

**THE EFFECT OF OLD-AGE INSURANCE
ON MALE RETIREMENT:
EVIDENCE FROM HISTORICAL CROSS-COUNTRY DATA**

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Abstract

I examine the effect of Old-Age Insurance systems on the labour supply of older men. Male retirement ages are crucial to the solvency of OAI systems. Historical data on participation rates and OAI rules in thirteen developed countries show rapid falls in participation among men aged 60-4 after pensions were extended to them. I estimate participation elasticities of -0.06 with respect to replacement rates and 0.19 to the net-of-tax wage. It does not appear that endogenous OAI changes bias the regression coefficients. The growth of OAI explains about 11 percent of the reduction in participation of men aged 60-4 since 1920; greater wealth probably explains most of the remainder.

JEL Classification: H55, J14, J21, J26

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1. Introduction

Labour-force participation rates of older men have declined in most industrial countries since at least 1920, though this decline essentially stopped in the US around 1980. Previous studies dispute the role of state Old-Age Insurance (OAI) in this decline. Costa (1998) argues that the downward trend in older men's participation predates the introduction of OAI systems. Despite finding some effect of OAI on retirement in US time series¹, she concludes that longer-term influences than the growth of OAI caused the majority of the participation declines. In contrast, a cross-country study edited by Gruber and Wise (1999) finds a strong relationship between countries' OAI rules and their average male retirement age. This finding is supported by an OECD study (Blöndahl and Scarpetta 1998) which finds retirement effects of OAI in a panel of countries from 1971 to 1995. Establishing the correct size of OAI effects on participation is important in calculating how much different OAI reforms would increase tax revenues and reduce governments' pension liabilities.

This paper examines the effect of OAI systems on male retirement ages in national time series. I model the retirement incentives created by OAI rules, showing the errors made by previous authors who consider only earnings tests or benefit accrual rates but not their combined effect. I use data from more countries and periods than previous studies, capturing more variance in OAI systems and allowing a fuller set of control variables. The panel examined measures aggregate male participation rates and OAI rules at approximately ten-year intervals from 1880 to 1990 for thirteen countries, though some countries lack observations from before 1950. The differences-in-differences approach of the panel regressions controls for country-specific omitted variables that may bias the cross-sectional work of Gruber and Wise. Data from before 1970 allow the influence of OAI to be separated from that of the oil shocks more effectively than is possible in the OECD study. The paper also examines the possibility that OAI rule-changes were endogenous to participation changes, which would bias the OAI regressions. Participation of five-year age-groups of men are examined, whereas the Costa and OECD studies examine ten-year or wider age-bands. Narrower bands permit better identification of the effects of OAI rule changes, which often affect men only at a narrow selection of ages. Inspection of narrow bands also separates OAI effects from those of population ageing, which tends to weight large age-bands progressively more towards men at their upper ends over time.

The panel regressions find that OAI provisions often reduce the labour-force participation of older men, particularly those aged 60-4. I characterize OAI systems primarily along two dimensions: the replacement rate of benefits they pay and the implicit tax rate they impose on earnings, both of which vary by workers' ages. The OAI replacement rate is defined as the ratio of the average OAI payment to the average male wage. The implicit OAI tax rate is defined as the lifetime benefits a man forfeits by continuing to earn the average male wage, as a proportion of this wage. Equal changes in tax and replacement rates are estimated to have very similar negative effects on participation. Most of the variation in the OAI variables comes from reductions in the OAI eligibility age, which typically affect replacement and tax rates and OAI wealth simultaneously. Thus the OAI variables are rather collinear (replacement and tax rates at

¹ In particular, Costa mentions the development of spikes in the US retirement hazard rate at ages 62 and 65 (Costa 1998 p.13-14).

ages 60-4 have correlation $r = 0.80$, for example) and their effects are hard to separate. The effects of OAI can, however, be separated from those of fluctuations in growth and unemployment. Men tend to retire earlier when OAI benefits exist for their age group, but do not do so in anticipation of benefits at higher ages. Thus changes in OAI eligibility ages are particularly important to male participation rates.

The panel regressions find a smaller effect of OAI on retirement than the cross-sections of countries. The panel coefficients on the tax rate imply participation elasticities with respect to the net-of-tax wage of around 0.2, whereas the cross-section tax coefficients imply elasticities between 0.6 and 1. It is possible that the panel regressions pick up a fairly short-term effect of OAI and that cross-sections show the longer-term effect. Alternatively, omitted variables may bias the cross-country regressions. Since decadal data allow for slow effects of OAI variables on participation, the panel coefficients are a more reliable measure of the effect of OAI. In the panel data OAI variables explain only 11% of the overall participation declines since 1920. There were steep falls in participation after 1970 of which OAI extensions explain only a small part; OAI explains 34% of the participation falls up to 1970. Disability and other near-retirement schemes excluded from the regressions might explain some of the remaining participation declines.

If changes in OAI rules were endogenous to participation trends, the panel coefficients would overestimate the effect of OAI on participation rates. Annual data are examined to establish the relative timing of OAI legislation and participation changes. These show that participation often responds swiftly to changes in ages of eligibility for OAI benefits. Typically OAI rule changes do not follow changes in participation rates, but rather precede them. Thus, if causality may be deduced from timing, OAI changes effecting large changes in retirement incentives caused lower participation, not the reverse. Contemporary commentary shows that policymakers did not extend OAI benefits in anticipation of the participation falls that followed, but instead were surprised by them. Changes in OAI therefore remain exogenous events and the panel coefficients do not seem subject to endogeneity bias.

This paper is structured as follows. Section 2 models a simple retirement decision and outlines theories of the decline in the participation of older men. Section 3 summarizes the history of male labour-force participation at ages above sixty. Section 4 reviews the growth of OAI programs and the evolution of eligibility ages. Section 5 describes the data in the thirteen-country panel. Section 6 shows that strong negative effects of OAI taxes appear in cross-country comparisons as early as 1970. Section 7 discusses the specification of the panel regressions, and their results. Section 8 summarizes the rule-change 'events' which particularly identify these regressions. Section 9 presents regressions using annual data testing which of OAI extensions and participation declines lead the other. Section 10 concludes that the growth of explains a significant minority of the total decline in male participation.

2. Theories Explaining Earlier Retirement

There are four main theories for the decline in average male retirement ages observed since around 1920. These are that changing norms or greater private wealth have induced the old to consume more leisure, that greater female labour-force participation has encouraged men to work less, that recessions cause permanent withdrawal from the labour force, and that OAI systems are responsible for earlier retirement. I divide the latter explanation into wealth, substitution and ‘liquidity’ theories.

An Older Worker’s Budget Constraint

To maximise clarity, I model a 64-year-old worker’s choice of whether to work or retire in the year before his 65th birthday. I assume the worker knows he will not be able to work beyond his 65th birthday for health reasons. I thereby rule out an ‘option value’ of staying in the labour force now to keep work as an option in an uncertain future. I restrict my analysis to a model where wage rates are known with certainty since some of its implications are not yet well understood. The worker has constant probability p of dying in any year. His utility increases in consumption and leisure in all years, but he has no bequest motive. On turning 64 he has assets A , faces the after-tax wage $W(1 - \tau_l)$, where τ_l is the (assumed proportional) income tax rate, and can borrow and lend at the fair annuity rate $r + p$, where r is the real interest rate.

The worker’s labour supply from age 64 to 65 depends on his wealth and after-tax wage. With no OAI, the worker’s budget constraint is

$$(1) \quad A + (1 - L)W(1 - \tau_l) \geq \sum_{i=0}^{\infty} C_i (1 + r + p)^{-i}$$

where L is the proportion of his sixty-fifth year the worker consumes as leisure. L is continuous rather than binary, but higher L could represent decreased labour-force attachment. Figure 1 shows budget constraints in (Leisure, Consumption) space. Budget constraint (1) is line XY, with slope equal to minus the net wage, or $-W(1 - \tau_l)$.

I assume both consumption and leisure rise with wealth A , and thus that both are normal goods. This is illustrated in figure 1 by the indifference curves U_1 and U_2 , on which preferred tangencies to a given budget slope trace a path to the north-east. A higher wage will have a substitution effect reducing leisure and a wealth effect increasing it. The net effect is ambiguous, but if the man’s possible remaining working career (here modelled as a year) is short, his maximal earnings W during it will be small compared to A . The relative wealth effect of a wage change is therefore smaller the shorter is the possible remaining working life, whilst the substitution effect remains constant. Thus a higher wage will reduce leisure if the remaining possible career is short.²

2 The graphical intuition is that rotations of budget sets around initial consumption bundles have effects unambiguous in sign. Changes in an older worker’s wages revolve his budget line round a ‘zero labour supply’ point. Older workers consume close to this point, so for them wage changes are ‘almost’ compensated price

Incentives to Retire

Higher household wealth (higher A) is Costa's foremost explanation for the long downward trend in male participation at higher ages. In figure 1, higher A implies a parallel shift up in the budget constraint XY , and lower labour supply given the indifference map U_1, U_2 . Life expectancy increased substantially in the twentieth century, however, which one would expect to make men retire later. The participation regressions below control for private wealth using levels and changes of GDP per capita. I hope the country and time fixed effects will also capture much of the effect of wealth, 'evolving social norms' about retirement and higher life-expectancy. Higher female labour-force participation adds to household wealth, raising A . This additional supply of labour may also reduce the male wage W . Husbands may also have preferences for retiring before or after their wives. In the early twentieth century female participation in work was highest at ages 20-4 but fell steeply with age thereafter. It has since increased at all ages below 60 and is no longer concentrated in the early twenties.³ To test for any effect of female retirements on men's, participation among men aged 60-4 is regressed on the ten-year lag of participation among women that age. If husbands' and wives' participation decisions are made jointly, regressions of men's participation on that of women in their wives' cohort would suffer from endogeneity bias. Lagged female participation is more plausibly exogenous to men's participation decisions.

Unemployment and growth rates may affect male labour-force participation by changing the wage W . As discussed above, a larger substitution than income effect of lower wages is plausible for men approaching a 'maximum' retirement age. Thus high unemployment will reduce labour supply and increase retirements. Asset-price falls in recessions would have the opposite effect via lower wealth A . Participation of older men changed relatively little across the Depression, but was more procyclical after the 1973 oil shock. In many countries participation rates fell heavily from 1974 to 1978, recovered slightly with GDP to 1980, but fell sharply again in the 1981-2 recession. The overall decline differed greatly in size across countries.⁴ The regressions below control for wage shocks using the unemployment rate and recent growth rates of per capita GDP. Male wages, particularly among the unskilled, may also have been depressed by structural changes since 1970. Some of these changes will be accounted for by the country and time effects in the regressions.

Old-Age Insurance systems may have wealth, substitution and 'liquidity' effects upon participation. Wealth effects would not obtain in a Ricardian model where agents care about their children's utility and realise that OAI benefits are paid by their children's cohort, as transfers through OAI would be offset by changes in bequests. Agents who do not care about their

changes.

3 Participation of women older than 60 has trended upwards in some countries (including the US) but downwards in others, particularly Austria and France, where OAI rules discourage female employment at these ages. I intend to write a follow-up paper on participation trends among older women.

4 See the graphs of annual participation rates discussed in section 8.

children's lifetime utilities will consider OAI benefits as additions to their own wealth, however.⁵ Here we assume the worker is eligible for OAI benefits of B_1 whilst sixty-four and B_2 in each subsequent year he is alive. Without a bequest motive, the worker's budget constraint on his sixty-fourth birthday will be

$$(2) \quad A + B_1 + \frac{B_2}{r + p} + (1 - L)W(1 - \tau_l) \geq \sum_{i=0}^{\infty} C_i(1 + r + p)^{-i}$$

This budget is line KL in figure 1, a parallel shift of budget XY without OAI. Here OAI is an increment to private wealth; were these benefits anticipated earlier in life, higher consumption might have reduced assets A .⁶ The effect of OAI wealth (or OAIW) on labour supply would thus be smaller than the size of the transfer might suggest. The effect of given OAI benefits on workers' lifetime wealths will also depend on a system's age and its degree of prefunding.⁷ The OAI systems studied here differ in vintage, and some are partially funded, but all made large net transfers to all retirees prior to 1990.⁸ The regressions below include an OAIW variable to test for this wealth effect. This variable's high correlation with replacement rates makes their effects hard to separate, however.

Some OAI systems impose implicit income taxes on workers eligible for benefits. There has been some confusion in OAI literature as to when an implicit tax obtains. Burkhauser and Turner (1978) argued correctly that earnings tests *and* sub-actuarial accrual are necessary for an implicit tax, expressing their argument with a figure similar to figure 1. However contributors to Gruber and Wise (1998) largely neglect the role of earnings tests, finding positive tax rates on labour even in the absence of earnings tests.⁹ Baker and Benjamin (1999) neglect the role of accrual, so their version of figure 1 assumes $a=0$, whereas their text shows this was not true in their case. Blöndahl and Scarpetta (1998) omit earnings tests from their regression equation,¹⁰ implicitly assuming these tests are strict, incorrectly for Sweden. I believe Burkhauser and

5 For these two arguments see Barro, and Feldstein's reply in Barro, (1978).

6 This is Feldstein's (1974) argument.

7 For example, early cohorts of retirees in a PAYGO system will receive much higher net transfers through the system than later cohorts, whose net transfers will eventually be negative.

8 Auerbach, Kotlikoff and Leibfritz, eds., (1999) survey the intergenerational transfer effects of OAI systems. The contributors typically conclude that OAI schemes made large net transfers to current and earlier retirees.

9 Börsch-Supan and Schnabel (NBER 1997) state that, in Germany, "After age 65, the earnings tests do not apply anymore and full benefits are paid irrespective of the type of pension." (p. 20) but find implicit tax rates on labour income "exceeding 50 percent... after age 67." (p.26). Their expression for the implicit tax rate (p.38) has an accrual term but no earnings-test term. Similarly Palme and Svensson (NBER 1997) give (p.32) an accrual-based definition of the implicit OAI tax, making no mention of earnings tests. There are no earnings tests on Swedish OAI pensions, so these authors' implicit tax rates calculated from accrual rates are incorrect. Correspondance with Pålme and Svensson has established that only housing benefits for pensioners are earnings tested, but these are received by only 30% of all pensioners and are on average small, as their paper (p.26) makes clear.

10 Blöndahl and Scarpetta, regression equation (1), p.36.

Turner's argument was not well understood because they did not express it algebraically. I hope the following algebra clarifies this question.

