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The effect of the Chilean Pension Reform on Wealth Accumulation

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Abstract

Chile went through a major pension system reform in 1981, replacing the state managed pay-as-you-go system by a privately-managed fully funded scheme. The reform implied a rather important increase in the net present value of expected pension wealth for most of those who opted-out to the new arrangement. We investigate the extent to which households substitute this increase by decreasing accumulation of other wealth. As the decision to either stay in the old system or to opt-out to the new one was not random, we follow an instrumental variable approach that allow us to overcome the unobserved heterogeneity problem. Using data from the Social Protection Survey we find two suitable instruments that we apply to two different subsamples. The displacement effect between expected pension wealth and non-pension wealth is estimated to be in the range of 30%. Among the possible reasons for the incomplete offset are imperfect information, the desire to compensate for new risks faced and habit formation.

JEL codes: E21 G23 H55

*Deputy Research Head at the Research Division Superintendence of Pensions and University College London. I would like to thank James Banks for his valuable guide, Emma Tominey, participants of the LACEA congress and of the SL seminar at UCL for useful comments. The study uses both the Social Protection Survey, which is property of the Undersecretary of Social Security of Chile and the Employment and Unemployment Survey, carried out by the Department of Economics of the University of Chile. I would like to thank both institutions for providing access to the databases. All errors are my own.

1 Introduction

Economic theory, in particular the simplest version of the life cycle model, suggests that there should be perfect substitution between savings for retirement and other sorts of wealth accumulation. In other words, the provision of (mandatory) pension plans would reduce one-to-one the incentives to save during working life. However, in reality the offset effect of pension wealth may well differ from the theoretical predictions due to several reasons: individuals may be credit constrained, pension wealth is illiquid and cannot be used as collateral, there may be bequests motives, there may be a discrepancy between individuals' discount factor and rates of return, mandatory pension contributions may have distortionary effects on labour supply, the different tax-treatment of pension savings and other savings, etc. Thus, the extent of the substitutability degree between pension wealth and other wealth is mainly an empirical issue.

To understand the relationship between pension wealth and other wealth is of major importance for policy implications, such as the effect of pensions reform on national savings and to shed light on how individuals/households make economic decisions over their life-cycle.

The true effect of pension wealth on other wealth is hard to pin down for various reasons. First off all, it is not common to observe exogenous variation in pension wealth that allows us to measure its impact on other wealth. Secondly, observed cross-section variation in wealth accumulation is explained by both observed and unobserved factors. Is the latter that makes it difficult to identify the true effect of pension wealth on individuals' wealth accumulation behaviour. Last but not least, the lack of appropriate micro-data containing earnings, consumption and assets has obstructed empirical research in the area.

Feldstein (1974) was one of the first ones to look at the issue. Using a time series for the United States he concludes that social security depresses personal savings by 30-50%. Amongst studies that use micro data, Gale (1998) significantly added to the literature by pointing out that the displacement effect would be underestimated if pension wealth is not adjusted by a factor that depends on the age of the individual. Using wealth and pension wealth data for the U.S. in 1983 he gets an average offset of between 33% and 68%. Attanasio and Brugiavini (2003) and Attanasio and Rohwedder (2003) use differences-in-differences together with instrumental variables to analyse the displacement effect of pension wealth and savings at a household level for Italy and the United Kingdom, respectively. Both studies also find a significant crowding-out effect.

Chile went through a major pension system reform in 1981, in which the pay-as-you-go system (PAYG) was replaced by a fully funded system with individual accounts. Individual accounts are privately managed by the Pension Fund Administrators (PFA). Even though the reform closed the old PAYG system for new entrants, it allowed individuals already affiliated to the pension system to choose between staying in the PAYG or opting-out to a PFA. Quintanilla (2009) finds that most individuals with choice would have got a higher pension in the PFA system, thus the reform implied a rather important increase in the net present value of expected pension wealth, EPW. The fact that the pension reform changed pension wealth for some groups (and did not for others) makes Chile an interesting case to investigate the relationship between pension and other wealth.

Evidence on the crowding-out effect for Chile is scarce. Using aggregated time series Bennett, Loayza, and Schmidt-Hebbel (2001) estimate that households offset between 36% and 88% the forced pension savings. The main difference between these two estimated values is that the latter considers consumption of durable goods, thus suggesting that households adjust mainly durable goods as a response to forced higher pension savings. Coronado (1998) uses micro data on earnings and expenditure for 1988 to estimate the effect of the reform on household saving rates. She uses a difference-in-difference approach comparing savings rates of the treatment group, comprised by those in the PFA scheme, to the savings rates of the control group, comprised by those in the PAYG; relative to their self-employed counterparts, who are not forced to contribute to the pension system. The estimated effect of the pension privatisation on household savings is positive and significant, ranging between 7.8 and 18 percentage points for tax payers (the estimate is zero for non-tax payers). However, two issues arise from this study. The first one is that both earnings and consumption data are likely to suffer from measurement error, making savings rates a rather noisy variable. Second, the dataset used does not allow identifying enrolment by pension arrangement, so the author assigns all households with a head under 40 years of age to the treatment group and those between 45 and 65 to the control group, on the basis of evidence that stayers were on average older than individuals that opted-out. Nevertheless, this is only a simple correlation, the reform did not define whatsoever age groups that were and were not affected. Indeed, there are strong reasons to believe that the decision to stay/opt-out is endogenous when explaining non-pension wealth. Not to take into account this problem would yield inconsistent estimations. Furthermore, Coronado does not take into account that the degree to which contributions to pension system affect wealth accumulation depend on expected future benefits.

In this paper we use earnings profiles and pension contribution patterns to compute individual-specific net present value of EPW. We find that there is variation in the net present value of EPW across pension systems. We then look at the extent to which there is a displacement effect between it and non-pension wealth. The fact that the pension reform changed pension wealth for some groups (and did not for others) makes Chile an interesting case to investigate the relationship between pension and other wealth. Notice that we use the *stock* of wealth accumulated by each individual two decades after the pension reform, as opposed to using saving rates at any particular period, which is indeed a *flow*. The latter measure is more likely to be subject to time specific or individual specific shocks that may affect the results and thus lead to misleading conclusions.

As mentioned before, there may be unobserved factors determining accumulation of both pension wealth and non-pension wealth. Not to take into account this heterogeneity may lead to misleading conclusions on the relationship between the two variables. In this paper we follow an instrumental variable (IV) approach to identify the effect of pension entitlements on household wealth accumulation. We use two alternative IVs. The first one is an indicator of whether the individual was forced to opt-out to a PFA, arguing that having been forced exogenously changed pension wealth. Our second IV exploits the fact that individuals already in the formal labour market at the time of the reform (more precisely, enrolled to the pension system) had the choice to either stay in the PAYG scheme or opt-out to a PFA. On the other hand, individuals yet to join the formal labour market had no choice but to enroll to a PFA. Amongst individuals of 15-24 years of age, those aged between 15 to 19 were mainly out of the labour force, thus had not choice but to join a PFA, whereas most of those aged 20 to 24 where already working so were able to choose between the PAYG scheme and the PFA arrangement. Both IVs exploit the degree of choice individuals had at the time of the reform.

To our knowledge this is the first attempt to analyse the crowding-out effect of pension wealth on other wealth for Chile at a micro level taking care of unobserved heterogeneity. That, the use of employment and contribution histories and the use of fine detail in pension formulae to compute EPW are the main contributions of this paper.

After this introduction, the next section compares the two schemes emphasising the main differences from the individuals' point of view: contribution rates, requirements for eligibility and pension formulae. Through this we aim to highlight the sources of variation of pension wealth across the two pension plans. Section 3 describes the data sources we use and gives detail on how pension wealth is computed. Section 4 begins by presenting a simple theoretical model that forms the basis of our empirical specification. We then raise empirical issues and possible sources of bias and discuss our identification strategy in detail. Section 5 presents the empirical results and Section 6 concludes.

2 The Chilean Pension Reform and its Effects on Expected Pension Wealth

Chile dramatically reformed its pension system in 1981 going from a PAYG to a PFA scheme[1]. While people already enrolled in the pension system at the time of the reform had the choice to either stay in the old arrangement or to opt-out

[1] There was a new comprehensive pension reform in 2008. However, this paper intends to compare the PAYG and the PFA system as they were before the 2008 reform, i.e. we compute

to a PFA, those yet to join the labour market had no choice but to enroll in a PFA. Individuals who had the choice and actually opted-out to a PFA could not later go back to the PAYG scheme, thus once taken, the opting-out decision was irreversible. The instrument used by the reform to credit past contributions for those who opted-out is the Recognition Bond, which is added to the individual's pension savings in the PFA upon retirement[2].

The PAYG and the PFA pension plans in Chile differ mainly in two ambits, the first one relevant during working life and the second upon retirement. While working, the contribution rate to the PAYG scheme is around 19.1% of labour earning in the main PAYG provider[3] whereas it is 12.5% in the PFA, of which 10% goes directly to the individual's account and the rest is used to pay administration fees and the disability and survival insurance.

At retirement age, the way eligibility and pension benefits are calculated differs substantially across schemes. To be eligible to a benefit in the PAYG system the individual needs at least 800 weeks of contributions and a density of contributions[4] of no less than 50%. The PAYG is a final salary scheme thus, once the two requirements have been met, the pension benefit starts with a minimum of a 56% of average earnings in the last 60 months. The benefit increases 1% for every 50 weeks on top of the first 800 with a cap at 70% of the average earnings of the last 60 months, which leads to a maximum of 30 years of positive accrual. Note the strict requirement of 800 weeks of contributions to be eligible for the benefit, i.e. individuals with less than (roughly) 16 years of contributions will not get a pension from the PAYG system whatsoever. The exact formula that summarises all these features is[5]:

the net present value of expected pension wealth as it would be according to the rules in force up to 2008.

For details of the new pension reform see http://www.spensiones.cl

[2] See Quintanilla (2009) for further details on the requirements and formulae of the Recognition Bond.

[3] It is, respectively, 20.15% and 19.03% in the second and third main providers (in terms of numbers of members).

[4] Density of contributions is defined as the rate of the number of periods contributed to the potential number of periods contributed during the working life.

[5] This is the pension formula for men in the main provider of the old PAYG scheme, the Social Security Service (SSS). Other providers had different formulae but in the interest of space and to ease comparison with pensions in the PFA system, we show only this formula in the text. Nonetheles, exact formulae according to each individual's provider are used in the empirical section. See Quintanilla (2009) for a detailed description of requirements and pension formulae in each provider.

$$P_{PAYG}=\begin{cases} \frac{\sum_{t=1}^{60} E_t}{60} * Min\{0.7, (0.5 * first\ 500\ weeks \\ \qquad + 0.01 * every\ 50\ weeks)\} & if\ 800\ weeks \\ & of\ contributions \\ & and\ dens >= 0.5 \\ 0 & otherwise \end{cases} \tag{1}$$

Where E_t represents labour earnings in each period t of the last 60 months.

