Is there an endogenous problem of sustainability on the Pay-as-you-go social security system? Using the Chilean experience as an experiment

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Abstract

The paper provides empirical evidence about the effects of the "pay-as-you-go" and the individual account social security systems over family choice variables such as fertility rate, schooling, and time spent on children and it links those effects with the sustainability of the fiscal budget on the "pay-as-you-go" system. The paper uses the 1998 CASEN database from Chile. On the database, the "pay-as-you-go" and the individual account systems coexist for individuals 35 years and older as result of the regulations established by the 1981 social security reform law. The results show that the numbers of children per family and female labor supply are depressed by increases on the "pay-as-you-go" payroll tax rate. Those effects produce an endogenous sustainability problem over the fiscal budget, as the number of individuals paying taxes and the amount of taxes paid by females decrease endogenously over time. The individual account system does not show effect at all over the family decision choice analyzed.

JEL classifications: H55, J13, J2.

1.Introduction

Social security programs are becoming the object of increasing interest between governments and economists. Governments that manage non-funded social security programs face a fiscal problem caused by the change on the age pyramid over time. On the other hand, economists had produced a large research on this topic. However the literature mainly focuses on the impacts on savings or economic growth of the social security system and usually the impacts on the family decision's variables, as fertility or labor supply, are neglected. Those two variables will be the main concern of this paper as they may allow the family to react to the establishment of a non-funded social security system. Negative effects of social security tax over fertility and labor supply produce a sustainability problem over the fiscal budget as the number of individuals paying social security taxes and the amount paid by them decrease over time.

Barro (1974) indicated that social security system should not affect family decision as long as people cannot avoid the social security tax. However, the family could take actions to avoid the tax when the tax is a not a lump sum contribution. In fact, when the tax is a labor tax the family may choose to reduce their labor supply and switch their time endowment to other time intensive activities like bearing children. In this case, impacts over the number of children and the time spent on them may occur.

Auerbach and Kotlikoff (1985) already addressed a similar problem in a general equilibrium model with a "pay-as-you-go" (PAYG) social security system where they show that facing an exogenous baby bust, the payroll tax rate should triplicate in a 70 years period. This case may be significantly aggravated if there exists a negative association between the payroll tax rate and the fertility rate, as this paper will emphasize. Those effects may be important for fiscal policy as they contribute to accelerate the change on the age pyramid. Hence, the negative impact on the family's fertility decision may aggravate the fiscal problem and accelerate the elimination of the "pay-as-you-go" social security system. In this scenario, the "pay-as-you-go" system has an endogenous problem of sustainability.

The paper will provide empirical evidence of the effect of the "pay-as-you-go" system over the family choice variables using a micro dataset from Chile. Later, evidence of the effect of the individual account system, if any, is also provided. This last case is also analyzed as countries facing problem of sustainability on their social security system usually switch to the individual account system. Hence, some effects of this transition over fertility rates and schooling may be provided. However, the main purpose of the paper aims to determine the existence of the endogenous relationship between the PAYG social security system and the age distribution.

The case of Chile seems interesting because Chile had a PAYG social security system since 1925 until 1981 when it introduced an individual account social security system. However, as it will be explained later, the law that introduced the change of system on 1981, allowed to some set of individuals to remain affiliated to the old PAYG system. Hence, currently there are individuals affiliated to the new individual account system and to the old PAYG system due to the characteristics of the 1981 reform law.

The argument developed in the paper basically indicates that there could exist an adverse effect of larger social security tax rates over fertility rates on the PAYG system that accelerates the change on the age pyramid and affects the sustainability of the program. In that case, the economics of the family literature would indicate that schooling might be positively affected due to the trade-off between quantity and quality of children (see Becker and Barro, 1988). Some initial evidence on those facts can be obtained when we analyze the evolution of aggregate fertility rates and aggregate schooling on Chile. Graph 1 shows the evolution of fertility rate and enrollment rates on secondary education throughout the twentieth century in Chile. During this period fertility rates were stable until 1930. Starting on 1930, fertility rates showed an initial drop accompanied by a sustained decrease over time. Also in 1978 it seems to exist another change on the behavior of the fertility rates, as it seems to stabilize. The two changes coincide with first the introduction of the PAYG social security and later the replacement of the PAYG system with the individual account system. Further, a similar but inverted behavior is followed by the enrollment

rate on secondary education, as it would be indicated by the existence of a trade-off between quantity and quality of children. Even when those changes coincide with the changes on social security system and hence they suggest some interaction between social security system and fertility or schooling, it must be notice that they also coincide with the largest crisis faced by the Chilean economy on 1930 and 1982 respectively[2] and thus, they may be not directly related to the social security system.

[Insert Graph 1]

The paper aims to identify the effects of the social security system over the family decision variables and it links those results with the sustainability of the PAYG system. The discussion and the results of the paper will be presented as follows. Section 2 presents a brief review of the literature on the topic. Section 3 analyzes the Chilean historic background on social security system while section 4 presents the dataset. The dataset contains data of individuals affiliated to new individual account pension system; individuals affiliated to the old pension system (the PAYG system) and individuals not affiliated at all to any pension system. In fact, individuals currently working on 1981 were allowed by the new law to choose between remaining on the "pay-as-you-go" system and switching to the new individual account system. Also self-employed individuals and individuals out of the labor force are allowed to remain not affiliated if they wish. This characteristic of the dataset will allow us to test the effect of the PAYG and the individual account system over the family decision variables on the PAYG and the individual account systems using the Chilean case as an experiment. Section 5 presents the empirical strategy followed on the paper. Two different estimation methods are proposed to deal with the self-selection problem faced by individuals allowed to choose between social security systems. The results are later reported on section 6. Also in this section, the evolution of the PAYG social security tax rate over time is simulated under the restrictions that the system has zero debt and fertility rate is affected by the tax rate. Finally section 7 concludes.

2. The link between social security and family choice variables

2.1 The Theory

Becker and Barro (1988) present a dynastic family setup where fertility rate is one of the choice variables. They link fertility rates and social security system by indicating that an increase on the PAYG social security tax rate faced by each child has a negative effect on the present value of child's income. Altruistic parents anticipate this effect and leave larger bequests. But larger bequests increase each child's marginal cost and discourage parents from having children.

Erlich and Zhong (1998) propose a moral hazard problem instead. They argue that children provide income to their parents when they are retired. Hence the costs of raising children are justified by the later benefits obtained. However when a PAYG social security system is instituted parents will obtain income from the government program when retired. As the benefits of having children are reduced, parents face less incentive to raise children.

Mulligan (1997) proposes instead, a positive effect of the PAYG system over fertility rates. He focuses on the time cost of children. In fact time has two alternative activities, bearing children and labor supply. In that case, when the social security tax rate is a payroll tax, the incentives to supply labor are smaller and more children are raised.

Cerda (2001) shows even when children are time intensive and labor is taxed, larger tax rates can be related to lower fertility rates. In fact, larger taxes provide more incentive to childbearing and time spent per child may increase. But as larger time will be spent per child, the marginal cost per children increases. It follows that the optimal number of children decreases. This case focuses on the quality quantity trade-off on children. Even when more total time is allocated to childbearing –as in Mulligan's case-, fertility may be decreased since per capita time spent on each child is largely increased.

The rate of return of the social security system may also be a determinant of fertility rates. On the Becker and Barro setup, larger current benefits faced by parent are associated with larger future taxes. As we increase the burden on children -they will pay larger taxes-, altruistic

parents leave larger bequests, increasing the marginal cost of each child and decreasing the number of children. On the same way, the moral hazard problem of Erlich and Zhong also argues for a lower number of children, as the rate of return on the PAYG system increases. The larger is this rate of return, the less transfers parents will be required from children when retired.

As indicated above, the effect over the number of children is usually linked with the effect over schooling. The links comes from the literature on the family that argues for a trade-off between quantity and quality of children. In fact the shadow price of an additional children depends positively on the human capital investment while the shadow price of an additional unit of human capital investment depends on the number of children, as we spent the same amount on each of them. Hence it follows that exogenous increases on fertility affect negatively schooling and also the effects of the initial changes on taxes over fertility rate are stretched out as the level of schooling is affected through the effect on the price of children.