Many OAI systems offer reduced benefits to workers who claim them earlier than the 'standard' age. In this example the 'standard' age of claimancy is 65. The accrual rate a is the proportional decrease in later benefit flows if benefits are claimed one year 'early', in this case at 64. If benefits are claimed early, annual benefits B_2 at age 65 become

$$(3) \quad B_2 = B_N - aB_1$$

where B_1 is the benefit claimed at 64. Note that the worker can choose to delay claiming benefits until age 65. He would choose this whenever $a > r + p$. Therefore his lifetime budget is

$$(4) \quad A + \frac{B_N}{r+p} + B_1 \cdot \max\left\{\frac{r+p-a}{r+p}, 0\right\} + (1-L)W(1-\tau_I)$$

This budget is line MN in figure 1. As drawn, $a > 0$, so MN lies below KL, where OAI has no early-claimancy penalty. Were $a = r + p$, line MN would shift down to PQ. On PQ, first-period benefits add no lifetime resources, but second-period benefits make PQ superior to XY, with no OAI. Therefore MN is drawn with $0 < a < r + p$. For any a , budget MN has the same slope as KL, PQ and XY, so OAI creates no implicit tax on earnings.

Some OAI systems condition benefits on current earnings. Denote the average benefit withdrawal rate of this earnings test τ_{SS} . If the worker retires at 64, he will have resources from (4) without any labour income, or point M in figure 1:

$$(5) \quad A + \frac{B_N}{r+p} + B_1 \cdot \max\left\{\frac{r+p-a}{r+p}, 0\right\}$$

If the worker works during his sixty-fifth year, he must choose whether to claim benefits in it, and thus has resources at point Q of

$$(6) \quad A + \frac{B_N}{r+p} + \max\left\{(1-L)W(1-\tau_I - \tau_{SS}) + B_1\left(\frac{r+p-a}{r+p}\right), (1-L)W(1-\tau_I)\right\}$$

where the term inside the curly brackets up to the comma reflects resources if benefits are claimed at 64, while the term after the comma represents resources with no benefit claim that year. The budget with an earnings test is a crooked line such as MFGQ in figure 1. I assume an earnings threshold below which no benefits are withdrawn operates between M and F. Between F and G benefits are withdrawn with income; a horizontal segment FG implies benefits are withdrawn one-for-one with earnings. At point G, the earnings test has equated returns to claiming benefits early and later. The worker could consume along segment GQ by deferring claimancy. The average returns to working would be the dashed line MQ. At point H, the earnings test stops withdrawing

benefits. H could lie either to the left or right of G. If the worker claims early benefits, he will consume along budget MFHJ and have the average return to work MJ. In figure 1 I assume the earnings test withdraws all of B_1 , so H is to the left of G, J is below Q and MQ lies above MJ. This is typical in practice, but not logically necessary.

The main result of this section is that net returns to working are

$$(7) \quad (6) - (5) = \max \left\{ (1-L)W(1-\tau_l - \tau_{SS}) + B_1 \left(\frac{r+p-a}{r+p} \right), (1-L)W(1-\tau_l) \right\} \\ - B_1 \cdot \max \left\{ \frac{r+p-a}{r+p}, 0 \right\}$$

Inspecting (7), if $a \geq r+p$, OAI imposes no tax on earnings. With such high a , the worker would not wish to claim benefits at age 64, so the returns to working are simply $(1-L)W(1-\tau_l)$. OAI also imposes no tax if there is no earnings test, or $\tau_{SS}=0$. Thus OAI can only impose an implicit tax on earnings if $a < r+p$ and $\tau_{SS} > 0$. The earnings tax rate is

$$(8) \quad 1 - \frac{\text{net returns}}{\text{gross earnings}} = \tau_l + \frac{\min\{NQ, NJ\}}{(1-L)W}, \text{ or} \\ \tau_l + \min \left\{ \tau_{SS}, \frac{B_1 \left(\frac{r+p-a}{r+p} \right)}{(1-L)W} = RR \left(\frac{r+p-a}{r+p} \right) \right\}$$

where $RR = B_1 / (1-L)W$ is the replacement rate of OAI benefits to labour earnings. In this paper I calculate OAI taxes at average male earnings. At these earnings, OAI earnings test typically withdraw all early benefits, so $J < Q$ and $\tau_{SS} = RR$. Therefore MQ is above MJ, deferred claimancy minimizes tax rate (8), so the implicit tax on earnings is

$$(9) \quad \tau_l + RR \left(\frac{r+p-a}{r+p} \right),$$

the income tax rate plus the replacement rate multiplied by the actuarial unfairness in the early claimancy penalty. The net wage implied by (9) is the slope of the dashed line MQ in figure 1. Tax rate (9) is precisely that found by Gruber and Wise. However, they also found this tax rate in cases (see footnote 8) with $\tau_{SS}=0$, where the tax was in fact τ_l , since the budget constraint was MN. I know no real-world example of $\tau_{SS} < 0$, but this case would show up correctly in the above algebra. Some European 'partial pension' systems, however, do subsidise earnings of all older workers, much like an Earned-Income Tax Credit for the old, which would here be an age-specific negative τ_l . I include these 'partial pension' systems in the empirical analysis, though since I omit personal income and payroll tax systems otherwise, arguably I should not.

The ‘liquidity-constraint’ theory is that workers can borrow only at a rate $r + p + m$ above their lending rate $r + p$. If such workers are net lenders, they face the local interest rate $r + p$, so they may be analyzed just as above. If such workers are net borrowers, their local interest rate is $r + p + m$, so the above analysis would hold with a higher value for $r+p$, implying a different ‘actuarially fair’ penalty a .¹¹ For a given a , liquidity-constrained net borrowers would be more likely to wish to claim benefits early, so any earnings tests would affect them more. As $m \rightarrow \infty$, early-claimancy penalties would become irrelevant to them. The ‘benefit tax’ rates used in the regressions are calculated for several annuity rates $r + p$, some allowing earnings tests to remain relevant when a is large. A further implication of high discounting is a wealth effect of early benefits beyond that captured by OAI wealth constructed using $r+p=0.07$. The regressions below test for the liquidity theory by including both OAI wealth so constructed and the replacement rate B_1/W . The collinearity of these two variables makes separating liquidity and wealth effects impossible, however.

Thus wealth, substitution and liquidity effects may be created by OAI schemes. Disability pensions and ‘special’ unemployment benefits for older workers may have similar effects. Gruber and Wise suggest such schemes have contributed substantially to earlier retirement in several countries. However, I omit such restricted benefits from the regressions below. This is because written program rules are insufficient to tell whether disability benefits, for example, were restricted to the genuinely disabled or given to any applicant, or when such restrictions were loosened.¹² Often disability policy seems not legislated but decided within government agencies. Omitting disability and ‘special’ unemployment benefits obviates the need for contestable judgements about the strength of restrictions on their receipt. Other labour-market institutions, such as income and payroll taxation, compulsory redundancy rules and employment-protection laws may also affect participation rates of older men, but are omitted from my analysis.

3. An Overview of Participation Rates

In most developed countries, male labour-force participation rates at ages above sixty have fallen markedly in the period captured by census records, or since about 1920. However, participation of US men aged 60 and above has been essentially constant since around 1980. Table 1 presents participation rates for men 60-4 and 65 and above around 1930, 1950 and 1990 for the thirteen countries examined in this paper, taken from national censuses. The census data used and the steps taken to ensure its comparability are discussed in Appendix A. Participation rates in older age-bands tend to fall over time because population ageing weights the older end of each band progressively more with time. This demographic effect can be reduced, though not eliminated, by studying narrow age-bands, such as the five-year groups studied here.¹³ Narrow

11 There would also be more complicated corner cases when workers had zero assets.

12 Contributors to the Gruber and Wise study typically calculate implicit tax rates under ‘Free access to disability benefit’ and ‘Restricted access to disability benefit’ cases, but have difficulty stating which case actually applies.

13 Participation rates of US men and women *by single year of age* for 1965-1999 from the CPS, though

age-bands are less subject to changing age-mixes and thus reflect behavioural changes better.

The first three columns of table 1 show that the participation rate of men aged 60-4 was comparable across countries in 1930 and 1950 but fell by very different amounts between 1950 and 1990. In this latter period Switzerland and Austria are opposites. Participation fell only 8.3 percentage points in Switzerland, but 55.8 percentage points in Austria, a striking difference between countries with a border and a language in common. As is discussed below, Switzerland does not pay OAI benefits to men younger than 65, while in Austria men aged 60 have been eligible for benefits since 1966. Participation among men aged 60-4 has also fallen heavily in France and Germany. The US participation decline, though much studied, is fairly mild in this international perspective.

The last three columns of table 1 reveal considerable variance in male labour-force participation rates at age 65 and above in all three time periods. The German census of June 1933 reports the lowest participation rates of any pre-World War II census, whilst contemporary Australian and New Zealand censuses also show low participation of men 65 and older. In all three countries participation of men in this age group rose modestly by around 1940. Thus there is limited evidence that the Depression temporarily reduced participation rates. All countries have experienced declines in participation of men 65 and older since 1950, though the size of these falls differs. Ireland and Switzerland experienced the largest declines amongst men over 65 from 1950 to 1990. The US did not experience the smallest fall but did have the highest participation rate in this age group in 1990.

4. The Growth of Old Age Insurance

The first Old Age Insurance system covering the generality of the population was enacted in Germany in 1881. Both contributions and benefits were earnings-related in this system, which influenced the design of many subsequent schemes. The next systems adopted, in Denmark (1891), New Zealand (1898), Britain and Australia (1908) all paid means-tested benefits, however. The last country in the sample of thirteen to adopt an OAI scheme was Switzerland in 1948.¹⁴ The data used here cover the creation of only four systems, due to the paucity of participation data in the late nineteenth and early twentieth centuries.¹⁵ The more recent data cover several large changes in national OAI systems, including reductions and increases in the age of first eligibility for benefits.

Three characteristics of OAI systems are of particular interest: the total lifetime benefits

unpublished, are available from the Bureau of Labor Statistics. The end of the downward trend in male participation rates around 1980 is particularly clear in these series.

14 A detailed account of the development of state Old-Age and Health Insurance in developed countries is given in Cutler and Johnson, *The Birth and Growth of the Social Insurance State: Explaining Old-Age and Health Insurance Across Countries*, which was chapter 1 of my Harvard PhD thesis and is a forthcoming NBER Working Paper.

15 Viz. in Germany (1889), the U.K. (1908), Canada (1927) and Switzerland (1948).

they provide, or 'OAI Wealth'; the tax rate on earnings attached to these benefits, and the replacement rate, defined as the ratio of the typical pension to contemporary average male earnings. The time variation in these variables stems largely from changes in the minimum age of eligibility to pensions. Figure 2 shows countries in the sample with OAI benefits for men aged 65 and above and 60-4 over time, thus giving the dates of system creations and eligibility age changes.¹⁶ By 1950 all thirteen countries paid pensions to men older than 65.¹⁷ By 1990 benefits were also paid to men younger than 65 in all but five (Australia, Britain, Ireland, Norway and Switzerland) countries.

OAI systems may have been created or expanded for political reasons with little connection with trends in male retirement behaviour. For example, Chancellor Bismarck's creation of German OAI in 1881 is commonly linked to his political competition with left-wing parties. If this case is typical, OAI variables will be exogenous variables in regressions of participation rates. Another possibility is that OAI benefits were extended in recessions to induce older men to retire and thereby create employment for younger men. Any dependence of retirement on unemployment rates could then cause omitted variable bias. I control for this possibility in section 7 by including unemployment and growth rates as regressors. A third theory is that benefits were increased or extended to men younger than 65 in response to earlier retirement. If so, OAI variables will be endogenous to participation rates, resulting in endogeneity bias in the panel regressions. This possibility is explored in the regressions in lags in section 9, and also in the country case studies presented in appendix C.

5. Data

Labour Force Participation Data

The ILO defines a labour force participant as someone either employed or unemployed and in search of employment. One hour per week of paid work fulfills the ILO's definition of employment. Section 7 uses an unbalanced panel of labour-force participation rates at roughly ten-year intervals for thirteen countries. In many cases the participation rates used are those constructed from national censuses and labour force sample surveys by the ILO according to its definition of labour-force activity. The remaining participation rates were taken directly from country censuses. The sample was restricted to thirteen countries by the ease of acquiring data. Those chosen are all rich countries with comparable trajectories of development, though Ireland was at all points the most agricultural. The British census of 1881 is the oldest used. Some censuses from before 1950 are discarded for systematically over-estimating participation at higher ages.¹⁸ Most censuses record participation rates in five-year age and sex groups, such as

16 The Republic of Ireland became independent from the U.K. in 1924; it maintained the 1908 pension system.

17 Included in this definition are benefits for all over 67 (Denmark and Sweden) and for all over 70 (Canada, Norway and the Republic of Ireland).

18 U.S. censuses prior to 1940 are excluded for this reason, as is discussed in appendix A.

men aged 55 to 9 and 60 to 4. Many, however, only report one participation rate for all men aged 65 and over. Participation in the 65-9 age group, where recorded, is a preferable regressand to that in the 65 and older group, since it is less affected by population ageing.

Sections 8 and 9 and appendix C analyze annual participation rates of men aged 60-4 from around 1960 to around 1995 in ten countries (annual participation data are not available for Ireland, Norway or Switzerland). These are taken from country labour force sample surveys, many summarized in the OECD's *Labour Force Statistics*. Often the annual participation rates do not exactly match the full census data. Appendix A lists for each country the participation data used, sources, and problems or ambiguities in these data.

Old-Age Insurance Data

OAI variables are calculated in census years. Each variable is calculated as it would apply to a married man whose wife had no earnings history, and was the same age as her husband.¹⁹ As section 2 implied, the calculation of replacement rates is key also to the calculation of benefit taxes and OAI wealth, since the latter variables are generally some multiple of replacement rates.

Replacement rates are calculated from the OAI rules described in *Social Security Programs Throughout the World*²⁰ and country yearbooks, and from wage records. Where a flat benefit existed, as for example in the U.K., its value for a married couple is divided by the contemporary average male gross wage to construct an average replacement rate. When no 'average male wage' is reported, the average wage of male industrial workers is used instead. Where this is not available, average nominal wage series are extended backwards using the indices in Mitchell (1998). Because the average male wage is probably above that available to most men aged sixty or more, under-estimation of replacement rates may lead the panel regressions below to overestimate the true OAI coefficients. The total effect of OAI on retirement estimated will not be biased, however. Replacement rates constructed from statutory benefits and average male wages will not reflect the experience of the very poor²¹ or very rich, but do give information on the benefits faced by the majority of the population. Use of post-tax wages and benefits would also be preferable, but is infeasible for some of the older observations. Hence all income and payroll taxes are omitted from these calculations.

19 This is similar to the base case used by Gruber and Wise (1999). The assumption that wives are the same age as their husbands simplifies the calculation of many of the OAI variables.

20 The Social Security Administration published the first edition of *Social Security Programs Throughout the World* in 1958. The similar volumes published by the Social Security Board/Administration in 1940 and 1949 are used to calculate OAI variables in 1940 and 1950.

