The Effect of Social Security Reform on Retirement[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 reform on the labor supply of older men. The data show a trend towards earlier retirement which can partially be explained by rising income levels. We find the average retirement age rises significantly when either the normal, or early, social security eligibility age rises, or pension benefits for postponing retirement are increased. A shift from a defined benefit to a defined contribution system, holding other factors such as the expected replacement rate constant, leads to a large increase in the average retirement age.

1. Introduction

Longer life spans 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 are healthier than in the past, which, in theory, allows longer working lives. However, male old-age labor force participation has fallen rapidly over the last decades, and triggered a continued policy debate about how to reform social security systems to maintain their solvency. An important issue in this debate 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, and could be undone by private borrowing and saving, and thus should not have any direct influence on labor market decisions (Stock and Wise 1990; Cremer, Lozachmeur et al. 2006). However most social security systems are not actuarially fair and their rules lead to large incentive effects that significantly affect retirement decisions (Gruber and Wise 2004). These systems can lead to little or 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 selected group of countries, and show that in each country retirement peaks at exactly the ages when the incentive effects in the system are strongest. However, their approach is a cross-country comparison. From a policy perspective a more interesting question is how reforms of a social security system within a country affect retirement behavior. To investigate this issue we estimate male labor supply equations for 50-54, 55–59, 60–64 and 65+ age groups in a five-year panel for 40 countries over the period 1970 to 2000. While we have large differences in social security arrangements across countries, we can also exploit the variation of social security arrangements over time within countries to see the effects of social security reforms.

We find that an increase in the capital to working-age population ratio reduces the labor supply of older men. We also find a large downward trend in male labor supply at older ages over time. We take these as indicating a powerful income effect on retirement since incomes tend to rise with the capital labor ratio and technological progress.

Our main focus is on the effect of social security systems on male labor supply. We use five indicators describing the institutional features of social security systems. The first is the social security eligibility, or normal, retirement age. The second is early retirement, which we define as the number of years a man can retire before this normal retirement age and still be eligible for some benefits. The third is the addition to retirement benefits a man receives for each year he delays retirement past the normal retirement age. We also calculate the replacement rate for a man of average income who retires at the normal retirement age, and divide the expected benefit flows into the replacement rate from a defined benefit plan and the implicit replacement rate from a defined contribution plan.

We find that increasing the social security eligibility or normal retirement age, or reducing the number of early retirement years allowed, increase the labor market participation of older men. We find these effects mainly on those over sixty, with an increase on the eligibility retirement age by one year increasing the average retirement age by about two months, and a delay in the option of early retirement increasing the average age of retirement by a slightly smaller margin. Increasing the bonus for delaying retirement past the normal retirement age raises the average age of retirement by just under one month for each one-percent increase in the pension 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 rate tends to reduce the labor supply for older men. On the other hand, in defined contribution schemes raising the replacement rate increases labor supply and the average retirement age. This means that our model predicts that shifting 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 and increase in the average age at retirement of about 2 years as a result of a switch from a defined benefit to a defined contribution scheme.

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 often do not apply to those who are about to retire, but are gradually phased in to apply to those that will retire in the future. Thus the system under which the current elderly are operating may be exogenous relative to their retirement decisions, though it depends on the retirement decisions of previous generations. 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 lower bounds.

The results presented in this paper complement a more general literature on the effects of social security systems. Social security systems can affect savings incentives (Zhang and Zhang 2004; Bloom, Canning et al. 2007), fertility decisions (Cremer, Gahvari et al. 2006), labor supply (Burtless and Moffitt 1985; Krueger and Pischke 1992; Coile and Gruber 2000; Coile and Gruber 2000), and economic growth (Zhang and Zhang 2004; Ehrlich and Kim 2005). 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 find large effect of such a switch on national savings rates when define contribution system is fully funded. We do not address the issue of female labor supply, which follows a very different pattern to male labor supply (e.g. see Bloom, Canning, Fink, and Finlay (2007)).

