THREE ESSAYS ON SOCIAL SECURITY

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DEDICATION

To Gastón and Pier, for making everything possible.

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PREFACE

One reason for government intervention in the pension system is redistribution. The study of pension distribution has usually been approached by two perspectives: an intergenerational dimension (i.e., distribution across generations), and an intragenerational dimension (i.e., within the same generation). The first aspect is related to the intertemporal relationship between the contributions made by the worker and the pension he receives as a retiree. Secondly, apart from this typical redistribution from young to old, the pension system can involve the redistribution within the same generation, for example if the government pays pensions to low earners that are a higher percentage of their salaries than the percentage paid to higher earners. In this context, the first two Chapters of this thesis deal with the redistributional aspects of the pension system, while the last Chapter is related to the individual objective of income security in the old age.

More precisely, the first Chapter studies which is the optimal redistribution policy instrument in terms of aggregate welfare when agents differ according their labor condition (formal or informal workers). Using a two-period OLG model, the investigation includes five policy specifications which involve intra and/or intergenerational income redistribution: (i) early redistribution to the young informal generation; (ii) late redistribution to the informal old generation; (iii) a mix between early and late redistribution; (iv) the case where the current formal young generation transfers income to the current formal old generation (redistribution across formal agents); and (v) the case where any form of redistribution takes place. In all of them, redistribution is financed by labor taxes paid by the young formal generation. They also receive a pension in the old age. Our findings suggest that, although redistribution imposes costs in terms of capital formation, it is optimal to redistribute in order to maximize total welfare. Even in a dynamically efficient economy, the introduction of a PAYG pension system could be justified when there is redistribution. We find that transferring to the young is always the dominant redistribution policy. Nevertheless, whether redistribution enhances lifetime income inequality depends on the proportion of redistribution.

Chapter 2 focuses on the distributional impacts within the group of pensioners, of the recent reforms on the pension system in Argentina. Using unpublished microdata of the National Social Security Administration (*Administración Nacional de la*

Seguridad Social –ANSES), the article documents pension inequality between 1995-2009. Besides, using Theil decomposition techniques and the microeconometric approach proposed by Juhn, Murphy and Pierce (1993), the Chapter analyzes the relationship between the reforms and the observed inequality during that period. We find that, before 2003, pensions under the SIJP rules, the incorporation of provincial benefits into the national scheme and the increase of female retirees play important roles in accounting for increased inequality. After 2003, the increase in the share of minimum pensions and the implementation of the Moratorium program appear to be the most significant factors in explaining the more equal distribution observed.

The third essay deals with the relationship between the decision of the workers who contribute to the pension system to migrate from the private capitalization scheme to the PAYG pension regime and an income maximizing behavior. This Chapter reports evidence for Argentina regarding the switchers' profiles and presents a simple simulation exercise to obtain the optimal age for switching from the private to the public pensions regime. The results suggest that the decisions taken by the affiliates are broadly in line with those of an agent who seeks to obtain the highest pension at retirement.

Finally, I would like to thank the members of my Thesis Committee, Professors Julio Elías (Supervisor), Mariana Conte Grand, Roque Fernández, and Leonardo Gasparini for their insightful suggestions. A special acknowledgment I owe to the Director of the Master in Economics at the UCEMA, Mariana Conte Grand, who has been a major influence throughout my time at the university. I have benefited from her valuable advice, warm support and permanent encouragement and I am very grateful for it. Professors Alejandro Rodriguez and Germán Coloma also deserve my thanks for providing constructive comments and advice on my work.

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Chapter 1

The PAYG system and the optimal redistribution instrument in an overlapping generation model

I. Introduction

From an individual point of view, the main reasons for the existence of social security in old age are consumption smoothing and insurance. Other reasons for government involvement in social protection have to do with poverty relief and income redistribution (Barr and Diamond, 2008). In this sense, lifetime redistribution within the same generation could be achieved, for example by paying pensions to low earners that are a higher percentage of their previous wage compared with high earning workers. There can also be redistribution across generations, for example when the government transfers income to the poor young individuals at the expense of lower pensions for the richer elderly. These policy interventions change the behavior of both aged and younger agents. Therefore, the optimal size and character of the social security program involves a balancing of protection and distortions (Feldstein and Liebman, 2002).

In the last years, the government of Argentina has implemented two important income transfer programs, which have become into the major redistribution policy instruments. On one hand, the *Retirement Inclusion Plan* (commonly known as the *Moratorium* program) implemented in 2005 by Law 25,994 of 2004, allows those elderly who do not meet the total contributions required to the pay-as-you-go (PAYG) pension system to receive a pension. On the other hand, by the Executive Order 1,602/2009 of 2009, the government implemented the *Universal Child Allowance* program, which consists in a non-remunerative monetary benefit per child that is given to their parents provided the children have attended school and have received all the health check-ups required. Both programs are financed with social security resources.[1] In this regard, the aim of this paper is to analyze which of these redistribution settings (i.e., programs targeted the young or to the elderly) is superior in terms of total welfare. Moreover, one question that arises is if the redistribution policy that maximizes total utility also has the best performance in reducing income inequality. In this sense, we

[1] In the case of Argentina, almost 60% of these resources comes from labor taxes, while the rest come from other sources of the National Treasure (for details see ANSES, 2009).

also investigate whether the optimal redistribution policy enhances inequality simultaneously.

The literature regarding redistribution is very rich, especially the one which involves the study of optimal taxation and optimal design of pension system. Nevertheless, only a few articles analyze whether it is better that the redistribution focuses on the young or on the old generation. For example, we can mention the work of Thakoor (2008) who investigates whether income support to the poor young agents or pensions to the poor elderly are the best instruments for redistribution. Assuming that these instruments are financed by labor taxes paid by the rich, he finds that the optimal timing and amount of redistribution depends on the initial endowment of the agents and in the proportion of poor agents in the economy. He also finds that though redistribution increases welfare in most cases, there are some situations where it is optimal to have no redistribution. More recently, Glomm and Jung (2013) have studied if programs that transfer income to the young dominate those that redistribute among the old individuals. They assume that the first type of programs is financed by labor taxes from the young generation and the second type of programs is financed by capital taxes on the interest of savings income from the elderly. They find that the optimal tax policy results of transferring all the taxes collected to the young generation and taxing labor income at 53% and interest income at 100%. Redistribution in the form of pensions is preferred only if the size of the transfer is small.

In line with these investigations, our work relies on the overlapping generation (OLG) model of Samuelson (1958) and Diamond (1965). But, unlike these papers, our model includes intergenerational redistribution within the formal sector of the economy. Therefore, a proportion of the taxes goes to the informal sector, while the remaining percentage is transferred to the current old formal individuals through the PAYG pension system. Taking into account the results of Aaron (1966) and Samuelson (1975) who show that the PAYG pension system can improve welfare only if the economy is dynamically inefficient, the idea here is to discuss whether in a dynamically efficient economy, the introduction of a PAYG pension system could be justified in terms of welfare when part of the tax revenues is redistributed to the informal agents.

We conduct our investigation using five policy specifications: (i) early redistribution to the young informal generation financed by a proportion of taxes on wage income of the current young formal generation; (ii) late redistribution to the informal old generation financed by a proportion of taxes on wage income of the current

young formal generation; (iii) a mix between early and late redistribution financed by a proportion of taxes on wage income of the current young formal generation and, for comparative reasons, we include the following two scenarios with no redistribution from formal to informal agents: (iv) the case where the current formal young generation transfers income to the current formal old generation through the PAYG pension system (redistribution across formal agents of different generations); and (v) the case where any form of redistribution takes place. We obtain the optimal tax level that maximizes aggregate welfare in the alternative scenarios and discuss in which setting the society as a whole is better off. We also discuss the implications of the regimens regarding income inequality. Although our model does not reflect the exact design of the PAYG system of Argentina, we find it a very useful instrument for the discussion regarding the optimal redistribution policy.

The rest of the article is organized as follows: the next Section outlines the model and defines the equilibrium. In Section III we conduct a policy analysis performing numerical simulations and discuss which is the optimal redistribution scheme in terms of total welfare. In Section IV we calculate the optimal tax rate in the different policy specifications and conduct a sensitivity analysis to check the robustness of our findings. Finally, Section V concludes.

II. The Model

A. The household sector

We consider a discrete two-period overlapping generation (OLG) model. Every period *t* and *t+1* the young and the old generation are alive. Population grows at a constant rate n>0. The young generation is endowed with one unit of labor and receives a wage at time *t*. Old agents do not work. Within each generation there are two types of agents (*j*) according they work in the formal (*f*) or informal (*i*) sector of the economy. It is also assumed that the informal workers are less productive than the formal ones. Such as in Thakoor (2008), the low productive agents receive a wage w_t^i that is a proportion $0<\mu<1$ of the high productive agents wages. We assume that formal agents make up a proportion π of total population and hence, the informal agents make up the remaining $(1-\pi)$, and these parameters are assumed to be constant overtime.

Formal workers pay a tax, τ_t, on their wage income. The proportion $0<\phi<1$ of the tax is redistributed to the informal workers. Assuming a PAYG pension system, the proportion (1-ϕ) of the tax τ_t paid by the currently young workers is used to finance pensions in period *t* of those who were formal workers in *t-1*. This is a kind of contract where the currently young pay the pension of the currently old and are paid back in the next period by a transfer from that period's young agents who pay a contribution of τ_{t+1}. We assume for simplicity that $\tau_{t+1} = \tau_t = \tau$ for all *t* and that they are the only source of funding for the redistribution programs. Agents value consumption in youth and old age and they are not altruists. At time *t* they decide how much to consume and how much to save for old age consumption to maximize utility. Regarding how the proportion ϕ is transferred to the formal sector of the economy we consider the following scenarios: (i) the currently young formal workers transfer a proportion ϕ of the tax τ_t to informal individuals of the same generation; (ii) the redistribution to the informal individuals takes place in the form of pensions and; (iii) transfers go to both currently young and old informal agents. We also analyze the case where redistribution only takes place among formal agents, i.e., when pensions are used to redistribute across generations of formal workers (scenario NR1) and, when there is any form of redistribution (scenario NR0).

Assuming that the utility function is of a Cobb-Douglas type, the formal and informal young agents that were born at time *t* solve the following optimization problem:

$$\underset{\{c_t^j, c_{t+1}^j, s_t^j\}}{Max}\ u^j(c_t^j, c_{t+1}^j) = \ln c_t^j + \gamma^j \ln c_{t+1}^j \qquad (1)$$

with $u'(\cdot) > 0, u''(\cdot) < 0$ and $\lim_{c\to 0} u'(\cdot) = \infty$, c_t^j and c_{t+1}^j stand for consumption during the first and second period, respectively, and $0<\gamma^j<1$ is the intertemporal discount factor . In the case of formal workers $\gamma^f = \theta$ and for informal workers the discount factor is $\gamma^i = \beta$.

The intertemporal budget constrain (IBC) varies depending on the scenario considered. The optimal levels of consumption and savings are the following:

<u>Scenario NR1: No Redistribution to the informal sector</u>

Informal workers	***Formal workers***
$c_t^i = w_t^i - s_t^i$	$c_t^f = w_t^f(1-\tau) - s_t^f$

$$c_{t+1}^{i} = s_t^{i}(1+r_{t+1}) \qquad c_{t+1}^{f} = s_t^{f}(1+r_{t+1}) + P_{t+1}^{f}$$

$$IBC^{i} : c_t^{i} + \frac{c_{t+1}^{i}}{(1+r_{t+1})} = w_t^{i}. \tag{2}$$

Introducing restriction (2) in problem (1) the solutions of the optimal c_t^i c_{t+1}^i and saving rate s_t^i for informal workers are:

$$c_t^{i*} = \frac{1}{(1+\beta)} w_t^{i} \tag{3}$$

$$c_{t+1}^{i*} = \frac{\beta}{(1+\beta)}(1+r_{t+1}) w_t^{i} \tag{4}$$

$$s_t^{i*} = \frac{\beta}{(1+\beta)} w_t^{i}. \tag{5}$$

For formal workers:

$$c_t^{f*} = \frac{1}{(1+\theta)}\left(w_t^{f}(1-\tau) + \frac{P_{t+1}^{f}}{(1+r_{t+1})} \right) \tag{6}$$

$$c_{t+1}^{f*} = \frac{\theta}{(1+\theta)}(1+r_{t+1})\left(w_t^{f}(1-\tau) + \frac{P_{t+1}^{f}}{(1+r_{t+1})} \right) \tag{7}$$

$$s_t^{f*} = \frac{1}{(1+\theta)}\left(\theta \cdot w_t^{f}(1-\tau) - \frac{P_{t+1}^{f}}{(1+r_{t+1})} \right). \tag{8}$$

In the case of formal agents, savings are increasing in the interest rate and in disposable wage income and decreasing in the pension transfer (crowding out effect). These optimal expressions of consumption and savings also apply to the rest of the policy specifications considered, except in the no redistribution scenario NR0 where τ =0. In this case, for formal individuals it holds that:

$$c_t^{f*} = \frac{1}{(1+\theta)} \cdot w_t^{f} \tag{9}$$

$$c_{t+1}^{f*} = \frac{\theta}{(1+\theta)}(1+r_{t+1}) \cdot w_t^{f} \tag{10}$$

$$s_t^{f*} = \frac{1}{(1+\theta)} \cdot \theta \cdot w_t^{f}. \tag{11}$$

<u>Scenario 1: Redistribution in the form of income transfers</u>

Informal workers ***Formal workers***

$$c_t^{i} = w_t^{i} - s_t^{i} + T_t^{i} \qquad c_t^{f} = w_t^{f}(1-\tau) - s_t^{f}$$

$$c_{t+1}^{i} = s_t^{i}(1+r_{t+1}) \qquad c_{t+1}^{f} = s_t^{f}(1+r_{t+1}) + P_{t+1}^{f}$$

$$IBC^{i} : c_t^{i} + \frac{c_{t+1}^{i}}{(1+r_{t+1})} = w_t^{i} + T_t^{i}. \tag{12}$$

Introducing restriction (12) in problem (1) the solutions of the optimal c_t^i c_{t+1}^i and saving rate s_t^i for informal workers are:

$$c_t^{i*} = \frac{1}{(1+\beta)}(w_t^{i} + T_t^{i}) \tag{13}$$

$$c_{t+1}^{i*} = \frac{\beta}{(1+\beta)}(1+r_{t+1})(w_t^{i} + T_t^{i}) \tag{14}$$

$$s_t^{i*} = \frac{\beta}{(1+\beta)}(w_t^{i} + T_t^{i}). \tag{15}$$

Thus, for informal workers, the saving rates are increasing in wage income and in the income transfer.

<u>Scenario 2: Redistribution in the form of pensions</u>

Informal workers ***Formal workers***

$$c_t^{i} = w_t^{i} - s_t^{i} \qquad c_t^{f} = w_t^{f}(1-\tau) - s_t^{f}$$

$$c_{t+1}^{i} = s_t^{i}(1+r_{t+1}) + P_{t+1}^{i} \qquad c_{t+1}^{f} = s_t^{f}(1+r_{t+1}) + P_{t+1}^{f}$$

$$IBC^{i} : c_t^{i} + \frac{c_{t+1}^{i}}{(1+r_{t+1})} = w_t^{i} + \frac{P_{t+1}^{i}}{(1+r_{t+1})} \tag{16}$$

$$IBC^{f} : c_t^{f} + \frac{c_{t+1}^{f}}{(1+r_{t+1})} = w_t^{f}(1-\tau) + \frac{P_{t+1}^{f}}{(1+r_{t+1})}. \tag{17}$$

Introducing restriction (16) in problem (1) yields the following solutions of the optimal c_t^j c_{t+1}^j and saving rate s_t^j. For informal workers:

$$c_t^{i*} = \frac{1}{(1+\beta)}\left(w_t^{i} + \frac{P_{t+1}^{i}}{(1+r_{t+1})}\right) \tag{18}$$

$$c_{t+1}^{i*} = \frac{\beta}{(1+\beta)}(1+r_{t+1})\left(w_t^{i} + \frac{P_{t+1}^{i}}{(1+r_{t+1})}\right) \tag{19}$$

$$s_t^{i*} = \frac{1}{(1+\beta)}\left(\beta \cdot w_t^{i} - \frac{P_{t+1}^{i}}{(1+r_{t+1})}\right). \tag{20}$$

Scenario 3: Redistribution using both transfers to informal young and old agents

Informal workers	***Formal workers***
$c_t^i = w_t^i - s_t^i + \lambda T_t^i$	$c_t^f = w_t^f(1-\tau) - s_t^f$
$c_{t+1}^i = s_t^i(1+r_{t+1}) + (1-\lambda)P_{t+1}^i$	$c_{t+1}^f = s_t^f(1+r_{t+1}) + P_{t+1}^f$

$$IBC^i : c_t^i + \frac{c_{t+1}^i}{(1+r_{t+1})} = w_t^i + \lambda T_t^i + (1-\lambda)\frac{P_{t+1}^i}{(1+r_{t+1})} \tag{21}$$

$$IBC^f : c_t^f + \frac{c_{t+1}^f}{(1+r_{t+1})} = w_t^f(1-\tau) + \frac{P_{t+1}^f}{(1+r_{t+1})}. \tag{22}$$

where λ is the fraction of total contributions that the government uses to pay the early redistribution program. As can be seen, scenario 1 and 2 are special cases of scenario 3 where λ=1 and λ=0 in the first and second case, respectively.

Introducing restriction (21) in problem (1) yields the following solutions of the optimal c_t^j c_{t+1}^j and saving rate s_t^j. For informal workers:

$$c_t^{i*} = \frac{1}{(1+\beta)}\left(w_t^i + \lambda T_t^i + \frac{(1-\lambda)P_{t+1}^i}{(1+r_{t+1})} \right) \tag{23}$$

$$c_{t+1}^{i*} = \frac{\beta}{(1+\beta)}(1+r_{t+1})\left(w_t^i + \lambda T_t^i + \frac{(1-\lambda)P_{t+1}^i}{(1+r_{t+1})} \right) \tag{24}$$

$$s_t^{i*} = \frac{1}{(1+\beta)}\left(\beta \cdot (w_t^i + \lambda T_t^i) - \frac{(1-\lambda)P_{t+1}^i}{(1+r_{t+1})} \right). \tag{25}$$

B. The production sector

We consider a competitive economy in which the production function is given by $Y_t = F(K_t, E_t)$ where Y_t is the level of output, K_t is capital input and $E_t = \pi \cdot L_t + \mu \cdot (1-\pi) \cdot L_t$ is the effective aggregate labor supply. Assuming constant returns to scale, the production function satisfies all the Inada regularity conditions. Maximization of profit leads to the standard equality between wage rate and marginal productivity of labor, and between the interest rate and the marginal productivity of

capital (with total depreciation assumed).[2] Using a Cobb-Douglas production function with no technological change, and taking into account the heterogeneity among workers, the production function is of the form: $Y_t = K_t^{\alpha} \cdot E_t^{1-\alpha}$. Then:

$$w_t^* = (1-\alpha) \cdot k_t^{\alpha} \tag{26}$$

$$r_{t+1}^* = \alpha \cdot k_t^{\alpha-1}. \tag{27}$$

where $k_t = \frac{K_t}{E_t}$ is the stock of capital per unit of effective labor; $y_t = f(k_t) = k_t^{\alpha}$; $f'(k_t) > 0$ and $f''(k_t) < 0$.

C. Government

The government acts as a kind of financial intermediary which collect taxes from the formal workers in period *t* and transfer a proportion (1-ϕ) of them to the current old formal workers in the form of pensions (P_t^f)while the way in which the proportion ϕ is transferred to the currently informal individuals depends on the policy program. In the early redistribution scheme the young generation receives a transfer T_t^i, in the late redistribution program the informal old generation receives a transfer in the form of pension P_t^i, whereas in the mix redistribution scenario all informal agents (young and old) receive a transfer.

Since total taxes are transferred, it holds that: $Taxes_t = \tau \cdot w_t^f \cdot \pi \cdot L_t = (1-\pi) L_t \cdot T_t^i + \pi \cdot L_{t-1} \cdot P_t^f$ in scenario 1, $Taxes_t = \tau \cdot w_t^f \cdot \pi \cdot L_t = (1-\pi) L_{t-1} \cdot P_t^i + \pi \cdot L_{t-1} \cdot P_t^f$ in scenario 2 and $Taxes_t = \tau \cdot w_t^f \cdot \pi \cdot L_t = (1-\pi)(L_t \cdot \lambda T_t^i + L_{t-1} \cdot (1-\lambda) P_t^i) + \pi \cdot L_{t-1} \cdot P_t^f$ in scenario 3. The equilibrium conditions require that: (i) $(1-\phi) \cdot \tau \cdot w_t^f \cdot \pi \cdot L_t = \pi \cdot L_{t-1} \cdot P_t^f$ and $\phi \cdot \tau \cdot w_t^f \cdot \pi \cdot L_t = (1-\pi) \cdot L_t \cdot T_t^i$ in scenario 1; (ii)

[2] In the case of wages, we assume that the productivity of the formal workers equals to 1,

$$w_t = w_t^f = F'_{L^f}(K_t, E_t) = (1-\alpha) \cdot K_t^{\alpha} \cdot (\underbrace{\pi \cdot L_t}_{L_t^f} + \mu \cdot \underbrace{(1-\pi) \cdot L_t}_{L_t^i})^{-\alpha} = (1-\alpha) \cdot K_t^{\alpha} \cdot E_t^{-\alpha} = (1-\alpha) \cdot k_t^{\alpha};$$

then: *and*

$$w_t^i = F'_{L^i}(K_t, E_t) = (1-\alpha) \cdot K_t^{\alpha} \cdot \mu \cdot (\underbrace{\pi \cdot L_t}_{L_t^f} + \mu \cdot \underbrace{(1-\pi) \cdot L_t}_{L_t^i})^{-\alpha} = (1-\alpha) \cdot K_t^{\alpha} \cdot \mu \cdot E_t^{-\alpha} = \mu \cdot (1-\alpha) \cdot k_t^{\alpha} = \mu \cdot w_t^f$$

$(1-\phi)\cdot\tau\cdot w_t^f\cdot\pi\cdot L_t=\pi\cdot L_{t-1}\cdot P_t^f$ and $\phi\cdot\tau\cdot w_t^f\cdot\pi\cdot L_t=(1-\pi)\cdot L_{t-1}\cdot P_t^i$ in scenario 2; and (iii) $(1-\phi)\cdot\tau\cdot w_t^f\cdot\pi\cdot L_t=\pi\cdot L_{t-1}\cdot P_t^f$ and $\phi\cdot\tau\cdot w_t^f\cdot\pi\cdot L_t=(1-\pi)(L_t\cdot\lambda T_t^i+L_{t-1}(1-\lambda)P_t^i)$ in scenario 3.

Finally, in the no redistribution scenario (NR1), the equilibrium requires that $\tau\cdot w_t^f\cdot\pi\cdot L_t=\pi\cdot L_{t-1}\cdot P_t^f$. Then, with stationary population structure $\left(\frac{L_t}{L_{t-1}}=(1+n)\right)$ the pensions of formal workers are defined as:

$$P_t^f=(1-\phi)\cdot\tau\cdot w_t^f\cdot(1+n) \tag{28}$$

The income transfers in scenario 1 are defined as:

$$T_t^i=\frac{\phi\cdot\tau\cdot w_t^f\cdot\pi}{(1-\pi)} \tag{29}$$

while the benefits that the informal old agents receive in time t under scenario 2 can be expressed as:

$$P_t^i=\frac{\phi\cdot\tau\cdot w_t^f\cdot\pi\cdot(1+n)}{(1-\pi)}. \tag{30}$$

D. Competitive equilibrium and steady state

The competitive equilibrium for the economy can be defined as a sequence of quantities $\{c_t^j,c_{t+1}^j,s_{t+1}^j\}_{t=0}^{\infty}$, a sequence of prices $\{w_t^j,r_{t+1}\}_{t=0}^{\infty}$ and a sequence of taxes and transfers $\{\tau\cdot w_t^f,T_t^i,P_t^j\}_{t=0}^{\infty}$ which satisfy (i) households optimization; (ii) firms optimization; and (iii) market clearing in each period *t*. At the same time, the government budget is always balanced and the economy's resource constraint is always satisfied (i.e., $y_t=\frac{c_t^t}{(\pi+\mu\cdot(1-\pi))}+\frac{c_t^{t-1}}{(1+n)\cdot(\pi+\mu\cdot(1-\pi))}+(1+n)\cdot k_{t+1}$ where c_t^t is the consumption in period *t* of people who were born at time t and c_t^{t-1} is the consumption in period *t* of people who were born at time *t-1*).