On the other hand, at retirement age, the PFA system does not impose any requirement to be eligible for a pension. The benefit depends entirely on the pension savings the individual has accumulated during her working life, which in turn depends on the contributions made to the PFA each period (10% of earnings) netted out of the fix administration fee and the market returns on those savings. Due to the compound interest effect, contributions in early periods are relatively more important in the pension fund than later contributions. Pension savings accumulated in the PFA at retirement age R then are:

$$PS_{PFA} = \sum_{t=1}^{(R-1)} (0.1 * E_t - fixed\ fee_t) * \prod_{v=t}^{(R-1)-1} (1 + r_v) \tag{2}$$

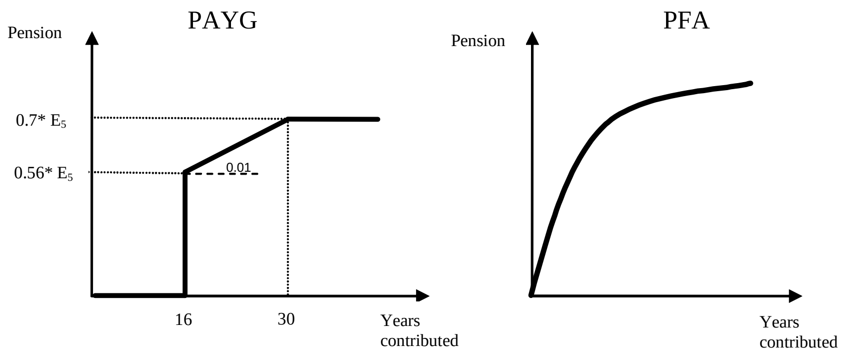
Then, the pension benefit in the PFA scheme is an always increasing function of labour earnings, periods contributed (participation) and the interest rate. In other words, as long as the rate of return is positive, the accrual rate is always positive[6].

Summarising, pensions in the PAYG system are highly non-linear in the number and timing of contributions. On the contrary, pensions in the PFA scheme do not have kinks of any sort. Figure 1 shows these features[7].

[6] See table A.21 in the Appendix for the series of annual real rate of return from 1981 to 2009. It can be seen that the rate of return has been negative only in 3 years -1995, 1998 and 2008 - where the latter was the most dramatric due to the credit crunch.

[7] Figure 1 is for illustrative purposes only. The two graphs are not to scale. We have omitted the Minimum Pension Guarantee in the PFA graph as it has strict access conditions and thus only a small share of individuals get it. We have also abstracted from the RB in the PFA system.

Figure 1



The difference both in contribution rates and in pension formulae implies that, for most individuals, the net present value of EPW in the PFA scheme is higher than in the PAYG system. Quintanilla (2009) computes, for each individual who could choose between the two pension plans, the net present value of EPW they would get in *either* system and finds that 87% would have got a higher net present value of EPW in the PFA than what they would have got from the PAYG. Following the same pension computation methodology but now computing the *actual* net present value of EPW for each individual in his relevant pension system, in this paper we find wide variation, with individuals in the PFA system getting a net present value of EPW, on average, four times higher than those in the PAYG (see t able 1 in Section 5 below). Is this variation introduced by the reform what we exploit to look a the extent to which individuals crowd-out pension and other wealth.

3 Data Sources and Estimation of Pension Wealth

3.1 The data

We use two sources of information:

1. The Social Protection Survey, EPS. The EPS contains a nationwide random sample of the Chilean population. It is a longitudinal study with the first and second waves carried out in 2002 and 2004, respectively. The survey comprises a wide range of socio-demographic characteristics as well as subjective retirement age and life expectations, pensions income entitlements, knowledge of the pension system, risk aversion, time preferences, etc. The EPS is also a *retroactive-panel* dataset in the sense that each interviewee was asked to self-report his/her contribution and employment history (and its features) from 1980 onwards. We use contribution histories as an input to construct individual-specific contribution profiles for

unobserved periods (before 1980 and after 2002), and employment histories as an input to construct earnings profiles for each individual's working life. With these profiles on hand, we then compute EPW.

The second wave of the EPS also contains information on asset accumulation from which we compute non-pension wealth.[8]

As neither of the waves of the EPS include past earnings, we use the following survey to simulate earning profiles[9].

2. Employment and Unemployment Survey, EUS,1957-2004. The EUS is a cross-section survey that collects information on earnings of a (rotating) representative sample of the labour force in Great Santiago. This is done yearly since 1957.

   We simulate earnings profiles for each EPS respondent matching group-earnings profiles estimated from the consecutive waves of the EUS[10][11]. Further details of the matching on section 3.2.1.

3.2 Computing pensions

In order to calculate an individual's EPW when reaching retirement age, R, we need both individual earnings profiles and contribution patterns. We now explain in turn the approaches followed to address these two issues.

3.2.1 Estimating Wages

As earning profiles are not available in the EPS, we simulate earnings histories by matching EPS respondents to earnings profiles from consecutive waves of cross-section data, employing a method similar to that used by Blundell, Meghir, and Smith (2002) and Banks, Emmerson, and Tetlow (2005). The cross-section data we use is the Employment and Unemployment Survey, EUS, from 1957 to 2004. A quantile regression on log earnings is used to find median gross earnings for a specific group in all years between 1957 and 2004[12]. Groups are defined by year of birth, gender and education level. We pooled together three birth years in one so as to have more observations in each group. Four education levels are

[8] For further details on the EPS visit www.proteccionsocial.cl

[9] The EPS has been linked, on an individual basis, to administrative records from the pension system. The link includes earnings and contribution histories. Unfortunately, the link is not yet available for researchers' public use.

[10] We could have used instead the National Employment Survey to simulate earnings profiles. However, this survey is available only since 1986 so the time span is too short for the period we need to cover in this paper. On the other hand, the time span covered in the EUS is much longer (since 1957). Around two thirds of the working population is concentrated in the area covered by the EUS, hence the national vs. Great Santiago issue shall not be so serious.

[11] The yearly sample size of the EUS we use are in the range between 3,217 and 9,249.

[12] Median earnings were calculated across three consecutive years of data. For example, median group earnings for 1998 were found by taking the median earnings for people in that group in 1997, 1998 and 1999.

used, no education, primary, secondary and degree. We allow full interactions between gender, education and cohorts.

Two adjustments were made to earning profiles. First, as there are some groups that have no observations (individuals) for certain ages/years, we impute the predicted median earnings for the same group in the previous year, (where mean earnings were accordingly updated with average earnings growth). Second, as those still in employment after the legal retirement age are not likely to be representative of the rest of their cohort, we replace their median earnings with the values predicted in the year before the legal retirement age.

With group-earning profiles on hand we match each EPS responded to the corresponding group. To do the matching, we use one extra piece of information: the earnings information available in the EPS2002 and in the EPS2004[13]. For each individual in the EPS we compute the ratio of actual earnings to group median earnings from the EUS for 2002 and 2004 and then average the ratios for the 2 years. We see this as an "individual effect" and assume that does not vary over time, i.e. implicitly assuming that shocks affect individuals in the same group in the same way, so within group ordering does not change over time[14].

Hence, from group-earning profiles and the individual effect we get individual-specific earnings profiles[15].

Finally, to get earnings in years after 2004 and until R (when corresponding) we use the predicted values from a median regression of group-earnings on age, its square and the unemployment rate[16].

3.2.2 Estimating Probability of Contribution

From the employment history section of the EPS2002 we know whether each respondent contributed or not and if so, to which pension system from 1980

[13]As some EPS respondents were out of work by the time of the survey we firstly need to simulate earnings for them in that particular year (both for 2002 and 2004). We used a quantile regression (using the median) of earnings across individuals younger than pension age in employment in the relevant year. We include age, age square and education dummies as covariates and estimate separate equations for men and women.

[14]In Quintanilla (2009) we try an alternative way to do the matching. We compute the distance each indiviual in the EPS is to the nearnest group-quartile in the EUS and then assume this distance is the same for every year. Even though this is a more flexible way to get earnings profiles (than just to do it through group-median regression from the EUS), there is a trade-off with precision due to the amount of data we have. Indeed, when comparing the resulting EPW of each method to aggregate adminsitrative data and to self-reports we get that the group-mean approach yields better results.

[15]It is worth mentioning at this point that we aim to compute *gross* pensions and *gross* pension wealth. However, earnings reported in the surveys are *net* earnings, both from income-taxes and from payroll taxes (pensions, health and unemployment contributions). Thus, to be consistent in our measures, we recovered gross earnings using the actual tax schedules that have been used in the last 40 years.

[16]The observed unemployment rate is used untill 2005. 7% is assumed from 2006 onwards.

(or his/hers first employment if later than that) to 2002[17]. The first step in obtaining contribution profiles for unobserved periods (i.e. before 1980 and after 2001) is to estimate the probability of contribution for each individual. In doing so we use a probit model in which, for each observed period t in the EPS (from January 1980 to December 2001) the left-hand side variable takes the value of 1 if contributing or 0 if not; given an initial state in t-1 that can as well take the value of 1 if contributed and 0 if not. Thus, we assume a first order Markov process to get the transitions from one period to the next one.

$$\Pr(C_{it} = 1 | C_{it-1} = 0, X_i) = \phi(C_{it-1} = 0, \delta_1 X_i) \tag{3}$$

$$\Pr(C_{it} = 1 | C_{it-1} = 1, X_i) = \phi(C_{it-1} = 1, \delta_2 X_i) \tag{4}$$

The variables included in the X vector are age, age squared, level of education, cohorts dummies, the interactions between the last two variables and the unemployment rate. We also include monthly dummy variables to control for seasonality and a trend to control for a declining pattern observed in the data on the unconditional probability of contributing given an initial state, not least when the initial state is not contributing (see figure A.2 in the appendix depicting such trend). Separate regressions are run for men and women.

Based on the predicted values for the probability of contributing, the second step is to project the probability of contributing for each unobserved period. There are two types of unobserved periods: before January 1980 and after December 2001. The former is relevant only for individuals that joined the labour force before 1980 while the latter matters for everyone who, by December 2001, has not yet reached retirement age. We follow the same approach to simulate contribution patterns for both types of unobserved periods.

Since we need to forecast a binary variable (to contribute or not to contribute), a random number is generated for each individual-period from a U[0,1] distribution. If the value of the random number is lower or equal than the predicted value, then a value of 1 is assigned to the variable in the unobserved period, i.e. the individual would contribute in that period. On the contrary, if the value of the random variable is higher than the prediction, then a value of 0 will be given to the individual-period observation, i.e. the individual would not contribute in that period. We do this recursively, so in each unobserved period we use the "updated" information on the contributing variable in the previous period and the relevant predicted value (either from equation 3 or from equation 4).

[17] Since respondents self-reported this information some concern might arise about recall-error, not least for periods far away in the past. Quintanilla (2009) carries out two validity checks to investigate the accuracy of the auto-reports, concluding that there is indeed some re-call error. However, it has the expected magnitude and is decreasing in time.

3.2.3 Computing pensions in PFA

Once we have projected earnings and contribution patterns as explained in sections 3.2.1 and 3.2.2, respectively, we have everything we need to build the Individual Pension Fund (IPF) in the PFA (see equation 2). We use the actual series of the pension funds' rates of return for observed periods (which averaged 10.3% between 1981 and 2004) and assume a real return of 4% for all future periods.

We also need to check eligibility and to compute the amount of the Recognition Bond, RB, for those who were members of the pension system at the time of the reform and opted-out to a PFA. We simulate the RB for each eligible individual based on the estimated contribution patterns and wage profiles.

Finally, total pension fund at retirement age is the sum of the PS and the RB. Once we have this value, we compute the corresponding expected annuity using the same formula and program actually used in the Chilean system[18]. The formula takes into account variables such as sex and marital status of the claimant, age of the spouse and sex-based life expectancy tables[19].

3.2.4 Computing pensions in PAYG

There are 3 main providers in the old PAYG scheme, each with different benefit eligibility requirements and benefit formulae. As the EPS does not specify provider affiliation, we need to allocate each individual to a provider. Since provider affiliation is (roughly) determined according to employment-sector, we do the allocation according to the monthly employment details from the EPS. Regarding unobserved periods (not in the EPS2002, either before 1980 or after 2001), individuals are assigned to their own most frequent (mode) provider again according to the employment details reported in the EPS data. We calculate the relevant average wage to be included in pension formulae from the earnings profiles as computed in 3.2.1.