We undertake a number of robustness checks for our results. Many of the cases of social security reform in our sample are in middle income countries. This raises the question if our results apply to more mature, richer, economies. In addition there is a worry that in some poorer countries the social security systems while legally universal, may in practice only apply to a limited number of formal sector workers. To address these issues we limit the sample to the 25 members of the OECD in 1975 but find very similar results to those for the full sample. There is also an issue that the effect of social security eligibility ages, and incentives to work past these ages, may vary between defined contribution and defined benefit schemes. We therefore repeat

the analyses to find estimates of the effects of social security reform in 32 countries that rely solely on defined benefit systems.

The rest 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 from 1970 to 2000 in 40 countries. The dependent variable in our empirical analysis is the male labor force participation rate. Labor market participation data are from the ILO Bureau of Statistics (2007) and are based on national labor market surveys and censuses. The participation rate is the number of economically active individuals divided by the total population in a given age group. Although definitions vary slightly across countries, 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 whole population age 65 and older.

Our explanatory variables are physical capital per working-age person, life expectancy, the percentage of the population living in urban areas, and the average years of schooling of men in the age group, and, of most interest for the purposes of this study, five variables describing the social security systems.

Life expectancy and urbanization data are from the World Development Indicators (World Bank 2006). The physical capital stock is imputed based on the real capital investment rates from the Penn World Tables 6.2 (Heston, Summers 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 as compiled by Lutz et al. (Lutz, Cuaresma et al. 2008) and described in further detail in Lutz et al. (2007) . This education by age group data is only available for 1970-2000 and this limits the time range of our study.

Data on social security systems were coded from the Social Security Administration's "*Social Security Programs Throughout the World*."[2] The data base originates from a survey

[2] http://www.ssa.gov/policy/docs/progdesc/ssptw/

conducted by the Social Security Administration that summarizes the key features of national social security systems. The survey covers more than 150 countries around the world 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 all employees of the country[3]. 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 these larger changes in the labor market. We also exclude countries with populations smaller 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, making the calculation of participation rates problematic.[4] Table 1 gives a list of the countries used in our study.

We generate five variables based on the information in this database. Our approach is to construct a hypothetical "typical" worker and construct variables that would pertain to this worker. We assume that the worker starts to work at age 15, or, if the average years of schooling is more than 10 years, at the typical age of school exit. We assume that the average worker is continuously employed until retirement, and earns wage in each year equal to two thirds of the county's GDP per capita[5].

The first variable we construct is the social security eligibility age. Most social security systems allow retirement if a worker has reached a certain age and/or has achieved a certain number of years of contributions. In some countries, workers need to achieve both a certain age and a given number of 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 construct the eligibility age according to these rules.

The second social security variable we use is the number of year prior to the social security eligibility age or "normal" retirement age a worker can retire at 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. mining. We assume that these special retirement clauses do not apply to the average worker.

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

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 some set 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 adjust benefits in a partial, or an actuarially fair manner.[6] The "deferred retirement bonus" variable we use in our empirical analysis captures the increase in social security pension, measured as percentage of the pension, for each additional year of work.

In addition to these three variables we calculate the replacement rate of the system. The replacement rate is given by the size of the annual pension of a "typical" worker who works to the social security eligibility age (without taking early retirement) receives upon retirement relative to his pre-retirement income. Distinguishing between the two broad types of pension systems, we calculate separate replacement rates for defined benefit and defined contribution systems. In defined benefit systems, the government fixes the pension level by law; the pension level can be a fixed amount, or dependent on the worker's income, or contributions, or years of work, or a mix of these. We calculate the percentage of income the benefits would replace for our "typical" worker given the assumed wage rates and number of working years.