21 Gruber and Wise, for example, use rules in UK Income Support, a means-tested benefit for the indigent, as a measure of the typical benefit structure. Since this benefit is only received by 13 percent of men aged 60-4, I omit it from my OAI calculations (see Gruber and Wise, *ibid*, p.29, p.413). Neumark and Powers (1998) argue that SSI may discourage labour supply of older Americans. However, since only 4.6% of Americans over 65 received SSI in 1991, this benefit is omitted from the OAI calculations in this paper.

In the earnings-related systems replacement rates are calculated from OAI rules, assuming that the average man had made thirty-five years of contributions by age 60 and forty years by age 65. Thus for example in the Canadian earnings-related system the replacement rate is a statutory 25 percent of the worker's average covered earnings. The increase in the replacement rate due to the omission of some of the worker's lowest-earning years from the average-earnings calculation is here ignored, since worker earnings histories are not available for the older observations. The U.S. benefit formula is more complicated and implies a range of different replacement rates, so U.S. replacement rates are calculated using SSA records on average benefits paid to retired men.²² A lack of detail on precise rules means replacement rates cannot be calculated in Germany or Sweden prior to 1950 at ages above 65.

I construct the replacement rates of available benefits in three age brackets; 60-4, 65 plus and 65-9. The values in the latter two brackets are identical but for a few cases where benefits were paid only at age 70. Where benefits were first payable at age 62, the replacement rate in the 60-4 age group is calculated as that at 62 multiplied by 0.6, and so forth. Table 2 shows the replacement rates constructed for men aged 60-4. Those for 1990 are lower than those constructed in the Gruber and Wise volume²³ because those authors calculate net-of-tax rather than my gross replacement rates, but are nevertheless fairly similar except for the British and French cases.²⁴ Due to the omission here of disability benefits in the U.K., the correlation between these replacement rates and those in the latter volume is only 0.58; dropping the U.K., the correlation is 0.84. Abrupt changes in OAI eligibility ages explain most of the variation across time in the replacement rates in table 2.

Table 3 reports the benefit tax rates for men aged 60-4 calculated using the replacement rates in table 2 and earnings-test and accrual rules. As was emphasized in section 2, replacement and benefit tax rates can differ if there is no earnings test or an accrual penalty to claiming benefits early. In table 3 I assume the annuity rate $r+p=0.07$ in all periods. In section 7 I discuss the sensitivity of the regression results to recalculating tax rates using annuity rates of 4%, 6% and 10%. Where longer contribution histories entitle workers to additional benefits, a 35-year history at age 60 is assumed; in Austria, France and Germany this mechanism leads to a credit for deferred retirement.²⁵ Extensions of benefits to workers younger than 65 and changes in earnings tests generate variation in tax rates at ages 60-4.²⁶ Sweden's partial pension scheme, which

22 This figure is multiplied by 1.5 to give the average benefit paid to a retired couple where the wife has no or a small earnings history.

23 See Gruber and Wise, *ibid.*, table 1 p.29.

24 Gruber and Wise assume all U.K. 60-year-olds may receive disability benefits, whereas benefits conditioned in theory on poor health are omitted from this study. Their French replacement rate is 91 percent rather than the 50 percent used here. This difference is largely due to their inclusion of pensions complementary to the general regime which are omitted here.

25 No allowance is made for the possibility that later years' earnings may replace earlier years' earnings in the benefit computation formula. Plausibly workers aged 60 have lower wages than they did when younger, so this may not be an important omission.

26 For example, retirement first became necessary for French pension receipt in 1983, whilst earnings tests for pensions in New Zealand at age 60 were suspended from 1977-1985.

subsidizes part-time work by 60-4-year-old workers, imply negative tax rates. Appendix B discusses this scheme and the construction of the other OAI variables in greater detail. The correlation between the tax rates used here and Gruber and Wise's 'tax force' is 0.91, despite disagreement as to the role of earnings tests and disability benefits.

Construction of the OAI wealth variable requires assumptions about interest rates and life expectancies. Since real interest rates are below 7%, my assumption $r+p = 7\%$ implies some probability of death each year. I then assume all surviving men die on their 80th and surviving women on their 85th birthdays. OAI wealth is calculated for a 60-year-old married couple, assuming the husband claims benefits at whichever age maximizes their net present value calculated at age 60. Wives are assumed to collect survivor benefits during the five years that they are widowed. Thus OAIW in year t is calculated as

$$(10) \quad \sum_{i=0}^{i=19} \frac{W_t \cdot RR_i}{1.07^i} + \sum_{i=20}^{i=24} \frac{W_t \cdot RRS_i}{1.07^i}$$

where RR_i is the replacement rate at age $60+i$, RRS_i is the replacement rate of survivor benefits²⁷ and W_t is the average male wage in year t . Internationally comparable data for real wages are not available for all the years in the sample, so real GDP per capita is used as a proxy for W_t . No adjustment is made to the OAIW variable for the age of the system or its degree of funding.

The OAI variables calculated are rather collinear, because reductions in the eligibility age for benefits typically also have large effects on tax rates and OAI Wealth. The correlation between replacement and tax rates at ages 60-4 is 0.80, while the correlation at ages 65 and above is only 0.17. OAI Wealth has correlations 0.69 and 0.73 with replacement rates at ages 60-4 and ages 65 and over respectively, and correlations 0.44 and 0.13 with tax rates in these two age groups. The collinearity of the OAI variables makes their effects somewhat hard to separate.

OAI coverage rates, the proportion of the population who are eligible for the benefits of the general scheme or its close relatives, have not been included in the regressions reported here, though they would be expected to affect the retirement rate. However, many of the OAI schemes covered all or a large majority of the labour force for most of the sample period, so the effect of including a coverage variable would probably be small.

Control Variables

Real GDP per capita and growth rates were taken from the Penn World Tables and from Maddison's historical series of GDP per capita.²⁸ All GDP figures are in 1985 U.S. dollars. Unemployment rates are taken from the OECD's *Labour Force Statistics* and from country statistical yearbooks.

Summary Statistics

²⁷ This is almost universally half the replacement rate obtaining for a married couple.

²⁸ Maddison, Angus, *Monitoring the World Economy 1820-1992*, OECD 1995.

Overall 81 observations of participation among men aged 60-4, 73 of men aged 65-9, and 82 of men aged 65 and older are usable in the regressions. These are listed in appendix A. Table 4 presents summary statistics for the dependent and independent variables measured in 1990. The country with the lowest OAI Wealth is Ireland, and that with the highest is Denmark. Average replacement rates are higher at ages 65 and above than at ages 60-4, since benefits at ages below 65 are often actuarially reduced, and in some countries are zero. For the latter reason the standard deviation of replacement rates is higher at ages 60-4, however. Average tax rates are comparable at ages 60-4 and 65 and above, but are again more variable at ages 60-4.

6. Cross-Country Comparisons

A first comparison of OAI systems and participation rates is given by cross-sections of countries in particular years. Figures 3 and 4 plot participation of men aged 60-4 against the average OAI tax rate in this age bracket in 1970 and 1990 respectively.²⁹ Both figures suggest a strong negative relationship between tax rates and participation. As figure 3 shows, in 1970 only two countries in the sample, Austria and New Zealand, had substantial benefit tax rates for men younger than 65, and these two countries also had low participation. This negative relationship predating the oil shocks suggests OAI has reduced participation independently of macroeconomic fluctuations since 1973.³⁰ Figure 4, which compares participation rates in 1990, is very similar to the Gruber and Wise cross-section³¹, although the group of countries compared differs slightly. The cross-country regression coefficients imply participation elasticities with respect to the net-of-tax wage of 0.62 in 1970 and 0.96 in 1990, substantially larger elasticities than are found in the panel regressions below. Gruber and Wise do not quote elasticities, but their tax variable explains over eighty percent of the cross-sectional variance in participation rates. The stronger effect apparent in the cross-sections than in the panel could result from omitted variables such as employment protection laws in parts of Europe which may discourage employment of older workers. It could also reflect a correlation between explicit OAI benefits and disability benefits, omitted from the tax rates calculated here.

²⁹ In 1950 and 1960 only New Zealand paid OAI benefits to men younger than 65, so cross-sections of participation in the 60-4 age-group are not drawn before 1970. Cross-sections of participation and replacement rates for men aged 65 to 9 show a strong negative relationship in 1960; the relationship with tax rates is somewhat weaker.

³⁰ Blöndal and Scarpetta, *op. cit.*, present a similar cross-section to figure 3 (their figure V.1, panel B), but find less effect of implicit OAI taxes, partly because their sample omits New Zealand.

³¹ See Gruber and Wise, eds., *ibid.*, Introduction, figure 17. Blöndal and Scarpetta find a similar relationship with more countries in their figure V.1, panel A.

7. Panel Regressions: Specification and Results

Regression Specification

The basic panel specification used is

$$(11) \quad LFP_{i,t,k} = \alpha_i + \eta_t + \beta_1 \cdot OAIW_{i,t} + \beta_2 \cdot RR_{i,t,k} + \beta_3 \cdot TR_{i,t,k} + \beta_4 \cdot UNEMP_{i,t} \\ + \beta_5 \cdot \Delta_5 \ln(GDP/Capita)_{i,t} + \beta_6 \cdot \Delta_{10} \ln(GDP/Capita)_{i,t} + \varepsilon_{i,t,k}$$

where i indexes countries, t years and k age groups, LFP is labour-force participation of men, $OAIW$ their OAI Wealth, RR is the replacement rate of benefits, TR the benefit tax rate, $UNEMP$ is the unemployment rate of all workers, $\Delta_5 \ln(GDP/C)$ the growth of per capita GDP over the preceding five years and $\Delta_{10} \ln(GDP/C)$ that over the preceding ten years.

The dependent variables are participation rates, which fall with earlier retirement. The employment-population ratio would be a more appropriate regressand if men counted as unemployed have in fact retired. Unemployment rates among older men are typically low, however. The width of the age-band in which participation is measured is, as argued above, critical to distinguishing behavioural effects from those of population ageing.

The country and time³² fixed effects make (11) a differences-in-differences specification. I also try adding country-specific time trends to time fixed effects as another method of controlling for secular retirement trends. Omitted variables constant over time within countries will be absorbed by the country effects. Omitted variables with a common effect on participation in all countries in a given year will be absorbed by the time effects. Sectoral shifts during the 1970s which reduced the value of some men's skills will induce a negative time effect in 1980. The effect of OAI changes during the 1970s should therefore be estimated correctly. Some omitted-variable biases will remain, however, including within-country variation in income and payroll taxes. A difference-in-difference-in-difference regression, which compares participation rates at ages 60-4 with those at ages 55-9 over time, controls for omitted variables affecting these age groups similarly. This comparison is made in more detail in section 8, which examines differences-in-differences-in-differences in participation on a case-by-case basis. Characteristics of disability and means-tested 'assistance' benefits remain parts of the error term, and may be correlated with the included OAI characteristics. Having taken the problem of omitted variables seriously, however, I hope that any such variables will have a relatively small effect on the OAI coefficients.

³² Although not all censuses were taken at the start of a decade, censuses from around 1950, for example, are coded as having been taken in that year in assigning time effects.

Results for Men Aged 60-4

This paper pays most attention to participation in the 60-4 age group. Participation among men this age is a particularly good variable in which to identify the effect of OAI systems because the data cover several episodes in which OAI benefits were abruptly extended to or withdrawn from them. These discontinuous changes in OAI systems present the best opportunity of separating the influence of OAI on male participation from those of other variables.

Table 5 reports regressions for the 60-4 age group. Columns 1 to 6 are difference-in-differences regressions, and column 7 is a triple-difference regression. In column 1 the coefficient on the OAI replacement rate is negative and highly significant. The implied participation elasticity is -0.1, though this figure is inflated by the correlation between replacement rates and omitted tax rates. In column 2, tax rates alone also have a strongly negative effect on participation, implying an elasticity with respect to the net-of-tax wage of 0.3. Both regressors are included in column 3, and participation is more sensitive to OAI taxes: the implied elasticities are -0.06 with respect to replacement rates but 0.19 with respect to the net-of-tax wage. However, the coefficients are almost identical, and replacement rates are typically larger, so they are responsible for slightly more of the participation declines in the sample. The average benefit extension to men aged 60-4 in the sample³³ created a replacement rate of 49 percent and a tax rate of 35 percent. Using the coefficients in column 3, this would depress participation by 4.7 percent via replacement rates and 3.7 percent via the lower net-of-tax wage. The relative size of the tax and replacement rate coefficients depends on the annuity rate assumed, as is explored below. In column 3 neither coefficient is significant at the 5 percent level since the variables' collinearity increases their standard errors. An F-test finds that jointly the two OAI variables have an effect on participation significant at the 1 percent level. The tax effect evident in column 2 remains when country-specific trends and time effects are used to control for background trends in retirement; the tax coefficient is -0.12 with a t statistic of -2.7.

In column 4 of table 5 OAIW has the expected negative effect on participation, though its coefficient is not significantly different from zero and the implied wealth elasticity of participation is only -0.1. Column 5 includes OAIW and replacement and tax rates on the right-hand-side. The OAIW coefficient is here, unexpectedly, positive and significant at the 5 percent level. This appears an artefact of the high ($r = 0.69$) correlation between OAIW and replacement rates noted above: since reductions in eligibility ages move replacement rates and the present value of OAI benefits together, it is hard to distinguish their effects. For this reason OAIW is omitted from further regressions. Column 6 tests whether the size of benefits affects retirement rates, or whether participation falls whenever any benefits are available at ages 60-4. A substantial effect of having any benefits (predicting a 3.8-point fall in participation) is found, and the marginal effect of higher benefits is small. This suggests that lower eligibility ages create norms for retiring at these new ages, though a negative tax effect remains. Column 7, in which the regressand is the difference between participation rates at 60-4 and 55-9, is a triple-difference

³³ This average is taken over the eight reductions of eligibility ages from 65 to a lower age in the sample.

regression.³⁴ The results are very similar to the difference-in-differences in column 3. Once more the coefficient on either replacement or tax rates is strongly significant if the other variable is dropped from the regression. An F-test again rejects the null that neither variable affects participation. Unemployment has small and generally insignificant coefficients in the regressions in this table, since participation was fairly stable during the high-unemployment years of the Depression. Growth over the previous five years has a positive effect, consistent with a procyclicality of participation rates. Growth over the preceding ten years has a negative coefficient, though this is never significant. This combination of coefficients suggests participation is procyclical in the short run but falls with higher long-run growth.