Consumer optimization in each policy specification is summarized by Eqn. (8) (11) (15) (20) and (25), which essentially determine the supply of capital, as period *t* saving is equal to the capital that will be rented in period *t+1*. The supply of labor is inelastic, and the demands for labor and capital are determined by Eqn. (26) and (27),

respectively. As all the capital stock consists of the savings of the young generation (both formal and informal), with complete depreciation of capital from one period to the next, the equation for the capital accumulation can be expressed as follows:

$$k_{t+1}(1+n) = \frac{\pi \cdot s_t^f + (1-\pi) \cdot s_t^i}{(\pi + \mu \cdot (1-\pi))}. \tag{31}$$

The steady state capital-labor ratio can be determined by setting $k_{t+1} = k_t = k^*$. Solving Eqn. (31) for each scenario we obtain:

$$k_{NR0}^* = \left[\frac{(1-\alpha)(1+\theta)}{(1+n)A} \cdot \left[\frac{\beta\mu(1-\pi)}{(1+\beta)} + \frac{\pi\theta}{(1+\theta)} \right] \right]^{\frac{1}{(1-\alpha)}} \tag{32}$$

$$k_{NR1}^* = \left[\frac{\alpha(1-\alpha)(1+\theta)}{(1+n)\left[A + \pi\tau(1-\alpha)\right]} \cdot \left[\frac{\beta\mu(1-\pi)}{(1+\beta)} + \frac{\pi\theta(1-\tau)}{(1+\theta)} \right] \right]^{\frac{1}{(1-\alpha)}} \tag{33}$$

$$k_1^* = \left[\frac{\alpha(1-\alpha)(1+\theta)}{(1+n)\left[A + \pi\tau(1-\alpha)(1-\phi)\right]} \cdot \left[\frac{\beta(\mu(1-\pi) + \pi\tau\phi)}{(1+\beta)} + \frac{\pi\theta(1-\tau)}{(1+\theta)} \right] \right]^{\frac{1}{(1-\alpha)}} \tag{34}$$

$$k_2^* = \left[\frac{\alpha(1-\alpha)(1+\theta)(1+\beta)}{(1+n)\left[A + (1+\theta)(1-\alpha)\pi\phi\tau + \pi\tau(1+\beta)(1-\alpha)(1-\phi)\right]} \cdot \left[\frac{\beta\mu(1-\pi)}{(1+\beta)} + \frac{\pi\theta(1-\tau)}{(1+\theta)} \right] \right]^{\frac{1}{(1-\alpha)}} \tag{35}$$

$$k_3^* = \left[\frac{\alpha(1-\alpha)(1+\theta)(1+\beta)}{(1+n)\left[A + (1+\theta)(1-\alpha)(1-\lambda)\pi\phi\tau + \pi\tau(1+\beta)(1-\alpha)(1-\phi)\right]} \cdot \left[\frac{\beta\mu(1-\pi) + \lambda\phi\tau\pi}{(1+\beta)} + \frac{\pi\theta(1-\tau)}{(1+\theta)} \right] \right]^{\frac{1}{(1-\alpha)}}. \tag{36}$$

where $A = \alpha(1+\theta)(\pi + \mu(1+\pi))$ is a set of parameters independent of the policy term.

III. Policy analysis of the different programs

In this Section we analyze which of the different policy schemes dominates in terms of welfare. We assume an utilitarian social welfare function, defined as the weighted sum of the lifetimes utilities of all individuals (young and old, formal and informal) who are born directly into the steady state. Following Thakoor (2008), we write aggregate welfare W as:

$$W = \pi \cdot \left[u(c^{y,f}) + \theta \cdot u(c^{o,f}) \right] + (1-\pi) \cdot \left[u(c^{y,i}) + \beta \cdot u(c^{o,i}) \right] \tag{37}$$

Assuming that the government's objective is to maximize total welfare, our first exercise is to find out which is the best redistribution program for the society as a whole. In this sense, Figure 1 presents a comparison of the different policy specifications, adjusting the tax rate that finances the programs from 0% to 25%. For the simulation, we chose the following combination of parameters which are in accordance with the values commonly found in the literature: the population growth rate (*n*) was taken from the Word Development Indicators Table of the Word Bank for Argentina over 1960-2012 and set at 0.01. Following Nehru and Dhareshwar from the Word Bank (1993), we set the share of capital in GDP (α) at 0.33. In addition, in line with the values often used in the literature, the discount factors were set at $\theta = 0.96$ and $\beta = 0.9$ for formal and informal agents, respectively. The proportion of formal workers (π) and the gap between the wage of formal and informal individuals (μ) were set using the information of the Socio-Economic Database for Latin America and the Caribbean (SEDLAC) from 2003 to 2013 which, in turn, is based on data of Argentina's Permanent Survey of Households. It was set $\pi = 0.6$ and $\mu = 0.5$. We consider three alternative values for the proportion of labor taxes redistributed: $\phi = 0.1$ (low redistribution setting), $\phi = 0.5$ (medium redistribution setting) and $\phi = 0.9$ (high redistribution setting). To make the presentation simple we report here the results of the medium setting while the other specifications are included in the Appendix of the article. Finally, in the mix scenario (scenario 3) we assume that $\lambda = 0.5$.

In Panel A of Figure 1 we can observe that the steady state capital level is the largest in the no redistribution scenario NR0 since, as expected, agents save more when τ =0 (see Panel D). Consequently, in equilibrium, the interest rate is the lowest in this setting. On the contrary, when redistribution takes the form of pensions, agents save less. This leads to the lowest level of capital and output which, in turn, are almost identical to the no redistribution scenario NR1. This is explained by the fact that both scenarios are characterized by transfers to the old generation. The small difference between them is explained by the difference in the discount factor of formal and informal agents. From Eqn. (33) and (35) it can be easily checked that when both types of individuals have the same discount factor, the level of capital in scenario 2 is the same as that of scenario NR1. This means that the distorting effect on capital formation is the same whereas the transfer goes to the informal old agents or to the formal old individuals.

Although the scenario NR0 presents the highest steady state aggregate output, the aggregate welfare is the highest in the early redistribution scheme (see Panel E). This is because the gap between the gains in utility due to the increased consumption and the costs from the reduction in capital is the widest when the funds collected are shifted to the young generation. Moreover, we can also observe that in all redistribution schemes, the welfare functions are non-monotonic in taxes. The turning point of these functions indicates that initially, despite the fall in capital levels, aggregate consumption increases and also does total welfare, but beyond certain critical tax values, the saving distortions are so strong that the aggregate consumption begins to fall and total welfare begins to go down. Figure 1 also shows that the higher the transfer to the young, the higher the critical tax rate at which welfare reaches its maximum value. Besides, when transfers are redistributed in the form of pensions across the formal generations (scenario NR1), the aggregate welfare falls as the tax rate increases. Moreover, the PAYG system that transfers income across the formal individuals of different generations is outperformed by the no redistribution setting in terms of welfare. This is in line with the classic result in dynamic public economics which states that there is no welfare rationale for introducing a PAYG pensions in a dynamically efficient overlapping generations economy with exogenous labor supply (see Aaron (1966) and, Samuelson (1975)). The authors show that a PAYG pension system is socially desirable if and only if the gross return on capital (r) is less than the economy's growth rate (n).

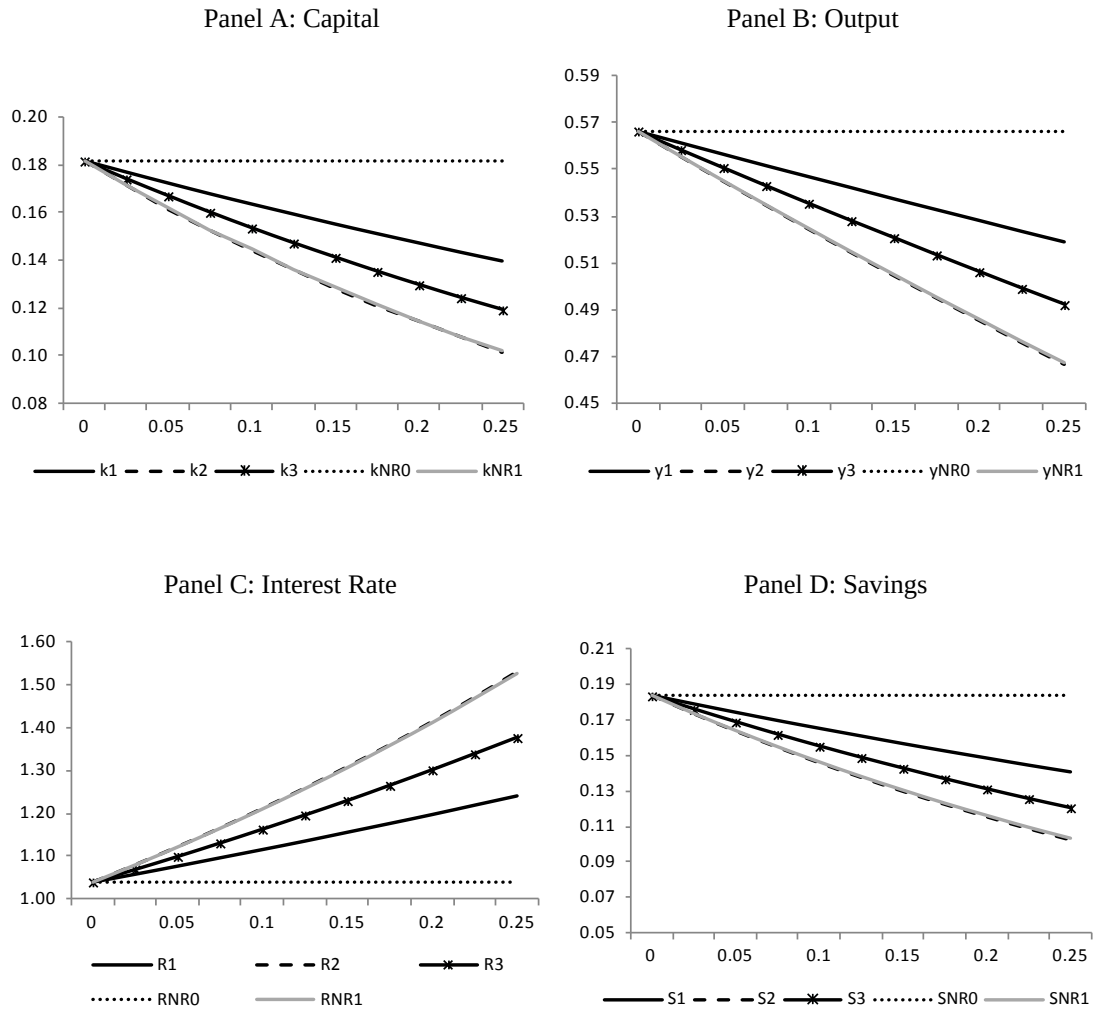
As can be observed in Panel C, as $R - n > 1$ (i.e., $r > n$), the steady state in the no redistribution scenario NR0 is dynamically efficient, and then there is no a welfare justification for PAYG pensions exists among the formal agents. Nevertheless, we find that the introduction of a PAYG pension system across formal generations can improve the stationary welfare of all two-period lived agents when a proportion (50% in this experiment) of the tax collected go to the informal agents (scenario 2). In our experiment, the late redistribution scenario dominates the no redistribution schemes when labor taxes are lower than 15%.

In addition, Panel E also shows that the mix redistribution program outperforms the late redistribution scheme and the no redistribution scenarios in terms of welfare.

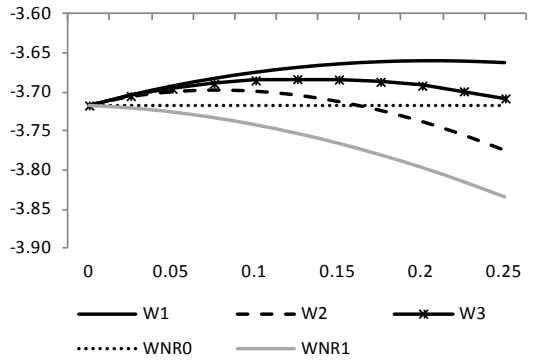
Finally, Panel H illustrates the relationship between the lifetime incomes (LIR) of informal and informal individuals in the different settings. This relationship could be considered as a simple measure of income inequality. We observe that, for all redistribution scenarios, inequality is decreasing with the labor tax. This is because as

the tax increase, the lifetime income of the informal agents increases while that of the formal individuals falls (see Panel G). Moreover, transferring the taxes collected to the young generation generates the best results in terms of income inequality. Inequality not only is the largest in the late redistribution setting, but also becomes worse as the taxes increase due to the strong distortions in capital formation. As can be seen in Panel G, in the scenario NR1, the fall in the lifetime income of the informal agents is stronger than the fall in the income of the formal workers.

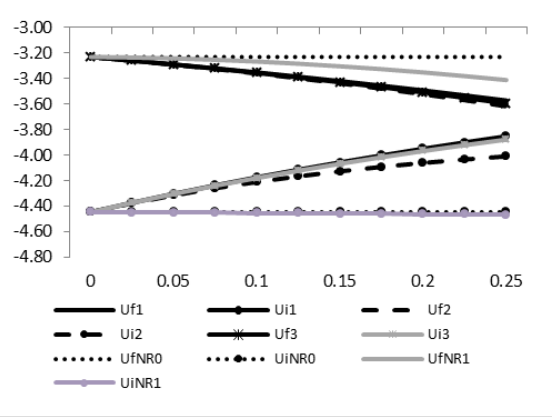
Figure 1. Steady state results of alternative redistribution policy specifications



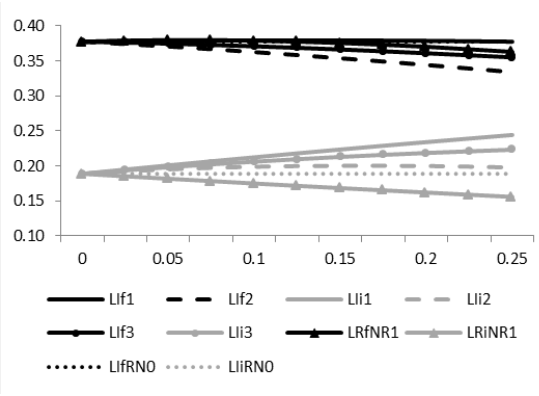
Panel E: Aggregate Welfare



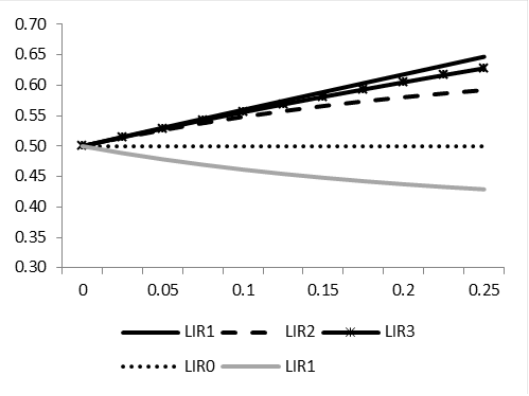
Panel F: Lifetime Utility



Panel G: Lifetime Income



Panel H: Relationship Lifetime Income



Note: We define R= (1+r).

This experiment shows that the redistribution programs are policy instruments that enhance aggregate welfare. Targeting the taxes collected to the old informal agents is preferred to the no redistribution scenario NR0 only when the tax is small. This reflects the strong negative effects on savings of late transfers in OLG models. We find that, for all the tax rates considered, transferring the funds to the young generation represents an improvement over the other redistribution schemes in terms of total welfare. In this sense, one conclusion of this exercise is that, in terms of total welfare, those programs that transfer income to the informal (less productive and poorer) young generation like the *Universal Child Allowance* program in Argentina overcome those redistributive programs whose target population are the elderly such as the *Moratorium* plan in Argentina. Besides, we also find that early redistribution dominates in terms of capital formation. However, as that the optimal tax rate that maximizes total welfare differs among the programs, the resulting optimal aggregate output could not necessary be the highest when redistribution is focused on the young generation. In addition, we

observe that, as expected, all redistribution programs enhance lifetime income inequality and the early redistribution scheme outperforms the other specifications.

To complete the discussion, Figures A1 and A2 of the Appendix show the results for the alternative values of the redistribution parameter. When $\phi = 0.1$, 90% of the tax collected goes to the formal old generation. Comparing the results of this setting with those with greater ϕ, in all the specifications considered the welfare falls faster as the tax rate increases. This reflects that in OLG models, the larger the redistribution to old formal agents, the less the benefits in consumption and the stronger the negative effects on capital accumulation. Nevertheless, it can be observed that the optimal policy still leads towards a non-zero tax rate. Once again, the point where the welfare of each scenario reaches its maximum is the highest when redistribution to the informal young generation takes place. In the case of $\phi = 0.1$, total welfare is maximized at very low tax rates (around 2.5% in scenarios 1 and 2), whereas the value is higher and the gap between the optimal tax rates is wider when $\phi = 0.9$. Regarding inequality, we find that when the proportion of redistribution is small, income inequality increases with the labor tax and the no redistribution scenario NR0 generates the most equal distribution. This is because, as the tax rate increases, the lifetime income of informal agents falls faster than the fall in the income of formal workers. This result indicates that whether the redistribution policies enhance total welfare and equality simultaneously depends on the proportion of redistribution.

In the Next Section, we calculate the optimal level of redistribution τ^* of different policy specifications and compare the steady state results of the aggregate economy in the alternative scenarios. We also include a sensitivity analysis to check the robustness of our findings.

A. Optimal tax and redistribution policy

We define optimal policy as the policy parameter τ that maximizes aggregate steady state welfare, such that the conditions of competitive equilibrium hold. Then, to calculate the tax rates where the government maximizes the total welfare of all agents living simultaneously we use Eqn. (37) and set $\frac{\partial W}{\partial \tau} = 0$. As there is no simple closed solution for τ in any of the redistribution schemes, we perform some numerical

simulations to obtain de optimal tax rate in each settings. We assume here $\phi = 0.5$ and below in the article we consider the alternative values for the redistribution parameter. As in scenario NR1 (where $\phi = 0$) the aggregate welfare is maximized when $\tau = 0$ (see Panel E of Figure 1) both no redistribution scenarios NR0 and NR1 present the same results at that point.

Table 1. Optimal simulation results

	Redistribution scenarios			
	NR0=NR1	**Redistribution young (1)**	**Redistribution old (2)**	**Mix redistribution (3)**
τ	0.000	0.195	0.073	0.121
y	0.566	0.525	0.535	0.528
k	0.182	0.145	0.154	0.147
R	1.039	1.209	1.163	1.196
w	0.378	0.350	0.357	0.352
$c^{young,f}$	0.193	0.158	0.175	0.166
$c^{old,f}$	0.192	0.184	0.195	0.191
$c^{young,i}$	0.099	0.119	0.103	0.111
$c^{old,i}$	0.093	0.125	0.108	0.120
s^f	0.185	0.123	0.156	0.143
s^i	0.089	0.110	0.076	0.084
S	0.147	0.118	0.124	0.119
P^f	0.000	0.034	0.013	0.022
P^i/T^i	0.000	0.051	0.020	0.032
u^f	-3.230	-3.470	-3.315	-3.375
u^i	-4.447	-4.003	-4.280	-4.114
W	-3.717	-3.669	-3.701	-3.684
RR^f	-	*9.9%*	*3.7%*	*6.1%*
RR^i	-	*14.6%*	*5.5%*	*9.1%*

Parameters			
n	0.01	**π**	0.60
α	0.33	**μ**	0.50
β	0.90	**ϕ**	0.50
Θ	0.96		

Note: R=(1+r) and S refers to aggregate savings ($S = \pi \cdot s^f + (1-\pi) \cdot s^i$).

In accordance with our findings in the previous Section, at the optimal tax rates all redistribution scenarios are an improvement over the no redistribution one in terms of welfare. On the contrary, the capital stock and consequently, the aggregate output is the highest when there is no redistribution. This is because when allowing for

redistribution to take place, the increased savings of the informal young agents are not sufficient to offset the fall in the savings of formal workers. Therefore, with the transfer programs, total savings fall 20% in scenario 1, 15% en scenario 2 and 19% in scenario 3.

However, despite the distortions in capital accumulation, aggregate welfare is higher after redistribution. This is because the gains in utility of the informal agents due to the transfer exceeds the fall in utility of the formal workers. More precisely, the gains in utility are 10% while the losses are 7.4% in scenario 1, in scenario 2 the percentages are 3.8% and 2.6%, respectively, whereas in scenario 3 the losses are 4.5% vs. the gains in utility of 7.5% with the redistribution.

It is known that, in the OLG models, any transfer to old agents causes strong negative effects on capital accumulation. Nevertheless, for the set of parameters chosen, we find that the late redistribution scheme presents the highest capital level among the redistribution scenarios as well as the lowest value of the aggregate welfare. This result has to do with the difference in the value of the optimal tax rate among the redistribution sets. The optimal tax rate of the late redistribution program is 19.5% in scenario 1, and it is 7.3% and 12.1% in scenarios 2 and 3, respectively. The strong distortions in savings of the late redistribution program are in part offset by the effect that a smaller tax rate has on capital formation. This causes that, when redistribution is introduced, the aggregate output falls 5.4% in scenario 2, 7.3% in scenario 1 and 6.8% in scenario 3. However, although the early redistribution scheme presents the highest optimal tax rate, the gap between the gains and losses in utility due to the redistribution is the largest, and so is the welfare. Specifically, for the parameters chosen, it holds that $\left(\pi \cdot \left| \frac{\partial u_1^f}{\partial \tau} \right| - (1-\pi) \cdot \frac{\partial u_1^i}{\partial \tau} \right) > \left(\pi \cdot \left| \frac{\partial u_3^f}{\partial \tau} \right| - (1-\pi) \cdot \frac{\partial u_3^i}{\partial \tau} \right) > \left(\pi \cdot \left| \frac{\partial u_2^f}{\partial \tau} \right| - (1-\pi) \cdot \frac{\partial u_2^i}{\partial \tau} \right)$.

It is important to mention that the optimal tax policy described above is not welfare enhancing in a Paretian sense, as in the steady state the formal agents reduce their consumption (and therefore their utility) when redistribution takes place.

We also find that the Replacement Rate (RR), defined as the relationship between pensions and wages of formal individuals, is the highest in scenario 1 for both formal and informal agents. In this case, the value of the pensions of formal people represents almost 10% of the wages of the current formal workers, while the transfers to the informal agents represents 14.6% of the wage of the formal sector of the economy

and, 7.3% of the wages of the informal workers. We can also observe that the transfers to informal individuals are 1.5 times the pensions received by formal workers.

Finally, another important conclusion of this exercise is that the redistribution program that transfers income to the young also has the best performance regarding equality. Table 2 shows that the relationship between the lifetime incomes of formal and informal agents in the different settings is the highest in the early redistribution scenario. Hence, our results show that, with the parameters chosen, redistribute to the young generation not only generate the highest total welfare, but also that it is the best instrument to reduce inequality.

Table 2. Relationship between lifetime incomes of formal and informal agents

	Redistribution scenarios			
	NR0=NR1	**Redistribution young (1)**	**Redistribution old (2)**	**Mix redistribution (3)**
Formal (A)	0.378	0.379	0.374	0.370
Informal (B)	0.189	0.226	0.190	0.206
(B)/(A)	*50%*	*60%*	*51%*	*56%*

Next, we investigate how sensitive are these results to changes in the exogenous parameters.

IV. Sensitivity analysis

To complete the analysis, we allow for the exogenous parameters to vary in order to check the robustness of our previous findings. What is important to mention is that when all the taxes collected go to the formal old individuals (scenario NR1), the negative impact on consumption and capital formation is so high that the optimal tax rate is zero for all the alternative parameters values considered.[3] Then, for the simulation we only consider the no redistribution scenario NR0. Besides, as the results of scenario 3 are among those of scenario 1 and 2, to keep the presentation simple we decided to analyze the extreme schemes, i.e., early and late redistribution programs. Finally, we assume the same discount factor $\gamma = 0.96$ for both types of individuals. Below in the paper we will vary this parameter.

Figure 2 reports the steady state results of the most relevant macroeconomic variables when the informal workers' productivity varies. As μ increases, the informal

[3] Detailed results are available upon request.

workers become richer and income inequality reduces. This causes aggregate savings to go up, which increases the capital levels and lowers the interest rate, except in scenario NR because, with the same discount factor for formal and informal individuals, it holds that $\frac{\partial k_{NR}}{\partial \mu} = 0$.[4]

Additionally, from Panel B we see that as income becomes more equal, the need of redistribution decreases and the necessary taxes to finance the programs fall. This result reinforces the positive impact on capital formation. Panel A also shows that $\tau_1^* > \tau_2^*$ and that, $k_2^* > k_1^*$ except for $\mu \leq 0.2$. This is because when the levels of income inequality are high, the necessary tax rate is also high and the saving distortions in scenario 2 become too large compared with scenario 1. But, as inequality decreases, τ_1^* and τ_2^* also fall as well as the savings distortions. In the limit, as μ tends to 1, τ_1^* and τ_2^* tends to zero and the capital stock in all settings tends to equalize.

In terms of welfare, we get the same results as in the baseline case. Panel C shows that optimal program is that which redistributes to the young generation. As income inequality disappears, the welfare of the different regimes tends to converge to a same value.

