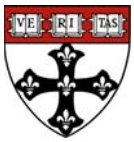

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The Effect of Social Security Reform on Male Retirement in High and Middle Income Countries[1]

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Abstract

We analyze panel data for 40 countries over the period 1970-2000 to examine the effect of social security reforms on the labor supply of older men. The data show a trend towards earlier retirement that can be explained by rising income levels. We find that the average retirement age rises significantly when the normal, or early, social security eligibility age rises, the pension benefits for postponing retirement are increased, or the system shifts from defined benefits to defined contributions. A package of social security reforms is capable of substantially increasing the labor supply of older men.

JEL numbers: H55, J26.
Keywords: Labor supply, labor force participation, pension.

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1. Introduction

Longer lifespans and aging populations are putting pressure on the retirement systems of many countries. The compression of morbidity and delay in the onset of disability mean that old people today are healthier than in previous generations, which, in theory, allows them longer working lives. However, male old-age labor force participation has fallen rapidly over the past several decades, triggering a policy debate about how to maintain the solvency of social security systems. An important issue in debating potential solutions is the magnitude of the labor supply response to social security reforms.

In this paper, we use new data on social security systems from 40 high- and middle-income countries over the period 1970-2000 to estimate the effect of changes in social security systems on male labor force participation and the average retirement age. In a world with complete markets and actuarially fair social security systems, expected benefits would perfectly match contributions, so that social security contributions should not have any direct influence on labor market decisions (Cremer et al., 2006b, Stock and Wise, 1990). However, most social security systems are not actuarially fair, and their rules lead to large incentive effects that significantly influence retirement decisions (Gruber and Wise, 2004). These systems can lead to little or no financial incentive to continue working beyond the social security retirement age, and only those with strong preferences for working continue to do so (Blondal and Scarpetta, 1999).

Gruber and Wise (1999, 2004) document the effect of social security systems on male retirement in a group of high income countries, and show that in each country retirement peaks at exactly the ages at which the retirement incentives are strongest. However, their approach is static in the sense that it analyzes labor force behavior in each country at only one point in time. From a policy perspective, it may be more important to consider how reforms of a social security system within a country affect retirement behavior over time. To investigate this issue we estimate male labor supply equations for the age groups 50-54, 55–59, 60–64 and 65+ in a five-year panel for 40 countries over the period 1970-2000. The use of panel data allows us to estimate the effects of changes in social security arrangements over time within countries.

In our analysis, we find a large downward trend in the labor supply of older males. Economic growth and rising wage rates generate both income and substitution effects on labor supply. Higher wages encourage work at the margin, but a higher lifetime income generates a

demand for increased leisure. The income effect appears to dominate, creating a downward trend in labor supply as income rise.

We also investigate the effect of social security arrangements on male labor supply. We define five indicators that describe the institutional features of social security systems in a given country and point of time for each cohort[2]. Social security can affect different workers very differently depending on their level of earnings and pattern of labor supply. We base our measures on the social security legislation as it would apply to a representative worker who starts school at age 6 and leaves school to start work after receiving the cohort average years of schooling, and then works continuously at average earnings until he decides to retire.

We construct five measures to capture the social security system. The first is the social security eligibility age, the age at which a worker becomes eligible for full benefits. The second measure is the number of years before the eligibility age that early retirement, at reduced benefits, is allowed. The third is the increase in benefits that a worker gains from a year of work past the eligibility age. Our final two measures capture the replacement rate, the percentage of average earnings replaced by the pension if the worker retires at the normal eligibility age. We measure the replacement rate from the defined benefit portion of a scheme separately from replacement that accrues from defined contributions.

The results from our empirical analysis imply that raising the social security eligibility or "normal" retirement age, or reducing the number of early retirement years allowed, significantly increase the labor market participation of older men. We find that raising the eligibility age for retirement by one year increases the average retirement age by about two months. This estimate is somewhat smaller that the six month effect estimated from recent increases in the eligibility age in the United States (Mastrobuoni, 2009). A one year delay in the option of early retirement increases the estimated average age of retirement by a slightly smaller margin. Raising the bonus for delaying retirement past the normal retirement age also increases the average age of retirement, by just under one month for each one-percentage point increase in the replacement rate per year of extra work.

We find that the effect of the replacement rate on retirement is very different in defined contribution and defined benefit schemes. In defined benefit schemes, raising the replacement

[2] Social security laws at a point in time often treat cohorts differently; for example a law may only apply to men born after a certain year.

rate tends to reduce the labor supply for older men. In defined contribution schemes, raising the replacement rate increases the labor supply. Our model predicts that a shift from a defined benefit to a defined contribution scheme, with the same expected replacement rate, should lead to a substantial increase in the retirement age. For a country like the United States, with a replacement rate of around 50%, we predict an increase in the average age at retirement of about 2 years if the United States were to switch from a defined benefit to a defined contribution scheme. We argue that in countries with defined benefit schemes and high replacement rates a package of reforms, increasing the social security eligibility age, reducing allowable early retirement, increasing incentives to keep working past the normal retirement age, and shifting from defined benefits to defined contributions, could increase men's average age of retirement by about 5 years.

These results complement a more general literature on the effects of social security systems. Social security systems can affect saving (Bloom et al., 2007, Zhang and Zhang, 2004), fertility decisions (Cremer et al., 2006a), labor supply (Burtless and Moffitt, 1985, Coile and Gruber, 2000, Krueger and Pischke, 1992), and economic growth (Ehrlich and Kim, 2005, Zhang and Zhang, 2004). Our results on the potential large effects of switching from a defined benefit to a defined contribution system complement those of Bloom and Canning (2007), who show a large effect of such a switch on national savings rates when the defined contributions system is fully funded. We do not address the issue of female labor supply, which follows a pattern very different from male labor supply (Bloom et al., 2009).

The remainder of the paper is structured as follows: we discuss the data in section two of the paper and present the empirical results in section three. We conclude with a short summary and discussion of our main results.

2. Data

The dataset we use in our empirical work is an unbalanced five-year panel covering the period 1970-2000 in 40 middle- and high-income countries. The dependent variable in our empirical analysis is the male labor force participation rate. Labor market participation data are from the International Labor Organization (ILO) Bureau of Statistics (2007) and are based on national labor market surveys and censuses. The participation rate for a given age group is the number of economically active individuals divided by the total population of that group. Those

persons classified as "economically active" are either employed or actively looking for work (ILO Bureau of Statistics, 2007). We use participation rates for the five-year age groups 50-54, 55-59, 60–64, and for the male population age 65 and older. We use labor supply by age to infer the average retirement age.

Our main interest is in the effect of the social security system. Data on social security systems are coded from the Social Security Administration's "Social Security Programs Throughout the World."[3] This database originates from a survey conducted by the Social Security Administration to summarize the key features of national social security systems. The survey covers more than 150 countries from 1958 to 2007. We restrict our analysis to the high and upper-middle income countries that have a universal social security system, i.e., a system covering employees of all sectors in the country.[4] We exclude the formerly communist countries of Eastern Europe. These countries underwent substantial economic reforms in the 1990s, and it is difficult to disentangle the effect of social security reforms from larger changes in the labor market. We also exclude countries with populations less than one million. Many of these small countries have large numbers of migrant workers in their workforce, or a large part of their domestic population working abroad, which makes the calculation of participation rates problematic.[5] Table 1 lists the 40 countries that remain after this selection process that are used in our study.

Our approach is to construct the social security rules that would pertain to a hypothetical representative worker. We assume that the hypothetical worker starts working at age 15, or at the age implied by starting school at age 6 and leaving after achieving the average schooling of the cohort, if the cohort average level of schooling exceeds 9 years. We assume that the representative worker is single and is continuously employed until retirement, and earns wages in each year equal to two thirds of the county's GDP per capita.[6]

Our first variable is the social security eligibility age, for full benefits, which we construct according to each country's eligibility rules. Most social security systems allow retirement if a worker has reached a certain age or has made contributions for a specified number of years. In some countries, workers need to achieve both a certain age and a given number of

[3] http://www.ssa.gov/policy/docs/progdesc/ssptw/
[4] We count as "universal" systems that have separate rules for public sector and agricultural workers, though we use in our analysis only the system for the rest of the workforce.
[5] 38 countries fall into this group, ranging from American Samoa and Andorra to Suriname and the Virgin Islands.
[6] Based on a labor share of 2/3, that is, the assumption that wages make up two thirds of GDP.

years of contributions; in others, workers can retire if they either reach a certain age *or* have contributed to the pension system for a given number of years. We find the age at which our "representative" worker becomes eligible.

The second social security variable is the number of years prior to the "normal" retirement age at which a worker can retire and still receive some social security benefits. Such early retirement typically comes with a lower pension. In some cases, countries allow earlier retirement for particular group of workers, e.g. miners. We assume that these special retirement clauses do not apply to our representative worker.