Figure 5 shows which observations generate the finding of an effect of OAI taxes on men aged 60-4. This figure graphs changes in participation against changes in tax rates for all countries and decades. Changes in the year effects have been subtracted from the participation changes to isolate the effect of tax rate changes. Many observations are near the origin, with little change in benefits or participation. Participation fell in the six country-decade episodes of the largest tax impositions on the 60-4 age group. Participation rose when taxes were removed from these men in Denmark in 1947. Thus the OAI tax rate coefficient is identified from these seven episodes. New Zealand's removal of its earnings test in 1977 did not raise participation of 60-4 year-old men by 1980, so the point labelled 'NeZ80' in figure 5 contradicts the negative relationship between participation and tax rates. Eleven rule-change 'events', including seven which appear important to the tax rate coefficient, are summarised in section 8.³⁵

The estimated OAI coefficients, though jointly significant, are fairly small. They imply the average eligibility-age reduction reduced participation among men aged 60-4 by 8.4 percentage points. Replacement and tax rates explain only 11% of the decline in average participation rates of men aged 60-4 from 1920 to 1990: the time effects 'explain' most of the participation changes. Large negative time effects are estimated in 1980 and 1990. Easier access to disability benefits after 1970 may explain some of these, yet large participation falls, such as the 12.6 point drop in US participation from 1970 to 1980, also occurred in countries with tightly-regulated disability systems. The participation declines not attributable to expansions of OAI or similar benefits plausibly result from higher private wealth. However, since the log of per capita GDP is similar to a time trend, we cannot distinguish the effects of private wealth and other trending variables using these data.

Sensitivity to Different Annuity Rates

Table 6 explores the sensitivity of the results in table 5 to different assumptions about the fair annuity rate $r+p$ used to construct the benefit tax rates. Each column in table 6 reports the coefficients on replacement and tax rates from a regression of participation rates on these

³⁴ The tax at ages 60 to 4 is itself a difference in tax rates, as there are no OAI benefits for men aged 55 to 59 in the sample.

³⁵ This summary excludes Denmark's eligibility age change from 60 to 65 in 1947, since its 1940 and 1950 censuses do not record the participation of the control group of men aged 55-9.

variables, macroeconomic controls and country and year effects. When an annuity rate lower than 7 percent is used, the replacement rate effect appears larger, and at 4 percent it becomes significant at the 10 percent level. The French and Austrian tax rates calculated fall with a lower annuity rate, so the negative relationship between participation and tax changes in figure 5 becomes weaker. The tax rate is still highly significant if included on its own, however. Thus the sensitivity of some of the tax rates calculated to the annuity rate makes the relative size of the replacement and tax rate effects hard to determine, but a negative effect of at least one variable remains whatever annuity rate is assumed.

Another type of sensitivity analysis would be to calculate replacement and tax rates at different earnings levels. If older men would, in the absence of OAI, earn less than average male earnings, this would alter the effective OAI replacement and tax rates and thus bias my regression results. Most of the earnings tests in the sample involve low exemptions and high marginal benefit withdrawal rates, with a zero marginal withdrawal rate at higher incomes. Therefore in general lower earnings would imply higher average OAI tax rates and higher replacement rates. Most earnings-test exemptions, and thus the range of earnings over which zero tax obtains, are very small.

Sensitivity to Macroeconomic Fluctuations

Table 7 presents two methods of separating OAI effects on men aged 60-4 from those of recessions following the oil shocks of the 1970s. The first three columns drop all observations from years after 1970. In column 1 replacement rates have a highly significant effect on participation, as do tax rates in column 2. The participation elasticities are -0.04 and 0.34 with respect to replacement rates and to the net-of-tax wage, though each effect is exaggerated by the omission of the other regressor. The correlation between tax and replacement rates at age 60 is even higher ($r = 0.95$) in the truncated than in the full sample ($r = 0.80$), so the two variables' effects are essentially indistinguishable, as is shown by the nonsensical positive coefficient on the OAI tax rate in column 3, which includes both regressors. Previous literature has analysed falls in male participation since 1970; here the strongest OAI effects are found in earlier data. Replacement and tax rates explain 34% of the (smaller) decline in participation in the period up to 1970. Most of the identification of these effects comes from benefit extensions in New Zealand in 1938 and Austria in 1961-6. Column 4, using a panel from 1970 to 1990, finds a replacement rate effect slightly smaller than in the full sample, and a negligible tax rate effect. The negative unemployment coefficient in column 4 shows that, once the Depression years are dropped from the panel, unemployment has the expected negative correlation with participation.

Columns 5 and 6 of table 7 examine a variant of the 'recession' theory, by testing whether tax rates reduce participation more in decades of slow growth. Column 5 includes the interaction of replacement rates at ages 60-4 and unemployment, and column 6 the interaction between replacement rates and GDP growth over the preceding decade. The unemployment interaction in column 5 does not substantially alter the OAI coefficients from those estimated in table 5. The negative growth interaction coefficient in column 6 suggests that taxes depress participation more in periods of high growth. This reflects that Austrian participation fell between 1960 and 1970 in a decade of high growth (38% over the decade) and low unemployment (no higher than

3.5 percent during this decade). In West Germany between 1970 and 1980, when participation of men aged 60-4 fell 30.5 percentage points, the unemployment rate never rose above 3.7 percent. Thus table 7 shows that OAI effects may be found in periods other than those of steep recessions.

Results for Men Older than 65

Table 8 analyses participation of men aged 65 and older. Columns 1 to 4 examine participation of men aged 65-9 and replacement and tax rates at that age.³⁶ In column 1 the replacement rate coefficient is negative, significant at the 5 percent level and implies a participation elasticity of -0.59. The tax rate coefficient is small and insignificant. Together these variables explain 6.6% of the fall in average participation rates from 1920 to 1990. Figure 6 shows which observations generate this replacement rate coefficient by plotting changes in the participation of men aged 65-9 against changes in their replacement rate, analogously to figure 5. Again contemporary changes in the year effects are subtracted from the participation changes. The decline in Irish participation between 1970 and 1980 whilst the OAI eligibility age was reduced from 70 to 65 in 1973-8 contributes heavily to the replacement rate coefficient. This episode is discussed in section 8 and appendix C. The replacement rate coefficient changes little with the inclusion of unemployment or growth cross-effects (columns 2 and 3 of table 8), but is smaller and insignificant when country-specific trends are also included (column 4). Column 5, which regresses participation of men 65 and older, supports Costa's conclusion of no effects of OAI on them. Columns 1 to 4, however, show that OAI effects on participation can be found in narrower age-bands, depending on the method used to control for time effects. The larger elasticity with respect to replacement rates among men aged 65-9 contrasts with the greater sensitivity to the net-of tax wage among younger men. No overall conclusion whether high replacement or implicit tax rates have more effect on participation is possible.

Other Controls

Participation of men and women aged 60-4 are positively correlated across countries. In 1990 $r = 0.6$ and Austria had the lowest participation of each sex by at least seven percentage points. In panel regressions the ten-year lag of participation of women aged 60-4 has a positive but insignificant effect on participation of men that age. The OAI effects on male participation found above are all present in regressions controlling for female participation.³⁷ OAI effects at ages 60-4 remain when replacement and tax rates at higher ages are included as regressors, confirming that current rather than expected future benefits generate the observed OAI effects on men aged 60-4. The replacement rate effect at ages 65-9 also remains when OAI variables at

³⁶The OAIW variable is omitted from these regressions due to its high correlation with replacement rates at 65 ($r=0.75$).

³⁷ Labour-force participation of women aged 60-4 has trended upward in some countries but downward in others (notably Austria and France) over time. A time-series study of elderly women's participation would therefore probably find similar results to those found here for men.

ages 60-4 are included as regressors. Thus there appears a genuine effect of benefits paid to men aged 65-9 on their participation, rather than merely effects due to benefits paid at younger ages.

Summary

Regressions using decadal data find negative effects of OAI replacement and tax rates on the labour-force participation of men aged 60-4, and negative effects of replacement rates on participation of men aged 65-9. Among 60-4 year-old men the tax and replacement rate effects are roughly equal, though these variables are too collinear to be satisfactorily separated. The replacement rate coefficient contains both wealth and liquidity effects, but OAI wealth is estimated to have little effect, so a liquidity effect may obtain. Large negative 'time effects' of the decades ending in 1980 and 1990 remain, however. A small number of abrupt reductions in the age of eligibility for OAI benefits and coterminous sharp falls in the participation of newly-eligible men generate the finding of negative OAI effects.

8. Event Studies of OAI Reforms.

To explain further the panel regression results, table 9 details eleven OAI reform events and the changes in participation between the preceding and following censuses.³⁸ The reforms are also described by figures 7 to 16. Column 1 compares the inter-censal change in participation in the age group affected by each OAI reform to the participation change of the same age group in a 'control' country which had no major change to its OAI system in that decade. Thus between 1970 and 1980, participation of 60-4 year-old men fell 21.4 points in Denmark, or 17.6 points more than in Norway. Column 2 compares the participation changes for an age group unaffected by the benefit extensions for the same countries. Column 3 reports the difference-in-difference-in-differences in replacement and tax rates and column 4 the difference-in-difference-in-difference in participation, the difference between the differences in columns 1 and 2. These participation, replacement and tax rate changes imply the participation elasticities with respect to the replacement rate and to the net-of-tax wage in column 5. The use of differences-in-differences-in-differences subtracts out omitted variables which affected men at different ages similarly, as well as country and time-specific effects, so as better to isolate the impact of the OAI changes.³⁹

The first six events listed in table 9 involved replacement and tax rates moving in the

³⁸ The differences in participation and replacement rates therefore took place over ten years, apart from the 1991 New Zealand reform where the differences are taken between 1990 and 1996. Appendix C contains a more detailed description of each reform event.

³⁹ All the inter-censal differences participation at age 60-4 in a given year are assumed to come from a common distribution. The standard deviation of these distributions are used to generate the t statistics in brackets in column 1. The same procedure for participation differences at age 55-9 is used in column 2. Each pair of distributions are assumed to be independent, so the square root of the sum of their variances is used to calculate the t statistics in column 4.

same direction. Participation changed considerably across each reform, not just absolutely, but in comparison to participation in the 'control' country shown and to participation of men in the reforming countries to whom pensions were not extended, as is shown in column 4. The Danish case described in the first row is particularly striking: the 'Post-Employment Wage' (PEW) introduced from January 1st 1979 effectively reduced the eligibility age for OAI benefits in Denmark from 67 to 60. As figure 7 shows, participation of men aged 60-4 in Denmark fell dramatically from 1978 to 1979. The PEW has the strictest income-testing of any OAI system; retirees who break its earnings limits are barred from receiving any further benefits until age 67. Figure 7 suggests the introduction of the PEW was not endogenous to participation changes, as there were no preceding participation falls which could have provoked the introduction of the PEW in 1979. The 1938 New Zealand Social Security Act, which made pensions payable at 60 rather than 65, had a smaller impact on participation of men aged 60-4. Nevertheless, figure 8 shows an enduring negative effect; participation of men aged 60-4 was lower in New Zealand than in Australia, where the eligibility age remained 65, in every census thereafter up to 1990, when the eligibility age in New Zealand started to rise towards 65. The French rule-change of 1983 which made 60 the standard retirement age does not appear to have broken the downward trend of French participation, as figure 9 shows. The vertical line in figure 9 shows that the enabling legislation for this reform was passed in 1981. One could argue that this legislation was a response to previous participation declines. The regressions in the next section summarize the evidence on this point. The relative falls in participation in Austria during the 1960s (illustrated in figure 10) and in West Germany during the 1970s (figure 11) were large. In each case the annual data graphed suggests that participation responded swiftly to the rule-change, and that the reforms were exogenous events as there was little decline in participation before them. The rise in New Zealand's eligibility age which began in 1991, illustrated using annual data in figure 12, followed a similar pattern.⁴⁰ No rise in participation in New Zealand prompted this reform, but participation rose dramatically after it. There was no similar rise in participation of Australian men this age. This response is particularly strong evidence of an OAI effect since rises in male participation have been rare.

The next group of three events in table 9 suggest the OAI tax rate is responsible for the participation changes we observe, since in each participation was little altered by reforms which increased benefits without extending OAI taxes. The Swedish reform of 1976, illustrated in figure 13, extended benefits to men under 65, with a negative tax on earnings, due to the creation of a partial pension system subsidising employment and other pensions' having no earnings-tests. Figure 13 shows little change in Swedish participation across this reform, and indeed Swedish participation fell less in the 1970s than other countries'. Similarly, the US introduction of early retirement benefits at 62 in 1961 (illustrated in figure 14) and the Canadian creation of early benefits at 60 in the reform of 1984-7 (figure 15) imposed almost no tax and had little effect on participation. This latter fact is shown better by the annual data in the figures than in table 9; these show downward trends in participation which were not affected by the reforms. The Canadian participation change between 1980 and 1990 reported in table 9 overstates the apparent effect of the 1984 and 1987 reforms, since much of this change predated these benefit extensions.

⁴⁰ A similar graph appears in an unpublished paper, *Labour Force Participation and Superannuation*, by David Frame of the New Zealand Treasury.

The last two reforms in table 9 suggest, by contrast, that replacement rates are more important to retirement than OAI tax rates. This conflict of evidence is reflected in the equal coefficients on replacement and tax rates in the regressions in section 7. The Republic of Ireland's OAI eligibility age reduction from 70 to 65 in 1973-8 was accompanied by minimal income testing. The triple-difference comparison between the Republic and Northern Ireland in figure 16 suggests this benefit extension had a strong effect on participation in the Republic, since it was only at ages 65-9 that participation followed a different trend than in the North. A larger role for replacement than tax rates is also apparent in the New Zealand reform of 1977, which raised replacement rates but removed the pre-existing income test at ages 60-4. Referring back to the comparison in figure 8, the reduced tax rate in New Zealand appears to have had no upward effect on its participation relative to Australia's between 1975 and 1985. Overall, the case studies suggest that, rather than effects on participation only working through tax rates or only through replacement rates, at some times one is important, and at some times the other. The Swedish reform of 1976 shows that zero or negative OAI taxes can keep older men in the labour force despite increased benefits. The Irish reform of 1973-8 shows that higher benefits, even with little income-testing, can influence men to retire. It is not clear why one effect applies in one setting and a different one in another.

9. The Timing of OAI and Participation Changes

Several of the graphs of annual participation rates discussed above show participation changing rapidly after changes in OAI rules, but not before them. This suggests that rule-changes were not provoked by participation changes but were rather exogenous events. A political economy theory might be that when participation is particularly low conditional on the prevailing OAI system, politicians increase OAI benefits. Thus benefit extensions would be preceded by large participation declines. Such endogeneity of benefit extensions would negatively bias the OAI coefficients reported in section 7. This section tests more formally for endogeneity of OAI policy by regressing legislated benefit tax rates on lagged participation and tax rates. Were OAI extensions endogenous, lagged participation rates would have predictive power in this regression. The data used are annual participation rates, taken from country labour force surveys and annual legislated tax rates, all for ten countries.⁴¹ Annual tax rates are calculated exactly as in the decadal data. Tax and replacement rates are highly correlated ($r = 0.75$) in the annual data.