The literature does not discuss the effect of the individual account system over the family choice variables. However, it is easy to extend the Barro and Becker setup to conclude that as the individual account system does not produce income effects and it just switches the path of income over time - as individuals' contribution are invested on the capital market and they obtain the capital market rental rate. Hence, no effects over fertility or schooling should observe. This conclusion may vary if borrowing constraints are included.

In summary, the literature predicts mainly negative effects over fertility rates and labor supply while positive effects over schooling when the social security tax rate increases on the PAYG system. An increase on the rate of return of the social security system should have opposite effects on the PAYG system. In general, in the case of the individual account system no effects should be observed as taxes raises.

2.2 The empirical evidence

The empirical evidence on the literature is not large and it mainly focuses on fertility rates using macro data. Song (2000) uses a sample of 95 countries over a period of 33 years (1960 to 1992). She separates the sample among three different sets of countries. The first set of countries did not change the PAYG social security system over the period, the second set of countries did not have social security system at the beginning of the sample and introduced a "pay-as-you-go" system and finally the last set of countries switched from a "pay-as-you-go" system to an individual account system. On the first set of countries, Song found that an increase on the size of the PAYG system from 10% to 15% produces a decrease of 0.3% on birth rates. On the second set of countries, a country that initially did not have social security and implemented a PAYG system has an 8% drop on birth rate. Finally, the last sample shows that a country switching to the private system from the PAYG system would increase its fertility rate by 29%.

The second study is the one of Erlich and Zhong (1998). They analyzed only PAYG pension system and separated the sample between rich and poor countries. They indicated that if the pension size were similar to its 1960 level as a fraction of GDP, the growth rate of rich countries would increase from 2.74% to 2.82%. They interpret this last evidence as effects over human capital accumulation. They also indicate that in poor countries the fertility rate is negatively affected on 0.22% on average.

Compared with the two papers above discussed, this paper uses a micro dataset that allows us to control by the different type of system and it focuses on fertility, schooling and labor supply decision at the household level.

3. The Chilean historic background

Chile has currently an individual account social security system but it just switched to this system on 1981[3]. The new system becomes obligatory to the individuals entering the labor force after the law changed. However, individuals currently working on 1981 were not required to

switch to the new system and they may choose if switching or remaining on the old PAYG system. Also, there was a set of individuals that is not required to affiliate to any social security system at all. Basically, self-employed individuals and individuals out of the labor force who have not worked before compose this group. Hence, those individuals may choose if affiliate or not to the social security system.

The factors that may affect the decision choice of the later group of individual -not affiliated to any social security system at all- will be now stated. The first set of factor is the employment status. The law allowed to self-employed individuals to remain unaffiliated if they wish. Hence, being an employee place immediate restrictions over this decision. It is expected that self-employed individuals affiliate less than any other worker, as they do not need to surpass the law to remain unaffiliated as other type of workers, such as employees.

A second set of factor to remain not affiliated deals with the decision of entering the labor force - individuals out of the labor force are not required to affiliate. In general, females have less incentive to enter the labor force as usually their husbands work. Also richer individuals may have a higher reservation wage and hence they are less likely to enter the labor force. In the same way, individuals with higher schooling face a larger wage rate and have larger incentives to enter to the labor force.

The second group not affiliated to the new system is the group of individuals affiliated to the PAYG system. They may be affiliated to four main institutions: the social security administration (SSA), the private worker pension administration (PWPA), the public worker pension administration (PUWPA) and the army forces pension administration (AAFFPA[4]). Some others institutions existed, but their size was smaller than those cited above. The social security administration manages the pension funds of unskilled workers of the non public sector. Individuals that remained affiliated to the social security administration currently pays 19.1% of their labor income as social security tax. The private worker pension administration includes skilled workers of the non public sector and taxes their affiliates at a 20.15%. The public sector

administration includes the majority of public sector workers and taxes their affiliates at 19.03%. Finally the army forces pension administration includes as contributors all individuals working on the army force. They are taxed at 20%. Those taxes are quite large when compared to the tax rate paid by the affiliated to the new pension system. In fact a worker affiliated to the individual account system pays only a 10% of her labor income as social security tax. This tax differential and the subsequent increase on the disposable income for those individuals switching to the new system may have been very influential on the overall switching. This is one of the facts that may explain that almost 75% of the affiliated to the PAYG at the beginning of 1981 switched to the new system[5] during the first year of implementation of the individual account system.

However, a large number of individuals stayed on the PAYG system. There are larger incentives to stay on the old system for some identifiable groups. On the PAYG system the pension are determined as fraction of the total wage income obtained during the last working years before retirement –usually the last 5 years -. Also there are debits to this wage income if the worker is a widow, a woman or a hard laborer. In fact if the worker is widow, she obtains an increase of 2 years of wage income if she is affiliated to the social security administration or the private worker pension administration. Maternity has a similar impact, as an increase on 1 years of wage income is added to the calculation base per child if she stays on the SSA or PRWPA. Finally, hard laborers have 10 years of debits in their accounts if they were affiliated to the SSA and they work at the mining sector and 5 years of debits if they were affiliated to the SSA and they did not work on the mining sector. Also workers on night shifts got 5 years of subsidy if they were affiliated to the PRWPA. Those sets of workers lost their subsidy if they switch to the new pension system[6].

Some others incentive to stay on the old system are linked to the level of compensation obtained from the institution they were affiliated. In fact, when we compare the level of pension on the 4 main institutions on the PAYG system we find that on 1980, the average pension receiver of the social security administration obtained a 46% of the average Chilean pension,

while individuals affiliated to the private worker pension administration obtained 77% of the average and individuals affiliated to the public worker pension administration received 148% of the average. In the case of the army forces pension administration, the benefit was 350% of the average Chilean pension. Notice that there could exist some self-selection in those data in the sense that workers affiliated to the social security administration are unskilled workers while the one affiliated to the private worker pension administration are skilled and hence the difference on pension may be explained, at least in part, by differences on past contributions. However there is also some exogeneity on those benefits. Public workers are not quite different to private workers and also army forces do not have larger wage incomes than the rest of the economy in general. This exogenous component of the difference on the level of pension may have had an impact on the decision of switching to the new pension system.

Finally, the age of the individual on 1981 may also have an effect on the decision of switching to the new system. Pensions, as explained above, were mainly determined by wage income during the last 5 years of work. Hence workers have a strong incentive to obtain higher wages during the last part of their working life only. In the new system, as the individual has a private account that gain interest over time, they have incentive to work and accumulate pension funds over all the working life. In that scenario older individuals that did not work hard enough during their working life before 1981, did not have incentives to switch as the pension they would receive on their retirement age would be lower than the one they would obtain on the PAYG system. On the other hand a fairly young individual at the moment the law was passed was not negatively influenced by the law change as she did not have already play her working life strategy. In fact, only 8% of affiliated workers aged 63 at the moment of the reform switch to the new system while almost 100% of the affiliated workers aged 28 or younger switch to the new system. Graph 2 shows the fraction of affiliated that switch to the new system when the law was implemented as a function of their age. As age increase the decline of the fraction increases as individuals are nearer to retirement and they can obtain the benefits of the old system.

[Insert Graph 2]

It should be notice that there are three sets of individuals that did not have the choice between systems. First, individuals 18 years old and younger when the law passed are obliged to affiliate to the new system as soon as they enter the labor force. Second, individuals already retired on 1981 stayed on the PAYG system as they were already receiving benefits from this system and finally, individuals affiliated to the army force were required to stay on the PAYG system by the 1981 law.

In summary, Chile has currently individuals affiliated to the old PAYG system, but also individuals affiliated to the new individual account system and individuals not affiliated at any system at all. Among those set of individuals self-selection arises for individuals that were currently working at 1981. Also there are some sets of individuals that could not choose between the systems due to exogenous restrictions imposed by law.

4. The data

This paper uses the 1998 CASEN[7] survey realized by the Chilean government during November and December of 1998. The survey is based on a random sample of 48107 households[8] with a probabilistic error of 0.45%. There are 188360 individuals on the sample. The survey has information on schooling, health, housing, income, employment and demographic characteristics.

