

Social security schemes and labor supply in formal and informal sector

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Abstract

This paper analyzes how changes in the retirement system affect the participation path of workers between the formal and the informal sector. The choice between the formal and informal sector is completely voluntary. In this framework, individuals, depending on the retirement program and their endowment of human capital, construct their decision paths in the labor market. I use Argentinean panel data in the period 1995-2010 to estimate a structural model, and this is used to evaluate changes in the worker's behavior when the pension scheme changes. Among the main results, if the substitution rate of the full pension is reduced from 80% to 70%, there is a slight reduction in the years of the formality and the percentage of workers who achieve a full pension. Moreover, the increase to 35 minimum years in the formality to achieve a full pension, rises the number of the years in the formality but it decreases the achievement of the a pension at all education levels. Finally, the increase in the minimum age to achieve the pension leads to an augmentation in the years in the formality, 93% of those individuals who have not completed the school reach a full pension (30 points more than in the benchmark).

JEL codes: E26, J24, J26, O17.

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1 Introduction

Informality defined as the lack of social security contributions is one of the main characteristics of the labor markets in developing countries. This feature has not only an impact on the current situation of the workers, but it also affects access to the pension system for the elderly. This paper discusses **the impact of retirement scheme changes in the labor path between informality and formality. I will explore the changes in the main variables of the current system, that is: i) number of years of contributing to the system; and ii) the minimum age which are required to obtain a pension.** Furthermore, this work handle the reform of the pension system, from a mixed system where coexist two pillars: a pay-as-you-go (PAYG) system and an individual capitalization system to a new system with only one of those pillars. In order to resume the different systems I take into consideration the rate of replacement and the different types of pensions (full, aging or survival).

Over the last few decades, in many developing countries there have been implemented several reforms in the pension scheme aiming to cover the increasing deficit of the public budget triggered by the advance of demographic transition. In South America, in 1975, there were 12.8 working age people (15-64) per each old individual (65 or more); this number fall to 11.4 in 2000 and the estimation for the few next years is a important fall, estimating 6.7 for 2025 and 3.7 for 2050 (?). This pattern is provoked not only by the rise in the life expectancy and survival rates, but also by the fall in the birth rates.

Argentina is a particular and interesting case because, on the one hand, it is in an advanced stage of demographic transition reaching levels as developed

countries¹ and, on the other, it has been the scenario of several reforms in the last 20 years. The reform which was established in 1993, transforming a public PAYG with persistent and increasing deficits into a mixed system (PAYG and individual capitalization) in the retirement program in which coexist private and public institutions. This reform was triggered by the need to make the system sustainable. This reform and its consequences were studied in depth by the academia and discussed in the political environments during the last decade, and finally it was reformed in December 2008 to return only to a publicly funded PAYG system. Despite this reform, the requirements to access to a pension are still relatively strict in comparison with the region.

The Argentinean program punishes severely specially short contribution careers in comparison with other countries of the region (?). Conversely, the program also has a wide promotion of extraordinary programs to access to the specials pensions, for those who have not enough years to have the right either to the full or the aging pension. Additionally, there has also been an increment of the level in the minimal pension in the last few years (?). These changes have led to the idea that the pension system is an essential factor in the formality path, because the workers can believe that even if they are in the informality the government commitment to maintain some requirement to access a pension can be relaxed (?).

? poses in the effect specifically of some social transfers as non-contributory pension in the great mobility between the formality and the informality. Latin America is one of the regions where the informality has been studied deeply. There are about 50% of salaried workers which are employed in the informality,

¹As is shown in the Figure ??, Argentina present a advance stage of the demographic transition even in the middle of the past century, and in the projection for 2015 is much closer to the high income countries.

defining the informal workers as those who are not covered by labor regulation, such as taxes, right to health system and right to pension income in the retirement age (? and ?). In this research informal workers are identified as those who declare that their employer is not paying the necessary contribution to have the right to a pension in old age.

It is relevant to analyze the nature of the informality, it was extendedly in the past the assumption of the existence of two segmented markets, which have different rules where there are a low and a high productivity sector. This concept have been discussed by the empirical literature using data of Mexico, Colombia, Argentina and Uruguay ², where the empirical evidence goes towards the idea that the workers decide where to be. The workers' individual decision to be in each sector given their characteristics, and this idea it is a fundamental pillar in this paper

1.1 Some facts from the data.

The informality is present in all the countries of the regions with different degrees depending on the level of development. In the Table ?? it is shown the level of informality in six countries of Latin America using the lack of contribution as definition. We can distinguish three groups: Argentina is in the middle one with more than 35% of the salaried workers in the informality. However, this problem it is also present in the most advanced country of the region: Chile³. In the middle and higher group of countries the percentage of women is higher than men, but it is not observable in the lower one. These differences are due to general development level of the countries, those which are the richest of the region show a better performance than the poorest one. However, the difference

²?, ?, ? and ?