In the political economy theory the key events to be explained are not changes of tax rates themselves but the passage of the legislation that brought them about. Therefore the dependent variable used to test the endogeneity theory is

⁴¹ These are Australia, Austria, Canada, Denmark, France, Germany, New Zealand, Sweden, the U.K. and the U.S. See Appendix A for a list of country-year data points used.

$$TR_{i,t}^{i,t+10},$$

the benefit tax legislated in country i in year t to exist in ten years' time. The 1991 New Zealand legislation scheduled a five-year increase in the eligibility age over the ten years from 1992 to 2001, so the ten-year lead is necessary to prevent the rise in participation in 1992 'causing' the increase in the eligibility age in years before 2001. The ten-year lead of the tax rate equals the current tax rate in all but the few cases in which legislation created rule changes far in the future.⁴² The regression testing for the effect of lagged participation on legislated tax rates is thus

$$(12) \quad TR_{i,t}^{i,t+10} = \alpha_i + \gamma_t + \beta_1 TR_{i,t-1}^{i,t+10} + \beta_2 TR_{i,t-2}^{i,t+10} + \beta_3 LFP_{i,t-1} + \beta_4 LFP_{i,t-2} + \varepsilon_{i,t}$$

and the relevant test statistic is the F statistic for the restriction ($\beta_3 = \beta_4 = 0$), implying the lagged participation rates have no predictive power. Causality from OAI taxes to participation rates can be tested using

$$(13) \quad LFP_{i,t} = \alpha_i + \gamma_t + \beta_1 LFP_{i,t-1} + \beta_2 LFP_{i,t-2} + \beta_3 TR_{i,t-1} + \beta_4 TR_{i,t-2} + \varepsilon_{i,t}$$

Here a test of the restriction ($\beta_3 = \beta_4 = 0$) tests for predictive power of lagged tax rates on participation.

Table 10 reports the results of these two regressions, and the associated F statistics. Column 1 tests for an effect of lagged participation rates on OAI legislation. The low F statistic shows that the lags of the participation rate add little explanatory power. The null of no effect of lagged participation rates on tax rates therefore cannot be rejected. Column 2 tests the predictive content of lagged values of the tax rate on participation rates. Again the F statistic is too low to reject the null of no causality. The lack of predictive power in either direction reflects the fact that tax and participation rates are highly contemporaneously correlated, rather than either leading the other. The size of the implied effect of replacement rates on participation in the long run when

$$LFP_{i,t} = LFP_{i,t-1} = LFP_{i,t-2} \quad \text{and} \quad TR_{i,t-1}^{i,t+10} = TR_{i,t-2}^{i,t+10} \quad \text{is, from (13),} \quad \frac{\beta_3 + \beta_4}{1 - \beta_1 - \beta_2}.$$

The implied coefficient is -0.2, with a standard error of 0.08, implying a participation elasticity with respect to the net-of-tax wage of 0.35. This coefficient is comparable to the tax effects found in section 7 above.

The lack of predictive power of participation on tax rates is to be expected given the shape of the graphs of annual data. The lack of predictive power of lagged tax rates on

⁴² These are the 1991 New Zealand reform (which will finish in 2001), the 1960 Austrian (finished in 1966), and the 1981 French reform of 1981 (which took effect in 1983).

participation is more surprising, but results from the speed of the participation responses to higher tax rates. Much of this reaction occurs within a year, as the cases of Denmark (figure 7), Austria (figure 10) and New Zealand after 1991 (figure 12) show. Since specification (13) uses annual data, no effect of lagged tax rates on participation is found. Higher frequency participation and tax rate data would probably show that rule-changes led participation changes, or at least confirm that participation changes did not lead OAI rule changes.

Summary

In annual data, participation trends do not predict changes in OAI rules. Therefore these data do not support the political economy theory that OAI extensions were endogenous to participation trends. Other regressions not reported here found no effect of lagged unemployment rates on changes in OAI legislation, contrary to the theory advanced in section 4 that OAI is extended to force older men to retire during recessions. Thus the OAI extensions remain largely exogenous, or mysterious, events, and the panel regressions in section 7 appear free from the endogeneity problem mooted. The annual series show participation rates changing exactly as tax rates changed. Thus no effect can be found of tax rates lagged one year on participation. Rather than showing a lack of tax effects on participation, however, the annual data suggest that participation responds quickly to altered benefit taxes. For OAI extensions to precede participation falls would be consistent with policymakers having anticipated future falls, in which case OAI need not have caused these declines. Anecdotal evidence suggests that participation falls were not anticipated, however. The 1978 OECD *Economic Survey of Germany* reports that the OAI systems' reserves fell heavily after 1973 in part because of "more frequent than predicted use of the early retirement option introduced in 1972." Similarly, the 1980 OECD *Economic Survey of Denmark* reports that "While it was originally estimated that 17,000 persons would join the [early retirement] scheme [when it started] in 1979...by the end of the year 50,000 persons had opted for early retirement.....60% or 30,000 were employed, while the rest came directly from unemployment." In these cases at least, OAI was not extended in anticipation of the ensuing participation falls.

10. Conclusion

This paper models the retirement incentives created by rules attached to OAI benefits more satisfactorily than previous studies. Taking this theory to data, it finds substantial evidence for negative effects of OAI tax and replacement rates on labour force participation of men aged 60-4, and also for an effect of replacement rates on participation of men aged 65-9. The implied participation elasticities at ages 60-4 are around 0.2 for the tax rate and -0.06 for replacement rates. Separating the effects of replacement and tax rates is hard due to their collinearity, but countries' OAI reform 'events' suggest that tax rates are important in some instances, and replacement rates in others. The rapid response of participation to changes in OAI variables makes a causal role for OAI rules particularly plausible. Effects of OAI are found before 1970,

so its influence may be distinguished from that of higher unemployment since the oil shocks. OAI effects remain after the inclusion of controls for growth rates and a variety of methods for dealing with unobserved variables. The estimated effects of OAI are of moderate size. OAI variables explain only around 11% of the decline in average participation rates from 1920 to 1990, and large falls in participation between 1970 and 1990 remain unexplained either by OAI variables, unemployment, or growth rates. Annual data for men aged 60-4 show sharp declines in participation at the same time as reductions in eligibility ages, but not before them. Thus it appears that changes in the generosity of OAI systems caused changes in participation rates, and not the reverse.

In designing OAI or other retirement systems, policymakers should be aware of the effects of system rules on retirement ages identified above. Starting from an optimal retirement age, benefit taxes on retirement will create deadweight losses in labour markets. If retirement ages are already non-optimal, however, due to income taxes or missing annuity markets, income effects of OAI benefits may also affect welfare. Policymakers may also wish to induce workers to retire later so as to reduce governments' pension liabilities. The OAI effects found here seem greater than those found by Costa, but less than those found by Gruber and Wise, although neither work quotes elasticities. Thus this paper suggests that increasing OAI eligibility ages to 65 or more would induce moderate participation increases and thereby reduce governments' liabilities fairly modestly. Further research is necessary to separate the participation effects of different aspects of OAI systems better than can be achieved with these data, and to establish what explains the large 'residual' declines in participation not explained by OAI.

Appendix A: Labour Force Participation Data

Comparability of Data

I took participation rates in censuses since 1945 from the ILO's *Year Book of Labour Statistics (YBLS)*. These data are constructed from answers given by governments to an ILO questionnaire, in an attempt to standardize the definitions used. Thus the unemployment rate a government quotes to the ILO may differ from that it publicizes elsewhere. The ILO also notes that, since 1945, an increasing number of countries have asked respondents to describe their labour market activity during a short reference period (such as the week or day before the census). Reference to a shorter period seems likely to give older men less opportunity to claim that they were, in fact, working. This increasing standardization of participation data suggests that later data will be more comparable across countries. I took participation rates directly from country censuses for years before 1945. Some large definitional changes are observable between censuses, in which case all observations using the older definitions (which typically overestimate participation among elderly men) are dropped from the panel. I hope this within-country scrutiny removes much of the measurement error from the participation rates used.

The Sample

In the decadal regressions of the participation of men 60-4, the following 81 censuses are used:

Australia	1933, 1947, 1954, 1960, 1970, 1980, 1991
Austria	1950, 1960, 1970, 1980, 1990
Canada:	1941, 1951, 1961, 1971, 1981, 1991
Denmark	1940, 1950, 1960, 1970, 1981, 1990
France	1954, 1962, 1970, 1980, 1990
Germany	1925, 1933, 1939, 1950, 1960, 1970, 1980, 1990
Ireland	1960, 1970, 1980, 1990
New Zealand	1936, 1945, 1956, 1961, 1971, 1980, 1991
Norway	1950, 1960, 1970, 1982 ⁴³ , 1990
Sweden	1930, 1940, 1950, 1960, 1970, 1980, 1990
Switzerland	1920, 1930, 1940, 1950, 1960, 1970, 1980, 1990
UK	1921, 1931, 1951, 1961, 1971, 1981, 1991
U.S.A.	1940, 1950, 1960, 1970, 1980, 1990

⁴³ Norwegian data for 1982 come from its labour force survey of that year; the 1980 census reported the age bands 60-6 and 67-74, and therefore could not be used.

In the regressions of participation among men 65 and older, the following 82 censuses are used (note that this is a similar but non-identical list to the above):

Australia	1933, 1947, 1954, 1960, 1970, 1980, 1991
Austria	1950, 1960, 1970, 1980, 1990
Canada:	1921, 1931, 1941, 1951, 1961, 1971, 1981, 1991
Denmark	1940, 1950, 1960, 1970, 1981, 1990
France	1954, 1962, 1970, 1980, 1990
Germany	1950, 1960, 1970, 1980, 1990
Ireland	1950, 1960, 1970, 1980, 1990
New Zealand	1926, 1936, 1945, 1956, 1961, 1971, 1980, 1991
Norway	1950, 1960, 1970, 1982, 1990
Sweden	1950, 1960, 1970, 1980, 1990
Switzerland	1930, 1940, 1950, 1960, 1970, 1980, 1990
U.K.	1891, 1901, 1911, 1921, 1931, 1951, 1961, 1971, 1981, 1991
U.S.A.	1940, 1950, 1960, 1970, 1980, 1990

Annual Regressions

The following 288 country-year observations are used in the annual regressions:

Australia	1970 - 1996	Germany	1966 - 1995
Austria	1955 - 1997	New Zealand	1987 - 1997
Canada	1976 - 1998	Sweden	1968 - 1992
Denmark	1972 - 1998	U.K.	1966 - 1996
France	1966 - 1996	U.S.A.	1953 - 1993

The annual data are from labour force surveys reported in the OECD's *Labour Force Statistics* unless indicated otherwise below.

Sources and Problems by Country

Australia

Census participation rates are taken from the national census of 1933 and from the ILO's *YBLS* for later years. The census of 1921 reports very high participation rates which suggest a definitional change between 1921 and 1933. Therefore censuses from before 1933 are not used.

Austria

Census participation rates are taken from the ILO's *YBLS*. Annual participation rates were supplied to the author by Erik Türk of the Austrian Social Insurance Administration.

Canada

Census data are from the ILO's *YBLS* and from the censuses of 1921, 1931 and 1941.

Denmark

Census data are taken from the ILO's *YBLS*, and from the *Danish Statistical Yearbook* for 1940. The 1940 participation rates are lower than those for 1950, consistent with the rise in the male OAI eligibility age from 60 to 65 in 1947. The 1940 census was conducted during the German occupation of Denmark and may thus be suspect. However the inclusion of this data-point does not greatly alter the OAI coefficients estimated in the regressions.

Annual data on participation of men aged 60-4 are taken from Statistics Denmark's publication *Living Conditions in Denmark* for the years 1972-1978. Data for the years 1971, 1973 - 1979 and 1981 - 1998 were supplied by Ms. Annette Ludvigsen of Statistics Denmark. The participation rates for 1973 and 1980 were interpolated. There is a slight discrepancy between the participation rates for 1973-79 supplied by Ms. Ludvigsen as coming from Labour Force Surveys, and those printed in *Living Conditions in Denmark*. The printed values are used in the regressions and in table 7. In fact Ms. Ludvigsen's values show a larger fall in participation from 1978 to 1979, from 80.0% to 59.8%. That there was a large fall in participation from 1978 to 1979 is therefore not disputed; further, both Pederson in Atkinson and Mögensen, eds., (1983), and Petersen in Schmähl, ed., (1989) show similar graphs to figure 7.

France

Census data are taken from the ILO's *YBLS*. Censuses prior to 1954 are not used because this census reports that a definitional change is responsible for some of the large decline in reported participation rates between the 1946 and 1954 censuses.

Germany

Census data are taken from the 1925, 1933 and 1939 censuses and from the ILO's *YBLS*.

Ireland

Census data are taken from the ILO's *YBLS* and directly from the census of 1950. Data for Northern Ireland are taken from its census.

New Zealand

Census participation rates are taken from the ILO's *YBLS* and directly from the censuses of 1926, 1936 and 1945. Participation rates reported in the census fall sharply from 1921 to 1926 due to a definitional change, so censuses from before 1926 are discarded. Very low participation rates are also reported in the 1951 census for all age-groups, (see figure 8), so this census is also

discarded, and the rates from the 1956 census assumed to apply in 1950. The full ascription of year effects to censuses is 1920 to the 1926 census, 1930 to the 1936, 1940 to 1945, 1950 to 1956, 1960 to 1961, and so on for the 1971, 1981 and 1991 censuses.

The *YBLS* reports participation among men aged 55-64 in 1945 but the census can be used to split this into participation in the 55-9 and 60-4 age-groups. In the 1926 Census, the category of 'Persons not Actively Engaged in Gainful Occupations' includes the retired, pensioners, invalids and mental hospital patients. From the 1936 census, I take 'Retired Persons, Dependants, etc.'⁴⁴ to be the non-participants, a category for which sub-divisions are not given. From the 1945 census, I add those 'Retired, of Independent Means, etc.' to those 'Invalid, sick, or under detention' to form the non-participants. This produces participation rates essentially identical to those reported for 1945 by the ILO, with the added benefit that the census allows participation to be defined in narrower age-groups. Thus there is little evidence for a reclassification of non-participants between the 1936 and 1945 censuses, which are important to the regression results in the paper.

Annual participation rates are taken from the 1998 edition of the New Zealand Department of Statistics' *Labour Market Statistics*.

Norway

Census data are taken from the ILO's *YBLS*.

Sweden

Census data are taken from the ILO's *YBLS* and directly from the censuses of 1930, 1940 and 1950. The 1920 census does not appear to divide the labour force by age.

