Implicit Redistribution within Argentina's Social Security System: A Micro-simulation Exercise

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Implicit Redistribution within Argentina's Social Security System: a micro-simulation exercise

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We assess intra-generational redistribution in the Argentinean pension and unemployment insurance programs on a lifetime basis. Using household surveys, we simulate lifetime declared labor income and flows of contributions and benefits, and compute the expected present values of income and net flows. The results show the PAYG-DB system appears to be regressive, specially for women in the private sector. Under the individual account option available until 2008, Social Security is regressive for private workers but not for those in the public sector. When we include income from informal jobs, the system becomes slightly progressive. A weak enforcement of the law makes the system less regressive. Assuming the removal of informal labor, the system becomes almost neutral, even showing a small level of progressivity.

Keywords: social security, redistribution, micro-simulations, Argentina.

JEL: H50, H55

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1. Introduction

This document assesses the implicit redistribution of the Argentinean pension and unemployment insurance programs on a lifetime basis. Using household surveys we simulate lifetime declared labor income and flows of contributions and benefits, and compute the expected present values of income and net flows. Standard distribution indexes are used to assess the distribution and redistribution implicit in these systems. We compare the current PAYG-DB system with the mandatory individual DC system that was in force, and coexisted with the PAYG-DB option, until the reform of November 2008.

The main finding is that the current PAYG-DB system in Argentina appears to be regressive, specially in the case of women working in the private sector. On the other hand, under an individual account system, social security is almost neutral, showing a slight regressiveness for private workers but not for those in the public sector. If income from informal jobs are also accounted for, the system becomes slightly progressive. A similar result emerges under a weak enforcement of the system rules.

Our main finding that a solidarity system as the PAYG-DB that is in place in Argentina is regressive appears to be at odds with the preconception that from a distributional point of view this type of arrangements are more progressive than a system with individual accounts, which almost by definition are actuarially fair. A possible explanation for our result that the PAYG-DB system does not improve income distribution is that if soft eligibility conditions were required, the system would be unbalanced from a financial point of view since contributions from current workers would not be sufficient to honor benefit payments, so the system requires strict eligibility conditions, specially in terms of the number of years of contributions, as well as low replacement ratios. This characteristic in an environment where informal job is widely present, at least for some population groups, means that many are left behind when reaching the age of retirement. This question, which is not present in a framework of individual accounts, mostly affects low-income earners, who are less likely to show compliance with the requirements for access to a retirement.

The paper is organized as follows. Section 2 presents the conceptual framework. A brief description of the old age pension and unemployment insurance programs is presented in section 3. Section 4 describes the data, while section 5 presents the methodology. The main results are discussed in section 6, while section 7 summarize the main findings.

2. Conceptual Framework[2]

Social Security (SS) programs are usually designed to redistribute income from the better to the worst off. Most benefit formulas include explicit redistributive ingredients, like minimum pensions and supplements to small pensions. Even individual accounts DC programs, which are based on the principle of actuarial fairness, tend to incorporate non-actuarial redistributive components in the real world.

But SS programs also redistribute income through less explicit mechanisms. First, high mortality rates may reduce the returns low income workers get for their contributions in pension programs when unified mortality tables are used (Garrett 1995; Duggan *et al.* 1995; Beach and Davis 1998). Second, government transfers that contribute to finance SS in many countries favor the population that is covered by the programs, which in developing countries

[2] This section summarizes the proposal of the Research Program developed with the support of the World Bank project "Assessing Implicit Redistribution within Social Insurance Systems", which included five case studies: Argentina and Mexico (Moncarz, 2011), Brazil (Zylberstajn, 2011), Chile (Fajnzylber, 2011) and Uruguay (Forteza and Mussio, 2012).

tends to be the better off (Rofman *et al.* 2008). Third, low densities of contribution may leave many workers ineligible for benefits. Low income workers have been shown to have particularly low densities of contribution (Forteza *et al.* 2009; Berstein *et al.* 2006). In the present case we focus on this last channel, i.e. the redistribution stemming from the fact that low income workers tend to have systematically shorter contribution histories. It should be clear that the impact of different mortality rates and different coverage on implicit redistribution is not assessed.

Micro-simulations of lifetime income and SS contributions and benefits are used to assess SS redistribution. The focus in this paper is on intra-generational redistribution: one cohort, current pension rules. Even when they are not less important, we do not analyze inter-generational transfers (e.g. between current workers and current beneficiaries), nor among those reached by the system, either because they have contributed during their working life and/or have access to a benefit, and those that are never included by the system.

The individual is considered as the unit of analysis, but it should be noticed that redistribution in the SS system may look very different at the family level. Gustman and Steinmeier (2001) show that, when analyzed at the individual level, the U.S. social security looks very redistributive, favoring low income workers, but it looks much less so at the family level (see also Lambert 1993, p 14). Sadly, the lack of appropriate data impedes us to follow this route. Also, an element that may reduce the difference between outcomes when considering the family or the individual as the unit of analysis, is that differently from the US system, the Argentinean case only allows for a "survivor benefit", while in the case of the US there is a "spouse benefit" which is paid even before the main beneficiary dies. Gustman and Steinmeier (2001) find that the "spouse benefit" is quantitatively important, and implies more a transfer within the family itself than between families.

Ideally, the assessment of the redistributive impact of social security programs should be based on the comparison of income distribution with and without social security. This is not the same as comparing pre- and post-social security income (i.e. income minus contributions plus benefits), because social security is likely to induce changes in work hours, savings, wages and interest rates. One possible drawback of these models is the assumption of full rationality, something that has been subject to much controversy, especially regarding long run decisions like those involved in social security. After all, the most appealed rationale for pension programs is individuals' myopia (Diamond, 2005, chap. 4). In turn, much of fiscal incidence analysis is done on the non-behavioral type of assumption. It is usually performed under the assumption that pre-tax income is not affected by the tax system. The approach here proposed is closer to the literature pioneered by Gruber and Wise (1999, 2004), who designed and computed a series of indicators of SS incentives to retire assuming no explicit behavioral responses.

The optimization models have the obvious advantage of incorporating behavioral responses, so not only the direct effects of policies are considered, but also the indirect effects that go through behavioral changes. However, in order to keep things manageable, these theoretically ambitious models necessarily make highly stylized assumptions regarding not only individual preferences and constraints, but also social security programs. Given the goals of the proposed research, this is a serious drawback. Non-behavioral micro-simulations are based on exogenously given work histories and geared to providing insights on the social security transfers that emerge from those histories. Thanks to their relative simplicity, non behavioral models allow for a much more detailed specification of the policy rules and work histories than inter-temporal optimization models. An additional advantage of micro-simulations is that the effects are straightforward, so no black-box issues arise. At the very least, it can be expected to capture the first-order impact effects of social security on income distribution.

The micro-simulation modeling can thus be seen as a first step in a more ambitious research program that incorporates behavioral responses in a more advanced phase.

3. The Argentinean pension and unemployment programs

With small variations, Diamond (2006), Valdés Prieto (2006), Lindbeck and Persson (2003) and Lindbeck (2006) classify social security systems according to three dimensions: the degree of funding, the distribution of risks, and the degree of actuarial fairness.

PAYG programs are totally unfunded and so they lie at one extreme of the degree of funding dimension. In these programs, benefits are entirely financed by the current flow of contributions and there are no funds to back pension rights. At the other extreme lie programs in which accrued pension rights are fully backed by previous contributions. Individual savings accounts are the most common form of fully funded pension schemes. In this case, pension rights are linked to accumulated financial assets in the individual account.

In the second dimension, pension programs are usually classified as DB or DC. In a DC program, contributions are fixed and benefits are residually determined, adjusted to ensure financial sustainability. In a DB program, benefits are fixed –or more commonly the relation between earnings and pension is settled in a formula– and contributions are adjusted endogenously.

The third dimension refers to the link between individual contributions and benefits. The program is actuarially fair if the expected sum of discounted benefits and contributions are equal. It is said to be "non-actuarial" if there is no link between contributions and benefits.

Most PAYG pension programs are DB and non-actuarial, and individual savings accounts are in principle fully funded, DC and actuarially fair. But other combinations are also possible. Non-financial-defined-contributions pension programs –also known as notional accounts– are totally unfunded (e.g. PAYG), and yet they are DC and also exhibit high degrees of actuarial fairness. Many DB programs have reserves that back pension rights, particularly so when programs are relatively young.

PAYG-DB programs usually have some in-built redistributive components, like minimum and maximum pensions, so they are often considered to be better equipped in principle to perform redistribution than more actuarial DC programs (Palmer, 2006). Pure individual savings accounts are actuarially fair and hence, by construction, do not perform redistribution. In this light, if pension programs are expected to alleviate poverty and reduce inequality in all age (Barr, 2001), PAYG-DB programs have an advantage over individual savings accounts. However, in the real world it is not always clear whether PAYG-DB programs are effective in alleviating poverty or reducing income inequality in old-age. Also many saving accounts programs are complemented with redistributive non-actuarial components, like minimum pension guarantees and matching contributions. Therefore, whether a program contributes to reducing inequality is an empirical issue.

In the US there has been an active debate over how progressive social security is in practice. Gustman and Steinmeier (2001) on redistribution at the individual *vs*. family level. Garrett (1995), Duggan *et al*. (1995), Beach and Davis (1998) on mortality rates. In developing countries, at least two additional factors may contribute to reduce the ability of social security to ameliorate poverty and reduce income inequality in old age. First, social security coverage is mostly limited to the better off (Rofman *et al*. 2008). Also governments often subsidize social security and, given that coverage is very low among low income individuals, these subsidies may be regressive. Second, low income individuals tend to have short work histories (Forteza *et al.* 2009), which in most DB programs imply reduced or even no pension benefits at all (Forteza and Ourens, 2012).

3.1. A brief history of Argentina's social security[3]

In Argentina, the first pension funds appeared in the early of the 20th century (in 1904, the employees of the public administration, in 1905, the railway workers). Between 1916 and 1930 the system extended to other activities, covering most public employees; the financial, banking and insurance sector; journalists; printing industry; merchant seamen and aviation workers. Despite the expansion of pension funds, the overall coverage was quite limited, and also there was a high heterogeneity among the different sectors, in terms retirement age, amount of contributions, and benefits. However, one common feature was that of individual capitalization.

Between 1944 and 1954 the system was extended further covering almost all formal workers, although there was still a marked heterogeneity across sectors. This last feature changed in 1954, when the system moved from one of individual accounts to a one of PAYG type, also it was introduced a progressive element with low and medium wage workers receiving higher replacement ratios at retirement. Another feature was that the system, due to its relative youth, enjoyed a financial surplus, but this would change quickly.