³Chile leads almost all the rankings about economic performance and economic development in Latin America.

Marginal effects 1995-2008			
	Unemployed	Formal	Informal
Unemployed(-1)	0.0773*** (0.0016)	0.0498*** (0.0031)	-0.1270*** (0.0029)
Formal (-1)	-0.0254*** (0.0015)	0.3324*** (0.0011)	-0.3070*** (0.0015)
Age	0.0011*** (0.0001)	0.0013*** (0.0001)	-0.0024*** (0.0001)
Education	-0.0026*** (0.0005)	0.0367*** (0.0007)	-0.0341*** (0.0008)
Married	-0.0122*** (0.0038)	0.0223*** (0.0047)	-0.0101* (0.0052)
Single	0.0255*** (0.0040)	-0.0257*** (0.0051)	0.0001 (0.0056)
Head	-0.0254*** (0.0021)	0.0447*** (0.0026)	-0.0193*** (0.0029)
Tenure	-0.0329*** (0.0005)	0.0515*** (0.0007)	-0.0186*** (0.0008)

Standard Errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 1: Marginal effects based in the multinomial model. (only men)

among the first group could be partially explained by institutional development.

In the Table 1 we can observe the marginal effects of the multinomial logit performed with data between 1995 and 2008, the age, the education and the tenure have a positive effect in the formality and a negative in the informality. Being married and being the head of the household has a positive effect of being formal and negative of being informal, meanwhile being single has negative effect in both sectors.

The distribution by education is clear, the prediction based in the multinomial logit shows that the formality is increasing and the informality and the unemployment is decreasing by education level, as is shown in the Table 2. The probability of being unemployed in the lower level of education (primary school incomplete) is the double of the highest one (college complete). The probability of being formal is two times bigger and the probability of being informal is four

Distribution in each sector 1995-2008			
Education	Unemployed	Formal	Informal
School incomplete	0.1468	0.3696	0.4836
School complete	0.1264	0.4668	0.4068
High School incomplete	0.1288	0.4830	0.3882
High School complete	0.0981	0.6322	0.2697
College incomplete	0.0943	0.6644	0.2413
College complete	0.0687	0.8023	0.1290
Age group	Unemployed	Formal	Informal
18-24	0.1897	0.3470	0.4633
25-34	0.1028	0.5745	0.3228
35-44	0.0698	0.6976	0.2325
45-54	0.0699	0.7227	0.2074
55-65	0.0816	0.7171	0.2012
Marriage status	Unemployed	Formal	Informal
Married	0.0689	0.6834	0.2477
Divorce-widow	0.0896	0.6452	0.2652
Single	0.1656	0.4517	0.3828
Total	0.1056	0.5965	0.2980

Table 2: Distribution in each sector by education, age group and marriage status based in the multinomial model. (only men)

times lower. It is remarkable the change in the probabilities when the workers achieve the college degree when the probability of being unemployed decrease in more of 3 points, the probability of being formal increase in almost 15 points and the to be informal decrease in more of 12 points.

The probabilities for age groups show that the unemployed is decreasing until the fifties and then it increase, the formality has a opposite behavior increasing and then a slightly decrease. Meanwhile, in the case of informality is decreasing. The distribution of marriage status, the single ones have more probability of being unemployed or being informality.

The distribution of the wages are shown in Figure ?? in the kernel simulations by education level. The mean of the wages are always higher in the formality in the different levels. However, the informal wages are definitely more volatile (higher standard deviations) than the formal ones, especially in the higher levels

of education.

