"THE IMPACT OF CHILE'S PENSION SYSTEM ON WORK PROPENSITIES OF MEN AND WOMEN: EVIDENCE FROM A RETROSPECTIVE DATA SET"

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Abstract

In 1981 Chile shifted its social security system from a defined benefit to an actuarially fair defined contribution scheme, exempted all pensioners and non-pensioners over 65 (60 for women) from the payroll tax, tightened early retirement eligibility and eliminated the implicit tax on own-pensions of widows. Old-system members remained largely subject to old-system rules. Using a retrospective data set of new and old system affiliates we ask whether work propensities increased for new-system members aged 50-70 and which rule changes had the greatest impact. We find large effects: Work probabilities were much higher among new-system affiliates, especially pensioners under 60/65 and non-pensioners over 60/65, who were exempt from the payroll tax in the new system but not the old. Aggregate work probabilities further increased as the proportion of non-pensioners rose due to tighter early pension rules, which made eligibility contingent on actuarially-determined replacement rates. The increase in work propensities is especially striking for women, particularly married women, who no longer have to give up their own pension in order to get a survivor's benefit.

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As populations age and longevity rises, increasing attention is being paid to policies that might keep older workers in the labor force. Yet, until recently, the labor force participation of older men has been declining. A considerable literature has developed on the ways in which social security rules have contributed toward this decline or can help reverse it. The experience of Chile offers an opportunity to test the impact on work propensities of large system changes.

Prior to 1981 Chile had a traditional pay-as-you defined benefit (DB) system that included disincentives to work among older individuals, similar to those in many countries today. Contribution rates were high and allowable pension ages low. Benefits didn't change commensurately with incremental contributions or postponed pensions. Workers had strong incentives to start their pensions as soon as possible and labor force participation dropped sharply when pensions started. Widows had to choose between receiving their own benefit or their survivor's benefit, which often meant they lost all their contributions.

This changed with the 1981 reform, which is best known for replacing the pay-as-you-go DB system with a fully funded defined contribution (DC) system, with worker control over market investments. This feature was eventually copied by many countries. But the new system also contained other important provisions: it exempted all pensioners and non-pensioners over 65 (60 for women) from the pension payroll tax, made early retirement contingent on replacement rate and eliminated the implicit tax on widows who had previously worked. Workers who stayed in the old system remained subject to old system rules, except that all pensioners got payroll tax exemption after age 60/65. Thus, two sets of rules have been operating in Chile since 1981. Moreover, the rules change at 60/65 and vary by pension and marital status, age and gender.

We use a retrospective data set of new and old system members (the Social Protection Survey collected by the University of Chile) to investigate the response of older individuals to these rule changes. These data give system affiliation, work histories and other demographic information about the individuals sampled. We test, first, whether new system members age 50-70 had higher work propensities than equivalent old system members; second, whether the pattern across sub-groups indicates this was due to actuarial fairness, payroll tax exemption or tighter early pension constraints; and third, whether women reacted differently from men because of the elimination of the implicit tax on widows' own-benefits.

We find large effects: Work probabilities were much higher among new-system affiliates, especially those who were exempt from the payroll tax in the new system but not the old--pensioners under 60/65 and non-pensioners over 60/65. Aggregate work probabilities further increased as the proportion of non-pensioners rose due to tighter early pension rules, which made eligibility contingent on actuarially-determined replacement rates. The increase in work propensities is especially striking for women, particularly married women, who no longer have to give up their own pension in order to get a survivor's benefit. Figures 1 and 2 contrast the behavior of new and old-system affiliates based on the raw data from our sample. These differences remain after we control for many individual and macro-economic variables, including educational level and changing social norms toward women's work. Our analysis shows that the higher probability of work could not have been caused by self-selection between old and new system members or between pensioners and non-pensioners in the new system.

Part 1 reviews the literature on the impact of social security system rules on retirement age and develops our hypotheses about work incentives in the new versus old Chilean schemes. Part II describes our data set, model and variables. Part III estimates the impact of the new

system on the probability of work by older men and women. Part IV considers alternative explanations—falling pension wealth, rising education and selection--for the observed increase in work propensities. The Conclusion highlights lessons for other countries.

I. HOW SOCIAL SECURITY SYSTEMS AFFECT WORK DECISIONS

Theory and Previous Empirical Studies

Social security systems can affect the decision to work or retire in several ways:

1) Most systems are financed by a payroll tax and pay a defined benefit. But the relationship between benefits and contributions is usually not actuarially fair. In particular, the expected present value (EPV) of incremental benefits from added work is often less than the EPV of the required incremental contributions, and the EPV of higher monthly benefits from postponing the start of pension is less than the EPV of foregone payments. This tax wedge induces individuals to start the pension and stop work sooner than they would have in an actuarially fair system, where equality holds.

2) For married women this tax wedge is especially great. Many systems grant them generous survivors' benefits when their husband dies, but they must give up their own pension to qualify (James, 2009). Thus the effective tax rate on their contributions is high, often 100%.

3) The required contribution rate and the EPV of expected lifetime benefits (their pension wealth) exceed the amounts that many individuals would voluntarily choose. This increases their desire to stop work and start consuming their retirement saving.

4) Governments generally set a normal retirement age at which the pension can start but usually this does not increase, nor do monthly pensions decrease, as life expectancy grows and lax rules have allowed many individuals to retire earlier than "normal" with little or no penalty.

As government policies increased the payroll tax, the degree of actuarial unfairness and expected pension wealth while reducing the pension age, the labor supply of older men dropped in many countries during the 1970's, 80's and 90's (OECD, 1998; Casey et al, 2003). During the past decade a large literature has developed to investigate this relationship between policies and the observed decline in labor force participation rates. The benchmark studies by Gruber, Wise and their colleagues (1999 and 2004) measure retirement incentives facing older men across eleven industrialized countries and through time. They show large work disincentives stemming from pay-as-you-go DB social security systems that are not actuarially fair, and the greater these disincentives the less likely individuals are to postpone retirement. Borsch-Supan (1998) finds similar effects for Germany and other European countries. A recent study by Lluberas (2007) finds that workers in employer-sponsored DC plans in the UK expect to retire later than those in DB plans. Baker and Benjamin (1999) and Disney and Smith (2002) find that when public pension benefits are diminished by private earnings, the labor supply of older workers falls in Canada and the UK, respectively. Butler, Huguenin and Teppa (2004) attribute the falling labor supply of older men in Switzerland to their rising mandatory pension wealth.

Several studies use U.S. data to examine the impact of social security wealth and implicit tax incentives on work propensities. The earlier studies, during the 1980's and 90's, find small to modest effects and a discontinuous drop in labor force participation at the earliest and normal eligibility age for pensioning. More recently, Song and Manchester (2007), Haider and Loughran (2008) and Engelhardt and Kumar (2009) find that the 2000 removal of the earnings test for workers over 65 increased work propensities substantially, especially among individuals in the higher income percentiles who were most affected. Pang, Warshawsky and Weitzer (2008) also find that the shift from employer-sponsored DB to DC plans delays retirement. Partly as a

result of these factors, over the last decade participation rates of older workers have been increasing in the U.S. Friedberg (2007) summarizes various explanations for this trend, including the elimination of the earnings test, the increased increment from delaying benefits, the gradually rising statutory retirement age and the shift from DB to DC systems.

System incentives in these high-income countries have not changed as dramatically as in Chile nor do they have such a long period of observed reaction time.

Retirement Rule Changes in the Chilean Reform

The Chilean pension reform was a complex package, with many rule changes. Starting with an old system that was unfair actuarially and made early retirement easy, the reform moved toward actuarial fairness, eliminated the pension payroll tax for all pensioners and for non-pensioners over 65, tightened early retirement pre-conditions and eliminated the implicit tax on prior work by widows.

The shift from DB to DC: Moving Toward Actuarial Fairness

The old Chilean system consisted of several sub-systems, with different details but similar general outlines. In the largest sub-system, Servicio Seguro Social (SSS), the payroll tax for pensions was 23% (SAFP, 2003; Cheyre, 1991). The monthly defined benefit was 0 for less than ten years of contributions, 50% of the base wage at the ten-year point but only 1% additional for each year thereafter, until a 70% ceiling was reached, at which point incremental benefits became 0. While returns for the first ten-year bloc were way above market, after the ten-year point incremental contributions or postponed pensions did not raise benefits commensurately—the old system was far from actuarially fair.

In the new system, each worker is required to contribute 10% of his or her wages to an individual DC account, plus another 2-2.5% for administrative fees and disability and survivors

insurance, totaling about half the old rate.[1] The system is actuarially fair during both the accumulation and payout stages. The entire contribution from new-system members is invested in a pension fund (AFP) of the worker's choice and earns a market return. Payouts take the form of price-indexed annuities purchased from insurance companies or gradual withdrawals over the person's lifetime, managed by the AFP. Most retirees use their retirement savings to purchase annuities. Delayed annuitization or additional voluntary contributions raise the monthly pension by an equivalent EPV, and annuities have had a money's worth ratio of 100% or more (James, Martinez and Iglesias, 2006). This implies a lower labor tax wedge that should encourage work.

Eliminating the Payroll Tax for all Pensioners and for Non-pensioners Over 65

In the new system all pensioners are exempt from the pension payroll tax. Non-pensioners are also exempt after the normal retirement age of 65 for men (60 for women). Any contributions after age 65 or after pensioning at any age are purely voluntary. The nominal net wage rises by 14% (12.5/87.5) after pensioning (or by a fraction of 14% if the implicit tax component is less than the full nominal tax). After 1981 old-system pensioners over 65 (60 for women) were also exempt from the payroll tax, but old-system pensioners under 60/65 and non-pensioners at any age were not exempt. We expect a higher work propensity in the new system among pensioners under age 60/65 and non-pensioners over age 60/65 because of their exemption from the payroll tax. The net impact on work by new-system non-pensioners under 60/65 depends on and informs us of their relative valuation of actuarial fairness.

[1] In the old system about 2/3 of the payroll tax was nominally paid by employers. In the new system workers pay the entire tax. Wage increases were legally required for workers who switched, to compensate. Studies on tax incidence suggest that markets shift payroll taxes to workers in the long run in any case. Gruber (1997) shows that average wages were higher in firms with lower average payroll tax rates after 1981 in Chile. He does not distinguish between wages paid to new and old system members. In this paper we assume that total compensation is the same for these two individuals so the wage component is higher for new-system members.