In 1958, it was introduced the mobility in the benefits, with a guarantee of 82% of the wage the beneficiary received before retirement. This element meant a certain homogenization in the benefits across the different sectors, and the abolishment of the progressive component introduced with the 1954 reform. Also, and perhaps most serious was that with the maturation of the system, and due to the existence of a high proportion of informal workers and high levels of evasion in the payment of contributions, the system began to experience deficits. These deficits lead to a new reform in 1969, which involved the union of the various pension funds, and the introduction of a centralized management, this last change in fact meant cross-sector transfers from those with surplus to those with deficits. The reform also introduced more stringent conditions to access to a benefit, with the increase of the minimum age and the number of years of contributions. Also, the benefit would be a function of the worker's earnings history, calculated as an average of the best three years of salaries during the last 10 years of work, which led to the replacement ratio to be between 70% and 82%. The mobility benefits were maintained. However, all these changes meant only temporary relief to the financial imbalances.

In 1980 a new reform contributed significantly to increase the system's deficit, with the elimination of employer contributions, and its replacement with resources from the collection of Value Added Tax (VAT). The growing of informal employment, evasion, and the greater maturity of the system led to the primary deficit to reach 60% of total expenditures. This meant that in the eighties the system was almost near the collapse, which meant the need for the reintroduction of employer contributions.

The penultimate structural reform took place in October 1993, with the reintroduction of the system of individual accounts that would coexist with the public system. Under this mix system, the retirement benefit of the public PAYG-DB pillar was conformed of three parts, a flat payment, a benefit based on contributions made before the reform, and another based on contributions made after the reform. The latter two components were calculated based on the years of contributions and the average wage received in the last years of work before retirement. For those who chose to migrate to, or new workers that choose the system of individual accounts, the total benefit also consisted of three parts. The same flat payment paid in the public pillar, a payment based on the contributions made to the public system, and other payment using the funds accumulated in the individual account. The first two components were the responsibility of the public sector. After a period spent in one system, workers had

[3] This section draws upon Basualdo *et al*. (2009).

the option to switch between systems. Even under the individual account system there was some redistributive components through the payment of a flat benefit, as well as the existence of a minimum pension. Benefits paid by the public system, and those of the individual account system that were its responsibility, were financed with contributions from employers and from workers belonging to the public pillar.

In the late 2008, at the peak of the global financial crisis, and under the official excuse that the balances in the individual accounts were rapidly losing much of their value, a last reform took place, and the individual account system was abolished. However, the most general belief was that the measure was heavily influenced by the needs of funding by the Government. At that moment of the abolishment, the funds accumulated in the individual account system were about 29 billions USD, but not less than half of that amount were public bonds issued by the Government itself. These funds were destined to the constitution of the *Fondo de Garantía de Sustentabilidad*[4] (FGS) administered by the Administración Nacional de Seguridad Social[5] (ANSES). However, maybe the most important issue was that the Government, by the intermediation of the ANSES, was able to take control over approximately 4 billions USD each year in contributions made by the employees that had in the past chosen the individual account system.[6]

3.2. The current system

At the present time, there still coexist several retirement systems. On the one hand there is the national system which covers private sector workers and federal public employees, as well as people that works in the public sector in some provinces. At the sub-national level, several provinces have their own systems which cover provincial and municipal public employees, more or less half of these systems were merged with the national system during the second half of the 1990s. Finally, professional councils that regulate professional activities, such as engineers, lawyers, etc., have their own systems that are organized at a provincial level. Even more, both at the national and sub-national levels there is a wide number of specific regimes covering specific activities, for instance the judiciary, university researchers, etc. Finally, an additional component that has gained importance in recent years is the widespread grant of non-contributory pensions.[7] However, due to data availability, the analysis here will concentrate only on the general regime under the administration of the ANSES, which is the one with the most coverage.[8]

More specifically, the current system is regulated by the Law 24241. The conditions salaried workers must meet in order to be entitled to a retirement benefit are the following:[9]

- 30 years of contributions
- 65 years for men and 60 for women. Women, if they choose to, can continue working until reaching 65 years.

[4] Sustainability Guarantee Fund.

[5] National Social Security Administration.

[6] With the abolishment of the individual account system, the ANSES has become one of the most important sources of financing to the public sector, only behind the Central Bank.

[7] Lusting and Pessino (2012) show that non-contributory pensions as a share of GDP rose by 2.2 percentage points between 2003 and 2009, while Argentina's total social spending as a share of GDP increased by 7.6 percentage points. The authors show that the increase in the weight of non-contributory pensions entailed a redistribution of income to the poor, and from the formal sector pensioners with above minimum pensions to the beneficiaries of the pension moratorium launched in 2004.

[8] This regime represents, approximately, between 75% and 80% of all beneficiaries, including survivor benefits.

[9] We exclude from the analysis people working under any other regime than salaried workers, such as self-employed.

- People that do not comply with the minimum length of contribution can compensate each year of missing contributions with two additional years counted after reaching the minimum retirement age.

People who do not meet the previous conditions can access an old-retirement pension if:

- They are 70 years old.
- Have a minimum of 10 years of contributions.
- Have 5 years of contributions in the 8-year period previous to retirement.

The Health and Social Security System is founded by contributions made by workers and employers. Workers contribute an 11% of the gross salary, while employers contribute a 16%. In June 2011 the maximum gross salary to calculate both contributions was A$ 16213.72 (US$ 3925.85), while the minimum wage was $A 498.89 (US$ 120.79). Workers also contribute a 6% for health insurance, and 1% in case they choose to affiliate to a trade union. Employers contribute a 8% for health insurance.[10] The final pillar of the system, which we do not include in the analysis below, is the labor accident coverage.

With respect to the benefits, the monthly payment is divided into two parts:

- A flat benefit known as Universal Basic Pension (PBU). In June 2011 the PBU was A$ 667.92 (US$ 161.72). If the person retired under the old-age pension scheme the PBU is 70% of the full amount.
- A compensatory payment (PC) that is equal to 1.5% for each year of contribution, or fraction above six months (with a maximum of 35 years) of the average real gross salary[11] (including the worker contributions to the Social Security System but excluding the employer contributions) over the last 10 years previous retirement. In order to calculate the average gross salary, periods in which the person was not working are excluded. In despite of the legal norm makes reference to the 10 years previous retirement, it is customary to consider the last 120 positive remunerations previous retirement. In June 2011, the maximum amount a person was entitled to receive under the PC was A$ 10507.90 (US$ 2544.28).
- In June 2011, the System guarantied a minimum pension of A$ 1434.29 (US$ 347.28).

Between October 1993 and November 2008 there coexisted two systems. The PAYG-DB system just summarized, and a system based on a mandatory individual account.[12] Leaving aside the transition period and those workers who had migrated between the two systems during their working life, anyone who chose the individual account system had access to the following benefits:

- The PBU conditional on having fulfilled the conditions of age and years of contributions stated above for the PAYG-DB system.
- To buy an annuity or to arrange for a scheduled retirement subject to having the minimum required age: 60 year for women and 65 for men.
- The minimum guaranteed pension was applied to anyone who was eligible to access the PBU[13].

[10] Employees' contributions to health insurance is 3% for their own coverage and another 3% to finance health insurance for those already retired. Employers' contributions are divided, but in this case 6% is for the employee health insurance, while the remaining 2% is for those already retired.

[11] The Social Security Secretary of the Labor Ministry is in charge of establishing the mechanism to calculate the average salary. In our case we use real wages deflated by the manufacturing wage index with base second quarter of 2011.

[12] The individual account system was suppressed on December 9, 2008.

[13] Before the reform of 2008, there existed an index known as the Módulo Previsonal (MOPRE). The minimum guaranteed pension as well as the flat benefit paid by the public sector, known as the PBU after the 2008 reform, were both expressed as a proportion of the MOPRE.

Under the private retirement option, only the worker contributions, 11% of the gross salary, was directed to finance its individual account. Employers contributions were used to finance the payment of the PBU and the minimum guaranteed pension. Under the current PAYG-DB system, both employee and employer contributions are paid to the ANSES, which is the responsible for the payments of retirement benefits, as well as non-contributory pensions and other benefits which we do not include into the analysis that follows.

Even when people contributing to the individual account system had two options when retiring: i) to buy an annuity or ii) to keep the balance of their account and to arrange for a programmed withdrawal, we assume that all individuals choose the first option. The expected (corrected by survival rates[14]) cumulated fund that each individual has at the moment of retirement, discounted to the time he/she is born, is calculated as follows:

$$K = \frac{1}{s_{ra}} \sum_{a=0}^{a=ra-1} c_a s_a \left(1+r\right)^{ra-a} \qquad (1)$$

where: a stands for age when contributing; ra for the retirement age; c for the amount of contribution; r for the real rate of return (we use a rate of 3%, which is a standard figure in this type of studies[15]); and s for the survival rate. In this formula we are assuming that a person starts to receive his/her annuity at the age of retirement.

The annuity a person is able to buy is calculated as follows:

$$p_{a \geq ra} = K / A \quad ; \quad A = \sum_{a=ra}^{\max age} \frac{s_a / s_{ra}}{\left(1+r\right)^{a-ra}} \qquad (2)$$

where *max* age is the potential maximum age. Since we are working with real values, there is no need to assume an indexation rule for p_a.

Finally, with regards to the unemployment insurance, this is quite limited and only covers private-sector workers, being funded with a 1.5% of the wage bill paid by the employer, employees make no contribution. Unemployed workers are entitled to a monthly payment that is equal to a half of the maximum wage earned in the six-month period previous to become unemployed, with a maximum of $A 400 (US$ 96.85) and a minimum of A$ 250 (US$ 60.53). The unemployment benefit is paid for up to twelve months depending on the length of contributions before unemployment (there is a minimum of 6 months contributions during the previous 3 years before unemployment), for the first four months the benefit is a 100%, between months 5 and 8 is an 85%, and from months 9 to 12 is a 75%. The first benefit is paid after 60 days of becoming unemployed.

4. Data

The data source is the Encuesta Permanente de Hogares (EPH) for the period 1995 to 2003.[16] The EPH is a household survey carried out twice a year, usually in the months of April/May and October. Each household, and all its individuals, is surveyed four consecutive times after which they are dropped from the survey.

The sample we work with includes only individuals that have been observed the four times and that at least in one occasion have declared themselves as employed or unemployed.

[14] Survival rates come from the Instituto Nacional de Estadísticas y Censos (INDEC).

[15] The 3% rate is applied on gross workers contributions. At the moment of the elimination of the individual account system in 2008, the average commission charged by the Administrators of Retirement Funds (Administradoras de Fondos de Jubilaciones y Pensiones: AFJP) was 1 ppt. of the workers contributions, plus a flat fee.

[16] From the second half of 2003 the EPH was subject to an important methodological change that impedes us to extend the period of analysis, also because of the timing households are survey under the new EPH this is less suitable for the purposes of the present study.