Our third variable measures the incentive to postpone retirement. As discussed extensively in Gruber and Wise (1999, 2004), retirement incentives come in many forms that generally translate into very high net effective tax rates on income earned once the worker passes a certain retirement age. Many pension systems do not adjust annual or monthly benefits at all if the worker decides to work and contribute beyond the social security eligibility rate, while other pension systems increase benefits in a more or less actuarially fair way.[7] The "deferred retirement bonus" variable we use in our empirical analysis captures the increase in social security pension, measured as a percentage point increase in the replacement rate, for each additional year of work.

In addition to these three variables we calculate two measures of the social security system's replacement rate for our representative worker if he retires when he reaches the normal eligibility age. The replacement rate is the annual pension received upon retirement as a percentage of his pre-retirement income. Distinguishing between the two broad types of pension systems, we calculate, for each country and each year, separate replacement rates from defined benefits and from defined contributions. In defined benefit systems, the pension levels are fixed by law; the pension level can be a fixed amount, or it can be dependent on the worker's income, contributions, or years of work, or on a mix of these. We calculate the percentage of income the benefits would replace for our "representative" worker given the assumed wage rates and number of working years.

In defined contribution systems, social security laws fix the amount which individuals have to contribute to their capital account. The pension is then paid from the invested

[7] Postponing retirement at age 65 by one year should lead to an increase in pensions by about 6-10 percent, depending on the conditional life expectancy at age 65.

contributions plus accrued interest.[8] For fully funded systems we assume that the contributions in the fund earn the long-run risk-free rate of return of 3% per year (Campbell, 2001), and are paid out on retirement at an inflation-adjusted annuity rate of 5%, which reflects current market rates for single males at age 65 in the UK, a market where private annuities are widely traded.[9] Because most defined contribution systems were introduced only recently, we use the contributions since the introduction of the system for our calculations. For workers who reach the normal retirement age shortly after the introduction of a defined contribution system, most of the pensions received come from their defined benefit, with a small contribution from their defined contributions. However, as time passes, a larger portion of the pension to retiring workers comes from the defined contribution element and a smaller portion from the defined benefit element.

For countries that introduce new pension systems, older workers are sometimes kept on the existing system while new rules are gradually phased in for younger workers. In our coding, we align each cohort with the appropriate system, i.e., if the new rules do not apply to workers potentially retiring at a given period we use the old social security laws. This coding is not clear-cut for countries (such as Chile or Argentina) that introduced new pension schemes and allowed some workers to choose between switching to the new scheme and remaining on the old scheme. In these cases we assume that all workers who get the choice between an old and a new system fall under the new system (as most eventually do), and calculate our measures accordingly.

Our additional explanatory variables are: physical capital per working-age person, life expectancy, percentage of the population living in urban areas, average years of schooling of men in the age group, and, Life expectancy and urbanization data are from the World Development Indicators (World Bank, 2006). We impute the physical capital stock based on the real capital investment rates from the Penn World Tables 6.2 (Heston et al., 2006). To avoid potential simultaneity biases in the estimation, we deflate the capital stock by the working-age population rather than the number of workers. Our human capital measure is the average years of schooling of men in that five-year age group (Lutz et al., 2008, Lutz et al., 2007). The education

[8] Most defined contribution systems are fully funded, but in theory the money either can be invested or may be placed in a notional account backed by the government. We treat these two as the same from the worker's point of view. From a national savings perspective, however, these systems are very different, since only a system in which contributions are actually invested will increase aggregate national savings.

[9] See, e.g. http://www.sharingpensions.co.uk/annuity_rates.htm#text1.

by age group data are only available for 1970-2000, which is why we restrict our analysis to this time window.

In Table 2 we report descriptive statistics on our dataset. Male labor force participation rates for 50-54 year olds average 90%, but fall rapidly for higher ages. The average social security eligibility age is 63 years, with a minimum of 50 and maximum of 70. Social security systems frequently allow early retirement, on average 2.3 years before the normal eligibility age. Most social security systems provide little incentive to work beyond the official retirement age, the average reward from delaying pension claims being a pension increase of only 1.1% of pre retirement wages. Average replacement rates in our sample are 59.6% from defined benefits and only 3.0% from defined contributions. Note, however, that few countries have defined contribution systems; the average replacement rate in systems that do have a defined contribution element is considerably higher at 29.2% and some of these countries also have a defined benefit part to their systems as well.

Table 3 shows the social security variables we construct for the 40 countries in the study. We report these at ten-year intervals, though in our analysis we use a panel with data every five years. Although we have substantial variation in social security arrangements across countries, we are more interested in the effects of social security reform within countries. Every country in our sample has some variation in social security arrangements, some of them quite large.

Some countries have simply increased the generosity of benefits by decreasing the eligibility age, allowing early retirement, or increasing the replacement rate. There are many examples of such changes. Finland increased its replacement rate substantially in the 1970s from 42% to 60%, and in the 1980s started to allow early retirement by up to 5 years. France substantially increased replacement rates from 20% to 50% during the 1970s and 1980s. Between 1980 and 2000 Greece increased the early retirement option from 2 to 7 years prior to the social security eligibility age. South Korea instituted early retirement in the 1990s, allowing up to 5 years. Luxembourg gradually increased the early retirement it allows, from 3 years in 1970 to 8 years in 2000. Mauritius increased its replacement rate from 26% in 1980 to 58% in 2000. Mexico increased its replacement rate in the 1970s, from 59% to 86%, and in the 1990s started to allow early retirement of up to 5 years. In the 1970s Panama granted the option of early retirement, up to 5 years, and increased the replacement rate from 69% to 100% but reduced the

deferral bonus from 5% to 2% of pre retirement income for each extra year worked. Saudi Arabia gradually increased its replacement rate from zero in 1970 to 62% in 2000.

By comparison, under financial strain many social security systems have made benefits less generous. In the 1990s Argentina increased its social security eligibility age from 60 to 64 while Italy increased its normal eligibility age from 60 to 65. Recent reforms in several European countries such as Austria, Germany, and Italy would also fall in this category, but are not captured in our data set which covers only reforms up to the year 2000.

Another group of countries started to make their systems more generous, but then rolled back these changes. Costa Rica increased the allowed period of early retirement to 8 years in 1980, and the replacement rate to 113% in 1990. However, by 2000 the period allowed for early retirement had fallen to 3 years, while the replacement rate had fallen to 87%. The deferral bonus in Costa Rica also fell from 5.6% per extra year worked in 1970 to 1.6% in 2000. Ireland reduced its social security eligibility age from 70 to 66 in the 1970s but then substantially reduced its replacement rate, from 66% to 33% in the 1990s. The Netherlands increased its replacement rate from 60% in 1970 to 87% in 1980 but it fell back to 51% by 2000. In the 1970s New Zealand reduced its normal retirement age from 65 to 60 while increasing its replacement rate from 48% to 87%; however, these changes were partially undone in the 1990s when it raised the normal retirement age to 64 and it had reduced the replacement rate to 66% by 2000. Spain increased its replacement rate in the 1970s from 50% to 100%, though it fell back to 86% during the 1980s; it also started to allow early retirement by up to 5 years in the 1990s.

A small number of countries have focused on changes to early retirement and incentives to keep working. In the 1980s, Canada introduced early retirement of up to 5 years but also introduced a deferral incentive of 3% of pre-retirement income for each year worked past the normal retirement age. Denmark introduced a deferral bonus of 6.8% per extra year worked in the 1970s and then eliminated it in the 1980s. In the 1980s Japan increased its normal retirement age from 60 to 65, but allowed early retirement by up to 5 years, while substantially reducing the replacement rate from 95% to 67% and introducing a large deferral bonus, increasing the pension by 8% for each extra year worked.

Two countries in our sample, Singapore and Malaysia, have relied exclusively on defined contribution schemes throughout the period. In 1970, these defined contribution systems provided relatively small replacement rates, primarily because workers retiring close to the start

of the schemes had little time to build up their capital. By 2000 the replacement rates we impute for these countries are much larger, due partly to saving over the whole working life, and partly to increases in the mandated contribution rates. Two additional countries introduced defined contribution elements to their social security schemes in the 1980s, Chile and Switzerland, and four more did so in the 1990s – Argentina, Australia, Costa Rica, and Denmark. For a worker reaching normal retirement age in 2000, however, the replacement rate from these defined contribution schemes is quite small due to their short period of operation.

Table 4 reports averages of the social security variables for the 34 countries for which we have complete data over the period 1970-2000. Although Table 3 shows that in individual countries there have been quite large changes in social security, the average across countries has moved very little. The final column reports on the number of countries with defined contribution elements in their systems.

Figure 1 shows the labor force participation rate for men aged 60-64 in 1970 and in 2000 for all 40 countries in our sample. We see very wide variations in participation rates, across countries, from a low of less than 20% to a high of close to 90% in 2000. We also see a downward trend in participation rates over time, with participation being lower in 2000 than in 1970 in most countries.