In defined contribution systems, the government fixes the contributions which then go to an individual capital account. The later pension is then paid from the invested contributions plus accrued interest[7]. For fully funded systems we assume that the contributions in the fund earn the long-run risk free rate of return of 3% a year (Campbell 2001), and are paid out at a inflation adjusted annuity rate of 5%, which reflects current market rates for single males at age 65.[8] Since most defined contribution systems were introduced only recently, we use the contributions since the introduction of the system for our calculations. This means that most of the pensions paid to workers reaching the normal retirement age shortly after the introduction of a defined contribution system, 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.

[6] Postponing retirement at age 65 by one year should lead to an increase in the later pensions by about 6-10 percent.
[7] Most defined contribution systems are fully funded but in theory the money can actually be invested or may be a notional account backed by the government. We treat these two as the same from the worker's point of view. Note that in terms of the implications for national savings the funding of the defined contribution system may be vital.
[8] See, e.g. http://www.sharingpensions.co.uk/annuity_rates.htm#text1.

For countries that introduce new pension systems, older workers are sometimes kept on the existing system and new rules are gradually phased in for younger workers. We code the system appropriate to the cohort under consideration. If the new rules do not apply to workers potentially retiring at a given period we use the old social security laws in our analysis. The coding is particularly difficult for countries (such as Chile or Argentina) that introduced new pension schemes and left the choice between the two systems to some workers. In these cases we assume that all workers who get the choice between an old and a new system eventually fall under the new system, and calculate our measures accordingly.

We report descriptive statistics on the dataset we use in Table 2 below. Male labor force participation rates up to at ages 50-54 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 years of age. 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, with an average reward from delaying pension claims of a pension increase of only 1.1%. 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 to do have a defined contribution element is considerably higher (29.2%).

Table 3 shows the social security variables we construct for the 40 countries we study. We report these at ten year intervals, though in our analysis we use a panel with data every five years. While 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 lowering the eligibility age, allowing early retirement, or increasing the replacement rate. 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% over the course of the 1970s and 1980s. Between 1980 and 2000 Greece increased allowed early retirement, from 2 to 7 years. South Korea started to allow early retirement, up to 5 years in the 1990s. Luxembourg has gradually increased allowed early retirement form 3 years in 1970 to 8 years in 2000. Mauritius has increased its replacement rate form 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. 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 started to allow early retirement, of up to 5 years, increased the replacement rate from 69% to 100% but reduced the deferral bonus form 5% to 2% of pension for each extra year worked. Saudi Arabia gradually increased its replacement rate from zero in 1970 to 62% in 2000.

On the other hand increasing financial strains have made 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 retirement age from 60 to 65.

Another group of countries initially started to make their systems more generous, but then rolled back these changes later. Costa Rica at increased allowed early retirement, to 8 years in 1980, and the replacement rate, to 113% in 1990, but by 2000 allowed early retirement had fallen to 3 years, while the replacement rate fell 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 with the normal retirement age rising to 64 and the replacement rate falling to 66% by 2000. Spain increased its replacement rate in the 1970s from 50% to100%, though it fell back to 86% during the 1980s and it 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 1980's Canada introduced early retirement of up to 5 years but also introduced a pension incentive of 3% 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 removed 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 on defined contribution schemes throughout the period. In 1970 these provided relatively small replacement rates, due mainly to the fact that workers retiring at that time had little time to build up their capital since the start of the schemes. By 2000 our imputed replacement rates in these countries are much larger, due partly to saving over the whole working life, and partly due to increases in the mandated contribution rates over time. Two additional countries introduced defined contribution elements to their social security schemes in the 1980s, Chile and Switzerland, while four more did so in the 1990s, Argentina, Australia, Costa Rica, and Denmark. However for a worker reaching normal retirement age in 2000 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. While 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 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 2-4 show the evolution of male labor force participation rates and social security systems over the sample period for the United States, Chile and France, respectively. All three countries start out with a defined benefit system and relatively high labor force participation rates up to age 64 in the 1960s. Up to 1980, Chile had the most generous pension system of the three countries, with average replacement rates of 70%, while France had the least generous system, with average replacement rates of only 20%. Over the period 1970-2000, the replacement rate in the US stays virtually the same, with a gradual increase in the deferral bonus to 8% in 2000. Over the same period, labor force participation stays relatively flat of the 50-59 year olds, and decreases from 80% to 60% for the group of the 60-64 year old. France witnessed a rapid increase in the generosity of its pension system between 1970 and 1985, with replacement rates going up from 20 to 50%. Over the whole period, but particularly after 1985, France experience