Working this way we feel we can approximate better the individual effects that are crucial for our simulations.
The variable that identifies the contributing status to the social security is available only for salaried employees. Thus, the sample will not include people that have declared a different employment status than salaried employees, when employed or in their previous job when unemployed, in any of the four opportunities they were surveyed.
Because of the potential differences in the system coverage for the different types of workers, the public and private sectors will be considered separately, as well as men and women. Because of the low number of observation for each individual we cannot model, with a minimum degree of confidence, the transitions between the private and public sectors, so we consider only individuals that when employed did not changed sectors. We only include individuals aged between 18 and 69 years old the four times they were surveyed. In Tables 1 to 4 we present some descriptive statistics. The main picture is the high incidence of the not-contributing/working status, especially in the private sector, mostly for women.

5. Methodology

5.1. Estimation of contribution status

As it is clear from the sample description, there is an important percentage of cases in which the individual is working but it does not contributes. This behavior is more evident for those working in the private sector, specially for women. Because of this characteristic that emerges from our sample, and under the assumption that those individuals that contribute are not a random draw of the working population, we use the Heckman Selection Model in order to control for the bias that would emerge if the contribution status were estimated without controlling for the probability that an individual could have a job but does not contribute to social security. In particular, we estimate the following model:

$$L_{it} = \beta^L X_{it} + \varepsilon_{it}^L \quad (3.a)$$

$$C_{it} = \beta^C Y_{it} + \varepsilon_{it}^C \quad (3.b)$$

where:
L_{it}: dummy variable equal to 1 if individual *i* is working and zero otherwise;
C_{it}: dummy variable equal to 1 if, conditional on working (L_{it}=1), individual *i* contributes and zero otherwise;
X_{it}: set of variables that explain the probability of individual *i* working;
Y_{it}: set of variables that explain the probability of individual *i* contributing;
t: stands for a semester.
Under the assumptions of the Heckman Selection Model, ε_{it}^L and ε_{it}^C are correlated with each other, such that the estimation of equation (3.b) without taking consideration of (3.a) would render a biased estimation of vector β^C.
Our aim with equation (3.a) and (3.b) is to project the probability of an individual working, and conditional on working the probability of contributing to social security. Both of these probabilities surely depend on individuals unobserved characteristics. To try to control for this unobserved characteristics in our simulations, we assume that the error terms in equations (3.a) and (3.b) are composed of two parts:

$$\varepsilon_{it}^L = \eta_i^L + u_{it}^L \quad (4.a)$$

$$\varepsilon_{it}^C = \eta_i^C + u_{it}^C \quad (4.b)$$

Equations (3.a) and (3.b) are estimated using the Heckman selection estimator, so the individual effects η_i^L and η_i^C are recovered as follows:

$$\hat{\eta}_i^L = \frac{\sum_{t=1}^{T_i}\left(L_{it} - \hat{\beta}^L X_{it}\right)}{T_i} \tag{5.a}$$

$$\hat{\eta}_i^C = \frac{\sum_{t=1}^{T_i}\left(C_{it} - \hat{\beta}^C Y_{it} - \gamma IMR\right)}{T_i} \tag{5.b}$$

where IMR are the inverse Mills Ratio which are defined as $IMR_{it} = \frac{\phi\left(\hat{\beta}^L X_{it}\right)}{\Phi\left(\hat{\beta}^L X_{it}\right)}$, where ϕ and Φ stand for the normal pdf and cdf respectively. Since our aim is also to recover the individual effects, $\hat{\eta}_i^L$ and $\hat{\eta}_i^C$, the contribution status (equation 3.b) is assumed to be lineal in its arguments, while for the working status (equation 3.a), which is estimated with a probit specification, we work with its lineal projection.

Equations (3.a) and (3.b) allow us to model, in a pretty much ad hoc way, transitions between informal and formal jobs. Sadly the short time frame that each individual is observed, does not allows us to use a proper transition model. Finally, another element to keep in mind is that, since we are working with a non-behavioral model, we do not control for the role that Social Security might have on the choice between having a formal or informal job.

In sample simulations

The probability of individual *i* working at moment *t* is calculated as:

$$\hat{P}_{it}^L = \hat{\beta}^L X_{it} + \hat{\eta}_i^L \tag{6.a}$$

Then, the simulated working status is defined as $\hat{L}_{it} = 1$ if $\hat{P}_{it}^L > draw_{it}^L$ and 0 otherwise, where $draw_{it}^L$ is a realization from a uniform (0,1) distribution for each period *t*.

The probability of individual *i*, with individual effect $\hat{\eta}_i^C$ and conditional on being working, contributing in time *t* is calculated as follows:

$$\hat{P}_{it}^C = \hat{\beta}^C Y_{it} + \hat{\gamma} IMR_{it} + \hat{\eta}_i^C \tag{6.b}$$

Then, conditional on $\hat{L}_{it} = 1$, the contribution status for individual *i* in time *t* is defined as $\hat{C}_{it} = 1$ if $\hat{P}_{it}^C > draw_{it}^C$; and 0 otherwise, where $draw_{it}^C$ is a realization from a uniform (0,1) distribution for each period *t*.

Out of sample simulations:

Since in this case the individual effects η_i^L and η_i^C are not directly observed, they are generated as follows:

$$\tilde{\eta}_i^L = \hat{\sigma}_{\eta^L} \tilde{z}_i^L \tag{7.a}$$

$$\tilde{\eta}_i^C = \hat{\sigma}_{\eta^C} \tilde{z}_i^C \tag{7.b}$$

where $\hat{\sigma}_{\eta^L}$ and $\hat{\sigma}_{\eta^C}$ are the standard deviations of the individual effects $\hat{\eta}_i^L$ and $\hat{\eta}_i^C$ respectively, and $\tilde{z}_i^L$ and $\tilde{z}_i^C$ are both pseudo-random draws from a Standard Normal distribution.

The probability of individual *i* working at moment *t* is calculated as:

$$\tilde{P}_{it}^{L} = \hat{\beta}^{L} X_{it} + \tilde{\eta}_{i}^{L} \quad (8.a)$$

Then, the simulated working status is defined as $\tilde{L}_{it} = 1$ if $\tilde{P}_{it}^{L} > draw_{it}^{L}$ and 0 otherwise, where $draw_{it}^{L}$ is a realization from a uniform (0,1) distribution for each period *t*.

Then, the probability of contributing is calculated as:

$$\tilde{P}_{it}^{C} = \hat{\beta}^{C} Y_{it} + \hat{\gamma} IMR_{it} + \tilde{\eta}_{i}^{C} \quad (8.b)$$

where *t* now stands for a month.

Then, conditional on $\tilde{L}_{it} = 1$, the contribution status for individual *i* in month *t* is defined as: $\tilde{C}_{it} = 1$ if $\tilde{P}_{it}^{C} > draw_{it}^{C}$; and 0 otherwise, where $draw_{it}^{C}$ is a realization from a uniform (0,1) distribution for each period *t*.

5.2. Projection of labor income

We estimate a maximum likelihood switching model[17] which describes the behavior of an agent with two regression equations and a criterion function, I_{it}, that determines which regime the agent *i* faces at time *t*.

$$I_{it} = 0 \quad \text{if} \quad \gamma Z_{it} + u_{it} \leq 0$$

$$I_{it} = 1 \quad \text{if} \quad \gamma Z_{it} + u_{it} > 0$$

$$\text{Regime 0 } (L_{it} = 1,\ C_{it} = 0): \quad \ln w_{it} = \beta^{0} X_{it} + e_{it}^{0} \quad \text{if} \quad I_{it} = 0 \quad (9.a)$$

$$\text{Regime 1 } (L_{it} = 1,\ C_{it} = 1): \quad \ln w_{it} = \beta^{1} X_{it} + e_{it}^{1} \quad \text{if} \quad I_{it} = 1 \quad (9.b)$$

Given that our main goal is to project income, we are particularly interested in exploring the impact on wages of time invariant and deterministic covariates, like age and education. In the equations above w_{it} is the log of real wage[18] received by person *i* in time *t* (semester); X_{it} is a set of regressors of personal characteristics, age and education; and the unemployment rate. As long as we expect w_{it} to be stationary we do not introduce any deterministic time trend in the equation. Z_{it} includes the same variables as the X_{it} plus a dummy variable equal to one if individual *i* is 65 years or older for men, and 60 years or older for women. The error terms $\left(u_{it};\ e_{it}^{0};\ \text{and } e_{it}^{1}\right)$ are assumed to have a trivariate normal distribution.

As with the working and contributing equations, to improve the goodness of our simulations, we assume that wages are also a function of some individual unobserved characteristics, which are time invariant and constant across regimes. As explained before, each individual in the sample is observed at most four times in which he/she can be in regime 0 (working but not contributing) or regime 1 (working and contributing). Thus, once equations (9.a) and (9.b) are estimated, the individual effect ν_{i} is recovered as follows:

$$\hat{\nu}_{i} = \frac{\sum_{t=1}^{T_i}\left(w_{it} - E\left(\hat{w}_{it} \mid I_{it} = 0, X_{it}\right)\right) + \sum_{t=1}^{T_i}\left(w_{it} - E\left(\hat{w}_{it} \mid I_{it} = 1, X_{it}\right)\right)}{T_{i}} \quad (10)$$

Conditional expectations in (9) are:

$$E\left(\hat{w}_{it} \mid I_{it} = 0, X_{it}\right) = X_{it}\hat{\beta}^{0} - \hat{\sigma}_{0}\hat{\rho}_{0}\frac{\phi\left(\hat{\gamma} Z_{it}\right)}{1 - \Phi\left(\hat{\gamma} Z_{it}\right)} \quad (11.a)$$

$$E\left(\hat{w}_{it} \mid I_{it} = 1, X_{it}\right) = X_{it}\hat{\beta}^{1} + \hat{\sigma}_{1}\hat{\rho}_{1}\frac{\phi\left(\hat{\gamma} Z_{it}\right)}{\Phi\left(\hat{\gamma} Z_{it}\right)} \quad (11.b)$$

[17] We use Stata command movestay (Lokshin and Sajaia, 2004).

[18] Wages are deflated using the Wage Index of Manufactures.

where $\hat{\sigma}_0$ and $\hat{\sigma}_1$ are the estimated standard deviations of the errors e_{it}^0 and e_{it}^1 respectively; while $\hat{\rho}_0$ and $\hat{\rho}_1$ are the estimated correlation coefficients between u_{it} and e_{it}^0 and e_{it}^1 respectively. $\phi(...)$ and $\Phi(...)$ are the normal and cumulative normal distribution functions.
Predictions according to equation (9.a) and (9.b) can only be computed for the individuals in the sample, e.g. individuals for which we can compute the individual effects. But the model is used to predict the labor income flow of "newborn" individuals. In this case, we simulate the individual effects:[19]

$$\tilde{v}_i = \hat{\sigma}_v \tilde{z}_i \tag{12}$$

where $\hat{\sigma}_v$ is the standard deviation of the individual effect $\hat{v}_i$. $\tilde{z}_i$ is a pseudo-random draw from a Standard Normal distribution. Thus, the labor income stream of the newborn individuals is computed as follows:

$$\ln \tilde{w}_{it} = X_{it}\hat{\beta}^0 + \tilde{v}_i - \hat{\sigma}_0\hat{\rho}_0 \frac{\phi(\hat{\gamma}Z_{it})}{1-\Phi(\hat{\gamma}Z_{it})} \qquad \text{if } \tilde{L}_{it}=1 \text{ and } \tilde{C}_{it}=0 \tag{13.a}$$

$$\ln \tilde{w}_{it} = X_{it}\hat{\beta}^1 + \tilde{v}_i + \hat{\sigma}_1\hat{\rho}_1 \frac{\phi(\hat{\gamma}Z_{it})}{\Phi(\hat{\gamma}Z_{it})} \qquad \text{if } \tilde{L}_{it}=1 \text{ and } \tilde{C}_{it}=1 \tag{13.b}$$

5.3. Computation of SS contributions and benefits

Based on the simulated work and income histories, we compute social contributions and benefits according to the existing laws as described in Section 3. We include the unemployment insurance program together with the retirement program. Working this way we are implicitly assuming that individuals leave no survivors and suffer no sickness or disability. We assume that all individuals claim their retirement benefits as soon as they are eligible to do so.