We use fine details on the requirements to be eligible and on the benefit formulae in each provider to compute expected pensions in the PAYG scheme. We also take into account minimum and maximum values pensions can take[20]. By doing so, we believe we get fairly accurate results.

[18] We are grateful to the Superintendence of Pensions for providing the program to compute pensions.

[19] Life expectancy tables were updated in 2005 and are applicable to individuals that retire from then onwards. We use the appropiate life expectancy tables (either the old or the new ones) to compute pension benefits for each individual according to when she claims the benefit.

[20] As defined by Law No. 15,386

3.2.5 Computing EPW

Both the PAYG and the PFA schemes entitle individuals that meet certain requirements and that do not self-finance a minimum threshold to the Minimum Pension Guarantee. While the requirements in the PAYG plan is simply to be eligible for a pension (according to formula 1) in the PFA is to have made at least 240 contributions. We adjust expected pensions in each system accordingly, i.e. we topped up pensions for those whose benefits are below the threshold and that satisfy the requirements.

As we need to compute the present value of EPW in either system, we discount the stream of the relevant expected annuity at a constant rate of 4% a year, considering the survivors' benefits if the individual has dependants and their corresponding life expectancy. Moreover, as contribution rates to the PAYG and PFA system are substantially different, we compute the *net present value of expected pension wealth* by deducting the present value of all contributions made up to retirement to the relevant scheme.

The remaining assumptions we make when computing expected pensions wealth are: we assume that everyone claims the benefit at the legal retirement age, we express all values in constant prices (of December 2002) and assume perfect foresight about inflation rates when computing future expected benefits. Finally, we assume that when forming their expectations about future pension benefits, people take their characteristics that affect pension benefits, such as current marital status, as given and fixed (Attanasio and Rohwedder (2003)). We discuss further the effects of the assumptions we make in section 4.2.2.

Based on the same methodology and assumptions used here, Quintanilla (2009) computes the net present value of the EPW each individual will get in the system he is actually enrolled to and the EPW he would have got had he made the opposite staying/opting-out decision. By comparing the two values it turns out that 87% of the sample would get a higher net present value of EPW in the PFA scheme. This is strong evidence that the pension reform indeed changed EPW[21]. In section 5 we present descriptive statistics on EPW and its variation by pension arrangement for the sample used in this paper.

4 Theoretical Model and Empirical Implications

4.1 Theoretical Framework[22]

According to a simple version of the life-cycle model, households (individuals) choose the stream of consumption that maximises their lifetime utility subject

[21] The interested reader can refer to the paper for a closer look on the winners and loosers of the reform

[22] This sub-section closely follows Gale (1998).

to a lifetime budget constraint that comprises labour-earnings, pension benefits and an interest rate. To simplify the analysis, we assume that earnings are exogenously determined (i.e. we do not consider labour supply decisions), that there is no uncertainty in the rates of return, that households do not face liquidity constraints and that they do not have bequest motives. We further assume a CRRA within-period utility function, thus the maximisation problem is the following:

$$\begin{aligned} \max_{\{C_t\}} V &= \int_0^T \frac{C_t^{1-\rho}}{1-\rho} e^{-\delta t} dt \\ &+ \lambda \left(\int_0^R E_t e^{-rt} dt + \int_R^T b_t e^{-rt} dt - \int_0^T C_t e^{-rt} dt \right) \end{aligned} \tag{5}$$

where t represents time (or age), C is consumption, ρ is the coefficient of risk aversion, δ is the time preference rate, E is real labour-earnings, r is the real interest rate, b is the real pension benefit, R is the retirement age and T the total life span.

Solving the maximisation problem in (5) yields consumption growth:

$$C_t = C_0 e^{(\frac{r-\delta}{\rho})t} \tag{6}$$

and the initial level of consumption:

$$C_0 = \frac{x}{e^{xT} - 1} \left(\int_0^R E_t e^{-rt} dt + \int_R^T b_t e^{-rt} dt \right) \tag{7}$$

where

$$x = \frac{r - \delta}{\rho} - r$$

It can be seen from equations 6 and 7 that the model predicts a perfect offset between pensions and other wealth: consumption in each period t depends on the present value of *total* endowment and not on the timing of it (i.e. on whether is of the form of labour-earnings or pensions).

Wealth accumulated at any period S before retirement is the sum of all labour earnings up to S minus consumption:

$$W_S = \int_0^S (E_t - C_t) e^{r(S-t)} dt \tag{8}$$

Substituting 7 into 6 and then in 8 yields:

$$
\begin{aligned}
W_S \quad = \quad & \int_0^S E_t e^{r(S-t)} dt \\
& -Q \left[\int_0^R E_t e^{r(S-t)} dt - \int_R^T b_t e^{r(S-t)} dt \right]
\end{aligned} \tag{9}
$$

where

$$
Q = \begin{cases} \frac{e^{x(t-tr)}-1}{e^{xT}-1} & \text{if } x \neq 0 \\ \\ \frac{t-tr}{T} & \text{if } x = 0 \end{cases} \tag{10}
$$

and tr represents the year of the pension reform, thus t-tr is the number of years the individual has been exposed to the new system.

Equation 9 relates other wealth at age S, W_S, to the net present value of earnings up to age S, the net present value of lifetime earnings adjusted by a factor Q, and the net present value of pension wealth also adjusted by Q. The main insight of Gale (1998) is that as $Q \in [0, 1)$,because t-$tr$$<T$, the crowding-out effect obtained from equation 9 will be biased towards cero, thus different from the true 100% offset that the model predicts in equations 6 and 7. Gale (1998) also notes that since Q, is increasing in t-tr, the estimated offset rises with the worker's age (actually with the worker's time spent in the reformed system). In other words, the effect of the unexpected change in pension wealth will be different for individuals at different stages of their working lives. The intuition behind is that younger individuals at the time of the unexpected change in pension wealth have more periods ahead to adjust their consumption path, thus will adjust wealth accumulation in a smooth fashion. On the contrary, an individual that faces an exogenous (say) increase in his pension wealth in the eve of his retirement, does not have many working-periods ahead to adjust his consumption, and hence will offset the pension wealth increase by decreasing other wealth in a more dramatic way.

4.2 Empirical Analysis

From equation 9, the empirical specification we use is

$$
W_i = \mathbf{X}_i * \boldsymbol{\gamma} + \boldsymbol{\beta} * \mathbf{EPW}_i + \boldsymbol{\epsilon}_i \tag{11}
$$

where W_i represents non-pension wealth for individual i, EPW_i computed as described in sections 3.2.3 and 3.2.4 is adjusted by the Gale's factor and ϵ_i represents the unobservables that affect wealth accumulation.

The control variables included in the vector $\mathbf{X}_i$ are sex, age[23], education dummies and the net present value of adjusted earnings (computed as described in section 3.2.1).

4.2.1 Empirical Issues

We use two measures of wealth: net financial wealth only and net worth, which comprises both real and net financial wealth. As for real assets we consider housing, other real state, cars, machinery and own business (all correspondingly net of mortgages or debt). Net financial wealth is the sum of savings in bank accounts, fixed term deposits, mutual funds, shares, state bonds, amongst others; minus financial liabilities.

The adjusting factor Q is determined not only by the year of the reform and the age of the individual but also by the preference parameters, ρ the coefficient of risk aversion and δ the discount rate (see equation 10). As regards, we take three values for ρ (1,2 and 3) and four values for δ (2%, 4%, 6% and 10%), yielding twelve possible combinations of which only 10 are relevant[24]. Following the analysis in Samwick (1998) about the appropriate wealth measure to be used, his estimations of δ are higher when using financial wealth as compared to when using net worth. Thus, if financial wealth is the pertinent wealth measure, we should probably rely on $\delta = 6\%$ or $\delta = 10\%$, while when using net worth the discount rate should be closer to 2% or 4%. In any case, we provide all the sensibility analysis in the results section.

4.2.2 Possible Sources of Bias

There are several reasons why our estimates of β in equation (11) may be biased, most of them due to measurement or specification issues. In this subsection we intend to analyse the extent and sign of these potential problems to gain a better understanding on the impact on our results.

There are three reasons why we may underestimate the displacement effect. Firstly, our measure of EPW is based on self reports of employment and contribution histories. The literature on measurement error on survey data, for example on the reporting of unemployment, indicates that the greater the length of the recall period, the greater the expected bias due to respondent retrieval and reporting error (see Bound, Brown, and Mathiowetz (2001) for a review

[23] As in Attanasio and Brugiavini (2003) and Attanasio and Rohwedder (2003), we could have allowed the effect of the exogenous change in pension wealth to vary with age so as to take into account that individuals at different stages in their life-cycles might face different degrees of liquidity constraints and thus might have different degrees of substitutability between pension wealth and non-pension wealth. However, as our sample is comprised only by individuals that were already working in 1981, age does not vary as much as in a non-restricted sample. In fact, the average age was 33 years old and the standard deviation is 9 years.

[24] Since we assume r=4%, when $\delta = 4\%$ both parameters cancel out and ρ becomes irrelevant.

of the literature and a comprehensive analysis of the topic)[25]. Applying this evidence to our case would suggests that individuals overestimate their contribution profiles, thus our measure of EPW would be biased upwards implying a downward bias in the estimated displacement effect. The authors also point out that the length of time may not be the only or most relevant factor in the measurement error. In particular, in our framework, the quality of the reports could be positively correlated with the attachment to the labour market. These two sources of measurement error would affect the quality of the reports to a greater extent for those in the PAYG plan.

Ideally, it should be possible to compare on an individual basis the self-reports from the EPS with administrative pension savings records. This information exists but, unfortunately, is not publicly available yet. As an alternative validity check, for each period (month) in the EPS, we compute the ratio of the number of individuals contributing to the PFA system to the number of individuals contributing to either system (PFA or PAYG); and compared this (aggregated) ratio to the corresponding one from aggregate official figures[26]. Figure A.1 in the Appendix shows that the difference between the two series is never greater than 3% in absolute value. Thus, the proportion of individuals who self-reported to have contributed to the pension system in any particular month does not significantly differ from the actual figures coming from aggregate statistics.

A second source of under estimation could arise from our assumption that everyone retires at pension age (thus no early retirement). This assumption should be rather innocuous when computing EPW for those in the PAYG system as the main provider does not allow for early retirement whatsoever. However, those in the PFA scheme that satisfy the requirements could choose early retirement and thus we would overestimate their EPW, which implies an underestimation of the displacement effect..

Finally, while our measure of EPW is before taxes, non-pension wealth is after taxes. This dichotomy is the third source of downward bias in the estimated displacement effect.

On the other hand, there is one source of over estimation. While our measures of wealth include assets held by the individual and his/her partner; the EPW includes the individual entitlements only[27] and thus does not consider the pension the partner will be entitled to on his/her own right. In other words, we have household-level wealth data but individual-level pension wealth data. Consequently, we underestimate EPW for individuals whose partner also participates in the labour market, is enrolled to the pension system and will draw

[25] However Bound et al. (2001) also emphasise that the empirical findings regarding the impact are not consistent.

[26] Reported by the Superintendency of Pensions and the Instituto de Normalizacion Previsional, INP. The latter is the govermental agency that manages the PAYG system.

[27] Including the survivors' benefits for the dependants.

a pension on his/her own right. The displacement effect will be overestimated for this group.

As long as the over and under estimation of EPW are similar across pension systems (which due to data limitations we cannot check) the bias will not be too severe.

