing the standard errors, D_0 is approximated by the numerical derivatives of the model's moments at the estimated vector of parameters, W_0 is approximated by the sample variance-covariance of $\left[\tilde{x}_j^m - \tilde{\mu}_j^m(\theta_0)\right]$, and the standard errors are corrected for the variance resulting from replacing the true model-implied moments by simulated moments.

9 Description of the data

The structural model estimation and simulations are based on three data sources: the EPS[31] longitudinal survey, linked administrative records of pension balances and contributions to retirement accounts, obtained from the Chilean supervising agency for pension fund administrators,[32] and data on the returns achieved by Chile's pension fund administrators (AFPs[33]).

The EPS was initially conducted in 2002, under the name HLLS[34], using a representative sample of individuals affiliated to the Chilean pension system,[35] by the Microdata Center (Centro de Microdatos) of the Department of Economics of the University of Chile. The survey data was then linked to the administrative records of the pension accounts of the

[31] *Encuesta de Proteccion Social*
[32] *Superintendency of Pensions* or SP
[33] *Administradoras de Fondos de Pensiones*
[34] *Historia Laboral y de Seguridad Social*
[35] The sample combines individuals affiliated to the AFP and INP pension programs.

sampled individuals. In 2004, 2006 and 2009 three follow-up surveys were administered, and the sample was augmented to include individuals that were not affiliated to any pension program, to obtain a total sample of 20,114 individuals, representative of the Chilean population in 2004. We use information on the 16,150 respondents who were interviewed in the 2006 round and use the survey weights to correct for attrition and no response.

The EPS questionnaire was designed specifically to study Chile's social protection programs including the pension system. It contains rich longitudinal information on socio-demographic variables, household composition, employment histories, earnings and assets. The main variables used in the estimation are age, schooling level, schooling level of the spouse, an indicator for the birth of a child in the current year, number of years the respondent worked in the covered sector, number of years the respondent worked in the uncovered sector, labor sector choice, labor sector choice of the spouse, annual accepted earnings and private household wealth. In addition, we obtained pension savings accumulations from the administrative pension account records provided by the Superintendency of Pensions (SP).

In arriving at our estimation sample, we apply the following restrictions to the EPS sample:

(i) First, it was decided the model would incorporate the rules of the AFP pension system, as the older INP system is being phased out. We thus excluded from the estimation sample workers who reported making contributions to a pension system other than AFP. This restriction applied to 2,152 EPS respondents. The characteristics of these excluded households are summarized in tables B.1 and B.2 at the end of this report. Note that we do incorporate those workers who worked before 1980, and thus accumulated some pension rights under the previous pension system. In the model,the value of these rights is captured through the Recognition Bond ("bono de reconocimiento"), and is added to the funds accumulated in the AFP account upon retirement.[36]

(ii) Second, incorporating marriage decisions is not feasible given the complexity of the

[36]We obtained a dataset on the recognition bond values from the Superintendence of Pensions, which we linked to the survey data.

model. To limit the impact of this simplification, we set the initial age in our model to 35, an age at which most people's marital status has been set, and we use in estimation individuals who are 35 or older in 2004, the initial year (4,899 households excluded, see tables B.3 and B.4). We excluded respondents who reported getting married after the age of 35 (1,183 cases, see tables B.5 and B.6).

Finally, we dropped household with missing information in key variables and with inconsistencies across survey rounds with respect to age, education and civil status, for an additional 2,502 respondents excluded (see tables B.7 and B.8). The final sample contains 5,314 households, some formed of a single person and some formed by a couple, for a total of 4,809 women and 4,309 men.

The main concern being that we might lose poorer households, who are the target of the policies we are evaluating, we report in Table 1 the distribution of earnings of working individuals above age 35 before and after the sample restrictions are applied. The distributions are very similar, except in the right tail of the distribution. The estimation sample contains a slightly smaller proportion of wealthy households, which is unlikely to affect our conclusions.

Tables 2 and 3 present summary statistics for the estimation sample. It is worth noting that the high average age of the sample is due to the fact that the estimation only incorporates workers who are over 35 years of age. The high levels of mean assets are heavily skewed by a handful of respondents with very high wealth levels.

10 Within- and out-of-sample model fit

As earlier described, we use data from the 2004 and 2006 EPS surveys to estimate the model and then use the estimated model to forecast behavior until 2014, or five years after the introduction of the pension reform.[37] The model will be used to study the impact of the 2008 pension reform on the indicators that were described in section two.

[37]Some aspects of the reform were introduced in July 2008, but many of the more important changes started in 2009.

Table 1: Effect of Sample Exclusions on the Distribution of Earnings

Annual Earnings (million pesos)		**mean**	**p10**	**p25**	**p50**	**p75**	**p90**
Before sample exclus.	Married men	4.8	1.2	1.9	2.8	4.6	8.4
	Single men	3.1	0.7	1.6	2.2	3.6	5.8
	Married wom.	3.1	0.6	1.2	1.9	3.6	7.2
	Single wom.	3.0	0.6	1.2	1.9	3.0	6.0
After sample exclus.	Married men	5.2	1.2	1.9	2.5	4.2	7.2
	Single men	2.7	0.6	1.4	2.0	3.0	5.4
	Married wom.	2.9	0.5	1.0	1.9	3.6	7.0
	Single wom.	2.7	0.6	1.1	1.9	3.0	5.8

Table 2: **Summary Statistics: Estimation Sample**

variable	**mean**
Couples (%)	66.9
Single Women (%)	22.0
Single Men (%)	11.1
Lab. Force Part. (wom., %)	36.2
Lab. Force Part. (men, %)	74.9
Formal sector* (wom., %)	59.5
Formal sector* (men, %)	61.4
Age (men)	51.4
Age (wom.)	50.8
Schooling (men, years)	8.7
Schooling (wom., years)	8.5
Children	3.0

Source: Encuesta EPS, Superintendencia de Pensiones

* as a fraction of those working

Table 3: **Summary Statistics: Estimation Sample**

variable	mean	p10	p25	p50	p75	p90
Annual Earnings (wom., MM PS)	2.2	0.5	1.0	1.6	2.6	4.8
Annual Earnings (men, MM PS)	5.0	1.0	1.6	2.2	3.6	6.0
Non-Pension assets** (MM PS)	13.0	0.0	2.5	7.0	15.0	27.9
Pension assets** (wom., MM PS)	2.5	0.0	0.0	0.0	0.5	4.2
Pension assets** (men, MM PS)	9.0	0.0	0.0	2.7	8.9	19.5

Source: Encuesta EPS, Superintendencia de Pensiones

Note: MM PS = Million Pesos

** The top 2% of pension values were trimmed in calculating these statistics to avoid sensitivity to outliers in the data

In order to evaluate the capacity of the the model to fit the data, we use the model to simulate the 2006 data using the 2004 data as initial conditions. That is, years 2005 and 2006 in the life of the respondents in the estimation sample are simulated. Table 4 to 9 compare the simulated and actual 2006 data on a number of dimensions. Then we simulate decisions until 2009, introducing the 2008 reform in the model in the way it was implemented in reality, and compare the model predictions with the information contained in the 2009 round of the EPS survey, collected in the summer of 2009, or about nine month after the introduction of the first phase of the reform. Thus, the 2009 data was not used in the estimation sample. We report and discuss the within (2006) and out-of-sample (2009) fit below.