The data on employment provides information about the social security system the individual is affiliated[9]. The survey shows that among the individuals aged 35 and older on 1998 – individuals 18 years and older on 1981- 41% is not affiliated at all to any social security system, while 22% is affiliated to the "pay-as-you-go" system and 37% to the new system.

The observation of some statistics obtained from the dataset shows some interesting patterns. In fact, it shows that the average number of children per head of households aged 35 and older and affiliated to the PAYG system is 1.21 while the average number for the group not affiliated to the PAYG system is 1.94. In the same way, the average number of years of schooling

for children of head of households aged 35 and older and affiliated to the PAYG system is 10.28 years while similar group where the head is not affiliated to the PAYG system has an average of 9.4 years of schooling per child. Finally, when we analyze the hours worked by females, we observe that females affiliated to the PAYG system work 43.3 hours on average while females affiliated to the individual account system work 44.2 hours on average. Hence in general, the observations seem to be in line with the theory as family substitute away from children but spent more time on each of them on the PAYG system. Even when the observations are in line with theory, they may be influenced by self-selection bias and some further analysis is required.

The description of the data is next. The two main variables of interest are the tax rate paid under the social security system and the rate of return of the social security system. The first variable is constructed using question 21 of the CASEN employment section. The question is: Are you affiliated to any pension system? The possible answers are: (1) Social Security Administration, (2) Public Worker Pension Administration, (3) Private Worker Pension Administration, (4) Private system (AFP[10]), (5) Army Forces Pension System, (6) Other, (7) Not affiliated. The tax rates are known by law -the values were indicated above- for groups (1) to (5), while the group (7) does not pay taxes. The groups of individuals that respond to be affiliated to other social security institution - category (6) - are individuals that are affiliated to a PAYG institution different than (1), (2), (3) and (5). The average level of tax rate on those institutions was imputed to category (6).

To construct the rate of return of the PAYG social security system it was estimated first, the present value of total contributions to the system and later the present value of total benefits obtained from the social security system. The contributions to the system were estimated using a Mincer equation for individuals affiliated to the PAYG system and currently working. Using this estimation, the lifecycle wage profile for individuals affiliated to the PAYG was constructed by varying age from 20 years to 65 years old on the case of males and 20 years to 60 years old on the case of females[11]. This procedure allows us to calculate the year contribution to the social security

system by using the tax rate. Using a 5% discount rate, the present value of tax contributions is computed. The procedure to construct the expected benefit from the PAYG system is analogous. Using the retirement income data, we estimated retirement income on the PAYG system as a function of schooling, and demographic characteristics as dummy variables for widow or married individuals plus age profiles. The lifecycle of retirement benefits were estimated from 60 to 80 years old for females and from 65 to 80 years old for males. The death date was set equal to 80 years, as life expectancy in Chile is approximately 80 years old on 1998. Using the 5% discount rate the present value of benefits was estimated and the rate of return of the PAYG social security system was constructed as the ratio of the difference between the present value of benefits and the present value of taxes over the present value of benefits.

On the case of individual not affiliated to the PAYG social security system, the calculations are as follows. The present value of the benefits received by the individuals affiliated to the individual account social security system is set equal to the present value of taxes, as the private system invests the individual contributions on the capital market. Hence the rate of return of the social security system is set equal to zero, by definition of the individual account system. Finally on the case of individuals not affiliated to any social security system, the present value of taxes and benefits was set equal to zero.

5. The empirical strategy

The empirical strategy followed in the paper will be to estimate a switching regression model. In fact, individuals –at least a set of them- may choose among three different status, affiliation to an individual account social security system, affiliation to a PAYG social security system and not affiliation at all. The individuals choose sequentially, first between affiliation and not affiliation to a social security system and second between the two different systems if they chose to affiliate. The general specification of the econometric model will be the following:

$$I_1^* = 1(affiliation) = 1(Z_1\gamma_1 > \varepsilon_1) \quad (1)$$

$$I_2^* = 1(PAYG) = 1(Z_2\gamma_2 > \varepsilon_2) \quad (2)$$

$$y^{NF} = X\alpha + u, \ldots if \ldots I_1^* = 0 \quad (3)$$

$$y^{PS} = \beta_o^{PS} tax + X\alpha + u, \ldots if \ldots I_1^* = 1, I_2^* = 0 \quad (4)$$

$$y^{PG} = \beta_o^{PG} tax + \beta_o^{PG} rben + X\alpha + u, \ldots if \ldots I_1^*, I_2^* = 1 \quad (5)$$

Where 1(•) is an indicator function equal to one if the enclosed statement is true and zero otherwise while Z_1 and Z_2 are variables determining the affiliation to a social security system and the affiliation to the PAYG social security system on the set of individuals that already chosen to be affiliated to a social security system. The error terms ε_1 and ε_2 are uncorrelated unobservable that affect the decision process. They are normally distributed. The variable y will be the natural log of the number of children on a family, the natural log of the average schooling of the children or the natural log of hours worked while "tax" is the tax rate faced by individuals and "rben" is the rate of return from the PAYG social security system calculated above. The matrix X is a set of others variables that may influence the decisions and u is a well-behaved error term with zero mean. The superscript NF, PS and PG denote no affiliation, private system and PAYG respectively.

Equation (3) corresponds to the behavior of individuals not affiliated to any social security system and obviously it does not include tax rate or rate of return of the system. Equation (4) corresponds to the behavior of individuals affiliated to the private system. The rate of return is not included as by definition this system has a present value of benefits equal to the present value of contributions. Finally, equation (5) presents the behavior of individuals affiliated to the PAYG system.

Two different estimation methods will be performed using the dataset available to check the quality of the estimates and to provide results for the case of the PAYG system and the individual account system over the family choice variables. It must be noticed that the main econometric problem faced is the one of self-selection. In fact, if individual decisions among social security choices are influenced by unobservable characteristics, a direct estimation of any of those three states equation could be biased. Hence, the procedures here proposed, correct the bias that could exist. The first procedure follows the self-selection methodology elaborated by Heckman (1974) and Lee (1978). We will estimate a three steps procedure to obtain the effects of the tax rate and the rate of benefits over the family choice variables on the PAYG case. The second procedure will use an instrumental variable approach to correct by self-selection; estimates for the individual account system and the PAYG system are obtained on this case.

5.1 Using control functions to correct by self-selection

Here, we discuss the first empirical strategy. The procedure will generate estimates of the effect of the PAYG social security system over the family choice variables.

The self-selection problem will be estimated by using a variant of the technique developed by Heckman (1974) and Lee (1978)[12]. Those papers applied to the labor market. In the case of Heckman (1974), it was estimated a labor supply function with self-selection between entering the labor force or remaining outside of it, while in the case of Lee (1978), the effects of unionism over wage rates were investigated where the worker chooses to enter the union or not. However, those two papers have as characteristic just one self-selection criteria. In our case, there are multiple self-selection criteria, namely (1) affiliation or not affiliation to any social security system (PAYG or individual account) and (2) given the individual chose to affiliate, choosing between the PAYG and the individual account system.

Basically to estimate the effect of the PAYG system over family decision choices, we need to estimate the following equation:

$$E(y|I_1^*, I_2^* > 0) = \beta_0^{PG} tax + \beta_1^{PG} ben + \alpha X + E(u|I_1^*, I_2^* > 0) \quad (6)$$

Hence, the direct estimation of equation (6) has bias due to the fact that $E(u|I_1^*, I_2^*>0)\neq 0$. The procedure developed by Heckman (1974) and Lee (1978) solves this problem when there is only one selectivity criteria by using a control function. In our case, there are two selectivity criteria, but as ε_1 and ε_2 are uncorrelated, the procedure can be easily extended. We have:

$$E(u|I_1^*, I_2^* > 0) = -\lambda_1 \frac{\phi(Z_1\gamma_1)}{\Phi(Z_1\gamma_1)} - \lambda_2 \frac{\phi(Z_2\gamma_{21})}{\Phi(Z_2\gamma_{21})}$$

Where ϕ and Φ are the probability density function of the normal distribution and the cumulative distribution of the normal distribution respectively and $\lambda_i = \text{cov}(u, \varepsilon_i)$ [13].