Regarding lifetime income inequality, Panel F shows that the LIR decreases with μ. More precisely, when the wage inequality is high (i.e., low values of μ), the transfers to the formal and informal agents are high because the optimal tax rate is also high. As productivity increases, wages becomes more equal, and since the tax rate required falls, the transfers to formal and informal agents fall, too. As can be observed from Panel E, in scenario 1 the lifetime income of the informal workers falls while that of the formal agents increases, resulting in a reduction of the LIR. When redistribution is in the form of pensions, the LI of the formal workers increase with μ whereas the LI of the informal agents tends to fall, leading to a fall in the LIR. Hence, the results of our experiment show that the lifetime income inequality increases with productivity and that the early redistribution program presents the highest LIR. This conclusion suggests that the positive effects of redistribution on lifetime income inequality worsen as the economy is more equal.

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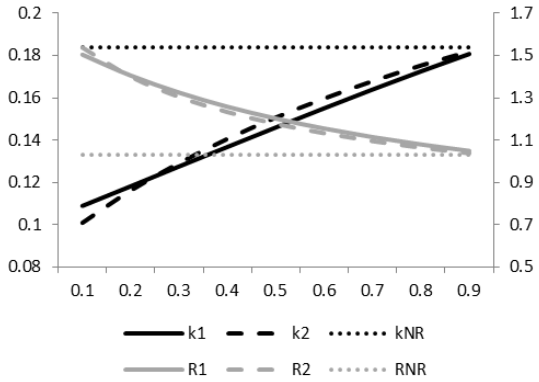
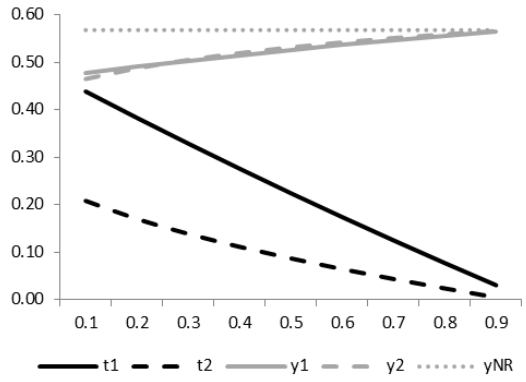
[4] More precisely, with $\beta = \theta = \gamma$, $k_{NR} = \left[\frac{(1-\alpha)}{(1+n)} \cdot \frac{\gamma}{(1+\gamma)}\right]^{\frac{1}{(1-\alpha)}}$, which does not depend neither on μ, nor on π.

Figure 2. Steady state results when productivity changes

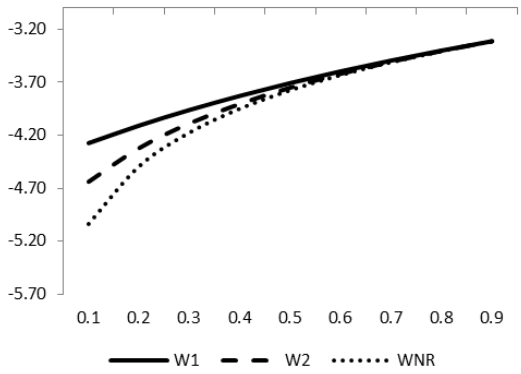
Panel A: Capital and Interest Rate



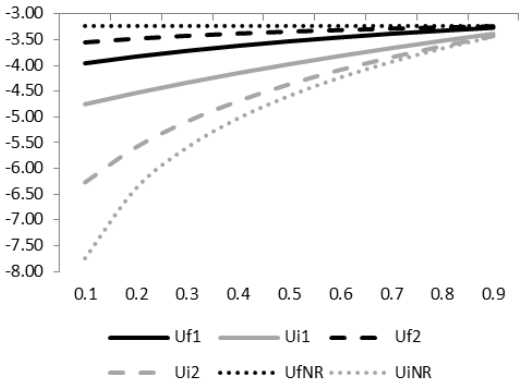
Panel B: Output and Tax Rate



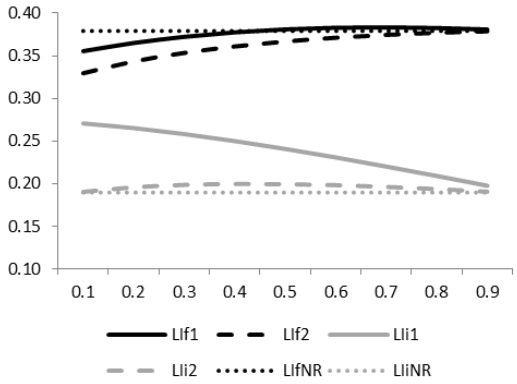
Panel C: Aggregate Welfare



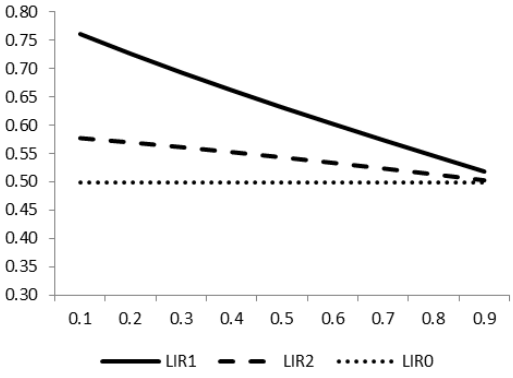
Panel D: Lifetime Utility



Panel E: Lifetime Income



Panel F: Relationship Lifetime Income



When considering changes in the proportion of formal workers, it can be noted in Figure 3 that the no redistribution scenario presents the highest capital level, which does not depend on the formality parameter. However, in both redistribution programs,

as π increases, the capital level per unit of effective labor falls for $\pi \leq 0.3$, reaches its minimum at $\pi = 0.4$ and then begins to increase (Panel A). This result could be explained by the following mechanism: as formality increases, aggregate savings go up which provokes a positive effect on capital. At the same time, as the number of productive workers increases, the level of effective young workers also increases and the stock of capital per unit of effective labor falls. On the other hand, as π increases, the necessary tax rate goes down, helping to offset the negative impact on capital.

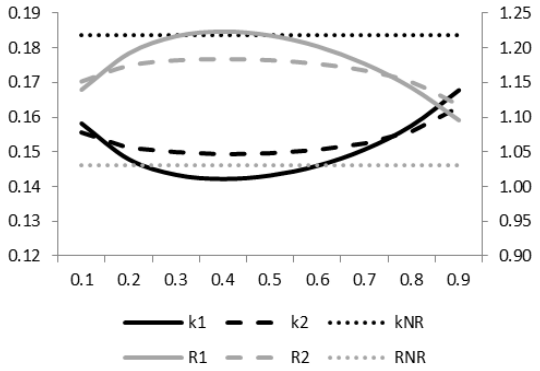
Hence, for low values of π (and therefore high values of τ^*), the adverse impact on capital formation dominates in both redistribution scenarios, while for $\pi > 0.3$ the low value of the tax rate helps to reverse the negative effect on capital formation. Once again, it holds that $\tau_1^* > \tau_2^*$ and, for the majority of the formality values considered, $k_2^* > k_1^*$. The latter inequality does not hold when the population of formal workers is so small that the magnitude of the tax required is so high that the savings distortions in scenario 2 are too large. In addition, Panel A also shows that $k_1^* > k_2^*$ for $\pi > 0.7$. This is because although it still holds that $\tau_1^* > \tau_2^*$, they are small in magnitude and the positive effect that redistribution to the young generation has on savings prevails over the negative impact of a higher tax. In all cases, welfare is increasing in π, and our finding that it is an optimal policy to redistribute towards the young agents is robust to changes in formality.

Another result that worth be highlighted from this exercise is that lifetime income inequality enhances as labor formality increases. In fact, when the population of formal workers is small, though the optimal tax rate is high, the number of contributors to the social security system is small. The transfers received by the informal agents are also small because they represent a relative high proportion of total population, while the pensions to formal individuals are high because they are small group. As formality increases, the needs of redistribution falls and the optimal tax rate goes down. However, there are more contributors to the system and less informal individuals that receive the benefits so, the transfers to the informal agents increase while the pensions to the formal individuals fall. This causes that the lifetime income (LI) of informal individuals increase faster than the fall in the LI of the formal workers (see Panel E). As shown in Panel G, this behavior results in an increasing lifetime incomes relationship (LIR) as formality increases. In general, the early redistribution

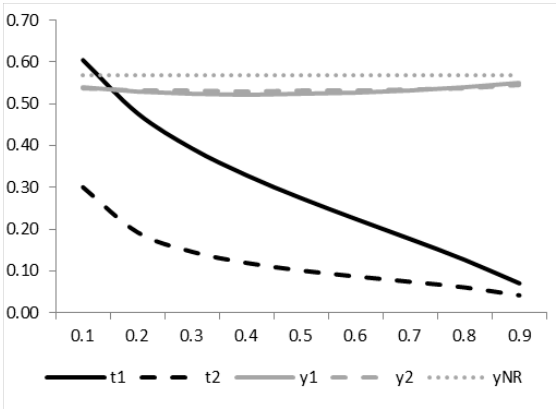
scheme presents the highest LIR, however, a very interesting finding of this exercise is that for small values of formality, the no redistribution scenario is the more equal policy.

Figure 3. Steady state results when formality changes

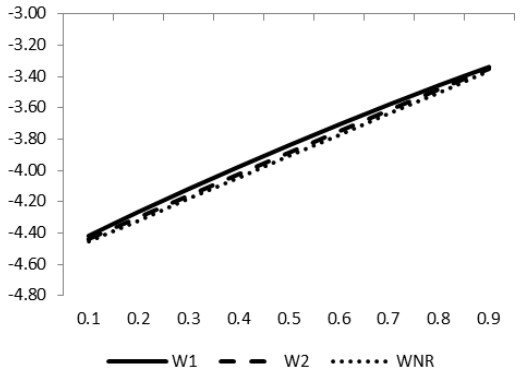
Panel A: Capital and Interest Rate



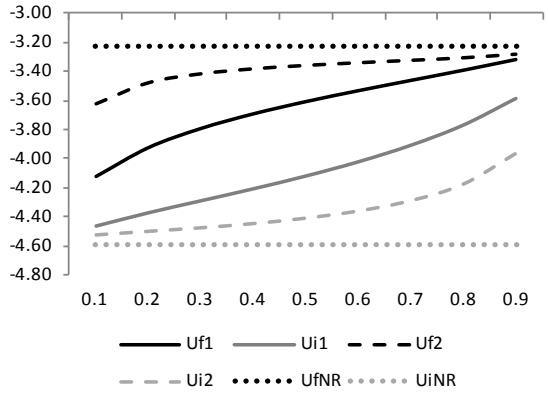
Panel B: Output and Tax Rate



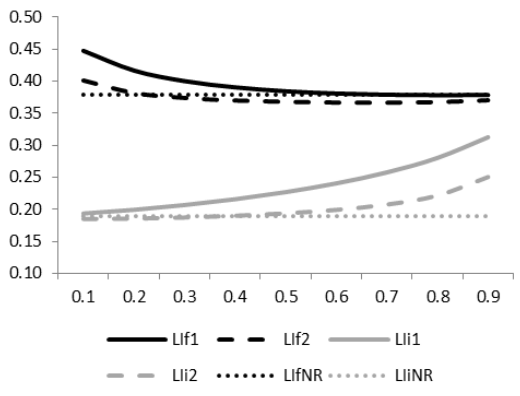
Panel C: Aggregate Welfare



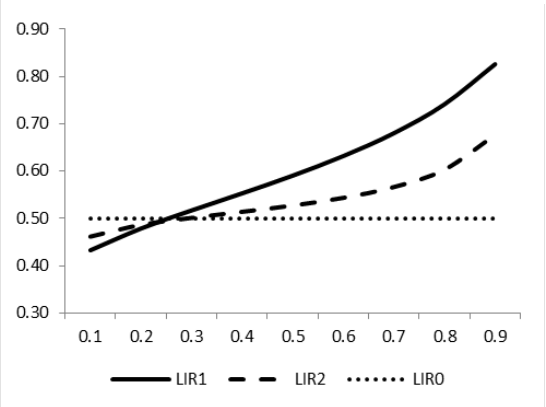
Panel D: Lifetime Utility



Panel E: Lifetime Income



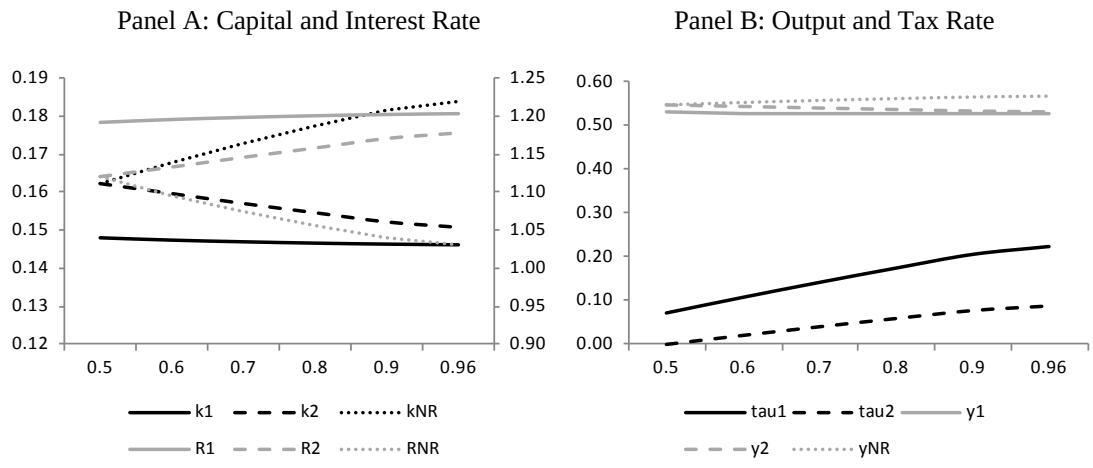
Panel F: Relationship Lifetime Income



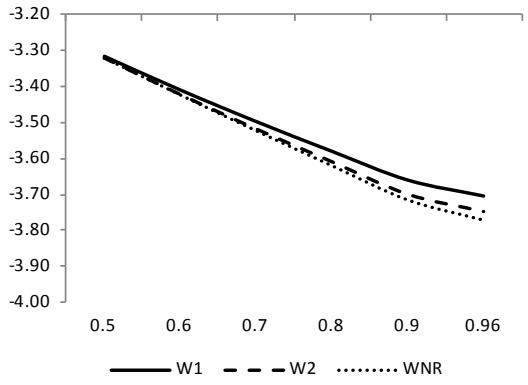
Additional sensitivity analysis was conducted by allowing the informal agents to discount the future at a higher rate than the formal ones. We tried the discount factor β in the range [0.5,0.96] in which the optimal tax rate is positive. As can be seen in Figure 4, the less the informal workers discount the future (i.e., the higher the discount factor β), the more the necessary tax rates to finance the redistribution programs. The adverse effect of labor taxation causes a fall in capital levels and in consumption, which lowers total welfare. On the contrary, when there is no redistribution, the increases in β lead to increases in capital stock. However, welfare falls because, as shown in Panel D, the utility of the informal agents strongly falls since the increased consumption when old does not compensate the reduced consumption levels when young. Panel C shows that across the different discount factors, the optimal program is the one that transfers to the young.

Finally, Panel F shows that inequality falls with the discount factor of informal individuals. As the optimal tax rate increases, the transfers also increase. But since the lifetime income of the informal workers increases faster than the income of the formal agents, in all the redistribution schemes the LIR increases with β. Once again, the redistribution program of scenario 1 is the superior one in terms of equality.

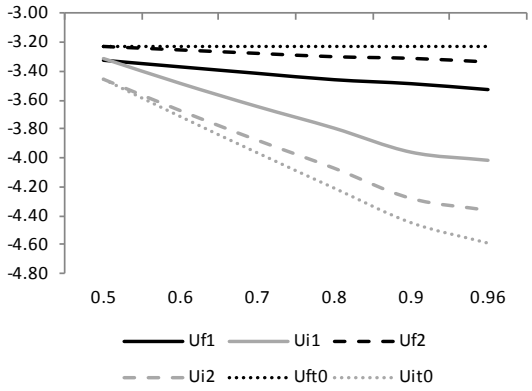
Figure 4. ***Steady state results when the discount factor β changes***



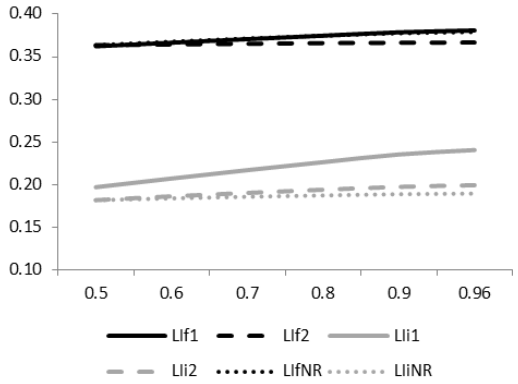
Panel C: Aggregate Welfare



Panel D: Lifetime Utility



Panel E: Lifetime Income



Panel F: Relationship Lifetime Income

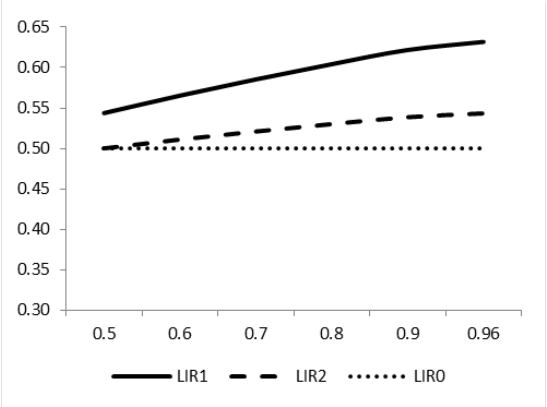


Table 3 shows that our results are also robust to changes in the population growth rate. As *n* increases, there will be more young individuals in the next period. This causes that the capital per unit of effective labor falls, and consequently, the optimal interest rate increases. This fall in capital formation impacts adversely in consumption, which leads to reductions in aggregate utility in all the schemes. We can also observe that across the alternative population growth rates considered, the optimal tax rate is kept unchanged. Once again, the society is better off in terms of welfare when the government implement the program that redistribute from formal agents to informal young individuals.

The effects of population growth on lifetime income inequality are marginal. The last column of Table 3 also shows that as *n* increases, LIR slightly decreases in the scenario 1 and it marginally decreases in scenario 2.[5] This is because, in both redistribution scenarios, the lifetime income of the informal workers falls at a faster rate

[5] The differences in the values can be observed when using more than 3 decimal places.

than the fall in the income of formal workers. This result could suggest that the effects on inequality of the redistribution programs would be larger in economies with higher growth rates.

Table 3. Steady state results when the population growth rate changes

No redistribution (NR)																
n	**τ**	**y**	**k**	**R**	**w**	**s^f**	**s^i**	**S**	**P^f**	**P^i/T^i**	**u^f**	**u^i**	**W**	**Li^f**	**LI^i**	**LIR**
-0.015	0.000	0.576	0.191	1.005	0.384	0.188	0.094	0.150	0.000	0.000	-3.230	-4.588	-3.773	0.384	0.192	0.500
-0.010	0.000	0.574	0.189	1.011	0.383	0.188	0.094	0.150	0.000	0.000	-3.230	-4.588	-3.773	0.383	0.191	0.500
0.000	0.000	0.571	0.187	1.021	0.381	0.187	0.093	0.149	0.000	0.000	-3.230	-4.588	-3.773	0.381	0.190	0.500
0.010	0.000	0.569	0.184	1.031	0.379	0.186	0.093	0.149	0.000	0.000	-3.230	-4.589	-3.774	0.379	0.190	0.500
0.015	0.000	0.567	0.183	1.036	0.378	0.185	0.093	0.148	0.000	0.000	-3.230	-4.589	-3.774	0.378	0.189	0.500
Redistribution young (1)																
n	**τ**	**y**	**k**	**R**	**w**	**s^f**	**s^i**	**S**	**P^f**	**P^i/T^i**	**u^f**	**u^i**	**W**	**Li^f**	**LI^i**	**LIR**
-0.015	0.214	0.531	0.150	1.183	0.354	0.120	0.062	0.097	0.037	0.057	-3.494	-4.083	-3.715	0.385	0.225	0.584
-0.010	0.214	0.530	0.149	1.189	0.353	0.120	0.062	0.097	0.037	0.057	-3.494	-4.084	-3.715	0.384	0.224	0.583
0.000	0.214	0.527	0.146	1.201	0.351	0.119	0.062	0.096	0.038	0.056	-3.494	-4.086	-3.715	0.383	0.223	0.582
0.010	0.214	0.525	0.144	1.213	0.350	0.119	0.062	0.096	0.038	0.056	-3.495	-4.089	-3.715	0.381	0.221	0.581
0.015	0.214	0.527	0.143	1.218	0.349	0.118	0.062	0.096	0.038	0.056	-3.495	-4.090	-3.716	0.380	0.220	0.580
Redistribution old (2)																
n	**τ**	**y**	**k**	**R**	**w**	**s^f**	**s^i**	**S**	**P^f**	**P^i/T^i**	**u^f**	**u^i**	**W**	**Li^f**	**LI^i**	**LIR**
-0.015	0.087	0.539	0.157	1.148	0.359	0.154	0.078	0.123	0.015	0.023	-3.332	-4.382	-3.752	0.373	0.200	0.536
-0.010	0.087	0.538	0.155	1.154	0.358	0.153	0.077	0.123	0.015	0.023	-3.333	-4.382	-3.752	0.372	0.199	0.536
0.000	0.087	0.535	0.153	1.165	0.357	0.153	0.077	0.122	0.016	0.023	-3.333	-4.382	-3.753	0.370	0.198	0.536
0.010	0.087	0.532	0.151	1.177	0.355	0.152	0.077	0.122	0.016	0.023	-3.333	-4.383	-3.753	0.368	0.197	0.536
0.015	0.087	0.532	0.150	1.183	0.354	0.151	0.077	0.121	0.016	0.024	-3.333	-4.383	-3.753	0.367	0.197	0.536

Finally, Table 4 bellow reports the steady state results for three different redistribution settings: $\phi = 0.1$ (low redistribution), $\phi = 0.5$ (medium redistribution) and $\phi = 0.9$ (high redistribution).

Table 4. Steady state results for different redistribution parameters

	Redistribution scenarios						
	NR	Redistribution young (1)			Redistribution old (2)		
	∀ ϕ	ϕ=0.1	ϕ=0.5	ϕ=0.9	ϕ=0.1	ϕ=0.5	ϕ=0.9
τ	0.000	0.024	0.214	0.218	0.016	0.083	0.100
y	0.569	0.559	0.524	0.559	0.562	0.534	0.527
k	0.184	0.175	0.144	0.175	0.177	0.152	0.147
R	1.031	1.065	1.213	1.066	1.056	1.170	1.200
w	0.379	0.373	0.350	0.373	0.375	0.356	0.351
$c^{young,f}$	0.193	0.190	0.156	0.153	0.191	0.173	0.163
$c^{old,f}$	0.191	0.194	0.182	0.156	0.193	0.194	0.188
$c^{young,i}$	0.097	0.096	0.118	0.151	0.096	0.101	0.110
$c^{old,i}$	0.096	0.098	0.131	0.151	0.096	0.113	0.127
s^{f}	0.186	0.174	0.119	0.139	0.178	0.153	0.154
s^{i}	0.093	0.092	0.114	0.147	0.091	0.077	0.066
S	0.149	0.141	0.117	0.142	0.143	0.123	0.118
P^{f}	0.000	0.005	0.038	0.008	0.005	0.015	0.004
P^{i}/T^{i}	0.000	0.001	0.056	0.110	0.001	0.023	0.048
u^{f}	-3.230	-3.238	-3.495	-3.661	-3.235	-3.328	-3.421
u^{i}	-4.589	-4.576	-4.089	-3.705	-4.593	-4.390	-4.191
W	-3.774	-3.773	-3.716	-3.670	-3.773	-3.753	-3.729
RR^{f}	-	*1.4%*	*10.8%*	*2.2%*	*1.4%*	*4.2%*	*1.0%*
RR^{i}	-	*0.4%*	*16.0%*	*29.4%*	*0.2%*	*6.3%*	*13.6%*

Note: Results for $\phi = 0.5$ *marginally differs from those of Table 1 since it was set here* $\gamma = 0.96$ *for formal and informal individuals.*

In general, we get the same results as in the baseline case. We find that in terms of aggregate welfare, redistribution is the optimal policy since the gains in consumption more than offset the distortions in the capital stock due to the labor tax. We also find that the early redistribution program also dominates in terms of capital formation when the proportion of redistribution is high. This is because as ϕ increases, the necessary tax to finance the benefits also goes up, leading to a fall in capital stock in both redistribution scenarios. At the same time, increases in ϕ have any impact on capital levels in scenario 2, but increases the capital stock in scenario 1, which offset, in part,

the fall.[6] Hence, although the optimal tax rate is the highest when redistribution targets the young generation, the higher proportion of redistribution helps to smooth the distortions on capital stock. The results in Table 4 not only reaffirm our finding that redistribution to young generation is the optimal policy but also show that the higher the redistribution parameter ϕ, the higher the aggregate welfare.