10.1 Within-sample fit (2006 data)

Model fit is overall reasonable, with the following caveats. The model tends to underestimate labor force participation, especially for married men (see Tables 4 to 9). Participation in the formal sector for men and for women is well approximated for all categories, to the exception of single men who overly participate in the formal sector in model simulations relative to the data. The fit is good for earnings at lower percentiles, but the model misses the right tail of very high earning single women. The model has difficulties in fitting the asset data, sometimes missing the right tail of very rich household, and overall underestimating the amount of non-pension assets held by households. This is in part attributable to the

high skewness of the distribution of assets. The model might have required more flexibility, possibility in the form of risk aversion heterogeneity, to be able to account for both the very large and very low non-pension asset holdings observed in the data.

Table 4: **Model fit (2006 data) - Couples (1)**

variable	**mean**	**sd**	**p10**	**p25**	**p50**	**p75**	**p90**
Children (model)	3.3	1.9	2.0	2.0	3.0	4.0	6.0
Children (data)	3.3	1.9	2.0	2.0	3.0	4.0	6.0
Male LF Part. (model)	62.7	48.4	-	-	-	-	-
Male LF Part. (data)	74.3	43.7	-	-	-	-	-
Fem. LF Part. (model)	39.4	66.1	-	-	-	-	-
Fem. LF Part. (data)	36.0	58.9	-	-	-	-	-
Men - Formal Sect. (model)*	67.9	49.5	-	-	-	-	-
Men - Formal Sect. (data)*	65.8	50.0	-	-	-	-	-
Wom. - Formal Sect. (model)*	47.7	38.7	-	-	-	-	-
Wom. - Formal Sect. (data)*	50.0	39.0	-	-	-	-	-
Men's Work Exp. (model)	27.6	10.8	17.0	22.0	27.0	34.0	42.0
Men's Work Exp. (data)	29.4	9.2	20.0	24.0	27.0	35.0	42.0
Wom.'s Work Exp. (model)	6.6	8.8	0.0	0.0	2.0	11.0	20.0
Wom.'s Work Exp. (data)	10.0	10.3	0.0	1.0	7.0	16.0	25.0

Source: EPS, Safp records and own calculations

* as a fraction of those working

Table 5: **Model fit (2006 data) - Couples (2)**

variable	**mean**	**sd**	**p10**	**p25**	**p50**	**p75**	**p90**
Ann. Earnings - Men (model)	3.3	2.4	1.0	1.5	2.7	4.3	6.3
Ann. Earnings - Men (data)	3.6	3.5	1.2	1.9	2.4	4.1	6.2
Ann. Earnings - Wom. (model)	1.8	1.6	0.4	0.7	1.3	2.4	3.8
Ann. Earnings - Wom. (data)	2.6	2.4	0.5	1.0	1.9	3.0	5.8
Assets (MM PS) (model)	7.5	11.7	0.0	0.2	1.5	10.1	24.1
Assets (MM PS) (data)	14.2	39.9	0.0	3.0	7.4	15.0	26.0

Source: EPS, Safp records and own calculations

Table 6: **Model fit (2006 data) - Single Women (1)**

variable	**mean**	**sd**	**p10**	**p25**	**p50**	**p75**	**p90**
Children (model)	2.7	2.5	0.0	1.0	2.0	4.0	6.0
Children (data)	2.7	2.5	0.0	1.0	2.0	4.0	6.0
Fem. LF Part. (model)	51.0	74.7	-	-	-	-	-
Fem. LF Part. (data)	58.5	65.6	-	-	-	-	-
Wom. - Formal Sect.(model)*	50.4	43.7	-	-	-	-	-
Wom. - Formal Sect.(data)*	52.7	46.3	-	-	-	-	-
Work Exp. (model)	14.5	11.6	0.0	4.0	14.0	22.0	30.0
Work Exp. (data)	15.4	11.9	0.0	5.0	15.0	24.0	31.0

Source: EPS, Safp records and own calculations

* as a fraction of those working

Table 7: **Model fit (2006 data) - Single Women (2)**

variable	**mean**	**sd**	**p10**	**p25**	**p50**	**p75**	**p90**
Ann. Earnings - Wom. (model)	2.0	1.8	0.4	0.7	1.5	2.8	4.3
Ann. Earnings - Wom. (data)	2.5	2.3	0.6	1.0	1.9	3.0	5.5
Assets (MM PS) (model)	4.8	9.2	0.0	0.0	0.1	5.8	15.8
Assets (MM PS) (data)	11.7	18.4	0.0	2.0	6.6	15.0	27.0

Source: EPS, Safp records and own calculations

Table 8: **Model fit (2006 data) - Single Men (1)**

variable	**mean**	**sd**	**p10**	**p25**	**p50**	**p75**	**p90**
Children (model)	1.2	2.0	0.0	0.0	0.0	2.0	4.0
Children (data)	1.2	2.0	0.0	0.0	0.0	2.0	4.0
Male LF Part. (model)	62.9	48.4	-	-	-	-	-
Male LF Part. (data)	66.8	47.1	-	-	-	-	-
Men - Formal Sect.(model)*	74.2	49.9	-	-	-	-	-
Men - Formal Sect.(data)*	49.7	47.1	-	-	-	-	-
Men's Work Exp. (model)	24.3	11.9	7.0	18.0	25.0	31.0	40.0
Men's Work Exp. (data)	24.9	12.2	9.0	18.0	25.0	31.0	40.0

Source: EPS, Safp records and own calculations

* as a fraction of those working

Table 9: **Model fit (2006 data) - Single Men (2)**

variable	mean	sd	p10	p25	p50	p75	p90
Ann. Earnings - Men (model)	2.8	2.1	1.0	1.4	2.2	3.5	5.5
Ann. Earnings - Men (data)	2.3	2.1	0.6	1.1	1.9	2.5	3.7
Assets (MM PS) (model)	3.1	8.0	0.0	0.0	0.0	1.0	12.5
Assets (MM PS) (data)	11.4	22.7	0.0	1.0	5.4	14.9	25.0

Source: EPS, Safp records and own calculations

10.2 Out-of-sample fit (2009 data)

Tables 10 to 15 compare the 2009 data with the 2009 model simulations. In comparing the 2006-2009 changes predicted by the model with the corresponding data, we observe that the model is qualitatively but not always quantitatively accurate. That is, the predicted changes are of the right sign, but the model tends to predict larger changes than observed in the data. In particular, labor force participation declines for all categories in the model simulations and for all except married women in the data. However, for example, the model predicts a 10 percentage points drop in labor force participation for married men while the data only exhibits a 3 percentage points drop. Remarkably, the model accurately predicts both the fall in formal sector participation observed in the data for married and single men, the increase observed for single women, and the stability exhibited by married women in that statistic. As with labor force participation, the model predicts a larger fall than observed in the data in the case of men.

The quantitative discrepancies observed are not very surprising considering that the data was collected shortly after the reform started to be phased-in, while the model assumes that workers immediately and fully adjust to the new rules of the pension system. In the data, the fraction of survey respondents who reported knowing about the reform at the time of the 2009 round of interviews was still low (between a quarter and a third according to Behrman et al (2011)). One might argue that behavioral responses will take more than a few months to spread in the population, which would result in more accentuated effects, possibly closer to the model predictions, in the long term.