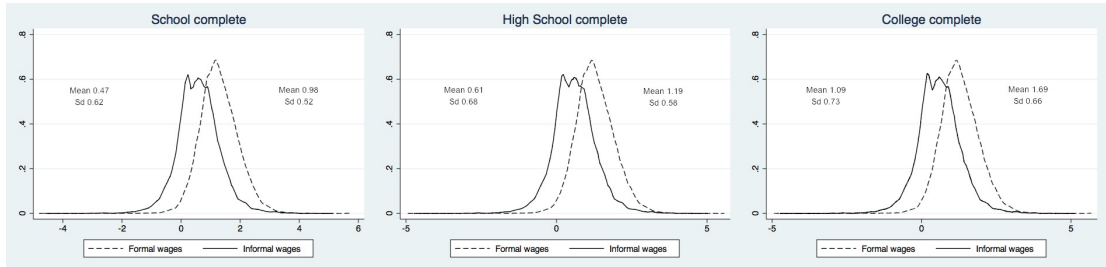
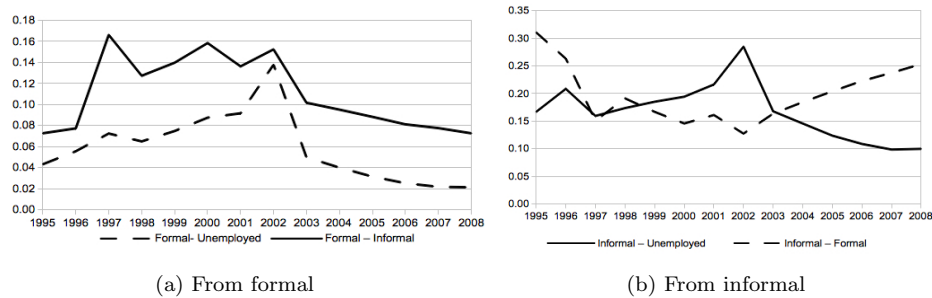


Figure 1: Distribution of the wages 1995-2008 by education level



(a) From formal

(b) From informal

Figure 2: Transition from formality (informality) to the other states

In the Figure ?? and Figure ?? are shown the transitions yearly from the formality (first panel), and the informality (second panel) are shown in the Figure ???. The formality is the sector where the workers stay more, but those who change goes more to other job in the informality rather than to the unemployment. In the second panel, there are 30% of the informal workers who annually change of sector; in 2003 there are equal percentage who goes to the formality and to be unemployed and in the latest years the major percentage who change to the formality (rather than the unemployment).

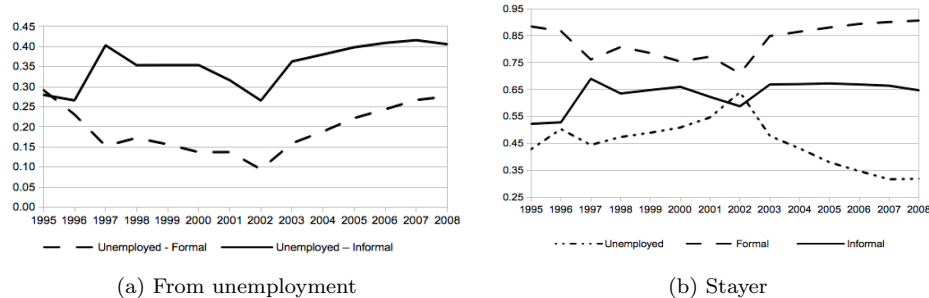


Figure 3: Transition from unemployment to the other states and those who remain in the same state

In the Figure ??, it is shown the the transition form the unemployment and those workers who do not change from the sector who were working the year before. The unemployed workers tend to change more to the informality than the formality, it is easier for the unemployed enter in the labor market through the informal sector ⁴.

Additionally, these transitions are also studied through the multinomial model which it was presented before. The Table 3 shows the probability of transitions of the active salaried workers. In the first block, in all the elements of the principal diagonal, there are the individuals who do not switch annually⁵. The rows in the table are the original sector where the workers have been in the last year ($t - 1$), and the columns are the final sector (t). Is important to note that the formality is 20 points more stable than the informality, and about 36% of the unemployed remain in this condition in two consecutive years. At the same time that the informal sector appear more unstable than the formality is easier to enter form the unemployment (40% instead to 23%), which give it

⁴This feature it is also observe if smaller period are consider such as, changes quarterly or biannual

⁵In the whole period 1995-2008

some attractiveness to this sector. Additionally, for the informality gives some experience to the worker to enter afterwards to the formality.

These changes can be analyzed also by the education level, in the second, third and fourth block there are the transition to the unemployment, the formality and the informality respectively. The stayers in the unemployment are quite similar to all the educative levels; in the case of the formal workers the percentage are quite low, but anyways the more educative workers have almost three times low probability of loss the job. In the case of the more educated informal workers, they can loss their job with two point more of probability than the less educated ones.

In the third block of the Table 3 shows the formality is remarkable more stable in the more educated individuals (10 point higher), and the educated workers who were in the informality can change to the formality with much more probability than the less ones (21 points more). Similar consideration can be done for the unemployed workers. In the fourth block, can be observed the transitions to the informality. The informality is more stable in the lower educative levels (almost 25 points of difference between the higher and the lower one). The less educated workers present also more probability when they used to be in the unemployment (49% and 29% the lower and the higher educative levels) and the formality (12% and 3% the lower and the higher educative levels).