rapid declines in male old age labor force participation; the fraction of males of age 60-64 working dropped from close to 60% in 1970 to less than 20% in 2000. The picture looks quite different from Chile, the first country implementing a radical switch from a very generous defined benefit to a defined contribution system in 1981. Following the 1981 reform, labor force participation increased for the groups of the 50-54, and 55-59 year olds, and stayed virtually constant around 70% for the group of 60-64 year olds – a trend quite different from most other countries in our sample.

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:

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

where LFP_{it} is the male Labor Force Participation rate of the age group in country i in period t, k is log capital per working age person, and *Educ* is the average years of schooling of men 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 is age 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. 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).

We also include male life expectancy as an explanatory variable. Prospective life span can affect life cycle behavior such as retirement and savings (Bloom, Canning et al. 2007). In

theory, in an optimizing model, an increase in life span will generally lead to later retirement, though it can result in earlier retirement if the longer expected life span is associated with a lower degree of uncertainty regarding the actual length of life (Kalemli-Ozcan and Weil 2005).

We regard a social system as having universal coverage if all employees are required to be in the system. However, many workers in agriculture are self employed and not covered by the social security system in the usual way. We include the level of urbanization in the country as a proxy for the importance of the agricultural sector.

While our age groups usually cover 5 year intervals, our 65+ age group is open ended and may span up to 50 years. Participation in the labor market of this group may be very dependent on the age distribution of those over 65 yeas of age, with higher participation rates expected if there are larger numbers of relatively young men in the group. Therefore, for this age group only, we include as an explanatory variable the proportion of those over 65 who are under age 70. We expect higher participation rates when this proportion is high and those over 65 years of age are relatively young.

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.

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

The expected retirement age is given

$$E(R) = \int_{15}^{T} t\, r(t) p(t) dt = 15 + p(T) + \int_{15}^{T} p(t) dt \qquad (1)$$

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 [9], so $p(50)=1, p(T)=0$, it follows that we can approximate the expected retirement age by

$$E(R)=15+\int_{15}^{T} p(t)dt \approx 50+5p_{50-54}+5p_{55-59}+5p_{60-64}+(T-65)p_{65+} \qquad (2)$$

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 (2) we approximate the participation rate in each age interval by the average participation rate of men in the age group.

The only remaining issue is to approximate T, the average terminal age. We take T to be five times the average ratio of the number of men in the 65+ group in our sample to the number of men in the 60-64 group. In out sample this ratio is 2.17. Under the simplifying assumption of equal cohort sizes before and after 65, this means that on average a man who reaches 65 in our sample lives an additional 10.9 years. 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 for each age group, equation (2) will allow us to transform these estimates into to an effect of the expected retirement age.

In Table 5 we report the results of our regression using simple OLS regressions. The log capital stock per worker is associated with significantly lower male labor market participation for men over 55 while years of education is 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. We find that a higher level of urbanization is associated with lower participation rates. This is expected if self employed agricultural workers are not covered by the social security system. We also find a negative effect of life expectancy on participation for those over 65. It may be that the human capital, and income, effects of improved health are larger than the effect of a longer lifespan.

[9] 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 (2) 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.

The effects of the social security system are as expected. We find that a higher social security eligibility age as well as fewer allowed years of early retirement are associated with a higher labor force participation rate for men between 50 and 64. A higher deferred retirement bonus is 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.