Tighter Pre-conditions for Early Pensioning, More Binding with Greater Longevity

In the old system, normal pension age was 65 for men, 60 for women, but earlier pensioning based on length of service, disability or for other reasons was common. In the new system, normal pension age was unchanged but early pensioning was not permitted before 1988. After 1988 it was allowed, providing the retirement accumulation generated a benefit that was at least 50% of the worker's own average wage and 110% of the minimum pension guarantee (recently raised to 70% and 150%, respectively) (Edwards and James, 2006; James, Martinez and Iglesias, 2006). The actuarially fair reduction in monthly pensions for early retirees made it difficult for younger people to meet these pre-conditions—a constraint that will become more binding over time as life expectancy grows. In addition, the qualifying criteria for an early disability pension became more stringent, as AFPs and insurance companies participated in the assessment procedure (James, Edwards and Iglesias, 2009). These tighter early pension pre-conditions should increase the proportion of individuals who are required to postpone pensioning. Non-pensioners are more likely to work than pensioners, because they face liquidity constraints. Thus, the higher proportion of non-pensioners should further increase aggregate work propensities in the new system.

Changing Treatment of Survivors' Benefit

The old system provided widows a survivor's benefit that was 60% of their husband's benefit. However, to get that benefit widows had to give up their own pension—a common provision. Most took the survivor's benefit because it exceeded their own pension. Then, any contributions that they had made became a pure tax. Studies in other countries have shown that such arrangements depress women's work (Munnell and Jivan, 2005; Munnell and Soto, 2005). The new system also provides benefits for widows, through a group insurance policy arranged by

the pension fund prior to retirement and a joint annuity that the husband is required to purchase at retirement. To finance the joint annuity, the husband gives up 10-20% of his own pension (James, Edwards and Wong, 2003 and 2008). The survivor's benefit is fully funded, it becomes the property of the widow, and she does not have to give up her own pension to get it. The high implicit tax on work facing married women is eliminated. The resulting substitution effect should strongly encourage work by women, but might discourage work by men.[2]

Changes in Pension Wealth

Besides the change in marginal returns for incremental work, the new system implies complex changes in total pension wealth stemming from prior contributions, which could reinforce or offset these tax changes. For example, the pension wealth of married women increases because they now keep their own + survivor's benefit, while that of married men decreases—this might counter-act the substitution effect just described. Individuals who plan to retire early experience a loss of pension wealth because of the actuarial adjustment in the new system but not the old. This might lead them to work more to rebuild their pension wealth, reinforcing the effect of lower marginal taxes.

Hypotheses: How These Rule Changes are Expected to Change Behavior

Our object is to measure $Workprob^{New}$ - $Workprob^{Old}$ for men and women and for subgroups: pensioners <60/65, pensioners >60/65, non-pensioners <60/65 and non-pensioners

[2] Originally widowers were not eligible for survivors' benefits unless disabled but since 2008 they have been treated symmetrically. However, widows are more likely to receive the benefit and pay less for the joint annuity that covers their husband, because women live longer than men and wives are often younger than husbands. (Unisex mortality tables are not required). In the old system short career workers faced further work deterrents that mainly affected women (James, Edwards and Wong, 2003 and 2008; Berstein, Larrain and Pino, 2005). For example, vesting required 10 years of work while in the new system it is immediate; and more years of contribution were required for minimum pension (MPG) eligibility in the new system. The MPG was replaced by a basic benefit with easier eligibility in 2008 but all our observations occurred by 2006-7.

>60/65, holding all other covariates constant, where *Workprob* = the probability that an individual in the given age*pension status*gender group will work. We expect:

(1) Pensioners under age 60/65 and non-pensioners over 60/65 will have a higher *Workprob* in the new system because of their payroll tax exemption.

(2) This new-system difference will disappear for pensioners at 60/65, when old-system pensioners also get tax exemption.

(3) The proportion of non-pensioners will be higher in the new system because of tighter early pension and disability pre-conditions. This will further increase ($Workprob^{New}$ - $Workprob^{Old}$) in pooled equations where pension status is not controlled.

(4) If the substitution effect dominates under the new joint pension arrangements, married women should have a larger ($Workprob^{New}$ - $Workprob^{Old}$) than married men or single women (but the opposite holds if the pension wealth effect dominates).

(5) The fall in pension wealth for early pensioners in the new system should increase their work propensity, reinforcing the impact of the payroll tax exemption.

The new-system impact on *Workprob* of non-pensioners under 60/65 depends on many counteracting forces, including individuals' valuation of actuarial fairness. The degree of actuarial fairness is usually evaluated using the market rate of return as the discount rate for lifetime benefits and contributions. However, the subjective discount rates for time or risk may exceed market rates, for many individuals. They may wish to save less than the mandatory rate, to start the pension sooner than the retirement age rules permit, to use saving to cover emergency or other consumption in the early years of retirement, or to invest in different ways from those permitted by regulations. In that case, they may not regard the new system as actuarially fair to

them, personally. Their response to the new system throws light on their valuation of actuarial fairness and the remaining implicit tax that they face.[3]

We have some preliminary evidence that the new system encouraged work by older men. Using cross-sectional data from 50 cohorts in 47 years of household surveys, Edwards and James (2010) show that participation rates rose strongly for cohorts that turned 50 after 1981 (which had a higher proportion of new-system members), in contrast to the falling rates for older cohorts (who were mainly in the old system). However, the data set used in this study did not include information about whether individuals belonged to the new or old system or any system at all, so individual behavioral differences could not be analyzed. Women were not covered by the study because many did not belong to any system and non-affiliates were not identified. The present paper uses direct information about system affiliation, thereby enabling us to contrast the behavior of individuals who were subject to new and old system rules and to distinguish between men and women. This is especially important in view of the larger response expected from married women.

II. DATA AND MODEL

To carry out this analysis we use data from the Social Protection Survey collected by the University of Chile. This is a panel that has followed a representative sample of about 20 thousand individuals. The first round was applied in 2002, after that 2004-5, 2006-7 and, most recently, 2009. Retrospective questions cover employment going back to 1981. We use the 2006-7 survey for this study.

[3] It has been estimated that a 50% implicit pension tax remains in Chile, based on wage differences between those who pay the payroll tax and get benefits versus those who don't (Edwards and Edwards, 2002). For a related UK analysis see Disney, 2004.

Although the survey includes people who are not affiliated to any system, we confine our analysis to affiliates since they are the ones who would be responsive to changes in system rules. We focus on the subset of individuals who were born between 1931 and 1957 and examine their work behavior between ages 50-70, as it occurs over the period 1981-2007. We start our analysis at age 50 because individuals under age 50 are unlikely to withdraw from the labor force unless they are disabled. We stop at age 70 because there are few new system members beyond this age. This produces an unbalanced panel, where some individuals contribute 1 year of data and many individuals contribute as many as 21 years. Our sample includes 42,641 observations of 4,054 individuals. About 60% of all individuals and almost half of all observations were in the new system. Of all individuals, 40% were women and of all observations 26% were pensioners (Tables 1A and B).

When the new system was adopted current workers were given the right to stay in the old system or switch. The survey does not record year of switching but we know from other sources that most switching occurred between 1982 and 1985. In this analysis we assume all switching occurred by 1982. Newly affiliating workers had to enter the new system. About 20% of individuals and 13% of all observations in our new-system sub-sample were new entrants. The old system in our sample therefore contains 1623 individuals, all of whom chose not to switch, while the new system contains 1953 individuals who switched and 478 who entered the labor market after 1981 and had no choice. Age was the most important predictor of choice. Old-system observations come disproportionately from earlier cohorts and are observed disproportionately at older ages than new-system observations. Nevertheless, there is substantial overlap in cohorts, ages and years observed in the old and new systems that allows us to examine

their behavior differences. We include a dummy variable to identify the no-choice subset and examine its behavior as part of our approach to analyzing self-selection bias (Tables 1A and B).

For each individual we know their demographic characteristics, labor force status and system affiliation at time of the interview. In addition, retrospective questions cover their labor and pension history as well as cursory data on health problems, going back to 1980. We investigate whether the propensity of these affiliates to work is different in the new and old systems, after controlling for other factors that might affect this decision.

Model of Retirement and Pension Probabilities

Our main dependent variable is the individual's probability of being employed ($Workprob_i$), which we model as a function of system affiliation (NS_i), controlling for pension status and pension-related variables (P_{it}), personal and family characteristics that are time invariant (X_i) or that vary over time (Y_{it}) and time-specific macro-economic characteristics (E_t)--variables that influence the person's potential wage and willingness to trade-off wage for leisure.

P_{it} indicate whether or not the person is a pensioner, if so, whether it is an old age, survivor's or disability pension, years since pension started and real value of monthly benefit. X_i include the person's education (> or < secondary ed), marital status (dummy for ever-married), number of children ever-born, the score we developed on a measure of the person's knowledge about the system and dummies for whether the person had a choice of system. Y_{it} include age (continuous age and dummies for 60-64 and 65-70 for men, 60-70 for women), a dummy to indicate major health problems and a dummy for spouse over normal retirement age. Our E_t variables are unemployment rate and income per capita. X_i are characteristics that are the same for all observations of a given person, while $P_{it,}$ Y_{it}, *and* E_t vary for different observations of the same person. All these variables explain variations in work propensities among individuals and

also control for differences in socio-economic conditions that applied to new and old system members.

To compare new-system effects on pensioners and non-pensioners we interact NS_i with P_{it} at different ages. We also interact NS_i with Marriage, which affects pensions differently in the two systems. In our reduced form model:

$$Workprob_{it}=\alpha NS_i + \beta_1 NS_i P_{it} + \beta_2 NS_i P_{it} d60/65_{it} + \delta NS_i X_i + \gamma E_{it} + \upsilon P_{it} + \mu X_i + \tau Y_{it} + \xi \quad (1)$$

We are particularly interested in α, β_1, β_2 and δ, which measure the effect of the new system on pensioners and non-pensioners under and over age 60/65 and on individuals with specified characteristics like being ever-married. We carry out the analysis separately for men and women.

We use two measures of *Workprob*. First, we use a continuous measure, defined as the proportion of time in a given year the individual has worked. We estimate a linear probability model with interaction terms for the new system effect. Second, we apply a probit analysis in which the individual is coded as working in a given year if he or she has worked more than half the time, not working otherwise. We use the probit coefficients to simulate the work probabilities for representative individuals in different gender-age-pension status-marital subgroups. The results are very similar for both approaches.

Covariates that are Hypothesized to Influence NS_i

Pension Status and Age

Apart from the main new system term (NS_i), the most important variables in our analysis are pension status and age above and below 60/65. Pensioners have access to an alternative non-wage source of income—their pension. Therefore they are less liquidity constrained than non-pensioners and have a lower probability of working, in both systems. If the new system requires

individuals to postpone pensioning and remain non-pensioners for longer, this should increase aggregate *Workprob* in pooled equations even if it remains constant within each pension status.