Figures 2, 3 and 4 show the evolution of male labor force participation rates and social security systems over the sample period for three countries: the United States, Chile, and France, respectively. These graphs should be viewed in light of the overall worldwide trend towards lower participation over time shown in Figure 1. In 1960 the United States had a social security eligibility age of 65 and a replacement rate of 46% from a defined benefit system. Up to 3 years of early retirement were allowed but there was no pension bonus from working after age 65. Over the period 1970-2000, there was a gradual increase in the deferral bonus to 3% in 2000, with only minor variations in the replacement rate. Labor force participation in the United States among 60-64 year olds and those over age 65 was declining before the introduction in the deferral bonus but the decline stopped and to some extent was reversed as the deferral bonus rose. Our data period does not cover the gradual increase in the social security eligibility age in the United States from 2000 onwards.

Until 1980, Chile had a define benefit scheme with a replacement rate of 70%. Chile switched from a defined benefit system to a defined contribution system in 1981. Following the

1981 reform, labor force participation increased among those aged 50-54 and 55-59, and stayed nearly constant around 70% for 60-64 year olds – a trend quite different from most other countries in our sample.

In 1970 France had an average replacement rate of only 20%. France witnessed a rapid increase in the replacement rate in its pension system between 1970 and 1985, with replacement rates increasing first to 25 and then in 1983 to 50%, though the deferral bonus was eliminated at the same time. France has experienced a rapid decline in male old age labor force participation; the fraction of males aged 60-64 participating in the labor force dropped from close to 60% in 1970 to less than 20% in 2000. Our data shows a larger decline in participation than usual over the period 1980-85, which coincides with the reforms to the social security system that occurred.

3. Empirical Specification and Results

To analyze the effect of social security on male labor force participation we estimate the parameters of the following equation separately for each age group:

$$LFP_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 Educ_{it} + \beta_3 LE_{it} + \beta_4 Urban_{it} + \beta_5 SocSec_{it} + \delta_i + \delta_t + \varepsilon_{it} \qquad (1)$$

where LFP_{it} is the age-group specific male labor force participation rate in country i in period t, k is log capital per working-age person, and *Educ* is the average years of schooling of men in the age group of interest. *LE* stands for male life expectancy, while *Urban* measures the degree of urbanization. It should be noted that that the capital stock, life expectancy and the urban population share in country i at time t are common to all age groups, while the years of schooling variable is age-group specific. *SocSec* are the social security variables discussed in the previous section. δ_i and δ_t are country and year dummies, respectively, and ε_{it} is an error term.

We use capital per working-age person and years of schooling as proxies for the wage rate. To address endogeneity concerns we normalize the capital stock to the population of working age rather than the actual number of workers. We expect wages to rise with the capital-to-working-age ratio and years of schooling. We also expect wages to rise over time with technological progress, captured by our time dummies. However, the wage rate has both income and substitution effects. A high wage rate encourages additional labor supply and later

retirement, but a high wage rate and income level over a person's life time leads to a greater demand for leisure and earlier retirement (Costa, 1995). This makes the effect of theses variables on retirement ambiguous, though we might expect them to have similar signs.

We also include male life expectancy as an explanatory variable. Prospective lifespan can affect life cycle behavior such as retirement and savings (Bloom, Canning, Mansfield and Moore, 2007, Hurd et al., 2004). In theory, in an optimizing model, an increase in lifespan will generally lead to later retirement, though it can result in earlier retirement if the longer expected lifespan is associated with a lower degree of uncertainty regarding the actual length of life (Kalemli-Ozcan and Weil, 2002).

We regard a social system as having universal coverage if workers in all sectors are covered by the system. However, workers in agriculture are sometimes subject to special rules and are not always covered by the social security system in the same way as non-agricultural workers. We include the level of urbanization in the country as a proxy for the importance of the agricultural sector.

Our age groups cover five-year intervals, with the exception of the 65+ age group, which is open-ended by construction. Participation in the labor market for this group depends on the age distribution within the group, with higher participation rates expected if the fraction of relatively young men is high. Therefore, we include the proportion of those under age 70 in the age group of 65+ as an explanatory variable, though for this age group alone.

Finally, we estimate the effect of our five social security variables: the social security eligibility age, the number of years prior to this early retirement is allowed, the deferred retirement pension benefit, and the replacement rates in defined contribution and defined benefit systems, respectively. We estimate the effect of the pension system on each age group separately. It is useful to combine the effect in the age specific participation rates into a single measure. We do this by calculating the expected retirement age given age specific participation rates and then finding the effect of s social security change on the expected retirement age.

We now model the expected retirement age. At each age t we take the participation rate to be $p(t)$, while the probability that a man who is working retires at age t (the retirement hazard rate) is $r(t)$. We assume men start working at age 15, work up to a retirement age R, and live up to age T. In this case the expected retirement age is given by

$$E(R) = \int_{15}^{T} t\, r(t)\, p(t) dt = 15 + p(T) + \int_{15}^{T} p(t) dt \qquad (2)$$

Men retire exactly at age t if they participate up to t and then retire at t, and we integrate over these retirement ages to get expected retirement age. The second equality can be derived by integration by parts and the fact that $\dot{r} = -\dot{p} / p,\ p(15) = 1$.

If we assume full participation up to age 50, and that retirement occurs before age T [10], so $p(50) = 1, p(T) = 0$, it follows that we can approximate the expected retirement age by

$$E(R) = 15 + \int_{15}^{T} p(t) dt \approx 50 + 5\, p_{50-54} + 5\, p_{55-59} + 5\, p_{60-64} + (T - 65)\, p_{65+} \qquad (3)$$

where p_{r-s} is the average participation rate of men aged *r-s,* and p_{65+} is the average participation rate of those 65 and older. In equation (3) we take the participation rate in each age interval to be the average participation rate of men in the age group.

The only remaining issue is to approximate T, the terminal age. We approximate the average value of T by assuming that there are negligible deaths before age 65 and a stable survival schedule and thereafter and no population growth. Let $d(t)$ be the death rate at time t and let $s(t)$ be the proportion of those that survive to t. Then

$$E(T) = 65 + \int_{65}^{\infty} t d(t) s(t) dt = 65 + \int_{65}^{\infty} s(t) dt = 65 + N_{65+} / N_{65} \approx 65 + 5(N_{65+} / N_{60-64}) = 75.9 \qquad (4)$$

In a stable and stationary population the ratio of those over 65, N_{65+} to those aged 65, N_{65} is equal to life expectancy at 65. We can approximate the number of people age 65 as one fifth of those aged 60-64 given negligible deaths in the pre-65 age group. The ratio of the male population over 65 to the male population 60-64 in our sample is 2.17. This means that a man who reaches 65 in our sample lives on average an additional 10.9 years.[11] This gives us as estimate of T = 75.9, which is about 6 years higher than the average life expectancy at birth in our sample. When we find an effect of changes in social security on average participation rates

[10] Assuming that participation rates are steady for those over 65 so that $p(T) = p_{65+}$ changes our result very little. The final term in equation (3) becomes $(T + 1 - 65)\, p_{65+}$ instead of $(T - 65)\, p_{65+}$. However, it seems more plausible that participation rates fall with age over 65 and approach zero at T.

[11] The population over 65 is the integral of the survival curve over 65, however this is also the average life span after 65.

for each age group, equation (3) will allow us to transform these estimates into to an effect of the expected retirement age. In the results presented below we estimate the effect of changes in social security on age-specific male labor force participation and also the effect of changes in social security on this constructed expected age of retirement.

In our analysis we assume that changes to social security system are exogenous and are set independently of labor supply. As pointed out by Gruber and Wise (1998), this assumption may be problematic if governments change social security schemes in response to labor market conditions. However, individual country studies (e.g. Börsch-Supan and Schnabel, 1998) have shown that changes in policy generally precede changes in labor supply. While social security reforms do respond to retirement behavior, in most cases reforms are implemented very slowly. Reforms generally do not apply to those who are about to retire, but are phased in gradually to apply to those that will retire in the future. Thus the system under which the current elderly are operating is likely not affected by their own retirement decisions. To the extent that there is an endogenous policy response (e.g., raising the social security eligibility age to counteract increasing early retirement) we will underestimate the true effect of social security reforms, so that our estimates could be interpreted as a lower bound for the true policy impact.

Results

In Table 5 we report simple ordinary least squares (OLS) estimates of the determinants of male participation rates. The log capital stock per worker is associated with significantly lower male labor market participation for men over 55, while years of education are associated with lower participation for men over 60. The time dummies are negative with large decreases in participation in later years for men under 65. These results are consistent with the idea that the income effect dominates the substitution effects so that higher wages, due to increased capital stock, education and technical progress, lead to earlier retirement and lower labor supply. A higher level of urbanization is associated with lower labor force participation, which may be due to lower pension coverage, or benefits, to agricultural workers. We also find a negative effect of life expectancy on participation for those over 65. This seems to suggest that the human capital and income effects of improved health are larger than the effect of a longer lifespan.

We find higher social security eligibility ages, as well as fewer allowed years of early retirement, to be associated with a higher labor force participation rate for men between the ages

of 50 and 64. Higher deferred retirement bonuses are associated with higher participation of men over 55. Higher replacement rates are associated with lower labor market participation for men between 55 and 59 years of age. The last column of table 5 shows the effect of our variables on the average retirement age calculated using equation (3).