While these results are interesting they rely on differences in social security arrangements and labor force participation across countries. Social security arrangements may be correlated with unobserved national characteristics that affect retirement. For example, national policies on social security may reflect deep seated social preferences that are reflected in retirement behavior, implying that the observed relationship between social security rules and retirement behavior across countries, seen in Table 5, may not be causal. From a policy perspective we are also more interested in what happens over time within a country if it changes its social security arrangements. Besley and Case (2000) recommend the use of fixed effects when examining the effect of policy changes on behavior.

In Table 6 we report the results of our regressions adding country fixed effects. These fixed effects control for unobserved variables that vary across countries but are constant over time. On the other hand, while time series variation in social security arrangements may also reflect deep seated changes in society, we might expect these underlying social attitudes to change slowly, while the policy reforms tend to occur in a few discrete jumps. If we can regard the timing of these policy jumps as random, due to political circumstances that occur for other reasons, we have exogenous variation in social security that we can use to identify its effects.

In Table 6, with fixed effects, we see that increases in the log capital stock per working age person, and the time dummies, are associated with reductions in male labor supply supporting 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, years of education is not significant. Increasing education may raise annual income, but it also delays entry to the workforce, which means it may not raise lifetime income by much unless retirement is postponed. In the fixed effects model the effect of the urban share of the population switches is positive; while countries with high levels of urbanization have lower participation, those that increase their urbanization rate see

higher level of participation. A rapidly raising level of urbanization may be a proxy of economic growth and high wages for older workers, relative to their lifetime average wage rate, which 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, using the formula in equation (2), shows that raising the eligibility age by one year increases average retirement age by about 0.16 years and 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.

The bonus for deferring retirement has a positive effect on participation for each group, with larger effects for those over 60. While none of the individual participation rate coefficients is statistically significant, the estimated effect on the average retirement age is positive and significant at the 5% level. We estimate that an addition of 1% to the pension for an additional year worked increases the average retirement age by 0.07 years.

Raising the replacement rate in defined benefit schemes tends to reduce participation rates, particularly in the 55-59 age group. We estimate that each 1% extra of income that is replaced lowers the average retirement age by 0.01 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 1% of income replaced in a defined contribution scheme (which requires higher contribution rates) increases the average retirement age by about 0.02 years.

All five of our social security variables have statistically significant effects on the average retirement age in Table 6. To get a better picture of the magnitude of the effects we estimate, consider a country like Italy. 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. We estimate that this increased its average retirement age by 0.78 years. However, if in addition to raising the normal retirement age, Italy had stopped allowing early retirement (for reduced benefits) we estimate an increase in the average retirement age of 1.06 years. An increased deferred pension benefit of 8% a year - as currently provided by Japan - would rise by

0.58 years according to our estimates. Taken together, this implies that a comprehensive reform of a defined benefit system could raise the average retirement age by 2.48 years. In addition, a switch from a defined benefit system to a defined contribution system with the same 80% replacement rate would, we estimate, increase men's average retirement age by a further 2.8 years. These reforms therefore appear to have the potential to raise the average retirement age by up to 5.3 years in total.

The incentive effects of change 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 schemes should have such a large effect on retirement behavior. Defined contribution schemes have a clear incentive to keep working, as later retirement allows a larger capital fund to be accumulated 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 contribution, and interest on capital, to be earned, before distributions from pension capital begin.

We hypothesize that defined benefit schemes have additional incentives to stop working that our model does not take into account. Most defined benefit schemes have a redistribution goal, as well as 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 "typical" worker we use in construction of our measures. For example, minimum and maximum pension payouts may make the system give large incentives to retire early to workers at both ends of the earnings distribution by making their pension insensitive to their choices, even if workers in the middle of the distribution are rewarded for retiring later. Unfortunately the "Social Security Programs Throughout the World" publication used as primary data source in this paper lacks sufficient detail on the social security systems to allow construction of measures that take account of such factors.