Additionally, we expect the *Workprob* of pensioners under 60/65 and non-pensioners over 60/65 to be higher in the new system than the old, due to the payroll tax exemption. The predicted difference in behavior of non-pensioners under 60/65 depends on their valuation of actuarial fairness and their response to the new vesting and minimum pension eligibility rules. The net impact is ambiguous for men but likely to be positive for women.

Gender and Marital Status

Married women have an alternative source of income—their husband's wage—and greater demands for their household services, so are less likely to work in both systems. But in the new system they are allowed to keep their own pension as well as the survivor's pension or joint annuity, while that is not true in the old system. Therefore the substitution effect leads to more work for married women relative to singles in the new system, but the pension wealth effect leads to less work. For men, the joint annuity requirement reduces their replacement rate, thereby making it more difficult for them to start their pension early and inducing longer work to rebuild their retirement wealth. But it also reduces their own reward for work if they don't fully value the benefit to their surviving wife. The expected net impact of marriage on NS_i is therefore ambiguous but it will be more positive for women if tax incentives dominate.

Other Co-variates

The average values of many of our co-variates changed over the period spanned by our study. This may create the illusion of an *NS* effect, when in fact the higher *Workprob* for new-system members may be due to increased education, improved health and changing social norms regarding women's work. By controlling for a long list of co-variates, we eliminate biases they

may create due to differing birth years and other characteristics of new and old system members.[4] We also analyze the *NS* effect within-educational and within-cohort groups. (See Table 2 and Appendix Tables 1 and 2 for a complete list of co-variates; Appendix is available from authors upon request).

Methodological Issues: Endogeneity and Self-selection

An obvious problem with the pension status variable is its potential simultaneity and endogeneity. People may choose to start their pension at the same time they choose to stop work and for similar reasons, so it may be incorrect to treat pension status as exogenous. However, these two decisions are not necessarily made jointly. Pensioning is a once-and-for-all decision; once a person pensions he stays pensioned. In contrast, the work decision is remade each month or year, depending on current preferences and circumstances (see Meghir and Whitehouse, 1997). In examining the work decision in any given period, we treat the status of pensioner as pre-determined at some earlier time.

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[4] In the 2006 health module, each individual is asked if he/she was ever diagnosed with one of ten major health problems (e.g. lung disease, depression, diabetes, cancer) and the year in which the disease was first diagnosed. "Health problems" takes value 1 from the first year any diagnosis applies. This may be more prevalent among old-system members, who are older and come from earlier birth cohorts. We include dummies for individuals who have had less than or more than secondary education. Educational levels were much higher in the new system. During the period of study, unemployment went through an entire cycle, starting with 23% in 1982, falling to 6% by 1995 and then rising to 14% by 2002. Per capita income went through a similar cycle, with an average growth rate of 4%. The existence of a complete business cycle reduces the correlation between unemployment, per capita income and system affiliation.
We would like to have included individual's voluntary saving, which may vary between new and old system members. People with voluntary saving and liquid assets can offset the mandatory saving requirement in the new system, making it more actuarially fair and like a tax exemption to them. However, we only had this data for 2006-7 so could not include it for varying observations over time. Aggregate household saving (including pension saving) increased during the post-reform period but voluntary saving was negative every year (ranging between -2 to -8% of GDP)—suggesting that the mandatory rate exceeded the preferred rate for most people (Bennett, Schmidt-Hebbel, and Soto, 1999).

Relatedly, age of pensioning, proportion of pensioners and their composition may differ in the new and old systems. New-system constraints lead to pension postponement for those whose pensions don't meet a specified threshold. Then, aggregate *Workprob* may be higher in the new system because it has proportionately more non-pensioners and relative *Workprob* for pensioners and non-pensioners may change because of different sorting between them of individuals with a strong taste for work.

Given these issues, we present our results with and without pension controls. The estimated pooled *NS* impact in specifications with no pension controls avoids the endogeneity and pension-status-composition problems and measures the change in aggregate *Workprob* due to new system incentives and constraints, including those operating through pension postponement. The specifications with pension controls allow us to examine the *NS* response of individuals within each pension status.

An over-riding challenge is the possibility that the new system may have self-selected people with a stronger work ethic that accounts for some of the apparent *NS* effect. Part IV addresses this issue, as well as other possible explanations for the observed pattern of *Workprob* differences. In this connection it is noteworthy that the aggregate labor supply of older workers rose as the new system was phased in; gains in the new system were not offset by losses in the old system as would be the case in a pure selection model.

III. NEW SYSTEM IMPACT ON WORK PROPENSITIES

Our regressions and simulations test 3 levels of differences—differences in work probabilities between new versus old system affiliates pooled, differences in new system effects between pensioners versus non-pensioners and differences in new-system effects between those under and over 60/65 for pensioners and non-pensioners separately. We also examine whether

NS differs between married and single individuals. We carry out the analysis separately for men and women.

Men

Pensioners and Non-pensioners pooled

Table 3, col. 1, presents linear probability results for the *NS* effects on *Workprob* of men, without differentiating by pension status or age groups. Table 4, row 1 presents the same for simulations based on the probit coefficients in Appendix Table 3. In both cases, new-system affiliation increases *Workprob* by 11-12 percentage points, an increase of 17% compared with mean *Workprob* among old-system observations. This captures all sources of increased participation for new-system members--exemption of pensioners under 60/65 and non-pensioners over 60/65 from the pension payroll tax, changing behaviors among non-pensioners due to actuarial fairness, increased proportion of non-pensioners as early retirement rules tighten, and elimination of the implicit widow's tax.[5]

Interaction of NS with Pension Status and Age.

Table 3, Col. 2 controls for pension status and Col. 3 allows the *NS* effect to differ by marital status and between pensioners and non-pensioners in different age groups. Table 5 presents simulations based on probits for pensioners and non-pensioners under and over age 60/65. All these tables have similar results, as did separate regressions for pensioners and non-pensioners (available from authors). Becoming an old age pensioner reduces male *Workprob* by 16-19 percentage points in the old system.[6] This reduction changes in the new system, by an

[5] Since all pensioners over 60/65 in the new and old systems have been exempt from the payroll tax since 1982, this would not have added to the *NS* effect although it might have increased *Workprob* by older pensioners in both systems and aggregate *Workprob* over time.

[6] We use the term "pensioner" here to mean old age pensioner, since a different set of incentives and constraints applies to disability pensioners. They are much less likely to be approved in the

amount that depends on age. For pensioners under 65 *Workprob* is 9-10 points higher and for non-pensioners over 65 it is 17 points higher in the new system—an increase of 17% and 29%, respectively, compared with old-system rates. The *NS* increment is much smaller for non-pensioners under 65 and it disappears for older pensioners, as expected. So the pensioner-non-pensioner gap narrows below 60/65 and widens over 60/65. Apparently payroll tax exemption for pensioners under 65 and non-pensioners over 65 has a much larger impact than actuarial fairness for younger non-pensioners.

Postponed Pensioning and NS

The new system has tighter disability procedures and early retirement requirements. Workers are not allowed to start their pension until their accumulation can finance a benefit that is 50% of their average wage (recently increased to 70%). The actuarial adjustment in pension size for early retirement (not present in the old system) makes this constraint binding for many individuals. For example, the replacement rate is cut almost in half when the pension starts at 55 instead of 65 (Table 6 and Figure 3B). As expected, in the new system the hazard of becoming a pensioner is much lower for the young-old and Kaplan-Meier survival rates as non-pensioners are higher until age 65 (Figure 2A and Appendix Figure 1A)—evidence that pensioning has been postponed. Regressions show that the probability of being a pensioner for young-old men are 8 percentage points lower in the new system, but they catch up by the mid-60's, when all men can pension regardless of amount (Appendix Table 4). The pension hazard rate peaks at age 65, at a higher rate in the new system than the old. This suggests that we are mainly observing the impact of tighter constraints rather than voluntary postponement (Appendix Figure 1A).

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new system and their health is relatively worse than in the old system, judging by their higher mortality rates after approval. Disability pensioners work 39 percentage points less than non-pensioners. (See James, Edwards and Iglesias, 2009).

Since non-pensioners work longer than pensioners, pension postponement should account for part of the pooled increase in *Workprob* in the new system. Indeed, when pension status is given, the *NS* effect is smaller. The weighted average of separate effects for pensioners and non-pensioners is about half of the total pooled effect—an approximation of the impact of postponed pensioning on *Workprob*. Nevertheless, the *NS* impact on *Workprob* of pensioners and non-pensioners remains significantly positive, albeit smaller, in the separate equations.

Marital Status

Single and married men exhibit the same *NS* effect when pension status is controlled, but marriage increases the *NS* effect when pension status is not controlled. Correspondingly, the reduction in pension probabilities is larger for men who are married. We attribute this to the fact that the joint annuity calculation reduces pension size and replacement rate of married men on an actuarially fair basis in the new system. To smooth expected consumption they must work and save more. In addition, married men find it harder to meet the early pension threshold. They must remain non-pensioners and work longer.

Women

Most striking is the stronger *NS* effect for women--twice as large as that for men. Women's *Workprob* rises by 20-23 percentage points (or 56%) in the new system. Furthermore, the *NS* effect is much larger for married than single women, whether or not pension status is controlled (Tables 3 and 4)--consistent with our hypothesis regarding the impact of eliminating the implicit tax on widow's own pensions. Married women know that eventually they are likely to get the survivor's benefit, which is often larger than their own pension, so they will lose their entire contribution in the old but not the new system. A large work deterrent has been removed.

As was the case for men, the new-system effect among women is strongest for pensioners under 60/65 and non-pensioners over 60/65. Their work propensities rise by 14 and 30 percentage points, respectively (a percentage increase of 43% and 90%, respectively, of their old system *Workprob).* But women non-pensioners under 60 also work substantially (22 percentage points) more in the new system, contrary to the situation for men. Besides the new treatment of survivors' benefits, this may be partially due to the immediate vesting of pension rights and the larger contributory requirements for early retirement or minimum pension eligibility. Below we discuss the compositional shift among women non-pensioners in the new system toward higher education and longer work norms, which may be contributing to this outcome.