Table 10: **Model fit (2009 data) - Couples (1)**

variable	**mean**	**sd**	**p10**	**p25**	**p50**	**p75**	**p90**
Children (model)	3.3	1.8	2.0	2.0	3.0	4.0	5.0
Children (data)	3.3	1.8	2.0	2.0	3.0	4.0	5.0
Male LF Part. (model)	57.3	49.4	-	-	-	-	-
Male LF Part. (data)	73.3	44.2	-	-	-	-	-
Fem. LF Part. (model)	37.1	65.5	-	-	-	-	-
Fem. LF Part. (data)	37.8	59.7	-	-	-	-	-
Men - Formal Sect. (model)*	53.6	65.5	-	-	-	-	-
Men - Formal Sect. (data)*	64.2	60.0	-	-	-	-	-
Wom. - Formal Sect. (model)*	47.9	38.3	-	-	-	-	-
Wom. - Formal Sect. (data)*	50.5	39.3	-	-	-	-	-
Men's Work Exp. (model)	29.3	10.8	18.0	24.0	30.0	36.0	43.0
Men's Work Exp. (data)	31.8	8.9	22.0	26.0	30.0	37.0	44.0
Wom.'s Work Exp. (model)	7.1	8.7	0.0	0.0	3.0	12.0	20.0
Wom.'s Work Exp. (data)	10.9	10.8	0.0	1.0	8.0	17.0	26.0

Source: EPS, Safp records and own calculations

* as a fraction of those working

Table 11: **Model fit (2009 data) - Couples (2)**

variable	**mean**	**sd**	**p10**	**p25**	**p50**	**p75**	**p90**
Ann. Earnings - Men (model)	2.9	2.3	0.9	1.4	2.3	3.9	5.8
Ann. Earnings - Men (data)	3.6	3.5	1.2	1.9	2.6	4.2	6.0
Ann. Earnings - Wom. (model)	1.8	1.6	0.4	0.7	1.3	2.3	3.6
Ann. Earnings - Wom. (data)	2.5	2.5	0.5	1.0	1.8	3.0	6.0
Assets (MM PS) (model)	7.0	12.7	0.0	0.1	0.3	7.9	25.9
Assets (MM PS) (data)	16.4	55.5	0.0	0.0	8.0	17.0	30.0

Source: EPS, Safp records and own calculations

Table 12: **Model fit (2009 data) - Single Women (1)**

variable	mean	sd	p10	p25	p50	p75	p90
Children (model)	2.7	2.5	0.0	1.0	2.0	4.0	6.0
Children (data)	2.7	2.5	0.0	1.0	2.0	4.0	6.0
Fem. LF Part. (model)	35.5	64.7	-	-	-	-	-
Fem. LF Part. (data)	54.8	63.7	-	-	-	-	-
Wom. - Formal Sect.(model)*	54.6	39.5	-	-	-	-	-
Wom. - Formal Sect.(data)*	56.0	46.2	-	-	-	-	-
Work Exp. (model)	15.1	11.7	0.0	4.5	14.5	23.0	31.0
Work Exp. (data)	16.7	12.3	0.0	6.0	17.0	25.0	33.0

Source: EPS, Safp records and own calculations

* as a fraction of those working

Table 13: **Model fit (2009 data) - Single Women (2)**

variable	mean	sd	p10	p25	p50	p75	p90
Ann. Earnings - Wom. (model)	2.1	1.8	0.5	0.9	1.6	2.8	4.3
Ann. Earnings - Wom. (data)	2.5	2.3	0.6	1.2	1.9	3.0	5.4
Assets (MM PS) (model)	2.8	7.8	0.0	0.0	0.0	0.6	8.8
Assets (MM PS) (data)	11.1	19.9	0.0	0.0	5.0	15.0	29.8

Source: EPS, Safp records and own calculations

Table 14: **Model fit (2009 data) - Single Men (1)**

variable	mean	sd	p10	p25	p50	p75	p90
Children (model)	1.3	2.0	0.0	0.0	0.0	2.0	4.0
Children (data)	1.3	2.0	0.0	0.0	0.0	2.0	4.0
Male LF Part. (model)	53.4	49.9	-	-	-	-	-
Male LF Part. (data)	64.7	47.8	-	-	-	-	-
Men - Formal Sect.(model)*	70.5	48.5	-	-	-	-	-
Men - Formal Sect.(data)*	49.3	46.7	-	-	-	-	-
Men's Work Exp. (model)	26.0	11.8	8.0	20.0	27.0	33.0	41.0
Men's Work Exp. (data)	26.8	12.0	12.0	21.0	27.0	33.0	42.0

Source: EPS, Safp records and own calculations

* as a fraction of those working

Table 15: **Model fit (2009 data) - Single Men (2)**

variable	mean	sd	p10	p25	p50	p75	p90
Ann. Earnings - Men (model)	2.8	2.0	0.8	1.4	2.1	3.7	5.5
Ann. Earnings - Men (data)	2.3	2.0	0.6	1.2	1.9	2.5	4.2
Assets (MM PS) (model)	1.5	5.4	0.0	0.0	0.0	0.2	2.1
Assets (MM PS) (data)	9.6	24.0	0.0	0.0	0.7	12.0	21.9

Source: EPS, Safp records and own calculations

11 Results

We next report results based on simulating the model (using the best estimated parameters thus far) up until the year 2014. The sample used in estimation is 35 or older in 2004, which makes the sample 45 or older in the year 2014. We use the model to simulate the labor force participation choices, savings choices, pension accumulations and withdrawals, assuming that the reform was introduced in the year 2009. For the years 2004-2009, we use actual market returns on assets as the return on pensions in the simulation, but for years 2010 or later we use an average of the 2004-2009 returns, which equals 6.3%. Along with simulating choices and savings, we also simulate fertility (possible for women younger than age 40), divorce (possible for women under age 60), and survival.

In the tables described below, we describe the pension levels, pension saving accumulation and labor force participation patterns with and without the reform. The simulation with the reform assumes that the reform was first implemented in 2009 and that it was unanticipated in earlier years.[38] We report results for the year 2014, after the individuals have experienced the reform for five years. We also simulate what the behavior of individuals would have been in the absence of the reform. Each table reports labor force participation, pension withdrawals and pension accumulations of the same individuals under two different scenarios - with the reform and without the reform. To keep the model tractable, we assumed that everybody chooses the option of programmed withdrawals.[39] If a couple qualifies for the

[38]If the reform had been anticipated, it could have affected the behavior of individuals in earlier years.

[39]In computing the programmed withdrawals we used the life tables RV-2004 published by the Superintendia de Pensiones. The 2009, 2010 and 2011 vectors of discount rates were used for the corresponding

Table 16
Mean and percentiles of predicted annual pension withdrawal amounts in 2014 for women age 60-79, without and with the reform in thousands of pesos*

Without reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
60-64	278.65	0.00	4.80	42.85	167.76	919.78
65-69	567.65	0.00	21.98	450.00	450.00	1144.4
70-74	402.09	0.00	17.74	450.00	450.00	900.00
75-79	426.67	0.00	450.00	450.00	450.00	900.00
With reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
60-64	452.22	51.83	77.75	136.87	257.83	1228.6
65-69	1248.7	931.38	959.69	996.94	1057.0	1728.2
70-74	1056.0	917.00	955.32	984.64	1015.5	1099.3
75-79	1010.4	900.00	936.82	983.29	1043.6	1098.0

PASIS pension, our simulation assigns the PASIS pension to the woman (only one member of the household can get the PASIS).

11.1 Reform impacts on pension withdrawals

Table 16 shows the mean and percentiles of annual pension savings withdrawal amounts for women age 60-79 in 2014 (age 50-69 in the 2004 data), with and without the pension reform, reported in thousands of pesos. Without the reform, more than 25% of women are predicted to have 0 or almost 0 pension withdrawal. These correspond in large part to married women, who do not qualify for PASIS due to their husband's income. The reform leads to a substantial increase in the pension withdrawal amounts for women, throughout the entire distribution, a consequence of the higher coverage rate and benefit levels of the Solidarity Pension System system relative to the PASIS and to the introduction of the bono por hijo. The average pension amount received by women is more than double after the reform for ages 65 and older.