As can be seen, the informal individuals prefer waiting until the next period to receive a transfer in the form of pensions only if the transfer in the current period is small. For instance, they will prefer receiving 50% of the tax rate in the form of pensions (where the utility derived from consumption is -4.390) than 10% of the tax in the form of current transfers (where the utility is -4.576).

Regarding replacement rates, the scenario 1 presents the highest values of RR. As can be seen from Table 4, the higher the parameter of redistribution ϕ, the lower the relationship between pensions and wages for formal workers and only when redistribution is low the RR of formal agents exceeds that of informal ones.

Finally, in line with what we mention previously, the early redistribution scheme outperforms the redistribution in the form of pensions in terms of income inequality (see Table 5). The higher the percentage of labor taxes redistributed, the lower the gap between the lifetime incomes of formal and informal individuals. Only when ϕ is small, not to redistribute rises as the optimal policy.

Table 5. Relationship between lifetime incomes of formal and informal agents for different ϕ

	Redistribution scenarios						
	NR	**Redistribution young (1)**			**Redistribution old (2)**		
	∀ ϕ	ϕ=0.1	ϕ=0.5	ϕ=0.9	ϕ=0.1	ϕ=0.5	ϕ=0.9
Formal (A)	0.379	0.378	0.381	0.381	0.380	0.369	0.354
Informal (B)	0.190	0.188	0.231	0.296	0.188	0.197	0.216
(B)/(A)	*50%*	*50%*	*61%*	*78%*	*50%*	*53%*	*61%*

[6] In fact, with $\beta = \theta = \gamma$, $k_1 = \left[\frac{\alpha(1-\alpha)(1+\gamma)}{(1+n)\left[\alpha(1+\gamma)(\pi+\mu(1-\pi))+\pi\tau(1-\alpha)(1-\phi)\right]} \cdot \frac{\gamma\left[\mu(1-\pi)+\phi\tau\pi+(1-\tau)\pi\right]}{(1+\gamma)}\right]^{\frac{1}{(1-\alpha)}}$.

If we write $k_1(\phi) = \left[\frac{g(\phi)}{h(\phi)}\right]^{\frac{1}{(1-\alpha)}}$, then $\frac{\partial k_1}{\partial \phi} = k_1'(\phi) = \frac{1}{(1-\alpha)} \cdot \left[\frac{\overbrace{g'(\phi)}^{+} \cdot \overbrace{h(\phi)}^{+} - \overbrace{g(\phi)}^{+} \cdot \overbrace{h'(\phi)}^{-}}{\underbrace{h(\phi)^2}_{+}}\right]^{\frac{-\alpha}{(1-\alpha)}} > 0$. In the case of scenario 2, $k_2 = \left[\frac{\alpha(1-\alpha)(1+\gamma)}{(1+n)\left[\alpha(1+\gamma)(\pi+\mu(1-\pi)+\pi\tau(1-\alpha)\right]} \cdot \frac{\gamma\left[\mu(1-\pi)+(1-\tau)\pi\right]}{(1+\gamma)}\right]^{\frac{1}{(1-\alpha)}}$ which does not depend on ϕ.

This exercise shows that when workers differ regarding productivity and labor condition (formal or informal) and with inelastic labor supply, the optimal government transfer is the one that redistribute to the young generation. Another finding that is worth mentioning is that for low values of the redistribution parameter ϕ, the no redistribution policy leads to the setting with the more equitable distribution. These results are robust across changes in the parameters.

V. Conclusions

In this article we study a two-period OLG model, with agents heterogeneity according they work in the formal or informal sector of the economy. Informal workers are less productive than the formal ones and the government uses the PAYG system as an instrument to redistribute to the informal individuals under five policy schemes: (i) early redistribution to the young informal generation financed by a proportion of taxes on wage income of the current young formal generation; (ii) late redistribution to the informal old generation financed by a proportion of taxes on wage income of the current young formal generation; (iii) a mix between early and late redistribution financed by a proportion of taxes on wage income of the current young formal generation and, for comparative reasons, we include the following two scenarios with no redistribution from formal to informal agents: (iv) the case where the current formal young generation transfers income to the current formal old generation through the PAYG pension system (redistribution among formal agents); and (v) the case where any form of redistribution takes place.

The main finding of this paper is that although the optimal tax rate is higher in the early redistribution scheme, the optimal policy in terms of welfare is the one where the transfers go from the current formal generation to the current informal one. In this sense, for Argentinean case, those programs that are in line with the *Universal Child Allowance* program should be an improvement over the *Retirement Inclusion* plan (*Moratorium* plan) in terms of welfare.

However, the issue about which setting presents the higher steady state output depends on the proportion of the taxes transferred to the informal agents. We show that the greater the proportion to be redistributed, the stronger the negative effects on capital formation when the transfers go to the old, favoring early redistribution. Increases in productivity and in the wage of the informal agents enhance welfare. On the contrary,

increases in the discount factor of informal individuals and in the population growth rate lower welfare.

This exercise also shows that even in a dynamically efficient economy, the introduction of a PAYG pension system could be justified in terms of welfare only if part of the tax revenues is redistributed to the informal agents. We also find that, in terms of aggregate utility, formal workers are better off when there is no redistribution, while the informal agents are better off in all redistribution scenarios. In this sense, from the initial no redistribution setting any of the redistribution policies discussed in the article is Pareto improving.

Finally, regarding income inequality, we have found that the early redistribution scheme outperforms the redistribution in the form of pensions. The higher the percentage of labor taxes redistributed, the lower the gap between the lifetime incomes of formal and informal individuals in all redistribution scenarios. Nevertheless, for small values of ϕ, inequality worsens with redistribution and not having redistribution leads to the more equitable distribution.

As in all theoretical studies, our model uses a set a simple assumptions. One of them is the inelastic labor supply. One extension could be assuming that the labor supply is elastic to include in the analysis the effects of labor distortions from taxing the wages of formal workers. To keep the analysis simple, we have restricted the pensions of formal workers to a proportion of the current tax collected. Other extension could be to include a lineal formula more similar to the one that is applied in the Argentinean PAYG system. For example, in line with Cremer et al. (2008), we can include a formula for the pension that consists of two components: a flat (Beveridgean) benefit related to the mean contributions to the system and a purely contributory (Bismarckian) component which depends on the contributions of each worker. Moreover, future research could also relax the assumption that only labor taxes finance the redistribution and include other public resources. Finally, future research could include some inequality aversion parameter to regulate the convexity of the social welfare function and investigate in which extent the results change as the social preference for equality changes.

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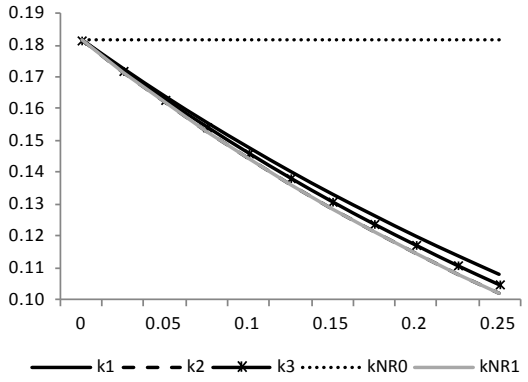
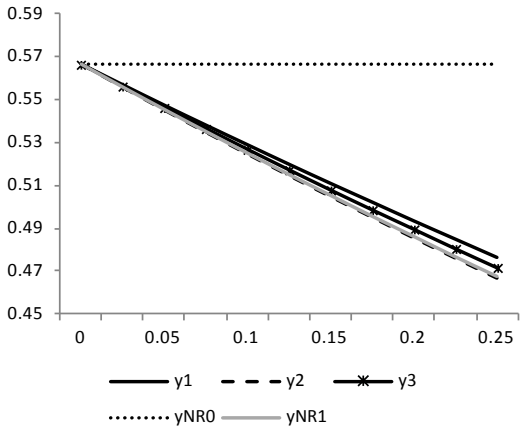
Appendix

Figure A1. Steady state results for $\phi = 0.1$

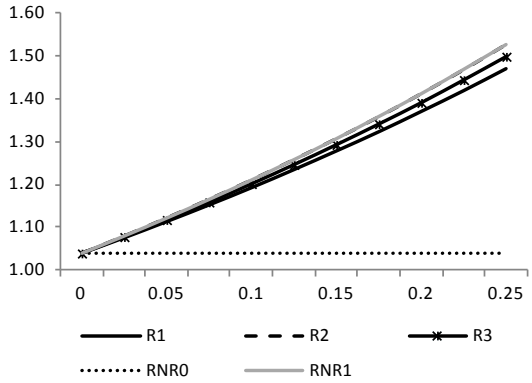
Panel A: Capital



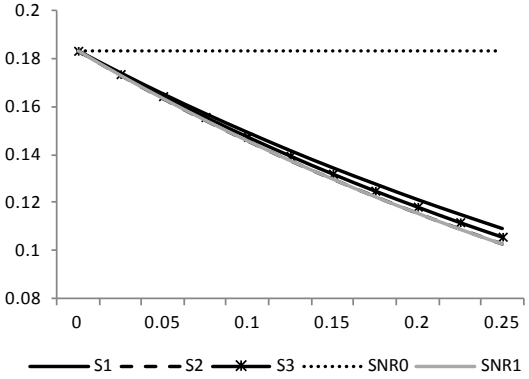
Panel B: Output



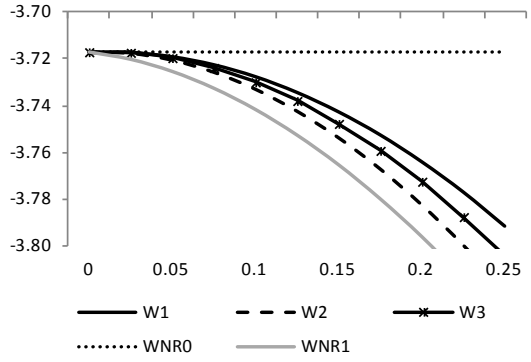
Panel C: Interest Rate



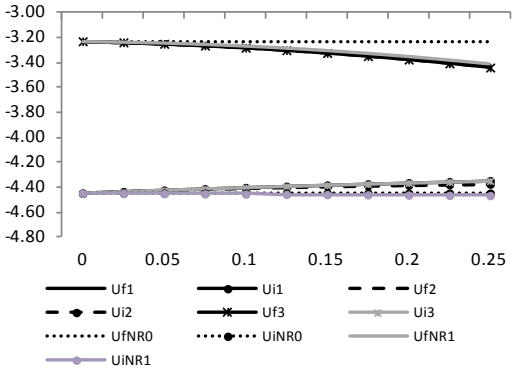
Panel D: Savings



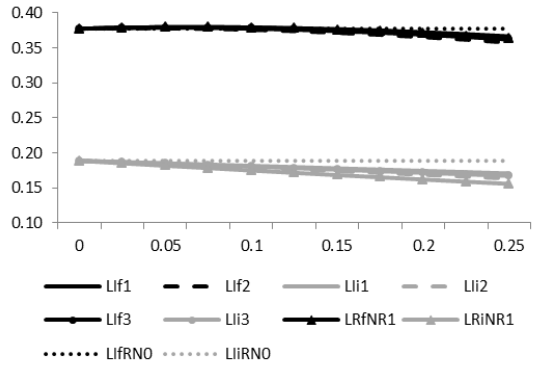
Panel E: Aggregate Welfare



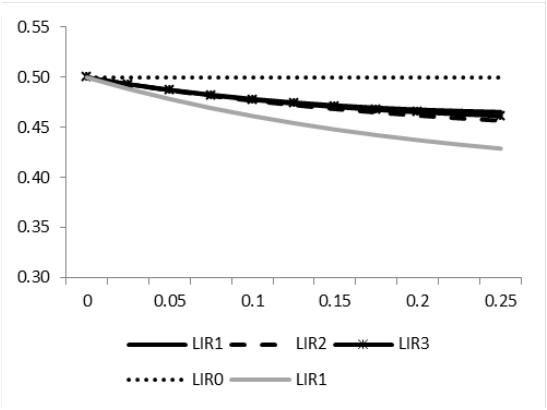
Panel F: Lifetime Utility



Panel G: Lifetime Income



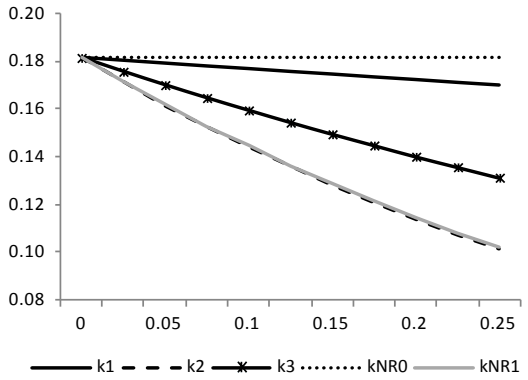
Panel H: Relationship Lifetime Income



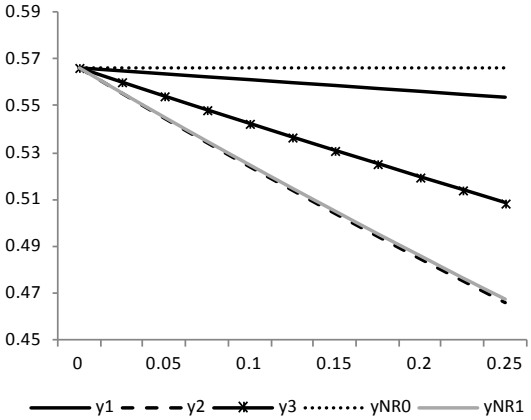
Note: We define R= (1+r).

Figure A2. Steady state results for ϕ = 0.9

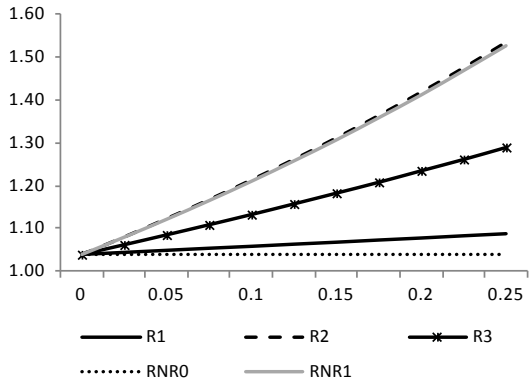
Panel A: Capital



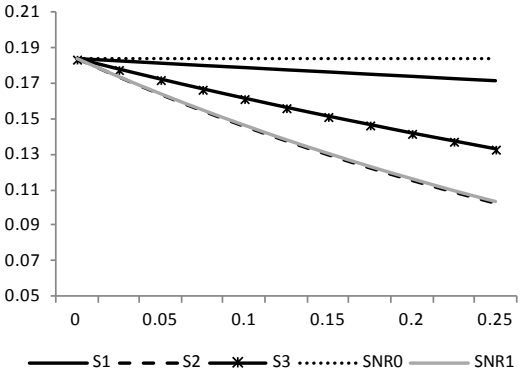
Panel B: Output



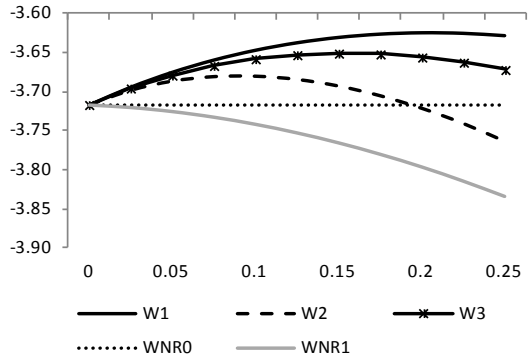
Panel C: Interest Rate



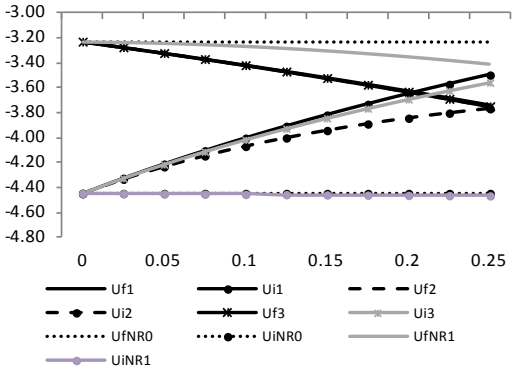
Panel D: Savings



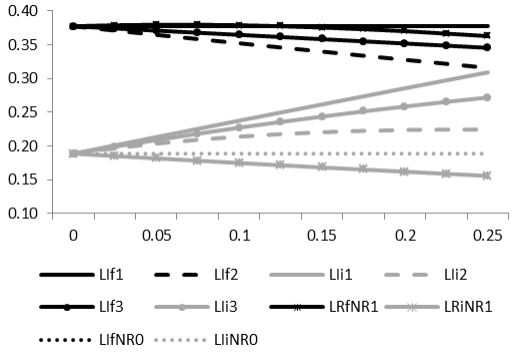
Panel E: Aggregate Welfare



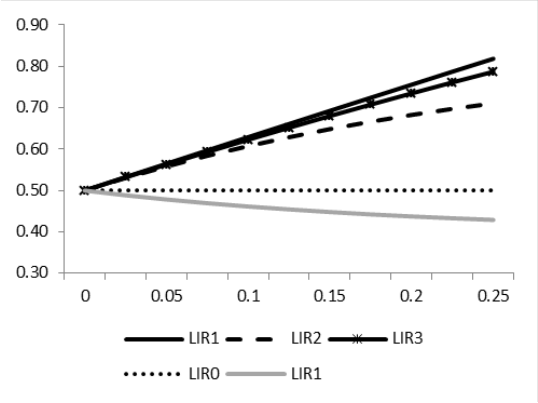
Panel F: Lifetime Utility



Panel G: Lifetime Income



Panel H: Relationship Lifetime Income



Note: We define R= (1+r).

Chapter 2
Changes in Pension Inequality: A Decomposition Analysis of Argentina, 1995-2009*

I. Introduction

During the 1990s, a wave of structural reforms was implemented that changed the distributional principles underpinning public policy in Argentina. One of the results of the process of deregulation, privatization and reduction of the role of the state in the economic sphere was a new design for the country's pension system that featured capitalization and pay-as-you-go (PAYG) components. Following this reform, the main performance indicators of the pension system (such as pension coverage and replacement rate) showed a continuous deterioration in line with certain labor market indicators. Since 2003, with a new national government, several regulatory adjustments have been made and in 2008 the pension system was completely reformed, becoming a public PAYG scheme once again.

All of these reforms have brought about changes in inequalities which affect the elderly group. Although there have been many empirical analyses of income distribution in Argentina in recent decades (see, for example, Cruces and Gasparini, 2009 and Groisman, 2008), empirical literature focusing exclusively on the distributional aspects of the Argentinean pension system is scarce.

By definition, a pension formula implies a transfer of income from the period during which a person works to their retirement period. As the public system in Argentina is a PAYG system, there is also an income transfer from current workers to current pensioners, because benefits are funded directly by current workers' contributions and taxes. In this case, the analysis of pension distribution has typically been approached from two perspectives: the intergenerational dimension (i.e., distribution analysis across generations), and the intragenerational dimension (i.e., distribution within the same generation). For example, using a lifetime income approach, Rofman (1995) concluded that older workers will receive better returns from the pension system (either public or private) than younger workers. Arza (2006) estimated

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the internal rates of return (IRRs) for different birth cohorts of workers, and concludes that earlier generations of workers benefited from higher pension IRRs than later generations.[1] Regarding intragenerational income transfers, Arza concludes that there has been some progressive redistribution among the covered elderly population, but this impact could be offset by unequal coverage (those who do not benefit from the system pay some costs via taxes).[2] In another line of analysis, Giuri and Martinez (2001) evaluated pension inequality in Argentina between 1992 and 2000 and concluded that inequality increased over that period, with the transfer of some provincial pension systems to the national system explaining that increase. They also found that subsidies and family allowances granted to the poorest retirees reduced inequality.

This article focuses on the distributional impacts of recent reforms on pension system. More precisely, this study: i) documents pension inequality between 1995 and 2009, ii) briefly describes the legislative pension reforms implemented during that period and 3) analyzes the relationship between the reforms and the observed inequality using Theil decomposition techniques and the microeconometric approach proposed by Juhn, Murphy and Pierce (1993).

The rest of the paper is organized as follows: Section II examines pension data from the National Social Security Administration (*Administración Nacional de la Seguridad Social* -ANSES) to evaluate the stylized facts explored in this study. It also includes a brief description of the main pension system reforms since 1993. Section III describes the methodology and data used to analyze the relationship between the reforms and changes in pension inequality, while the results are presented in Section IV. Finally, Section V presents concluding remarks and suggests some issues to guide future research.

II. Changes in Inequality: Basic Facts

Using unpublished data from the National Social Security Administration (ANSES), empirical evidence shows that pension inequality fell between 1993 and 2009. However, this decrease in inequality was not uniform throughout the period. As can be seen in Table 1, the Gini index increased slightly in the 1993-1997 period. From 1998 to 2002,

[1] The IRR is defined as "…the rate at which total social security contributions paid over the lifetime equal the present value of the expected stream of benefits received after retirement" (Arza, 2006: 84).
[2] For the distributional impacts of unequal coverage, see also Arza (2008).

the index remained relatively stable, and in the following years, starting in 2003, the distribution changed substantially, becoming more equal until 2008. In fact, 2008 appears to be the most egalitarian point in the entire period, while in 2009 inequality increased. This behavior is echoed in the other measurements considered. In 1993, the average pension of the highest decile represented about 6.5 times the average pension of the lowest decile while in 2003 this ratio increased to 9.4 times. However in 2009 it decreased to almost 3.4. The last column of Table 1 shows the evolution of the labor income Gini coefficient. As can be seen, both pension and income distribution present very similar patterns, but the decline in the income index from 2003 to 2008 is smoother than the decrease in the pension index. Moreover, while the income Gini index remains relatively stable in 2008 and 2009, it shows an increase in inequality for the pension sector.

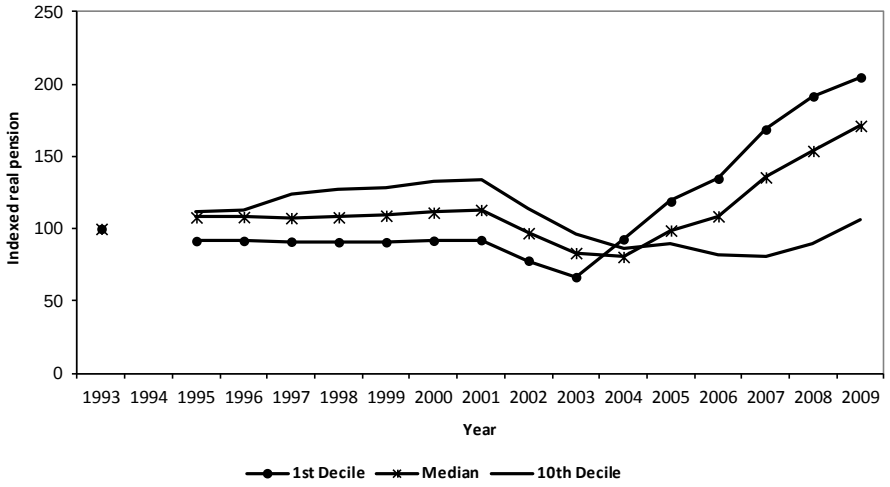
Table 1. Inequality indexes, 1993-2009

Period	N	Average real pension	Gini. Pensions	Confidence Interval 95%		Theil	Atk(1)	Atk(2)	Atk(3)	Std. Dev. (log pension)	Decile 10/1
				Lower	Upper						
1993	4,164,747	$ 693	0.361	0.361	0.362	0.250	0.187	0.281	0.331	0.564	6.5
1995	2,113,865	$ 743	0.391	0.390	0.391	0.281	0.212	0.318	0.374	0.609	7.9
1996	2,079,620	$ 752	0.393	0.393	0.394	0.283	0.214	0.322	0.379	0.615	8.0
1997	2,152,661	$ 808	0.415	0.414	0.416	0.310	0.235	0.351	0.412	0.651	8.8
1998	2,146,397	$ 836	0.418	0.417	0.418	0.309	0.237	0.357	0.419	0.659	9.1
1999	2,075,558	$ 860	0.410	0.409	0.410	0.298	0.229	0.347	0.409	0.647	9.2
2000	2,022,099	$ 888	0.412	0.411	0.412	0.299	0.231	0.351	0.414	0.653	9.4
2001	1,989,575	$ 906	0.412	0.412	0.413	0.297	0.231	0.352	0.417	0.655	9.5
2002	1,961,374	$ 776	0.412	0.412	0.413	0.295	0.231	0.353	0.420	0.657	9.5
2003	1,935,513	$ 652	0.403	0.402	0.403	0.283	0.221	0.340	0.405	0.642	9.4
2004	1,892,448	$ 633	0.357	0.356	0.357	0.236	0.182	0.279	0.330	0.566	6.1
2005	1,855,355	$ 720	0.311	0.310	0.311	0.184	0.145	0.226	0.271	0.502	4.9
2006	1,900,464	$ 711	0.256	0.255	0.257	0.138	0.109	0.171	0.207	0.430	3.9
2007	3,062,380	$ 766	0.183	0.182	0.183	0.093	0.072	0.113	0.136	0.343	3.1
2008	3,547,782	$ 861	0.177	0.176	0.177	0.089	0.069	0.109	0.132	0.335	3.0
2009	4,000,344	$ 979	0.197	0.196	0.197	0.104	0.080	0.124	0.149	0.409	3.4

Notes: A(e)= Atkinson's inequality index with parameter e. Average pensions are expressed in Argentine pesos of April 2009. The estimation of the confidence intervals for the Gini indices follows the bootstrap technique presented in Gasparini and Sosa Escudero (2001).
Source: Own elaboration based on ANSES data of April of each year. Information of April 1994 was not included due to consistency problems.