The lifecycle model we use in this paper has some limitations that could also lead us to not to get the true offset effect between pensions and other wealth. In particular, we do not include credit constraints and uncertainty in the analysis. Firstly, both issues could affect the choice of pension scheme: credit constrained individuals could have opted out to the PFA plan motivated by the lower contribution rate (and thus the higher take home wage) and the rate of return uncertainty could have deterred individuals from switching from the PAYG to the PFA scheme. Secondly, both issues could affect the offset between pension wealth and other wealth: individuals that are credit constrained would offset less of the increase in pension wealth as compared to those non-constrained. Likewise, uncertainty would make more risk averse individuals to offset less of the increase in pension wealth for precautionary motives savings as compared to those less risk averse. Thus, by no taking into account these considerations, the estimated offset effect would have an upward bias.

4.2.3 Identification Strategy

To apply simple OLS to equation 11 on individual data would yield biased and inconsistent estimates of the effect of adjusted EPW on other wealth. There are at least two reasons for that. First, no matter how fine detail on pension formulae we use our computations of EPW are likely to suffer from measurement error (see section 4.2.2). Second, there may be unobserved heterogeneity in at least two aspects: (i) individuals may differ in the expectations and information they had about the reform and this unobserved heterogeneity may be correlated with savings behaviour; and (ii) individuals may differ in their taste for savings, thus for example those with high wealth may also have high pension wealth. This would be even more evident if the reform did increase the EPW for those who opted-out (as mentioned in sections 3.2.3 and 3.2.4), but individuals who opted-out are not a random sample of the population. Consequently, to properly identify the effect of pension entitlements on household wealth accumulation, we use an instrumental variable (IV) approach . We use two alternative IVs. The first one exploits the fact that the reform was undertaken by the economic team of the military government and many people declare to have been forced to opt-out to a PFA[28]. Thus, we use *forced* as an exogenous change in EPW.

[28] The EPS2002 inquires about the reasons for opting-out. The alternatives were: (i) To get a higher take home wage, (ii) Private management of pensions funds is better than public management, (iii) I hope to get a higher pension, *(iv) I was forced by my employer*, (v) I was afraid that the PAYG system would had been shut down, (vi) Advertisement of the PFA system, (vii) I computed my RB, (viii) Advice from friends, (ix) Advice from a PFA clerk,

Our second IV exploits differences in participation in the labour market across *cohorts* at the time of the pension reform. Individuals already in the formal labour market in 1981 (more precisely, enrolled to the pension system) had the choice to either stay in the PAYG scheme or opt-out to a PFA. On the other hand, individuals yet to join the formal labour market had no choice but to enroll to a PFA. Thus, our second IV exploits the fact that amongst individuals of 15-24 years of age, those aged between 15 to 19 were mainly out of the labour force, thus had no choice but to join a PFA, whereas most of those in the immediate older cohort (aged 20 to 24) where already working so were able to choose between the PAYG scheme and the PFA arrangement. Thus, the former low-choice group should, in average, have higher EPW than the latter high-choice group.

Our identification strategy, thus, exploits the fact that the reform exogenously increased EPW for some individuals but not for others. The exogeneity that supports both of our instruments relies on the degree of choice individuals had when choosing pension arrangement.

As became apparent in section 4.1, an exogenous change in the budget constraint given by the increase in pension wealth should be reflected in a total crowding-out effect in other wealth. Hence we would expect a coefficient β in equation 11 equal to -1. Nonetheless, fundamental differences in the risks individuals face in either pension systems may cause the displacement effect not to be complete. For example, if individuals believe they face higher risks under the PFA system (the rate of return risk or the life expectancy risk) they may increase their savings outside the pension system, which in turn would yield an estimated β lower than $|1|$. Further, our estimation of the displacement effect may be biased if there is non-random heterogeneity in the preference parameters- the discount rate and the elasticity of substitution. For instance, the latter could lead individuals to save for pre-cautionary motives (on top of retirement), which would yield downward-biased estimates of the displacement effect. The IV approach used in this paper does not allow us to identify whether the displacement effect comes from the preferences parameters or from the change in the budget constraint induced by the change in pension wealth. This differentiation would be possible in a structural model, which we leave for future research.

5 Results

5.1 Forced as IV

Before presenting the results of IV regression of equation 11, we provide some descriptive statistics of the sample and of how EPW and other wealth vary with

(x) To get a higher rate of return, (xi) I retired in the PAYG system but kept contributing to the PFA system.

the "forced" IV. Of the 2,580 non-pensioners in our sample[29], as many as 43% were forced to a PFA. Table 1 gives an overview of the sample. From panel A, around 69% opted out to a PFA and the remaining 31% stayed in the PAYG system. Stayers and those who opted-out are fairly different in the observable characteristics tabulated. For instance, men and more educated individuals are over-represented in the PFAs in comparison with the PAYG plan, supporting the idea that the choice of pension scheme was endogenous. The bottom panel shows average net present value of EPW, net worth and net financial wealth by pension system. Individuals in the PFA scheme have significantly more net present value of EPW and, at the same time, less net worth. This relationship holds even when taking into account some observed heterogeneity. For example, amongst individuals with primary education those who opted out expect a pension wealth 3.6 times higher than those who stayed in the PAYG system and, at the same time, have less net worth. Therefore, there is not only wide variation in net present value of EPW by pension system but also there is an inverse relation between it and net worth. Though the latter relationship is only a simple correlation, it suggests the existence of the displacement effect.

Some concern may arise about the genuine exogeneity of forced, i.e. the validity of the instrument. Indeed, our variable may suffer from measurement error as it was self-reported by individuals in the EPS 21 years after the pension reform. Also, the reform could have or could have not met individuals' expectations, which may influence the reasons they give nowadays of why they opted-out to the PFA scheme, so forced could be subjective to some extent, which in turn could lead to an unknown-direction bias in the responses. For example, someone who now realises would have got a higher (lower) net present value of EPW in the PAYG than in the PFA scheme may declare he was (was not) forced to opt out while in reality he was not (was). Although we cannot directly test this possibility, Quintanilla (2009) computes each individual's net present value of EPW in either system (the pension system he is actually affiliated and what he would have had in the opposite pension scheme). Amongst those in our sample and in the PFA system, an overall, 83% will get a higher net present value of EPW in the PFA than they would have got in the PAYG scheme (thus they took the optimal choice). This share does not vary across those who were forced and those who were not forced to opt-out, which we interpret as suggestive of that individuals did not report this variable subjectively.

[29] We have also dropped from the sample those individuals whose net present value of earnings, net worth and net financial wealth is in the bottom or top percentile of each distribution.

Table 1: Sample Characteristics and EPW using Forced as IV, by system

A. Sample Characteristics

	System		
	PAYG	PFA	Total
All	800	1,780	2,580
Men	44.9%	65.8%	59.3%
Women	55.1%	34.2%	40.7%
None	48.4%	23.9%	31.5%
Primary	38.1%	42.2%	41.0%
Secondary	8.8%	18.4%	15.4%
Degree	4.8%	15.4%	12.1%
Age in 1981	38	29	32

B. Mean NPV_EPW, Net Worth and Net Financial Wealth ($millions, 2002)

	NPV_EPW			Net Worth			Net Financial Wealth		
	PAYG	PFA	Total	PAYG	PFA	Total	PAYG	PFA	Total
All	4.8	19.9	15.2	11.2	10.8	10.9	-0.1	-0.3	-0.3
Men	4.3	20.2	16.5	11.3	10.9	10.9	-0.1	-0.3	-0.3
Women	5.2	19.2	13.3	11.2	10.7	10.9	-0.1	-0.4	-0.3
None	3.0	14.1	8.8	8.8	6.5	7.6	-0.1	-0.1	-0.1
Primary	3.7	13.6	10.8	11.7	9.5	10.1	-0.1	-0.3	-0.2
Secondary	4.5	24.7	21.1	13.1	12.3	12.4	-0.6	-0.4	-0.4
Degree	30.8	40.2	39.0	28.5	19.2	20.4	-0.4	-0.8	-0.7

It could also be the case that some individuals were more likely than others to be forced to opt-out. Table A.1 in the appendix shows a probit regression for the probability to have been forced to opt-out against a set of controls that include several job related characteristics at the time of the reform. The results show that, except for a small effect of age and a marginally significant effect of sex, forced cannot be explained by education level or any job-characteristic, thus giving support to the exogeneity of forced.

Table 2 shows the results on the first stage of the IV estimation, i.e. the reduced form for the net present value of EPW on all covariates plus the instrument. In the interest of space, only the estimated coefficient of the instrument, forced, is reported. Each of the ten rows of table 2 represent the estimation for one particular combination of the preference parameters. The F-test on the significance of the variable forced rejects the null hypothesis that the coefficient is equal to zero, which rules out the possibility of weak identification. Further, we reject the null of underidentification, i.e the instrument satisfies the rank condition. Both, non-weak identification and non-underidentification, are so for all 10 combinations of the preference parameters

Table 2: First stage regression results, using Forced as IV
Estimated coefficient of Forced

Parametrisation		EPW
δ value	ρ value	
2%	1	4,261,050 (359,295)***
2%	2	4,696,442 (397,245)***
2%	3	4,834,709 (409,348)***
4%	-	5,098,900 (432,529)***
6%	1	5,779,083 (492,449)***
6%	2	5,460,942 (464,390)***
6%	3	5,345,044 (454,180)***
10%	1	6,640,764 (568,507)***
10%	2	6,053,186 (516,648)***
10%	3	5,779,083 (492,449)***
N		2,580

* p<0.1, ** p<0.05, *** p<0.01

In table 3 we report the results from estimating β in equation 11 both by OLS and by IV[30]. While columns 1 and 3 contain the results when using net worth, columns 2 and 4 when using net financial wealth. Each row represents one of the ten possible combinations of the preference parameters (δ and ρ). As discussed in section 4.2.1, when the dependent variable is net worth, then the relevant values for δ are 2% and 4%, while if the outcome we are looking at is financial wealth then we should use higher values for δ, 6% and 10%. Even though table 3 provides the whole set of results, we will focus only on the relevant combinations for the analysis.

[30] As EPW is a computed meassure, all standard errors have been bootstrapped.

Table 3: Estimated Effects of EPW on Non-Pension Wealth
Using Forced as IV

Parametrisation		OLS		IV	
δ value	ρ value	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
2%	1	0.130	-0.006	-0.362	-0.020
		(0.049)***	(0.003)**	(0.134)***	(0.010)**
2%	2	0.122	-0.005	-0.327	-0.018
		(0.040)***	(0.003)**	(0.131)**	(0.009)**
2%	3	0.119	-0.005	-0.317	-0.018
		(0.039)***	(0.003)**	(0.125)**	(0.009)**
4%	-	0.114	-0.005	-0.300	-0.017
		(0.034)***	(0.002)**	(0.126)**	(0.009)*
6%	1	0.104	-0.005	-0.264	-0.015
		(0.032)***	(0.002)**	(0.112)**	(0.007)**
6%	2	0.108	-0.005	-0.280	-0.016
		(0.033)***	(0.002)**	(0.108)***	(0.008)**
6%	3	0.110	-0.005	-0.286	-0.016
		(0.036)***	(0.002)**	(0.114)**	(0.008)*
10%	1	0.091	-0.004	-0.230	-0.013
		(0.029)***	(0.002)**	(0.096)**	(0.006)**
10%	2	0.099	-0.005	-0.252	-0.014
		(0.031)***	(0.002)**	(0.097)***	(0.007)**
10%	3	0.104	-0.005	-0.264	-0.015
		(0.031)***	(0.002)**	(0.101)***	(0.007)**
N		2,580	2,580	2,580	2,580

Bootstrapped standard errors in parentheses
p<0.1, ** p<0.05, *** p<0.01

The first feature that emerges from the table is the upward bias from the OLS regression. We get positive and significant estimates of between 12% and 14% when net worth is the outcome variable, estimates that are very similar to the findings of Coronado (1998). The estimated coefficients when financial wealth is the dependent variable are also upward biased compared to the IV results but to a much lesser extent. Thus, not taking into account the unobserved heterogeneity would lead us to conclude that there is a crowding-in effect from pension wealth on private wealth. On the other hand, when we follow the IV approach, we get that there is an average crowding-out effect of between 30% and 36% for net worth. These magnitudes are qualitatively the same, although in the bottom of the range, when compared to the results from Gale (1998) for the United States, from Attanasio and Brugiavini (2003) for their non age interaction specification for Italy and from Bennett et al. (2001) for Chile.