5.4. Computation of pre- and post-social-security lifetime income, and distribution indexes

The expected pre-SS lifetime labor income is the present value of the expected simulated labor income:

$$\bar{W}(r) = \sum_{a=0}^{a=r-1} p(a)W(a)(1+\rho)^{-a} \tag{14}$$

where:
r is age at retirement;
$p(a)$ is the probability of worker's survival at age a;
$W(a)$ is total labor cost (including employee and employer contributions) at age a;
ρ is the discount rate (we use a 3% rate).
We compute the lifetime Social Security Wealth (SSW) as an indicator of SS transfers. SSW is the present value of expected net transfers to SS. It can be obtained as the sum of the discounted expected flows of old-age pensions (PB) and unemployment benefits (UB) net of contributions (SSC).

$$SSW = PB + UB - SSC \tag{15}$$

[19] The implicit assumption here is that the distribution of the individual effects does not vary with age or cohort.

$$PB = \sum_{a=r}^{a=\max age} p(a)B(a,r)(1+\rho)^{-a} \quad (16)$$

$$UB = \sum_{a=0}^{a=r-1} p(a)UB(a)(1+\rho)^{-a} \quad (17)$$

$$SSC = \sum_{a=0}^{a=r-1} p(a)C(a)(1+\rho)^{-a} \quad (18)$$

where:

$\max age$: maximum potential age;

$B(a,r)$: the amount of retirement benefits at age *a* conditional on retirement at age *r*;

$UB(a)$: the unemployment benefit collected at age *a*;

$C(a)$: the amount of contributions (both by the employee and the employer) to the SS at age *a*, excluding health insurance contributions.

Finally, the expected post-SS lifetime labor income is defined as $\bar{W}(r) + SSW$.

Two alternatives of pre- and post-SS life time labor incomes are calculated. Firstly only considering labor income subject to contributions ($\tilde{L}_{it} = 1$ and $\tilde{C}_{it} = 1$), and secondly including also labor income from which the person does not contribute ($\tilde{L}_{it} = 1$ and $\tilde{C}_{it} = 0$).

6. Results

As pointed out in Section 3, even when is possible a priori to distinguish between the distributional effects of different SS arrangements, it becomes mostly an empirical matter. In our case, to assess the redistributive impact of social security we use some descriptive statistics of pre-SS lifetime income, SSW, and SSW to pre-SS income ratio. We calculate also two additional indexes, the Gini Coefficient (for pre- and post-SS lifetime income) and the Reynolds-Smolensky-type index of net redistributive effect (Lambert, 1993, p 256). This last index assesses the redistributive impact of a program computing the area between the Lorenz pre-program income and the concentration post-program income. A positive (negative) value indicates that the program reduces (increases) inequality.[20]

For each population group we work with a simulated population of 10000 individuals, starting at an age of 18 years old. Each individual potentially work until she/he is 69 years old (inclusive) if she/he does not retire earlier. The maximum age an individual lives is 100 years old. In equations (3) and (9) two dummies are included to control for the level of education (see Tables 5 and 7 for a definition of these variables). These dummies are assigned following the proportion in the samples used for the estimation of equation (3). Even when some education levels are completed at an age older than 18, we assume that the proportion of population with such level of education has it from the beginning of the simulated period. In the case of the selection equation we also include a dummy variable equal to one if the individual is male/female and 65/60 years or older.[21]

Table 5 reports the results for the working and contribution status equations. In results do not reported here we obtained that for women in the private sector the IMR was not statistically significant, also the selection model generates too low simulated contribution densities when

[20] The Gini coefficients and the Reynolds-Somelinsky index were estimated using DASP (Araar and Duclos, 2009).

[21] Even when the household survey has a wide range of additional variables, both at the individual and the household levels, we are restricted to using deterministic variables that can be predicted over the life of each individual.

comparing with observed ones. Thus, for women in the private sector we estimate equations (3.a) and (3.b) without assuming the two error terms are correlated between them.

For the most of the variables we obtain the expected signs. In the case of the age effect, the interpretation is more difficult since this variable enter the regression through a cubic polynomial, a better picture is given by Figure 1 that shows the observed and out-of-sample simulated densities. The goodness of fit is quite high when measured by the proportion of correct predictions for the in-sample simulations (see Table 6).

With regards to the income equation, the results are reported in Table 7. As expected the education dummies are positive and increasing in the level of education, they are always statistically significant. For the age coefficients these are mostly also significant.

Table 8 to 10 show some statistics about the simulated populations in relation to the history of contribution and access to a retirement benefit. For the simulations under the current PAYG system we assume that each individual retires as soon as she/he meets the required conditions, while for the case of the individual account system we work under the assumption that each individual works until she/he is entitled to the benefits in charge of the public sector (the PBU and the guaranteed minimum pension). Working this way means that changing the system we work with has no behavioral effect on when people decided to retire. Because of our working assumptions, it comes as no surprise that the average age of retirement are close to the minimum required age, specially in the case of men (see Table 8). Table 9 shows that the proportion of the simulated populations, excluding those that never contributed, that access to a retirement benefit under the PAYG system and to the PBU under the individual account system, are higher for public workers. Also, a higher proportion of men access to a benefit than women, independently of the sector they work in, but this difference is very much important in the case of the private sector, which does not come as a surprise since for women in the private sector our sample shows only a 27.7% of cases with a declared contribution status (this percentage goes up to 47.3% when the reference group are those that declare a working status), while for men the percentage is 58.9% (71.7%). Finally, in Table 10 we report the average years of contributions of the simulated populations. The average length of contributions is longer in the public than in the private sector (considering all individuals, regardless of whether they access to a retirement benefit). This outcome is surely a reflection of the higher labor stability of public workers relative to private ones. Because of men need to contribute, at least, until they are 65 years old while for women the minimum age is 60 years, men contribute more than women. When we restrict the analysis only to individuals that access to a pension benefit under the PAYG system and to the PBU under the individual account system, the years of contributions are in all cases above the minimum requirement.

Moving our attention to the redistributive effects of the social security system, in Table 11 we present some descriptive statistics for the simulated populations for the pre-SS lifetime income, SSW, and SSW to pre-SS lifetime income ratio.

When only considering formal labor income, for which people contribute to social security, average expected pre-SS lifetime income goes between 111.2 thousand for women in the private sector to 260.2 thousand for men in the public sector. In the case of men the difference between public and private sector is quite less important than for the case of women, 19% in the case of mean against a 68% for women. Men, on average, have a higher pre-SS lifetime income than women, specially in the private sector with an average value 97% higher than for women, while in the public sector the difference is 39%. This important difference against women in the private sector is a reflection of their much lower probability of working.

If we now include income form jobs for which there was no contribution, informal income, the pattern between public and private sectors, and women and men is more or less much the same, with a slight improvement in the relative position of people working in the private sector relative to those in the public sector, and for women relative to men. These changes are

explained because it is in the private sector, specially for women, where the is a higher percentage of people that have a job but do not contribute.

The simulated populations show a large degree of income dispersion given by the ratio between the average income of the 99 and 1 percentile. These differences are much important in the private sector, and for women than for men. As expected, the distributions are skewed to the right, with the median pre-SS lifetime income consistently lower than the mean values.

It comes as no surprise that the average SSW is never positive whatever the system we are considering. Both, under the PAYG and Individual Accounts options there is an important part of contributions, those made by the employer, that has no effect on the amount of the pension benefit. On the one hand, under the PAYG system the PC is calculated based on the average gross wage that includes the contributions from the employee (11% of gross wages), but not the contributions from the employer (16% over the gross wages), which are used for payment of the PBU and to guarantee the minimum pension. Similarly, under the system of individual accounts, only the employee contributions are used to finance his/her personal account, which then determines the amount of the annuity, while employer contributions are to finance the payment of the PBU and to guarantee the minimum pension. Under both systems, the PBU is for most cases the smallest part of the total retirement benefit. In addition, for private sector workers, the low coverage of unemployment benefits also contributes negatively to the SSW.

In the case of the PAYG system, the average SSW ranges from -40.8 thousand (men in the public sector) to -17.8 thousand (women in the private sector). SSW is considerably more negative for men than for women, with a 2.1 to 1 relation in the public sector and 2.2 to 1 in the private sector. The differences between public and private sectors are less important for men than for women. Measured by the difference between percentiles 1 and 99, within each category, SSW shows the highest dispersion among men in the private sector and the lowest among women in the private sector. When comparing the two systems, the average SSW increases under the individual account system for three out of the four groups, the exception is women in the public sector where there is small deterioration. This improvement is much more important, in monetary terms, for those with the lowest SSW, men either in the private or public sector; in proportional terms the differences across groups are of a lesser magnitude.

On average, the SSW to pre-SS lifetime income ratio ranges from -20% among women in the private sector to -12.2% among women in the public sector under the PAYG system. Ranked by this ratio, there is an important dispersion, as for percentile 1 the ratio is about -22%, while for percentile 99 its range is between -15.2% and -7.2%. The described pattern is not much affected if we consider also the income from not contributing jobs, however women in the private sector show an improvement relative to men, and private workers relative to public ones. The reason for this is the higher probability of the former having an informal job. As it was the case with the SSW, SSW to pre-SS lifetime income improves in almost all cases under the individual account system.

The results just summarized show that social security redistributes wealth in the case of Argentina. We now move to look in what direction this redistribution goes.

Figures 2.A show the relationship between pre-SS lifetime income and SSW when only contributing jobs are included. Under both regimes, the negative slope would suggest that the redistribution is progressive, the greater the pre-SS labor income the lower is SSW. However, it is possible to observe a wider dispersion under the PAYG system than under the Individual Account option. This dispersion reflects some sort of redistribution but does not reduce inequality. Similar results were found for Brazil (Zylberstajn, 2011) and Uruguay (Forteza and Mussio, 2012). Liebman (2001) points out to the same issue for the United States. Also, in the case of the PAYG system there appears to be different sub-groups within each of the

four population groups. The pattern does not change significantly when we include income from jobs that do not contribute (see Figures 2.B).