Figure 1 shows the median and the 1st and 10th deciles of the real pension distribution for the 1993-2009 period. Given the availability of the data, the average pension in April of each year was considered to be representative of the annual average. The information from 1994 is not taken into account because of consistency issues. Average pensions are indexed to 100 in 1993 for all three series.

Figure 1. Indexed real pensions by decile, 1993-2009



Source: Own elaboration based on ANSES data of April of each year.

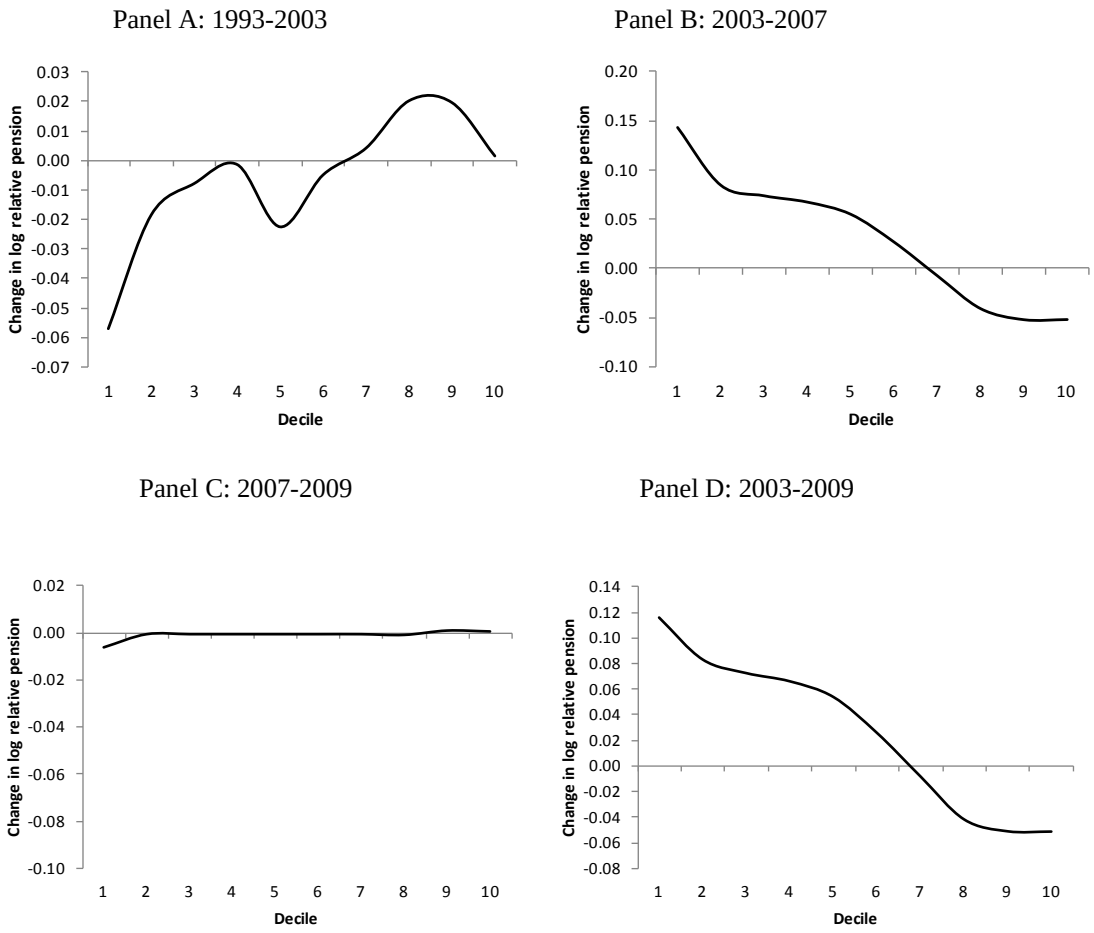
Until 2001, pensions in the 1st decile and the median pension remained relatively stable, while pensions in the highest decile increased by 52% in real terms (with a 31% increase in 1997). Due to the economic crisis of 2001 and devaluation of the Argentine peso (the official exchange rate increased from 1 to 1.4 pesos per U.S. dollar), real pensions fell almost 30% in all three groups until 2003.[3] From 2003 to 2009, pensions in the bottom 10% and the median pension increased steadily (208% for the former and 106% for the latter). In contrast, pensions in the top 10% of the distribution declined 17% during the 2003-2007 period, and then rose more than 30% in the next two years. By the end of the period, all groups had exceeded the 2001 values, but there were significant differences in pension evolution among the different groups. This means that pension inequality changed starting in 2003, with inequality declining from 2003 to 2009.

Taking into account the abovementioned results, Figure 2 below decomposes the changes in pensions by decile in four subperiods.

The first period extends from 1993 to 2003 (Panel A), the second period is from 2003 to 2007 (Panel B), and the third one extends from 2007 to 2009 (Panel C). In all cases, the pension changes per decile are normalized using the mean log pensions over each period. Finally, Panel D shows the pension distribution for the 2003-2009 period.

[3] The convertibility of one peso to one U.S. dollar was established by Law No. 23,928 enacted in April 1991 and was abandoned with the promulgation of Law No. 25,561, which devaluated the peso in January 2002.

Figure 2. Change in log relative pension by decile, 1993-2009



Source: Own elaboration based on ANSES data of April of each year.

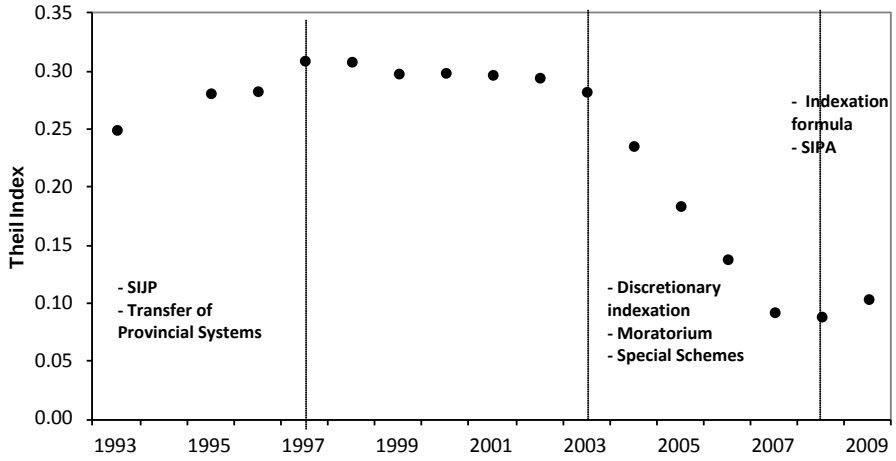
As shown in Figure 2, from 1993 to 2003 pensioners in or below the first pension distribution decile lost about 6% relative to the average, while pensioners in the highest deciles gained between 0.1% and 2% in relation to the average pension.

The changes during the 2003-2007 period are totally contrary. As can be seen in Panel B, pensioners in the lowest decile gained about 14% relative to the mean, while pensioners in the highest deciles lost more than 6%. The increase in pensions over the period is roughly a linear function (with a negative slope) of the deciles. Panel C shows that the change in inequality was quite modest over the last period (2007-2009). Pensioners in the lowest decile lost approximately 0.7% in relation to the mean pensioner, and pensioners in the upper deciles gained about 0.1% in comparison to the mean pensioner. Finally, the distribution pattern of Panel D is very similar to that in Panel B, because pension dispersion has barely changed in the last few years.

The overall conclusion is that pension inequality changed over the entire period, and that the direction and magnitude of the change depended on the period considered. In this sense, two periods of analysis can be distinguished: 1993 to 2003 and 2003 to 2009.

Figure 3 shows the evolution of inequality (Theil index), together with the main pension system reforms in 1993-2009.

Figure 3. Theil index and pension reforms, 1993-2009



Source: Own elaboration based on ANSES data of April of each year

As can be seen, the evolution of pension inequality over the whole period is consistent with the implementation of the most extensive reforms to Argentina's pension system during that period. The main characteristics of such reforms are presented below.

A. Pension system reforms from 1993 to 2009

(i) Creation of the SIJP

In 1993, in response to the serious financial problems faced by Argentina's pension system, a new system known as the Integrated Retirement and Pension System (*Sistema Integrado de Jubilaciones y Pensiones*, or SIJP) was approved, and it came into force in July 1994 (SSSa, 2003). The design of the new scheme was largely based on ideas published in the World Bank's 1994 report *Averting the Old Age Crisis* (see Arza, 2008).

With this reform, Argentina's social security system became a mixed scheme on the one hand, a government-run pay-as-you-go (PAYG) system continued to exist (as it had since 1954), and in addition, a fully funded, privately managed scheme was created.[4] Until this reform, benefits comprised of between 70% and 82% of the pensioner's salary during the three highest-earning years in the 10 years before retirement. A minimum of 10 years of contributions were required, and it was stipulated that this requirement would increase over the next years up to a maximum of 30 years.

With the new design, the pension system became a multi-pillar scheme combining defined-benefit and defined-contribution components.[5] Pension entitlement was made up of the sum of three independent benefits: a flat-rate benefit (*Prestación Básica Universal* -PBU), an earning-related pillar that recognizes contributions made before the reform (*Prestación Compensatoria* -PC), and an additional earnings-related pillar for contributions made after July 1994, paid either by the public system if the worker remained in the PAYG regime, or the insurance company if the worker was affiliated with the private system. This third pillar was known as the *Prestación Adicional por Permanencia* (PAP) in the first case, and *Jubilación Ordinaria* (JO) in the second. Like the PC, the PAP is defined as a percentage of the worker's salary, while the JO was calculated as an actuarial annuity (see Table A1 of Appendix 1).[6]

Apart from the change in the benefit formula and the vesting period, the retirement age has been increased from 55 to 60 for women and from 60 to 65 for men. This change has been implemented progressively (over a 15-year period after the reform) in order to avoid abrupt impacts on workers close to retirement.

(ii) Transfer of provincial pensions to the national sphere

In August 1993, the national government and the provinces signed Fiscal Agreement II (*Pacto Federal para el Empleo, la Producción y el Crecimiento*), wherein the national government committed to incorporating provincial pensions into the national system.

[4] At that time, each worker had to choose a system. Those who decided to enter the private system do not have the option of returning to the public scheme, although workers in the PAYG system could change to the private regime).

[5] A defined benefit plan guarantees a certain payout upon retirement, according to a fixed formula that usually includes the member's salary and the number of years of membership in the pension system. A defined contribution plan provides a payout upon retirement that depends on the amount of money contributed and performance of the investment vehicles utilized (World Bank, 1994).

[6] From 1994 to 2007 the PC was calculated as 1.5% of the worker's salary per year of contribution, and the PAP was defined as 0.85% of the worker's salary per year of contribution. In 2007, the PAP percentage was increased to 1.5%.

Prior to the reform, each province maintained a separate pension fund for employees and benefit payments were funded out of current revenues. These included, in addition to earmarked salary deductions, subsidies from general treasury revenues.

Under Fiscal Agreement II, the federal government agreed to take over the pension system of every province that passed a Law authorizing it to do so. After the transfer, the federal pension system would eventually confer on federal and provincial civil servants the same retirement eligibility conditions, contributions, and benefits that were available to the private sector.

Since the 1994 reform, 12 jurisdictions have been transferred to the national scheme (the most recent province system was transferred in 1997).[7] Benefits from these schemes were generally 82% of the worker's mean salary, and therefore pensions in this group were higher than those in the national scheme.

(iii) Coverage and the moratorium scheme

One important performance indicator of a pension system is its coverage. The proportion of elderly people (aged 65 or more) with a pension benefit decreased in the aftermath of the 1993 reform: In 1994, in a context of growing unemployment and informality, there were 77 beneficiaries for every 100 elderly people in Argentina, and by 2003 this number had dropped to 68 (Rofman, Lucchetti and Ourens, 2008). If only retirees participating in the national system are considered, the coverage is estimated to have been 57% in 2003 and 55% in 2005.

To regularize the social security debts of independent workers, a program referred to as a moratorium was approved in 1995. Under Law No. 24,476, self-employed workers were allowed to pay contributions they owed to the system prior to September 1993 in installments.[8] But this Law failed to improve pension coverage. In January 2004, Law No. 25,865 allowed self-employed people of minimum retirement age or older to apply to receive a pension by paying the contributions owed to satisfy the required contribution time period (there was no restriction regarding the period that could be regulated). This Law expired in 2005.

[7] To date, the jurisdictions that have subscribed to the SIJP are: Municipality of Buenos Aires (1994), the provinces of Santiago del Estero (1994), Catamarca (1994), Salta (1996), Mendoza (1996), San Juan (1996), La Rioja (1996), Río Negro (1996), Jujuy (1996), Tucumán (1996), San Luis (1996) and the Municipality of Tucumán (1997).

[8] Decree No. 1,454/2005 allows the contributions owed to be discounted from pensions.

But the main program of the moratorium scheme was passed in December 2004 with Law No. 25,994, the Retirement Inclusion Plan (*Plan de Inclusión Previsional*), which allowed people of retirement age with insufficient contributions to receive a pension after recognizing their past debts to the system. It also allowed individuals who met the minimum contribution time requirement but not the minimum age (up to five years younger than required), to apply for a pension benefit. The program, which was in effect until April 2007, increased the number of new beneficiaries under the Law by around 2.1 million by 2010, with women accounting for more than 80% of new beneficiaries. Since the implementation of the plan, coverage has expanded, and by 2010 the proportion of the elderly receiving a national pension was almost 88% (D'Elia, et al., 2010).

(iv) Special pension schemes

Until 1994, there were special pension schemes for teachers, scientific researchers, diplomats and judiciary employees. Workers affiliated with these schemes obtained a pension with a replacement rate that ranged from 82% to 85% of the last monthly remuneration received. Unlike other schemes, in the special pension programs neither the remuneration subject to contributions nor the pensions were capped. Contributions in some of these schemes were increased by two percentage points (i.e., instead of 11%, participants contributed 13% of their salary).[9] While Decree 78/1994 phased out the special pension schemes, starting in 2001, these programs were gradually restored and by 2007 all were operating again.[10]

(v) Pension indexation

From 1994 until the 2001 crisis, the minimum pension amount remained stable in both real and nominal terms (ARS 150). With the devaluation of the Argentine peso and the resulting inflationary situation, minimum benefits declined around 20% in real terms in 2002. In order to restore retirees' purchasing power, pensions were adjusted discretionally during 2003-2008. Minimum pensions increased 360% in nominal terms and 195% in real terms using the consumer price index compiled by the National Institute of Statistics and Censuses (*Instituto Nacional de Estadística y Censos* -INDEC)

[9] See Decree No. 160/2005.

[10] For further details on these programs, see Law No. 24,016 and Law No. 26,508 (for teachers in public primary and secondary schools and public universities, respectively), Law No. 22,929 (for scientific researchers), Law No. 22,731 (for diplomats), and Law No. 24,018 for judiciary employees.

as a deflator. The average pension, however, increased less than the minimum: 142% in nominal terms and 56% in real terms over the period.[11]

In October 2008, an automatic formula for pension indexation was approved with Law No. 26,417. The formula took into account the evolution of the financial resources of the pension system, the evolution of salaries and the number of pensioners.[12] Under this formula, all pensions are adjusted twice a year (in March and September), with the first adjustment occurring in March 2009.[13]

(vi) The creation of SIPA

In November 2008, a new reform was approved with Law No. 26,425, which created the Argentinean Integrated Pension System (*Sistema Integrado Previsional Argentino*, or SIPA). The private, fully funded scheme was eliminated and the entire pension system became a PAYG scheme again. Workers affiliated with the private system were transferred to the national program together with the funds accumulated in their individual accounts.[14] More than 9.7 million contributors to the Retirement and Pension Funds Managing Companies (*Administradoras de Fondos de Jubilaciones y Pensiones*-AFJPs) (representing 60% of total affiliates) were switched to the public system (AFIP, 2008) and almost 380,000 private pensions were transferred to the national scheme (with the exception of beneficiaries receiving their pensions through a life annuity). The Guarantee and Sustainability Fund (*Fondo de Garantia de Sustentabilidad* -FGS) received the stock accumulated in the individual accounts, which was worth ARS 80.2 billion in December 2008 (ANSES, 2009).

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[11] Using an alternative price index constructed as an average of the official indices of seven agglomerations in Argentina (Jujuy, Neuquén, Paraná, Rawson-Trelew, Salta, Santa Rosa and Viedma), the minimum and average pension increased 128% and 20% respectively.

[12] The indexation formula is defined as $m = \begin{cases} a = 0.5 \cdot RT + 0.5 \cdot w & if\ a \le b \\ b = 1.03 \cdot r & if\ a > b \end{cases}$ where m is the index, RT is the semiannual change in per benefit tax resources that finance the national pension system, w is the semiannual change in salaries and r is the annual change in per benefit total resources of ANSES.

[13] Benefits under some schemes (such as those for academic researchers, school and university teachers, diplomats, energy workers, etc.) have indexation coefficients different from that of Law No. 26,417. However, such benefits represent only 3% of total benefits.

[14] Previously, Law No. 26,222 of 2007 established the possibility of switching contributors from the funded to the PAYG scheme. More than 2.6 million workers moved to the public system (21% of total affiliates at that time): 49% of the transfers were voluntary and the rest were compulsory (workers covered by special schemes and workers with less than ARS 20,000 in their accounts (AFIP, 2008)). The funds accumulated in the individual pension accounts were transferred to the Guarantee and Sustainability Fund (FGS) created in 2007 by Decree No. 897 and managed by ANSES.

Each reform divides the population of pensioners into mutually exclusive groups, such as pensioners who access a benefit through a moratorium versus non-moratorium pensioners and pensioners who belong to a special scheme versus pensioners who belong to a general scheme. If these reforms are related to observed changes in pension differentials, it is possible to analyze the effects that each episode of reform could separately have on pension distribution. In this sense, examining inequalities between the pensions of different groups defined by the reforms above results in a pioneering and valuable approach to analysis of the factors that could determine pension distribution. The section below presents the methodology used to characterize both the level of pension inequality and changes to that level in light of the most significant reforms.

III. Methodology and Data

Decomposability of inequality measures involves dividing the target population into groups, considering relevant factors that potentially account for income inequality. In the context of additive decomposability, the total inequality index can be decomposed into two elements: within inequality and between inequality. The "within" inequality element captures inequality due to income variability within each group, while the "between" inequality element captures inequality due to income variability across different groups.

One measure that is perfectly decomposable in the “within” and “between” elements is the Theil index.[15] Assuming *j* groups, its decomposition adopts the following form:

$$T = \underbrace{\sum_j \left(\frac{N_j \cdot \mu_j}{N \cdot \mu} \right) \cdot T_j}_{within} + \underbrace{\sum_j \left(\frac{N_j \cdot \mu_j}{N \cdot \mu} \right) \cdot \ln\left(\frac{\mu_j}{\mu} \right)}_{between}. \qquad (1)$$

[15] There are several decomposable inequality indicators. In practice, the most convenient one for the decomposition is the family of generalized entropy Indices including the mean logarithmic deviation, the Theil coefficient, and half of the squared coefficient of variation (for further details, see Bourguignon, 1979; Cowell, 1980; and Shorrocks, 1984). For an empirical analysis of income distribution in Argentina using the Theil decomposition, see Gasparini (1999) and for an empirical study of pension distribution see Giuri and Martinez (2001).

The first term is the weighted average of the Theil inequality indices of each group (*Tj*), with weights represented by total income share. This is the "within" part of the decomposition (not explained by the factors chosen).

The second term is the Theil index calculated using subgroup means instead of actual incomes. This follows the logic of replacing actual income distributions in each group with the average income level of the same group. This yields the "between" part of the decomposition.

The inequality “accounted for” by the decomposition is the "between" element, while the "within" element identifies the contribution to inequality of the variability of each group income taken separately.

It is also worth identifying the components of the change in inequality between different points in time. A recent stream of decomposition methodologies is based on a parametric representation of the way in which individual income is linked to individual socio-demographic characteristics. Changes in inequality could arise from changes in the distributions of observable covariates, the observable return of those characteristics, and changes in the dispersion of unobservables. In this sense, the microeconometric decomposition technique proposed by Juhn, Murphy and Pierce (1993, referred to hereafter as JMP) results in a useful framework for exploring the extent to which the different factors that determine changes in inequality explain observed changes in pension distribution.[16]

Following JMP closely, it is possible to decompose the total inequality change into three effects: changes in observed characteristics, changes in observed prices, and changes in unobserved prices and characteristics.

To perform the decomposition, we consider two periods of analysis: the first is 1996 to 2003 and second is from 2006 to 2009.[17] Delimitation of these periods has to do with the availability of data (pensioners’ gender details are available from 1996) and with the fact that because the moratorium program and special regime schemes were not fully implemented until 2006, it was not possible to decompose the change prior to that year and capture the contributions of these policies on inequality change after 2003.

First, we estimate a simple pension model:

[16] In addition to the methodology proposed by JMP, other examples of these microeconometric methods are the pioneering Oaxaca-Blinder decomposition of differences in mean incomes across population groups with different characteristics (Blinder, 1993 and Oaxaca, 1993) and Bourguignon, Ferreira and Lustig (2005), and variants of these techniques.

[17] As shown in Figure A1 of Appendix 2, pension distribution became more unequal during the 1996-2003 period and more equal during the 2006-2009 period.

$$Y_{it} = \alpha_t + \sum_{k=1}^{K} \beta_{kt} X_{it} + \mu_{it}. \quad (2)$$

where Y_{it} is the vector of log real pension for individual *i* in year *t*; X_{it} is a vector of individual characteristics (including gender, national/provincial nature of the benefit, pre/post-SIJP nature of the benefit in the 1996 and 2003 equations, and adding the moratorium/non-moratorium and special/general scheme nature of the benefits as explanatory variables in the 2006 and 2009 equations). β_{kt} is the vector of estimated coefficients (observable prices), α_t is the constant term of the regression of year *t*, and μ_{it} is the pension component accounted for by the unobservables. This residual includes all factors other than the independent variables that also determine the pension amount, for example, the unobservable characteristics of the individual that affect pension level.

The residual gap is thought to consist of two components: an individual's percentile in the residual distribution p_{it} and the distribution function of the pension equation residuals $F_t(.)$. Then, $p_{it} = F_t(\mu_{it} \mid X_{it})$ can be considered the percentile of an individual residual in the residual distribution of the model in year *t.* Hence, the percentile represents the probability that another residual chosen randomly may be less than μ_{it}.

By definition, we can write:

$$\mu_{it} = F_t^{-1}(p_{it} \mid X_{it}) \quad (3)$$

where $F_t^{-1}(. \mid X_{it})$ is the inverse of the cumulative distribution function for pensions with characteristics X_{it} in year *t.*

Next, let us assume $\overline{F(.)}$ to be the reference residual distribution (e.g., the average residual distribution over both samples, 1996-2003 and 2006-2009), and $\overline{\beta_k}$ and $\overline{\alpha}$ an estimate of benchmark coefficients (e.g., the coefficients from a model pooled over the whole sample). Using this framework, we can reconstruct hypothetical outcome distributions with any of the components that remain fixed. We can then determine:

1. hypothetical outcomes with varying quantities between the groups and fixed prices (coefficients) and a fixed residual distribution, such as:

$$Y_{it}^{(1)} = \alpha_t + \sum_{k=1}^{K} \overline{\beta}_k X_{it} + \overline{F}^{-1}(p_{it} \mid X_{it}). \quad (4)$$

2. hypothetical outcomes with varying quantities and varying prices, and fixed residual distribution, such as:

$$Y_{it}^{(2)} = \alpha_t + \sum_{k=1}^{K} \beta_{kt} X_{it} + \overline{F}^{-1}(p_{it} \mid X_{it}). \quad (5)$$

3. outcomes with varying quantities, varying prices, and a varying residual distribution, such as:

$$Y_{it}^{(3)} = \alpha_t + \sum_{k=1}^{K} \beta_{kt} X_{it} + F_t^{-1}(p_{it} \mid X_{it}) = \alpha_t + \sum_{k=1}^{K} \beta_{kt} X_{it} + \mu_{it} = Y_{it}. \quad (6)$$

The differential $Y_{it} - Y_{it-1}$ can be decomposed as follows:

$$\underbrace{Y_{it} - Y_{it-1}}_{T} = \underbrace{\left[Y_{it}^{(1)} - Y_{it-1}^{(1)}\right]}_{Q} + \underbrace{\left[\left(Y_{it}^{(2)} - Y_{it-1}^{(2)}\right) - \left(Y_{it}^{(1)} - Y_{it-1}^{(1)}\right)\right]}_{P} + \underbrace{\left[\left(Y_{it}^{(3)} - Y_{it-1}^{(3)}\right) - \left(Y_{it}^{(2)} - Y_{it-1}^{(2)}\right)\right]}_{U} \quad (7)$$

where *T* is the total difference, *Q* can be attributed to differences in observable quantities, *P* to differences in observable prices, and *U* to differences in unobservable quantities and prices. This last component not only captures the effect of unmeasured prices and the effect of differences in the distribution of unmeasured characteristics (e.g., one of the unmeasured characteristics is more important in year *t* or *t-1* for generating pensions), but also the measurement error. The ability to estimate how different parts of the pension distribution have been affected by the various components is the major advantage of the full distribution accounting scheme proposed here.