Table 17 shows the annual pension withdrawals for men. Before age 64, pensions come

years. To discount years more than 20 years in the future, the twentieth discount rate was repeated. For years after 2011, the 2011 vector was used. For years before 2009, a single discount rate of 5% was used.

Table 17
Mean and percentiles of predicted annual pension withdrawal amounts in 2014 for men age 60-79, without and with the reform in thousands of pesos*

Without reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
60-64	721.18	0.00	0.00	0.00	1248.2	1993.4
65-69	1105.7	0.00	450.00	900.00	1334.4	2559.2
70-74	1191.0	0.00	323.26	900.00	1448.9	2835.1
75-79	675.43	0.00	450.00	450.00	900.00	900.00
With reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
60-64	611.03	0.00	0.00	0.00	1109.3	1724.4
65-69	1570.5	900.00	920.48	1176.7	1771.3	2633.0
70-74	1648.5	900.00	911.48	1042.6	1912.1	2901.2
75-79	1099.1	900.00	900.00	906.34	951.87	1399.8

exclusively from contributions made during working years. As described below, the reform is expected to slightly lower contribution densities, resulting in lower contributory pensions. For men age 65 and older, pension withdrawals increase at the low end of the distribution due to the reform. If a household qualifies for the PASIS benefit before the reform, our simulations give the PASIS to the woman, which mainly accounts for the 10% of lowest male pension values pre-reform (the column of zeros). After the reform, men age 65 and older with pension withdrawals below the median all get at least 900,000 pesos, which is the PBS level. The reform also modestly increases age 65+ male pension levels at higher deciles because they qualify for the pension supplement, or *Aporte Previsional Solidario* (APS).

Table 18 shows the ratio of women's and men's pensions. Without the reform, the mean level of pension withdrawals for women is substantially smaller than that of men, about half as large between ages 65-69. The ratio tends to be more equal at older ages, when many of the men have exhausted their pension funds and the household relies on the PASIS. With the reform, women's pension withdrawal amounts increase substantially. In the first two quartiles of the distribution amounts, pension withdrawal amounts are about equal or even slightly higher for women due in part to the child pension benefit. Above the median, there

Table 18 - Counterfactual #2
Ratio of predicted womens and mens annual pension withdrawals in 2014, mean and percentiles age 60-79, without and with the reform

Without reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
60-64	0.39	.	.	.	0.13	0.46
65-69	0.51	.	0.05	0.50	0.34	0.45
70-74	0.34	.	0.05	0.50	0.31	0.32
75-79	0.63	.	1.00	1.00	0.50	1.00
With reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
60-64	0.68	.	.	.	0.21	0.67
65-69	0.84	1.03	1.04	0.86	0.59	0.66
70-74	0.63	1.04	1.05	0.92	0.54	0.38
75-79	0.92	1.00	1.05	1.08	1.12	0.79

A value of . indicates that mens pension withdrawal value was zero so it was not possible to take the ratio.

Table 19
Predicted percent of households living in poverty in 2014* without and with the reform

Without reform		
age group	**poverty rate #1**	**poverty rate #2**
45-49	28.16	29.38
50-54	25.72	26.58
55-59	25.74	26.86
60-64	24.95	28.54
65-69	0.31	30.73
70-74	0.00	42.58
75-79	0.00	64.01
With reform		
age group	**poverty rate #1**	**poverty rate #2**
45-49	26.12	27.12
50-54	26.18	27.94
55-59	27.53	28.61
60-64	23.60	25.66
65-69	0.31	0.31
70-74	0.00	0.00
75-79	0.00	0.00

* A household is defined as poor under measure #1 if household income, including pension withdrawals, is less then 400000 pesos. Poverty measure #2 uses a cut-off of 500000 pesos.

remains a significant gender disparity, but it is much smaller than prior to the reform.

11.2 Reform impacts on poverty rate

Table 19 shows the percentage of households living in poverty by age category of the female, where households are defined as poor if their annual household income, including receipt of any pension income, is less than 400,000 pesos (poverty measure 1) or 500,000 pesos (poverty measure 2) annually.[40] The threshold used to defined poverty is important, as the PASIS

[40]the 500,000 annual pesos threshold was obtained from the poverty threshold used by the Economic Commission for Latin America and the Caribbean (ECLAC) for Chile in 2003. ECLAC defines an urban

pension level is in between the two thresholds considered (450,000). As a result, many older households who receive PASIS before the reform are deemed poor per measure 2, but not measure 1, and will not be poor by either measure once they receive the PBS. Thus the reform is predicted to reduce poverty for persons who qualify for the PBS, which it does. It also, however, induces a slight increase in the rate of poverty for households with women age 50-59

11.3 Reform impacts on contribution density

Table 20 shows the simulated effect of the pension reform on the contribution density distribution for women up to age 64. The contribution density is measured as the number of years spent working in the covered sector divided by the potential number of years worked since age 18 (age-18). Women age 45-49 spend on average 17% of their potential working years in the covered sector without the reform. The reform leads to a slight decrease in the density of contributions for women age 50 and older in deciles above the median. Table 21 similarly shows the simulated effect of the reform on the contribution density for men up to age 65. Men spend on average about half of their potential working years in the covered sector. The reform also reduces the density of contribution for men age 50 and older. This reflects the changes in labor supply and changes in labor force sector participation decisions described in the tables below.

11.4 Reform impacts on labor supply and covered sector work

Tables 22 and 23 consider the effects of the reform on labor supply for women and men, distinguishing between work in the covered and uncovered sectors. The generous benefits under the reform, the absence of a minimum number of months of contribution, and the new child pension benefit appear to jointly have some disincentive effects on female labor force participation in the covered sector, particularly for women ages 50 and older. However,

and a rural poverty line based on monthly income (43.712 and 29,473 pesos respectively) which were weighted by the fraction of the Chilean population living in urban areas (86.6%) and annualized and rounded (the exact number is 501,712 pesos). The 400,000 pesos measure is presented as a sensitivity check.

Table 20
Mean and percentiles of predicted contribution density distribution in 2014 for women age 45-59, without and with the reform
(density = ratio of years of contribution divided by (age-18))

Without reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
45-49	0.17	0.00	0.03	0.10	0.24	0.48
50-54	0.16	0.00	0.03	0.10	0.21	0.41
55-59	0.14	0.00	0.01	0.08	0.19	0.43
60-64	0.13	0.00	0.00	0.07	0.15	0.38
With reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
45-49	0.18	0.00	0.04	0.12	0.26	0.50
50-54	0.15	0.00	0.03	0.09	0.21	0.41
55-59	0.12	0.00	0.00	0.05	0.16	0.41
60-64	0.11	0.00	0.00	0.02	0.12	0.36

Table 21
Mean and percentiles of predicted contribution density distribution in 2014 for men age 45-64, without and with the reform
(density = ratio of years of contribution divided by (age-18))

Without reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
45-49	0.51	0.10	0.27	0.53	0.74	0.86
50-54	0.47	0.00	0.15	0.50	0.77	0.88
55-59	0.42	0.00	0.10	0.44	0.71	0.84
60-64	0.41	0.00	0.09	0.43	0.70	0.82
With reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
45-49	0.54	0.14	0.30	0.57	0.77	0.90
50-54	0.47	0.00	0.14	0.52	0.76	0.88
55-59	0.40	0.00	0.08	0.41	0.68	0.78
60-64	0.38	0.00	0.07	0.40	0.65	0.78

Table 22
Predicted percent not working or working in covered or uncovered jobs in 2014 for women age 45-69, without and with the reform

		Without reform	
age group	**not working**	**working in covered sector**	**working in uncovered sector**
45-49	62.3	29.8	7.92
50-54	61.2	30.3	8.48
55-59	59.6	28.3	12.2
60-64	58.4	33.0	8.62
65-69	70.4	9.33	20.2
		With reform	
age group	**not working**	**working in covered sector**	**working in uncovered sector**
45-49	60.8	32.8	6.40
50-54	60.5	23.9	15.5
55-59	60.3	6.17	33.5
60-64	58.2	21.8	19.9
65-69	70.5	14.7	14.8

* The model restricts individuals age 70 or older to not work.

labor supply increases by almost 2 percentage points for the youngest age group.