The procedure will be a three-step procedure. On the first step, using all the sample of individuals 35 years and older, equation (1) is estimated using a probit method. We focus on individuals 35 years and older as they were 18 years and older on 1981, when the new social security law was approved. This set of individuals is the one that can self-select and hence for them is relevant to run the probit model. With the estimates, it is constructed $\phi(Z_1\hat{\gamma}_1)/ \Phi (Z_1\hat{\gamma}_1)$, where the ^ indicates fitted value. On the second step, and using only the individuals 35 years and older affiliated to any social security system, it is estimated equation (2) and we construct $\phi(Z_2\hat{\gamma}_2)/ \Phi (Z_2\hat{\gamma}_2)$. On the last step equation (6) is estimated using only the individuals 35 years and older affiliated to the PAYG system. The control functions constructed above are used on the last step. The result will be discussed below.

This procedure could be extended to the set of individuals affiliated to the individual account system however there is a caveat. When the third step on individuals affiliated to the

private system is run, the tax rate does not present any variation on the individual account system and hence the effect of the tax rate cannot be estimated. Instead it will be used an instrumental variable approach as it will be explained below.

5.2 The instrumental variable approach

In this case the whole set of observations for head of households will be used to obtain variation on tax rate. The specification indicated by the equations (1)-(5) can be combined in the following way:

$$y = y^{NF}(1 - I_1^*) + y^{PS}(I_1^*(1 - I_2^*)) + y^{PG}(I_1^* I_2^*) \quad (7)$$

or

$$y = X\alpha + \beta_o^{PS}(I_1^* tax) + (\beta_0^{PG} - \beta_0^{PS})(I_1^* I_2^* tax) + (\beta_1^{PG})(I_1^* I_2^* rben) + u \quad (8)$$

Where y are the observed family decision variables while (I_1^*tax) is a variable that includes the tax rate paid by all individuals affiliated to any social security system and zero otherwise. Also (I_1^* I_2^*tax) is a second indicator function that includes the tax rate if the individual is affiliated to the PAYG system and zero otherwise, while the variable (I_1^* I_2^*rben) is a third indicator function that includes the return obtained from the social security system for individuals affiliated to the PAYG system and zero otherwise. As usual to obtain consistent estimates we require that the covariance between the right hand side variables and the error term is zero and moreover that cov(I_1^*tax,u)=cov(I_1^* I_2^*tax,u)=cov(I_1^* I_2^*rben,u)=0. However, those conditions may possibly not hold, as the individuals may be self-selecting based on unobservable variables as indicated above.

To avoid the problem of inconsistency we are going to use four different variables as exogenous instruments. The first variable will be a dummy variable that is equal to one if the individual is not a self-employed worker and zero otherwise. As indicated on section 3, self-employed individuals were allowed exogenously to remain not affiliated by property of the 1981

law while individuals with employment status other than self-employment must be affiliated to a system. Hence, this last dummy variable contains all the individuals that cannot choose to remain not affiliated to any social security system. A second instrument will be the set of individuals affiliated to the army forces. The instrument will be a dummy variable equal to one if the individual works on the army forces and zero otherwise. In fact, this set of individuals was required to stay affiliated to the PAYG system by the 1981 law. The third instrument will be determined by the set of individuals aged 18 years or younger on 1981. Those individuals are exogenously required by law to affiliate to the individual account system when they enter the labor force. Hence a dummy variable equal to one if the individual was 18 years or younger on 1981 and zero otherwise is defined. Finally, a fourth instrument will be the set of individuals aged 65 years and older when the law passed. Those individuals were retired on 1981 and they were already receiving pensions benefits on the old PAYG system.

The four instrumental variables are obviously correlated with (I_1^*tax), (I_1^* I_2^*tax) and (I_1^* I_2^*rben) as we require. Also since the 1981 law determined exogenously the four sets of individuals, they must be uncorrelated with the error term of equation (8), as those individuals cannot react to the social security system as a response to unobservable variables. In fact some evidence on this last claim can be obtained. Let z be the set of instruments, the claim as usual requires that cov(u,z)=0. A stronger condition that will in general satisfy this last requirement is that cov(z,y)=0; namely that the covariance between the instruments and the independent variables as number of children, average schooling and hours supplied to the labor market is zero. Table 2 tests for mean equality for different group of individuals among demographic variables, location variables, income variables (including subsidies) and hours supplied to the labor market. The first two columns present the mean of the variables if the individuals are affiliated to the private system or to the PAYG system. The third column tests mean equality between the first two columns. The test is always strongly rejected. The same procedure is followed for columns 4 to 6, where column 4 represents the set of individuals not self-employed and column 5 represents

the set of self-employed individuals. Column 7 to 9 corresponds to the army force case, while column 10 to 12 and column 13 to 15 corresponds to individuals with threshold of 18 and 65 years old when the law was passed. The results indicate that when the same tests are considered for our set of instrumental variables, even when the null hypothesis may be rejected, the differences between individuals belonging or not belonging to our instrumental sets are considerably smaller than the one observed between individuals on the private system versus individuals on the PAYG system.

Moreover when consider the number of children we observe that the differences between PAYG and individual account system are quite large and significantly different. When controlling by our instrument, even when the test reject mean equality, the differences are considerably smaller and the T-test are also much smaller than the one comparing the first two columns. This evidence indicates that even when the covariance between the independent variable -number of children- and the instruments may be not zero, the instruments allows us to avoid the larger correlations of using the affiliation to PAYG system directly. The case of hours supplied to the labor market shows a much stronger condition. In fact, when controlling by our instruments there are no statistical differences between the means, while the test comparing the individual account and the PAYG system shows clear differences on means. Hence, this case argues that $cov(y,z)=0$, where z is the set of instruments.

Also when we control for variables such as location, income, or subsidies, we obtain statistically equal means when the instrumental variables are used. Hence labor income shocks or subsidies shocks are uncorrelated with our instrumental variables. Those shocks may be an indicator of unobservable variables that allows us to infer that the condition $cov(u,z)=0$ holds. Thus, we can be confident about the fact that the instrumental variables here used, are uncorrelated with the unobservable shocks.

[Insert table 2]

6 The result and discussion

6.1 The PAYG system

Two sequential probit models, following the argument indicated on section 3, were use to estimate the first method proposed above.

The first probit model is constructed on the following way. It has a dummy variable measuring affiliation to any social security system on the left hand side and uses as explanatory variables the following set of variables: age, dummy variable for females, schooling, dummy variable for home ownership, dummy variable for self-employed worker, dummy variable for employee, dummy variable for domestic servant, dummy variable for family member on family business, dummy variable for permanent job, dummy variable for part-time job, dummy variable for temporary job, some geographic location variables that identify the household, a dummy variable for individuals on the army forces and a dummy variable for not married people. House ownership was included as a proxy variable for wealth, while the other set of variable included should be positively correlated with informal work. The second probit includes a dummy variable indicating affiliation to the PAYG social security system on the left hand side while the right hand side has as independent variables the age at the moment when the law was passed, dummy variable for females, dummy variable for widow, dummy variable for hard worker, schooling, dummy variable for affiliation to the army forces, dummy variable for affiliation on one of the main four institutions if the individual had stayed on the old system. Also the geographic location variables were included. The inclusion of those variables follows the discussion on section 3. The results for the two probit models have the signs we expected from the discussion of section 3. Table 3 shows those results.

[Insert table 3]

The last step involved running regressions for the three main variables: number of children, average child schooling and hours worked by parents. All regressions are for head of households aged 35 and older[14], as this is the set of individuals presenting the self-selection

problem. On the case of the number of children, as dependent variable is used the natural log of the number of children while as independent variables are included the tax rate, the rate of return of the social security system, the control functions, location variables, a dummy variable for being married, dummy variable for females, age and age squared, the natural log of after-tax wage income and the natural log of years of schooling of the head of household. The inclusion of the additional variables to tax rate and rate of return follows from the possible heterogeneity among family's preferences. The results show that an increase of 1% on the social security tax produces a decrease of 4.4% on the number of children while an increase of 1% on the return of the social security tax produces an increase of 2.5% on the number of children. However, the second variable is not significant. Suppose there is an increase on the tax rate from its actual mean of 20% to a 30% on the PAYG system while holding the rate of return constant. In this case, the average number of children on the social security system should decrease from 1.21 to 0.86. Other interesting results are that married people have 16% more children and females have 25% less children than men. The specification was extended as a matter of sensitivity analysis. Initially it was additionally included a set of subsidies obtained by the household from the government and later health variables. The coefficient of tax rate and rate of return remains similar as it can be seen on table 4.1 and 4.2[15].