Table 12 reports the Gini coefficients for pre- and post-SS lifetime incomes. When only income form contributing jobs are considered, the PAYG system is regressive for men in the private sector and women in the public sector (in both cases the Gini increases a 1.5%, approximately 0.6 ppt.), while not surprisingly there is a considerable regressiveness for women in the private sector (the Gini increases a 2.9%, 1.7 ppt.). For men in the public sector the system is slightly progressive (the Gini falls 0.1%, 0.05 ppt.). On the other hand, under the individual account system, SS is regressive only for private sector workers, however the effects are much less important than under the PAYG system. For public workers, SS induces a more progressive distribution of income under the individual account system, in the case of men the simulated effect is pretty much the same as with the PAYG system, while for women SS reduces the Gini coefficient by 0.2 ppt. (-0.6%) under the individual account system, while under the PAYG option there is an increase of 0.6 ppt. (1.4%).

The same pattern emerges when looking at the Reynolds-Smolensky-type index (see Table 13). Under the PAYG option the index is negative for the first three groups, specially for women in the private sector, while it is positive for men in the public sector. For the individual account system the index is negative only for private sector workers and positive for those who were employed in the public sector.

The results change quite importantly when we also include income from informal employment, over which there is no contribution. This is especially true under the PAYG option. Now SS is progressive for men, either in the private or public sectors under any of the two systems. For women the same is true with the exception of the PAYG system in the public sector, but the negative effect is just one third of that when only formal jobs are taken into account. The same results emerge when using the Reynolds-Smolensky-type index, SS is always progressive but for women in the public sector under the PAYG option.

The failure of the current Argentinean PAYG-DB social security program to reduce inter-generational inequality represents a puzzle. The vesting period condition might help explain it. A possible explanation for our results is that as Forteza *et al*. (2009) show, large segments of the population have a low probability of having contributed thirty or more years when they reach retirement ages, and this probability is particularly low among low income individuals (see Figure 3 and 4). Forteza and Ourens (2012) show that the implicit rate of return on contributions paid to these programs is very low when individuals have short contribution histories. Hence, low income individuals might be getting a bad deal from social security because they have short histories of contribution. Figure 3 shows the kernel densities for the average labor cost per year of contribution distinguishing between people that contributed to the system and do not get a retirement benefit and those who do. Figure 4 shows the average labor cost per year of employment for each of the two groups when including income from informal jobs. It is very clear from the simulated data that low wage earners have a much lower chance of fulfilling with the conditions the system requires to obtain a pension at the age of retirement.[22] However, under the individual account system the fact that low earners show shorter contribution histories plays a less negative role because now all individuals who do not fulfill the conditions to be entitled to the PBU and the minimum guaranteed pension,

[22] A very parsimonious linear probability model such as $R_i = \delta_1 \tilde{\eta}_i^C + \delta_2 \ln(\overline{w}_i) + u_i$, where $R_i = 1$ if the person get a retirement benefit, and zero otherwise, $\tilde{\eta}_i^C$ is the simulated individual fixed effect obtained from equation (1), and $\overline{w}_i$ is the average wage (including employer and employee contributions) per year of contribution, explains a large proportion of the probability of getting a pension, with a 1% increase in the average wage increasing the probability of getting a pension between 0.07-0.30% depending on the type of worker and the sector, if we exclude women in the private sector the effect ranges between 0.20-030%.

only lose the contributions made by their employers (16% of the gross salary), while their own contributions (11% of the gross salary) allows them to buy an annuity when retiring.
A *de facto* progressive component, maybe the most important, is the weak enforcement of the law, in particular with regards to if a person fulfills the minimum requirements to access a retirement benefit. To account for the *de facto* application of the law we run an alternative scenario under a weak enforcement of the conditions to access to a benefit. We assume that everyone that having worked, when reaching 70 years old does not have access to a retirement benefit, is granted the PBU. As reported in Table 14, not surprisingly, an scenario with a weak enforcement of the law reduces importantly the regressiveness of the system. This improvement is more important for the private than for the public sector, and for women than for men. These results are mainly driven by the lower probability that people in the private sector, and particularly women, have of fulfilling the conditions for a retirement benefit. It emerges clearly, and once again without to be a surprise, the case of women in the private sector, which as shown before have a much lower probability of obtaining a retirement benefit if the law is strictly enforced. The same patterns emerge when we include informal labor income.
Finally, we run another alternative scenario under the assumption that there is no informal jobs, so every time an individual is working we assume she or he contributes to SS. In this case, we use the results of labor status equation (equation (3.a)) to calculate the working histories. Then we estimate a new single equation random effect model to generate the income histories[23]. Working this way has the drawback that, for those individuals in the sample who are in an informal job, we use their observed wage, instead of the wage he/she would have received if he/she would have had a formal job. This would bias downward the individual effect for these individuals, and so also their simulated income history.
As Table 15.A shows, there is an important increase in the share of population that would access to a retirement benefit. With regards to the distributive impacts of SS, both the PAYG and individual accounts systems are almost neutral, showing a slight progressiveness (see Table 15.B). This last result makes very clear the importance of reducing the incidence of informal labor.

7. Concluding remarks

Argentina Social Security System, based on a PAYG-DB scheme, appears to be regressive, specially for women working in the private sector. This result constitutes, a priori, a puzzle, that might find explanation in the lower probability that low-income earners have of accessing to a retirement benefit as reported in Forteza *et al*. (2009). This effect is much more important in the case of the private sector, specially for women.
Under a program of individual accounts, the system is almost neutral from a distributional point of view, the main reason is that even though some people would not be entitled to the PBU and the guaranteed minimum pension, they would still receive something back from their own contributions (11% of gross wages), while "*lose*" the contributions made by employers (16% of gross wages).
As pointed out in the Introduction, these results appears to be at odds with the idea that PAYG-DB systems are mostly progressive, while systems based on individual accounts are mostly neutral. To explain these findings, we propose that in order to be financially sustainable there is a need for strict eligibility conditions as well as low replacement ratios. Thus, the fact that low wage earners, specially women in the private sector, have a high probability of working in the informal sector plays a crucial role, since they cannot fulfill the

[23] The results for these estimates are available upon request.

conditions for accessing to a retirement benefit loosing all their contributions, something that is not the case under the individual account option.

To grasp an idea of the role of eligibility conditions, we run some alternative simulations. First, we get that the system becomes slightly progressive when including into the inequality measures the income derived from jobs people do not make contributions. This result is explained by the fact that according to our simulations are low earners individuals, who show lower probabilities of being entitled for a retirement benefit, the ones that derive most of their labor income from jobs for which they do not make contributions. This last result means that low earner workers have low incentives to look for jobs in the formal sector, with the negative externalities that this kind of behavior brings during the working life, such as lack of health service coverage. Second, when we assume a weak enforcement of the social security law, the PAYG-DB system becomes less regressive when not considering income from informal jobs, while it is progressive for the four groups when informal jobs are taken into account. These changes are more likely for women than for men, and in the private than in the public sector. Both cases could be explained, once again, because women and those working in the private sector have lower probability of fulfilling the conditions to have access to a retirement benefit. Finally, assuming the removal of the informal labor market, the system becomes almost neutral, whether considering the PAYG option or of individual accounts, even showing a small level of progressivity.

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Table 1
Sample sizes

		Sector	
		Public	**Private**
Gender	**Female**	5,784	11,069
	Male	5,417	12,445

Source: own based on EPH.

Table 2
Distribution of samples depending on having contributed at least in one out of the four possible occasions

		Public		**Private**	
		Female	**Male**	**Female**	**Male**
Contributed at least one time	**No**	13.8	5.7	61.9	26.8
	Yes	86.2	94.3	38.1	73.2

Source: own based on EPH.

Table 3
Sample working status (%)

		Public		**Private**	
		Female	**Male**	**Female**	**Male**
Working status	**Not Working**	12.8	5.7	41.3	17.8
	Working	87.2	94.3	58.7	82.2

Source: own based on EPH.

Table 4
Sample contributing status (%)
a) All sample

		Public		**Private**	
		Female	**Male**	**Female**	**Male**
Contribution status	**Not contribute**	20.5	10.9	72.3	41.1
	Contribute	79.5	89.1	27.7	58.9

b) Conditional on working

		Public		**Private**	
		Female	**Male**	**Female**	**Male**
Contribution status	**Not contribute**	8.8	5.5	52.7	28.3
	Contribute	91.2	94.5	47.3	71.7

Source: own based on EPH.

Table 5
Results Equation (3)

	Private Sector				Public Sector			
	Male		Female (a)		Male		Female	
	Contribution	Working	Contribution	Working	Contribution	Working	Contribution	Working
Age	-0.0110	0.3991***	0.0755***	0.0427***	-0.0071	0.7288***	-0.0364	0.3281***
	(0.020)	(0.017)	(0.007)	(0.007)	(0.018)	(0.041)	(0.041)	(0.037)
Age2 (i)	0.2004	-7.5029***	-1.4818***	-0.7821***	0.1480	-15.0138***	0.4328	-5.8119***
	(0.403)	(0.466)	(0.183)	(0.179)	(0.381)	(1.043)	(0.864)	(0.969)
Age3 (ii)	0.0059	4.0525***	0.9212***	0.4363***	-0.0520	9.5028***	0.0323	3.0991***
	(0.257)	(0.391)	(0.150)	(0.155)	(0.263)	(0.836)	(0.598)	(0.817)
Education 2 (iii)	0.1169***	-0.0706***	0.3260***	0.0734***	0.0426***	-0.2042***	0.0210	0.3428***
	(0.008)	(0.015)	(0.006)	(0.005)	(0.008)	(0.035)	(0.034)	(0.027)
Education 3 (iv)	0.1155***	0.0866***	0.4909***	0.2277***	0.0314***	0.0415	-0.0578	0.7419***
	(0.015)	(0.032)	(0.008)	(0.007)	(0.009)	(0.045)	(0.055)	(0.028)
Unemployment	0.0063***	-0.0417***	0.0063***	-0.0047***	-0.0001	-0.0145**	0.0093**	-0.0141**
	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.006)	(0.004)	(0.006)
Elderly (v)		-0.1426**		-0.0484**		-0.2581**		-0.1213
		(0.072)		(0.024)		(0.115)		(0.102)
IMR	-0.7907***				-0.4630***		-1.0536***	
	(0.111)				(0.083)		(0.216)	
Constant	0.9004***	-4.4216***	-0.9925***	-0.0657	1.0414***	-8.7631***	1.6982**	-4.5652***
	(0.301)	(0.204)	(0.089)	(0.079)	(0.262)	(0.510)	(0.689)	(0.460)
Observations	49,780		25,980	44,276	21,668		23,136	
Censored	8866				1242		2972	
Uncensored	40914				20426		20164	

(a) Working and Contribution equations were estimated independently of each other. (i) (Age^2)/1000; (ii) (Age^3)/100000; (iii) Complete high school/incomplete tertiary-university; (iv) Complete tertiary-university; (v) Dummy equal to one if the individual is 65 years old or more for men, and 60 or more for women. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6
In sample simulations: Right predictions (*)

a) Working Status

	Private Sector		Public Sector	
	Male	Female	Male	Female
Not working	65.8	76.4	72.5	71.4
Working	90.7	83.4	96.9	94.8
Total	86.3	80.5	95.5	91.8

b) Contribution Status

	Private Sector		Public Sector	
	Male	Female	Male	Female
Not contributes	82.8	93.5	76.7	83.2
Contributes	88.2	86.1	96.0	95.0
Total	86.0	91.5	93.9	92.6

c) Contribution Status (conditional on working)

	Private Sector		Public Sector	
	Male	Female	Male	Female
Not contributes	82.5	92.9	73.6	82.1
Contributes	88.2	86.1	96.0	95.0
Total	86.6	89.7	94.8	93.9

(*) The simulated status matches the observed status.