The reform appears to have very little effect on their overall labor supply of men up through age 64, and, in fact, working rates increase slightly up through ages 45-64. However, the simulations indicate the reform alters decisions about whether to work in the covered or uncovered sectors, with a much higher percentage of men ages 50 and older choosing to work in the uncovered sector after the reform. These results suggest that attempts to make the reform more incentive-compatible by tapering-off non-contributory benefits seem to be insufficient to offset income effects resulting from higher benefit levels. As retirement nears, incentives to contribute to the pension system are lower than before the reform due to higher expected income in retirement. This tends to reduce participation in the labor market at older ages, particularly in the covered sector relative to before the reform.

11.5 Reform impacts on pension savings accumulations

Tables 24 and 25 show the amount of pension accumulations for men and women at the typical ages of retirement (age 60 for women and age 65 for men). The pension reform greatly increases women's pension accumulations, from an average of 3746 thousand pesos to 7317

Table 23
Predicted percent not working or working in covered or uncovered jobs in 2014 for men age 45-69, without and with the reform

		Without reform	
age group	**not working**	**working in covered sector**	**working in uncovered sector**
45-49	30.5	55.0	14.5
50-54	33.2	47.7	19.1
55-59	38.2	36.2	25.5
60-64	47.6	25.5	26.8
65-69	54.5	21.1	24.4
		With reform	
age group	**not working**	**working in covered sector**	**working in uncovered sector**
45-49	29.0	60.8	10.2
50-54	32.9	31.2	35.9
55-59	37.8	12.5	49.7
60-64	45.8	6.04	48.2
65-69	55.3	8.26	36.4

Table 24
Predicted mean and percentiles of pension savings distribution in 2014 for women at age 60, without and with the reform in thousands of pesos*

				Without reform		
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
age 60	3746.154	0.00	44.4482	619.3265	2326.406	15307.32
				With reform		
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
age 60	7317.198	751	751.4702	1878.676	4150.868	17176.16

thousand pesos. There are increases through the pension savings distribution. Given the lack of significant increase in labor supply, the increase in pension accumulations most likely comes mainly from the per child pension benefit. Table 27 shows the pension accumulations for men, which are much less affected by the reform than those of women. In fact, pension accumulations decrease slightly at the first, second and third quartiles as participation in the covered sector goes down, which is likely related to the decrease in formal sector work observed in Table 17. The increase in women's pensions and the decrease in men's pensions both serve to reduce the gender gap.

Table 25
Predicted mean and percentiles of pension savings distribution in 2014 for men at age 65 without and with the reform in thousands of pesos*

Without reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
65	12893	0.00	917.38	8953.0	15057	32956
With reform						
age group	**mean**	**P10**	**P25**	**P50**	**P75**	**P90**
65	12432	0.00	1058.8	8248.2	14856	32956

11.6 Reform impacts on full-time and part-time work

Table 26 shows the predicted effects of the reform on women working, distinguishing between not working, working full-time or working part-time.[41] The simulation results indicate that more of the younger women (age 45-54) work with the reform and that the reform has little effect on overall labor supply at ages older than 55. Table 27 presents the effects on labor supply for men, for whom part-time work is not an option. The reform is associated with a higher rate of working at ages 45-64 by about 1-2 percentage points. For both men and women, there do not appear to be significant disincentive effects on working until older ages (60-69), although the earlier tables indicated large effects on whether men work in the covered or uncovered sectors.

11.7 Reform impacts on full-time and part-time work by child status

Table 28 shows the working patterns of women by child status, where the categories are having had no children, one child, or two or more children. The reform does not seem to disproportionately alter labor force participation of women with more kids. This implies that the child bonus (bono por hijo), does not generate sizeable disincentives for female labor force participation.

[41] Adding a part-time option in the model for men was costly in terms of tractability and did not seem as crucial as for women.

Table 26
Predicted percent not working, working full-time or working part-time in 2014 for women age 45-69 by age group, without and with the reform*

Without reform			
age group	**not working**	**working full-time**	**working part-time**
45-49	62.3	23.8	13.9
50-54	61.2	28.9	9.81
55-59	59.6	29.5	10.9
60-64	58.4	25.0	16.6
65-69	70.4	19.5	10.1
With reform			
age group	**not working**	**working full-time**	**working part-time**
45-49	60.8	25.1	14.2
50-54	60.5	29.4	10.0
55-59	60.3	28.9	10.8
60-64	58.2	25.0	16.8
65-69	70.5	19.2	10.3

* The model restricts individuals age 70 or older to not work.

Table 27
Predicted percent not working or working in 2014 for men age 45-79 by age group, without and with the reform

Without reform		
age group	**not working**	**working**
45-49	30.5	69.5
50-54	33.2	66.8
55-59	38.2	61.8
60-64	47.6	52.4
65-69	54.5	45.5
With reform		
age group	**not working**	**working**
45-49	29.0	71.0
50-54	32.9	67.1
55-59	37.8	62.2
60-64	45.8	54.2
65-69	55.3	44.7

* The model restricts individuals age 70 or older to not work.

Table 28
Predicted percent not working or working in covered or uncovered jobs in 2014
for women age 45-69 by age group and child status, without and with the reform*

Without reform				
age group	child status	not working	working full-time	working part-time
45-49	no children	53.2	21.7	25.1
	one child	68.2	21.1	10.7
	two or more	62.3	24.5	13.2
50-54	no children	60.7	23.5	15.8
	one child	56.1	31.9	11.9
	two or more	62.1	28.9	9.00
55-59	no children	59.7	34.7	5.60
	one child	54.9	32.8	12.3
	two or more	60.0	28.8	11.1
60-64	no children	67.0	25.3	7.73
	one child	55.8	15.6	28.7
	two or more	58.1	25.6	16.3
65-69	no children	78.8	21.2	0.00
	one child	58.0	26.9	15.1
	two or more	71.5	18.5	9.94
With reform				
age group	child status	not working	working full-time	working part-time
45-49	no children	50.1	24.8	25.1
	one child	68.2	20.3	11.5
	two or more	60.7	26.0	13.4
50-54	no children	60.7	18.8	20.5
	one child	54.6	33.4	11.9
	two or more	61.5	29.6	8.91
55-59	no children	59.7	34.7	5.60
	one child	54.9	32.8	12.3
	two or more	60.9	28.1	10.9
60-64	no children	67.0	25.3	7.73
	one child	55.8	15.6	28.7
	two or more	57.9	25.6	16.5
65-69	no children	78.8	21.2	0.00
	one child	58.0	26.9	15.1
	two or more	71.6	18.2	10.3

* The model restricts individuals age 70 or older to not work.

11.8 Reform impacts on work around typical retirement ages

Table 29 and Table 30 show working patterns (not working, full-time work and part-time work) around typical ages of retirement (ages 55-70) for women and men. The fraction of women not working increases over all the age categories, which suggests that the reform encourages earlier retirement. For men, the reform does not affect much the proportion working until age 69, after which fewer men work with the reform. Also, the working rates of men age 55-56 are lower by about 3 percentage points with the reform.