The data used in this study have been taken from the ANSES and this is one of the most valuable innovations in this analysis: this is the first paper on the Argentinean pension system that uses microdata on the total pensioner population (rather than samples of the ANSES database) and the period covered is substantial (16 years).[18] The database contains information about different pensioner characteristics, including the pension amount in April of each year from 1993 to 2009, with the exception of April 1994 (individual data were not available for that year; see Table 1). The information is

[18] Previous empirical studies on the Argentinean contributory pension system use different permanent household surveys conducted by the National Institute of Statistics and Censuses (INDEC) (see, for example, Rofman et al., 2008, Alejo et al. 2007 and Arza, 2006). In addition to permanent household surveys, another set of papers more closely related to the labor aspect of SIPA use data from a sample of workers collected by the Federal Administration of Public Revenues (*Administración Federal de Ingresos Públicos* -AFIP), the National Institute of Social Security Resources (*Instituto Nacional de los Recursos de la Seguridad Social* -INARSS) and ANSES (see SSSb, 2003). The only study that uses ANSES data from the entire population of beneficiaries is Giuri and Martinez (2001), but they work with aggregate information rather than microdata.

cross-sectional in nature, with no follow-up. It is worth mentioning that the only benefits considered in this study are elderly adult pensions. Other contributory benefits managed by ANSES, such as widow/widower pensions and non-contributory pension benefits (i.e., veterans of the Malvinas war, poor mothers with seven or more children, etc.) were not taken into account.

IV. Results

A. Decomposition of inequality levels

Table 2 shows the results of Theil's decomposition for different pensioner groups. Benefits from provincial systems (4% of the total) are higher on average than national benefits. At the same time, the Theil index (and the standardized Theil index) indicates that pension distribution is more equal in the latter group of pensions.[19] However, the mean pension difference between groups does not account for most of the dispersion. As can be seen, the origin of the benefit (province or nation) accounts for 11% of total pension inequality.

[19] The standardized Theil index ensures that the measure of inequality is independent of the number of observations.

Table 2. Theil decompositions by groups, April 2009

Description		N	%	Average real pension	Theil	Theil Std.
Provinces´ system		154,195	4%	$ 1,789	0.188	0.157
Nation's system		3,846,149	96%	$ 947	0.086	0.057
	TW	*89%*				
	TB	*11%*				
Before SIJP		775,821	19%	$ 1,059	0.135	0.099
After SIJP		3,224,523	81%	$ 960	0.095	0.063
	TW	*99%*				
	TB	*1%*				
Excluding Moratorium pensions						
Before SIJP		775,820	40%	$ 1,059	0.135	0.099
After SIJP		1,139,833	60%	$ 1,274	0.178	0.128
	TW	*98%*				
	TB	*2%*				
Female		2,442,945	62%	$ 872	0.046	0.031
Male		1,525,477	38%	$ 909	0.158	0.111
	TW	*91%*				
	TB	*9%*				
Moratorium		2,084,691	52%	$ 789	0.002	0.002
Non Moratorium		1,915,653	48%	$ 1,187	0.167	0.115
	TW	*83%*				
	TB	*17%*				
Special Schemes		56,950	1%	$ 1,639	0.169	0.154
General Scheme		3,943,394	99%	$ 634	0.091	0.060
	TW	*89%*				
	TB	*11%*				
Minimum pension		2,901,989	73%	$ 771	0.000	0.000
Non minimum pension		1,098,355	27%	$ 1,544	0.159	0.114
	TW	*55%*				
	TB	*45%*				
Excluding Moratorium pensions						
Minimum pension		956,128	50%	$ 771	0.002	0.001
Non minimum pension		959,525	50%	$ 1,617	0.166	0.120
	TW	*63%*				
	TB	*37%*				
Ex AFJP system		281,416	7%	$ 1,098	0.186	0.148
PAYG system		3,718,928	93%	$ 978	0.103	0.068
	TW	*93%*				
	TB	*7%*				

Source: Own elaboration based on ANSES data of April 2009. Average real pensions are expressed in Argentine pesos of April 2009.

Benefits from the scheme prior to the 1994 reform account for 19% of total pensions. The average pension is 10% higher in this group while the Theil value is almost 60% higher. Nevertheless, this reform plays a marginal role in explaining pension inequality compared to the other factors. Only 1% of inequality is due to differences in the average pension, and this percentage is 2% when excluding moratorium pensions.

Because there is a relationship between wages and pensions, analyzing pension distribution by gender provides some information on the differences in the working histories of female and male workers. As can been seen, retiree gender accounts for 9% of total inequality, 62% of total pensions corresponds to women, and these pensions are not only lower than those of men but less dispersed, which means that the working income considered in pension determination was more equally distributed for women.

On the contrary, the moratorium program has a more significant effect in the characterization of the pension distribution. These benefits account for 52% of the total benefits with an average pension of ARS 788.52, which is very close to the minimum legal pension of that period (ARS 770.96). Although the dispersion within each group (moratorium and non-moratorium benefits) accounts for most of the observed inequality, the program makes a significant contribution to total pension inequality (17%).

Table 2 also shows that the benefits of special schemes account for 1% of total pensions. Both the average pension and the standardized Theil value of this group are about 150% higher than those of the general regime. Between-group inequality accounts for 11% of the total pension dispersion, which implies that the difference between the mean pensions of both groups is lower than the differences within each scheme.

Minimum pensions represent 73% of the total benefits and almost 50% of the pension inequality is accounted for by the difference between minimum and non-minimum pensions. This indicates that the pension indexation rules implemented during the period, together with the relative increase of new pensioners who entered the system with low incomes, had a significant impact on the pension distribution. As the vast majority of the moratorium benefits were minimum pensions, we excluded those benefits in an attempt to isolate the indexation effect. As can be seen, 37% of the decrease in total inequality is attributable to the gap between minimum and non-minimum pensions.

In sum, the implementation of the moratorium scheme together with all the measures that bring the minimum and non-minimum pension groups closer are the most important factors that account for the inequality observed in 2009.[20] Nevertheless, the relevance of each factor to explaining the inequality depends on the period under consideration. For example, the importance of the implementation of Law No. 24,241 to

[20] It is worth pointing out that although these measures are closely linked as almost all the moratorium benefits are minimum pensions, they are not the same because pension indexation is independent of the type of law giving rise to the benefit.

pension inequality increased until 1998, with between-group effects rising from 2.5% to nearly 10%. Since then, the relevance of the new Law in accounting for the evolution of pension inequality has been declining. This factor represented 8.8% of the total dispersion in 2003, just 1.2% in 2008 and 0.8% in 2009. Table A2 of Appendix 1 shows the Theil decomposition over the 1995-2008 period.

B. Components of the change in pension inequality

The JMP framework is used to estimate the contribution of both observed and unobserved quantities and prices to the observed change in pension inequality. To perform the technique described in the previous section, we estimate the following regressions by ordinary least squares (OLS): [21]

For 1996 and 2003:

$$\log(pension)_{it} = \alpha_t + \beta_{1t} male_{it} + \beta_{2t} provincial_{it} + \beta_{3t} beforeSIJP_{it} + \\ + \beta_{4t} minimum_{it} + \mu_{it} \quad (8)$$

For 2006 and 2009:

$$\log(pension)_{it} = \alpha_t + \beta_{1t} male_{it} + \beta_{2t} provincial_{it} + \beta_{3t} beforeSIJP_{it} + \beta_{4t} minimum_{it} + \\ + \beta_{5t} moratorium + \beta_{6t} special + \mu_{it} \quad (9)$$

The Table below quantifies the contribution of observed quantities and prices and of unobservables (i.e., the within-group component) to the standard deviation increase in the 1996-2003 period (from 0.615 to 0.642, see Table 1), and to the pension dispersion decrease in the 2006-2009 period (from 0.430 to 0.409, see Table 1). The significant information shown in Table 3 is the difference in explanatory power for inequality above and below the mean.

[21] Table A3 of Appendix 1 shows the regressions results.

Table 3. Observable and unobservable components of changes in inequality

Percentile Differential	Total Change	Observed Quantities	Observed Prices	Unobserved Prices and Quantities
		1996-2003		
90-10	0.098	0.102	0.027	-0.032
90-50	0.081	0.193	0.022	-0.134
50-10	0.016	-0.091	0.005	0.102
		2006-2009		
90-10	-0.349	-0.105	0.027	-0.270
90-50	-0.349	-0.105	0.015	-0.258
50-10	0.000	0.000	0.012	-0.012

Source: Own elaboration based on ANSES data of April of each year.

Over the 1996-2003 period, the positive sign of the 90th and 10th percentiles' differential indicates an increase in pension inequality. The differential is higher in the upper part of the distribution. For those pensions, changes in observed quantities exerted the most significant effect on the increase in inequality. Table A4 of Appendix 1 shows that this result could be explained by the increase in the relative size of post-SIJP and provincial pensions in 2003, since these benefits presented higher average pensions and less dispersion than existing benefits at that time. For pensions below the median, the observed quantities and the unobserved component were almost equally important (but with opposite signs) in the change in inequality. The negative sign of the observed characteristic component could be explained mainly by the relative increase in the number of female retirees. By 2003, this group presented lower and less dispersed pensions than those of male retirees, reducing total pension dispersion (see Table A4 of the Appendix). Concerning the effect of the unobserved component, one possible explanation discussed below may be related to the dispersion of wages. In sum, from 1996 to 2003 pension distribution became more unequal and the change in the dispersion of pensions seems to be much more understandable in terms of the change in the composition of the beneficiaries (observed characteristics) rather than in terms of changes in the prices of those characteristics (i.e., changes in pension amounts).

In the second period, the unobserved component was the greatest contributor to the total decrease in inequality. As shown, the residual component accounts for the vast majority of the decrease in inequality for pensions above the median while the second factor in importance is the quantities component. The latter component reflects the

increase in the number of moratorium and minimum pension benefits resulting from the moratorium plan. In fact, because of the incorporation of moratorium benefits, in 2006, 50% of pensions were minimum pensions and in 2009 that percentage increased to 70%. As both groups presented less dispersion and lower pensions than average benefits in 2009, their relative increase in total benefits favors a more equal distribution of pensions (see Table A4 of Appendix 1). For pensions below the median, the positive change in the return of the observed characteristics and the negative change in the unobserved component (both with a similar absolute value magnitude) account for the absence of change in inequality, since the quantities component is null. As stated above, the negative sign of the residual is probably linked to the dispersion of the wages used to determine the pension amount.

In sum, over the entire period changes in the observed characteristics of pensions were more relevant in accounting for changes in inequality than changes in the return of those characteristics. Besides, the unobserved factors determining pensions played a significant role in accounting for the more equal distribution over the 2006-2009 period, and a secondary role in accounting for the increase in inequality over the 1996-2003 period.

One factor that is linked to pension amounts is the retirees' salaries, or more precisely, salaries subject to contributions. The relationship between labor market factors and pensions depends on the formula established by the different pension systems. For pensions under Law No. 18,037 of 1967 (for wage earners), the benefit was established between 70% and 82% of salary upon retirement, depending on the total number of years of contributions to the system. In the case of self-employed workers (Law No. 18,038 of 1968), pensions were calculated as 100% of estimated average income. For provincial benefits transferred to the national system, the pension amount was generally established as 82% of the salary, depending on the province.[22] Benefits under the special regimes are calculated between 82% and 85% of the salary.

Finally, as mentioned in Section 2, the pension benefit amount under Law No. 24,241 (SIPA) is defined as the sum of a flat component (PBU), which is identical for all workers regardless of their contributions, plus a component that depends on salary

[22] For details, see provincial Laws No. 4,094/4,620 (Catamarca), No. 2,432/2,502 (Río Negro), No. 4,042 (Jujuy), No. 6,719 (Salta), No. 4,266/6,561 (San Juan), No. 6,446 (Tucumán), No. 3,794 (Mendoza), 3,900 (San Luis), No. 4.558 (Santiago del Estero), No. 5,451 (La Rioja), as well as ordinances No. 27,897 and No. 40,594 of the Municipality of Buenos Aires and ordinances No. 296/78 and No. 224/84 of the Municipality of Tucumán.

(PC+PAP), which is defined as 1.5% of the average salary over the 10 years before retirement, multiplied by the number of years the worker has contributed to the pension system.[23] This formula establishes a relationship between salary and pension. For example, for workers with 30 years of contributions, the contributory pillars (PC+PAP) of the benefit will account for 45% of the average reference salary. This sum will not exceed 52.5% of the workers' reference wage (i.e., 1.5% multiplied by 35 years).[24]

Hence, if the dispersion of salaries subject to contributions is similar to pension dispersion, the residuals of the JMP methodology regressions could be reflecting the impact of labor income on the pension distribution.

As the database does not include retirees' salaries, we analyze the unobserved factor of equations (8) and (9) together with the distribution of the unrestricted pension amount (hereafter "pure pension") as a proxy of labor income. The pure pension is defined as the sum of PBU + PC + PAP for benefits under Law No. 24,241 (general regime) or the legal percentage of salaries for other benefits (Law No. 18,037, 18,038 and special regimes). The distribution of pure pensions differs from that of real benefits since they do not consider either the minimum pension restriction or the maximum pension cap.[25]

Because the database includes the pure pension amounts at the time retirees enter the system and these remain fixed over time, the pure pension distribution of the stock of beneficiaries at any time will also reflect the cohort effect (i.e., variations due to differences at the time pensioners enter the system). So, in the analysis below we have only considered the pure pensions of new pensioners who enter the system each year.

It is worth mentioning that in order to receive a pension, retirees of the moratorium program were required to be registered as self-employed workers with the Federal Administration of Public Revenues *(*AFIP). Nearly all retirees were registered in the category with the lowest estimated income, which was used as reference when determining the pension amount.[26] As the vast majority of the program beneficiaries entered the system in 2007, pure pension dispersion fell sharply due to this method.

[23] From April 1996 to April 2009, the PBU increased 92% in nominal terms (from ARS 190 to ARS 364.1).
[24] Law No. 24,241, Articles 24 and 30.
[25] It should be noted that consideration of the taxable wage in the pension formula does not mean that the resulting pension amount is equal to the maximum legal pension.
[26] For the lowest category of self-employed workers, a monthly income of ARS 400 is assumed for those years. In 2007, the average salary of workers registered as both dependent and independent (excluding moratorium beneficiaries) amounted to ARS 855.12.

Therefore, to minimize distortions in the relationship between pensions and wages, we have excluded the benefits from the moratorium program.

Table 4 reveals an interesting finding: In all cases, the sign of the log pure pension differential is the same as that of the log real pension differential. However, the magnitude of the change differs. Apart from the fact that moratorium benefits have been excluded, this occurs because while pure pensions are linked to salaries subject to contributions, they include the flat PBU component.[27] In addition, we have considered the pure pension dispersion of new retirees entering the system in April of each year, while the pension residuals are estimated for the stock of beneficiaries in April of each year.

Table 4. Changes in inequality for log proxied salaries and log pension residuals

Percentile Differential	Log Pure Pensions	Log Pension Residuals
	1996-2003	
90-10	-0.054	-0.032
90-50	-0.075	-0.134
50-10	0.022	0.102
	2006-2009	
90-10	-0.217	-0.270
90-50	-0.066	-0.258
50-10	-0.150	-0.012

Source: Own elaboration based on ANSES data of April of each year.

This simple exercise shows that the effect of the taxable labor income dispersion on total pension distribution could be the one captured in the unobserved component of the pension equation.[28] Both in the first and second period, the differential of the residuals' 90th and 10th percentiles is negative, but the magnitude is much higher in the 2006-2009 period. This result could suggest not only a greater share of the PBU component in total pension amount, but also that the indexation of the maximum taxable income has been lower than wage increases. In fact, from April 2003 to April 2009 mean gross wages increased 94% (AFIP, 2012) while the average taxable wage (R*emuneración Imponible Promedio de los Trabajadores Estables*, RIPTE) increased

[27] However, the effect of the exclusion of moratorium benefits should not be significant since the majority of pensioners under Law No. 25,994 entered the system in 2007 and in 2009 this plan was closed (only new pensions under Law No. 24,476 were registered).

[28] It is important to distinguish between taxable and gross (before-tax) labor income because the latter, unlike residuals, became more unequal over the 1996-2003 period (see Table 1).

86% (MTESS, 2012) indicating that indexation of the salary cap plays a significant role in characterizing pension distribution.[29]

V. Conclusions

During the last two decades, the Argentinean pension system has undergone substantial structural reforms. In 1994, as part of the wave of deregulation that spread throughout the economic sphere, the system became a mixed scheme combining defined benefit and defined contribution components, as well as private and public management. However, the unfavorable evolution of the labor market during the 1990s and 2000s (rising unemployment and informality) caused the model to fail. In an attempt to solve the negative results of the SIJP scheme, especially low and decreasing pension coverage and loss of purchasing power among pensioners, since 2003 national authorities have implemented several reforms and, in 2008, the retirement pension system became a public PAYG scheme once again.

At the same time, we identify changes in pension distribution during the 1993-2006 period. Two different periods can be distinguished: the first starts with SIJP implementation in 1994 and continues to 2003, while the second one is from 2003 to 2009. The first period is characterized by a slight increase in pension inequality, whereas in the last period pension distribution was more equal. Over the 1996-2003 period the incorporation of pensions under SIJP rules, as well as the transfer of provincial benefits to the national system, appear to play an important role in increased inequality. This effect has more to do with the rising share of these retiree groups (with less dispersed pensions but a much higher income relative to the overall mean pension) than with changes in pension amounts. Additionally, the relative increase of female retirees also plays a significant role in changes in distribution as a smoothing factor of inequality. From 2003 onward, the increase in the share of minimum pensions, together with the implementation of the moratorium program, appear to be the most relevant factors in accounting for the more equal distribution.

The JMP microdecomposition also shows that the unobserved factors (i.e., factors included in the error term of the pension equation) play a significant role in

[29] Over the first period (1996-2003), mean gross wages decreased almost 9% while RIPTE decreased 4% (MTESS, 2012). In this case, the potential role of the salary cap in pension distribution in 1996 could have lost strength in the context of decreasing salaries in 2003.

characterizing the observed changes in pension distribution, mainly in the second period. One factor that is linked to pension amounts are retirees' salaries, or more precisely, salaries subject to contributions. Using data on unrestricted pension amounts (pure pension) as a proxy of taxable labor income, we have found that there is a direct relationship between changes in the residuals of pension inequality regressions and pure pensions. The negative sign of the difference between the 90th and 10th percentiles could suggest not only a greater share of the PBU component in total pension amount, but also that the salary cap plays a significant role in pension inequality.

These findings provide some direction for future research. One extension of this paper could be a detailed study of the effect of each component of pension distribution using a technique that enables aggregation of the different components of the decomposition, such as a combination of quantile regression and JMP decomposition. Another interesting issue that emerges from this paper is the analysis of taxable salaries and pension caps and the implications in terms of inequality. Finally, the research topics suggested, together with the changes in pension inequality documented here, could guide future research to support policy recommendations for design of the PAYG scheme.

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Appendix 1: Tables

Table A1. Pension formula, 1994

Benefit	Formula	Pensioners	
		PAYG system	**Funded system**
Flat-rate benefit (prestación básica universal, PBU)	Per Law No.24,241. the PBU amounts to 2.5 times the average employee's contributions (*aporte medio previsional obligatorio*, AMPO). However, Decree 833/97 changed the PBU to 2.5 times the *módulo previsional*, MOPRE, which was set at $80 by Resolution 661/97 of the Ministry of Labor. Its value was adjusted on an ad hoc basis until Law No. 26,417 on indexation of benefits.	Yes	Yes
Earning-related benefit (*prestación compensatoria*, PC)	$PC = \frac{1}{10} \cdot \sum_{x=R-10}^{R-1} (w_x \cdot i\ ) \cdot 0.015 \cdot y_{before\ July94}$ Where *w* is the annual salary, *x* is the worker's age, *i* is the annual indexation coefficient, *y* is the number of years of contribution before July 1994 and *R* is the retirement age.	Yes	Yes
Prestación Adicional por Permanencia (PAP)	***1994-2007*** $PAP = \frac{1}{10} \cdot \sum_{x=R-10}^{R-1} (w_x \cdot i\ ) \cdot 0.0075 \cdot y_{after\ July94}$ ***since 2007*** $PAP = \frac{1}{10} \cdot \sum_{x=R-10}^{R-1} (w_x \cdot i\ ) \cdot 0.015 \cdot y_{after\ July94}$ Where *w* is the annual salary, *x* is the worker's age, *i* is the annual indexation coefficient, *y* is the number of years of contribution after July 1994 and *R* is the retirement age.	Yes	No
Jubilación Ordinaria (JO)	$JO = \frac{1}{ac} \cdot \sum_{x=1994-B}^{R-1} w_x \cdot (c-e) \cdot (1+r)^{R-x}$ Where *c* is the contribution rate, *e* are the administrative and insurance costs, *r* is the capital return, *ac* is the cost of an annuity of $1, *B* is the year of worker birth, *x* is the worker's age and *R* is the retirement age.	No	Yes

Table A2. Theil decompositions by group, 1995-2008

Year	Pre SIPJ/ Post SIJP		National/ Provincial		Men/ Women		Minimum / Non Minimum		Moratorium/ Non Moratorium		S. Scheme/ G. Scheme	
	TW	*TB*	*TW*	*TB*	*TW*	*TB*	*TW*	*TB*	*TW*	*TB*	*TW*	*TB*
1995	96.6%	3.4%	97.0%	3.0%			85.0%	15.0%				
1996	97.4%	2.6%	97.3%	2.7%	91.8%	8.2%	84.8%	15.2%				
1997	91.0%	8.2%	88.7%	11.3%	92.4%	7.6%	86.6%	14.8%				
1998	90.1%	9.9%	86.9%	13.1%	93.8%	6.2%	88.5%	11.5%				
1999	90.4%	9.6%	87.1%	12.9%	94.5%	5.5%	90.7%	9.3%				
2000	90.7%	9.3%	87.7%	12.3%	94.1%	5.9%	90.9%	9.1%				
2001	90.7%	9.3%	88.1%	11.9%	93.7%	6.3%	91.3%	8.7%				
2002	90.9%	9.1%	88.3%	11.7%	93.6%	6.4%	91.4%	8.6%				
2003	91.2%	8.8%	88.5%	11.5%	93.3%	6.7%	94.2%	5.8%				
2004	92.7%	7.3%	88.8%	11.2%	93.7%	6.3%	70.4%	29.6%				
2005	94.0%	6.0%	89.1%	10.9%	93.5%	6.5%	68.1%	31.9%				
2006	97.4%	2.6%	88.2%	11.8%	93.2%	6.8%	63.3%	36.7%	99.0%	1.0%	96.9%	3.1%
2007	99.1%	0.9%	86.4%	13.6%	88.2%	11.8%	56.3%	43.7%	86.1%	13.9%	94.0%	6.0%
2008	98.8%	1.2%	86.9%	13.1%	90.0%	10.0%	55.4%	44.6%	83.6%	16.4%	90.6%	9.4%

Source: Author's calculations based on ANSES data for April of each year.

Table A3. OLS regressions of log monthly pensions

	1996		2003		2006		2009	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Male	0.246	0.001	0.280	0.001	0.066	0.001	0.033	0.000
Province	0.554	0.003	0.514	0.002	0.254	0.001	0.202	0.001
Before SIJP	-0.179	0.001	-0.266	0.001	0.011	0.001	0.027	0.000
Moratorium					0.015	0.002	0.030	0.000
Special Regime					0.201	0.002	0.452	0.001
Minimum	-0.635	0.001	-0.586	0.002	-0.481	-0.001	-0.522	0.000
Constant	6.493	0.001	6.241	0.001	6.627	0.001	7.116	0.000
Adj R-square	0.273		0.264		0.425		0.407	
N	2,079,620		1,935,513		1,900,464		4,000,344	

Note: All independent variables were defined as dummy variables (0-1). All show a p-value<0.01.