The share of elderly men who achieve some pension payment is shown in the table 4. In the data in 2001, most of men achieve some pension payment after 75 years old. However, this data is only a photo in 2001, if we analyze the work histories (?) in the pre 2008 pension scheme Argentina the simulation shows that only 40% of men would reach at least 30 years of contributions.

Probability of being in each sector			
	Unemployed	Formal	Informal
Unemployed (-1)	0.3909	0.2276	0.3815
Formal (-1)	0.0349	0.8765	0.0886
Informal (-1)	0.1318	0.2117	0.6564
Probability of being unemployed by education and sector of precedence			
Education	Unemployed (-1)	Formal (-1)	Informal (-1)
School incomplete	0.4151	0.0731	0.1314
School complete	0.4010	0.0494	0.1272
High School incomplete	0.3978	0.0466	0.1290
High School complete	0.3783	0.0319	0.1287
College incomplete	0.3609	0.0300	0.1262
College	0.4063	0.0208	0.1666
Probability of being formal by education and sector of precedence			
Education	Unemployed (-1)	Formal (-1)	Informal (-1)
School incomplete	0.1489	0.7560	0.1396
School complete	0.1783	0.8171	0.1687
High School incomplete	0.1911	0.8341	0.1859
High School complete	0.2432	0.8811	0.2392
College incomplete	0.2913	0.8973	0.2825
College	0.3193	0.9331	0.3202
Probability of being informal by education and sector of precedence			
Education	Unemployed (-1)	Formal (-1)	Informal (-1)
School incomplete	0.4360	0.1708	0.7289
School complete	0.4207	0.1335	0.7041
High School incomplete	0.4111	0.1192	0.6851
High School complete	0.3785	0.0870	0.6321
College incomplete	0.3478	0.0726	0.5913
College	0.2743	0.0460	0.5133

Table 3: Probabilities of being in each sector, based in the multinomial model 1995-2008. (only men)

	65-69	70-74	75+
Contributive	64.18	81.8	84.52
Full pension	60.06	75.99	75.37
Advanced age	3.31	4.95	8.16
Non contributive pension	1.31	2.35	3.87

Table 4: Coverage of the pension system (only men). Source: Bertranou et. al.(2001)

1.2 Reviewing the literature

In the tradition of discrete choice models, ? developed a seminal model which provided an estimation of the decision between home production, schooling, and occupational choice. Following this modeling, ? develop and estimate a model of labor supply and consumption in low income households with individuals in their fifties. In this model, the individual decides whether to work full or part time or not at all, subject to the social security rules, limited borrowing, bequests, uncertain health and death. They analyze single and married individuals separately, and find a lower response among married individuals when social security benefits are reduced by 25%, a reduction in labor supply for individuals below 62 and an increase of total hours for the individual over this age.

Furthermore, ? estimate a retirement dynamic model which includes the decision of savings and medical expenses, with special attention paid to the different systems of medical expenses and the role of health insurance. They point out in the relevance of Medicare eligibility in the labor decisions of the individuals older than 60 years.

In two recent papers, ? and ? assess the behavior of individuals among the covered and uncovered sector for Chile, changing the rules of the pension system. Theoretically, the main differences with both works is the definition of informal workers that they are using. They consider as covered (formal) workers those who have a contract, while the uncovered are those who have not a contract and self employed workers. Additionally, ? estimate the model only with men and ? work with couples as a decision unit and he allows for savings in the model.

In respect to this last two papers, I consider the pension system as a general provision system and not only as a saving system, as in these two researches.

This allows me to manage different pension schemes and compare them. From an empirical point of view, they are using data for Chile where the rate of uncovered workers is significantly lower than in Argentina. Furthermore, the recent reform in Argentina is a interesting point to study.

Additionally, ? estimates an intertemporal utility maximization model for Brazil using a pseudo-panel. The individual decides where to work and savings given a set of social policies. This research has many shortcomings, the main one being the estimation using pseudo-panel that triggers higher measurement errors. Finally, they do not take into account data about wages nor do they model the longitudinal transition of the workers.

This paper is structured as follows. Section 2 provides the main features of the Argentinean pension system, Section 3 present the structural model. Section 4 provides the data which is used in the estimation. Section 5 presents the main results of the estimation and the policy experiments. Finally, the Section 6 there are the main conclusions.

2 The Argentinean background: pension system and savings

In Argentina, the pension system has changed drastically twice in the last twenty years. The system changed first in 1994, and was established a multipillar system based on a PAYG and individual capitalization. The first pillar was a PAYG scheme, which was financed with employer's contribution (16% of gross taxable income), and the workers would obtain an Universal Pension Benefit (UPB) with 30 years of contribution and at 60 or 65 years old depending on gender. It is an monthly flat amount which is about the 28% of the average

wage.