12 Conclusions

The simulations indicate the following impacts of the pension reform on pension withdrawals, pension savings, labor supply, and retirement:

(i) The pension reform significantly increases the level of pension withdrawals for women, who before the reform were mainly getting pension income through the PASIS welfare pen-

Table 29
Working patterns around the age of retirement in 2014
for women age 55-70, without and with the reform

Without reform			
age group	not working	working full-time	working part-time
55-56	57.0	31.4	11.5
57-58	57.0	28.5	14.6
59-60	52.7	29.1	18.2
61-62	62.4	24.8	12.8
63-64	56.5	24.1	19.4
65-66	68.8	16.7	14.4
67-68	63.9	26.6	9.56
69-70	94.8	5.15	0.00
With reform			
age group	not working	working full-time	working part-time
55-56	58.8	29.7	11.5
57-58	57.6	27.9	14.6
59-60	53.1	29.1	17.8
61-62	62.1	24.8	13.1
63-64	56.5	24.1	19.4
65-66	68.8	14.3	16.9
67-68	64.0	28.6	7.46
69-70	94.8	5.15	0.00

* The model restricts individuals age 70 or older to not work.

Table 30
Working patterns around the age of retirement in 2014
for men age 55-70, without and with the reform

Without reform		
age group	not working	working full-time
55-56	31.9	68.1
57-58	41.3	58.7
59-60	50.3	49.7
61-62	44.5	55.5
63-64	43.3	56.7
65-66	54.5	45.5
67-68	53.7	46.3
69-70	78.8	21.2
With reform		
age group	not working	working full-time
55-56	35.5	64.5
57-58	40.0	60.0
59-60	48.1	51.9
61-62	40.6	59.4
63-64	43.8	56.2
65-66	55.3	44.7
67-68	53.7	46.3
69-70	80.2	19.8

* The model restricts individuals age 70 or older to not work.

sion. The reform also leads to modest increases in the pension withdrawal amounts for males, at the lower end of the pension withdrawal distribution. The level of women's pension withdrawals after the reform is equal to that of men in the first two quartiles and the gender gap is much reduced across the upper quartiles.

(ii) The pension reform largely eliminates old-age poverty (given our definitions of poverty). The pre-reform poverty rates for people aged 60 or younger are fairly sensitive to the measure used to define poverty, in particular, whether receipt of the PASIS pension qualifies as being poor. The pension reform leads to a slight increase in poverty rates for the younger age groups due to work disincentive effects.

(iii) The simulations indicate a disincentive effect of the reform on working in the covered sector for both men and women for ages 50 and older, which leads to a drop in their density of contributions. As retirement nears, incentives to contribute to the pension system are lower than before the reform due to higher expected income in retirement. This tends to reduce participation in the covered labor market.

(iv) The pension reform seems to introduce some disincentives for earlier retirement for women aged 55-70 and for men age 69 and older.

(v) The pension reform leads to increases of about 95% in the mean level of women's pension savings, but a decrease of 7.7% in men's pension savings, due to the shift towards working in the uncovered sector.

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A List of estimation moments

The following is the list of moments of the joint distribution of savings, labor force participation and sector choices used to fit the model to the data. They correspond to information on the estimation sample in year 2006.

1 Fraction with under 3 million Private savings 35-45 - married
2 Fraction with under 3 million Private savings 45-55 - married
3 Fraction with under 3 million Private savings 55-65 - married
4 Fraction with over 6 million Private savings 35-45 - married
5 Fraction with over 6 million Private savings 45-55 - married
6 Fraction with over 6 million Private savings 55-65 - married
7 Fraction with under 3 million Private savings 35-45 - single males
8 Fraction with under 3 million Private savings 45-55 - single males
9 Fraction with under 3 million Private savings 55-65 - single males
10 Fraction with over 6 million Private savings 35-45 - single males
11 Fraction with over 6 million Private savings 45-55 - single males
12 Fraction with over 6 million Private savings 55-65 - single males
13 Fraction with under 3 million Private savings 35-45 - single females
14 Fraction with under 3 million Private savings 45-55 - single females
15 Fraction with under 3 million Private savings 55-65 - single females
16 Fraction with over 6 million Private savings 35-45 - single females
17 Fraction with over 6 million Private savings 45-55 - single females
18 Fraction with over 6 million Private savings 55-65 - single females
19 Fraction with under 3 million total wealth 35-45 - married
20 Fraction with under 3 million total wealth 45-55 - married
21 Fraction with under 3 million total wealth 55-65 - married
22 Fraction with over 12 million total wealth 35-45 - married
23 Fraction with over 12 million total wealth 45-55 - married
24 Fraction with over 12 million total wealth 55-65 - married
25 Fraction with under 3 million total wealth 35-45 - single males
26 Fraction with under 3 million total wealth 45-55 - single males
27 Fraction with under 3 million total wealth 55-65 - single males
28 Fraction with over 12 million total wealth 35-45 - single males
29 Fraction with over 12 million total wealth 45-55 - single males
30 Fraction with over 12 million total wealth 55-65 - single males
31 Fraction with under 3 million total wealth 35-45 - single females
32 Fraction with under 3 million total wealth 45-55 - single females
33 Fraction with under 3 million total wealth 55-65 - single females
34 Fraction with over 12 million total wealth 35-45 - single females
35 Fraction with over 12 million total wealth 45-55 - single females
36 Fraction with over 12 million total wealth 55-65 - single females
37 Fraction working 35-45 - males
38 Fraction working 45-55 - males
39 Fraction working 55-65 - males
40 Fraction working 65-70 - males
41 Fraction working 35-45 - married females
42 Fraction working 45-55 - married females
43 Fraction working 55-65 - married females
44 Fraction working 65-70 - married females
45 Fraction working 35-45 - single females
46 Fraction working 45-55 - single females
47 Fraction working 55-65 - single females
48 Fraction working 65-70 - single females
49 Fraction in part-time work 35-45 - married females
50 Fraction in part-time work 45-55 - married females
51 Fraction in part-time work 55-65 - married females
52 Fraction in part-time work 35-45 - single females
53 Fraction in part-time work 45-55 - single females