Impact of Covariates on *Workprob* of Men vs. Women

Macro-economic and individual-specific variables

We include a long list of macro-economic and individual-specific co-variates in all regressions, mainly to see if the *NS* impact remains when other relevant variables are controlled. It clearly does—but we also found that these covariates are generally more important for women than men. *Workprob* falls, especially for women, when unemployment or income per capita rise. Being married decreases *Workprob* in the old system and has a positive effect on *NS,* especially for women. Having a spouse past the normal retirement age is never significant for men but is usually significantly negative for women—apparently women are more likely than men to adjust their behavior to coordinate with other family members. Being diagnosed with a serious illness has a significantly negative effect on *Workprob* for men and even more so for women. The coefficients for higher education are generally more positive for women—it leads to a larger gain from market over household work.

System Knowledge

Recent research has shown that workers' knowledge about retirement systems is extremely low. To test the impact of system knowledge on individuals' propensity to work, we constructed a crude measure of knowledge, Score, based on the answers given to four survey questions--about the contribution rate, normal pension age, value of the MPG and number of years of contributions required for eligibility. A person's Score equals their number of correct answers. The mean score for old-system members is 1, for new-system members 1.2**.** The most common correct answer concerned normal pension age, which most workers knew. *Score* increases with schooling and age, peaking at 62 for men. Not surprisingly, people who are near or past retirement know more about the retirement system. Knowledge about the pension system had a significantly positive impact on *Workprob* of both genders, in both systems, but this coefficient is twice as large for women as for men.

In Sum:

Women's reactions to the new system and to the exogenous covariates are much larger than those of men, especially when viewed as a percentage of the initial *Workprob* of each gender. This is consistent with a model in which women have greater discretion than men over the choice between market and household work, so they are more responsive to system incentives, family pressures and labor market conditions.

IV. OTHER EXPLANATIONS FOR INCREASED *WORKPROB*

Our analysis has pointed to tax incentives and early pension constraints as generating increases in work probabilities. But there are several alternative explanations: pension wealth may have fallen in the new system, which may induce people voluntarily to work longer to smooth consumption over the life cycle; educational composition and social norms toward work may have changed between the earlier cohorts who predominate in the old system versus the

later cohorts who predominate in the new system; and/or individuals with a high propensity for work may have selected themselves into the new system or into early pensioner status in the new system. By controlling for pensioner status, pension amount and educational level we have partially addressed the first two issues. In this section we examine them further and also deal with selection bias. Although these other explanations are shown to play some role, a strong *NS* effect from tax incentives and early pension constraints remains after this analysis.

Could the NS Effect be due to Falling Expected Pension Wealth*?*

Monthly pension amounts and expected pension wealth may have increased over the period studied for exogenous reasons--Chile's strong economic growth. The income or wealth effect might then have led to declines in the *Workprob* of new-system members, who come disproportionately from later cohorts. But endogenous factors--the actuarially fair adjustment of private market annuities for longer expected lifetime and early retirement--may have slowed down this growth and even made it negative for some in the new system. Did expected pension wealth go up or down? If the latter, did people respond by voluntarily working more; was this partially responsible for the positive *NS* effect, especially among early pensioners?

To account for the pension wealth effect, as a first approximation we include real *pension amount* in some regressions, since pension wealth is the present value of expected future monthly pensions.[7] The raw data for men show higher average pensions in the new system for normal age pensioners (perhaps due to economic growth) but no change for male early pensioners (perhaps due to offsets from actuarial adjustments for early retirement). Average amounts are higher for women in the new system for both groups, but especially for normal age pensioners. As expected, *pension amount* has a negative impact on *Workprob*.

[7] Old and new system pensions are price-indexed. In this analysis we only have 2006 values, which we assume are constant in real value over time (see James, Martinez and Iglesias, 2006).

However, *pension amount* poses several problems. First, it is only available for pensioners so doesn't through light on the behavior of non-pensioners. Second, it is endogenous, because it is a function of years worked. If new-system tax incentives lead individuals to work more this increases their pensions. We would like to analyze the impact on *Workprob* of pension amounts that would have been generated under old-system rules (the ex ante situation), but instead, for new-system members, we observe the pensions that they ended up with as a result of their adjusted *Workprob* under new-system rules (the ex post situation). In that case, the pension variable already captures some of the new-system effect on work. This may help explain why the *NS* coefficient becomes smaller once pension status and amount are controlled.

To avoid these endogeneity problems, we simulate what pensions would have been in the new and old systems for given years of work. This tells us whether pension wealth differentials exist when years-worked are held constant at the old-system values, which might lead individuals to work more or less in the new system. We use wage-replacement rates as our pension measure since this is the relevant concept for income-smoothing decisions, determines eligibility for early retirement and largely abstracts from economic growth. While pensions in the old system depend simply on years worked and wage in the last few years, annuity values in the new system depend on many variables--contribution rate, investment earnings, wages throughout the lifetime, years of contributions and age of pensioning. Simulations show:

1. For a typical person who starts the pension at age 60, old-system replacement rates and pension wealth dominate for almost all possible years of contributions (after ten) if the real rate of return is 4%, while new-system replacement rates and pension wealth dominate with a 10% return. With a 7% return, pension wealth is higher in the old system for individuals who plan to work between 10-22 years, while those who plan to work under 10 or over 22 years get

more in the new system. During the period studied the average annual return was close to 7% real, taking into account both AFP investments and recognition bonds, indicating that pension wealth fell for those with partial (25-50%) labor market attachment (Figure 3A).[8]

2. Assuming a 7% return, pension wealth is higher in the old system for persons who plan to pension at 55 and in the new system for persons who plan to pension at 65, because of actuarial adjustments for expected lifetime after retirement in the new system but not the old (Figure 3B and Table 6).

These simulations do not give us individual-specific values, but they do tell us which groups may have increased their work propensities in response to a decline in pension wealth in the new system. People observed as pensioners under 60/65 are all early pensioners, whose pension wealth would have declined. This may explain part of their increased work propensities.[9] Along similar lines, the pension wealth of single women probably fell relative to that of single men given their partial labor market attachment and the shift to gender-specific mortality tables in calculating annuities. This may help explain the positive *NS* effect among single women. The new joint pension arrangement reduced the pension wealth of married men while increasing that of married women, which should have led married women to work less and married men to work more. However, in fact we find the opposite—the *NS* impact is strongest for married women

[8] Over the period studied real rates of return to retirement accounts averaged 10%. At the same time, individuals who switched into the new system were given recognition bonds by the government to compensate them for their prior contributions. These earned a 4% real rate of return until retirement, at which point the bonds were redeemed and became part of the balance for annuitization. The relative size of these two components varied across individuals, but 7% is probably a reasonable average weighted return to use in calculations of replacement rates and pension wealth.

[9] Pensioners observed over 60/65 are a mixture of early and normal age retirees, in which case their lifetime pension wealth may be lower or higher in the new system. This mixture may help account for the insignificant NS effect for this group. Similarly, we don't know whether pension wealth went up or down for non-pensioners since we don't know when they planned to start their pension and stop work.

relative to single women and married men. This implies that the steep decline in their implicit tax has a stronger impact than the rise in their pension wealth.

In sum, simulated differences in pension wealth between the two systems are consistent with some of the new–system effects on *Workprob* but inconsistent with others. Differences in implicit plus explicit taxes give a more robust explanation for the observed behavioral changes.

Do Changing Education and Social Norms Explain the *NS* Impact?

Women's education has increased dramatically over recent decades, raising the gain from market over household work. Cohorts with highly educated women are concentrated in the new system. In our old-system sample 76% of all female observations have less than secondary education while only 13% have more than secondary education. In contrast, in the new system 59% of females have less than secondary education, while 28% have higher education. This shift was much less marked among men (Table 2 and Appendix Table 2). Higher education raises work propensities for women sharply—the positive impact stemming from higher wages and access to more interesting jobs outweighs the negative impact stemming from the income effect. Our regressions show that women with more than secondary education have a *Workprob* that is 18-20 percentage points higher than those with less than secondary education, while for men the disparity is 9-11 points (Table 3). This changing educational composition of the sample, combined with the higher work propensities of women with more education, may account for part of the apparent *NS* effect, thereby overstating the impact of system rules.

To deal with this possibility, we control for education in all our regressions. In addition, we broke the sample into those with more and less than secondary education, to see if the *NS* effect was still strong when educational composition was held relatively constant. The *NS* effect

is still highly significant and its magnitude is roughly unchanged, implying that the impact of system rules has not been overstated by the change in educational composition (Table 7).

We carried out a similar analysis for the possibility that changing social norms accounts for the higher *NS* effect among females. The new system has a much greater concentration of more recent cohorts. Among all females in the old system, 59% were born before 1942 while only 20% of females in the new system were born before 1942. A similar pattern, although somewhat weaker, obtains for men. To investigate the possibility that the *NS* effect stems from a difference in cohort norms between the two systems, we broke the sample into cohorts born before 1942 versus those born 1942 and later. Again, the *NS* effect remains significant and largely unchanged when cohort composition is held constant (Table 7).

Is the Strong *NS* Effect due to Self-selection into the New System?

Is the strong NS effect due to selection of individuals with high work propensities into the new system? Most individuals in our sample had a choice between staying in the old system vs. switching to the new system. It is possible that individuals with a higher propensity to work would have chosen the new system because they believed longer work would be better rewarded there, while those with lower work expectations stayed in the old system. We noted above that individuals who planned to work more than 22 years would have fared better in the new system, while those who planned to work 10-22 years would have fared better in the old system.

We used two approaches to investigate the impact of selection. First, we included a dummy variable (a*ffiliated after reform*) to identify individuals who entered the formal labor market after 1981 and therefore did not have a choice of system. This group would have been subject to the new system rules as a requirement, not a matter of choice, which might have given it a significantly negative coefficient if selection were driving the positive main *NS* term.

However, the very fact that they entered the system after 1981 means that they were working at that point, which might have given a*ffiliated after reform* a positive coefficient in the years shortly after entry. To remove this bias we entered another variable (*first3postaffil*), identifying the individual's first 3 years of affiliation if this occurred after 1981. We expected that its coefficient would be positive and it would remove most of the bias from the remaining observations of new entrants. In fact, we found that *first3postaffil* had a significantly positive effect on *Workprob* for women but *affiliated after reform* never had a significant effect and its inclusion doesn't change *NS*. Beyond the first three years, individuals who affiliated after the reform and therefore had no choice of system had the same work propensities as those who affiliated earlier and had choice. This suggests that selection into the new system did not play a large role in shaping its higher work ethic.