Table 7
Results Equation (9)

	Private Sector				Public Sector			
	Male		Female		Male		Female	
	Not Contributes	Contributes	Not Contributes	Contributes	Not Contributes	Contributes	Not Contributes	Contributes
Age	0.2601***	0.1941***	0.0379**	0.1432***	-3.0915	0.4562***	0.1169***	0.1642***
	(0.017)	(0.009)	(0.015)	(0.013)	(5.191)	(0.173)	(0.041)	(0.017)
Age2 (i)	-4.4763***	-3.3804***	-0.5632	-2.8788***	53.3424	-8.5124**	-2.7686**	-2.9035***
	(0.438)	(0.235)	(0.381)	(0.341)	(90.187)	(3.581)	(1.106)	(0.407)
Age3 (ii)	2.2647***	1.7768***	0.1830	1.8444***	-27.9807	5.0675**	2.1535**	1.6586***
	(0.362)	(0.193)	(0.310)	(0.278)	(48.226)	(2.424)	(0.936)	(0.318)
Education 2 (iii)	0.3346***	0.3142***	0.2279***	0.4319***	-2.7132	0.4311***	0.3298***	0.3584***
	(0.017)	(0.007)	(0.017)	(0.019)	(5.109)	(0.088)	(0.031)	(0.013)
Education 3 (iv)	0.9304***	0.6985***	0.5319***	0.6139***	-3.0300	0.7707***	0.9950***	0.5269***
	(0.047)	(0.015)	(0.031)	(0.026)	(6.660)	(0.107)	(0.043)	(0.013)
Constant	4.2137***	4.7306***	6.5077***	5.3670***	13.7157	3.1601**	5.5498***	4.9795***
	(0.197)	(0.114)	(0.179)	(0.177)	(21.958)	(1.403)	(0.487)	(0.226)
IMR					35.1362	0.1455		
					(48.537)	(2.863)		
Observations	38,228		24,214		19,483	19,483	19,184	

(i) (Age^2)/1000; (ii) (Age^3)/100000; (iii) Complete high school/incomplete tertiary-university; (iv) Complete tertiary-university; * significant at 10%; ** significant at 5%; *** significant at 1%.

Note: for men in the public sector the Stata command movestay did not converge to a solution, so in this case we run two Heckman regressions. In the first regression, the dependent variable in the selection equation was a dummy variable equal to 1 if individual *i* had an informal job, while in the second regression the dummy variable was equal to 1 if individual i had a formal job.

Table 8
Average retirement age of simulated populations

Group	Years
Private-Female	63.2
Private-Male	65.3
Public-Female	61.8
Public-Male	65.2

Notes: (i) Unemployment rate used in simulations: 8%;
(ii) people retire as soon as they meet the required conditions.

Table 9
Proportion of simulated populations that access to a retirement benefit

Group	(*)	(**)
Private-Female	22.0	26.2
Private-Male	60.4	61.3
Public-Female	78.1	78.2
Public-Male	92.4	92.4

(*) Includes people that did not contributed while working.
(**) Excludes people that did not contributed while working.
Note: (i) Unemployment rate used in simulations: 8%.

Table 10
Average number of years of contribution of simulated populations

Group	(*)	(**)	(***)
Private-Female	12.9	15.4	31.2
Private-Male	29.1	29.5	37.5
Public-Female	29.1	29.1	32.8
Public-Male	37.6	37.6	38.8

(*) Includes people that do not access to a retirement benefit, independently of the contribution status while working. (**) Includes people that do not access to a retirement benefit, only with a contributing status while working. (***) Includes only people who access to a retirement benefit.
Note: (i) Unemployment rate used in simulations: 8%;
(ii) people retire as soon as they meet the required conditions.

Table 11
Pre-social security lifetime labor income and Social Security Wealth
(in thousands of June 2011 US dollars)

A) Excluding income from informal jobs

		Pre-SS Income	PAYG system		Individual account system	
			SSW	SSW / Pre-SS Income	SSW	SSW / Pre-SS Income
Private-Male	Mean	219.0	-38.8	-19.1	-28.6	-13.3
	P1	3.1	-129.3	-22.7	-98.5	-13.9
	Median	176.4	-30.1	-17.8	-22.5	-13.3
	P99	788.1	-0.7	-15.2	-0.4	-12.0
	Skewness	1.6	-1.1	-0.2	-1.1	1.8
Private-Female	Mean	111.2	-17.8	-20.0	-14.1	-13.4
	P1	0.4	-81.7	-22.7	-79.6	-13.9
	Median	60.8	-13.6	-22.6	-8.4	-13.8
	P99	634.2	-0.1	-10.7	-0.1	-11.2
	Skewness	2.5	-1.8	1.2	-2.2	1.6
Public-Male	Mean	260.2	-40.8	-15.8	-30.8	-11.8
	P1	33.3	-113.0	-21.8	-86.6	-12.9
	Median	225.7	-35.3	-15.7	-26.7	-11.9
	P99	825.2	-7.3	-12.8	-4.3	-9.8
	Skewness	1.6	-0.9	-1.6	-1.0	1.2
Public-Female	Mean	186.8	-19.5	-12.2	-20.6	-11.0
	P1	6.9	-69.8	-21.8	-76.2	-12.9
	Median	151.8	-14.0	-10.0	-15.3	-10.9
	P99	660.8	-1.5	-7.2	-0.9	-8.9
	Skewness	1.6	-1.6	-1.2	-1.4	-0.1

Table 11 (continued)

B) Including income from informal jobs

		Pre-SS Income	PAYG system		Individual account system	
			SSW	SSW / Pre-SS Income	SSW	SSW / Pre-SS Income
Private-Male	Mean	234.9	-38.2	-15.0	-28.2	-10.6
	P1	27.2	-129.1	-22.5	-98.4	-13.7
	Median	195.5	-29.6	-16.0	-22.0	-11.4
	P99	785.6	0.0	0.0	0.0	0.0
	Skewness	1.8	-1.1	1.7	-1.1	1.7
Private-Female	Mean	111.6	-14.9	-11.0	-11.9	-7.6
	P1	1.5	-79.6	-22.4	-75.9	-13.7
	Median	65.2	-9.2	-12.0	-5.7	-9.2
	P99	596.5	0.0	0.0	0.0	0.0
	Skewness	2.6	-1.9	0.3	-2.4	0.6
Public-Male	Mean	267.9	-40.8	-14.9	-30.8	-11.1
	P1	46.6	-113.0	-20.2	-86.6	-12.5
	Median	233.5	-35.3	-15.3	-26.7	-11.5
	P99	825.2	-7.3	-11.0	-4.3	-8.0
	Skewness	1.7	-0.9	0.1	-1.0	1.0
Public-Female	Mean	198.6	-19.5	-10.4	-20.6	-9.7
	P1	15.3	-69.8	-21.8	-76.2	-12.9
	Median	167.5	-14.0	-9.2	-15.3	-10.0
	P99	660.8	-1.4	-5.9	-0.8	-4.7
	Skewness	1.7	-1.6	-1.5	-1.4	0.7

Table 12
Gini coefficients of life time labor income before and after social security

		Excluding informal job income			Including informal job income		
		Estimate	LB (95%)	UB (95%)	Estimate	LB (95%)	UB (95%)
Private Female	pre-SS	0.5832	0.5765	0.5899	0.5451	0.5391	0.5512
	post-SS (PAYG)	0.6001	0.5935	0.6068	0.5419	0.5358	0.5480
	post-SS (IA)	0.5853	0.5786	0.5921	0.5348	0.5287	0.5409
Private Male	pre-SS	0.4280	0.4226	0.4335	0.3717	0.3668	0.3765
	post-SS (PAYG)	0.4344	0.4287	0.4400	0.3649	0.3600	0.3699
	post-SS (IA)	0.4288	0.4233	0.4344	0.3636	0.3587	0.3685
Public Female	pre-SS	0.3999	0.3948	0.4049	0.3602	0.3553	0.3650
	post-SS (PAYG)	0.4057	0.4004	0.4109	0.3618	0.3568	0.3668
	post-SS (IA)	0.3978	0.3926	0.4029	0.3539	0.3489	0.3588
Public Male	pre-SS	0.3408	0.3362	0.3454	0.3198	0.3154	0.3242
	post-SS (PAYG)	0.3403	0.3355	0.3451	0.3157	0.3111	0.3203
	post-SS (IA)	0.3399	0.3352	0.3446	0.3162	0.3117	0.3207

Table 13
Reynolds-Smolensky index of effective progression

	Excluding informal job income		Including informal job income	
	PAYG	IA	PAYG	IA
Private Female	-1.6731	-0.2139	0.0594	0.8241
Private Male	-0.6246	-0.0784	1.1880	1.1697
Public Female	-0.5555	0.2118	-0.0051	0.7266
Public Male	0.0517	0.0929	0.7280	0.5673

Table 14
Redistributive effects under a week law enforcement scenario

A. Gini coefficients

	Excluding informal job income		Including informal job income	
	pre-SS	post-SS (PAYG)	pre-SS	post-SS (PAYG)
Private-Female	0.5832	0.5852	0.5451	0.5282
Private-Male	0.4280	0.4312	0.3717	0.3622
Public-Female	0.3999	0.4023	0.3602	0.3587
Public-Male	0.3408	0.3397	0.3198	0.3151

B. Reynolds-Smolensky index of effective progression

	Excluding informal job income	Including informal job income
Private-Female	-0.1863	1.7294
Private-Male	-0.3096	0.9661
Public-Female	-0.2226	0.1669
Public-Male	0.1123	0.4743

Table 15
Scenario with no informal jobs

A) **Proportion of simulated populations that access to a retirement benefit**

Group	%
Private-Female	67.51
Private-Male	95.41
Public-Female	92.05
Public-Male	99.11