The results in table 5 use differences in social security arrangements to explain differences in labor force participation across countries. Yet social security arrangements may be correlated with unobserved national characteristics that affect retirement. For example, national policies on social security may be rooted in deep-seated social preferences on labor supply that are also reflected in retirement behavior, and thus the observed relationship between social security rules and retirement behavior across countries, as seen in Table 5, may not be causal. From a policy perspective, it is important to track what happens over time within a country as it changes its social security arrangements. For this reason Besley and Case (2000) recommend the use of fixed effects when examining the effect of policy changes on behavior in panel data.

In Table 6 we report the results of our regressions adding country fixed effects. The included country fixed effects control for unobserved variables that are country-specific but do not vary within a given country over the sample period. While social security arrangements are likely to reflect social attitudes and preferences in the long run, policy reforms tend to occur in discrete episodic jumps. If we can regard the timing of these policy jumps as random or reflective of unrelated political circumstances, we have exogenous variation in social security that we can use to identify the effect of policy changes.

In table 6 increases in the log capital stock per working-age person, and the time dummies, are associated with large reductions in male labor supply. This supports the idea of a large income effect on the demand for leisure. We estimate that the average retirement age in our sample of countries has fallen by 2.3 years between 1970 and 2000 simply through the time trend.

However, in the fixed effects model, the number of years of education is not significant. Extending the length of education may raise annual income, but it also delays entry to the workforce. As a result, it may not significantly raise lifetime income unless retirement is postponed. In the fixed effects model, the effect of the urban share of the population on participation becomes positive for some age groups; whereas countries with high levels of urbanization have lower participation, those that increase their urbanization rate see higher levels

of participation. A rapidly rising level of urbanization may be a proxy of economic growth and high wages for older workers, relative to their lifetime average wage rate. This may spur high participation rates.

Our main focus, however, is on the effect of social security arrangements. The social security eligibility age has a positive and statistically significant (at the 5% level) effect on the participation of men over 60. Column 5 of Table 6, which is based on the formula derived in equation (3), shows that raising the eligibility age by one year increases average retirement age by about 0.16 years. This effect is significant at the 1% level. Allowing early retirement significantly lowers the participation of men aged 60 and above. We estimate that an additional allowed year of early retirement reduces the average retirement age by about 0.11 years.

We estimate that the bonus for deferring retirement has a positive effect on participation for each group, with larger effects for those over 60. Although none of the individual age specific participation rate regressions give coefficients on the bonus that is statistically significant, the estimated effect on the average retirement age is positive and significant at the 5% level. We estimate that augmenting pensions by 1% of wage income for each additional year worked increases the average retirement age by 0.07 years.

On one hand, raising the replacement rate in defined benefit schemes tends to reduce participation rates, particularly in the 55-59 age group. We estimate that each additional 10% of income that is replaced lowers the average retirement age by 0.1 years. On the other hand, increasing the replacement rate in the defined contribution scheme appears to raise participation rates for men under 65. We estimate that each additional 10% of income replaced in a defined contribution scheme (which requires higher contribution rates) increases the average retirement age by about 0.2 years.

All five of our social security variables have statistically significant effects on the average retirement age, as shown in Table 6. The incentive effects of changing the social security eligibility age, allowed years of early retirement, and the pension bonus for working past the normal retirement age are clear. It is less obvious why switching from a defined benefit to a defined contribution scheme should have such a large effect on retirement behavior. Defined contribution schemes provide a clear incentive to keep working, as later retirement allows for the accumulation of a larger capital fund and gives a higher pension when retired. However, we account for this in our deferred pension bonus where we assume that additional years of work

allow both larger contributions and interest on capital to be earned before distributions from pension capital begin.

One possible explanation for our finding is that defined benefit schemes offer additional incentives to stop working, relative to defined contribution systems, that our model does not take into account, such as distributional effects and differences in risk (Feldstein and Liebman, 2002). Most defined benefit schemes have a redistribution goal, in addition to providing a method of saving. The incentives for those at the top and bottom of the earnings distribution may be different from those for the representative worker we use in the construction of our measures. For example, minimum and maximum pension payouts may generate large incentives for workers at either end of the earnings distribution to retire early by making their pension insensitive to their choices, even if workers in the middle of the distribution are rewarded for retiring later. Our data lacks sufficient detail on the social security systems to allow construction of measures that take account of these subtler but potentially significant incentive effects at different points in the income distribution.

An alternative explanation is that even if the incentives implicit in a defined benefit and a defined contribution system are the same, workers may think of the two systems differently. Framing effects are important in decision making, and framing a decision as retiring to get access to public funds, as opposed to retiring and drawing down ones "own" funds, may elicit different labor supply decisions, even if the two decisions have the same effect on current and future income.

We undertake a number of robustness checks to assess the generality of our results. The results in Table 6 cover all 40 countries in our sample. Many of the cases of social security reform in our sample involve middle-income countries, there is a concern that our results may not apply to high income countries. In addition, some of the middle income countries in our sample underwent very rapid economic growth over the period 1970-2000, which may have affected their labor markets dramatically. In particular, the two countries with the most reliance on defined contribution systems, Singapore and Malaysia, may not be representative of richer countries in the Western world. Moreover, the social security systems in some of the middle-income countries in our sample, while theoretically universal in their coverage, may in practice only apply to formal sector workers. There may be unregulated, informal sectors in some of our sample countries that are not covered by the social security system, but which do affect measured

participation rates. To address these concerns we report in Table 7 estimates for only the 23 countries that were members of the OECD in 1975 as noted in Table 1. The sample restriction appears to have little effect; the results in Table 7 are very similar to those found in Table 6, with slightly larger estimated retirements effects associated with moving from a defined benefit to a defined contribution system.

A second issue arises when estimating the effect of social security reform (changing from defined benefit to defined contribution) when countries use only a defined benefit system. In Table 6 we pool countries from defined benefit and defined contribution systems. However, the effect of changes in eligibility and early retirement ages, and the deferred retirement bonus, may differ across the two systems. In Table 8 we therefore report estimates for the 32 countries that had only defined benefit systems throughout the period. We find that the estimated effects of social security reform within a defined benefit system are very similar to those estimated for the whole sample in Table 6. We do not report separate results for defined contribution systems; only eight countries had such systems, and in many cases these make up a small portion of the overall pension scheme.

To get a better picture of the magnitude of the effects we estimate, it is useful to consider an individual country. In 1990, Italy had a social security eligibility age of 60, allowed up to 10 years of early retirement and had a replacement rate of 80% in a defined benefit system, with no bonus for delaying retirement. By 2000, Italy had raised its normal retirement age to 65. Using the results reported in Table 6, we estimate that this five year increase in the eligibility age increased its average retirement age by 0.78 years. However, if in addition to raising the normal retirement age, Italy had reduced allowing early retirement by five years we estimate an increase in the average retirement age of 1.06 years. An increase in the deferred pension benefit to 5% a year would cause average retirement age among Italian men to rise by 0.36 years according to our estimates. Taken together, these estimates imply that a comprehensive reform of a defined benefit system could raise the average retirement age in Italy by about 2.3 years. In addition, a switch from a defined benefit system to a defined contribution system with the same 80% replacement rate would increase men's average retirement age by a further 2.8 years according to our estimates. These reforms therefore appear to have the potential to raise the average retirement age by up to 5.1 years in total. We report these estimates of the effect of a hypothetical package of reforms in Table 9.

4. Summary and Discussion

In this paper, we estimate the effect of the institutional features of national social security systems on male labor force participation and the average retirement age. Our empirical results yield two main findings. First, income effects seem to dominate the substitution effect in old-age labor force participation decisions, in that higher wages (due to higher capital stocks and technical progress) and incomes lead to earlier retirement ─ a finding consistent with previous US-focused studies by Krueger and Pischke (1992) and Costa (1995) .

The main focus of this paper, however, lies in our second finding, which highlights the importance of social security arrangements. We find that increasing the social security eligibility age, reducing allowed years of early retirement, and increasing pensions for workers who work past the normal retirement age significantly increase male labor supply and the average retirement age. We also find large increases in the retirement age when countries shift from defined benefit to defined contribution systems with similar replacement rates. We hypothesize that this reflects either "hidden" retirement incentives inherent to defined benefit systems but not captured in our coding, or framing effects.

Our work has two weaknesses when compared with national-level studies. One is our use of measures of national social security systems as derived from countries' reports to the US Social Security Administration. These reports give crude indicators of systems that are generally very complex. More detailed national studies allow for this complexity, particularly looking at how incentives vary for men with different income levels (Klaauw and Wolpin, 2008) as well as the treatment of women and married couples, the tax treatment of pensions, the availability of disability benefits (Duggan et al., 2007), and the construction of age specific incentive effects (Coile and Gruber, 2001). A second issue is our use of aggregate data on participation rates by age group. More detailed studies use microeconomic labor force data, which show how retirement varies by education level, earnings, and martial status. Microeconomic data also allows the estimation of a structural model based on individual decision making (French, 2005, Gustman and Steinmeier, 2005).