Our second approach was to look at pooled *Workprob* among new and old system members combined, over varying cohorts, as new system members constituted an increasing share of the total in later cohorts. Specifically, we re-ran equation 1 with $Workprob_{it}$ as the dependent variable, omitting the individual's system affiliation but adding a dummy variable for cohorts born 1942 or later (new-system members constituted more than half of all individuals in each birth cohort starting in 1942). If the entire new-system effect were due to the self-selection of members who had a higher work ethic, aggregate *Workprob* would have remained constant as the proportion of new-system members increased and the cohort dummy would have been insignificant. In the case of men, we found large significant increases in *Workprob* for later cohorts that had a bigger share of new-system members. This is consistent with (Edwards and James 2010), which examined changes in aggregate labor force participation rates of men over a longer period and found rising rates for more recent (post-reform) cohorts. For women, the

estimated effect is also positive and equally large (indeed, much larger as a percentage of initial work propensities), but not statistically significant--possibly because of the smaller size and greater variability of the women's sample (Table 9).

In general, these tests suggest that aggregate work propensities increased for recent cohorts, the increase was concentrated in new system members and the reason was the change in system rules, which changed their behavior.

Could the Effect on Pensioners Under 65 be due to Selection of Early Pensioners?

Could the larger positive response by pensioners under age 60/65 be due to selection bias—a change in composition among early pensioners toward individuals with higher work propensities, in the new system? The old system granted early retirement status liberally, including to many with low work propensities. Pensioners often could not keep their jobs, so some individuals with a high taste for work did not become pensioners. In contrast, the new system permits pensioning prior to 60/65 only if the individual has accumulated enough retirement saving to finance an annuity with a 50% replacement rate (recently increased to 70%). This was mainly possible for those who contributed persistently. And pensioners can keep their jobs. These forces could result in higher work propensities among new-system pensioners due to sorting and selection, rather than changes in individuals' work behavior. Since everyone was permitted to start their pension at age 60/65, selection of those with a work ethic into pensioner status would have stopped at that point also.

However, our empirical findings are not consistent with selection as the major explanation for the increase in work proclivities of early pensioners. If selection were the main explanation, the *NS* effect would have been negative for non-pensioners under 60/65 and would have been insignificant for all pension groups taken together. On the contrary, we find that the

NS effect was (modestly) positive for male non-pensioners under 65, much more positive for female non-pensioners under 60 and the over-all effect, when pooling all pension groups, was very positive (Tables 3 and 4). This implies that we are observing behavioral change due to new incentives, rather than a selection of people into different groups, with unchanged behaviors.

V. CONCLUSION

Many countries with aging populations are seeking to delay pensioning and increase work propensities among older individuals. Chile has succeeded in accomplishing this for the last 30 years. We argue that Chile's unusual trend is due, in large part, to incentives and constraints in the new social security system that it adopted in 1981. The long duration of these system changes and the differentiated rules for various sub-groups afford us a unique opportunity to investigate the labor market impact of pension reform.

Using a retrospective household survey that gives employment history and system affiliation, we estimate the work probabilities of older workers (ages 50-70), how they differ between new and old system affiliates and how the new-system effect differs between men and women and varying age*pension*marital sub-groups that face different incentives and constraints. Most previous work has emphasized the financial market impact of the 1981 reform, but our findings indicate that the new system increased Chile's economic growth through another route as well--by raising the labor supply of older individuals, especially women.

Our results underscore that older workers respond strongly to tax incentives. Although payroll taxes for prime-age workers, particularly men, are relatively non-distortionary because their labor supply is inelastic, this does not hold for older workers who have access to an alternative income source—their pension. The largest increments in work propensities are experienced by pensioners age 50-60/65 and non-pensioners over 60/65, who get exemption

from the pension payroll tax in the new system but not the old. If incentives play a larger role in shaping the work propensities of older workers, efficient social security/tax policy may be age-related.

Married women get an additional work incentive boost in the new system, both as pensioners and non-pensioners, because of the elimination of the high implicit tax on prior contributions by widows. Women have to give up their own benefit to get the survivor's benefit in the old system (a very common arrangement) but not the new system. These results all hold after we control for differing educational composition of the new and old-system members, changing social attitudes toward women's work and self-selection of individuals with a strong work ethic into the new system or early pensioner status within the new system. The strong positive response by married women suggests that other countries (including the U.S.) might also spur increased work by eliminating this implicit tax on widows. For example, married couples might be offered a joint defined benefit that is actuarially equivalent to the individual defined benefit for singles, and the surviving spouse could keep the joint benefit in addition to her own.

This analysis throws light on how actuarial fairness may work and how large its impact may be. The new system moved toward actuarial fairness at two stages of the pension determination process: 1) at the accumulation stage, when contributions are made and invested and 2) at the payout stage, when accumulated savings are converted into annuities or other pensions. Actuarial fairness during the saving stage means that contributions are accumulated and invested at the market rate of return. This has the efficiency advantage that it decreases the tax wedge stemming from below-market returns and potentially increases work among non-pensioners. But it is controversial because it implies a DC-type scheme, which has been attacked by some because of its distributional and risk properties. The efficiency effects are muted if the

individual's savings preferences are much lower than mandated and his subjective discount rate is much higher than the market rates earned in allowable investment portfolios. In fact, we found only a small positive new-system work response among male non-pensioners age 50-60/65, suggesting that to them, actuarial fairness does not eliminate the implicit tax on work at the savings-investment stage.

We found much stronger effects of actuarial fairness at the payout stage, operating through the annuity conversion factor. Holding constant years of work, replacement rates and pension wealth are reduced for potential early retirees in the new system, because of actuarial adjustments. This encourages their voluntary continued work and contributions to rebuild their pension wealth. More important, this makes it more difficult for them to meet the eligibility criteria for early pensioning, which depend on replacement rates in Chile. The consequent higher proportion of non-pensioners raises aggregate work probabilities and explains about half of the total work increment that we observed. Actuarial fairness at the payout stage, in conjunction with a replacement rate threshold for early retirement, could be adopted to postpone pensioning and increase the labor supply of older individuals in other countries, whether the underlying social security scheme is DB or DC.[10]

[10] For example, moves in this direction have also been made by Germany, Finland and Japan, where the defined benefit amount or allowable pension age have been tied to life expectancy after retirement, and by Sweden, which uses an actuarially fair conversion of accumulations in its notional DC accounts.

Table 1A: Number of individuals, by age observed and birth cohort

Birth cohorts	Number individuals	Years observed in sample	Ages observed in sample	%NS	%pensioners last obs'ved
1931-35	414	1981-2005	50-70	0.26	0.72
1936-40	565	1986-2007	50-70	0.36	0.76
1941-45	724	1991-2007	50-66	0.51	0.48
1946-50	934	1996-2007	50-61	0.65	0.20
1951-1957	1,417	2001-2007	50-56	0.80	0.07
total	4,054	1981-2007	50-70	0.60	0.34

Table 1B: Number of Observations by birth cohort and age

	Birth Cohort							
Age Range	1931-35	1936-40	1941-45	1946-50	1951-57	Total	% New System	% Pensioners
50-54	2,060	2,794	3,526	4,598	4,632	17,610	0.57	0.10
55-59	2,045	2,782	3,538	3,608	334	12,307	0.48	0.20
60-64	2,018	2,743	2,820	252	0	7,833	0.4	0.42
65-70	2,373	2,291	227	0	0	4,891	0.31	0.70
Total	8,496	10,610	10,111	8,458	4,966	42,641	0.48	0.26
%New System	0.26	0.36	0.51	0.64	0.79	0.48		
% Pensioners	0.36	0.38	0.24	0.13	0.07	0.26		

Table 2: Variables and their means—based on last year of observation for each individual

Variable	All	Men	Women	Women OS	Women NS	Men OS	Men NS
As % of full sample							
Workprob	0.587	0.678	0.456	0.271	0.609	0.489	0.787
New System (NS)	0.600	0.635	0.549				
Age	59.6	59.9	59.2	62.3	56.6	63.0	58.1
> sec ed	0.231	0.222	0.244	0.154	0.319	0.161	0.257
< sec ed	0.634	0.648	0.615	0.726	0.524	0.730	0.600
ever-married	0.775	0.841	0.680	0.722	0.646	0.840	0.841
#children	3.3	3.4	3.1	3.3	2.8	3.9	3.2
Health Problems	0.482	0.411	0.584	0.651	0.530	0.482	0.371
Born 1930-39	0.241	0.257	0.219	0.390	0.079	0.427	0.159
Born 1940-49	0.409	0.408	0.410	0.414	0.407	0.426	0.398
Born 1950-56	0.350	0.335	0.371	0.196	0.514	0.148	0.442
Old age & survivors pensioners	0.259	0.289	0.216	0.312	0.136	0.362	0.248
Disability pensioners	0.052	0.066	0.033	0.067	0.004	0.159	0.012
Score	1.099	1.124	1.062	0.927	1.173	0.992	1.200
Unemployment rate	7.838	7.834	7.845	8.070	7.660	8.052	7.708
As % of New System members only							
Affil. After reform	.197			na	.335	na	.113
As % of married members only							
Spouse over 65			0.171	0.229	.117	na	
Spouse over 60		0.257				0.371	0.192
Means for pensioners only							
Pension amount-000 pesos monthly	136	150	112	107	126	147	153
Years since pension	9.21	9.55	8.64	9.62	6.44	11.56	7.21
Number of Individuals	4054	2393	1661	749	912	874	1519

Table 3: Probability of working (based on % time worked each year), all observations, age 50-70

	(1) men	(2) men	(3) men	(1) women	(2) women	(3) women
NS and NS interactions						
New System	0.108*	0.059*	0.051***	0.196*	0.177*	0.161*
NS*d60-64			0.023			
NS*d65-70			0.123**			
NS*d60-70						0.069
NS*Old Age or Surv.			0.054			-0.071
NS*Disability			-0.057			-0.512*
NS*d60-64*Pensioner			-0.088***			
NS*d65-70*Pensioner			-0.221*			
NS*d60_70*Pensioner						-0.209**
NS*Married			0.003			0.059
Applies only to NS members						
Affiliated After Reform	-0.002	-0.018	-0.019	0.032	0.034	0.022
first3postaff	-0.051	-0.068	-0.066	0.174*	0.167*	0.167*
Pension-related variables						
Old Age or Surv. Pensioner		-0.163*	-0.188*		-0.065	-0.031
Disability Pensioner		-0.377*	-0.386*		-0.127***	-0.084
d60_64p		0.012	0.049			
d65_70p		0.079**	0.158*			
d60_70p					0.069***	0.114*
Pension Amount (thCH$2006)		-0.000*	-0.000*		-0.001*	-0.001*
Yspension		-0.003***	-0.004***		-0.004***	-0.006**
Other individual characteristics						
Score	0.022**	0.025*	0.025*	0.050*	0.056*	0.052**
less than secondary	0.015	-0.005	-0.004	-0.053	-0.068**	-0.070**
more than secondary	0.106*	0.090*	0.091*	0.123*	0.129*	0.127*
Married	-0.037**	-0.020	-0.023	-0.103*	-0.098*	-0.126*
number of children born	0.000	-0.000	-0.000	-0.004	-0.006	-0.007
spouse_over_60	0.002	0.018	0.017			
spouse_over_65				-0.052	-0.068***	-0.061***
Health problems	-0.093*	-0.055*	-0.054*	-0.082*	-0.069*	-0.070*
Macro-economic variables						
Income/cap (US$2000)	-0.020*	-0.018*	-0.018*	-0.022**	-0.027*	-0.027*
Unemployment	-0.008*	-0.008*	-0.008*	-0.012*	-0.011*	-0.011*
Constant	0.995*	1.026*	1.032*	0.800*	0.834*	0.851*
Observations	25910	25910	25910	16731	16731	16731
R-squared	0.167	0.260	0.262	0.190	0.209	0.216
ll_0	-13840	-13840	-13840	-11747	-11747	-11747
N_clust	2393	2393	2393	1661	1661	1661

Continuous age and age dummies for d60-64 and d65-70 (men), d60-70 (women) were also included as variables in this and all other regressions.