The 1930-50 censuses each report two tables on the population divided by their means of support, age, sex and marital status. The first of these tables reports only the economically active, whilst the second reports the whole population, enabling participation rates at each age and sex to be found. In the 1930 census, the 'economically active' include a categories of 'Pensioners' and 'Household Workers'. Subtraction of the pensioners from the total of those 'active' results in very plausible participation rates by age, which are reported in table 1 and used in the regressions. The age distribution of 'Household Workers' (they are predominantly women between 20 and 30) suggests that these were waged workers rather than a default category for women without paid employment. Therefore the 'Household Workers' are included in the totals of the economically active.

Switzerland

Census data are taken from the ILO's *YBLS* and directly from the censuses of 1920, 1930 and 1940. Much of the census information is summarized in the 1990 census, Vol. 3, p.194.

⁴⁴ New Zealand, *Population Census, 1936, Vol. XII, Incomes*, p.9.

The U.K.

Census data are taken from the ILO's *YBLS* and from Paul Johnson's summary (Economic History Review, 1994) of earlier UK censuses. Johnson is suspicious whether census-taking methods in 1881 are comparable with those used later, but reaches no firm conclusions. Recorded participation trends smoothly down until 1970, so the inclusion of the earlier UK censuses is not crucial to the regression results.

The U.S.A.

Census data is taken from the US census of 1940 and from the ILO's *YBLS*. Censuses prior to 1940 are excluded because that year's census reports that "persons unable to work and retired workers...were excluded from the labour force in the 1940 census. In earlier censuses such persons frequently reported their former occupations and were counted as gainful workers." Thus "the 1940 data on the labour force are not directly compatible with the census statistics for gainful workers in 1930 and earlier years."⁴⁵ This is unfortunate since both OAA and OASI were created between 1930 and 1940. For reference, the participation rates reported for men in the 1930 and 1940 censuses are:

	Age 55 to 59	Age 60 to 64	Age 65 to 69	Age 65 plus
1930	93	86.8	75.7	58.3
1940	87.9	79	59.4	41.8

If the 1930 data were included in the panel, they would support section 7's that higher benefits for men aged 65-9 encourage them to retire. There has been much debate about the accuracy of these data; see Ransom and Sutch (1986), Margo (1993), and Costa (1998). Omitting them here prevents the panel regressions from being identified by contested data. Annual data are taken from the US Bureau of Labor Statistics' *Employment and Earnings*. This publication lists the participation of men aged 55-64 from 1948 on but splits this age group into men aged 55-9 and 60-4 from 1953 onwards.

⁴⁵ *Sixteenth Census of the U.S.: 1940, Population, Vol.III, The Labor Force, Part 1: United States Summary*, p.5.

Appendix B: Old-Age Insurance Data

Information about OAI benefits and rules comes from various years of the SSA's *Social Security Programs Throughout the World* and its similar publications *Outline of Foreign Social Insurance and Assistance Laws* (1940) and *Social Security Legislation Throughout the World* (1949), except where specified otherwise below. The notes below list the primary sources of earnings data; where there were gaps in earnings series wages were imputed using the nominal wage series in Mitchell's *European Historical Statistics, 1750-1993* (1998).

Sources and Problems by Country

Australia

All data are taken from various years of the *Official Yearbook of Australia*.

Austria

Wage data are from various years of the *Statistical Handbook of the Republic of Austria*.

Canada

Canadian OAI data are taken from various years of the *Canada Year Book* and from the SSA publications. Average male wages are taken from the census and from various years of *Canada Pension Plan Contributors; Earnings and Contributions*.

Canada had a means-tested Old-Age pension from 1927 to 1951, payable to all citizens 70 or older. The Old Age Security Act (OASA) of 1951 ended the means-test. The eligibility age was dropped by one year per year from 70 to 65 between 1965 and 1970. However, in this paper pensions are taken to have been extended to men aged 65-9 in Canada in 1951. This is because the OASA also created an Old-Age Assistance (OAA) system, which paid means-tested benefits to persons aged 65 to 9. *The Canada Year Book* of 1960⁴⁶ records that OAA benefits were received by 21% of 65-9 year-olds that year. OAI variables include the Guaranteed Income Supplement introduced in 1966 and the Quebec and Canada Pension Plans introduced in 1965. The Spousal Allowance, (SPA) introduced in 1975, pays means-tested benefits to 60-4 year-old wives of men aged 65 or more. The SPA is thus a 'special case' for couples differing in age, not relevant here since I assume husbands and wives are the same age.

Denmark

OAI data are taken from the SSA publications listed above and from *Social Denmark* (1947). The OAI eligibility age for men was 60 from 1891, was raised to 65 in 1947, and again from 65 to 67 between 1956 and 1961. The SSA states that benefits at age 67 are 'means-tested'

⁴⁶ See the *Canada Year Book, 1960*, p.271-2.

but do not specify the exact test used. It is assumed that earning the average male wage would preclude receiving any benefit since the available information suggests that marginal benefit withdrawal rates were and are high. A description of the means-test for the 'Post-Employment Wage' is given by J.H. Petersen in W. Schmähl (ed.), *Redefining the Process of Retirement*. Wage data are taken from various years of the Danish *Statistical Yearbook*.

France

OAI data are taken from the SSA publications and from Weise (*Social Security Bulletin* May 1972). Wage data are taken from the *Annuaire Statistique de la France*. Only the provisions of the General Regime of the OAI system are used to construct the OAI variables; the complementary regimes, of which membership is often compulsory, are omitted, due to their number and variety.

It is difficult to date the reform that made full benefits payable at 60 in France. Until 1972, men could claim pensions equal to 40% of their average wage at 65, or claim up to 5 years earlier with permanent 5 percent reductions in their benefits for each year of earlier retirement. There was no earnings test. By 1976, 15 percent of workers were entitled to retire at 60 with full benefits, due to the rules of specific pension funds for workers in the railways, utilities and government service. As of July 1976, this possibility was extended to 'workers engaged in strenuous labour'.⁴⁷ A law of 1981 extended this right to all workers in the OAI system's General Regime from April 1st 1983.⁴⁸ In this paper 1983 is used as the date of the OAI extension, since this is when full benefits at 60 became available for the generality of the population, though Blanchet and Pelé⁴⁹ show that the 1976 reform also had some effect on retirement rates at age 60. In both 1976 and 1983 entitlement for a full pension at 60 was made conditional on retirement from the worker's previous job; further employment elsewhere was permitted but subject to a 'special tax'. These conditions on future work are assumed to create a strict earnings test, following Blanchet and Pelé, though I do not have details of the 'special tax'.

Germany

Wage data are taken from various years of the *Statistical Yearbook of Germany*.

Ireland

The OAI variables constructed refer to the means-tested pensions paid prior to 1961 and benefits in the contributory system introduced in that year thereafter. Although means-tested benefits are still paid to poorer elderly men, a man with a substantial record of contributions to the contributory scheme would not receive them. Thus the post-1961 system is defined as having

⁴⁷ Lois S. Copeland, *France Gradually Lowers Retirement Age*, *Social Security Bulletin* December 1976.

⁴⁸ Gary Freeman describes this law's passage in John S. Ambler, ed., *The French Socialist Experiment*, 1985.

⁴⁹ Blanchet and Pelé's article is in Gruber and Wise, eds., *ibid*.

no earnings test. Wage data are taken from the Irish census.

New Zealand

Data are taken from the SSA publications and various years of the *New Zealand Official Yearbook*.

Norway

Wage data are taken from various years of the *Statistical Yearbook of Norway*.

Sweden

Swedish wage data come from various years of the *Statistical Abstract of Sweden*. Replacement and tax rates of zero prior to 1950 at ages 60-4 are used in the panel regressions above. Insufficient data is available to construct replacement rates at ages 65 and above or the OAIW variable prior to 1950, however.

No income test was attached to either the basic pension or the earnings-related ATP in the postwar era.⁵⁰ An income test was attached to a municipal housing allowance, a younger wife's allowance and the widow's pension.⁵¹ The younger wife's pension is not relevant for equal-aged couples and the housing supplement is ignored here due to a lack of historical information. Palme and Svensson make clear that the typical housing supplement in the early 1990s was small (see footnote 9). This and the small number of people claiming housing supplements make it sound more like a welfare benefit than a part of OAI.

In 1976 Sweden introduced a partial pension. This may only be claimed by workers aged 60-4 who transfer from full-time (at least 22 hours per week) to part-time work (17 to 35 hours per week). The partial pension is 50% of the salary loss involved, and thus represents a subsidy to continue working, albeit with a 50% implicit marginal tax. The maximum subsidy is one quarter of previous earnings, but many participants would receive less. Without a compelling means of constructing the average subsidy, the maximum subsidy of 25% is multiplied by one half to give a negative tax of 12.5%. No addition to the replacement rate is made, because the partial pension cannot be claimed by retirees. The pension rights of a worker at age 65 are not reduced by his receipt of a partial pension. Packard reports that the partial pension was popular in Sweden by 1982, with 20.2% of all men aged 60-4 claiming it.⁵² Denmark (in 1987) and Germany (in 1992) introduced comparable partial pension systems.

⁵⁰ The SSA's *Social Security Programs Throughout the World* states that 'Retirement is unnecessary for either [basic or earnings-related] pension'. Michael D. Packard (*Social Security Bulletin*, 1982) also describes a lack of income-testing.

⁵¹ Konrad Persson, *Social Welfare in Sweden*, 1959, p. 15.

⁵² Packard, op. cit., Table 4.

Switzerland

Wage data come from various years of the *Statistical Yearbook of Switzerland*.

The U.K.

Post-1949 data come from various years of *Britain: An Official Handbook*. Earlier pension rates and rules come from MacNicol (1998). Earlier wage data come from the census. OAI variables are constructed only for flat-rate pensions; the State Earnings-Related Pension Scheme (SERPS), created in 1978, is omitted, because it was never compulsory. Employees with defined-benefit occupational pensions could opt out of SERPS from its beginning in 1978. The Social Security Act of 1986 also allowed employees with defined-contribution pensions also to opt out of SERPS.⁵³ Blundell and Johnson (in Gruber and Wise, 1999) report that over three-quarters of eligible workers had opted out of SERPS by 1996.

The USA

Average benefits under OASI are taken from tables 5.B and 5.C of the *Social Security Bulletin Annual Statistical Supplement*, 1998. These tables allow the average benefit for a married man first claiming benefits at 65, whose wife had no earnings history, to be established. This figure is then reduced appropriately for earlier claimancy. The entire history of OASDI rules is given on the SSA's website at <<http://www.ssa.gov/OACT/HOP/hopi.html>>.

Average male earnings are taken from the US Census Bureau's series P-6, available on <<http://www.census.gov/hhes/income/histinc/p06.html>>. Since this series extends back only to 1967, median male earnings in table 4.B6 of the *SSB Annual Statistical Supplement* of 1998 are used as an index with which to extend mean male earnings back to 1940.

All OAI variables constructed refer to OASI benefits. Although it was suggested that I use replacement and tax rates obtaining under Old Age Assistance (OAA) in 1940, the values calculated using figures from Friedberg (1998) were very similar to those calculated as obtaining in OASI, so the latter are used.

⁵³ For a detailed description on the laws relating to SERPS, see Blake (1995).

Appendix C: Case-Studies of Benefit Extensions

New Zealand, 1938

The reduction in the OAI eligibility age in New Zealand from 65 to 60 in 1938 is important to the finding of OAI retirement effects in section 7. Participation of New Zealand men aged 60-4 fell 13.4 points between the censuses of 1936 and 1945⁵⁴. A comparison between New Zealand and Australia suggests the benefit extension caused much of this fall. Figure 8 plots census participation rates of men aged 60-4 in Australia and New Zealand against time. Since 1908, Australia's OAI eligibility age for men has been 65. Its system is thus highly similar to that New Zealand had prior to 1938. Figure 8 shows that, whilst participation rates were comparable in the 1930s, after 1938 the New Zealand participation rate was consistently around ten points lower than that in Australia.

Denmark, 1947

The Danish OAI eligibility age increase from 60 to 65 in 1947 appears to have influenced the rise in the participation of men aged 60-4 from 78.3% in the 1940 census to 85.9% in the 1950 census. Participation of men aged 65 also rose, from 35.1% to 35.9%. Both replacement and tax rates at ages 60-4 were reduced by the 1947 reform. Rising male participation rates over time are unusual; unfortunately annual participation data do not exist for this period.

New Zealand, 1977

Until 1977 New Zealand had income-tested Age Pensions paid at age 60 and Superannuation benefits, which were not means-tested, paid at age 65.⁵⁵ Both pensions were at similar levels, so this system can be thought of as a single pension with an income test at ages 60-4. In 1977 a new National party government replaced these two pensions with 'National Superannuation', a benefit available from age 60 without means-testing. Benefits were increased relative to the previous systems. Although annual participation data for New Zealand are not available for this period, the census participation rates plotted in figure 8 show that between the 1976 and 1986 censuses participation among men aged 60-4 fell rapidly in both New Zealand and Australia. No positive effect on participation seems to have arisen from the end of earnings-testing in 1977. In 1985 a new earnings-test was introduced: this taxed earnings of pensioners above an exemption at a 25% marginal rate, in addition to the income taxes paid by all workers.

⁵⁴ The 1936 and subsequent New Zealand censuses are described in appendix A. No important changes in classifications of older men's labour-force status between 1936 and 1945 are apparent. The participation rates in the 1951 census are surprisingly low, however, and it is dropped from the data set.

⁵⁵ A useful source on this reform is *Reforming Public Pensions*, by Robert Holzmann for the OECD, 1988.

New Zealand, 1991-2001

In 1991 New Zealand paid benefits to all workers at age 60, with an earnings test. The 1991 budget stipulated that, starting in 1992, the OAI eligibility age would rise six months each year, with a target of returning to 65 in 2001.^{56,57} The simultaneous rise in participation among men aged 60-4 has been dramatic (participation rose 19.3 percentage points from 1990 to 1997), particularly as there are few examples of rising male participation in any country. Figure 12, which plots annual participation and replacement rates for New Zealand and Australia since 1986 show this recent episode in more detail. Both the benefit tax and replacement rates were reduced by the increasing eligibility age, so this participation increase cannot be ascribed solely to the change in either variable. OAI benefits were not available to Australian men aged 60-4 during this period, and their participation shows no upward trend. Thus the experience of New Zealand suggests that participation in the 60-4 age group is very sensitive to available OAI benefits, though a distinction between the effects of taxes and replacement rates cannot be made.