The second message we draw from our estimates is that most of the displacement effect comes from net worth and very little from financial wealth, though the latter is still marginally significant. These results are not surprising as most individuals in our sample keep real rather than financial assets and as the magnitude of average net worth is considerable higher than of financial wealth (see table 1). Moreover, considering that pensions savings and real assets are both illiquid savings, it is sensible to see them as substitutes.

Full regressions results are reported in the appendix. The estimated coefficients for the other right-hand side variables do have the expected signs and magnitudes. On average, wealth accumulation is increasing in age, in education and in the net present value of earnings.

5.2 Cohort as IV

We now turn to the results when we use the 15-19 and 20-24 cohorts as IV. Indeed, 56% of individuals between 20-24 years of age in 1981 could choose between pension arrangements while only 26.2% in the immediately younger cohort had choice. Table 4 describes the sample showing that there are differences between those who opted -out and those who stayed.

As for the case of forced as instrument, the reduced form estimates show that cohort does determine the net preset value of EPW. We formally check for under and weak identification rejecting both for all ten combinations of the preference parameters. Table 5 reports the estimated coefficients for cohort in the first stage regression (also as in the case of forced, only the estimated coefficients for the instruments are displayed. Each row represents the estimation for one of the 10 preference parameters combinations).

Table 4: Sample Characteristics and EPW using Cohort as IV, by system

A. Sample Characteristics

	System		
	PAYG	PFA	Total
All	61	2,803	2,864
Men	23.0%	53.9%	53.2%
Women	77.0%	46.1%	46.8%
None	42.6%	17.8%	18.3%
Primary	39.3%	41.6%	41.6%
Secondary	18.0%	23.5%	23.4%
Degree	0.0%	17.1%	16.7%

B. Mean NPV_EPW, Net Worth and Net Financial Wealth ($millions, 2002)

	NPV_EPW			Net Worth			Net Financial Wealth		
	PAYG	PFA	Total	PAYG	PFA	Total	PAYG	PFA	Total
All	6.6	5.9	5.9	9.2	6.6	6.7	0.0	-0.3	-0.3
Men	8.7	6.4	6.4	6.5	6.7	6.7	-0.1	-0.3	-0.3
Women	6.0	5.4	5.4	10.0	6.5	6.6	0.0	-0.3	-0.3
None	4.6	4.5	4.5	5.8	4.0	4.1	-0.1	-0.1	-0.1
Primary	7.4	5.0	5.1	14.4	6.2	6.3	0.1	-0.2	-0.2
Secondary	9.6	6.3	6.3	5.8	6.6	6.6	0.0	-0.3	-0.3
Degree		9.0	9.0		10.5	10.5		-0.6	-0.6

When we run OLS to equation 11 for this sub-sample, we obtain a positive, significant and rather high coefficient of 21-27% on the effect of EPW on net worth. However, when we take care of the unobserved heterogeneity problem through the IV regression, we get a point estimate of the pension offset of 100%. The results are displayed in Table 6. However, taking into account the confidence intervals, the results when using *forced* (table 3) and when using *cohort* (table 6) are not statistically different from each other. In other words, both instruments suggest that the offset is not complete.

Our findings for the cohort sample are fairly similar to the displacement effect found by Bennett et al. (2001) with aggregate data for Chile and by Gale (1998) for the LAD regression. Also, considering that the mean age of individuals in our sub-sample is 42 years old in 2004, our estimates are quite similar to the displacement effects found by Attanasio and Brugiavini (2003) for Italy in the specifications where pension wealth is interacted with age[31]. The crowding out for this sub-sample comes entirely from net worth, the estimates on net financial wealth have the right sign but are non-significant.

[31] As in our paper, Gale (1998) uses stock of wealth, thus his and our results are directly comparable in this respect. On the other hand, our results are not strictly comparable to those of either Bennett et al. (2001) and Attanasio and Brugiavini (2003) as they use saving rates rather than the stock wealth as the dependent variable.

Table 5: First stage regression results, using Forced as IV
Estimated coefficient of Cohort

Parametrisation		EPW
δ value	ρ value	
2%	1	1,063,476
		(155,837)***
2%	2	1,223,484
		(178,441)***
2%	3	1,274,339
		(185,634)***
4%	-	1,615,865
		(234,142)***
6%	1	1,502,527
		(217,996)***
6%	2	1,460,711
		(212,052)***
6%	3	1,907,984
		(276,027)***
10%	1	1,711,431
		(247,800)***
10%	2	1,615,865
		(234,142)***
10%	3	1,371,187
		(199,348)***
N		2,864

* p<0.1, ** p<0.05, *** p<0.01

Table 6: Estimated Effects of EPW on Non-Pension Wealth
Using Cohorts as IV

Parametrisation		OLS		IV	
δ value	ρ value	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
2%	1	0.270	-0.006	-1.398	-0.014
		(0.106)**	(0.010)	(0.848)*	(0.065)
2%	2	0.236	-0.005	-1.213	-0.012
		(0.089)***	(0.009)	(0.627)*	(0.058)
2%	3	0.227	-0.005	-1.165	-0.011
		(0.089)**	(0.009)	(0.664)*	(0.060)
4%	-	0.211	-0.005	-1.082	-0.011
		(0.082)**	(0.008)	(0.548)**	(0.061)
6%	1	0.180	-0.004	-0.917	-0.009
		(0.074)**	(0.007)	(0.502)*	(0.046)
6%	2	0.193	-0.005	-0.987	-0.010
		(0.078)**	(0.007)	(0.538)*	(0.047)
6%	3	0.198	-0.005	-1.015	-0.010
		(0.073)***	(0.008)	(0.478)**	(0.049)
10%	1	0.152	-0.004	-0.776	-0.008
		(0.059)**	(0.006)	(0.441)*	(0.039)
10%	2	0.170	-0.004	-0.866	-0.009
		(0.065)***	(0.007)	(0.513)*	(0.045)
10%	3	0.180	-0.004	-0.917	-0.009
		(0.074)**	(0.007)	(0.509)*	(0.046)
N		2,864	2,864	2,864	2,864

Bootstrapped standard errors in parentheses
p<0.1, ** p<0.05, *** p<0.01

5.3 Possible Reasons for Incomplete Offset

There are at least three possible explanations for the incomplete offset found in this paper, one arising from the methods used and the other two from economic theory.

As for the methods used, the result could be driven by the first source of measurement error in EPW mentioned in section 4.2.2. If individuals are overoptimistic when self-reporting their contribution history we would then overestimate their EPW which would in turn lead us to underestimate the pension offset. As the recall error is more severe for periods far away in the past, the downward bias of the estimated displacement effect would be higher for older individuals. In this sense, the estimated effect for the forced sample would be a lower bound.

The second possible reason for our results could be that, provided the risk of shocks to rate of return, the offset will be less than perfect.

Finally, another explanation is found by relaxing the time separability assumption of the utility function. In particular, if we allow for habit formation in consumption, utility would depend not only on contemporaneous consumption but also on the stock of habits, which is in turn influenced by past consumption. The intuition behind this is that habits tend to pull consumption towards the level of the habit stock (Carrol, Overland, and Weil (2000)). Indeed, using panel data to control for fixed effects, Carrasco, Labeaga, and López-Salido (2005) find that there is indeed habit formation for food and services. Going back to our framework, if the utility function exhibits time separability, an increase in EPW should be completely offset by a reduction of wealth through higher consumption. However, if we apply the habits intuition, habit forming consumers desire to smooth consumption growth so they will increase consumption to a lesser extent and thus their displacement effect would be less than complete.

Although to model habit formation is far beyond the scope of this paper, we try to provide some evidence on it. We focus on house ownership as most of the displacement effect estimated comes from net worth and most of net worth comes from housing. According to the EPS2004, individuals in the forced sample bought their house when they where 37 years old on average and 45% already owned their houses around the time of the reform[32]. If individuals are habit-formers that derive utility from past consumption of housing, then in spite of the positive shock on pension wealth they would not downsize their house-wealth as they would do if had time separable preferences.

6 Conclusions

Chile went through a major pension system reform in the early '80s which induced an important increase in EPW. In the framework of the life-cycle model we study the extent to which households responded to this increase in EPW by decreasing other wealth. The simplest version of the model predicts perfect offset between EPW and non-pension wealth.

We take into account the fact that the degree of substitutability between EPW and other wealth will depend on the stage of the life-cycle individuals were at the time of the reform because this would determine how many remaining periods they have to re-adjust consumption. We do this by adjusting EPW by a factor that is increasing in age.

[32] More precicely by 1986. 30% owned their houses by 1981.

We use an IV approach that allows us not only to control for the unobserved heterogeneity that is likely to link wealth accumulation and EPW but also to get rid of the measurement error we are likely to face when computing EPW. We use two IVs on different sub-samples, both exploit the degree of choice individuals had when making their staying/opting-out decision. We find that individuals in our older sample offset 30% of the exogenous increase in expected pension wealth and that the displacement is not statistically different to this figure for the younger sample. The crowding out for both samples is mainly through real assets. There are several reasons why the displacement effect may differ from 100%, ranging from liquidity constraints to the lack of understanding of the benefit structure to the habit formation theory. In any case, our results are very much in line with the results found by the relevant literature.

Our results have important policy implications, not least nowadays that a second pension reform has recently been passed in Chile. The reform widens the safety net, thus increasing EPW for individuals in the bottom 60% of the income distribution. It also aims to increase competition, to reduce management costs and to extend foreign investment limits so as to have higher expected pension fund returns. These three latter measures would increase EPW for middle and high income individuals. Should EPW be increased by the reform, our findings suggest that individuals would decrease their non-pension wealth accumulation. Note however, that the extent of the crowiding-out will depend upon the clarity individuals have of the effects of the pension reform and of the willingness to cover the extra risks they may face. Further, considering that pension savings have a much more generous tax treatment than other savings, different magnitudes of the displacement effect for individuals in different points of the income distribution may have significant redistributive effects.

Appendix

Figure A.1. Share of individuals contributing in PFA
(Administrative Data - EPS self reported Data)

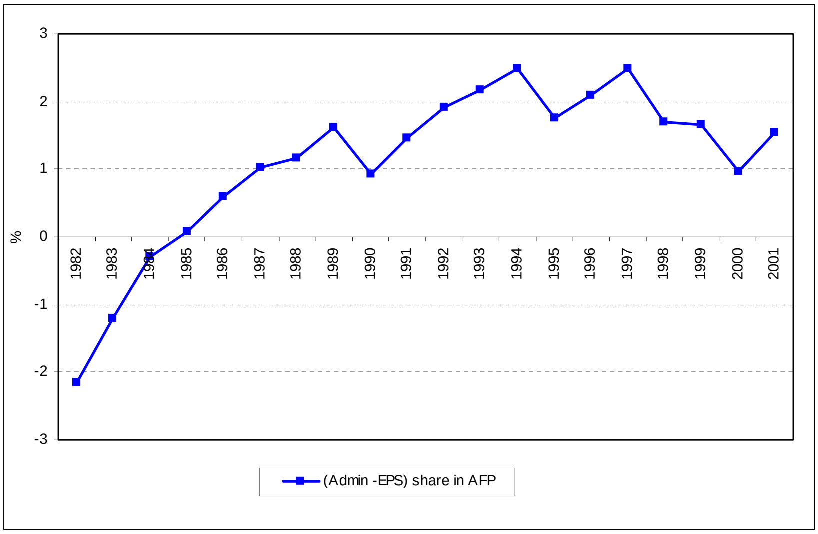


Figure A.2. Unconditional Probability of Contributing Given Initial State.