Despite these limitations, we our approach does allow us to see the effects of large social security reforms on overall participation, and provides estimates of the magnitude of these effects. Within individual countries there are often only a very limited range of reforms, and the

timing of a particular reform may make it difficult to separate its effects from other changes to the national economy. By pooling cross-country and time series data for many countries, we do lose some detail, but we gain in the range and number of reforms experienced, and our ability to identify their effects.

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Table 1: Country List

1	Argentina	21	Luxembourg[a)]
2	Australia[d)]	22	Malaysia
3	Austria[a)]	23	Malta
4	Belgium[a)]	24	Mauritius
5	Brazil	25	Mexico
6	Canada[a)]	26	Netherlands[a)]
7	Chile	27	New Zealand[e)]
8	Costa Rica	28	Norway[a)]
9	Cyprus	29	Panama
10	Denmark[a)]	30	Portugal[a)]
11	Finland[c)]	31	Saudi Arabia
12	France[a)]	32	Singapore
13	Gabon	33	South Africa
14	Germany[a)]	34	Spain[a)]
15	Greece	35	Sweden[a)]
16	Hong Kong, China	36	Switzerland[a)]
17	Ireland[a)]	37	Turkey[a)]
18	Italy[a)]	38	United Kingdom[a)]
19	Japan[b)]	39	United States[a)]
20	Korea, Rep.	40	Uruguay

Notes: a) Original OECD member

b), c), d), e): Joined the OECD in 1964, 1969, 1971 and 1973, respectively

Table 2: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Male labor force participation, age 50-54	90.0	4.2	69.0	97.5
Male labor force participation, age 55-59	79.3	9.3	50.2	95.2
Male labor force participation, age 60-64	56.2	17.7	14.1	87.0
Male labor force participation, age 65+	23.4	16.0	1.9	71.5
Log(capital per working age person)	3.7	0.8	1.5	5.0
Male life expectancy	69.3	5.9	45.5	78.0
Urban population share	70.6	15.7	32.0	100.0
Average years of education, males 50-54	7.6	3.2	0.9	14.1
Average years of education, males 55-59	7.0	3.3	0.6	13.4
Average years of education, males 60-64	6.5	3.4	0.4	13.1
Average years of education, males 65+	5.6	3.4	0.2	12.9
Share of population 65-69 over population 65+	38.4	4.6	26.3	53.7
Social security eligibility age	63.0	3.8	50.0	70.0
Allowed years of early retirement	2.3	3.9	0.0	20.0
Replacement rate: defined benefits	59.6	26.5	0.0	114.0
Replacement rate: defined contributions	3.0	14.2	0.0	118.9
Deferred retirement bonus (% increase in pension per year)	1.1	1.9	0.0	11.7

Based on 264 observations in 40 countries from 1970 to 2000.

Table 3 Social Security System Data

Country	Year	Social Security eligibility age	Allowed Years of early retirement	Deferred retirement bonus %	Replacement rate: defined benefit	Replacement rate: defined contribution
Argentina	1970	60	0	4.1	82.0	0.0
Argentina	1980	60	0	1.7	70.0	0.0
Argentina	1990	60	0	1.7	70.0	0.0
Argentina	2000	64	0	2.3	89.3	2.5
Australia	1970	65	0	0.0	40.9	0.0
Australia	1980	65	0	0.0	50.4	0.0
Australia	1990	65	0	0.0	47.3	0.0
Australia	2000	65	0	0.4	47.8	2.9
Austria	1970	65	5	0.0	76.5	0.0
Austria	1980	65	5	2.3	76.5	0.0
Austria	1990	65	5	0.0	79.5	0.0
Austria	2000	65	5	3.2	80.0	0.0
Belgium	1970	65	5	0.0	60.0	0.0
Belgium	1980	65	5	0.0	64.4	0.0
Belgium	1990	65	5	0.0	63.7	0.0
Belgium	2000	65	5	0.0	62.6	0.0
Brazil	1970	65	20	0.0	75.0	0.0
Brazil	1980	65	20	0.0	95.0	0.0
Brazil	1990	65	15	0.0	95.0	0.0
Brazil	2000	65	12	0.0	100.0	0.0
Canada	1970	65	0	0.0	41.8	0.0
Canada	1980	65	0	0.0	50.6	0.0
Canada	1990	65	5	3.0	50.8	0.0
Canada	2000	65	5	2.8	47.2	0.0
Chile	1970	65	0	2.3	70.0	0.0
Chile	1980	65	0	2.3	70.0	0.0
Chile	1990	65	0	2.8	64.0	4.2
Chile	2000	65	0	2.3	41.1	12.0
Costa Rica	1970	65	5	5.6	70.0	0.0
Costa Rica	1980	65	8	5.6	94.0	0.0
Costa Rica	1990	65	4	1.7	113.5	0.0
Costa Rica	2000	65	3	1.6	86.9	1.2
Cyprus	1980	65	0	0.0	33.0	0.0

Country	Year	Social Security eligibility age	Allowed Years of early retirement	Deferred retirement bonus %	Replacement rate: defined benefit	Replacement rate: defined contribution
Cyprus	1990	65	0	0.0	46.8	0.0
Cyprus	2000	65	2	0.0	37.0	0.0
Denmark	1970	67	0	2.0	62.0	0.0
Denmark	1980	67	0	6.8	68.4	0.0
Denmark	1990	67	0	0.0	53.7	0.0
Denmark	2000	67	0	0.1	58.6	0.1
Finland	1970	65	0	1.5	32.4	0.0
Finland	1980	65	0	4.0	60.0	0.0
Finland	1990	65	5	1.6	60.0	0.0
Finland	2000	65	5	4.3	60.0	0.0
France	1970	60	0	0.8	20.0	0.0
France	1980	60	0	1.3	25.0	0.0
France	1990	60	0	0.0	50.0	0.0
France	2000	60	0	0.0	50.0	0.0
Gabon	1970	55	0	0.0	35.0	0.0
Gabon	1980	55	0	0.0	40.0	0.0
Gabon	1990	55	0	0.0	47.0	0.0
Gabon	2000	55	0	0.0	57.0	0.0
Germany	2000	65	2	4.7	78.2	0.0
Greece	1970	62	2	0.0	114.0	0.0
Greece	1980	62	2	0.0	99.1	0.0
Greece	1990	65	5	0.0	91.3	0.0
Greece	2000	65	7	0.0	85.5	0.0
Hong Kong	1980	70	0	0.0	10.2	0.0
Hong Kong	1990	70	5	0.0	5.9	0.0
Hong Kong	2000	70	5	0.0	6.7	0.0
Ireland	1970	70	0	0.0	47.0	0.0
Ireland	1980	66	1	0.0	64.2	0.0
Ireland	1990	66	1	0.0	66.5	0.0
Ireland	2000	66	1	0.0	33.0	0.0
Italy	1970	60	10	0.0	74.0	0.0
Italy	1980	60	10	0.0	80.0	0.0
Italy	1990	60	10	0.0	80.0	0.0
Italy	2000	65	10	0.0	80.0	0.0

Country	Year	Social Security eligibility age	Allowed Years of early retirement	Deferred retirement bonus %	Replacement rate: defined benefit	Replacement rate: defined contribution
Japan	1970	60	0	0.0	86.8	0.0
Japan	1980	60	0	0.0	94.9	0.0
Japan	1990	65	5	8.0	66.6	0.0
Japan	2000	65	5	8.1	67.2	0.0
Korea, Republic	1990	60	0	0.0	33.3	0.0
Korea, Republic	2000	60	5	0.0	37.5	0.0
Luxembourg	1970	65	3	0.0	83.3	0.0
Luxembourg	1980	65	5	0.0	83.3	0.0
Luxembourg	1990	65	5	0.0	101.6	0.0
Luxembourg	2000	65	8	0.0	97.6	0.0
Malaysia	1970	55	0	1.0	0.0	13.8
Malaysia	1980	55	0	1.3	0.0	25.9
Malaysia	1990	55	0	2.2	0.0	50.9
Malaysia	2000	55	0	2.8	0.0	64.1
Malta	1970	63	0	0.0	50.3	0.0
Malta	1980	61	0	0.0	66.7	0.0
Malta	1990	61	0	0.0	66.7	0.0
Malta	2000	61	0	0.0	66.7	0.0
Mauritius	1980	60	0	0.0	26.3	0.0
Mauritius	1990	60	0	0.0	39.2	0.0
Mauritius	2000	60	0	0.0	58.0	0.0
Mexico	1970	65	0	2.0	59.0	0.0
Mexico	1980	65	0	0.0	86.4	0.0
Mexico	1990	65	0	0.0	90.8	0.0
Mexico	2000	65	5	0.0	93.5	0.0
Netherlands	1970	65	0	0.0	60.2	0.0
Netherlands	1980	65	0	0.0	86.9	0.0
Netherlands	1990	65	0	0.0	72.1	0.0
Netherlands	2000	65	0	0.0	51.5	0.0
New Zealand	1970	65	0	0.0	47.7	0.0
New Zealand	1980	60	0	0.0	86.7	0.0
New Zealand	1990	60	0	0.0	98.2	0.0
New Zealand	2000	64	0	0.0	66.3	0.0
Norway	1970	70	0	0.0	40.5	0.0