54 Fraction in part-time work 55-65 - single females
55 Fraction in the Formal sector - No HS - males
56 Fraction in the Formal sector - HS dropout - males
57 Fraction in the Formal sector - HS graduate - males
58 Fraction in the Formal sector - College graduate - males
59 Fraction in the Formal sector - No HS - females
60 Fraction in the Formal sector - HS dropout - females
61 Fraction in the Formal sector - HS graduate - females
62 Fraction in the Formal sector - College graduate - females
63 Fraction transiting from Formal to Formal - males
64 Fraction transiting from Formal to Informal - males
65 Fraction transiting from Informal to Formal - males
66 Fraction transiting from Informal to Informal - males
67 Fraction transiting from Inactive to Formal - males
68 Fraction transiting from Inactive to Informal - males
69 Fraction transiting from Formal to Formal - females
70 Fraction transiting from Formal to Informal - females
71 Fraction transiting from Informal to Formal - females
72 Fraction transiting from Informal to Informal - females
73 Fraction transiting from Inactive to Formal - females
74 Fraction transiting from Inactive to Informal - females
75 Average annual earnings - No HS - Formal sector - males
76 Average annual earnings - HS dropout - Formal sector - males
77 Average annual earnings - HS graduate - Formal sector - males
78 Average annual earnings - less than 5 years of labor market experience - Formal sector - males
79 Average annual earnings - 5-15 years of labor market experience - Formal sector - males
80 Average annual earnings - 15-25 years of labor market experience - Formal sector - males
81 Average annual earnings - 25-35 years of labor market experience - Formal sector - males
82 Average annual earnings - 35-45 years of labor market experience - Formal sector - males
83 Average annual earnings - 45-55 years of labor market experience - Formal sector - males
84 Average annual earnings - No HS - Informal sector - males
85 Average annual earnings - HS dropout - Informal sector - males
86 Average annual earnings - HS graduate - Informal sector - males ”
87 Average annual earnings - less than 5 years of labor market experience -Informal sector - males
88 Average annual earnings - 5-15 years of labor market experience - Informal sector - males
89 Average annual earnings - 15-25 years of labor market experience - Informal sector - males
90 Average annual earnings - 25-35 years of labor market experience - Informal sector - males
91 Average annual earnings - 35-45 years of labor market experience - Informal sector - males
92 Average annual earnings - 45-55 years of labor market experience - Informal sector - males
93 Average annual earnings - No HS - Formal sector - females
94 Average annual earnings - HS dropout - Formal sector - females
95 Average annual earnings - HS graduate - Formal sector - females
96 Average annual earnings - less than 5 years of labor market experience - Formal sector - females
97 Average annual earnings - 5-15 years of labor market experience - Formal sector - females
98 Average annual earnings - 15-25 years of labor market experience - Formal sector - females
99 Average annual earnings - 25-35 years of labor market experience - Formal sector - females
100 Average annual earnings - No HS - Informal sector - females
101 Average annual earnings - HS dropout - Informal sector - females
102 Average annual earnings - HS graduate - Informal sector - females
103 Average annual earnings - less than 5 years of labor market experience - Informal sector - females
104 Average annual earnings - 5-15 years of labor market experience - Informal sector - females
105 Average annual earnings - 15-25 years of labor market experience - Informal sector - females
106 Average annual earnings - 25-35 years of labor market experience - Informal sector - females
107 Fraction with under 1.5 million annual earnings - covered sector - males
108 Fraction with under 1.5 million annual earnings - uncovered sector - males
109 Fraction with over 4.5 million annual earnings - covered sector - males
110 Fraction with over 4.5 million annual earnings - uncovered sector - males
111 Fraction with under 1.5 million annual earnings - covered sector - females
112 Fraction with under 1.5 million annual earnings - uncovered sector - females
113 Fraction with over 4.5 million annual earnings - covered sector - females
114 Fraction with over 4.5 million annual earnings - uncovered sector - females
115 Average 1st difference in earnings - males (conditional on working at t and t-1)
116 Average 1st difference in earnings - females (conditional on working at t and t-1)
117 Fertility - married females

118 Fertility - single females
119 Fertility - no HS
120 Fertility - HS dropout
121 Fertility - HS graduate
122 Fertility - married females with one-two kid
123 Fertility - married females with three-four kids
124 Fertility - single females with one-two kid
125 Fertility - single females with three-four kids
126 Fraction of break ups - 35-45
127 Fraction of break ups - 45-55
128 Fraction of break ups - 55-65
129 Fraction of break ups - 65-75
130 Fraction of break-ups - no HS
131 Fraction of break-ups - HS dropout
132 Fraction of break-ups - HS graduate
133 Fraction of break-ups - Age difference¿=5
134 Fraction of break-ups - Age difference¡5,¿-5
135 Fraction of break-ups - Age difference¡=-5
136 Fraction working in the covered sector 35-45 - males LFP
137 Fraction working in the covered sector 45-55 - males LFP
138 Fraction working in the covered sector 55-65 - males LFP
139 Fraction working in the covered sector 65-70 - males LFP
140 Fraction working in the covered sector 35-45 - married females LFP
141 Fraction working in the covered sector 45-55 - married females LFP
142 Fraction working in the covered sector 55-65 - married females LFP
143 Fraction working in the covered sector 35-45 - single females LFP
144 Fraction working in the covered sector 45-55 - single females LFP
145 Fraction working in the covered sector 55-65 - single females LFP
146 Fraction working in the covered sector 65-70 - single females LFP
147 Fraction working 35-45 - single females - no child LFP
148 Fraction working 45-55 - single females - no child LFP
149 Fraction working 55-65 - single females - no child LFP
150 Fraction working 65-70 - single females - no child LFP
151 Fraction working 35-45 - married females - two or more children LFP
152 Fraction working 45-55 - married females - two or more children LFP
153 Fraction working 55-65 - married females - two or more children LFP
154 Fraction working 65-70 - married females - two or more children LFP
155 Fraction working 35-45 - single females - two or more children LFP
156 Fraction working 45-55 - single females- two or more children LFP
157 Fraction working 55-65 - single females - two or more children LFP
158 Fraction working 65-70 - single females - two or more children LFP

B Exclusion Restrictions

Table B.1: **Exclusions: Households who contributed to the INP system**

variable	**mean**
Couples (%)	66.7
Single Women (%)	21.8
Single Men (%)	11.5
Lab. Force Part. (wom., %)	32.1
Lab. Force Part. (men, %)	60.9
Formal sector* (wom., %)	58.8
Formal sector* (men, %)	56.1
Age (men)	59.7
Age (wom.)	57.4
Schooling (men, years)	8.0
Schooling (wom., years)	7.9
Children	3.1

Source: Encuesta EPS, Superintendencia de Pensiones
* as a fraction of those working

Table B.2: **Exclusions: Households who contributed to the INP system**

variable	**mean**	**p10**	**p25**	**p50**	**p75**	**p90**
Annual Earnings (men, MM PS)	3.5	0.8	1.5	2.2	3.6	6.6
Annual Earnings (wom., MM PS)	2.5	0.6	1.1	1.8	2.6	5.2
Non-Pension assets** (MM PS)	16.5	0.0	4.0	9.7	18.0	35.0

Source: Encuesta EPS, Superintendencia de Pensiones
Note: MM PS = Million Pesos
** The top 2% of pension values were trimmed in calculating these statistics to avoid sensitivity to outliers in the data

Table B.3: **Exclusions: Individuals younger than 35 in 2004**

variable	**mean**
Couples (%)	48.6
Single Women (%)	24.2
Single Men (%)	27.2
Lab. Force Part. (wom., %)	51.6
Lab. Force Part. (men, %)	87.8
Formal sector* (wom., %)	73.0
Formal sector* (men, %)	71.4
Age (men)	30.2
Age (wom.)	28.5
Schooling (men, years)	11.4
Schooling (wom., years)	11.7
Children	1.0

Source: Encuesta EPS, Superintendencia de Pensiones
* as a fraction of those working

Table B.4: **Exclusions: Individuals younger than 35 in 2004**

variable	**mean**	**p10**	**p25**	**p50**	**p75**	**p90**
Annual Earnings (wom., MM PS)	2.4	0.6	1.2	1.8	3.0	4.5
Annual Earnings (men, MM PS)	3.2	1.2	1.6	2.4	3.6	5.5
Non-Pension assets** (MM PS)	8.9	-0.1	0.3	4.8	11.9	20.9
Pension assets** (wom., MM PS)	1.8	0.0	0.0	0.0	0.3	1.8
Pension assets** (men, MM PS)	7.0	0.0	0.2	1.1	3.0	6.0

Source: Encuesta EPS, Superintendencia de Pensiones
Note: MM PS = Million Pesos
** The top 2% of pension values were trimmed in calculating these statistics to avoid sensitivity to outliers in the data