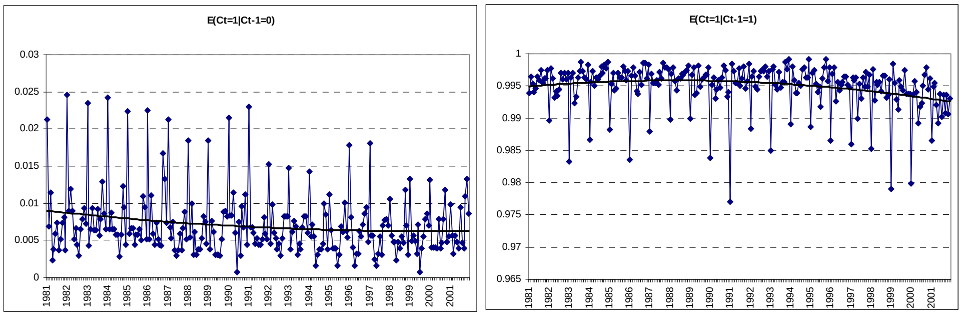


Table A.1. Probability of Being Forced

Man	0.15
	(0.07)**
Age	-0.02
	(0.00)***
None	-0.07
	(0.12)
Primary	0.14
	(0.11)
Secondary	0.09
	(0.12)
Agriculture	-0.41
	(0.40)
Mining	-0.66
	(0.45)
Industry	-0.12
	(0.40)
Construction	-0.37
	(0.40)
Retailing	-0.31
	(0.40)
Transport	-0.29
	(0.41)
Financial Services	-0.28
	(0.43)
Social and Personal Services	-0.10
	(0.40)
Region I	0.51
	(0.41)
Region II	0.12
	(0.41)
Region III	0.06
	(0.48)
Region IV	0.45
	(0.39)
Region V	0.60
	(0.37)
Region VI	0.59
	(0.38)
Region VII	0.36
	(0.38)
Region VIII	0.46
	(0.37)
Region IX	0.45
	(0.38)
Region X	0.74
	(0.38)*
Region XIII	0.49
	(0.45)
Region XIII	0.58
	(0.36)
Self-Employed	-0.87
	(0.58)
Civil Servant	0.09
	(0.57)
Employee	-0.21
	(0.58)
Domestic Worker	-0.54
	(0.59)
Unpaid Family Worker	-0.16
	(0.97)
Blue Collar [a]	0.20
	(0.20)
White Collar [a]	0.08
	(0.20)
Belongs to Union	0.11
	(0.08)
Constant	0.85
	(0.79)

(a) Blue collar and whote collar refer, respectively, to workes enrolled to the Social Service Insurance and Private Employees providers from the PAYG system

Full set of results using Forced as instrument. OLS and IV estimates

Table A.2: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 2\%$, $\rho = 1$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.130	-0.006	-0.362	-0.020
	(0.045)***	(0.003)**	(0.143)**	(0.010)**
sex	-5.64e+05	57.200.818	-8.07e+05	49.997.305
	(6.45e+05)	-43.759.255	(6.95e+05)	-44.093.694
age	2.53e+05	2.824.411	5.05e+05	10.309.167
	(41165.788)***	(1692.504)*	(83930.722)***	(5337.396)*
primary	3.24e+06	-7.16e+04	4.13e+06	-4.52e+04
	(5.89e+05)***	(33963.669)**	(6.62e+05)***	-37.204.124
secondary	4.15e+06	-1.95e+05	6.22e+06	-1.33e+05
	(9.11e+05)***	(73144.683)***	(1.15e+06)***	(80349.711)*
degree	9.84e+06	-3.99e+05	1.53e+07	-2.38e+05
	(1.50e+06)***	(1.07e+05)***	(2.41e+06)***	(1.39e+05)*
pv_earnings	0.012	-0.001	0.035	-0.000
	(0.005)**	(0.000)***	(0.008)***	(0.001)
cons	-8.49e+06	-2.15e+05	-2.23e+07	-6.23e+05
	(2.36e+06)***	(1.08e+05)**	(4.64e+06)***	(2.99e+05)**
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Table A.3: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 2\%$, $\rho = 2$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.122	-0.005	-0.327	-0.018
	(0.040)***	(0.003)**	(0.130)**	(0.009)**
sex	-5.01e+05	54.204.660	-7.33e+05	47.481.201
	(6.41e+05)	-43.557.488	(6.89e+05)	-43.832.054
age	2.56e+05	2.680.382	5.05e+05	9.897.174
	(41275.617)***	-1.689.907	(82881.477)***	(5244.748)*
primary	3.25e+06	-7.16e+04	4.16e+06	-4.52e+04
	(5.89e+05)***	(33950.056)**	(6.63e+05)***	-37.291.795
secondary	4.17e+06	-1.95e+05	6.31e+06	-1.33e+05
	(9.11e+05)***	(73067.563)***	(1.16e+06)***	(80724.942)*
degree	9.84e+06	-3.98e+05	1.55e+07	-2.34e+05
	(1.50e+06)***	(1.07e+05)***	(2.44e+06)***	(1.41e+05)*
pv_earnings	0.010	-0.001	0.031	-0.000
	(0.004)**	(0.000)***	(0.007)***	(0.000)
cons	-8.69e+06	-2.06e+05	-2.23e+07	-5.99e+05
	(2.37e+06)***	(1.09e+05)*	(4.58e+06)***	(2.94e+05)**
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Table A.4: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 2\%$, $\rho = 3$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.119	-0.005	-0.317	-0.018
	(0.039)***	(0.003)**	(0.126)**	(0.009)**
sex	-4.83e+05	53.369.289	-7.13e+05	46.748.239
	(6.40e+05)	-43.502.253	(6.87e+05)	-43.762.714
age	2.57e+05	2.639.638	5.05e+05	9.781.185
	(41302.415)***	-1.689.173	(82569.322)***	(5217.421)*
primary	3.25e+06	-7.17e+04	4.17e+06	-4.52e+04
	(5.90e+05)***	(33946.476)**	(6.64e+05)***	-37.315.532
secondary	4.17e+06	-1.95e+05	6.34e+06	-1.33e+05
	(9.10e+05)***	(73044.938)***	(1.16e+06)***	-80.829.537
degree	9.84e+06	-3.97e+05	1.55e+07	-2.33e+05
	(1.50e+06)***	(1.07e+05)***	(2.45e+06)***	(1.42e+05)
pv_earnings	0.010	-0.001	0.030	-0.000
	(0.004)**	(0.000)***	(0.007)***	(0.000)
cons	-8.75e+06	-2.03e+05	-2.22e+07	-5.92e+05
	(2.37e+06)***	(1.09e+05)*	(4.56e+06)***	(2.92e+05)**
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Table A.5: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 4\%$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.114	-0.005	-0.300	-0.017
	(0.037)***	(0.002)**	(0.120)**	(0.008)**
sex	-4.53e+05	51.920.183	-6.80e+05	45.439.027
	(6.38e+05)	-43.407.286	(6.85e+05)	-43.645.977
age	2.59e+05	2.567.557	5.05e+05	9.577.565
	(41345.334)***	-1.687.868	(82003.825)***	(5168.196)*
primary	3.25e+06	-7.17e+04	4.18e+06	-4.53e+04
	(5.90e+05)***	(33940.422)**	(6.65e+05)***	-37.356.021
secondary	4.18e+06	-1.95e+05	6.38e+06	-1.33e+05
	(9.10e+05)***	(73004.173)***	(1.16e+06)***	-81.009.063
degree	9.84e+06	-3.97e+05	1.56e+07	-2.31e+05
	(1.50e+06)***	(1.07e+05)***	(2.47e+06)***	(1.43e+05)
pv_earnings	0.009	-0.001	0.027	-0.000
	(0.004)**	(0.000)***	(0.007)***	(0.000)
cons	-8.85e+06	-1.99e+05	-2.22e+07	-5.79e+05
	(2.38e+06)***	(1.09e+05)*	(4.53e+06)***	(2.89e+05)**
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Table A.6: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 6\%$, $\rho = 1$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.104	-0.005	-0.264	-0.015
	(0.033)***	(0.002)**	(0.106)**	(0.007)**
sex	-3.91e+05	49.015.585	-6.20e+05	42.627.395
	(6.34e+05)	-43.218.687	(6.80e+05)	-43.425.314
age	2.62e+05	2.412.177	5.04e+05	9.150.920
	(41419.113)***	-1.684.967	(80748.557)***	(5060.330)*
primary	3.25e+06	-7.17e+04	4.20e+06	-4.53e+04
	(5.90e+05)***	(33928.406)**	(6.66e+05)***	-37.435.067
secondary	4.20e+06	-1.95e+05	6.46e+06	-1.32e+05
	(9.10e+05)***	(72913.811)***	(1.17e+06)***	-81.346.879
degree	9.84e+06	-3.95e+05	1.58e+07	-2.28e+05
	(1.50e+06)***	(1.07e+05)***	(2.51e+06)***	(1.45e+05)
pv_earnings	0.008	-0.000	0.023	-0.000
	(0.003)**	(0.000)***	(0.006)***	(0.000)
cons	-9.06e+06	-1.89e+05	-2.21e+07	-5.54e+05
	(2.38e+06)***	(1.09e+05)*	(4.45e+06)***	(2.83e+05)**
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Table A.7: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 6\%$, $\rho = 2$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.108	-0.005	-0.280	-0.016
	(0.035)***	(0.002)**	(0.112)**	(0.008)**
sex	-4.17e+05	50.232.121	-6.44e+05	43.841.899
	(6.36e+05)	-43.297.610	(6.82e+05)	-43.515.553
age	2.61e+05	2.479.807	5.04e+05	9.333.961
	(41390.083)***	-1.686.254	(81298.593)***	(5107.338)*
primary	3.25e+06	-7.17e+04	4.19e+06	-4.53e+04
	(5.90e+05)***	(33933.486)**	(6.66e+05)***	-37.402.214
secondary	4.19e+06	-1.95e+05	6.43e+06	-1.32e+05
	(9.10e+05)***	(72953.489)***	(1.16e+06)***	-81.211.147
degree	9.84e+06	-3.96e+05	1.58e+07	-2.29e+05
	(1.50e+06)***	(1.07e+05)***	(2.49e+06)***	(1.44e+05)
pv_earnings	0.008	-0.000	0.025	-0.000
	(0.003)**	(0.000)***	(0.006)***	(0.000)
cons	-8.97e+06	-1.93e+05	-2.22e+07	-5.65e+05
	(2.38e+06)***	(1.09e+05)*	(4.49e+06)***	(2.85e+05)**
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Table A.8: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 6\%$, $\rho = 3$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.110	-0.005	-0.286	-0.016
	(0.035)***	(0.002)**	(0.114)**	(0.008)**
sex	-4.28e+05	50.736.316	-6.54e+05	44.328.280
	(6.37e+05)	-43.330.302	(6.83e+05)	-43.553.883
age	2.60e+05	2.506.597	5.04e+05	9.407.703
	(41377.275)***	-1.686.751	(81515.328)***	(5125.975)*
primary	3.25e+06	-7.17e+04	4.19e+06	-4.53e+04
	(5.90e+05)***	(33935.558)**	(6.65e+05)***	-37.388.511
secondary	4.19e+06	-1.95e+05	6.41e+06	-1.32e+05
	(9.10e+05)***	(72969.069)***	(1.16e+06)***	-81.151.996
degree	9.84e+06	-3.96e+05	1.57e+07	-2.30e+05
	(1.50e+06)***	(1.07e+05)***	(2.49e+06)***	(1.44e+05)
pv_earnings	0.009	-0.000	0.026	-0.000
	(0.003)**	(0.000)***	(0.006)***	(0.000)
cons	-8.93e+06	-1.95e+05	-2.22e+07	-5.69e+05
	(2.38e+06)***	(1.09e+05)*	(4.50e+06)***	(2.87e+05)**
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Table A.9: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 10\%$, $\rho = 1$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.091	-0.004	-0.230	-0.013
	(0.028)***	(0.002)**	(0.092)**	(0.006)**
sex	-3.44e+05	46.859.429	-5.85e+05	40.225.752
	(6.32e+05)	-43.074.984	(6.78e+05)	-43.274.360
age	2.65e+05	2.270.389	5.02e+05	8.787.382
	(41462.322)***	-1.681.866	(79600.840)***	(4964.097)*
primary	3.26e+06	-7.17e+04	4.22e+06	-4.53e+04
	(5.91e+05)***	(33918.071)**	(6.68e+05)***	-37.494.722
secondary	4.22e+06	-1.95e+05	6.51e+06	-1.32e+05
	(9.10e+05)***	(72828.940)***	(1.17e+06)***	-81.526.021
degree	9.84e+06	-3.94e+05	1.60e+07	-2.25e+05
	(1.50e+06)***	(1.07e+05)***	(2.54e+06)***	(1.47e+05)
pv_earnings	0.006	-0.000	0.020	-0.000
	(0.003)**	(0.000)***	(0.005)***	(0.000)
cons	-9.25e+06	-1.81e+05	-2.20e+07	-5.33e+05
	(2.39e+06)***	(1.09e+05)*	(4.39e+06)***	(2.77e+05)*
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Table A.10: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 10\%$, $\rho = 2$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.099	-0.005	-0.252	-0.014
	(0.031)***	(0.002)**	(0.101)**	(0.007)**
sex	-3.72e+05	48.155.652	-6.04e+05	41.722.686
	(6.33e+05)	-43.162.482	(6.79e+05)	-43.363.553
age	2.64e+05	2.360.555	5.03e+05	9.014.897
	(41437.998)***	-1.683.933	(80328.545)***	(5024.761)*
primary	3.26e+06	-7.17e+04	4.21e+06	-4.53e+04
	(5.91e+05)***	(33924.632)**	(6.67e+05)***	-37.458.307
secondary	4.21e+06	-1.95e+05	6.48e+06	-1.32e+05
	(9.10e+05)***	(72883.223)***	(1.17e+06)***	-81.433.025
degree	9.84e+06	-3.95e+05	1.59e+07	-2.26e+05
	(1.50e+06)***	(1.07e+05)***	(2.52e+06)***	(1.46e+05)
pv_earnings	0.007	-0.000	0.022	-0.000
	(0.003)**	(0.000)***	(0.005)***	(0.000)
cons	-9.13e+06	-1.86e+05	-2.21e+07	-5.46e+05
	(2.39e+06)***	(1.09e+05)*	(4.43e+06)***	(2.81e+05)*
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Table A.11: OLS and IV (using Forced) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 10\%$, $\rho = 3$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.104	-0.005	-0.264	-0.015
	(0.033)***	(0.002)**	(0.106)**	(0.007)**
sex	-3.91e+05	49.015.585	-6.20e+05	42.627.395
	(6.34e+05)	-43.218.687	(6.80e+05)	-43.425.314
age	2.62e+05	2.412.177	5.04e+05	9.150.920
	(41419.113)***	-1.684.967	(80748.557)***	(5060.330)*
primary	3.25e+06	-7.17e+04	4.20e+06	-4.53e+04
	(5.90e+05)***	(33928.406)**	(6.66e+05)***	-37.435.067
secondary	4.20e+06	-1.95e+05	6.46e+06	-1.32e+05
	(9.10e+05)***	(72913.811)***	(1.17e+06)***	-81.346.879
degree	9.84e+06	-3.95e+05	1.58e+07	-2.28e+05
	(1.50e+06)***	(1.07e+05)***	(2.51e+06)***	(1.45e+05)
pv_earnings	0.008	-0.000	0.023	-0.000
	(0.003)**	(0.000)***	(0.006)***	(0.000)
cons	-9.06e+06	-1.89e+05	-2.21e+07	-5.54e+05
	(2.38e+06)***	(1.09e+05)*	(4.45e+06)***	(2.83e+05)**
N	2.580	2.580	2.580	2.580