Country	Year	Social Security eligibility age	Allowed Years of early retirement	Deferred retirement bonus %	Replacement rate: defined benefit	Replacement rate: defined contribution
Norway	1980	67	0	4.9	54.2	0.0
Norway	1990	67	0	0.0	58.2	0.0
Norway	2000	67	0	0.0	44.4	0.0
Panama	1970	60	0	5.0	69.0	0.0
Panama	1980	60	5	2.0	100.0	0.0
Panama	1990	60	5	2.0	100.0	0.0
Panama	2000	62	0	2.0	100.0	0.0
Portugal	1970	65	0	0.0	70.0	0.0
Portugal	1980	65	0	0.0	70.0	0.0
Portugal	1990	65	0	0.0	80.0	0.0
Saudi Arabia	1970	60	0	0.0	0.0	0.0
Saudi Arabia	1980	60	0	0.0	22.0	0.0
Saudi Arabia	1990	60	0	0.0	42.0	0.0
Saudi Arabia	2000	60	0	0.0	62.0	0.0
Singapore	1970	55	0	0.9	0.0	11.1
Singapore	1980	55	0	2.1	0.0	38.1
Singapore	1990	55	0	4.2	0.0	91.7
Singapore	2000	55	0	5.1	0.0	118.9
South Africa	1970	65	0	0.0	16.8	0.0
South Africa	1980	65	0	0.0	25.7	0.0
South Africa	1990	65	0	0.0	48.3	0.0
South Africa	2000	65	0	0.0	37.0	0.0
Spain	1970	65	0	0.0	50.0	0.0
Spain	1980	65	0	0.0	100.0	0.0
Spain	1990	65	0	0.0	85.7	0.0
Spain	2000	65	5	0.0	85.7	0.0
Sweden	1970	67	4	3.5	48.4	0.0
Sweden	1980	65	5	4.5	62.6	0.0
Sweden	1990	65	5	5.6	67.2	0.0
Sweden	2000	65	5	4.2	49.4	0.0
Switzerland	1970	65	0	0.0	27.7	0.0
Switzerland	1980	65	0	0.0	47.3	0.0
Switzerland	1990	65	0	1.0	45.8	4.4
Switzerland	2000	65	0	1.0	58.8	11.5

Country	Year	Social Security eligibility age	Allowed Years of early retirement	Deferred retirement bonus %	Replacement rate: defined benefit	Replacement rate: defined contribution
Turkey	1970	55	0	0.7	68.0	0.0
Turkey	1980	55	12	0.6	60.0	0.0
Turkey	1990	55	9	0.8	80.0	0.0
Turkey	2000	55	9	0.0	70.0	0.0
United Kingdom	1970	65	0	2.2	38.2	0.0
United Kingdom	1980	65	0	4.4	58.8	0.0
United Kingdom	1990	65	0	3.5	47.0	0.0
United Kingdom	2000	65	0	3.1	41.3	0.0
United States	1970	65	3	0.0	49.0	0.0
United States	1980	65	3	0.5	45.9	0.0
United States	1990	65	3	1.9	47.1	0.0
United States	2000	65	3	3.0	46.0	0.0
Uruguay	1970	50	0	0.0	100.0	0.0
Uruguay	1980	60	0	0.0	70.0	0.0
Uruguay	1990	60	0	0.0	75.0	0.0
Uruguay	2000	60	0	3.0	55.0	0.0

Table 4: Social Security System Averages over Time

Year	Retirement Age	Early retirement years	Replacement rate defined benefits	Deferment bonus	Replacement rate defined contributions	Number of defined contribution systems
1970	62.8	1.7	52.8	0.9	0.7	2
1975	62.6	2.1	59.3	1.5	1.1	2
1980	62.6	2.4	63.5	1.3	1.7	2
1985	62.7	2.5	63.9	1.1	2.8	3
1990	62.8	2.6	65.4	1.2	3.9	4
1995	63.0	2.7	62.7	1.2	4.8	6
2000	63.3	2.7	60.9	1.4	5.5	8

Notes: Based on 34 countries with complete data from 1970-2000.

Table 5: Determinants of Male Labor Force Participation
Method of Estimation: OLS

Dependent variable	**Male labor force participation**				**Retirement Age**
Age group	*50-54*	*55-59*	*60-64*	*65+*	
	(1)	(2)	(3)	(4)	(5)
Log(capital stock per working age)	-0.816	-4.150***	-8.685***	-6.409***	-1.381***
	(0.532)	(1.109)	(1.876)	(1.395)	(0.189)
Life expectancy (males)	0.057	0.023	-0.011	-0.624**	-0.065*
	(0.075)	(0.120)	(0.244)	(0.281)	(0.034)
Urban population share	-0.055***	-0.077**	-0.158**	-0.217***	-0.038***
	(0.018)	(0.038)	(0.068)	(0.050)	(0.007)
Male years of education	0.106	0.097	-0.636*	-0.744**	-0.103**
	(0.150)	(0.234)	(0.378)	(0.314)	(0.041)
Social security eligibility age	0.193**	0.459***	1.018***	-0.125	0.070*
	(0.092)	(0.139)	(0.255)	(0.298)	(0.036)
Allowed early retirement years	-0.248***	-0.715***	-0.557**	-0.280	-0.106***
	(0.067)	(0.129)	(0.232)	(0.205)	(0.026)
Deferred retirement bonus	0.216	0.787**	1.437***	1.081**	0.240***
	(0.145)	(0.331)	(0.539)	(0.463)	(0.060)
Replacement rate: defined benefit	-0.018	-0.049**	-0.054	-0.026	-0.009*
	(0.011)	(0.023)	(0.041)	(0.036)	(0.005)
Replacement rate: defined contribution	0.031*	-0.074*	0.063	0.106	0.013
	(0.017)	(0.043)	(0.059)	(0.069)	(0.008)
Share (ages 65-69/population 65+)				-0.142	
				(0.253)	
Year 1975	-0.608	-0.879	-2.153	-1.772	-0.375
	(0.933)	(1.710)	(3.299)	(2.738)	(0.354)
Year 1980	-0.991	-1.488	-4.488	-3.080	-0.684*
	(0.922)	(1.700)	(3.327)	(2.789)	(0.359)
Year 1985	-1.440	-2.822	-6.389*	-4.169	-0.987**
	(0.888)	(1.743)	(3.385)	(3.011)	(0.381)
Year 1990	-1.802*	-3.752**	-7.997**	-2.952	-0.999***
	(0.945)	(1.810)	(3.482)	(3.006)	(0.384)
Year 1995	-2.320**	-4.619**	-8.816**	-1.188	-0.917**
	(0.971)	(1.840)	(3.623)	(3.143)	(0.401)
Year 2000	-2.773***	-3.992**	-8.351**	-0.433	-0.803*
	(1.050)	(1.836)	(3.696)	(3.549)	(0.441)
R-squared	0.206	0.331	0.347	0.539	

Notes:
Robust standard errors in parentheses. All regressions are based on 264 observations in 40 high- and middle-income countries over the period 1970-2000.
*** p<0.01, ** p<0.05, * p<0.1.

Table 6: Determinants of Male Labor Force Participation
Method of Estimation: Fixed Effects

Dependent variable	**Male labor force participation**				**Effect on**
Age group	*50-54*	*55-59*	*60-64*	*65+*	**retirement age**
	(1)	(2)	(3)	(4)	(5)
Log(capital stock per working age)	-3.764***	-7.488***	-13.905***	-5.417**	-1.848***
	(1.114)	(1.565)	(2.628)	(2.496)	(0.317)
Life expectancy (males)	0.175	0.196	0.347	-0.080	0.027
	(0.125)	(0.199)	(0.384)	(0.184)	(0.030)
Urban population share	0.091	0.250***	0.385***	0.021	0.039***
	(0.062)	(0.083)	(0.122)	(0.105)	(0.014)
Male years of education	-0.242	-0.342	0.228	0.860	0.076
	(0.228)	(0.427)	(0.741)	(0.766)	(0.094)
Social security eligibility age	0.231*	0.277	1.204***	0.658**	0.157***
	(0.119)	(0.271)	(0.303)	(0.310)	(0.040)
Allowed early retirement years	0.112	-0.114	-0.550**	-0.721**	-0.106***
	(0.242)	(0.265)	(0.227)	(0.279)	(0.037)
Deferred retirement bonus	0.077	0.177	0.333	0.392	0.072**
	(0.107)	(0.190)	(0.237)	(0.241)	(0.031)
Replacement rate defined benefit	-0.006	-0.075***	-0.041	-0.047	-0.011***
	(0.018)	(0.029)	(0.043)	(0.029)	(0.004)
Replacement rate defined contribution	0.081***	0.106***	0.142***	0.065	0.024***
	(0.019)	(0.028)	(0.037)	(0.049)	(0.006)
Share (ages 65-69/population 65+)				0.330***	
				(0.114)	
Year 1975	-0.648	-1.093	-3.024*	-2.627**	-0.524***
	(0.615)	(0.991)	(1.692)	(1.303)	(0.175)
Year 1980	-1.499**	-2.750**	-6.931***	-5.040***	-1.108***
	(0.748)	(1.164)	(2.014)	(1.408)	(0.196)
Year 1985	-2.183**	-4.880***	-10.889***	-6.840***	-1.643***
	(0.911)	(1.350)	(2.358)	(1.703)	(0.234)
Year 1990	-2.731**	-6.542***	-14.617***	-8.701***	-2.142***
	(1.148)	(1.677)	(2.848)	(2.052)	(0.284)
Year 1995	-3.206**	-7.760***	-16.345***	-8.394***	-2.280***
	(1.399)	(1.965)	(3.355)	(2.565)	(0.347)
Year 2000	-3.602**	-7.303***	-16.848***	-8.487***	-2.312***
	(1.434)	(2.145)	(4.176)	(3.038)	(0.412)
R-squared	0.801	0.889	0.929	0.943	

Notes:
Robust standard errors in parentheses. All regressions are based on 264 observations in 40 high- and middle-income countries over the period 1970-2000.
*** p<0.01, ** p<0.05, * p<0.1.