[Insert table 4.1 and table 4.2]

The case of schooling used as dependent variable the natural log of the average years of schooling of the children of the same household. The same basic specification, as in the case of children, was used but it was also added the natural log of the average age of children. The results indicate that an increase on the tax rate should increase the average year of schooling, but the coefficient is not significant at 40%. However, the effect of an increase on the tax of return has a negative and significant, 4% effect over schooling. As above different specifications were included but on all them the results were similar.

The equation for hours worked is specified in two ways. First separated equations for female and male head of household are estimated. Second the dependent variable is specified as the average hours of work supplied by the marriage. Hours worked are measured on natural log and the specification includes the same variable as in the case of the number of children plus job characteristics. The results for male head of household labor supply show that an increase on the tax rate may decrease labor supply and an increase on the rate of return may increase labor supply. However, the estimated coefficients are clearly not significant. The elasticity of labor supply with respect to labor income is positive and highly significant. The age profile shows that men supply lower labor supply as they become older. A different picture appears when the case of women is analyzed. The results for women show that an increase in 1% on the tax rate decreases the hours supplied on 15% and the estimate is significant while the change on the rate of return has the opposite sign but it is clearly not significant. Consider the case of a woman providing 48 hours a week to the labor market (full time job). If the tax rate increases in 10% on the PAYG system from its mean, 20% to 30%, the labor supplied decreases to 11 hours per week (part-time job). The elasticity with respect of labor income is positive and significant as expected. The age profile on the labor supply is U-shaped, meaning that women provides larger labor supply when older. This result resembles the labor supply profile of any woman that brings up children in her reproductive lifecycle –typically 20 to 40 years old- and provides work later. When considered the average hours of work supplied by the marriage, the result show that an increase on the tax rate on 1% produce a 4.5% decrease on average hours supplied. The effect of the rate of return is again clearly not significant. Consider a marriage where wife and husband work a full time job, and they face an increase of 10% over the tax rate. In that case, the marriage decreases the average hours worked from 48 hours to 30 hours. Notice this last average is compatible with the husband working 48 hours (full time job) and the wife decreasing her labor supplied to 12 hours (part time job). Hence the specification for the marriage as a whole

replicates the result obtained above for men and women separately. The sensitivity analysis was carried out as above, but there was no significant change on the coefficients.

6.2 Individual account estimates using the second procedure

The estimations obtained using the instrumental variables seem quite interesting. As above it was used as a baseline specification a set of variables including demographic variables such as dummy variables for the head of household being married, female or widow plus her schooling level and age plus age squared. Later the introduction of subsidies and health variables are considered as a way of testing the sensitivity of estimations. In this case all the set of household observations are used (not just the one with head of households 35 years and older on 1998). The variables (I_1^*tax), (I_1^* I_2^*tax) and (I_1^* I_2^*rben) are instrumented by fitted values obtained from running a regression between each of them and the four instruments stated above.

As a remainder, notice that from equation (8), we have that the effect of an increase on tax rate over fertility rate on the individual account system is given by the coefficient of I_1^*tax, while the effect of the tax rate on the PAYG system is given by the sum of the coefficients of (I_1^*tax) and (I_1^* I_2^*tax). Finally, the effect of the rate of return on the PAYG system is given only by the coefficient of the variable (I_1^* I_2^*rben). The results show that the number of children is not affected by changes on the level of the tax rate on the private system while it is negatively affected by increases on tax rate of the PAYG system. The coefficient corresponding to the effect of the PAYG tax rate over the number of children shows a negative effect near to 5.5%, however the results shows no effect of the individual account system tax rate over fertility. Notice that the effect of the tax rate over number of children on the PAYG system is almost the same as the one obtained on the first estimation method used. Schooling presents non-significant results for the PAYG or the private system tax changes.

Also, the effect of the tax rate over labor supply reaffirms the findings obtained using the first estimation method. In fact, a 1% increase on the PAYG tax rate should have not effect over

the male component of the marriage while it should decrease female labor supply on 10%. The effect on the private system has the same direction but the magnitude is stronger on the female case (16%), while male labor supply is not affected. The baseline results and the sensitivity analysis of them can be observed on table 5, 6.1 and 6.2.

[Insert table 5, table 6.1 and table 6.2]

Hence, we can conclude that the results, using both methods, seem to indicate that time the PAYG system may have a significant impact over fertility and labor supply decisions. In fact, larger tax rate decreases number of children as family may anticipate larger costs of bearing children. Also, time is an intensive input on childbearing production function and it is usually the mother's time endowment the more used on that production function. Hence mother's time is highly responsive to change on fiscal policy while father's time is not. It may be that the mother is more productive than the father on child education or that father's time has a larger opportunity cost at the labor market than her wife's time. Both cases are plausible and it will not be analyzed the empirical relative relevance of them as this question is not part of this study.

6.3 Effects over the sustainability of the PAYG system

The results show two clear effects of an increase on the level of taxes on the PAYG system, namely fertility rates and female labor supply are negatively influenced. But, those effects on the family decision choice have also an effect on the fiscal budget. In fact, the smaller are the fertility rate and the female labor supply, the smaller is the income base the government faces to obtain revenues and the larger should be the tax rate individuals must face, given the level of expenditure. The PAYG system has an endogenous problem of sustainability in that scenario. An initial increase on tax rate requires larger future tax rate as the income base becomes smaller in the near future. Furthermore, larger tax rates on the future produce smaller fertility rates and smaller female labor supply. This is a vicious circle that generates the elimination of the

PAYG system on a finite horizon of time. To describe the impact of this circle over the tax rate path, a simulation of a very stylized economy will be illustrated next.

Let's consider the problem of the reaction of fertility to changes on the PAYG system. The labor supply responses will be neglected for simplicity. Suppose a very stylized economy with a zero growth rate where the government taxes labor income at rate τ and promises to the generation currently working a social security return Φ over their contributions and a level of benefits independents of past contributions, Γ, when retired. Those promises are not broken and the government maintains an equilibrated budget at each moment of time. Hence it must adjust the payroll tax rates at each moment of time, τ_t, to keep balance between current revenues and current expenditures on social security, given the parameters Φ and Γ, if the level of revenues or expenditures are not constants over time.

As labor supply is neglected from the problem, individuals supply inelastically their time to the labor market and they receive labor income at time t, w_t. Labor income is constant over time, as the economy does not growth.

Let Exp_{t+1} be current government expenditure on period t+1 per retired individual. The government spends at period t+1, $(1+\Phi)$ of the revenues obtained at period t, namely the payroll taxes at period t, plus the lump sum benefits. The component of retirement benefits that is independent of past contributions, Γ_{t+1}, will be a constant fraction Δ of total income at t+1, $w_{t+1}n_t$. This last feature indicates that the government spends a constant fraction of GDP on lump sum benefits. Hence its expenditures at t+1 are:

$$Exp_{t+1} = (1+\Phi)\tau_t w_t + \Gamma_{t+1} = (1+\Phi)\tau_t w_t + \Delta w_{t+1} n_t$$

On the revenue side, the revenues at t+1 depend on taxes at t+1 and the current labor income at t+1. As the number of individuals working compared to those retired has been increased by the fertility rate n_t, the revenues at t+1 are:

$$\mathrm{Re}v_{t+1} = n_t \tau_{t+1} w_{t+1}$$

Then equating revenues and expenditures, we have:

$$\mathrm{Re}v_{t+1} = Exp_{t+1} \Rightarrow \tau_{t+1} = \frac{1+\Phi}{n_t}\tau_t + \Delta \qquad (9)$$

This last expression describes the evolution of taxes over time. Whenever $1+\Phi$ is smaller than fertility rate, the long run level of taxes converge to $\tau = n\Delta/(n-(1+\Phi))$ while when $1+\Phi$ is larger than fertility rate, the tax rate explodes for any initial level of lump sum benefits. In fact, on the former case the system is sustainable as the aggregate growth rate of the economy, determined by population growth rate, is larger than the rental rate of return of the social security system. On the later case, the opposite holds and the system is unsustainable by definition.