* p<0.01, ** p<0.05, *** p<0.1. Standard errors correct for correlations across repeated observations.

Table 4: Simulated differences in the probability of work between New and Old System—All and by marital status (based on probit model)

	MEN			WOMEN	
	New System Effect	As % of Old System workprob		New System Effect	As % of Old System workprob
All--no pension controls (Eq 1)	.122*	17%		.226*	56%
All--with pension controls (Eq 2)	.080*	10%		.204*	50%
By marital status, no pension controls (Eq 1 w. NS*Marr)					
Single	.109	15%		.192*	34%
Married	.124*	17%		.256*	60%
By marital status, with pension controls (Eq 3 w. NS*Marr)					
Single	.080*	11%		.154*	30%
Married	.077**	10%		.218*	59%

Table 5: Simulated differences in the probability of work between New and Old System--by pensioner status (based on probit model)

	PENSIONERS			NON-PENSIONERS	
	New System Effect	As % of Old System workprob		New System Effect	As % of Old System workprob
Men					
All (Eq 2)	.042	10%		.064*	8%
Age 50-59 (Eq 3)	.093**	17%		.041*	5%
Age 65-70 (Eq 3)	-.003	-1%		.174*	29%
Women					
All (Eq 2)	.077***	32%		.234*	51%
Age 50-59 Eq 3	.136***	43%		.217*	44%
Age 60-70 Eq 3	.053	24%		.298*	90%

Simulation in Tables 4 and 5 are based on probit models in Appendix Table 3, for individuals with mean characteristics for the corresponding sample. See "CLARIFY: Software for Interpreting and Presenting Statistical Results". (M. Tomz, J. Wittenberg, and G. King. 2003. Version 2.1. Stanford University, University of Wisconsin and Harvard University. http://gking.harvard.edu). Also see Allison 1999; Berry, Esarey and Rubin 2007; Norton, Wang and Ai 2004.

Pensioners are assumed not to be disability pensioners.

* p < 1%; ** p < 5%; *** p < 10%.

Standard errors are corrected for correlations across repeated observations.

Table 6: Actual pension amounts and simulated replacement rates for various groups based on simulated lifetime accumulations and annuity conversion rates

	Old system	New system	
Average observed pension amounts			
Early pensioner	155	154	
Normal age pensioner	122	149	
Simulated replacement rates*			
	Pensioned at 55 or 65	**Pensioned at 55 (early pensioners)**	**Pensioned at 65 (normal age)**
Worked & contributed 10 years	50%	*22%*	38%
20 years	60%	*43%*	76%
30 years	70%	65%	114%
35 years	70%	76%	152%

Note: italicized numbers indicate these people would not have been observed as pensioned at 55 because their replacement rate did not exceed 50%.

*Replacement rate as % of final wage. Simulations are based on assumption of 2% real wage growth actual average over study period), 7% real rate or return (approximate average annual rate of return, including return to recognition bonds, over study period), expected age of death = 80, person starts work at 20, years of contributory work are evenly distributed throughout lifetime from age 20 to date pension starts and person stops contributing when pension starts.

This is case for an immediate individual annuity purchased by a single man. Replacement rate for married man would be 10-20% less in the new system because of actuarial adjustment for mandatory joint annuity. Replacement rate for single woman would be 5-10% less because of greater longevity of women and use of gender-specific mortality tables. Expected pension wealth for married women would be about 30-50% higher because they can keep their own pension as well as the joint annuity in the new system (James, Edwards and Wong, 2008).

Table 7: New System Effect for pooled pensioners and non-pensioners, subsets with more and less education, early and late cohorts

NS coefficient for subsets with more and less education			
Men		**Women**	
Less than sec	**Sec or more**	**Less than sec**	**Sec or more**
0.12*	0.12*	0.23*	0.19*
NS coefficient for early and late cohorts			
Born before 1942	**Born 1942 or after**	**Born before 1942**	**Born 1942 or after**
0.11*	0.14*	0.22*	0.22*

Separate regressions by subset using specifications 1 and 4 in Table 3.
*p < 1%, based on robust standard errors.
Standard errors are corrected for correlations across repeated observations.

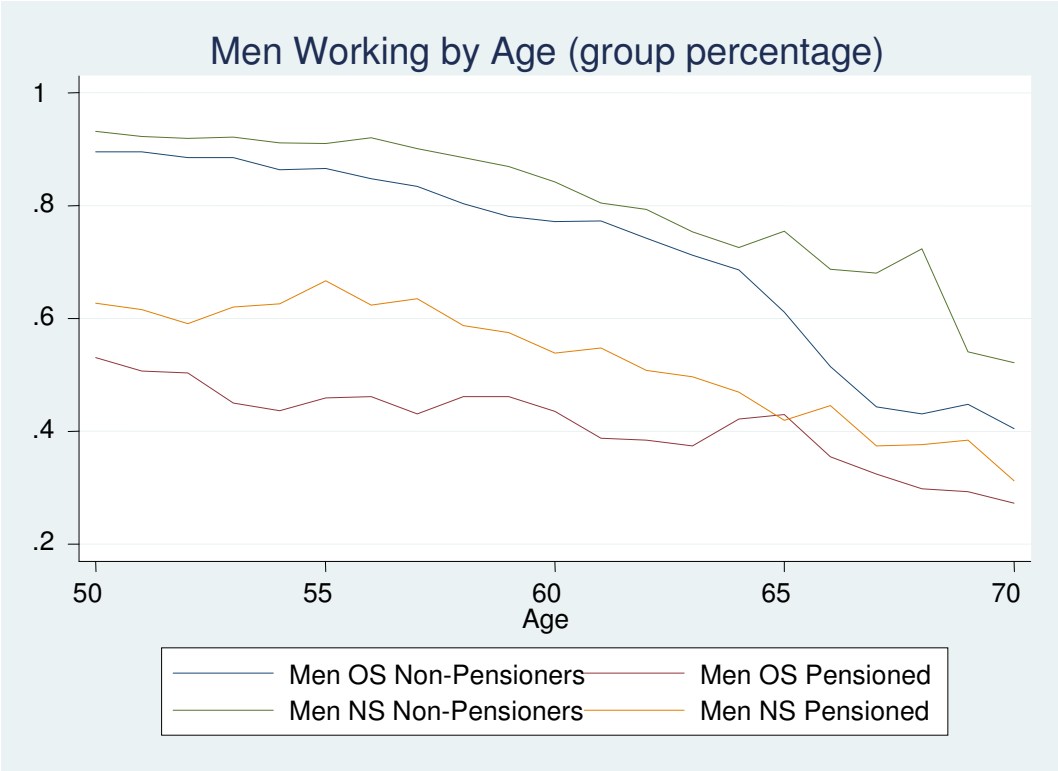
Table 8: Probability of working (based on % time worked each year), all observations, age 50-70. Does *Workprob* increase for later cohorts with more new system members?

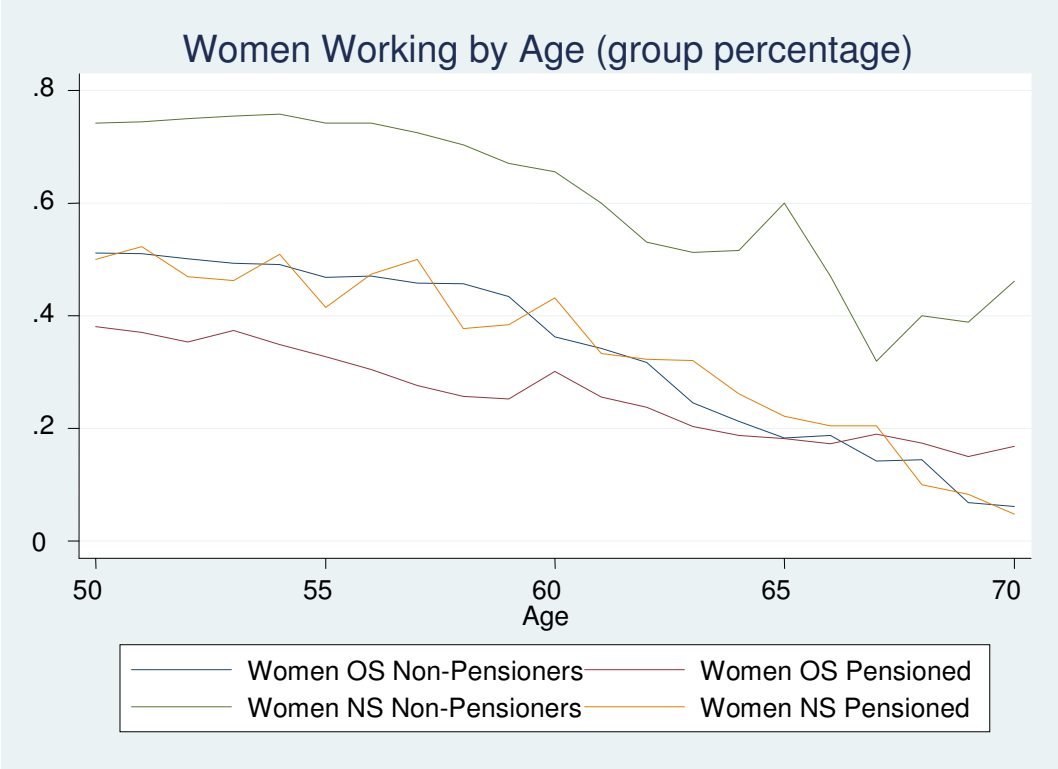
	(1) men	(1) women
Born 1942 or after	0.047**	0.043
Other individual characteristics		
Score	0.028*	0.069*
less than secondary	0.009	-0.061***
more than secondary	0.105*	0.130*
Married	-0.028*	-0.112*
number of children born	-0.001	-0.002
spouse_over_60	-0.012	
spouse_over_65		-0.052
Health problems	-0.099*	-0.095*
Macro-economic variables		
Income/cap (US$2000)	-0.023*	-0.001
Unemployment	-0.011*	-0.011*
Constant	1.097*	0.771*
observations	25910	16731
R-squared	0.149	0.156
N_clusters	2393	1661