Austria, 1961-6

The reduction of Austria's OAI eligibility age for men from 65 to 60 from 1961-6 is important to the finding of OAI effects before 1970. Participation of Austrian men aged 60-4 fell from 66% to 44.9% from 1960 to 1970, a decade of fairly stable participation rates elsewhere. Figure 10 graphs annual participation rates of men 60-4 in Austria from 1955 to 1997 against the replacement rate constructed from payment records and system rules.⁵⁸ The age of male eligibility for benefits was 65 up to 1960, but a length of service provision effectively reduced it to 64 in 1961-2, and then a further one year annually until eligibility was fixed at 60 in 1966.⁵⁹ This figure suggests a very rapid response of participation rates to the benefit extensions in the 1960s. There may also have been some lagged response, though this is hard to separate from the effects of macroeconomic fluctuations in the 1970s. These data also suggest that the OAI changes led the participation declines: it does not appear that OAI was extended in response to a pre-existing fall in participation.

U.S.A., 1961

In the US, men could claim OAI benefits from age 62 from 1961. An earnings test is applied to these benefits, but deferring claimancy by one year increases benefits by 6.67%.

⁵⁶ This episode does not affect the results of the decadal panel, which ends in 1990.

⁵⁷ I am indebted to David Frame of the New Zealand Treasury for information on the New Zealand reforms initiated in 1991.

⁵⁸ I am grateful to Eric Türk of the Austrian Social Insurance Administration for the annual participation rates graphed here and other information on the Austrian reforms of 1961-6.

⁵⁹ Men may claim benefits earlier than 65 if they have 35 years of insurance coverage; I assume the typical man has them by age 60. The 'standard' retirement age in the Austrian system remains 65 (see, for example, *Social Security Programs Throughout The World*, 1997).

Previously men could not claim benefits before age 65. Figure 14 shows participation rates of 60-4-year-old men in the US from 1953 to 1993. Participation rates of men aged 55-64 from 1948 onwards are also plotted. Little effect of the 1961 rule change is identifiable, perhaps because of the approximately actuarial deferment credit. Examination of retirement hazard rates at various ages suggests this benefit extension has reduced participation: a spike in retirements at exactly age 62 appeared for the first time in the 1970 census, and 62 is now the most common age of retirement in the U.S. (Costa 1998). Thus although plausibly the 1961 reform affected male participation, this effect is too small to identify the panel regressions.

West Germany, 1973

West Germany reduced its OAI eligibility age from 65 to 63 in legislation passed in 1972. Benefits were first paid at age 63 in January 1st 1973. Benefits claimed before age 65 are earnings-tested and there is no specific accrual benefit, though a lengthened earnings history implies a less-than-actuarial benefit accrual. Participation of men aged 60-4 in West Germany fell from 74.7% to 44.2% between 1970 and 1980, the largest decadal fall in the sample. Figure 11 shows annual participation rates for men aged 60-4 in Western Germany from 1966 to 1995. Participation fell somewhat from 1966 to 1972, but this decline appears to have accelerated in exactly 1973. Thus in Germany the OAI changes led the participation decline, not vice versa. Per capita GDP growth was close to zero in 1974 and turned negative in 1975 and again in 1982. Thus some of the participation decline after 1973 is probably attributable to recessions, and some also to easier access to pseudo-retirement schemes such as disability benefit.⁶⁰ However, the rapidity of the participation falls in 1973-5 suggest a causal role for the OAI extension.

Republic of Ireland, 1973-8

After its independence in 1924, the Republic of Ireland maintained the pre-existing British Old-Age Pension, which paid a means-tested sum to people aged 70 or more. In 1961 a contributory system was introduced which paid benefits to men at age 70 without an earnings test. From 1973-8 the Republic of Ireland reduced the eligibility age one year per year until it was 65 in 1978. An earnings test applied only to men claiming the pension in their 65th year. Participation of men aged 65-9 fell dramatically between the 1970 and 1980 censuses, from 63.9% to 36.5%. Annual data exists only for the later part of this decade. However, an illustration of this event in a difference-in-difference-in-difference perspective is given by figure 16, which shows participation rates of men aged 60-4 and 65-9 in the Republic of Ireland and Northern Ireland, which, being part of the UK, had an eligibility age of 65 for men after 1946. Little difference is evident between the participation trends among men aged 60-4. The large decline in participation of men 65-9 in the Republic between 1970 and 1980 was not matched in the North, suggesting that the benefit extension in the Republic was the cause of most of this decline.

⁶⁰ Börsch-Supan and Schnabel in Gruber and Wise, op. cit., list a number of near-pension systems in Germany.

France, 1983

The history of the French OAI system and the difficulty of dating the extension of full benefits to men aged 60 are described in appendix B. Until 1976, the standard retirement age was 65, and benefits were reduced a perpetual 5% per year for early claimancy. There was no earnings test at any age. Legislation effective July 1st 1976 made retirement at 60 on the full pension previously payable at 65 possible for manual workers, subject to their termination of employment at their previous firm.⁶¹ This possibility did not exist for the generality of workers until April 1st 1983, however, when the standard retirement age was reduced to 60, under legislation passed in March 1981. It is assumed here that the employment termination condition is equivalent to a retirement requirement, so that the replacement rate obtaining at age 60 is also the benefit tax rate.

Figure 9 plots French participation rates among 60-4 year-old men from 1966-96. The large participation fall in 1983 occurred exactly as benefits and taxes were increased for most workers. The French case is somewhat confused because benefits rules were changed for a minority of workers in 1976. The decline in participation from 1980-1 might suggest that the legislation of that year was a response to retirement trends.

Sweden, 1976

Prior to 1959 the Swedish OAI eligibility age was 67. In that year the option of claiming reduced benefits at age 63 was created along with the earnings-related ATP pension. Two reforms in 1976 increased the benefits available in the 60-4 age group. First, the standard retirement age was reduced from 67 to 65, with no reduction in benefits. Second, benefits could be claimed as early as age 60, albeit with a 6% reduction in benefits for each year before 65 that benefits were taken. The partially-funded ATP system was also rapidly increasing its average benefit during this period, and a partial pension for older people in employment was created. Figure 13 plots annual participation and replacement rates for men 60-4 in Sweden from 1968 to 1989. Participation fell 3.2 percentage points from 1976 to 1977 but remained relatively high thereafter. This may be explained by the lack of income testing for receipt of Swedish pensions, and also by the partial pension scheme, also introduced in 1976, which subsidises part-time employment for workers aged 60-4. The Swedish case suggests that replacement rates lead participation rates, but also that implicit tax rates affect retirement, since the zero or negative tax rates obtaining in Sweden appear to have influenced its high participation rates.

Denmark, 1979

The 'Post-employment wage' (PEW or 'Efterløn') for those aged 60-6 in Denmark, introduced on January 1st 1979, had a dramatic negative effect on participation, which has been noted elsewhere.⁶² In 1978, the OAI eligibility age for men was 67. 'Early retirement pensions'

⁶¹ This legislation is described by Copeland, *Social Security Bulletin* December 1976.

⁶² See Petersen in Schmähl, (1989), and Pedersen in Atkinson and Mogensen, (1993).

existed, but were restricted to a small number of men with failing health. From 1979 the PEW gave workers aged 60-6 unemployment benefits for 2.5 years and 80% of these benefits thereafter until age 67. The only eligibility condition⁶³ is membership of an unemployment insurance fund in 10 of the previous 15 years, which tends to exclude the genuinely disabled. Restrictions on employment whilst receiving the PEW are very tight.⁶⁴ Thus the PEW introduced high benefits for men aged 60-6 with an equal implicit tax rate. Figure 7 plots the participation rate of Danish 60-4 year-old men from 1970 to 1994.⁶⁵ Participation fell from 78.9% to 59.8% from 1978 to 1979, and somewhat more thereafter. Petersen and Pedersen agree that the PEW was designed to encourage older workers to leave employment during the prevailing recession, not to provide benefits to men already outside the labour force. Such motives would make OAI extensions endogenous to the unemployment rate, but not to older men's participation rates. The design of the PEW and the fall in participation after but not before its introduction suggest strongly that participation responded to OAI rule changes, and not the reverse. The OECD *Economic Survey of Denmark* for 1980 (see section 8 above) states that the size of the participation decline in 1979 surprised the Danish government. Thus the PEW was not instituted in anticipation of the participation fall that followed it.

Canada, 1984-7

Benefits under the earnings-related Quebec Pension Plan and Canada Pension Plan were extended from men aged 65 to those aged 60 in 1984 and 1987 respectively. In both plans early receipt is accompanied by a roughly actuarial penalty of 6% of benefits per year of early receipt. There is a restrictive earnings test. Figure 15 plots the participation rate of Canadian men aged 60-4 from 1976 to 1998. There is little perceptible break in the downward trend of male participation in 1984 or 1987. The Canadian data are fairly neutral as regards the relative timing of benefit increases and participation falls, and suggest, like the US and Swedish series, that benefit extensions which do not imply high taxes have relatively little effect on participation.

⁶³ Voluntarily entry to the PEW and its lack of a job-search requirement make it an OAI benefit rather than an unemployment benefit. Still, it is sometimes erroneously described as an unemployment benefit, as for example in *SSPTW* 1997.

⁶⁴ Paid work for more than 200 hours in a year would disqualify a recipient from receiving PEW benefits for the rest of his life (Petersen, op. cit., p.73).

⁶⁵ A similar graph appears in Pedersen in Atkinson and Mogensen, 1993, p.249.

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Table 1
Male Participation Rates in 1930, 1950 and 1990

Country	<u>Age 60-4</u>			<u>Age 65+</u>		
	1930	1950	1990	1930	1950	1990
Australia	86.6 ¹	79.8 ²	51.9	38.1 ¹	33.2 ²	9.6
Austria	...	69.9	14.1	...	18.4	2.2
Canada	...	81.4	47.6	55.7	38.6	10.3
Denmark	...	85.9	45.5	...	35.9	15.1
France	80.7	71.7 ²	21.3	61.6	36.2 ²	3.5
Germany	66.2 ¹	73.2	34.9	28.6 ¹	26.4	5.3
Ireland	60.9	...	58.4	16.8
New Zealand	...	67.5 ³	35.8	40 ⁴	25.1 ³	10.3
Norway	...	89	63	...	42.1	14.5
Sweden	82.9	79.8	63.9	49.1	36.1	10.7
Switzerland	85.3	87.9	79.6	62.5	50.7	9.2
U.K.	87.2	87.5	56.7	47.5	30.8	8
U.S.A.	86.8	79.4	55.1	58	47	18.4

Note: ¹ Data taken from 1933 censuses, ² 1954 census, ³ 1956 census, ⁴ 1926 census.

Table 2
Replacement Rates at Ages 60-4

	1930	1940	1950	1960	1970	1980	1990
Australia	0	0	0	0	0	0	0
Austria	0	0	0	0	64.5	64.5	64.5
Canada	0	0	0	0	0	0	18.3
Denmark	...	42.2	0	0	0	83	85
France	20	20	20	25	50
Germany	0	0	0	0	0	24	24
Ireland	0	0	0	0	0	0	0
New Zealand	0	66.2	56.3	57.2	60.2	74.1	49.1
Norway	0	0	0	0	0	0	0
Sweden	0	0	0	0.01	9.8	57.4	55.9
Switzerland	0	0	0	0	0	0	0
U.K.	0	0	0	0	0	0	0
U.S.A.	0	0	0	0	14.1	20.9	23.6

Replacement Rate at Ages 60 to 4 =

(Statutory Benefit for Married Couple Both Aged 60 / Average Wage for All Men) or

(Statutory Benefit for Married Couple Both Aged 65-x / Average Wage for All Men)*(x/5)

where the pension eligibility age '65-x' is between 60 and 65.

For the U.S. the average rather than the statutory benefit is used.

Table 3
Percent Implicit Tax Rates at Ages 60 to 4

	1930	1940	1950	1960	1970	1980	1990
Australia	0	0	0	0	0	0	0
Austria	0	0	0	0	43.1	43.1	43.1
Canada	0	0	0	0	0	0	2.6
Denmark	...	30.4	0	0	0	83	65.4
France	0	0	0	0	0	50	50
Germany	0	0	0	0	0	15.4	15.4
Ireland	0	0	0	0	0	0	0
New Zealand	0	66.2	56.3	57.2	60.2	0	19.9
Norway	0	0	0	0	0	0	0
Sweden	0	0	0	0	0	-12.5	-12.5
Switzerland	0	0	0	0	0	0	0
U.K.	0	0	0	0	0	0	0
U.S.A.	0	0	0	0	0.6	0.9	1

Tax Rate at ages 60-4 =

$(\text{Replacement Rate at Ages 60 to 4}) * (r+p-a) / (r+p)$

0

< 0

with a strict earnings test,

where there is no earnings test, and

when participation is subsidized.

Table 4
Summary Statistics for All Variables in 1990

Variable	Mean	Standard Deviation	Minimum	Maximum
Participation of Men 60-4	48.5	18.2	14.1	79.6
Participation of Men 65-9	17.1	8.4	3.3	31.2
Participation of Men 65 plus	10.1	4.8	2.2	18.4
Social Security Wealth	79,224	31,514	28,727	123,568
Replacement Rate at 60-4	28.5	29.3	0	85
Tax Rate at 60-4	14.4	23.8	-12.5	65.4
Replacement Rate at 65 plus	58.8	13.7	37.3	77.7
Tax Rate at 65 plus	20.5	26.3	0	72
GDP per capita	14,190	2,334	9,274	17,945
$\Delta \ln$ GDP/capita 1985-90	0.11	0.06	0.006	0.24
$\Delta \ln$ GDP/capita 1989-90	0.19	0.05	0.11	0.31
Unemployment Rate	7.07	3.71	0.5	13.7

Note: SSW and GDP/Capita are measured in 1985 US Dollars.

Table 5
Dependent Variable: Labour Force Participation of Men Aged 60-4
 (Column 7: Participation of Men 60-4 - Participation of Men 55-9).

	1	2	3	4	5	6	7
<i>Social Security</i>							
Replacement Rate at ages 60 – 4	-0.17** (-3.41)		-0.10† (-1.51)		-0.21** (-2.44)	-0.04 (-0.52)	-0.09† (-1.6)
Implicit Tax Rate at ages 60 – 4		-0.17** (-3.53)	-0.11*† (-1.72)		-0.09 (-1.41)	-0.11* (-1.76)	-0.07† (-1.3)
Benefits Paid Before 65? (0 or 1)						-3.77 (-1.19)	
Social Security Wealth (\$ '000s)				-0.06 (-0.89)	0.17** (2.03)		
<i>Controls</i>							
Unemployment	-0.21 (-0.82)	-0.13 (-0.5)	-0.19 (-0.77)	0.02 (0.05)	-0.08 (-0.28)	-0.18 (-0.71)	0.48* (-1.8)
Growth of GDP/Capita $t-5$ to t	12* (1.83)	14.7** (2.36)	11.9* (1.84)	19.5** (2.83)	9.49 (1.44)	12.7* (1.96)	3.14 (0.5)
Growth of GDP/Capita $t-10$ to t	-8.9 (-1.4)	-5.91 (-0.92)	-7.77 (-1.2)	-1.24 (-0.16)	-5.89 (-0.83)	-8.43 (-1.3)	-2.81 (-0.4)
N – k	81-24	81-24	81-25	76-24	76-26	81-26	69-25
R ²	0.92	0.92	0.93	0.91	0.93	0.93	0.91
<i>Participation Elasticities</i>							
Replacement Rate	-0.1		-0.06		-0.12	-0.02	-0.05
Net-of-Tax Wage		0.3	0.19		0.16	0.19	0.12

Note: All regressions include country and year fixed effects. T statistics are in brackets.