Consider now, the case where $1+\Phi$ is smaller than the fertility rate –the sustainable case, in absence of the effect of tax over fertility rate. Table 7 presents simulations of the evolution of tax rate for subsequent generations for different values of the parameters when the effect of an increase of 1% of the social security tax over fertility rate is a negative impact 5%, as we found on our empirical results. The case illustrates the evolution of taxes for initial values of the parameters where $(1+\Phi)/n$ ranges between 0.7 and 0.8 and Δ between 1.5% and 3%. The initial level of taxes is set at the level $\tau = n\Delta/(n-(1+\Phi))$, where n indicates the long run level of fertility in absence of PAYG social security system. The value of n is set equal to 2. The case of Δ and $(1+\Phi)/n$ equal to 1.5% and 80% respectively, shows that the tax rate becomes 12% and the number of children is 1.1 after three generations while the initial long run tax level is only 8%. The same case, but Δ being 3%, shows a larger impact with tax rate becoming 37% after three generations, while the number of children decrease to 0.3.

[Insert table 7]

The cases where $(1+\Phi)/n$ is smaller than 0.8, similar but smaller effects are obtained. Hence the system may become unsustainable in as a short period of 3 generations. This evolution

of taxes seems to follow the evolution of social security taxes in Chile. The SSA taxed their contributors (employee plus employer tax) only on 5% on 1925. However, the tax rate increase steadily until reaching 56.9% on 1974 and decrease from its 1974 value to 34.3% on 1980. The fertility rate followed the opposite behavior over the period. On 1981 the system was reformed due to a sustainability[16] problem.

In summary, the PAYG system may have an endogenous sustainability problem as it affects fertility rates and lowers the income base where revenues can be obtained. The impact is accumulative over time and in a finite time horizon implies the fiscal program to be not sustainable.

7. Summary

This study tests the prediction of the literature linking social security system and family decision choices using a micro-database obtained from Chile. Two different methods of estimations are used. In one hand, self-selection control functions are used, while on the other hand, instrumental variables methodology is followed. The set of instrumental variables follows from the characteristics of the law that reformed the social security system on 1981. In fact, the law allows to some individuals to self-select between systems, while other individuals were required exogenously to affiliate either to the PAYG system or the individual account system.

Both estimations show similar results for fertility and labor supply decisions. The PAYG system should have a negative impact over fertility rate, and in fact, a 1% increase on social security tax should decrease the number of children on nearly 5%. The results also sustain the importance of time on childbearing. Mothers' time is highly responsive to change on the fiscal policy while fathers' time is not. Larger social security taxes may explain the difference between part time and full time jobs on the case of females.

Those results indicate an endogenous problem of sustainability for "pay-as-you-go" social security system as they decrease fertility rate and hours worked by females producing a

decrease on revenues over time. Simulations show large effects over tax rate -after two to three generations of the implementation- on the PAYG system.

Contrarily to the PAYG effects the individual account system shows no effect over fertility rate or the quality of children, measured using schooling level. This result may indicates that in absence of borrowing constraints, the individual account social security system should not produce any effect over the intertemporal budget constraint or marginal cost of children, as it may on the PAYG system.

Finally, on the paper it was assumed that time spent on each child may have a positive effect on education, however time spent on children may also, and maybe more importantly, affect others aspects of child's life such as family formation, abortion, crime, etc... Hence the analysis may also be extended to those areas where further impacts may be found.

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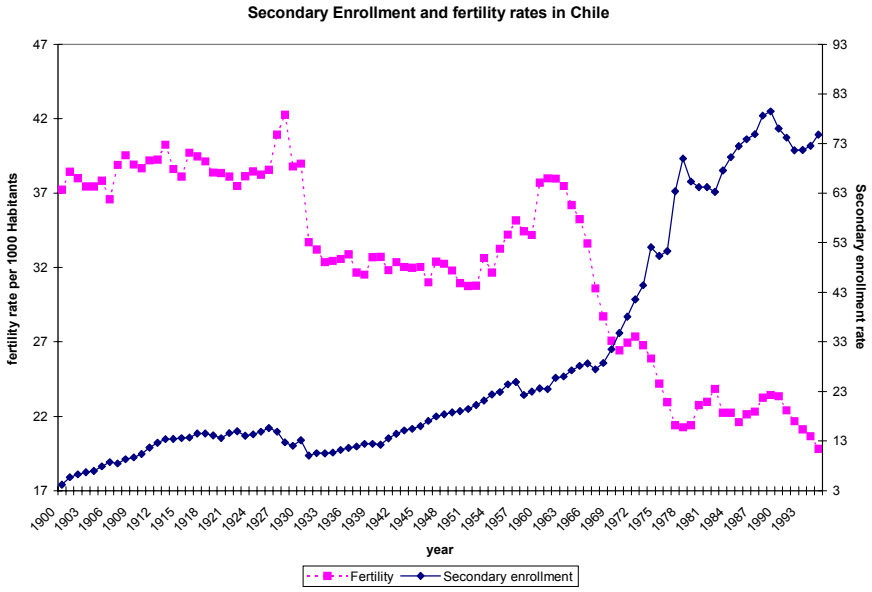
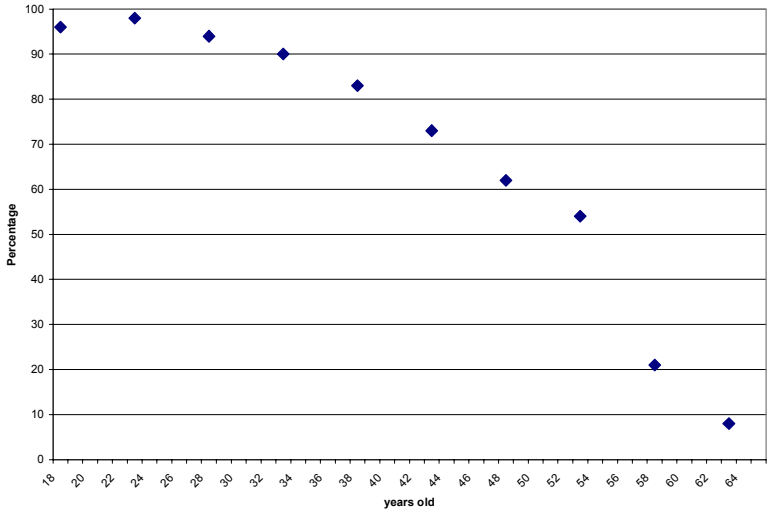
Graph 1

Chile 1900-1995



Graph 2

Fraction of people switching to the individual account system on 1981, by age



Data Appendix

The dataset is the 1998 CASEN survey from Chile. It is available from the Chilean government. The survey describes the socioeconomic characteristics of the Chilean population at the individual level.

Table 1
Summary Statistics

	Observations	Mean	Standard Dev.	Min	Max
Tax rate	144522	5.74	6.63	0	22.5
Rate of return of PAYG	67895	-57.4	26.8	-99	45.3
Rate of return of PAYG if Female, widow and less than 6 years of schooling	431	-78.6	33.6	-91	45.1
Rate of return of PAYG if more than 12 years of schooling	10173	-58.9	18.3	-99	-29
Hours worked by head of household If age >35	24642	52.44	63.89	0	99
Hours worked by head of household If age >35 and PAYG affiliation	5058	54.57	87.48	0	80
Hours worked by head of household If age >35 and no PAYG affiliation	21047	52.14	60.35	0	80
Number of children per head of household if age >35	37257	1.65	1.41	0	11
Number of children per head of household if age >35 and PAYG affiliation	15230	1.21	1.27	0	10
Number of children per head of household if age >35 and no PAYG affiliation	25627	1.94	1.31	0	10
Average child schooling on household where head is 35 years and older	27775	9.41	3.39	0	19
Average child schooling on household where head is 35 years and older and PAYG Affiliation	9623	10.28	3.26	0	19
Average child schooling on household where head is 35 years and older and no PAYG Affiliation	21860	9.40	3.52	0	19
Age of head of household If age >35	37257	54.69	13.28	36	99