The second pillar was financed by employee contributions (11% of gross taxable income). This contribution financed the PAYG or individual capitalization scheme. In this scheme participated private and public institutions (?). There are also employer and employee contributions for different funds to finance redistribution programs and the health system.

In December 2008 as a consequence of the global financial crisis, the scheme changed again return to a single public pillar with a PAYG scheme. The pension is composed by the UPB and Compensatory Pension (CP), which is included to compensate the elimination of individual capitalization. This system is financed by current contributions and general taxes. The employee and employer contributions do not change, only changes the administrator of the resources. In the model estimation, I will consider the period 1995-2008 in order to capture the first scheme and the period 2008-2011 as the out of sample validation.

The severe financial crisis that Argentina suffered in 2001 impact deeply in the saving decisions, because many banks closes and the savers lost much of their money. Moreover, in the last two years many obstacles have carried out to the private access to the foreign money. However, a pension system is related with the saving decision for the elderly, based in the events of the last decade I decide not to take into account the saving decision in the model.

3 Model

The model describe the decision problem of the individual in different periods after they leave the education system. In each period the individuals choose between either be working in the formal or informal sector or remain

unemployed. The individuals have an endowment of human capital which was acquired in the past and depends on the years of schooling. For instance, I assume that young individual leaves the education system with a certain level of formal education between incomplete elementary school and university degree. They face a finite horizon decisions and choose among the different options that they can in the seminal paper of ?.

The state space is the time, the experience in the labor market, the number of years in the formality, the sector where the individual has worked in the last period, and the shock in the wages.

$$\Omega(t) = \left[a, E, X, a_F, \mathbf{I}_k^{t-1}, \epsilon(a)^k \right] \quad (1)$$

$$\ln(R^j(a)) = \alpha_0^j + \alpha_1^j E + \alpha_2^j X + \alpha_3^j \left(\frac{X}{10} \right)^2 + \epsilon(a)^j \quad (2)$$

$j = \{\text{Formal (F), informal (I)}\}$

$$R^u(a) = \begin{cases} b_1 \mathbf{E}[R^F(a-1)] + B_4(a) + \epsilon^u(a) & \text{if } \mathbf{I}_F^{-1} = 1 \quad \text{with } 0 \leq b_1 \leq 1 \\ B_3(a) + B_4(a) + \epsilon^u(a) & \text{otherwise} \end{cases} \quad (3)$$

$B_4(a)$ is a leisure function which is increasing on the age.

The **first stage of analysis** is the pure active life until R_1 , the individual decides taking into account the transition probabilities: $\lambda_f(E)$, is the formal job destroy probability (formality \rightarrow unemployment), $\lambda_i(E)$, is the informal job destroy probability (informality \rightarrow unemployment), $\phi^F(E)$ (unemployment \rightarrow formal) is the probability to find a job in the formal sector, and $\phi^I(E)$ (unemployment \rightarrow informal) is the probability to find a job in the informal

sector. The value function V^j is the value of being employed in the sector j , and V^u is the value of being unemployed.

The value function of working in the formality V^F is the wage in the formal sector, plus the expected discounted value of all the years of the first period (pure active life), plus the value function of the second period. The former term is defined as a Mincer equation, the second one depends on the probability $1 - \lambda_k(E)$ of being employed and the future realization of the wages. Then, if in the last year of the former period, the individual is employed, he face similar decision choices but among the values of the second period (between R_1 and R_2). Conversely, if in R_1 the individual is unemployed, they decide depending on the probability of find an offer in both sectors and the realization of the wages. Note that in this case, the current income of continue being unemployed is a survival income.

$$V(\Omega(t)) = \max\{V^F, V^I, V^u\} \quad (4)$$

The value function of being working is compose with the utility of the rewards and the cost of switch sector $\varphi^{-k}(a, E)$:

$$\begin{aligned} V^k(\Omega(a)) &= U\left(R^k(a) - (\varphi^{-k}(a, E))\mathbf{I}^{-k}\right) \\ &+ \beta \left[\lambda_k(E)\mathbf{E}_{\Omega(a+1)/\Omega(a)}V^u(\Omega(a+1)) \right. \\ &\left. + (1 - \lambda_k(E))\mathbf{E}_{\Omega(a+1)/\Omega(a)}\max\left\{V^I(\Omega(a+1)), V^F(\Omega(a+1))\right\} \right] \\ &(\epsilon(a)^I, \epsilon(a)^F, \epsilon^u(a)) \sim N(0, \sigma^k(a)) \end{aligned} \quad (5)$$