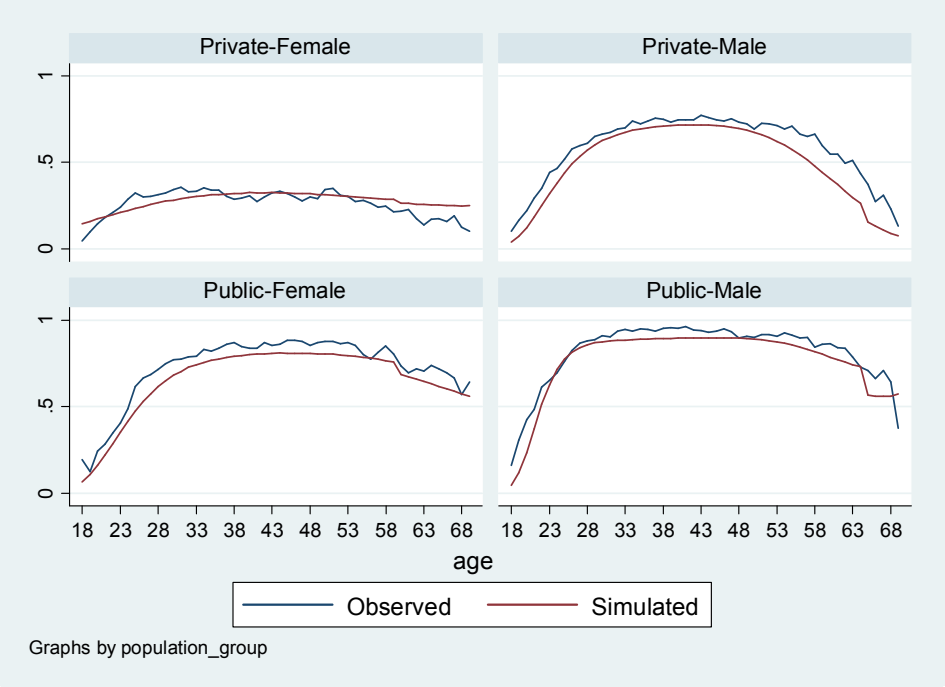
Note: (i) Unemployment rate used in simulations: 8%.

B) Gini Coefficients

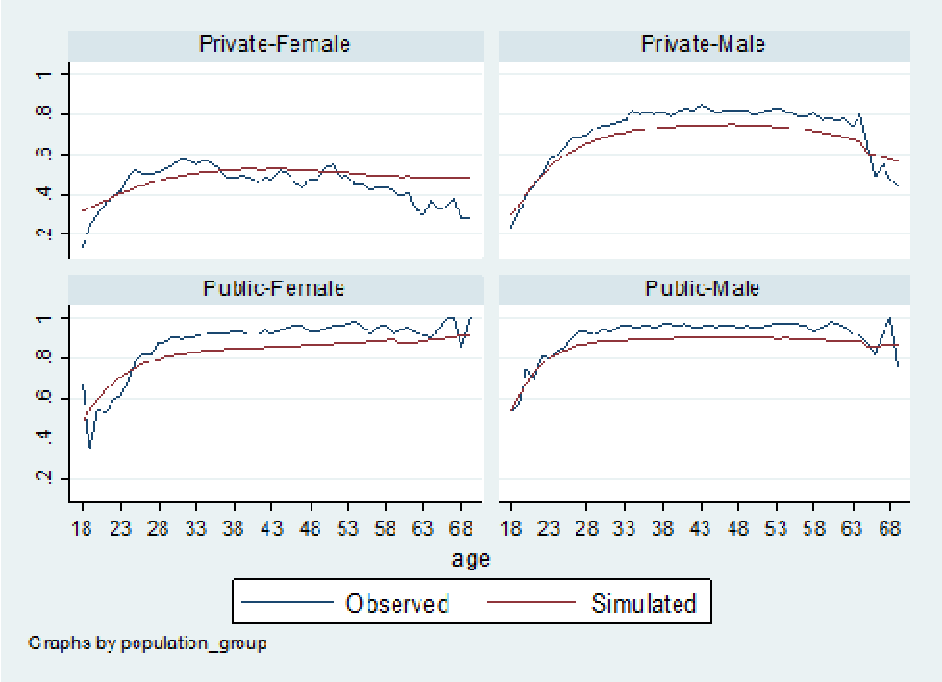
	pre-SS	post-SS	
		PAYG	Ind. Account
Private-Female	0.5181	0.5121	0.5103
Private-Male	0.3326	0.3297	0.3300
Public-Female	0.3753	0.3704	0.3699
Public-Male	0.3191	0.3174	0.3176

Figure 1
Observed and out-of-sample simulated contribution densities by age

a) Share of overall sample



b) Share of sample with a working status

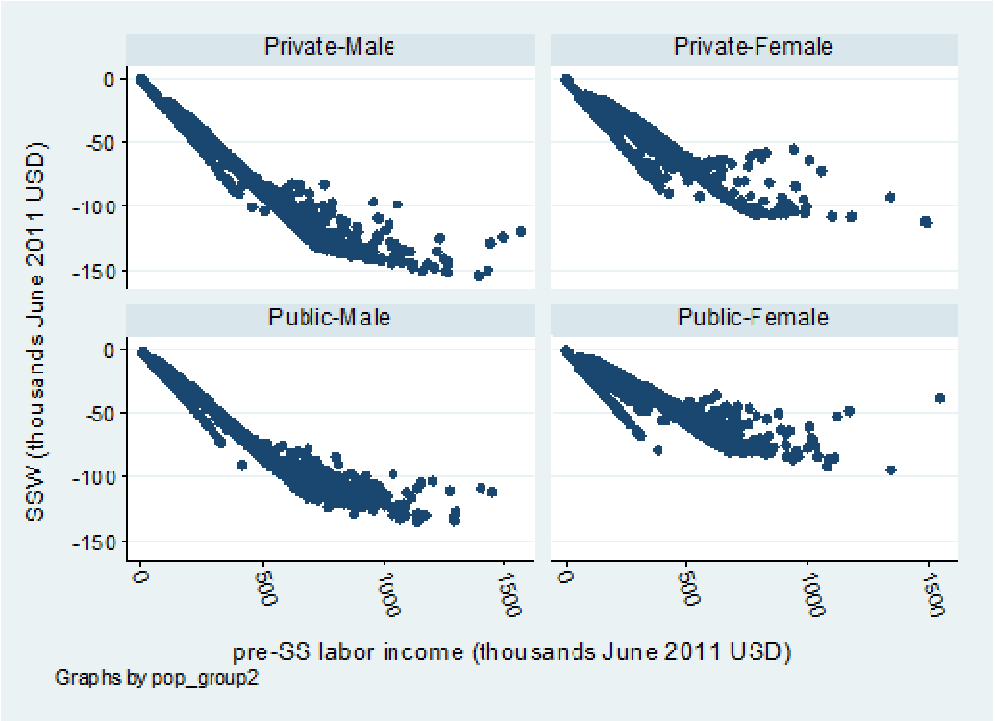


Note: The unemployment rates used for the simulated densities are 15.3 for men and 17.4 for women. These figures are the average rates for the period covered by the country sample used in equation (1).

Figure 2
Social Security Wealth and life time income

A) Excluding informal jobs

A.1) PAYG system



A.2) Individual Account system

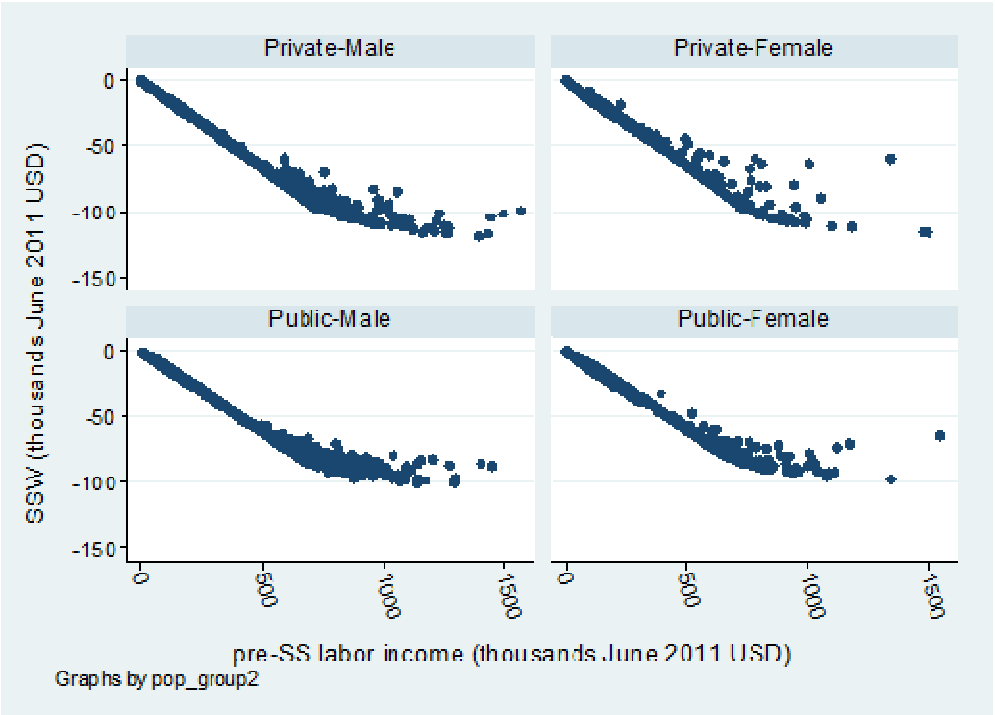
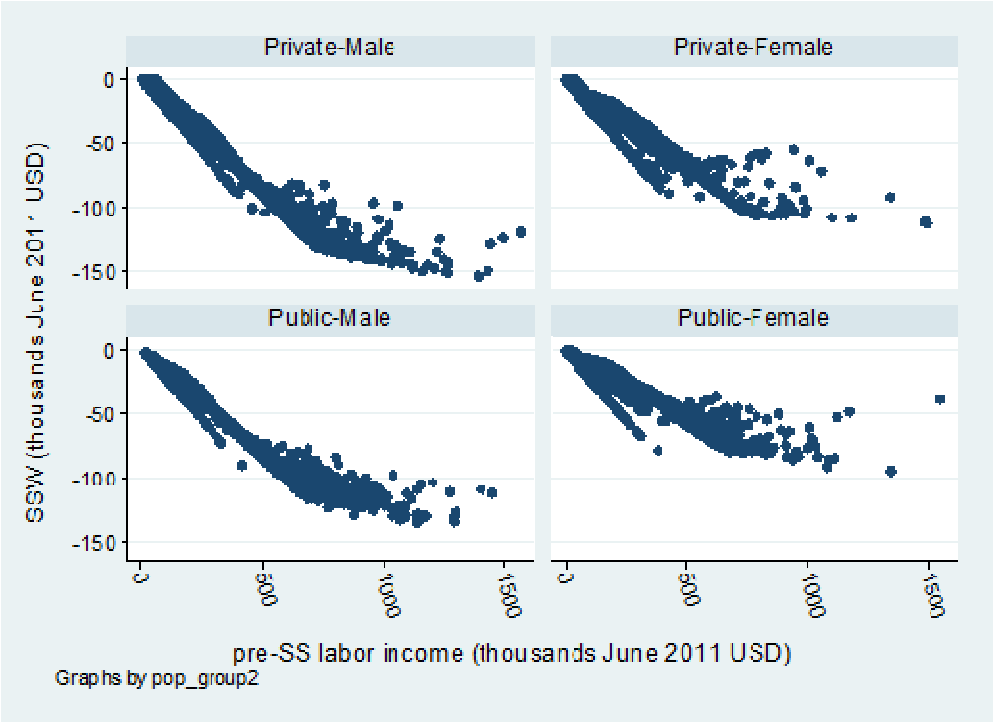