Table 2
Social Security systems and Instrumental variable estimators by characteristics

	PAYG	AFP	T TEST	Non Self-Empl.	Self-Empl.	T TEST	ARMY FORCES	NOT ARMY FORCES	T TEST	LESS THAN 18 years	MORE THAN 18 years	T TEST	MORE THAN 65 years	LESS THAN 65 years	T TEST
N. Children	**1.18**	**1.82**	**-43.6**	**1.75**	**1.61**	**8.63**	**1.64**	**1.91**	**-3.91**	**1.55**	**1.66**	**-7.66**	**0.67**	**1.66**	**-23.7**
Size	3.57	4.06	-23.4	4.01	3.88	6.11	3.91	4.06	-1.6*	3.62	3.98	-17.4	2.88	3.93	-18.2
Married	0.62	0.84	-46.4	0.80	0.71	18.5	0.96	0.73	-10.3	0.84	0.70	27.4	0.36	0.74	-27.7
Widow	0.23	0.02	65.5	0.05	0.12	-19.9	0.002	0.11	6.99	0.004	0.14	-38.5	0.55	0.10	47.0
Female	0.26	0.11	36.1	0.11	0.23	-27.5	0.01	0.21	9.83	0.12	0.23	-24.4	0.44	0.20	18.7
Location	0.26	0.31	-9.94	0.23	0.29	-11.6	0.22	0.27	2.44*	0.29	0.27	2.7*	0.22	0.28	-4.34
Education	7.61	10.4	-64.4	8.79	9.25	-9.94	12.45	9.14	-16.0	10.94	8.71	49.12	5.66	9.24	-28.5
Hours worked	**47.7**	**49.8**	**-8.00**	**53.15**	**52.33**	**1.10***	**55.3**	**48.7**	**-7.78**	**52.9**	**52.4**	**0.66***	**57.4**	**52.5**	**0.64***
Labor income	197886	285545	-8.24	281289	249121	4.02	296672	256962	-1.1*	213119	271517	-7.16	78900	258462	-3.97
Subsidy 1	1281	2480	-29.9	584	1923	-37.5	2716	1646	-6.65	1989	1571	11.59	376	1684	-13.3
Subsidy 2	454	678	-8.47	1357	752	19.6	7.7	881	6.34	1199	792	13.18	342	886	-6.46
Subsidy 3	295	231	4.91	232	254	-1.6*	32	252	3.84	130	280	-11.7	270	249	0.59*
Subsidy 4	3516	820	31.45	2710	2795	-0.7*	152	2799	5.17	570	3333	-24.2	9250	2631	21.2
Sick	0.33	0.18	29.6	0.21	0.24	-5.16	0.16	0.23	3.64	0.16	0.30	-23.5	0.47	0.18	22.6
Hospital	0.36	0.21	30.7	0.25	0.28	-6.2	0.12	0.28	6.8	0.22	0.35	-21.2	0.38	0.21	13.4

Note: * indicates not significant at 1%. Location is a dummy variable equal to one if the individual lives on Santiago (The main city in Chile). Subsidy 1 is a subsidy mainly related to minimum pensions for elderly. Subsidy 2 is governmental subsidy per child attending school. Subsidy 3 is an unemployment subsidy. Subsidy 4 is a subsidy for low-income families to pay water supply services. Sick and hospital are dummy variables equal to one if the individual has been sick or in a hospital during the last three months.

Table 3
Probit estimations

	Probit 1 Dependent variable 1(Affiliation)	Probit 2 Dependent variable 1(PAYG)
1(female)	-0.7103 (-36.762)	0.2923 (11.50)
1(widow)	-	0.1392 (3.116)
Age	0.0231 (30.262)	-
1(Not married)	0.1105 (4.912)	-
Years of Schooling	0.0449 (18.918)	-0.043 (-11.57)
1(House owner)	-0.0214 (-1.161)	-
1(self employed)	-0.1817 (-3.649)	-
1(employee)	1.2468 (25.677)	-
1(domestic worker)	0.6623 (10.251)	-
1(Non paid family related working on family business)	-0.1896 (-1.697)	-
1(Army forces)	1.6973 (6.198)	-
1(Permanent work)	0.1993 (4.189)	-
1(temporal work)	-0.3623 (-6.489)	-
1(part time work)	-0.1803 (-2.455)	-
Age on 1981	-	0.0637 (52.203)
1(Hard worker)	-	0.2281 (5.625)
1(SSA)	-	-0.8823 (-22.012)
1(PRWPA)	-	-0.7728 (-22.191)
1(PUWPA)	-	-0.2670 (-4.077)
Constant	-0.7414 (-9.967)	-2.1971 (-22.164)
Pseudo R^2	0.2465	0.4177
Prob >chi2	0.0000	0.0000
Number of Observations	69225	40504

Note:1(•) is an indicator function, one if true and zero otherwise. The estimation is among individuals 35 years and older. T-ratios are in parenthesis. The second probit includes individuals that chose to affiliate only. The location variables are omitted from the table.

Table 4
The Baseline regression using control functions

	Log of number of children	Log of average years of schooling	Log of hours worked, female	Log of hours worked, male	Log of hours worked, marriage
Tax rate	**-0.0436* (-2.192)**	**0.0067 (0.766)**	**-0.1761* (-2.443)**	**-0.02 (-0.668)**	**-0.04594* (-2.231)**
Rate of return	**0.025 (0.831)**	**-0.0464* (-2.734)**	**-0.040 (-0.349)**	**-0.0497 (-0.186)**	**0.004 (0.342)**
Log of schooling (years)	0.023 (0.410)	0.1261* (4.523)	-0.3473 (-0.924)	-0.2527 (-1.141)	-0.1432* (-2.993)
Log of labor income	0.0167 (1.306)	0.0343* (4.841)	0.2765* (2.988)	0.1595* (7.059)	0.1533* (6.822)
1(female)	-0.2596* (-1.873)	0.2525* (3.610)			
Control function for Affiliation	0.2015 (1.283)	0.1154 (1.590)	-2.488* (-5.150)	-1.7414* (-6.314)	-1.497* (-6.839)
Control function for PAYG	0.005 (0.054)	0.0912* (1.974)	-0.1242 (-0.126)	-0.077 (-0.961)	0.0206 (0.231)
Log of average age of children		0.46768 (18.567)			
Constant	4.4325* (2.8878)	-5.7756 (-.3569)	5.8368 (0.619)	-2.0862 (-0.082)	3.7438 (2.788)
R^2	0.1796	0.5141	0.2388	0.1492	0.1489
Prob F	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	2948	2877	465	2975	3443

The estimations are among head of households affiliated to the PAYG social security system currently being aged 35 years and older. T-ratios are in parenthesis and are calculate using robust standard errors. The estimations also include location and age variables. Last three columns also include job characteristics. Also * indicates significant at least at 5%.

Sensitivity analysis

Table 5.1 Subsidies included

	Log of number of children	Log of average years of schooling	Log of hours worked, female	Log of hours worked, male	Log of hours worked, marriage
Tax rate	-0.040* (-2.052)	0.003 (0.46)	-0.15* (-2.02)	-0.017 (-0.58)	-0.039* (-1.99)
Rate of return	0.020 (0.668)	-0.04* (-2.41)	-0.03 (-0.31)	-0.063 (-0.23)	0.026 (1.594)
Control function for Affiliation	0.36* (2.35)	0.14* (1.985)	-4.80 (-4.43)	-2.90* (-5.98)	-2.79* (-7.41)
Control function for PAYG	-0.052 (-0.52)	0.099* (2.16)	3.37 (3.11)	0.63* (3.48)	0.88* (5.15)
Constant	Yes	Yes	Yes	Yes	Yes
Subsidies	Yes	Yes	Yes	Yes	Yes
Health vars.	No	No	No	No	No
R^2	0.2319	0.533	0.348	0.1615	0.1769
Prob F	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	2948	2877	465	2975	3443

Table 5.1 has the same specification as table 3, plus subsidies. The estimations are among head of households affiliated to the PAYG social security system currently being aged 35 years and older. T-ratios are in parenthesis and are calculate using robust standard errors. The estimations also include location variables and dummy variables for married and widow individuals, age, age squared and log of labor income. Last three columns also include job characteristics. Also * indicates significant at least at 5%.