Table 7: Determinants of Male Labor Force Participation in OECD Countries
Method of Estimation: Fixed Effects

Dependent variable	**Male labor force participation**				**Effect on**
Age group	*50-54*	*55-59*	*60-64*	*65+*	**retirement age**
	(1)	(2)	(3)	(4)	(5)
Log(capital stock per working age)	-0.959	-0.193	-10.527	-3.651	-0.982
	(2.574)	(4.758)	(6.471)	(3.893)	(0.597)
Life expectancy (males)	-1.195***	-2.528***	-0.526	0.082	-0.203***
	(0.379)	(0.377)	(0.702)	(0.457)	(0.066)
Urban population share	-0.126	0.122	0.099	-0.686***	-0.070***
	(0.112)	(0.125)	(0.223)	(0.171)	(0.023)
Male years of education	-0.667***	-0.664	-0.710	1.583**	0.070
	(0.245)	(0.443)	(0.913)	(0.751)	(0.097)
Social security eligibility age	0.478*	0.086	0.738*	0.430*	0.112**
	(0.243)	(0.491)	(0.445)	(0.257)	(0.045)
Allowed early retirement years	0.282	0.162	-0.504*	-0.812***	-0.091***
	(0.248)	(0.227)	(0.267)	(0.232)	(0.033)
Deferred retirement bonus	0.236	0.435*	0.529	0.644***	0.130***
	(0.173)	(0.229)	(0.329)	(0.243)	(0.034)
Replacement rate defined benefit	0.037*	-0.054	-0.162***	-0.062**	-0.016***
	(0.022)	(0.035)	(0.051)	(0.028)	(0.004)
Replacement rate defined contribution	0.191	0.249	-0.070	0.950***	0.122***
	(0.141)	(0.196)	(0.364)	(0.303)	(0.040)
Share (ages 65-69/population 65+)				0.144	
				(0.112)	
Year 1975	0.589	0.526	-1.848	-2.483*	-0.307
	(0.852)	(0.976)	(1.942)	(1.342)	(0.187)
Year 1980	1.171	1.158	-4.679*	-6.235***	-0.797***
	(1.330)	(1.503)	(2.597)	(1.572)	(0.237)
Year 1985	1.965	1.244	-8.292***	-8.059***	-1.132***
	(1.824)	(1.733)	(3.100)	(2.039)	(0.298)
Year 1990	2.624	1.444	-10.161***	-9.102***	-1.296***
	(2.427)	(2.318)	(3.814)	(2.514)	(0.373)
Year 1995	3.976	2.236	-11.224**	-9.719***	-1.309***
	(3.047)	(2.890)	(4.512)	(3.224)	(0.467)
Year 2000	5.482	6.603*	-9.093	-9.863**	-0.925
	(3.656)	(3.575)	(5.596)	(4.044)	(0.580)
R-squared	0.848	0.939	0.955	0.949	

Notes:
Robust standard errors in parentheses. All regressions are based on 155 observations in 23 OECD countries over the period 1970-2000. Countries are included in the sample if they were OECD members by 1975.
*** p<0.01, ** p<0.05, * p<0.1.

Table 8: Determinants of Male Labor Force Participation in Countries with Defined Benefit Systems Only
Method of Estimation: Fixed Effects

Dependent variable	**Male labor force participation**				**Effect on**
Age group	*50-54*	*55-59*	*60-64*	*65+*	**retirement age**
	(1)	(2)	(3)	(4)	(5)
Log(capital stock per working age)	-4.174***	-5.716**	-15.676***	-12.439***	-2.633***
	(1.528)	(2.195)	(3.376)	(2.171)	(0.320)
Life expectancy (males)	0.036	0.025	0.347	0.393*	0.063*
	(0.103)	(0.213)	(0.454)	(0.221)	(0.035)
Urban population share	0.050	0.282**	0.334**	-0.239**	0.007
	(0.085)	(0.116)	(0.153)	(0.099)	(0.015)
Male years of education	-0.226	0.214	0.189	1.786**	0.203*
	(0.296)	(0.531)	(0.854)	(0.829)	(0.104)
Social security eligibility age	0.365***	0.362	1.078***	0.478*	0.142***
	(0.134)	(0.300)	(0.264)	(0.277)	(0.037)
Allowed early retirement years	0.115	-0.169	-0.571**	-0.794***	-0.118***
	(0.236)	(0.265)	(0.224)	(0.240)	(0.033)
Deferred retirement bonus	0.133	0.276	0.694***	0.388	0.097***
	(0.160)	(0.252)	(0.218)	(0.291)	(0.037)
Replacement rate defined benefit	0.026	-0.041	-0.017	-0.070**	-0.009**
	(0.019)	(0.031)	(0.048)	(0.029)	(0.004)
Replacement rate defined contribution					
Share (ages 65-69/population 65+)				0.240**	0.026**
				(0.103)	(0.011)
Year 1975	-0.448	-1.780	-2.712	-1.271	-0.386**
	(0.719)	(1.144)	(1.905)	(1.253)	(0.179)
Year 1980	-1.091	-3.781***	-6.208***	-3.229**	-0.906***
	(0.903)	(1.359)	(2.228)	(1.340)	(0.201)
Year 1985	-1.490	-6.235***	-10.075***	-5.704***	-1.511***
	(1.119)	(1.603)	(2.585)	(1.693)	(0.245)
Year 1990	-2.107	-8.435***	-14.347***	-7.944***	-2.110***
	(1.398)	(1.970)	(3.197)	(2.046)	(0.299)
Year 1995	-2.246	-10.244***	-15.866***	-6.963***	-2.176***
	(1.719)	(2.338)	(3.789)	(2.593)	(0.369)
Year 2000	-2.422	-10.210***	-15.732***	-7.053**	-2.186***
	(1.792)	(2.651)	(4.815)	(3.070)	(0.442)
R-squared	0.809	0.900	0.938	0.957	

Notes:
Robust standard errors in parentheses. All regressions are based on 208 observations in 32 high- and middle-income countries with no defined contribution systems over the period 1970-2000.
*** p<0.01, ** p<0.05, * p<0.1.

Table 9: Interpreting the Results: The Effect of a Reform Package

Reform	Effect on expected retirement age (years)
Increase Social Security Eligibility age by 5 years	0.8
Reduce allowed early retirement by 5 years	1.1
Increase deferral benefit by 3% a year	0.4
Switch from 80% defined benefit to 80% defined contribution replacement rate	2.5
Total	5.1