$k = \{\text{Formal (F), Informal (I)}\}$

$$\mathbf{I}^{-k} = \begin{cases} 1 & \text{if the individual worked in the sector } -k \text{ in the previous period} \\ 0 & \text{otherwise} \end{cases} \quad (6)$$

The utility function takes a general form CRRA such as:

$$U\left(R^k(a)\right) = \frac{1}{1-\gamma} R^k(a)^{\frac{1}{1-\gamma}} \quad (7)$$

The value function for the unemployed worker is:

$$\begin{aligned} V^u\left(\Omega(a)\right) &= U\left(R^u(a)\right) \\ &+ \beta \left[\left(1 - \phi_F(E) - \phi_I(E)\right) \mathbf{E}_{\Omega(a+1)/\Omega(a)} V^u\left(\Omega(a+1)\right) \right. \\ &+ \phi_F(E) \mathbf{E}_{\Omega(a+1)/\Omega(a)} \max\left\{V^u\left(\Omega(a+1)\right), V^F\left(\Omega(a+1)\right)\right\} \\ &\left. + \phi_I(E) \mathbf{E}_{\Omega(a+1)/\Omega(a)} \max\left\{V^u\left(\Omega(a+1)\right), V^I\left(\Omega(a+1)\right)\right\} \right] \quad (8) \end{aligned}$$

The **second stage of analysis** is between R_1 and R_2 , when at this age everyone is retired. In this period the individuals can choose working in both sectors under some restrictions. The individuals who reach the minimum years in the formality (F_1) to get a full pension, they would retire and enjoy B_4 as pensioner's leisure which is increasing with the age after the sixties. Otherwise, the pension could be achievable in this period when a_F (years in the formality) reach the threshold F_1 . The value function with the subscript 2 are evaluated at age R_1 and reflex the value of the second stage of the analysis.

$$\begin{aligned}
V\left(\Omega(a)\right) &= \left[U\left(r_{30}R^k(a) + B_4(a)\right) + \beta \mathbf{E}_{\Omega(a+1)/\Omega(a)} V\left(\Omega(a+1)\right) \right] \mathbf{I}_{a_F \geq 30} \\
&\quad + \left[\max\left\{ V^u\left(\Omega(a)\right), V^I\left(\Omega(a)\right), V^F\left(\Omega(a)\right) \right\} \right] \mathbf{I}_{a_F < 30}
\end{aligned} \tag{9}$$

The individuals who reach the full pension are:

$$\mathbf{I}_{a_F \geq 30} = \begin{cases} 1 & \text{if the individual worked in the formality 30 years or more} \\ 0 & \text{otherwise} \end{cases} \tag{10}$$

The **third stage of analysis** starts at R_2 years old, and all the individuals are retired. The value function of these pensioners is determined by the income that the individual would receive and, the number of years in the formality (F_1 and F_2). It is determined by the replacement rate and the last wage receiving in the last active life. There would be three types of pensions: the full, the aging and the survival pension.

$$\begin{aligned}
V\left(\Omega(a)\right) &= U\left(r_{30}R^k(a) + B_4(a)\right) \mathbf{I}_{a_F \geq 30} + U\left(r_{10}R^k(a) + B_4(a)\right) \mathbf{I}_{30 > a_F \geq 10} \\
&\quad + U\left(b_3 + B_4(a)\right) \mathbf{I}_{a_F < 10} + \beta \mathbf{E}_{\Omega(a+1)/\Omega(a)} V\left(\Omega(a+1)\right)
\end{aligned} \tag{11}$$

The individuals who reach the aging pension are:

$$\mathbf{I}_{30 > a_F \geq 10} = \begin{cases} 1 & \text{if they worked in the formality 10 years or more and less than 30} \\ 0 & \text{otherwise} \end{cases} \tag{12}$$

4 Data

I use the Permanent Household Survey (EPH in Spanish) carried by the National Institute of Statistics and Census (INDEC in Spanish) for the period 1995 and 2011. The sample is restricted to the urban regions, covering 28 large urban centers where live 70% of the 90% of the Argentinean population.

Between 1995 and 2002 the survey was semestral, in 2003 it become quarterly. In the first period, the panel is rotative losing each period the 25% of the cases. In the second period, the rotation has the following characteristics: i) two consecutive quarters share 50% of the cases, ii) two quarters with one quarter in the middle, have not any case in common, and iii) two quarters with two quarters in the middle, share 25% of cases. Any quarter shares the 25% of the cases with the same one in consecutive years. In the whole period it is possible follow some individuals for one year and half.