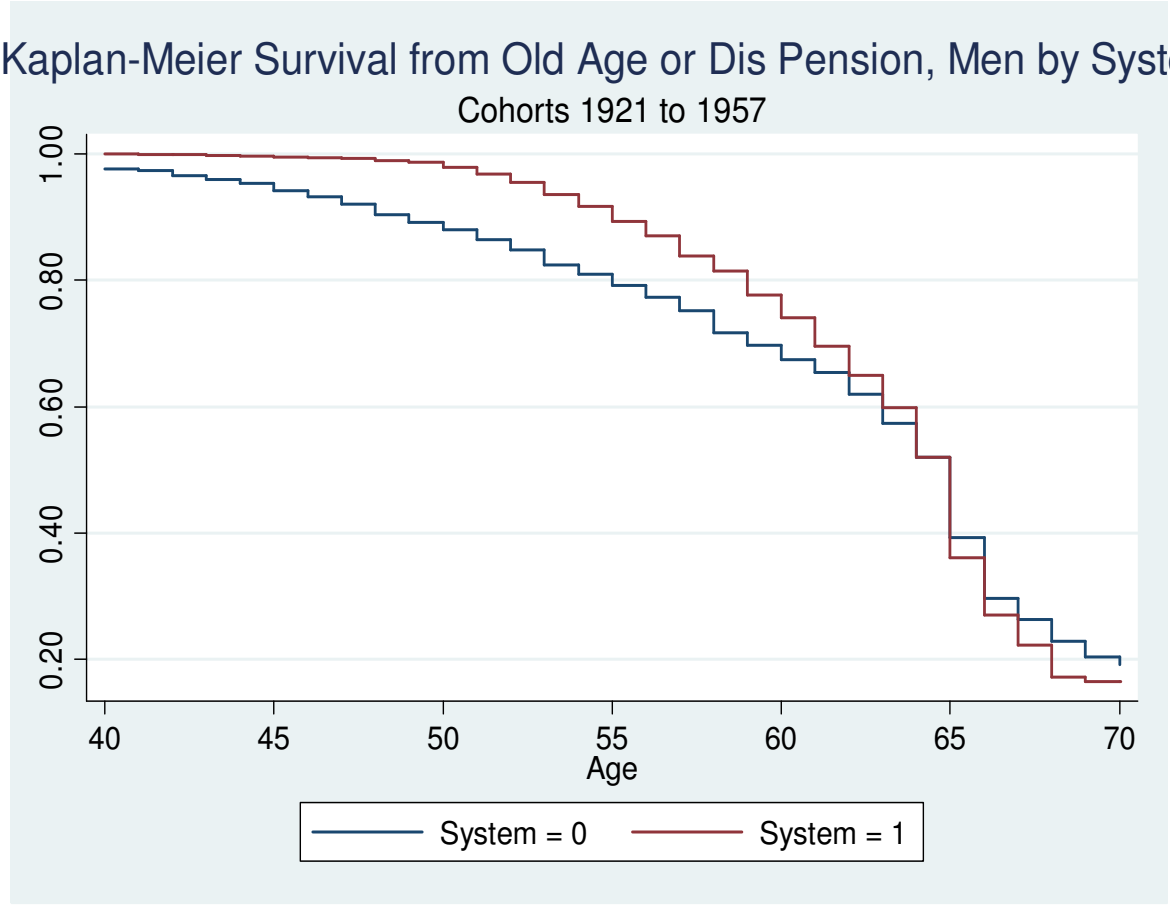
* p < 1%, ** p < 5%, *** p < 10%

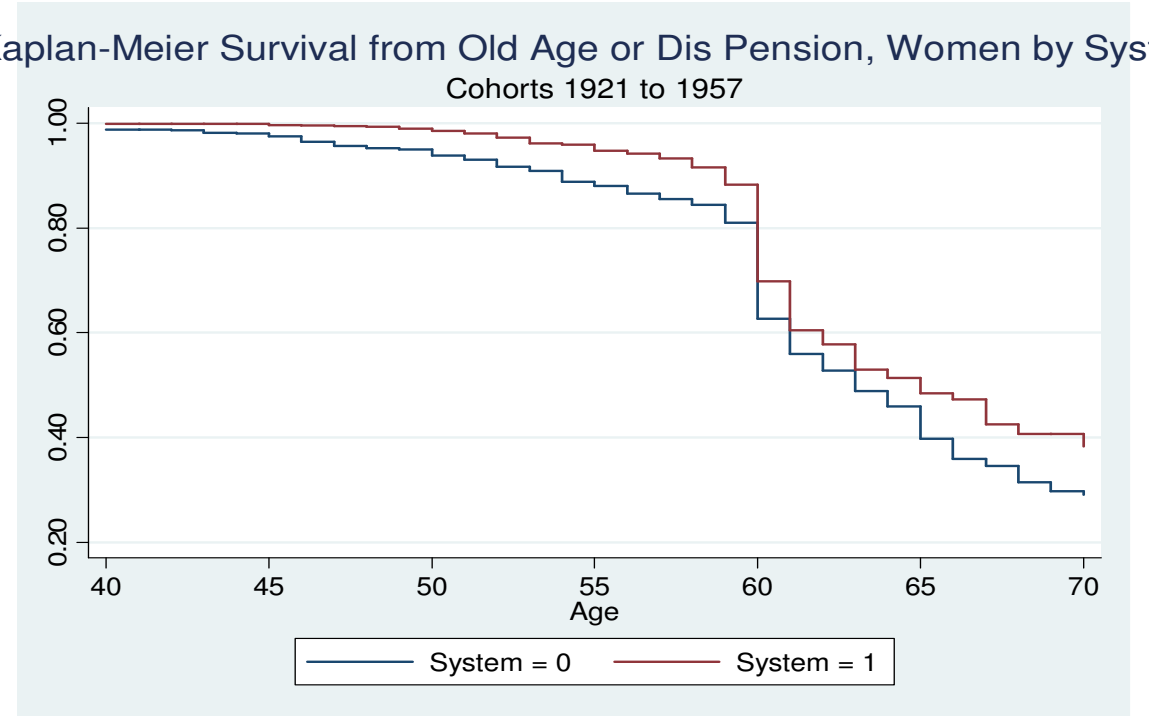
Based on equations 1 and 4, Table 3, with cohort instead of NS. Standard errors correct for correlations across repeated observations. Continuous age was also included as a variable in this and all other regressions. For Tables 7 and 8 we chose 1942 as the year for dividing the early and late cohorts, since more than 50% of individuals in cohorts born 1942 or thereafter were affiliated to the new system.

Figures 1A and 1B



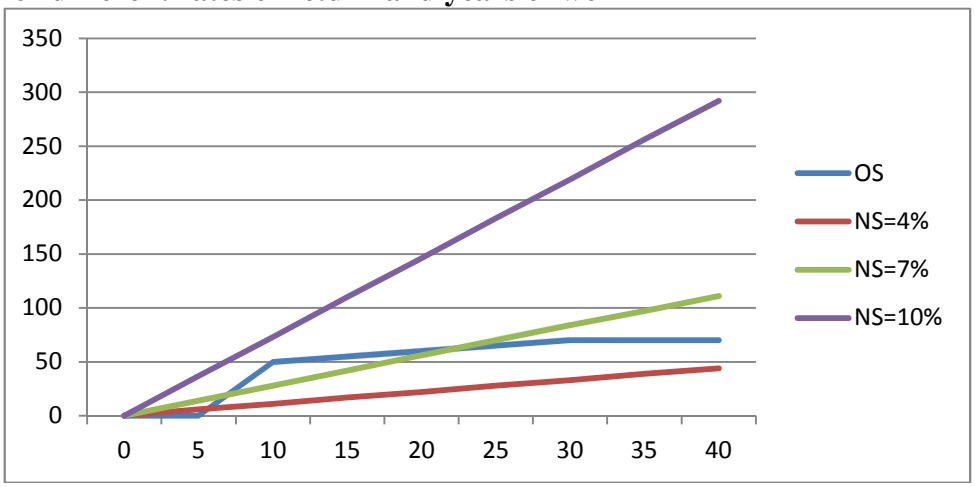






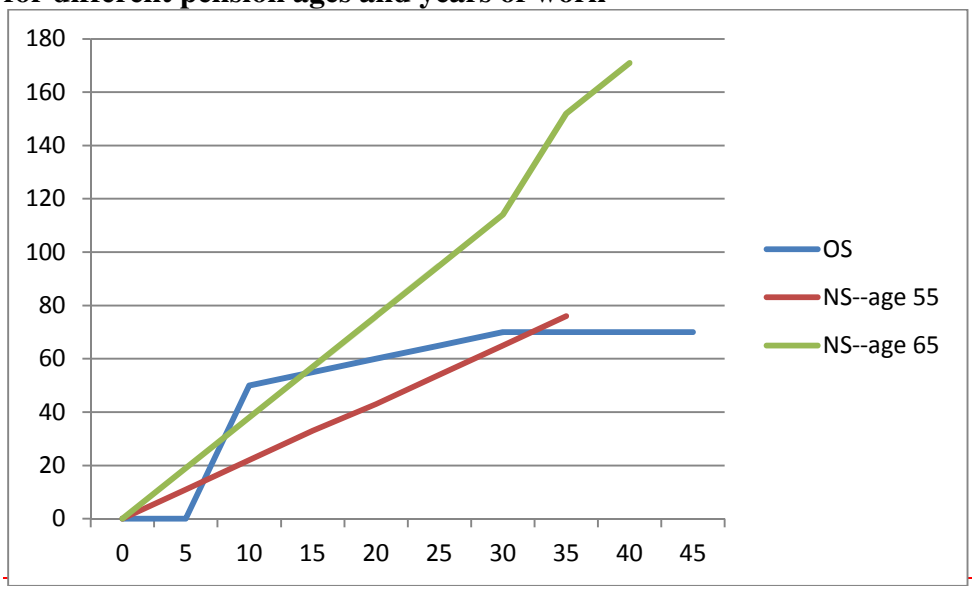
Figures 2A and 2B

Figure 3A: Replacement rates as indicator of pension wealth/wage in old and new systems for different rates of return and years of work



Individual is assumed to start pension at age 60, with 20 years of expected future lifetime. Years of work are assumed to be evenly distributed between ages 20 and 60. Real rate of return is 4%, 7% or 10%, respectively (see text). Real rate of wage growth is 2%.