* p<0.1, ** p<0.05, *** p<0.01

Full set of results using Cohort as instrument. OLS and IV estimates

Table A.11: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 2\%$, $\rho = 1$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.382	-0.006	-1.398	-0.014
	(0.103)***	(0.010)	(0.734)*	(0.068)
sex	-6.82e+05	43.540.271	-2.94e+06	31.887.754
	(4.15e+05)	-43.997.648	(1.08e+06)***	(1.01e+05)
age	1.79e+05	-8.230.260	1.00e+06	-6.426.022
	(80505.504)**	-7.868.450	(3.12e+05)***	-28.536.438
primary	2.04e+06	-1.13e+05	2.07e+06	-1.13e+05
	(3.77e+05)***	(31774.372)***	(4.00e+05)***	(31708.328)***
secondary	1.84e+06	-1.18e+05	1.68e+06	-1.19e+05
	(4.75e+05)***	(43722.279)***	(5.35e+05)***	(45182.422)***
degree	5.06e+06	-4.40e+05	5.94e+06	-4.35e+05
	(7.14e+05)***	(71261.767)***	(8.10e+05)***	(76619.415)***
pv_earnings	0.007	-0.001	0.032	-0.000
	(0.002)***	(0.000)***	(0.011)***	(0.001)
cons	-4.74e+06	3.13e+05	-3.82e+07	2.44e+05
	(3.39e+06)	(3.30e+05)	(1.26e+07)***	(1.15e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Table A.12: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 2\%$, $\rho = 2$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.336	-0.005	-1.213	-0.012
	(0.090)***	(0.009)	(0.638)*	(0.059)
sex	-6.52e+05	41.986.884	-2.91e+06	30.460.803
	(4.14e+05)	-43.935.061	(1.08e+06)***	(1.01e+05)
age	1.82e+05	-8.454.381	1.00e+06	-6.758.571
	(80641.778)**	-7.886.344	(3.10e+05)***	-28.364.875
primary	2.04e+06	-1.13e+05	2.06e+06	-1.13e+05
	(3.77e+05)***	(31775.856)***	(4.00e+05)***	(31711.971)***
secondary	1.85e+06	-1.18e+05	1.69e+06	-1.20e+05
	(4.75e+05)***	(43729.306)***	(5.35e+05)***	(45205.213)***
degree	5.07e+06	-4.40e+05	5.95e+06	-4.35e+05
	(7.14e+05)***	(71297.915)***	(8.10e+05)***	(76642.695)***
pv_earnings	0.006	-0.001	0.028	-0.000
	(0.002)***	(0.000)***	(0.010)***	(0.001)
cons	-4.89e+06	3.24e+05	-3.82e+07	2.59e+05
	(3.40e+06)	(3.31e+05)	(1.25e+07)***	(1.14e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Table A.13: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 2\%$, $\rho = 4$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.323	-0.005	-1.165	-0.011
	(0.087)***	(0.008)	(0.612)*	(0.056)
sex	-6.44e+05	41.575.810	-2.90e+06	30.081.744
	(4.14e+05)	-43.918.508	(1.08e+06)***	(1.01e+05)
age	1.83e+05	-8.513.285	1.00e+06	-6.845.623
	(80677.379)**	-7.891.074	(3.09e+05)***	-28.319.783
primary	2.04e+06	-1.13e+05	2.06e+06	-1.13e+05
	(3.77e+05)***	(31776.254)***	(4.00e+05)***	(31712.982)***
secondary	1.85e+06	-1.18e+05	1.69e+06	-1.20e+05
	(4.75e+05)***	(43731.089)***	(5.35e+05)***	(45211.285)***
degree	5.07e+06	-4.40e+05	5.95e+06	-4.35e+05
	(7.14e+05)***	(71307.487)***	(8.10e+05)***	(76648.981)***
pv_earnings	0.006	-0.001	0.027	-0.000
	(0.002)***	(0.000)***	(0.009)***	(0.001)
cons	-4.93e+06	3.26e+05	-3.82e+07	2.63e+05
	(3.40e+06)	(3.31e+05)	(1.25e+07)***	(1.14e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Table A.14: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 4\%$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.302	-0.005	-1.082	-0.011
	(0.081)***	(0.008)	(0.569)*	(0.052)
sex	-6.31e+05	40.891.231	-2.89e+06	29.449.671
	(4.14e+05)	-43.890.974	(1.08e+06)***	(1.00e+05)
age	1.85e+05	-8.610.897	1.00e+06	-6.989.835
	(80736.240)**	-7.898.942	(3.08e+05)***	-28.245.135
primary	2.04e+06	-1.13e+05	2.06e+06	-1.13e+05
	(3.77e+05)***	(31776.927)***	(4.00e+05)***	(31714.708)***
secondary	1.85e+06	-1.19e+05	1.69e+06	-1.20e+05
	(4.75e+05)***	(43733.938)***	(5.34e+05)***	(45221.333)***
degree	5.07e+06	-4.40e+05	5.95e+06	-4.35e+05
	(7.14e+05)***	(71323.412)***	(8.09e+05)***	(76659.885)***
pv_earnings	0.006	-0.000	0.025	-0.000
	(0.001)***	(0.000)***	(0.009)***	(0.001)
cons	-4.99e+06	3.31e+05	-3.82e+07	2.70e+05
	(3.40e+06)	(3.31e+05)	(1.24e+07)***	(1.14e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Table A.15: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 6\%$, $\rho = 1$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.258	-0.004	-0.917	-0.009
	(0.069)***	(0.007)	(0.483)*	(0.044)
sex	-6.07e+05	39.667.446	-2.86e+06	28.319.774
	(4.13e+05)	-43.842.007	(1.08e+06)***	(1.00e+05)
age	1.87e+05	-8.783.216	1.00e+06	-7.245.808
	(80840.153)**	-7.912.950	(3.07e+05)***	-28.113.994
primary	2.04e+06	-1.13e+05	2.06e+06	-1.13e+05
	(3.77e+05)***	(31778.183)***	(4.00e+05)***	(31717.912)***
secondary	1.86e+06	-1.19e+05	1.70e+06	-1.20e+05
	(4.75e+05)***	(43738.377)***	(5.34e+05)***	(45238.476)***
degree	5.07e+06	-4.40e+05	5.95e+06	-4.35e+05
	(7.15e+05)***	(71351.710)***	(8.09e+05)***	(76682.640)***
pv_earnings	0.005	-0.000	0.021	-0.000
	(0.001)***	(0.000)***	(0.007)***	(0.001)
cons	-5.11e+06	3.39e+05	-3.83e+07	2.81e+05
	(3.41e+06)	(3.32e+05)	(1.24e+07)***	(1.13e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Table A.16: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 6\%$, $\rho = 2$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.277	-0.004	-0.987	-0.010
	(0.074)***	(0.007)	(0.519)*	(0.048)
sex	-6.16e+05	40.150.509	-2.87e+06	28.765.405
	(4.13e+05)	-43.861.274	(1.08e+06)***	(1.00e+05)
age	1.86e+05	-8.715.635	1.00e+06	-7.144.976
	(80799.335)**	-7.907.434	(3.07e+05)***	-28.165.268
primary	2.04e+06	-1.13e+05	2.06e+06	-1.13e+05
	(3.77e+05)***	(31777.675)***	(4.00e+05)***	(31716.631)***
secondary	1.85e+06	-1.19e+05	1.69e+06	-1.20e+05
	(4.75e+05)***	(43736.767)***	(5.34e+05)***	(45231.929)***
degree	5.07e+06	-4.40e+05	5.95e+06	-4.35e+05
	(7.15e+05)***	(71340.585)***	(8.09e+05)***	(76672.868)***
pv_earnings	0.005	-0.000	0.023	-0.000
	(0.001)***	(0.000)***	(0.008)***	(0.001)
cons	-5.06e+06	3.35e+05	-3.83e+07	2.76e+05
	(3.40e+06)	(3.32e+05)	(1.24e+07)***	(1.14e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Table A.17: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 6\%$, $\rho = 4$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.284	-0.005	-1.015	-0.010
	(0.076)***	(0.007)	(0.534)*	(0.049)
sex	-6.20e+05	40.364.262	-2.88e+06	28.962.822
	(4.13e+05)	-43.869.830	(1.08e+06)***	(1.00e+05)
age	1.86e+05	-8.685.525	1.00e+06	-7.100.285
	(80781.190)**	-7.904.987	(3.08e+05)***	-28.188.191
primary	2.04e+06	-1.13e+05	2.06e+06	-1.13e+05
	(3.77e+05)***	(31777.456)***	(4.00e+05)***	(31716.071)***
secondary	1.85e+06	-1.19e+05	1.69e+06	-1.20e+05
	(4.75e+05)***	(43735.986)***	(5.34e+05)***	(45228.920)***
degree	5.07e+06	-4.40e+05	5.95e+06	-4.35e+05
	(7.15e+05)***	(71335.639)***	(8.09e+05)***	(76668.936)***
pv_earnings	0.005	-0.000	0.023	-0.000
	(0.001)***	(0.000)***	(0.008)***	(0.001)
cons	-5.04e+06	3.34e+05	-3.83e+07	2.75e+05
	(3.40e+06)	(3.32e+05)	(1.24e+07)***	(1.14e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Table A18: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 10\%$, $\rho = 1$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.220	-0.004	-0.776	-0.008
	(0.059)***	(0.006)	(0.409)*	(0.038)
sex	-5.94e+05	38.990.118	-2.85e+06	27.698.852
	(4.13e+05)	-43.815.349	(1.08e+06)***	(1.00e+05)
age	1.88e+05	-8.875.883	1.00e+06	-7.387.194
	(80896.920)**	-7.920.608	(3.06e+05)***	-28.044.544
primary	2.05e+06	-1.13e+05	2.06e+06	-1.13e+05
	(3.77e+05)***	(31778.950)***	(4.00e+05)***	(31719.726)***
secondary	1.86e+06	-1.19e+05	1.70e+06	-1.20e+05
	(4.75e+05)***	(43739.923)***	(5.34e+05)***	(45246.197)***
degree	5.07e+06	-4.40e+05	5.95e+06	-4.35e+05
	(7.15e+05)***	(71367.030)***	(8.09e+05)***	(76701.027)***
pv_earnings	0.004	-0.000	0.018	-0.000
	(0.001)***	(0.000)***	(0.006)***	(0.001)
cons	-5.17e+06	3.43e+05	-3.83e+07	2.87e+05
	(3.41e+06)	(3.32e+05)	(1.23e+07)***	(1.13e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Table A.19: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 10\%$, $\rho = 2$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.244	-0.004	-0.866	-0.009
	(0.065)***	(0.006)	(0.456)*	(0.042)
sex	-6.01e+05	39.361.657	-2.86e+06	28.038.491
	(4.13e+05)	-43.829.889	(1.08e+06)***	(1.00e+05)
age	1.88e+05	-8.825.517	1.00e+06	-7.309.589
	(80865.854)**	-7.916.424	(3.06e+05)***	-28.082.095
primary	2.05e+06	-1.13e+05	2.06e+06	-1.13e+05
	(3.77e+05)***	(31778.517)***	(4.00e+05)***	(31718.731)***
secondary	1.86e+06	-1.19e+05	1.70e+06	-1.20e+05
	(4.75e+05)***	(43739.234)***	(5.34e+05)***	(45242.312)***
degree	5.07e+06	-4.40e+05	5.95e+06	-4.35e+05
	(7.15e+05)***	(71358.692)***	(8.09e+05)***	(76689.843)***
pv_earnings	0.004	-0.000	0.020	-0.000
	(0.001)***	(0.000)***	(0.007)***	(0.001)
cons	-5.14e+06	3.41e+05	-3.83e+07	2.84e+05
	(3.41e+06)	(3.32e+05)	(1.24e+07)***	(1.13e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Table A.20: OLS and IV (using Cohort) regressions. Dependent variables Net Worth and Net Financial Wealth.
Parametrisation: $\delta = 10\%$, $\rho = 4$