Figure 1

Labor force participation of men aged 60-64 in 1970 and 2000

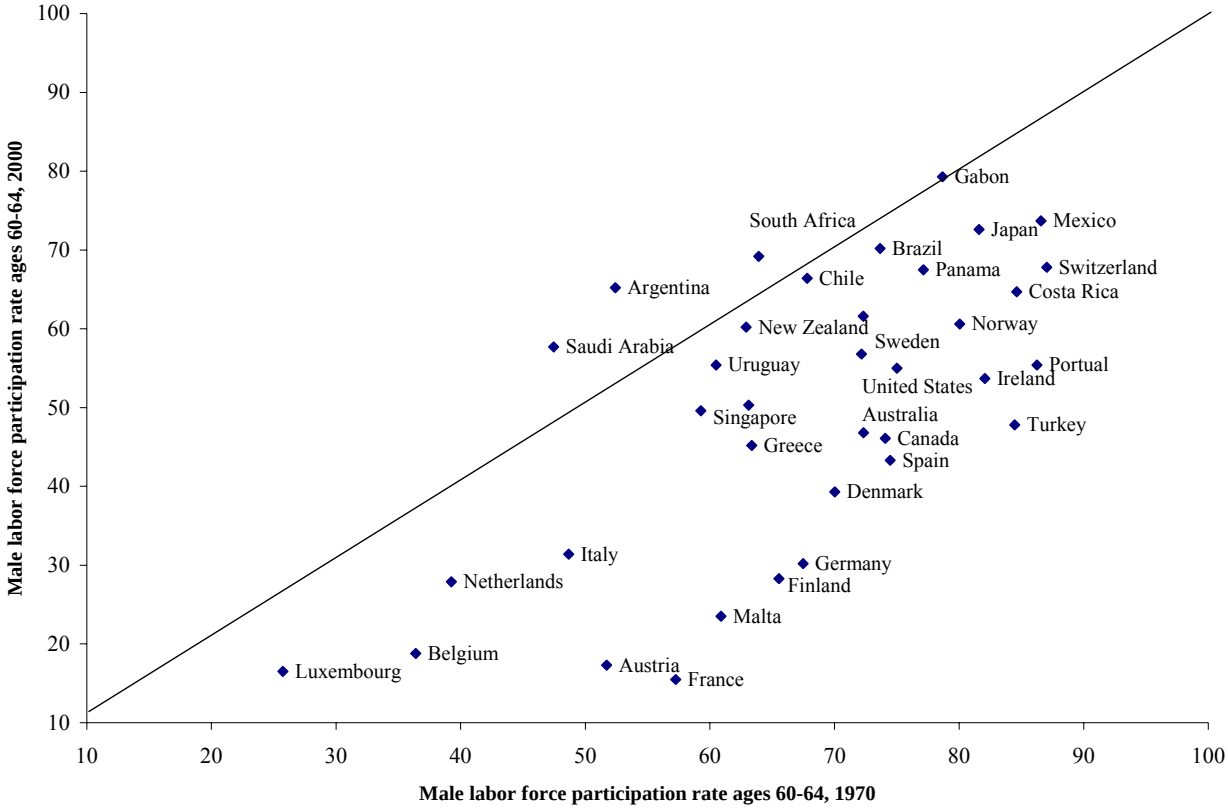

Figure 2 Participation rates and social security in the United States

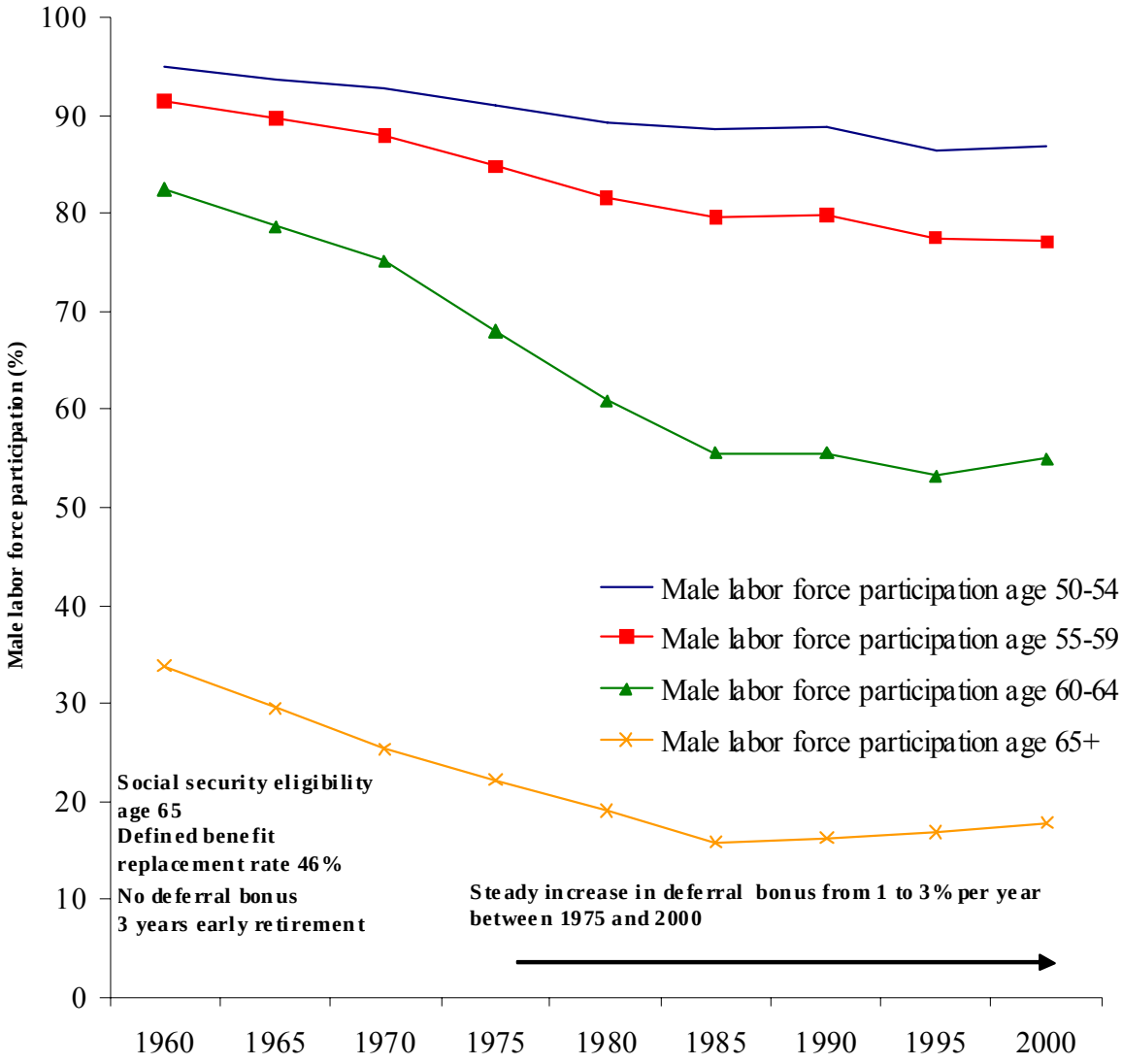

Figure 3: Participation rates and social security in Chile

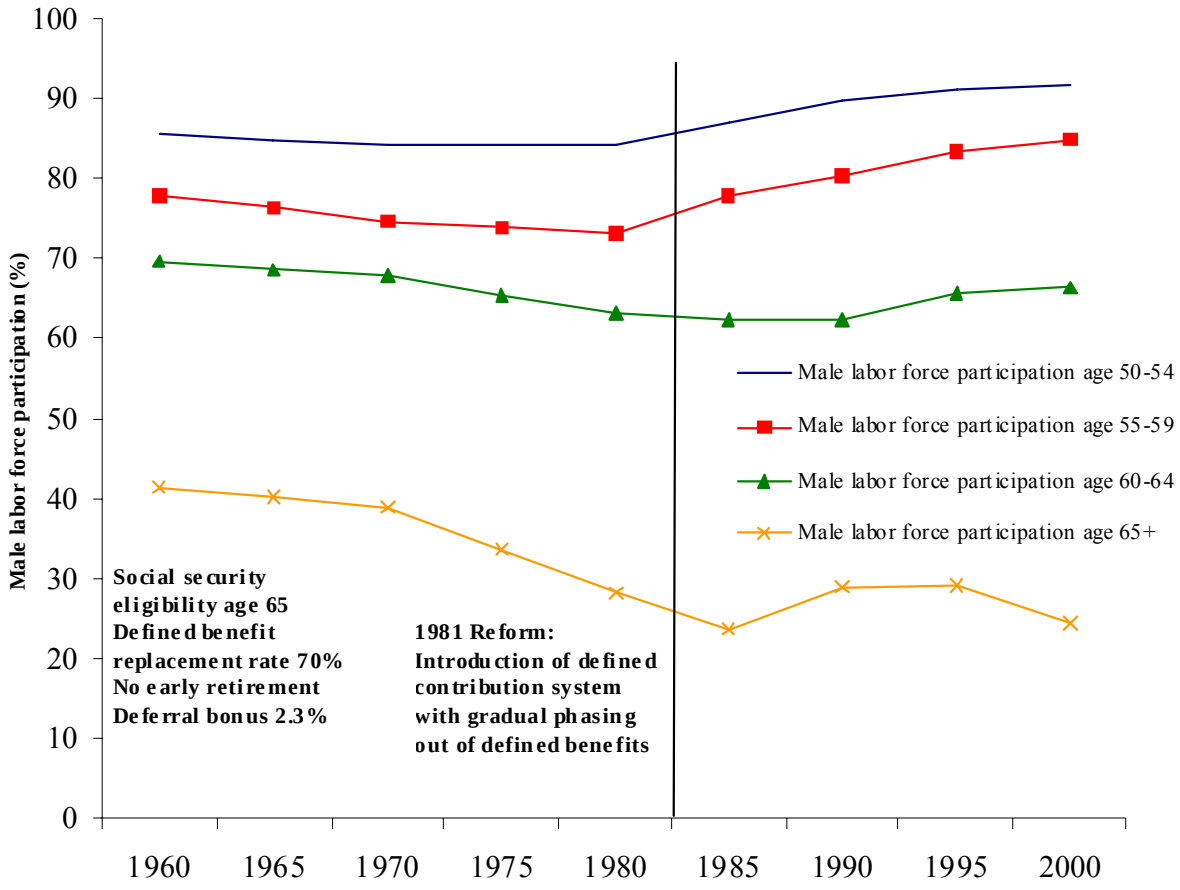

Figure 4: Participation rates and social security in France