The results in Table 6 cover the 40 countries in our sample. There is a worry that the pooling these countries may lead to results that may not be applicable to richer countries. Some of the poorer 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. In addition, in some of the

middle-income countries in our sample, social security systems while theoretically universal in their coverage may in practice only apply to formal sector workers. There may be a large, unregulated, informal sector, that is not covered by the social security system, but which does affect measured participation rates. To address these concerns we report estimates for only the 23 countries that were members of the OECD in 1975 in Table 7 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 is estimates of the effect of social security reform for countries with defined benefit systems only. 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 types of system. 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 8 countries had such systems and in many cases these make up a small portion of the overall pension scheme.

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, 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 highlighting 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 increases 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, which we hypothesize reflect other "hidden" retirement incentives inherent to defined benefit systems but not captured in our coding.

Our work has two weaknesses when compared to national level studies. One is our use measures of national social security systems derived from reports of the countries to the US Social Security Administration. These reports give crude indicators of systems that are generally very complex. A more detailed study would allow for this complexity, particularly looking at how incentives vary for men with different income levels as well as the treatment of women and married couples, and the availability of disability benefits. A second issue is our use of aggregate data on participation rates by age group. A more detailed study would use micro data which would allow us to see how retirement varied by education level, earnings, and martial status.

However, we feel 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.

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Table 1: Country List

1	Argentina	21	Luxembourga)
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 50-55	7.0	3.3	0.6	13.4
Average years of education, males 50-56	6.5	3.4	0.4	13.1
Average years of education, males 50-57	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	Numer 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**				**Effect on**
Age group	*50-54*	*55-59*	*60-64*	*65+*	**retirement age**
	(1)	(2)	(3)	(4)	(5)
Log(capital stock per working age)	-0.816	-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
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.