Figure 2 (continued)

B) Including informal jobs (*)

B.1) PAYG system



B.1) Individual Account system

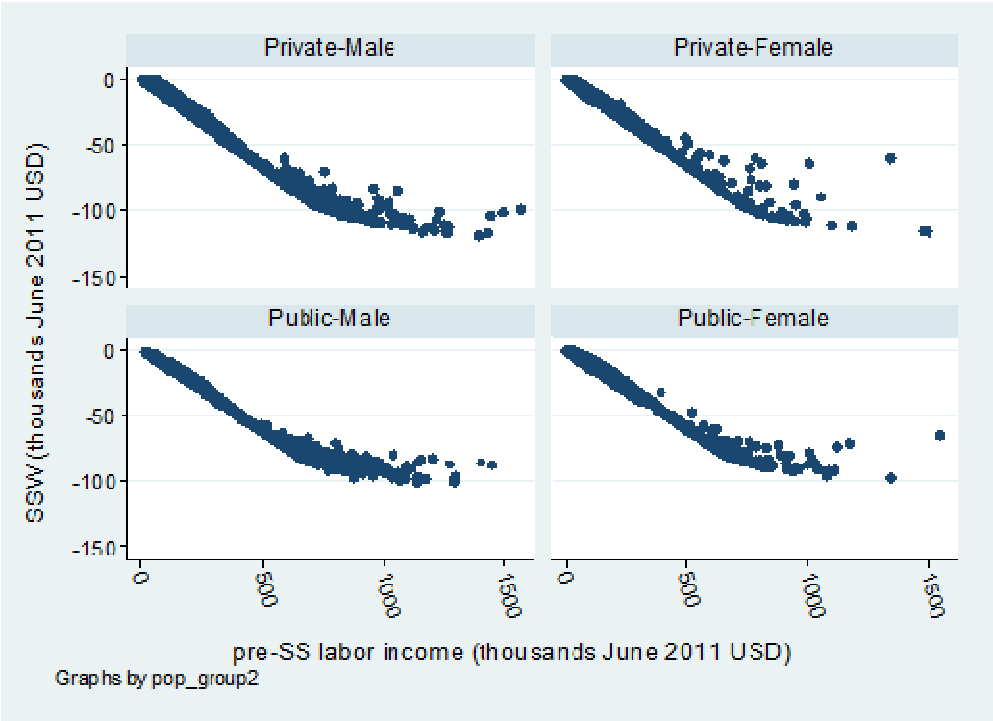
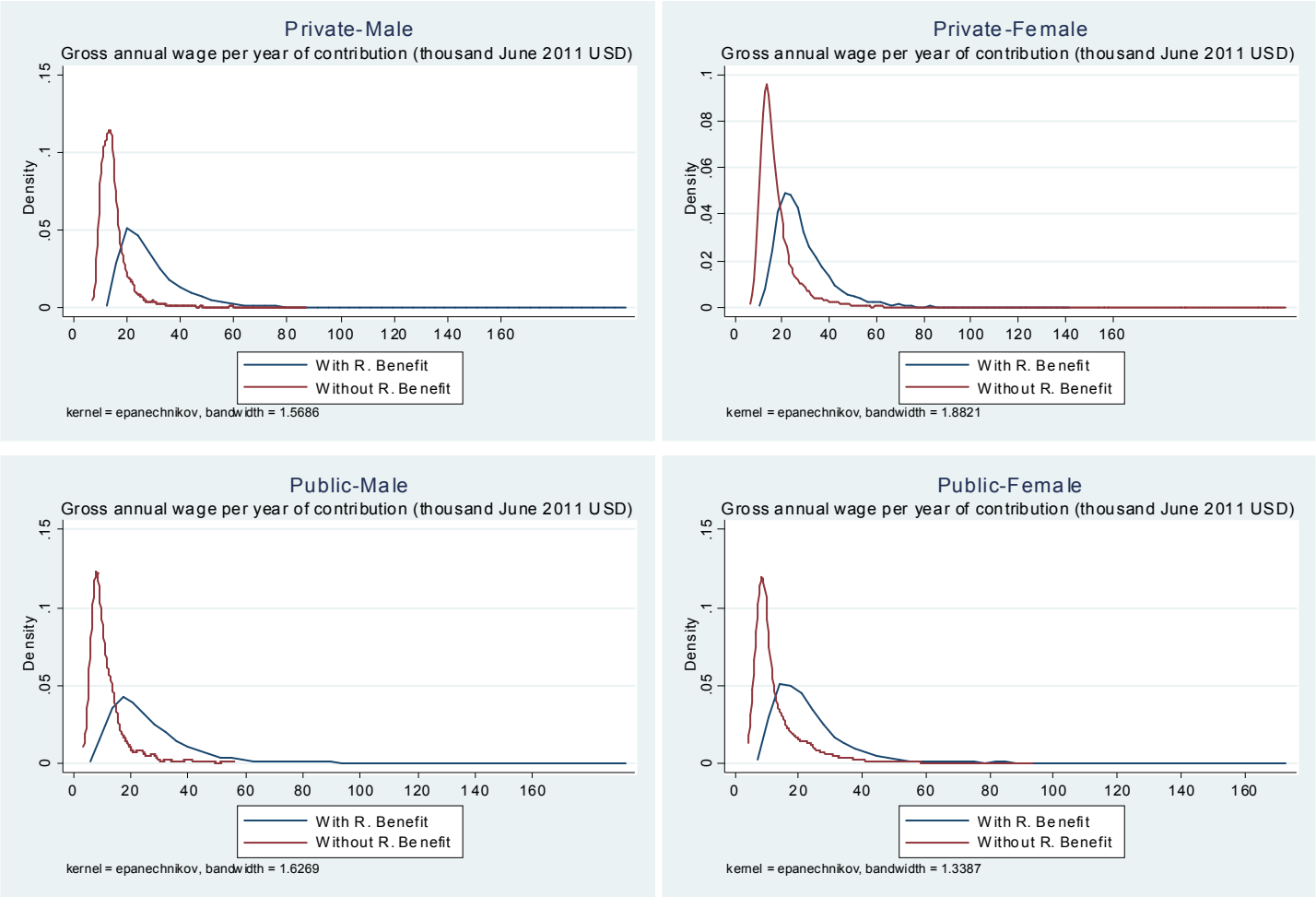
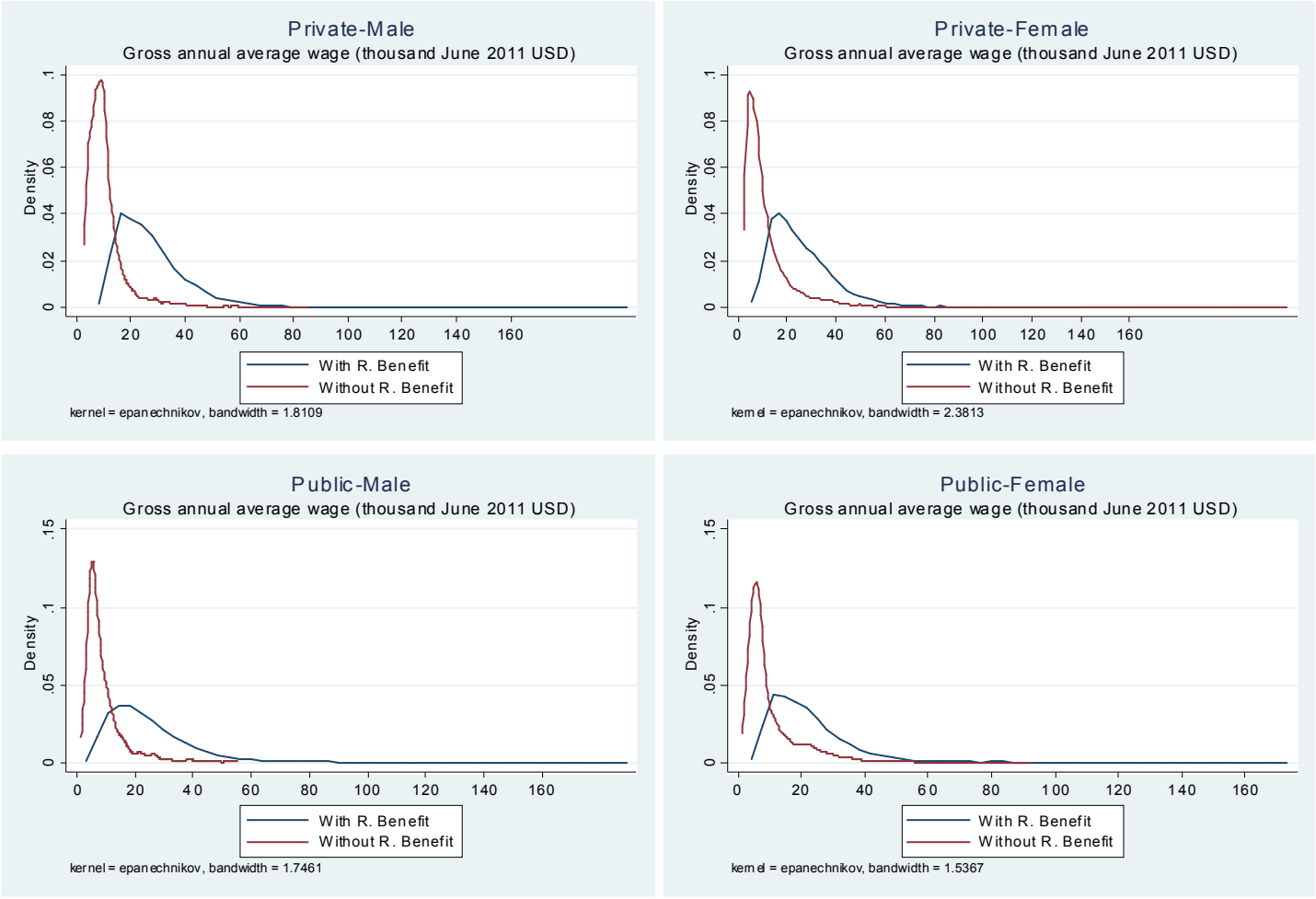


Figure 3
Argentina: average labor cost per year of contribution (*)



(*) Includes employee and employer contributions. **Note:** excluding informal jobs.

Figure 4
Argentina: average labor cost per year of employment (*)



(*) Includes employee and employer contributions. **Note:** including informal jobs.