Table 5.2 Subsidies and health variable included

	Log of number of children	Log of average years of schooling	Log of hours worked, female	Log of hours worked, male	Log of hours worked, marriage
Tax rate	-0.040* (-2.05)	0.006 (0.71)	-0.15* (-2.05)	-0.014 (-0.483)	-0.039* (-1.996)
Rate of return	0.017 (0.598)	-0.038* (2.3)	-0.05 (-0.41)	-0.049 (-0.185)	0.027 (1.61)
Control function for Affiliation	0.41* (2.68)	0.163* (2.21)	-4.85* (-4.46)	-2.90* (-5.95)	-2.77* (-7.32)
Control function for PAYG	-0.05 (-0.55)	0.108* (2.31)	3.35* (3.10)	0.66* (3.61)	0.89* (5.212)
Constant	Yes	Yes	Yes	Yes	Yes
Subsidies	Yes	Yes	Yes	Yes	Yes
Health vars.	Yes	Yes	Yes	Yes	Yes
R^2	0.2356	0.5377	0.3507	0.1677	0.1783
Prob F	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	2948	2877	465	2975	3443

Table 5.2 has the same specification as table 3, plus subsidies and health variables. The estimations are among head of households affiliated to the PAYG social security system currently being aged 35 years and older. T-ratios are in parenthesis and are calculate using robust standard errors. The estimations also include location variables and dummy variables for married and widow individuals, age, age squared and log of labor income. Last three columns also include job characteristics. Also * indicates significant at least at 5%.

Table 6
Estimations using instrumental variable approach
Baseline Regressions

	Log of number of children	Log of average years of schooling	Log of hours worked, female	Log of hours worked, male	Log of hours worked, marriage
(I_1^*tax)	0.02 (1.67)	0.00009 (0.015)	-0.16* (-3.91)	0.011 (0.282)	-0.003 (-0.09)
(I_1^* I_2^*tax)	-0.067* (-5.48)	0.005 (0.866)	0.07 (1.898)	0.029* (2.332)	0.019 (1.60)
(I_1^*rben)	-0.011* (-6.86)	0.001 (1.403)	-0.017* (-6.297)	0.005 (1.205)	0.001 (0.376)
Age	0.06* (14.16)	0.029* (10.84)	0.0002 (0.02)	0.007* (2.16)	0.005 (1.893)
Age squared	-0.0007* (-16.48)	-0.003* (13.17)	-0.000 (-0.68)	-0.0001* (-3.501)	-0.0001* (-3.266)
Log of labor income	0.009 (1.51)	0.027* (8.412)	0.16* (7.012)	0.062* (8.434)	0.062* (9.303)
Demographic variables	Yes	Yes	Yes	Yes	Yes
Subsidies	No	No	No	No	No
Health vars.	No	No	No	No	No
Constant	-0.92 (-8.06)	-0.97 (-15.72)	2.45 (8.549)	3.19 (18.83)	3.24 (19.58)
R^2	0.1068	0.7462	0.1275	0.0479	0.046
Prob F	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	21960	18522	2637	22152	24844

The estimations are among head of households. The variables: (I_1^*tax), (I_1^*rben), (I_1^* I_2^*tax) are instrumented using the four dummy variable described in section 5.2. T-ratios are in parenthesis and are calculate using robust standard errors. The estimations also include location variables and dummy variables for married and widow individuals, age, age squared and log of labor income. Last three columns also include job characteristics. Also * indicates significant at least at 5%.

Table 6.1
Instrumental variable approach: Including subsidies

	Log of number of children	Log of average years of schooling	Log of hours worked, female	Log of hours worked, male	Log of hours worked, marriage
(I_1^*tax)	0.002 (0.177)	-0.001 (-0.17)	-0.167* (-3.95)	0.01 (0.289)	-0.002 (-0.071)
(I_1^* I_2^*tax)	-0.056* (-4.90)	0.003 (0.56)	0.07 (1.90)	0.015 (0.80)	0.014 (0.77)
(I_1^*rben)	-0.01* (-7.87)	0.0006 (0.713)	-0.017* (-6.27)	0.003 (1.02)	0.001 (0.31)
Demographic variables	Yes	Yes	Yes	Yes	Yes
Subsidies	Yes	Yes	Yes	Yes	Yes
Health vars.	No	No	No	No	No
R^2	0.1927	0.7500	0.1352	0.050	0.0484
Prob F	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	21960	18522	2637	22152	24844

The estimations are among head of households. The variables: (I_1^*tax), (I_1^*rben), (I_1^* I_2^*tax) are instrumented using the four dummy variable described in section 5.2. T-ratios are in parenthesis and are calculate using robust standard errors. The estimations also include location variables and dummy variables for married and widow individuals, age, age squared and log of labor income. Last three columns also include job characteristics. Also * indicates significant at least at 5%.

Table 6.2
Instrumental variable approach: Including subsidies and health variables

	Log of number of children	Log of average years of schooling	Log of hours worked, female	Log of hours worked, male	Log of hours worked, marriage
(I_1^*tax)	-0.000 (-0.005)	-0.001 (-0.23)	-0.166* (-3.90)	0.012 (0.33)	-0.001 (-0.044)
(I_1^* I_2^*tax)	-0.055* (-4.87)	0.003 (0.56)	0.069 (1.85)	0.014 (0.74)	0.013 (0.47)
(I_1^*rben)	-0.012* (-8.06)	0.0005 (0.64)	-0.017* (-6.61)	0.003 (1.04)	0.001 (0.32)
Demographic variables	Yes	Yes	Yes	Yes	Yes
Subsidies	Yes	Yes	Yes	Yes	Yes
Health vars.	Yes	Yes	Yes	Yes	Yes
R^2	0.194	0.7501	0.1366	0.0515	0.0501
Prob F	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	21960	18522	2637	22152	24844

The estimations are among head of households. The variables: (I_1^*tax), (I_1^*rben), (I_1^* I_2^*tax) are instrumented using the four dummy variable described in section 5.2. T-ratios are in parenthesis and are calculate using robust standard errors. The estimations also include location variables and dummy variables for married and widow individuals, age, age squared and log of labor income. Last three columns also include job characteristics.

Table 7
Simulations: Evolution of the tax rate

Case:		Δ=1.5%			Δ=3%	
	Fertility rate	Tax Level, %	$(1+\Phi)/n$, %	Fertility rate	Tax Level, %	$(1+\Phi)/n$, %
Generation 1	2.00	5	70	2.00	10	70
Generation 2	1.50	5	88	1.00	10	105
Generation 3	1.50	6	88	1.00	14	105
Generation 4	1.43	7	91	0.83	17	123
Generation 1	2.00	6	75	2.00	12	75
Generation 2	1.40	6	98	0.80	12	120
Generation 3	1.40	7	98	0.80	17	120
Generation 4	1.31	9	104	0.58	24	152
Generation 1	2.00	8	80	2.00	15	80
Generation 2	1.25	8	110	0.50	15	140
Generation 3	1.25	10	110	0.50	24	140
Generation 4	1.11	12	122	0.28	37	203

[1] University of Chicago and Pontificia Universidad Catolica de Chile. E-mail: r-cerda@uchicago.edu
[2] Chile faced two consecutives external crisis on 1975 and 1982.
[3] The law was passed and implemented during 1981.
[4] There also existed a pension administration for the police department.
[5] "Reforma a los Sistemas de Pensiones", Asociacion Internacional de Organismos Supervisores de Fondos de Pensiones, 1996, page 77.
[6] See Arellano (1984).
[7] This survey describes the socioeconomic characteristics of the Chilean population.
[8] 33714 urban and 14393 rural households
[9] As social security taxes are paid as a fraction of labor income the information of social security affiliation is directly linked to employment.
[10] Individual account system
[11] Females retire at 60 years old while males at 65 years old by law.
[12] The procedure is also developed in Maddala (1993), page 278.
[13] See Maddala (1993).
[14] Individuals that could self-select themselves.
[15] The tax rate becomes more significant as more variables are added, but with the same sign.
[16] The PRWPA charged a tax rate of 64.7% of the labor wage on 1974.