Figure 1

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

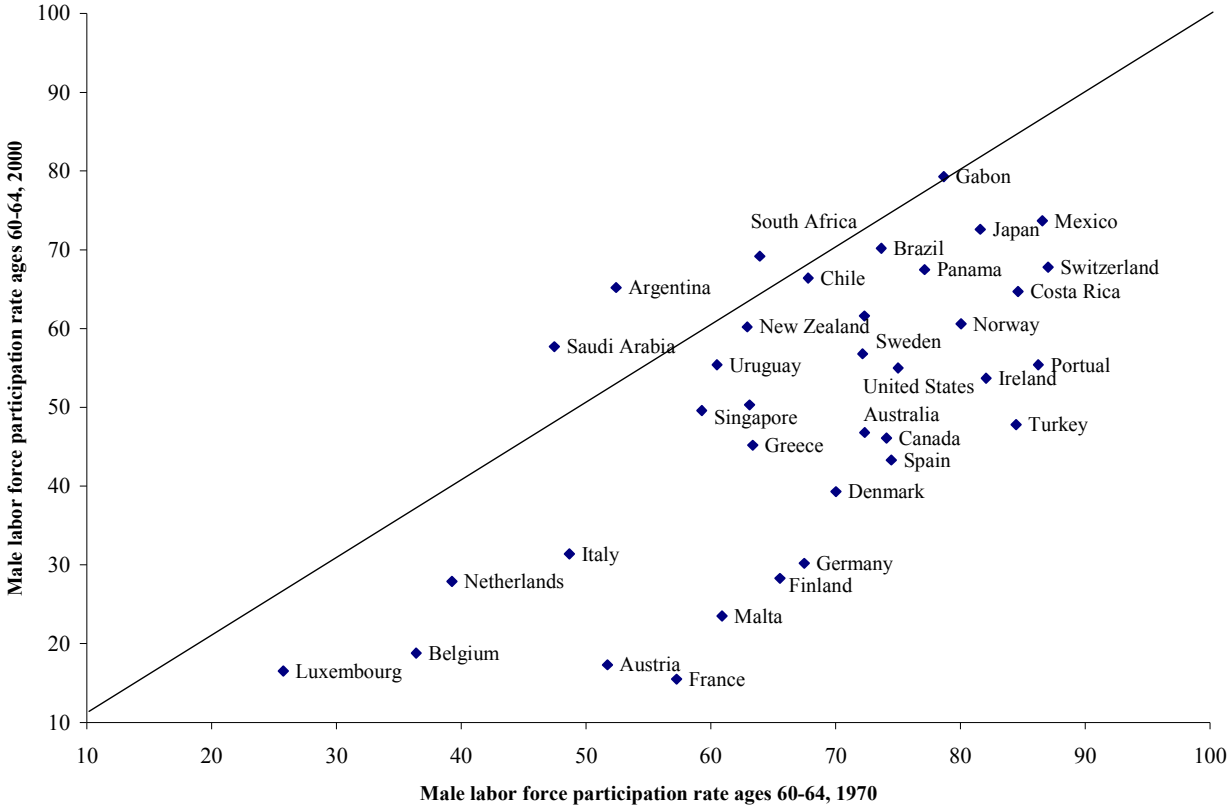

Figure 2 Participation rates and social security in the United States