	OLS		IV	
	Net Worth	Net Financial Wealth	Net Worth	Net Financial Wealth
npv_epw	0.258	-0.004	-0.917	-0.009
	(0.069)***	(0.007)	(0.483)*	(0.044)
sex	-6.07e+05	39.667.446	-2.86e+06	28.319.774
	(4.13e+05)	-43.842.007	(1.08e+06)***	(1.00e+05)
age	1.87e+05	-8.783.216	1.00e+06	-7.245.808
	(80840.153)**	-7.912.950	(3.07e+05)***	-28.113.994
primary	2.04e+06	-1.13e+05	2.06e+06	-1.13e+05
	(3.77e+05)***	(31778.183)***	(4.00e+05)***	(31717.912)***
secondary	1.86e+06	-1.19e+05	1.70e+06	-1.20e+05
	(4.75e+05)***	(43738.377)***	(5.34e+05)***	(45238.476)***
degree	5.07e+06	-4.40e+05	5.95e+06	-4.35e+05
	(7.15e+05)***	(71351.710)***	(8.09e+05)***	(76682.640)***
pv_earnings	0.005	-0.000	0.021	-0.000
	(0.001)***	(0.000)***	(0.007)***	(0.001)
cons	-5.11e+06	3.39e+05	-3.83e+07	2.81e+05
	(3.41e+06)	(3.32e+05)	(1.24e+07)***	(1.13e+06)
N	2,864	2,864	2,864	2,864

* p<0.1, ** p<0.05, *** p<0.01

Observed Rate of Return of Pension Funds

Table A 21: Real Rate of Return by Fund Type

Year	Fund A	Fund B	Fund C	Fund D	Fund E
1981			12,80		
1982			28,51		
1983			21,25		
1984			3,56		
1985			13,42		
1986			12,29		
1987			5,41		
1988			6,49		
1989			6,92		
1990			15,62		
1991			29,68		
1992			3,04		
1993			16,21		
1994			18,18		
1995			-2,52		
1996			3,54		
1997			4,72		
1998			-1,14		
1999			16,26		
2000			4,44		6,32
2001			6,74		8,41
2002	0,68	-0,52	2,98	-1,03	8,90
2003	26,94	16,02	10,55	8,94	3,34
2004	12,86	10,26	8,86	6,80	5,44
2005	10,71	7,32	4,58	2,84	0,94
2006	22,25	18,82	15,77	11,46	7,43
2007	10,06	7,46	4,99	3,29	1,89
2008	-40,26	-30,08	-18,94	-9,86	-0,93
2009	43,49	33,41	22,53	15,34	8,34
Average (1)	8,90	7,03	9,24	4,99	5,12

Note: (1) From September 2002 to December 2009 for Funds A, B and D; from July 1981 to December 2009 for Fund C and from May 2000 to December 2009 for Fund E.

References

Attanasio, O. and A. Brugiavini (2003): Social Security and Household Saving. *The Quaterly Journal of Economics*, Vol. 118(No. 3).

Attanasio, O. and S. Rohwedder (2003): Pension Wealth and Household Saving: Evidence from Pensions Reforms in the United Kingdom. *The American Economic Review*, Vol. 93(No. 5).

Banks, J.; C. Emmerson; and G. Tetlow (2005): Estimating Pension Wealth of ELSA Respondents. *Working Papers 05/09.* The Institute for Fiscal Studies.

Bennett, H.; N. Loayza; and K. Schmidt-Hebbel (2001): Un estudio del ahorro agregado por agentes económicos en Chile. *Serie Banca Central, Análisis y Políticas Económicas. Vol.I.* Banco Central de Chile.

Blundell, R.; C. Meghir; and S. Smith (2002): Pension Incentives and the Pattern of Early Retirement". *In Social Security Programs and Retirement around the World: Micro-Estimation.* Ed. Gruber and Wise. The University of Chicago Press.

Bound, J.; C. Brown; and N. Mathiowetz (2001): *Handbook of Econometrics, Vol. 5*, Eds. J.J. Heckman and E Leamer. Elsevier Science B. V., chap. Measurement Error in Survey Data.

Carrasco, R.; J. Labeaga; and J. López-Salido (2005): Consumption and Habits: Evidence from Panel Data. *The Economic Journal*, Vol. 115(No. 500).

Carrol, C.; J. Overland; and D. Weil (2000): Saving and Growth with Habit Formation. *The American Economic Review*, Vol. 90(No. 3).

Coronado, J. (1998): The Effects of Social Security Privatization on Household Saving: Evidence from the Chilean Experience. *Finance and Economics Discussion Series 1998-12. Division of Research and Statistics and Monetary Affairs.* Federal Reserve Board.

Feldstein, M. (1974): Social Security, Induced Retirement and Aggregate Capital Accumulation. *The Journal of Polictical Economy*, Vol. 82(No. 5).

Gale, W. (1998): The Effectos of Pensions on Household Wealth: A Reevaluation of Theory and Evidence. *The Journal of Polictical Economy*, Vol. 106(No. 4).

Gruber, J. and D. Wise (2004): *Social Security Programs and Retirement around the World. Micro-estimation*, Eds. J. Gruber and D. Wise. The University of Chicago Press, chap. 1-Introduction and Summary.

Margozzini, F. (1988): Estimaciones de las Pensiones de Vejez que Otorgará el Actual Sistema de Pensiones. *In Sistema Privado de Pensiones en Chile.* Ed. S. Baeza and R. Manubens. Centro de Estudios Públicos.

Pino, F. (2005): Retiros Programados y Nuevas Tablas de Mortalidad. *Superintendencia Pensiones. Serie de Notas Técnicas*, (No. 1).

Piñera, J. (2001): Empowering Workers: The Privatization of Social Security in Chile. *Cato Journal*, Vol. 15(No. 2-3).

Quintanilla, X. (2009): Individual Choice of Pension System. Did Chileans Maximise Pensions when Choosing between PAYG and DC? Mimeo.

Samwick, A. (1998): Discount Rate Heterogeneity and Social Security Reform. *Journal of Development Economics*, Vol. 57(No. 1).

Wooldrigde, J. (2002): *Econometric Analysis of Cross Section and Panel Data*. The MIT Press.