Figure 3B: Replacement rates as indicator of pension wealth/wage in old and new systems for different pension ages and years of work



Individual is assumed to start pension at age 55 or 65, with 25 or 15 years of expected future lifetime, respectively. Years of work are assumed to be evenly distributed between ages 20 and age that pension starts. Real rate of return is 7% and real rate of wage growth is 2%.

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Appendix Table 1: Variable definitions

New System	= 1 if the individual is non pensioner and contributing to the new system, or is a new system pensioner.
Applies only to NS members	
Affiliated After Reform	= 1 if the individual is a new system contributor who did not switch from the old system. Individual must have entered the formal labor market after 1981.
first3postaff	= 1 if the individual affiliated after the reform and is in his/her first three years of affiliation.
Time invariant individual characteristics	
Score	Variable created from EPS 2006 main interview module. Measures knowledge of four aspects of pension system: (1) contribution rate as % of wage; (2) normal pension age (by gender); (3) approximate size of minimum pension guarantee; (4) number years of contributions required to qualify for minimum pension. "Score" is sum of correct answers.
less than secondary	=1 if individual did not complete secondary schooling.
more than secondary	=1 if individual had some schooling beyond secondary level.
Married	=1 if the individual is married, separated or widow.
number of children born	Created from questionnaire about family characteristics. Each individual is asked about the number of children ever-born. Children are typically grown, not living with parents.
Time varying individual characteristics	
spouse_over_60/65	=1 if spouse age is above 60/65 in year of observation. Takes value 0 if individual never married or spouse is 60/65 or less.
Health problems	Created from EPS 2006 health module. Each individual is asked if he/she was ever diagnosed with one of ten major health problems (e.g. lung disease, depression, diabetes, cancer) and the year in which the disease was first diagnosed. "Sick" takes value 1 from the first year any diagnosis applies. Takes value 0 in years before any diagnosis.
Pension-related variables	
Old Age or Surv. Pensioner	= 1 if individual is old age or disability pensioner. Takes value 0 in all pre-pension years.
Disability Pensioner	=1 if individual is disability pensioner, 0 in prior years.
Pension Amount (th. $ 2006)	Pension amount in thousand of pesos of 2006. Observed at the time of interview (in 2006). Since most pensions are price-indexed, its real value is invariant to time.
Yspension	Years elapsed from the first pension benefit claim
Macro-economic variables	
Income/cap(US$2000)	Gross National Income per capita measured in thousands of US dollars of 2000 as reported in World Development Indicators & Global Development Finance, The World Bank, July 28 2011. http://data.worldbank.org/data-catalog/world-development-indicators.
Unemployment	Unemployment at national level in December, as percentage rate. Chilean National Institute of Statistics (INE).

Appendix Table 2: Variables and their means—based on repeated observations

Variable	All	Men	Women	Women OS	Women NS	Men OS	Men NS
As % of full sample							
Workprob	0.652	0.754	0.495	0.380	0.663	0.673	0.825
New System (NS)	0.481	0.529	0.408				
Age	56.9	57.0	56.7	57.7	55.3	57.9	56.2
> sec ed	0.185	0.182	0.190	0.131	0.276	0.145	0.216
< sec ed	0.694	0.698	0.689	0.760	0.586	0.753	0.648
ever-married	0.803	0.859	0.716	0.757	0.656	0.853	0.864
#children	3.6	3.7	3.3	3.6	3.0	4.1	3.4
Health Problems	0.309	0.261	0.384	0.395	0.368	0.281	0.243
Born 1930-39	0.448	0.461	0.428	0.581	0.205	0.599	0.338
Born 1940-49	0.435	0.428	0.447	0.363	0.570	0.360	0.488
Born 1950-56	0.116	0.111	0.125	0.056	0.224	0.041	0.173
Old age & survivors pensioners	0.194	0.208	0.173	0.217	0.109	0.230	0.188
Disability pensioners	0.044	0.056	0.024	0.039	0.003	0.108	0.010
Score	1.056	1.084	1.012	0.915	1.154	0.983	1.174
Unemployment rate	8.371	8.355	8.396	8.331	8.491	8.298	8.405
As % of New System members only							
Affil. After reform	.126	0.067	0.246	na	.246	na	.067
As % of married members only							
Spouse over 65			0.106	0.120	.082	na	
Spouse over 60		0.134				0.159	0.113
Means for pensioners only							
Pension amount-000 pesos monthly	138	155.5	109	106	120	155	156
Years since pension	8.55	8.98	7.83	8.54	5.43	11.28	5.46
Number of observations	42,641	25,910	16,731	9,913	6,818	12,197	13,713

Appendix Table 3: Probit model used in simulations, all observations, age 50-70

	(1) men	(2) men	(3) men	(1) women	(2) women	(3) women
NS and NS interactions						
New System	0.414*	0.267*	0.330**	0.551*	0.502*	0.461*
NS*d60-64			-0.034			
NS*d65-70			0.228			
NS*d60-70						0.199
NS*Old Age or Surv.			-0.017			-0.228
NS*Disability			-0.275			
NS*d60-64*Pensioner			-0.172			
NS*d65-70*Pensioner			-0.497**			
NS*d60_70*Pensioner						-0.571**
NS*Married			-0.006			0.149
Applies only to NS members						
Affiliated After Reform	-0.005	-0.092	-0.113	0.089	0.091	0.053
first3postaff	-0.257	-0.341	-0.343	0.583*	0.569*	0.571*
Pension-related variables						
Old Age or Surv. Pensioner		-0.642*	-0.608*		-0.114	-0.016
Disability Pensioner		-1.177*	-1.140*		-0.234	-0.207
d60_64p		0.215*	0.285*			
d65_70p		0.446*	0.611*			
d60_70p					0.130	0.280**
Pension Amount (thCH$2006)		-0.001*	-0.001*		-0.002**	-0.002**
Yspension		-0.008	-0.010***		-0.016**	-0.020**
Other individual characteristics						
Score	0.089**	0.121*	0.120*	0.150*	0.172*	0.164*
less than secondary	0.055	-0.033	-0.026	-0.158***	-0.197**	-0.199**
more than secondary	0.435*	0.430*	0.438*	0.384*	0.416*	0.416*
Married	-0.148***	-0.093	-0.095	-0.295*	-0.283*	-0.350*
number of children born	0.001	-0.001	-0.001	-0.008	-0.015	-0.016
spouse_over_60	0.022	0.060	0.061			
spouse_over_65				-0.184	-0.229***	-0.219***
Health problems	-0.315*	-0.204*	-0.199*	-0.237*	-0.204*	-0.207*
Age50	-0.054*	-0.034*	-0.034*	-0.029*	-0.018*	-0.018*
d60-d70				-0.252*	-0.225*	-0.287*
d60-d64	-0.089**	-0.156**	-0.139**			
d65-d70	-0.316*	-0.476*	-0.539*			
Macro-economic variables						
Income/cap (US$2000)	-0.078*	-0.085*	-0.089*	-0.072**	-0.086*	-0.088*
Unemployment	-0.038*	-0.041*	-0.041*	-0.038*	-0.037*	-0.036*
Constant	1.716*	1.954*	1.931*	0.927*	1.011*	1.052*
Observations	25910	25910	25910	16731	16731	16731
R-squared	0.144	0.219	0.221	0.145	0.158	0.163
ll_0	-14461	-14461	-14461	-11581	-11581	-11581
N_clust	2393	2393	2393	1661	1661	1661

* p<0.01, ** p<0.05, *** p<0.1. Standard errors correct for correlations across repeated observations.

Appendix Table 4: Pension probability (old age and disability), ages 50 – 70

Linear model

	(1) men	(2) men	(3) men	(1) women	(2) women	(3) women
NS and NS interactions						
New System	-0.075*	-0.117*	-0.076**	-0.054*	-0.044*	-0.057**
NS*d60-64		0.086*	0.087*			
NS*d65-70		0.191*	0.193*			
NS*d60-70					-0.036	-0.037
NS*Married			-0.049			0.020
Applies only to NS members						
Affiliated After Reform	-0.081*	-0.076*	-0.074*	-0.021	-0.022	-0.023
first3postaff	-0.043	-0.041	-0.044	-0.010	-0.011	-0.010
Obs. before 1988	-0.100*	-0.071*	-0.069*	-0.075*	-0.083*	-0.084*
Individual characteristics						
Score	0.011	0.012	0.012	0.034**	0.034**	0.034**
less than secondary	-0.063**	-0.063**	-0.063**	-0.069**	-0.068**	-0.069**
more than secondary	-0.075**	-0.074**	-0.073**	-0.040	-0.041	-0.041
Married	0.043**	0.044**	0.069*	0.001	0.0003	-0.009
number of children born	-0.001	-0.001	-0.001	-0.022*	-0.022*	-0.022*
spouse_over_60	0.037	0.037	0.036			
spouse_over_65				-0.038	-0.039	-0.038
Health problems	0.089*	0.088*	0.088*	0.046*	0.046*	0.046*
Age50	0.021*	0.020*	0.020*	0.020*	0.020*	0.020*
d60-d70				0.220*	0.232*	0.232*
d60-d64	0.037*	-0.005	-0.005			
d65-d70	0.250*	0.173*	0.172*			
Macro-economic variables						
Income/cap (US$2000)	-0.005	-0.0005	-0.0004	-0.039*	-0.039*	-0.040*
Unemployment	0.005*	0.005**	0.005**	0.004***	0.004***	0.004***
Constant	0.072	0.080	0.057	0.231*	0.231*	0.238*
Observations	25910	25910	25910	16731	16731	16731
R-squared	0.232	0.237	0.238	0.258	0.259	0.259
ll_0	-15531	-15531	-15531	-8328	-8328	-8328
N_clust	2393	2393	2393	1661	1661	1661

* p<0.01, ** p<0.05, *** p<0.1 based on robust standard errors

Standard errors correct for correlations across repeated observations.

Appendix Figures 1A and 1B