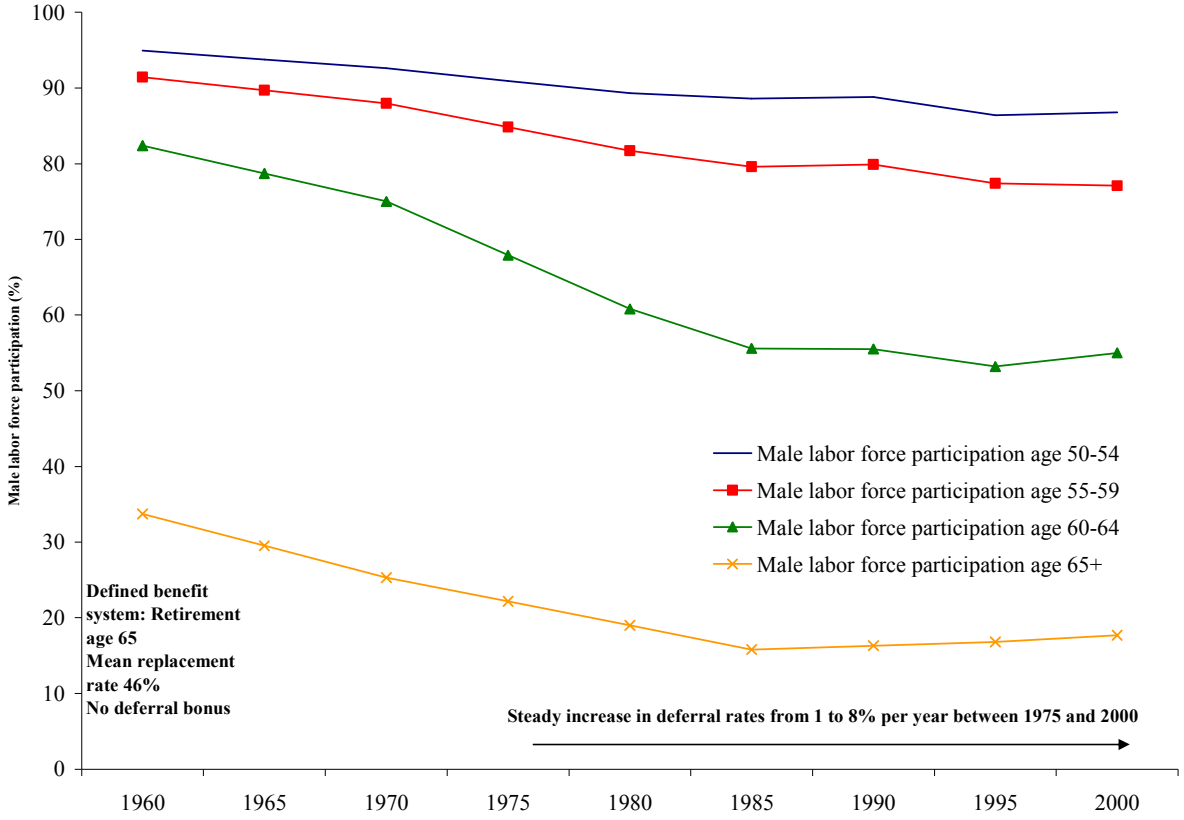

Figure 3: Participation rates and social security in Chile

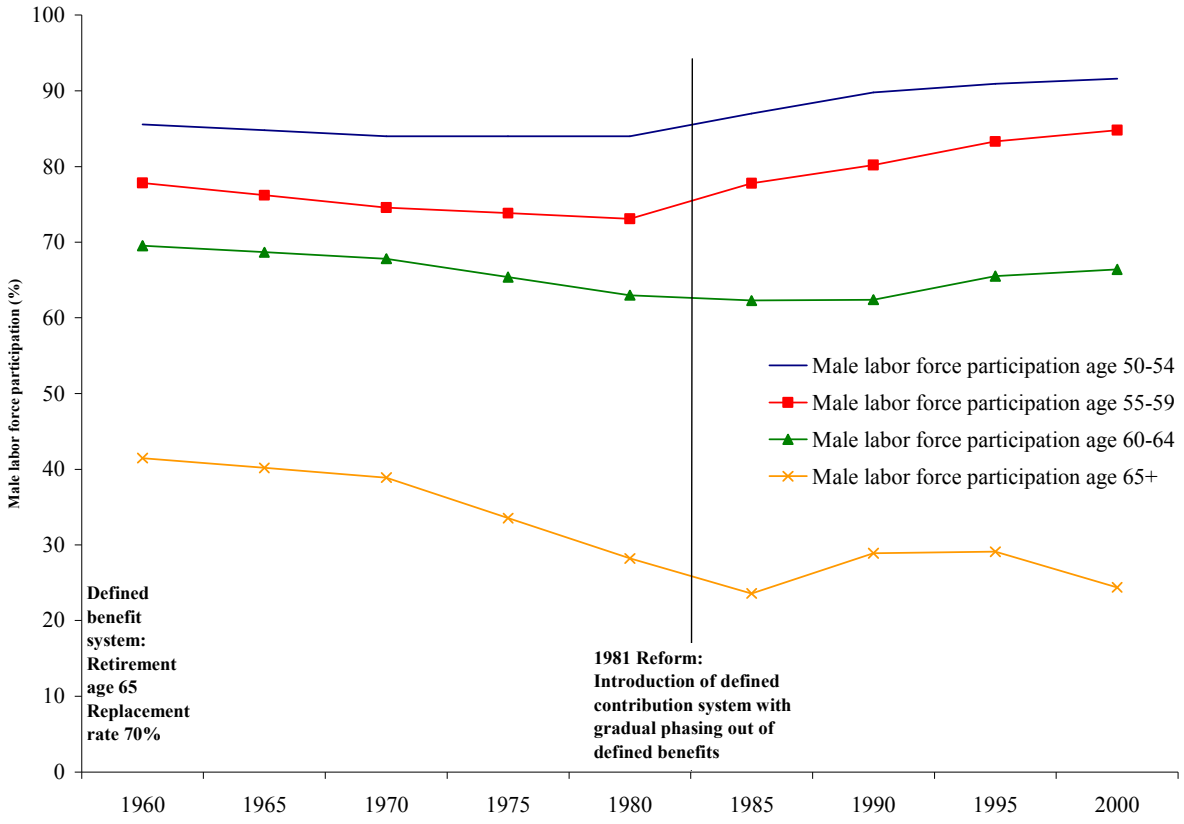

Figure 4: Participation rates and social security in France