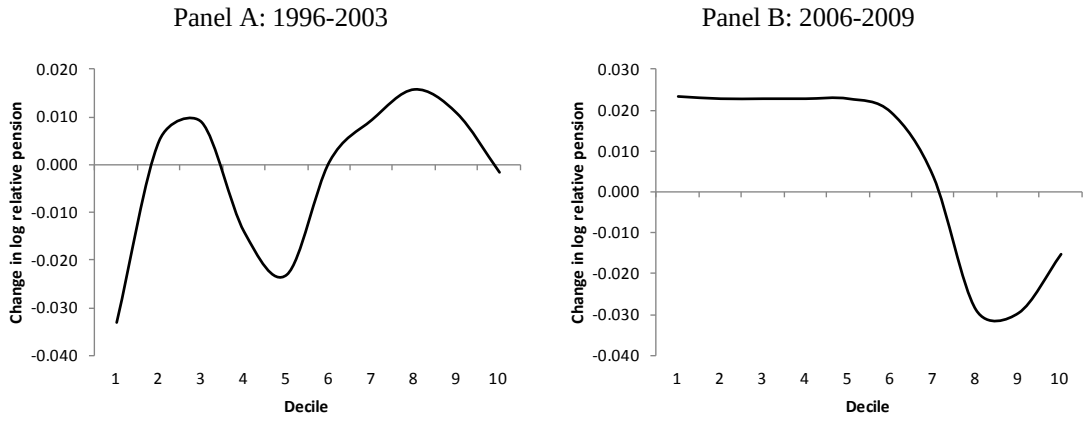
Table A4. Population share, average real pension and Theil index, by group

Description	Population share			Average real pension			Pension differentials relative to the overall average			Theil index		
	1995	**2003**	**2009**	**1995**	**2003**	**2009**	**1995**	**2003**	**2009**	**1995**	**2003**	**2009**
Provinces´ system	2.0%	9.6%	3.9%	$ 1,513	$ 1,248	$ 1,789	103.6%	87.3%	82.7%	0.156	0.237	0.188
Nation's system	98.0%	90.4%	96.1%	$ 728	$ 605	$ 947	2.1%	9.2%	3.3%	0.278	0.256	0.086
	1995	**2003**	**2009**	**1995**	**2003**	**2009**	**1995**	**2003**	**2009**	**1995**	**2003**	**2009**
Before SIJP	92.3%	65.0%	19.4%	$ 711	$ 555	$ 1,059	4.3%	16.7%	8.1%	0.272	0.277	0.135
After SIJP	7.7%	35.0%	80.6%	$ 1,125	$ 873	$ 960	51.4%	30.9%	2.0%	0.261	0.233	0.095
Excluding Moratorium	***1995***	***2003***	**2009**	***1995***	***2003***	**2009**	***1995***	***2003***	**2009**	***1995***	***2003***	**2009**
Before SIJP	*92.3%*	*65.0%*	40.5%	*$ 711*	*$ 555*	$ 1,059	*4.3%*	*16.7%*	10.8%	*0.272*	*0.277*	0.135
After SIJP	*7.7%*	*35.0%*	59.5%	*$ 1,125*	*$ 873*	$ 1,274	*51.4%*	*30.9%*	7.3%	*0.261*	*0.233*	0.178
	1996	**2003**	**2009**	**1996**	**2003**	**2009**	**1996**	**2003**	**2009**	**1996**	**2003**	**2009**
Female	40.5%	42.7%	61.6%	$ 561	$ 518	$ 872	25.3%	22.2%	11.0%	0.18	0.24	0.05
Male	59.5%	57.3%	38.4%	$ 883	$ 778	$ 1,151	17.4%	16.7%	17.5%	0.30	0.29	0.16
	1995	**2003**	**2009**	**1995**	**2003**	**2009**	**1995**	**2003**	**2009**	**1995**	**2003**	**2009**
Minimum pension	18.9%	5.5%	72.5%	$ 330	$ 233	$ 766	55.6%	65.1%	21.8%	0.00	0.00	0.00
Non minimum pension	81.1%	94.5%	27.5%	$ 839	$ 692	$ 1,544	12.9%	3.8%	57.6%	0.27	0.27	0.16
Excluding Moratorium	***1995***	***2003***	**2009**	***1995***	***2003***	**2009**	***1995***	***2003***	**2009**	***1995***	***2003***	**2009**
Minimum pension	*18.9%*	*5.5%*	50.1%	*$ 330*	*$ 233*	$ 756	55.6%	65.1%	36.3%	*0.00*	*0.00*	0.00
Non minimum pension	*81.1%*	*94.5%*	49.9%	*$ 839*	*$ 692*	$ 1,617	12.9%	3.8%	36.2%	*0.27*	*0.27*	0.17
		2006	**2009**		**2006**	**2009**		**2006**	**2009**		**2006**	**2009**
Moratorium		2.7%	52.1%		$ 494	$ 789		30.5%	19.5%		0.00	0.00
Non Moratorium		97.3%	47.9%		$ 717	$ 1,187		0.9%	21.2%		0.14	0.17
Moratorium		**2006**	**2009**		**2006**	**2009**		**2006**	**2009**		**2006**	**2009**
Men		19.6%	20.5%		$ 503	$ 802		1.8%	1.7%		0.00	0.01
Women		80.4%	79.5%		$ 492	$ 785		0.4%	0.4%		0.00	0.00
Non Moratorium		**2006**	**2009**		**2006**	**2009**		**2006**	**2009**		**2006**	**2009**
Men		57.9%	59.0%		$ 790	$ 1,279		10.2%	7.7%		0.16	0.18
Women		42.1%	41.0%		$ 616	$ 1,055		14.0%	11.1%		0.09	0.13
		2006	**2009**		**2006**	**2009**		**2006**	**2009**		**2006**	**2009**
Special Schemes		1.9%	1.4%		$ 1,232	$ 2,482		73.4%	153.4%		0.10	0.17
General Scheme		98.1%	98.6%		$ 701	$ 958		1.4%	2.2%		0.14	0.09

Source: Own elaboration based on ANSES data of April of each year. Average real pensions are expressed in Argentine pesos of April 2009.

Appendix 2: Figures

Figure A1. Change in log relative pension by decile, 1996-2003 and 2006-2009



Source: Own calculations based on ANSES data for April of each year.

Chapter 3

The optimal age for switching from the funded pension scheme to the PAYG pension system: Evidence for Argentina*

I. Introduction

In November 2008, the Argentine Senate approved Law No. 26,425 to create the Argentinean Integrated Pension System (*Sistema Integrado Previsional Argentino* -SIPA).With this reform, the country's privately managed defined-contribution pension funds were absorbed into the public pay-as-you-go (PAYG) scheme.

The precedent to this reform was the promulgation of Law No. 26,222 in March 2007 which enabled contributors to transfer from the individual accounts scheme to the PAYG scheme within a limited period (up to 31 December 2007).

Originally, Law No. 24,241 established that workers included in the Integrated Retirement and Pensions System (*Sistema Integrado de Jubilaciones y Pensiones* -SIJP) could contribute to either the public or the private pension scheme. Workers having opted for the public scheme could switch to the private system at any time during their working life. However, once workers began to contribute to the private Retirement and Pension Funds Managing Companies (*Administradoras de Fondos de Jubilaciones y Pensiones* -AFJPs), they had to remain in the private system until retirement (and they could change fund manager up to twice a year). This one-way transfer was intended to support the success of the new private system.

Under Law No. 26,222, those workers who contributed to the private defined contribution individual accounts scheme could switch for the first time to the PAYG scheme. This law also allowed the migration between both systems (i.e., from the public to the private pension regime and vice versa) once every five years. The transfer to the public PAYG system did not mean transferring funds out of the individual accounts (*Cuentas de Capitalización Individual* -CCI). Once the affiliate were switched to the PAYG scheme, the workers' contributions began to be allocated to the public pension

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* This is a modified version of the article "Determining factors leading affiliates to transfer from an individual accounts pension scheme to a pay-as-you-go pension scheme: Evidence from Argentina" published in the *International Social Security Review* 62 (1): 55-76. April-June 2009.

regime, while funds already deposited in the CCIs continued to cumulate interest in the private scheme.

Although the characteristics of the different pensions systems have been widely documented, little has been written about the factors that affect individual decisions in favor of choosing one pension system over others. Focusing on theories of public choice, Wang and Davis (2003) analyzed the factors influencing the choice of a pensions system. They used data from 52 countries over the period 1992 to 1997. Performing an ordered probit model for panel data, these authors concluded that variables related to freedom (both political and economic) encouraged the adoption of individual accounts systems. In other line of research, Berstein and Cabrita (2007) analyzed the factors determining the choice of a Pension Fund Managing Company (*Administradora de Fondos de Pensión* - AFP) in Chile using microdata. They estimated the demand for AFPs using a lineal probability model and panel data and, in line with other investigations, they found that the transfers between the fund managers are related to the size of the sales. Following the same line of research, Arango and Melo (2007) used aggregated data to study the determining factors in the choice of AFPs in Colombia. They find that the rate of return and the employed population are the main determinants of the number of active participants to the different pension fund managers. However, any of this empirical literature addresses the issue of the determinants of migrating between systems.

The main objective of this article is to study in detail the profiles of those who, under Law No. 26,222 transferred to the PAYG scheme as well as analyzing whether there is any link between that voluntary transfer and the (retirement) income maximizing behavior.

The main importance of this article is that it is the first paper which, using unpublished data of the National Social Security Administration (*Administración Nacional de la Seguridad Social* –ANSES), characterized the switchers profiles. This characterization also sheds some light regarding whether the income maximization behavior could lead the decision to migrate to the public pension scheme.

The article is structured as follows: the next Section presents the switchers profiles together with the relative risks of transferring from the private to the public scheme. Section III presents a simple simulation exercise to obtain the optimal age for switching from the private to the public pensions regime. The simulation assumes that the objective of the workers who contribute to the pension system is the maximization

of the pension they will receive at retirement. The results obtained are compared with those of the profiles. We also discuss the robustness of our results to changes in the rate of return, the wages growth rate and in the contribution density. Finally, Section IV includes the conclusions.

II. Switchers profiles and relative risks

Before analyzing the characteristics of those who migrated to and who remained in the AFJPs scheme due to the implementation of Law No. 26,222, it is important to distinguish between two types of transfer to the PAYG scheme: compulsory and voluntary. The compulsory group comprises members having been transferred to the public scheme because their deposits in the CCIs were less than ARS 20,000 (US$ 6,500 approx.) when aged 50 or older (women) or aged 55 or older (men). This group also included workers transferred because their activities were subject to special social insurance legislation (such as teachers, researchers, diplomats, etc.). On the other hand, the voluntary transfer group included all those workers who did not belong to any of the above-mentioned groups and formally requested to ANSES to be transferred to the public scheme.

One of the innovations of this article is that this is the first paper that uses unpublished micro data from ANSES of the affiliates to the SIJP in February 2008. Out of the total of affiliates (approximately 15 million of contributors) we included in this study those who voluntarily transferred to the public scheme in 2007 together with those affiliates who remained in the AFJP scheme. Originally, there were identified 1,083,864 cases of voluntary switchers and, after processing missing values and mistaken data, 710,409 cases were finally considered. Hence, the total observations incorporated were 3,990,666 cases including contributors who voluntary opted to transfer to the PAYG pension system (18% of total affiliates to the private regime) who and those remain in the private AFJP scheme (the remaining 82%).

Table 1 reports the profiles of the affiliates of the private system by switcher/non-switcher condition according to demographic information (gender, age, marital status and region of residence) and socio-economic characteristics (occupational group – dependent or mixed worker-, taxable income and months contributing to the pension system).

Table 1. Affiliates profiles by switcher/non-switcher status

Affiliates´ characteristics	PAYG option (%)	Remaining in AFJP (%)	Proportion over total affiliates (%)	RR
Gender				
Male	64.9	71.9	70.7	0.92
Female	35.1	28.1	29.3	1.20
Age				
20 or younger	0.1	0.9	0.8	0.13
21 to 30	12.7	32.8	29.2	0.44
31 to 40	26.9	33.0	31.9	0.84
41 to 50	32.8	21.9	23.8	1.38
51 to 60	23.3	8.3	11.0	2.12
61 to 65	3.4	1.5	1.9	1.83
66 to 70	0.6	0.9	0.9	0.74
71 to 99	0.1	0.5	0.4	0.30
+ 100	0.0	0.1	0.1	0.19
Marital status				
Single	31.0	45.2	42.7	0.73
Married	63.3	48.7	51.3	1.23
Separated	4.6	0.7	5.2	0.88
Widow	1.2	5.3	0.8	1.45
Occupational group				
Self-employed	2.3	2.3	2.3	0.98
Dependent or mixed worker	97.7	97.7	97.7	1.00
Taxable income (ARS)				
less than 1,000	33.3	46.3	44.0	0.76
between 1,000.01 and 2,000	41.9	35.4	36.6	1.15
between 2,000.01 and 3,000	15.2	9.7	10.7	1.42
between 3,000.01 and 4,000	5.7	4.0	4.3	1.31
between 4,000.01 and 5,000	2.5	2.3	2.3	1.07
+ 5000	1.4	2.2	2.1	0.68
Contributions				
between 1 and 5 months	2.5	8.0	7.0	0.36
between 6 and 10 months	3.0	8.3	7.3	0.41
between 11 and 15 months	4.1	8.8	7.9	0.52
between 16 and 20 months	4.5	7.9	7.3	0.62
between 21 and 25 months	5.1	7.6	7.1	0.71
between 26 y 30 months	5.9	7.6	7.3	0.80
between 31 and 35 months	11.9	11.9	11.9	1.00
36 months of contributions	63.0	40.0	44.1	1.43
Region of residence				
Capital Federal	13.4	13.4	13.4	0.99
Buenos Aires	35.2	39.8	39.0	0.90
Catamarca	2.0	1.3	1.4	1.38
Córdoba	4.7	8.1	7.5	0.63
Corrientes	1.1	1.5	1.4	0.78
Entre Ríos	2.3	2.2	2.2	1.06
Jujuy	3.3	1.1	1.5	2.25
La Rioja	1.3	0.7	0.8	1.70
Mendoza	6.1	5.4	5.6	1.10
Salta	3.5	2.4	2.6	1.36
San Juan	1.7	1.3	1.4	1.26
San Luis	1.1	1.0	1.1	1.06
Santa Fe	8.0	7.7	7.8	1.03
Santiago del Estero	1.5	1.0	1.1	1.37
Tucumán	5.2	2.0	2.6	2.04
Chaco	1.1	1.2	1.2	0.94
Chubut	1.4	1.7	1.7	0.85
Formosa	0.5	0.5	0.5	1.01
La Pampa	0.5	0.8	0.7	0.62
Misiones	1.0	2.1	1.9	0.51
Neuquén	0.8	1.3	1.2	0.68
Río Negro	3.0	2.1	2.3	1.34
Santa Cruz	0.8	0.8	0.8	0.93
Tierra del Fuego	0.5	0.6	0.5	0.84
Observations	**710,409**	**3,280,257**	**3,990,666**	

Source: Own elaboration based on ANSES data of February 2008.

In addition, the last column of Table 1 shows the relative risks (RR). This indicator is defined as the proportion of individuals with a given characteristic which present the phenomenon under review (in this case, individuals who switched to the public pension scheme) compared with the proportion of individuals with the aforementioned characteristic. For example, the relative risk to transfer to the public pension scheme for women can be calculated using the Table below.

Table 2. Matrix for the calculation of RR, by gender

		Transfer	
		Yes	*No*
Women	*Yes*	a	b
	No	c	d

Mathematically, the RR to transfer for women can be defined as:

$$RR = \frac{\frac{a}{(a+c)}}{\frac{(a+b)}{(a+b+c+d)}}. \quad (1)$$

If RR > 1, the proportion of women who switched to the public pension scheme relative to all switchers is higher than the proportion of women in the total population, indicating that this group presents a high risk of transfer from the private individual accounts to the public regime.

Returning to Table 1, it can be observed that the majority of affiliates are men in both groups. However, as RR < 1 for men, the women are more likely to migrate to the pubic PAYG scheme than men. Regarding marital status, single workers were the most likely group to remain in the individual account system (they present the lowest RR). This is an expected result given that the AFJPs provided higher returns to single workers. The latter holds because single individuals do not have to provide any survivor's pension in case of the affiliate death. On the other hand, married (and widows) workers were the most likely group to transfer to the PAYG scheme.

Concerning labor income, workers at the lowest and the highest groups of income present RR <1 while the rest of the income groups show a RR >1. In the case of the high-income workers, this results could be explained by the fact that the higher the wage, the higher the contributions, the higher the accumulated fund and therefore, the

higher the benefits of capitalization. In the case of the lower-income group of workers, more than 40% of the affiliates of this group were younger than 31 years old, and this could explain, at least in part, the lower risk to transfer.

As regards employment category, we find a small difference in the relative risks between self-employed and salaried workers that favors the latter group.[1]

Moreover, the tendency to transfer to the public scheme increases with months of contributions. Since our information is confined to the last 36 months, this does not mean that members who contribute more regularly are more likely to transfer to the PAYG scheme, but rather that transfers become more frequent in older age individuals because the lower age groups have contributed fewer months to the pension system. To be more precise, 3% of the workers less than 20 years old contributed more than 36 months, and this percentage increases to 18% for workers between 21 and 30, 26% for affiliates between 31 and 40 and, 71% for individuals aged between 61 and 65.

Regarding the region of residence of the affiliate, we could not distinguish any clear pattern concerning the likelihood of transfer. For example, the provinces of Jujuy and Misiones are similar regarding socioeconomic characteristics. Nevertheless, Jujuy presents the highest RR (2.25), while Misiones shows the lowest RR (0.51).

Table 1 also shows that affiliates aged between 41 and 65 years old are, on average, clearly more likely to transfer to the PAYG scheme. The group with the highest relative risk is the one consisting of workers aged between 51 to 60 years old, which presents a RR equal to 2.12. The correlation matrix of Appendix 1 (Table A1) shows the relationships among the above variables. It can be observed that the age is the variable that presents the highest correlation with the transfer variable. Then, we also analyze the risk of switching at each range of age, by gender.

Table 4 shows the proportion of male and female affiliates who transferred to the public scheme by ranges of age and additionally, the RR' column reports the probability that women transfer to the PAYG scheme relative to men. The matrix to obtain the relative risks RR' that the switchers are women relative to men by ranges of age is now:

[1] The self-employed workers are those who carry out remunerated work without any kind of employment contract, i.e., they are the sole owners or participants in the enterprise for which they work, while salaried workers are those who have a contractual relationship with their employers.

Table 3. Matrix for the calculation of RR'

		Range of age x	
		Yes	*No*
Women	*Yes*	a	b
	No	c	d

Then,

$$RR' = \frac{\frac{a}{(a+b)}}{\frac{c}{(c+d)}}. \qquad (2)$$

Table 4. Transfers by gender and age groups

Age	Men	RR men	Women	RR women	RR'
20 or younger	0.11%	0.13	0.09%	0.13	0.794
21 to 30	11.64%	0.42	14.72%	0.46	**1.264**
31 to 40	25.18%	0.80	30.01%	0.90	**1.192**
41 to 50	31.24%	**1.29**	35.71%	**1.57**	**1.143**
51 to 60	27.00%	**2.19**	16.45%	**2.14**	0.609
61 to 65	3.95%	**2.18**	2.42%	**1.21**	0.612
66 to 70	0.73%	0.78	0.48%	0.69	0.649
+ 70	0.14%	0.33	0.09%	0.24	0.673

Source: Own elaboration based on ANSES data of February 2008

As can be observed, the range of age with the higher proportion of switchers is the one that goes from 41 to 50 years old for both genders. More precisely, 31.24% of total men aged between 41 and 50 opted to transfer, whereas 35.71% of the women in this range of age switched to the public scheme. The second range is the one that goes from 51 to 60 years old in the case of men but it is the 31 to 40 years old range in the case of women. This result suggests that the women who transferred to the PAYG regime were, on average, younger than men. Those women between 21 and 50 years old are more likely to switch to the public pension system than men since RR'>1, and this risk is higher when the age goes from 21 to 30 years old.

In the next Section we will discuss whether these results are in line with an income maximizing behavior. Since the age is the variable that presents the highest correlation with the transfer variable, we perform a simulation exercise to find out the optimal age for transferring to the PAYG pension scheme. We assume a labor history for a representative worker and then we obtain the value of the pension according to the

age he decides to switch. The optimal age for transferring is the one that leads to the higher pension.

III. The optimal age to switch to the PAYG pension scheme

In this Section we analyze if there is a link between the previous results of the ages at which the agents are more likely to transfer to the PAYG scheme and the income maximization behavior.

In this simple experiment we assume that at the moment the agents begin their working careers, they chose the pension system where to contribute (either AFJP or the PAYG scheme). Taking into account the provisions of Law No. 24,241 and 26,222, we assume that the workers decide the optimal timing in their working life to transfer from the capitalization scheme to the PAYG system, but once they are contributing to the public scheme, they have to remain in that regime. This is a limitation of our experiment since we do not simulate the possibility of migrating between both systems every five years. For the simulation we assume that the objective of the worker is to obtain the maximum pension at retirement. Since the retirement age differs between men and women (65 and 60 years old, respectively), the optimal age will be different in the both cases even if their earnings profile is the same. Our experiment uses the following assumptions:

- Single salaried worker (no widow's pension or child allowances).
- Monthly taxable earnings of ARS 1,800 (average salary during the first semester 2008, AFIP 2008).[2]
- 3% real annual salary growth. This percentage was calculated as the average of the GDP real growth over the last 30 years. This result is in line with other estimations of the long-term productivity for (see, for example, Maia and Kweitel (2003).
- Age on entering the labor market: 22 years old (AFIP, 2008).
- 6% real annual rate of return on individual account funds (SAFJP, 2008).
- Fees charged by the Pension Fund Managers (AJFPs): 1% of earnings (Law No. 26,222).
- Charges for invalidity and death (survivors') insurance: 1% of earnings (annual average since June 1994, AFJP Superintendence).

[2] Taxable earnings are those earnings of salaried workers subject to SIJP contributions. In February 2008, the taxable earnings ceiling was ARS 6,750.

• Personal contributions: 11% of taxable earnings under both schemes (Law No. 26,222).

• Contribution density: 100%, (i.e., the worker begins to contribute when entering the labor market and continues contributing without interruption until reaching retirement age). We also include a sensitivity analysis to changes in this parameter.

The simulation also assumes that the worker enters into the labor market in 2008, so the PAYG benefit consists of the sum of the flat Universal Basic Pension pillar (*Prestación Básica Universal* -PBU) and the earning-related Additional Permanence Benefit (*Prestación Adicional por Permanencia* –PAP). The simulated pension does not include the Compensatory Benefit (*Prestación Compensatoria* –PC) since this latter takes into account contributions to the public scheme made prior to July 1994.[3] Regarding the private benefit, the Basic Pension (*Jubilación Ordinaria*- JO) is assumed to be provided in the form of a life annuity.[4] The PBU is added to the JO to calculate the private pension amount.

Thus, assuming that workers based their decision regarding the choice of the pension scheme on the amount of the pension they will receive when they retire, the problem of the agents consists of comparing the gains and losses of contributing an additional year to the private scheme. More precisely, individuals compare the gains in the JO benefit versus the losses in the PAP benefit due he contributes one year less to the PAYG regime.

In the case of the private scheme, the accumulated capital in the individual account is defined as:

[3] By the time of the implementation of Law No. 26,222 (i.e., before the approbation of Law No. 26,425 that eliminated the private pension pillar and created the SIPA), the Argentinian pension system had two pillars. The first pillar consisted of a flat benefit granted to all workers who met the required age and years of contribution. This benefit, called the *Prestación Básica Universal* (PBU), was administered by ANSES. The second pillar depended on the exercised option (i.e., the pension scheme chosen). The PAYG regime granted an additional benefit, called the *Prestación Adicional por Permanencia* (PAP), equivalent to 0.015 times the average wage of the last 10 years per every year contributed to the public regime after 1994. The capitalization regime granted an annuity, called the *Jubilación Ordinaria* (JO), based on the accumulated balance. Workers who made contributions before 1994 were entitled to the *Prestación Compensatoria* (PC), which was a compensatory benefit computed like the PAP. Except the JO, the other benefits are included in the SIPA.

[4] The benefits under the individual account scheme were the following: pension insurance annuities, programmed retirement, and partial retirement. In the first type, monthly payments were calculated in Argentine pesos and adjusted monthly to take interest into account but the nominal value was not be reduced. Under programmed retirement the amount of the monthly payment was calculated annually in the form of a fixed number of quotas, which were deducted from the worker's CCI. Its amount in Argentine pesos varied from month to month depending on changes in the value of the quota of the fund managed by the AFJP. With partial retirement, the amount of the monthly benefit was equal to 50% of the PBU. Each month, this amount was deducted by the AFJP from the worker's CCI.

$$F = w_0 \cdot (t - c - i) \cdot \left[(1+g)^{n-1} + (1+g)^{n-2}(1+r) + ... + (1+g)(1+r)^{n-2} + (1+r)^{n-1} \right] \quad (3)$$

where t is the personal contribution rate, c is the administrative tax charged by the AFJP and, i represents the insurance tax; w_0 is the annual taxable wage at the beginning of the working history; r is the real annual rate of return on individual account funds; g is the real annual salary growth and; n are the years of contributions to the pension system.