This survey has socioeconomic purpose and it is crucial to identify workers in different sector of the economy. The identification of the formal workers is directly assessed asking if the employer pays the social contribution to have the right to access a pension payment in the elderly. Unluckily, the questionnaire does not ask anything about the contribution of the self employers. This is the main shortcoming of this survey, then this research would analyze only the dynamic of the salaried workers. This feature allows me to analyze the pure transitions form job to job without taking into consideration the self-employment as possible escape from the unemployment.

Parameters			
Name	Symbol	Value	Standard deviation
Discount factor	β	0.98	
IES	γ	0.0	
Rate of substitution (full)	r_{30}	0.7	
Rate of substitution (partial)	r_{10}	0.3	
% formal salary (unemployment)	b_1	0.85	
Survival income (unemployment)	b_2	0.4	
Survival income (passive)	b_3	0.1	
Leisure (pension age)	b_4	0.2	
Cost of find a formal	φ^I	0.2	
Cost of find an informal	φ^F	0.15	
Coefficients estimated from the Mincer equations			
Constant formal	α_0^f	0.2337	(0.0159)
Constant informal	α_0^i	0.4117	(0.0213)
Schooling formal	α_1^f	0.1694	(0.001)
Schooling informal	α_1^i	0.1086	(0.0018)
Experience formal	α_2^f	0.0313	(0.0005)
Experience informal	α_2^i	0.0133	(0.0068)
Experience ² formal	α_3^f	-0.0046	(0.00017)
Experience ² informal	α_3^i	-0.0015	(0.00016)

Table 5: Parameters

5 Simulation

5.1 Benchmark

I simulate the model with the parameters shown in the Table 5. In the first and in the third block, there are the parameters which define the model and some of those would be estimated. In the second block, there are the parameters which are estimated with the Mincer equations and characterize the wages in the formal and in the informal sector.

Pension scheme: 60 -70 ($R_1 - R_2$); 30-10 (F_1-F_2); 0.8 - 0.2 (rate of replacement).				
	Full pension	Age pension	Survival Pension	Years formality
School Inc.	0.558 - 0.636	0.292 - 0.224	0.15 - 0.14	26.522 + 1.186
School Comp.	0.934 - 0.97	0.058 - 0.024	0.008 - 0.006	34.694 + 0.204
H School Inc.	1	0	0	36.894
H School Comp.	1	0	0	36.986
College Inc.	1	0	0	37.07
College Comp.	1	0	0	37.11

Table 6: Simulation: benchmark

The benchmark is simulated with 60 years old as the minimum age to get the full pension and 70 years old is the age to get the aging pension and the parameters shown in the Table 5 . To achieve the full pension the workers have to work 30 years in the formality and 10 years to get the aging pension. The rates of replacement are 80% and 20% in both pensions. In this situation, we can observe the Table 6 that only 56% and 64% workers with incomplete school reach the full pension at 60 and 70 years old respectively. Additionally, 14% of these workers reach only a survival pension at 70 years old. almost all the workers with more education reach the full pension at 60 years old, only the 6% workers with elementary school have to work after the sixties to achieve the minimum requirements.

In the Figure 4 is shown the simulation where the dash line is the simulated shares and the straight line is the data ones. The trend is correctly approximated, although the formal is overestimated in almost 20 points and the informality and the unemployment are underestimated. This result could be triggered for example by the parameters used or by the non introduction of fictions in the labor market.