Table B.5: **Exclusions: Individuals who remarried after the age of 35**

variable	**mean**
Couples (%)	59.7
Single Women (%)	26.9
Single Men (%)	13.5
Lab. Force Part. (wom., %)	38.2
Lab. Force Part. (men, %)	70.1
Formal sector* (wom., %)	64.6
Formal sector* (men, %)	55.6
Age (men)	54.8
Age (wom.)	52.0
Schooling (men, years)	8.3
Schooling (wom., years)	8.1
Children	2.7

Source: Encuesta EPS, Superintendencia de Pensiones
* as a fraction of those working

Table B.6: **Exclusions: Individuals who remarried after the age of 35**

variable	**mean**	**p10**	**p25**	**p50**	**p75**	**p90**
Annual Earnings (wom., MM PS)	3.4	0.5	1.0	1.7	3.6	6.0
Annual Earnings (men, MM PS)	7.9	0.7	1.4	2.0	3.6	6.6
Non-Pension assets** (MM PS)	12.7	0.0	1.9	5.1	15.0	29.7
Pension assets** (wom., MM PS)	2.7	0.0	0.0	0.0	0.8	5.7
Pension assets** (men, MM PS)	11.5	0.0	0.0	2.4	7.7	17.7

Source: Encuesta EPS, Superintendencia de Pensiones
Note: MM PS = Million Pesos
** The top 2% of pension values were trimmed in calculating these statistics to avoid sensitivity to outliers in the data

Table B.7: **Exclusions: Inconsistent or missing answers**

variable	**mean**
Couples (%)	71.2
Single Women (%)	18.8
Single Men (%)	10.0
Lab. Force Part. (wom., %)	47.0
Lab. Force Part. (men, %)	81.2
Formal sector* (wom., %)	60.0
Formal sector* (men, %)	61.7
Age (men)	49.4
Age (wom.)	48.6
Schooling (men, years)	10.0
Schooling (wom., years)	9.9
Children	2.9

Source: Encuesta EPS, Superintendencia de Pensiones
* as a fraction of those working

Table B.8: **Exclusions: Inconsistent or missing answers**

variable	**mean**	**p10**	**p25**	**p50**	**p75**	**p90**
Annual Earnings (wom., MM PS)	3.5	0.6	1.2	1.9	4.2	6.1
Annual Earnings (men, MM PS)	7.0	1.3	1.8	3.0	4.8	9.6
Non-Pension assets** (MM PS)	14.5	0.0	3.0	6.9	16.2	30.5
Pension assets** (wom., MM PS)	2.6	0.0	0.0	0.0	0.5	4.1
Pension assets** (men, MM PS)	13.2	0.0	0.4	4.2	10.7	26.7

Source: Encuesta EPS, Superintendencia de Pensiones
Note: MM PS = Million Pesos
** The top 2% of pension values were trimmed in calculating these statistics to avoid sensitivity to outliers in the data

C Parameter Estimates

Table C.1: Probability of no pregnancy: logistic regression

	Coef.	**Std. Err.**	**z**
married	-0.92086***	0.241469	-3.81
number of kids	-0.78756***	0.085428	-9.22
married*kids	0.302895***	0.092842	3.26
schooling	-0.05482***	0.01195	-4.59
age	0.149925***	0.011537	13
constant	0.449574	0.478111	0.94

Table C.2: Simulated Method of Moments Estimates

Name	**Symbol**	**Estimate**	***Std. errors***	**z**
CRRA coefficient	σ	-0.5755***	*0.0198*	-29.0286
Marginal utility of consumption coefficients:				
Stock of children (female)	ν_0^f	0.2750***	*0.0665*	4.1375
Stock of children (male)	ν_0^m	0.8734***	*0.0633*	13.7912
Leisure (female)	ν_1^f	1.6336***	*0.2487*	6.5686
Leisure (male)	ν_1^m	0.9219***	*0.1620*	5.6907
Utility from staying at home				
female, type 1	δ_l^f	0.0725***	*0.0144*	5.0204
female, type 2	δ_l^f	0.2225***	*0.0371*	5.9927
male, type 1	δ_l^m	-0.0280**	*0.0121*	-2.3178
male, type 2	δ_l^m	-0.0355***	*0.0093*	-3.8372
Utility of part-time work (female)	δ_p^f	0.4992***	*0.0411*	12.1562
Log Income coefficients (Formal sector, male):				
Constant (type 1)	θ_{0C}^m	-0.2138***	*0.0724*	-2.9509
Constant (type 2)	θ_{0C}^m	-0.2825**	*0.1110*	-2.5447
Schooling	θ_{1C}^m	0.1100***	*0.0080*	13.7818
Experience	θ_{2C}^m	0.0320***	*0.0057*	5.6262
Experience squared	θ_{3C}^m	-0.0006***	*0.0001*	-4.8938
Log Income coefficients (Informal sector, male):				
Constant (type 1)	θ_{0U}^m	-0.6252***	*0.1945*	-3.2142
Constant (type 2)	θ_{0U}^m	-0.1839*	*0.0969*	-1.8986
Schooling	θ_{1U}^m	-0.0075	*0.0062*	-1.2084
Experience	θ_{2U}^m	0.0200***	*0.0048*	4.1708
Experience squared	θ_{3U}^m	0.0001	*0.0001*	0.7821
Log Income coefficients (Formal sector, female):				
Constant (type 1)	θ_{0C}^f	-0.4509***	*0.1017*	-4.4355
Constant (type 2)	θ_{0C}^f	-0.4784**	*0.2042*	-2.3432
Schooling	θ_{1C}^f	0.0980***	*0.0094*	10.4468
Experience	θ_{2C}^f	0.0423***	*0.0086*	4.9384
Experience squared	θ_{3C}^f	-0.0008***	*0.0003*	-2.7306
Log Income coefficients (Informal sector, female):				
Constant (type 1)	θ_{0U}^f	-0.3125***	*0.0983*	-3.1792
Constant (type 2)	θ_{0U}^f	-0.6488***	*0.2945*	-2.2026
Schooling	θ_{1U}^f	0.0000	*0.0009*	0.0000
Experience	θ_{2U}^f	0.0400***	*0.0086*	4.6626
Experience squared	θ_{3U}^f	-0.0005*	*0.0003*	-1.7201
Probability of no separation coefficients				
Constant	π_0	-5.2075***	*0.1519*	-34.2915
Age of the husband	π_1	0.0274***	*0.0009*	30.2029
Schooling	π_2	0.0278***	*0.0008*	37.0225
Age difference	π_3	0.0017***	*0.0001*	14.0455
Switching costs				
Between sectors (male)	δ_s^m	0.0085***	*0.0017*	5.0223
Between sectors (female)	δ_s^f	0.0040***	*0.0005*	7.8330
Returning to work (male)	δ_w^m	0.6735***	*0.0729*	9.2444
Returning to work (female)	δ_f^f	0.6704***	*0.0692*	9.6889
Type logit coefficients				
Constant	ρ_0	0.1000	*0.0796*	1.2562
Schooling (female)	ρ_s^f	0.0134	*0.0086*	1.5590
Schooling (male)	ρ_s^m	-0.0035	*0.0039*	-0.8920
Shock variances				
Earnings (male, covered sector)	σ_C^m	0.1950***	*0.0442*	4.4158
Earnings (male, uncovered sector)	σ_U^m	0.5812***	*0.1119*	5.1942
Earnings (female, covered sector)	σ_C^f	0.2200***	*0.0528*	4.1687
Earnings (female, uncovered sector)	σ_U^f	0.6758***	*0.1525*	4.4321
Utility of staying home (male)	σ_H^m	0.1530***	*0.0284*	5.3819
Utility of staying home (female)	σ_H^f	0.2663***	*0.0419*	6.3600