The JO is defined as:

$$JO = \frac{1}{ac} \cdot F \quad (4)$$

where ac is the annual cost of a ARS 1 annuity. This cost varies according to the worker gender, marital status, age of husband/wife, number of children, etc. at the age of retirement.

Furthermore, the PAP is defined as:

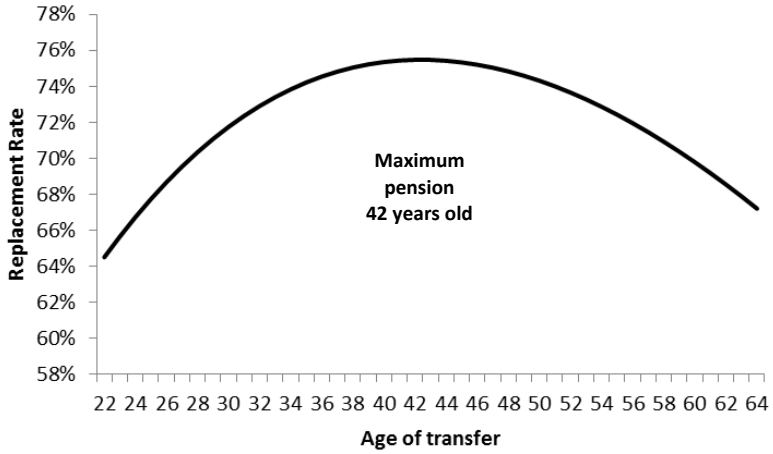
$$PAP = \frac{1}{10} \cdot \sum_{x=R-10}^{R-1} w_x \cdot 0.015 \cdot y_{after\ July\ 1994}. \quad (5)$$

R is the age of retirement, w_x is the annual taxable wage at age x (i.e., the wage at age x is considered for the calculation of the PAP only if the affiliate paid the required contribution to the SIJP at that age) and, y represents the years of contributions.

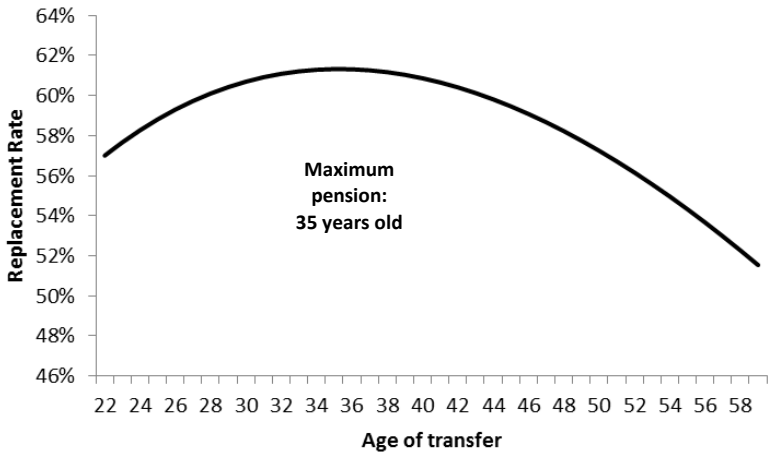
For each age at which the representative worker switches to the PAYG scheme, Figure 1 shows the simulated pension paths in terms of replacement rates (i.e., pension/average wage over the last 10 years of contributions). We can observe that if the worker is a man, he will obtain the maximum pension if he transfers from the private to the public pension scheme at age 42 while the optimal age to stop contributing to the private system and switch to the PAYG regime is 35 years old in the case of women.

Figure 1. Pension path and the optimal age of transfer

Panel A: Men



Panel B: Women



Since this experiment assumes the same wage profile for male and females workers, the main reason for the difference in the optimal age of transfer between men and women is the earlier retirement age for this latter group of workers and their longer life expectancy. Women retire five years before than men and, therefore they have less time to capitalize their individual accounts. Moreover, the life expectancy of women is higher than that of men, indicating that, on average, women receive the JO benefit for a

longer period of time.[5] Therefore, as the payments of the AFJPs are based on the concept of life annuities, the JO is smaller for women than for men. Moreover, these reasons also explain that, for each age, the optimal replacement rate of men dominates that of women.

The estimated replacement rate for a man who contributes to the PAYG scheme since the beginning of his working career is 65%, while it is 67% if the worker remaines in the private system during all his working life. In the case of women, the replacement rate is 57% if she has always contributes to the public system, whereas it drops to 52% if she remains in the private scheme during all her working life. Nevertheless, Figure 1 indicates that, for the baseline scenario, a combination of years of contributions to both systems leads the highest pension when they retire.

More precisely, the results of the simulation show that a male worker who decides to transfer to the PAYG scheme at age 42 will obtain a future pension that represents 75% of the reference salary used in the calculation of the PAP. Meanwhile, a woman who transfers at age 35 will receive a pension that represents 65% of the reference salary. In both cases, combining the two systems provides the highest pension income. In the case of men, under the assumption of 43 years of contributions, it is optimum to contribute the first 21 years to the private pension system, and the remanding 22 years to the PAYG regime. In the case of women, it is optimum to remain during the first 14 years of their working history in the AFJPs system and to contribute the remaining 24 years to the public scheme.

Besides, once the worker knows his pension path at each age, at time *t* (in this case, from March 2007 to December 2007 that was the period when the possibility to migrate to the PAYG scheme was allowed), he compares the pension he would receive if during *t* he chooses to switch to the PAYG system versus the pension he would receive in *t+5* (which is the time when he will be allowed to migrate to the public system again). So, migrating from the private system is the optimal decision for female workers older than 32 years old and for male workers older than 39 years old since the replacement rates of switching at those ages at time *t* are higher than the replacement rates in *t+5*. In general, these results show same concordance with those of Table 1 and Table 4 where the relative risk of transfer is higher than 1 for the upper ranges of age.

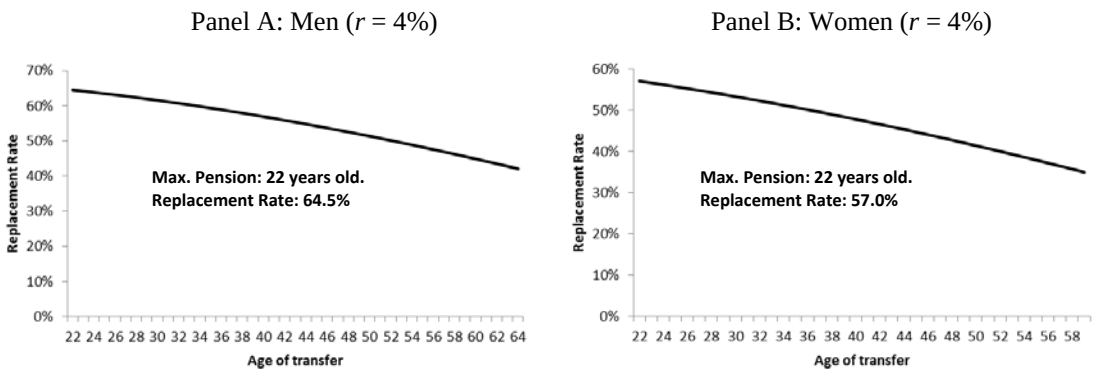
[5] The life expectancy of women is estimated at 78.8 in 2009 and 80.3 en 2015, while in the case of men, it is 72.1 and 73.8, respectively (INDEC, 2014).

To check the robustness of our findings, we also perform a sensitivity analysis varying the profitability of the funds *r*, the wages growth rate and the contribution density. In the case of the rate of return of the funds of the CCI, we consider how the optimal age changes when the rates take the values 8%, 7%, 5% and 4%.

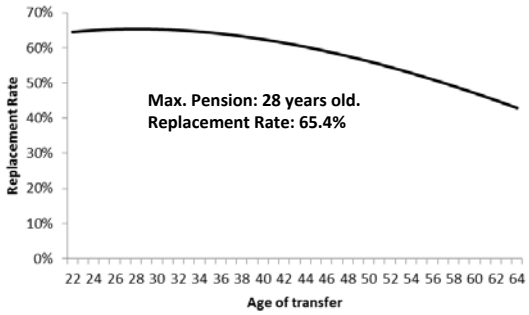
As expected, from Figure 2 we can observe that the higher the profitability of the fund (CCI), the optimal age for switching increases since the JO benefit increases with *r*. Besides, the higher the rate of return of the pension fund, the higher the replacement rate, except in the case where at different taxes, the optimal age is 22 years old. As can be seen from Panels B and C, both cases present the same replacement rate. This is because in these situations, besides the PBU, the only component of the pension is the PAP whose value does not depend on *r*. We can also observe that the replacement rates of men always exceed those of women. As men and women were assigned the same wage profile, the difference in the replacement rates is mainly explained by the difference in the retirement age. For example, when the rate of return was set at 4%, the resulting optimal age to transfer is 22 for men and women; nevertheless, the optimal replacement rate of men is 7.5 percentage points higher than the rate of women.

Figure 2 also shows that, at moment *t*, migrating from the private system is the best option for all the affiliates to the AFJP system when the rates of return are small. However, when *r* is set at 7%, the optimal ages for transferring to the public scheme is 49 years old for men and 42 for women. When *r* equals to 8%, the optimal ages increase to 51 and 46 years old for men and women, respectively.

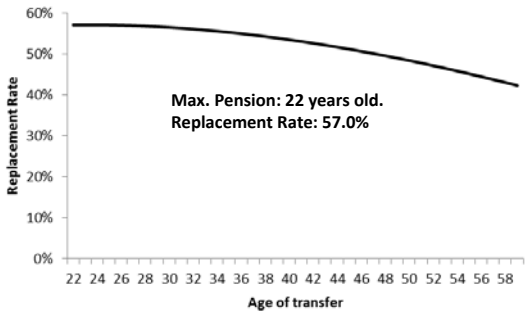
Figure 2. Optimal results when r changes



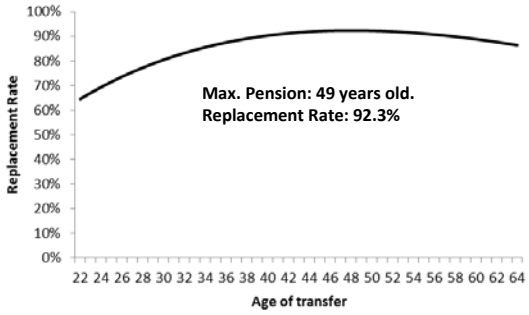
Panel C: Men (r = 5%)



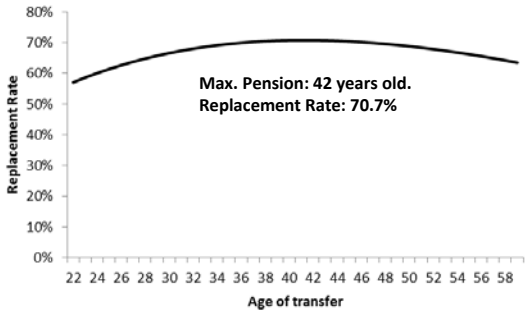
Panel D: Women (r = 5%)



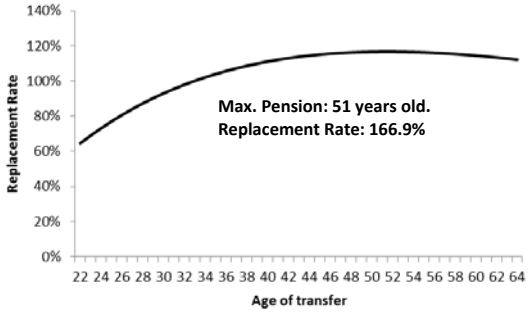
Panel E: Men (r = 7%)



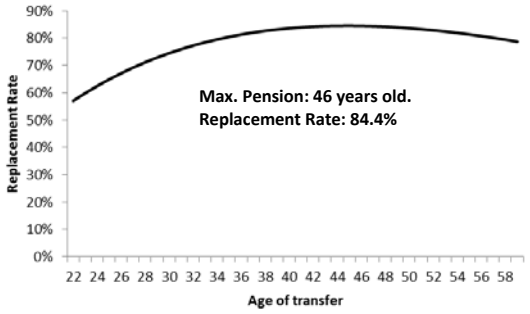
Panel F: Women (r = 7%)



Panel G: Men (r = 8%)



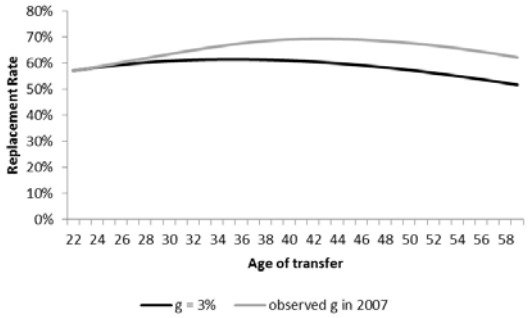
Panel H: Women (r = 8%)



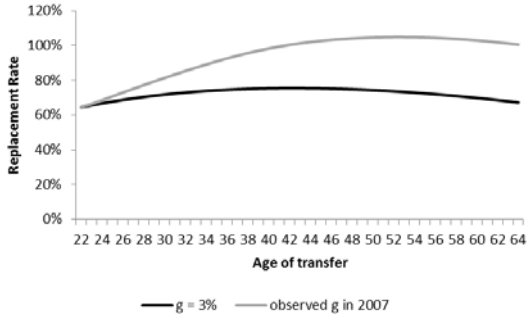
We also analyze the sensibility of the results to changes in the wages profiles. With data from the Federal Administration of Public Revenues (*Administración Federal de Ingresos Públicos* -AFIP), we considered the average taxable wages registered in 2007 for men and women by age separately (see Figure A1 of Appendix 2). With the observed growth rates of both salary profiles, we project the working history of the representative worker.

Figure 3. Optimal results when g changes

Panel A: Men



Panel B: Women



In both cases, the optimal age for transferring increases comparing with the baseline scenario. The explanation for this result is that wages increase more than 3% during the first years of the working life. The accumulation of the funds in the capitalization account is much higher during the first years of contributions, which encourages contributing to the private pension system for a longer period of time. As can be observed, the results suggest that for those men who were aged 53 or more at the moment of the implementation of Law No. 26,222, switching to the PAYG system was the optimal decision since the replacement rate of switching exceeds that of not switching. In the case of women, migrating from the AFJP scheme was the optimal decision if the agents were more than 42 years old. More precisely, taking into account that workers can migrate to the other pension scheme every five years, migrating is an optimal decision for men older than 50 and for women older than 40 since the replacement rates of switching at those ages at time *t* are higher than the replacement rates in *t+5*. These results are more in line with the observed profiles of Table 4, especially in the case of women.

Finally, we conduct a sensitive analysis changing the assumption of the contribution density. We use data from AFIP of the mean effective contributions of salaried workers over the period 2003-2006. The database does not follow the same individual in the period; however we consider it a valid approximation given the scarcity of information. The information is based on the sworn statements (*Declaración Jurada*) of employers that are required before depositing the social security contributions of employees. For each age (from 22 years old to the age of retire), we calculate de density of contribution of men and women separately as the ratio of the

count of effective to potential months of contributions to the social security system. For the period observed, the average density is 55%. This result is line with other investigations that uses an older labor histories database that was built by the Direction of Social Security Policies of the Ministry of Labor and Social Security of Argentina which includes information of the affiliates between July 1994 to December 2001 (see, for example, Bertranou and Sánchez 2003; De Biase and Grushka 2003; DNPSS 2003; Forteza et al. 2011). Figure A2 of Appendix 2 shows the contribution densities by age for men and women separately. As in DNPSS (2003) the contribution densities of woman are lower than that of men during the first years, the frequency of contribution of the women increases as age increases until they exceed the densities of men. We find that, for those male workers younger than 48 years old at time *t*, remaining in the AFJP system is the option that maximizes the future pension. In the case of women, the best option is to transfer to the PAYG regimen at the beginning of their working careers. This result is the same as in the baseline scenario.

Finally, Table 5 summarizes the optimal ages and replacement rates assuming the observed contribution density *d*, the observed wage growth rate *g* and, *d* and *g* simultaneously.

Table 5. Optimal results when d and g change

	Observed d		***Observed g***		***Observed d + observed g***	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
Optimal age (max. pension)	50	22	53	43	54	45
Replacement Rate	78.8%	63.2%	104.9%	69.2%	103.0%	70.1%

As can be seen in Table 5, when we include in the simulation the observed contribution density and the observed salary growth rate, the quantitative value of the optimal ages are more in line with the results in Table 1. To be precise, taking into account that workers can migrate to the other pension scheme every five years, migrating is an optimal decision for men and women 2 years old younger than the optimal ages reported in Table 5 since the replacement rates of switching at those ages at time *t* are higher than the replacement rates in *t+5*. In sum, focusing on the age of migration, this exercise suggests that the decisions taken by the affiliates are broadly in line with those of an agent who seeks to obtain the highest pension at retirement. Across

the changes in the parameters, the optimal results differ in levels but they are robust in qualitative terms.

IV. Conclusions

The approval of Law No. 26,222 in March 2007 by the government of Argentina, allowed those workers who were contributing to the private pension system to migrate to the PAYG pension scheme within the year 2007. Using unpublished data from ANSES, the first part of this article presents the first (and only) analysis of the profiles of those affiliates to the AFJPs regime who switched to the public system.

The transfer profiles indicate that both women and married members were more likely to transfer. From age 41 until retirement, the relative risk of transfer to the PAYG scheme is higher than one, indicating that these were the groups most likely to migrate from the AFJPs scheme. Regarding labor income, the relative risks indicate that neither the lowest nor the highest income groups were likely to transfer. In the case of the high-income workers, this results could be explained by the fact that the higher the wage, the higher the contributions, the higher the accumulated fund and therefore, the higher the benefits of capitalization. In the case of the lower-income group of workers, more than 40% of the affiliates of this group were younger than 31 years old, and this could explain, at least in part, the lower risk to transfer.

As regards occupational group, there is no difference in the risk of transfer for self-employed and salaried workers. Regarding the region of residence of the affiliate, we could not distinguish any clear pattern concerning the likelihood of transfer.

Since we find that the age is the variable that presents the stronger statistically significant relationship with the transfer variable, in the second part of this article we perform a simulation exercise to find out the optimal age for transferring to the PAYG pension scheme. We assume a labor history for a representative worker and then we obtain the value of the pension according to the age he decides to switch. The optimal age for transferring is the one that leads to the higher pension at retirement. In the baseline scenario, we find that a male worker who decides to transfer to the PAYG scheme at age 42 will obtain a future pension that represents 75% of the reference salary used in the calculation of the PAP. Meanwhile, a woman who transfers at age 35 will receive a pension that represents 65% of the reference salary.

Besides, once the worker knows his pension path at each age, at time *t* (when the possibility to migrate between systems is allowed), he compares the pension he would receive if during *t* he chooses to switch to the PAYG system versus the pension he would receive in *t+5* (which is the time when he will be allowed to migrate to the public system again). So, migrating from the private system is the optimal decision for female workers older than 32 years old and for male workers older than 39 years old since the replacement rates of switching at those ages at time *t* are higher than the replacement rates in *t+5*. To check the robustness of these results, we also perform a sensitivity analysis varying the profitability of the funds *r*, the wages growth rate and the contribution density.

As expected, we find that the higher the profitability of the fund (CCI), the optimal age for switching increases for both types of workers. When we change the wage growth rate profile, we find that the optimal age for switching increases for men and women. The explanation for this result is that wages increase more than 3% during the first years of the working life. Finally, when we consider in the simulation the observed contribution density and the observed salary growth rate, the cut-off ages are more in line with the observed profiles.

In sum, focusing on the age of migration, this exercise suggests that the decisions taken by the affiliates are broadly in line with those of an agent who seeks to obtain the highest pension at retirement. One limitation of this experiment is that it assumes that the workers decide the optimal timing in their working life to transfer from the capitalization scheme to the PAYG system, but once they are contributing to the public scheme, they remain in that regime. In this sense, future research could simulate the possibility of migrating between both systems every five years in order to analyze not only if migrating from one pension system to the other more than once during the working careers leads to higher pensions, but also which are the optimal ages for switching.

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Appendix 1: Tables

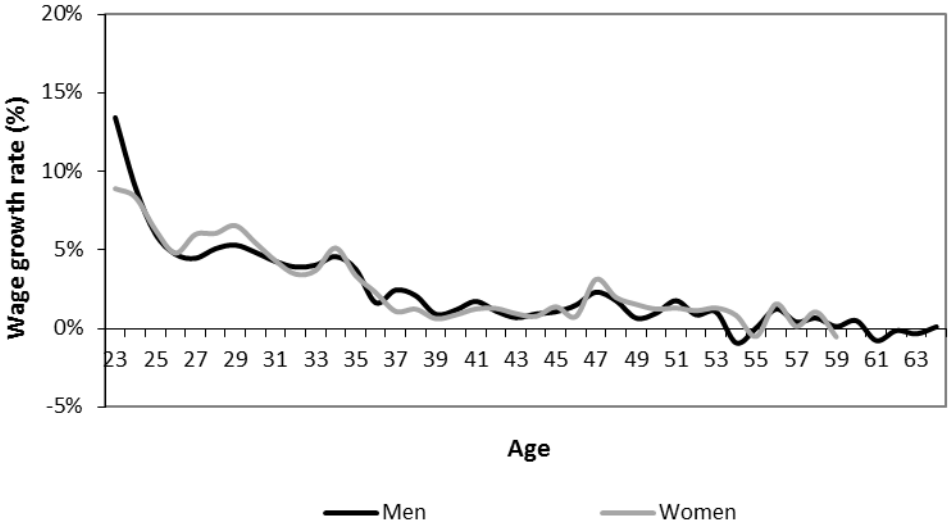
Table A1. Correlation matrix

	transfer *	age	male *	single *	married*	widower/ widow *	separated *	labor income	contributions	dependent worker *
transfer *	1									
age	0.2123	1								
male *	-0.0592	0.0562	1							
single *	-0.1098	-0.4301	-0.1036	1						
married*	0.111	0.3976	0.1068	-0.8866	1					
widower/ widow *	0.0189	0.1297	-0.0532	-0.0776	-0.0923	1				
separated *	-0.0128	0.0112	0.0118	-0.2015	-0.2396	-0.021	1			
labor income	0.0647	0.286	0.0908	-0.2054	0.2129	0.013	-0.0268	1		
contributions	0.1863	0.3111	0.0502	-0.2673	0.2697	0.0222	-0.0205	0.4086	1	
dependent worker *	0.0014	-0.1248	-0.0068	0.0597	-0.0633	-0.0183	0.017	0.1244	0.0325	1

Note: (*) indicates that the variable is dichotomous. All the correlations present a p-value=0.000.

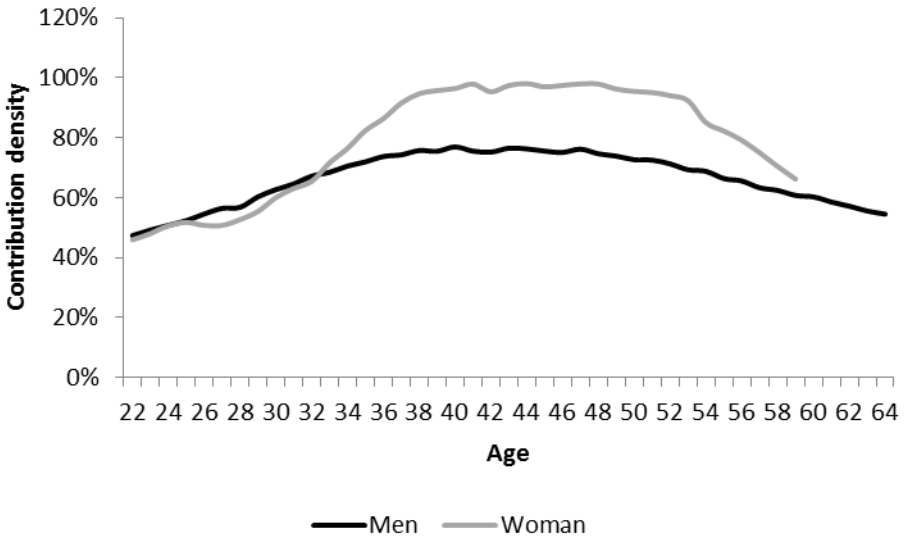
Appendix 2: Figures

Figure A1. Wage growth rates by age and gender, observed average 2007



Source: Own elaboration based on AFIP data.

Figure A2. Contribution density by gender, observed average 2003-2006



Source: Own elaboration based on AFIP data