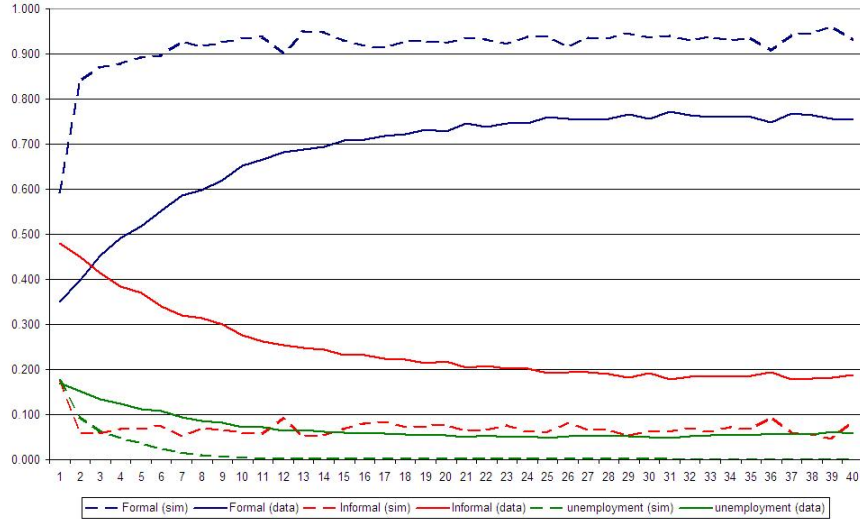


Figure 4: Simulation

Pension scheme: 60 -70 ($R_1 - R_2$); 30-10 (F_1-F_2); 0.7 - 0.2 (rate of replacement).				
	Full pension	Age pension	Survival Pension	Years formality
School Inc.	0.544 - 0.592	0.308 - 0.274	0.148 - 0.134	26.13 + 1.196
School Comp.	0.926 - 0.966	0.066 - 0.028	0.008 - 0.006	34.532 + 0.248
H School Inc.	0.998 - 0.998	0.002 - 0.002	0	36.806
H School Comp.	1	0	0	36.904
College Inc.	1	0	0	36.996
College Comp.	1	0	0	37.03

Table 7: Policy experiment: rate of replacement 0.7

5.2 Policy Experiments

The first policy experiment is to reduce the rate of replacement that the workers would get with the full pension in 10 points. There are not a considerable change in the results that are shown in the Table 7 in the percentages of workers who get the different pensions and there are a slightly fall in the average years in the formality.

Pension scheme: 60 -70 ($R_1 - R_2$); 35-10 (F_1-F_2); 0.8 - 0.2 (rate of replacement).				
	Full pension	Age pension	Survival Pension	Years formality
School Inc.	0.446 + 0.598	0.454 + 0.308	0.1 + 0.094	28.514 + 1.722
School Comp.	0.662 + 0.908	0.334 + 0.088	0.004 + 0.004	35.112 + 1.362
H School Inc.	0.906 + 0.992	0.094 + 0.008	0	36.872 + 0.51
H School Comp.	0.92 + 1.00	0.08 + 0.0	0	36.942 + 0.478
College Inc.	0.942 + 1.00	0.058 + 0.0	0	37.032 + 0.344
College Comp.	0.944 + 1.00	0.056 + 0.0	0	37.074 + 0.33

Table 8: Increment years of formality for the full pension

Pension scheme: 65 -70 ($R_1 - R_2$); 30-10 (F_1-F_2); 0.8 - 0.2 (rate of replacement).				
	Full pension	Age pension	Survival Pension	Years formality
School Inc.	0.928 + 0.932	0.038 + 0.034	0.034 + 0.034	38.208 + 0.104
School Comp.	1	0	0	39.932
H School Inc.	1	0	0	41.688
H School Comp.	1	0	0	41.754
College Inc.	1	0	0	41.8
College Comp.	1	0	0	43.148

Table 9: Increment years of minimum age to get the pension

The second policy experiment is the increment of the minimum years in the formality to achieve the full pension, the Table 8 shows these results. In this case, there are an increment of workers of all education levels who work after the 60 years old in order to get the full pension. There are also an increment of individuals getting the aging pension and at the same time a reduction of those who get a survival pension triggered by the rise of years in the formality in the individuals with lower education.

In the Table 9 there are the results of the third policy experiment, where there an increment of the minimal age to get the full pension from 60 to 65 years old. the main result is the rise in the percentage of individuals with low education who get the full pension, and the amazing increment of the years that the individuals work in the formal sector.

6 Estimation of the Model

I estimate the model using the Method of simulated Moments (MSM), minimizing the distance between the estimated moments through the maximization of value function and the moments in the data. I select some moments to match, and estimate the discount factor β , the shape of the utility function γ , the value of the survival income b_2 and b_3 , the leisure parameter b_4 and the cost to switch form one sector to the other φ^I and φ^F .

6.1 Choice of the moments

The list of moments are:

- Labor Decision
 - Proportion of the individuals choosing each sector by age.
 - Proportion of the individuals choosing each sector by education.
- Earnings
 - Mean of log earnings by age.
 - Mean of log earning by education.
 - Standard deviation of log earnings by age.
 - Standard deviation of log earning by education.
- Transitions
 - Transition sector by sector in one period by education.
 - Transition sector by sector in one period by age.

7 Preliminary considerations

In this paper, I simulate a discrete choice model where the workers choose between to work in the formal and in the informal sector depending on the pension scheme. In the preliminary selection of parameters, the trend by age is well simulated but not in the level. The policy experiments show that the decrease of rate of substitution is a bit insensible, the extension of the required years in the formality leads a slight increment in the mean years in the formality, and decreases the share of workers who reach the full pension and, finally the rise of the minimum age provoke an increment of the mean years in the formality.