** Denotes coefficients significant at the 5% level, * at the 10% level.

† F statistics testing the joint contribution of replacement and tax rates to regressions 3 and 7 in each case show a contribution significant at the 1% level.

Table 6
Dependent Variable: Participation of Men Aged 60-4
OAI Effects Assuming Different Annuity Rates $r+p$

	Annuity Rate			
	4%	6%	7%	10%
Replacement Rate	-0.12* (-1.97)	-0.103 (-1.62)	-0.096 (-1.51)	-0.09 (-1.32)
Tax Rate	-0.07 (-1.16)	-0.097 (-1.58)	-0.105* (-1.72)	-0.12* (-1.93)
Elasticity w.r.t. Replacement Rate	-0.07	-0.06	-0.06	-0.05
Elasticity w.r.t. Net-of-Tax Wage	0.13	0.17	0.19	0.21

Note: Controls for unemployment and growth of GDP/Capita over the preceding five and ten years, as well as country and year effects, were also included in these regressions. T statistics are in brackets. * Denotes coefficients significant at the 10% level.

Table 7
Dependent Variable: Participation of Men 60-4

Sensitivity of Results to Growth Slowdowns

	Years ≤1970	Years ≤1970	Years ≤1970	Years ≥1970	All Years	All Years
<i>Social Security</i>						
Replacement Rate at ages 60 - 4	-0.24** (-5.51)		-0.3* (-1.87)	-0.097 (-0.99)	-0.09 (-1.37)	-0.08 (-1.3)
Implicit Tax Rate at ages 60 - 4		-0.28** (-4.94)	0.07 (0.37)	-0.01 (-0.06)	-0.09 (-1.17)	-0.004 (-0.03)
<i>Controls</i>						
Unemployment	0.11 (0.72)	0.13 (0.81)	0.1 (0.67)	-2.12** (-2.69)	-0.16 (-0.61)	-0.23 (-0.91)
Growth of GDP/Capita <i>t-5 to t</i>	4.91 (1.22)	5.74 (1.36)	4.93 (1.21)	-25.28 (-0.48)	11.64* (1.79)	12.06* (1.89)
Growth of GDP/Capita <i>t-10 to t</i>	-4.46 (-1.2)	-3.82 (-0.98)	-4.59 (-1.21)	12.87 (0.39)	-8.11 (-1.24)	-6.47 (-0.98)
Tax Rate* Unemployment					-0.01 (-0.52)	
Tax Rate* Growth of GDP/Capita <i>t-10 to t</i>						-0.56 (-0.99)
N - k	55 - 22	55 - 22	55 - 23	39 - 20	81 - 26	81 - 26
R ²	0.93	0.92	0.93	0.96	0.93	0.93

Note: All regressions include country and year fixed effects. T statistics are in brackets.
** Denotes coefficients significant at the 5% level, * at the 10% level.

Table 8
Dependent Variables: Participation of Men Aged 65-9 and 65+

	Men 65-9	Men 65-9	Men 65-9	Men 65-9	Men 65+
<i>Social Security</i>					
Replacement Rate at ages 65-9 (or 65 plus)	-0.17** (-3.29)	-0.12* (-2.1)	-0.14* (-1.74)	-0.11 (-1.3)	0.03 (0.64)
Implicit Tax Rate at ages 65-9 (or 65 plus)	-0.01 (-0.17)	-0.003 (-0.07)	-0.01 (-0.15)	0.02 (0.32)	-0.03 (-0.63)
<i>Controls</i>					
Unemployment Rate	-0.1 (-0.42)	0.25 (0.76)	-0.1 (-0.42)	0.22 (0.71)	-0.29 (-1.4)
Growth of GDP/Capita $t-5$ to t	1.27 (0.22)	0.86 (0.15)	1.07 (0.19)	7.05 (1.01)	-3.33 (-0.65)
Growth of GDP/Capita $t-10$ to t	2.13 (0.36)	1.31 (0.22)	6.73 (0.49)	5.72 (0.99)	0.7 (0.12)
Replacement Rate* Unemployment Rate		-0.01 (-1.54)			
Replacement Rate* Growth of GDP/Capita $t-10$ to t			-0.09 (-0.37)		
N – k	72 – 25	72 - 26	72 - 26	72 - 37	82 - 28
R ²	0.97	0.97	0.97	0.98	0.95
<i>Participation Elasticities</i>					
Replacement Rate	-0.59	-0.42	-0.49	-0.38	0.17
Net-of-Tax Wage	-0.04	-0.01	-0.04	0.09	0.24

Note: All regressions include year and country fixed effects. Column 2 also includes country-specific time trends. T statistics are in parentheses. ** Denotes coefficients significant at the 5% level, * at the 10% level.

Table 9: Ten-Year Changes in Male Participation Rates Across OAI Reforms

Event	Treatment Country, Age Δ LFP Δ LFP - Δ LFP (t statistic)	Control Country, Age Δ LFP	Treatment Country, Age ₂ Δ LFP ₂ Δ LFP ₂ - Δ LFP ₂ (t statistic)	Control Country, Age ₂ Δ LFP ₂	D-in-D-in-D, Δ RR, Δ Tax	D-in-D-in-D, Participation (t statistic)	Elasticity to RR, W(1- τ)
Events in which OAI Tax and Replacement Rates Changed in the Same Direction							
Denmark 1979 Eligibility age cut from 67 to 60	Denmark, 60-4 -21.4 -17.6 (-1.4)	Norway, 60-4 -3.8	Denmark, 55-9 -3.3 -4 (-1)	Norway, 55-9 0.7	Δ RR = 83 Δ Tax = 83	-13.6 (-1)	-0.23 0.05
N. Zealand 1938 Eligibility age cut from 65 to 60	NZ, 60-4 -13.4 -6.7 (-0.7)	Australia, 60-4 -6.7	NZ, 55-9 -5.1 -3.8 (-1.4)	Australia, 55-9 -2.3	Δ RR = 66.2 Δ Tax = 66.2	-2.9 (-0.3)	-0.03 0.02
France 1983 Benefits up at 60-4, earnings-test introduced.	France, 60-4 -17.8 0 (0)	UK, 60-4 -17.8	France, 55-9 -7.3 4.4 (-1.1)	UK, 55-9 -11.7	Δ RR = 25 Δ Tax = 50	-4.4 (-0.3)	-0.13 0.07
Austria 1961-6 Eligibility age cut from 65 to 60	Austria, 60-4 -21.1 -23.5** (-2.8)	W.Ger, 60-4 +2.4	Austria, 55-9 -3.2 -3.7 (-1.2)	W.Ger, 55-9 0.5	Δ RR = 64.5 Δ Tax = 43.1	-19.8** (-2.2)	-0.3 0.4
W. Germany 1973 Eligibility age cut from 65 to 63	W.Ger, 60-4 -30.5 -25.9** (-2.1)	Switz, 60-4 -4.6	W.Ger, 55-9 -5.7 -4.4 (-1.1)	Switz, 55-9 -1.3	Δ RR = 24 Δ Tax = 15.4	-21.5 (-1.7)	-0.29 1.58

N. Zealand 1991-7 Eligibility age up from 60 to 63	NZ, 60-4 +14.7	Australia, 60-4 -6.2 20.9** (2.3)	NZ, 55-9 +3	Australia, 55-9 -1.2 4.2 (0.6)	Δ RR = -35.6 Δ Tax = -13	16.7 (1.5)	-0.26 3.28
Events Suggesting OAI Taxes are More Important than Replacement Rates							
Sweden 1976 Eligibility age cut from 63 to 60	Swe, 60-4 -10.7	UK, 60-4 -12 1.3 (0.1)	Swe, 55-9 -4.5	UK, 55-9 -3.7 -0.8 (-0.2)	Δ RR = 47.6 Δ Tax = -12.5	2.1 (0.2)	0.03 0.25
USA 1961 Eligibility age cut from 65 to 62	US, 60-4 -4.6	Canada, 60-4 -1.7 -2.9 (-0.3)	US, 55-9 -0.9	Canada, 55-9 -1.8 0.9 (0.1)	Δ RR = 14.1 Δ Tax = 0.6	-3.8 (-0.3)	-0.04 8.11
Canada 1984-7 Eligibility age cut from 65 to 60	Canada, 60-4 -21.2	US, 60-4 -5.3 -15.9* (-1.9)	Canada, 55-9 -6.1	US, 55-9 -1.9 -4.2 (-1.3)	Δ RR = 18.4 Δ Tax = 2.6	-11.7 (-1.3)	-0.17 6.37
Events Suggesting OAI Replacement Rates are More Important than OAI Taxes							
New Zealand 1977 Earnings test dropped, benefits increased.	NZ, 60-4 -22.5	Australia, 60-4 -22.5 0 (0)	NZ, 55-9 -3.2	Australia, 55-9 -7.1 3.9 (1)	Δ RR = 13.9 Δ Tax = -60	-3.9 (-0.3)	-0.3 -0.09
Ireland 1973-7 Eligibility age cut from 70 to 65	Ireland, 65-9 -27.4	UK, 65-9 -13.4 -14 (-1.6)	Ireland, 60-4 -14.5	UK, 60-4 -12 -2.5 (-0.2)	Δ RR = 35.8 Δ Tax = 4.4	-11.5 (-0.8)	-0.18 3.91
Note: T statistics are in parentheses; * denotes significance at the 5% level.							

Table 10
Tests for Endogeneity with Annual Data, Men Aged 60-4

Dependent Variable:	Legislated Tax Rate	Participation Rate
Participation Rate (<i>t-1</i>)	0.17 (0.79)	1.1** (14.08)
Participation Rate (<i>t-2</i>)	-0.11 (-0.52)	-0.23** (-2.88)
Legislated Tax Rate for Year <i>t+10</i> (<i>t-1</i>)	0.84** (12.37)	
Legislated Tax Rate for Year <i>t+10</i> (<i>t-2</i>)	-0.01 (-0.19)	
Tax Rate <i>t-1</i>		0.01 (0.54)
Tax Rate <i>t-2</i>		-0.04 (-1.41)
Country Effects	Yes	Yes
Year Effects	Yes	Yes
N - k	268 - 57	268 - 57
R ²	0.94	0.99
F statistic	F(2,211) = 0.4	F(2,211) = 2.08
Lagged X Predicts?	No	No

Note: t statistics are in parentheses. ** Denotes t statistics significant at the 5% level.
The 5% critical value of F(2,∞) is 3.

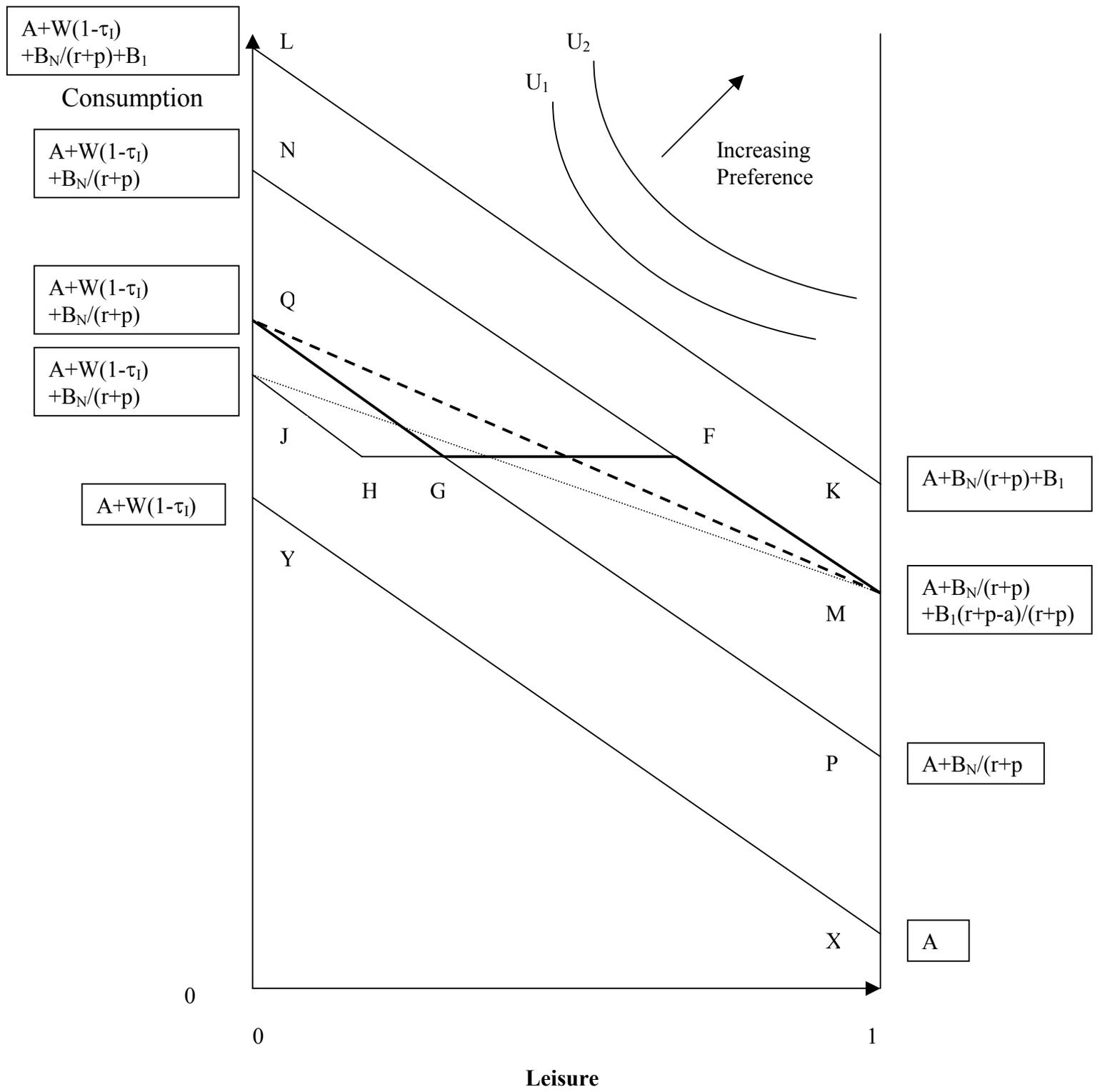


Figure 1: The Worker's Trade-Off Between Consumption and Leisure, Showing Effects of Different OAI Rules.

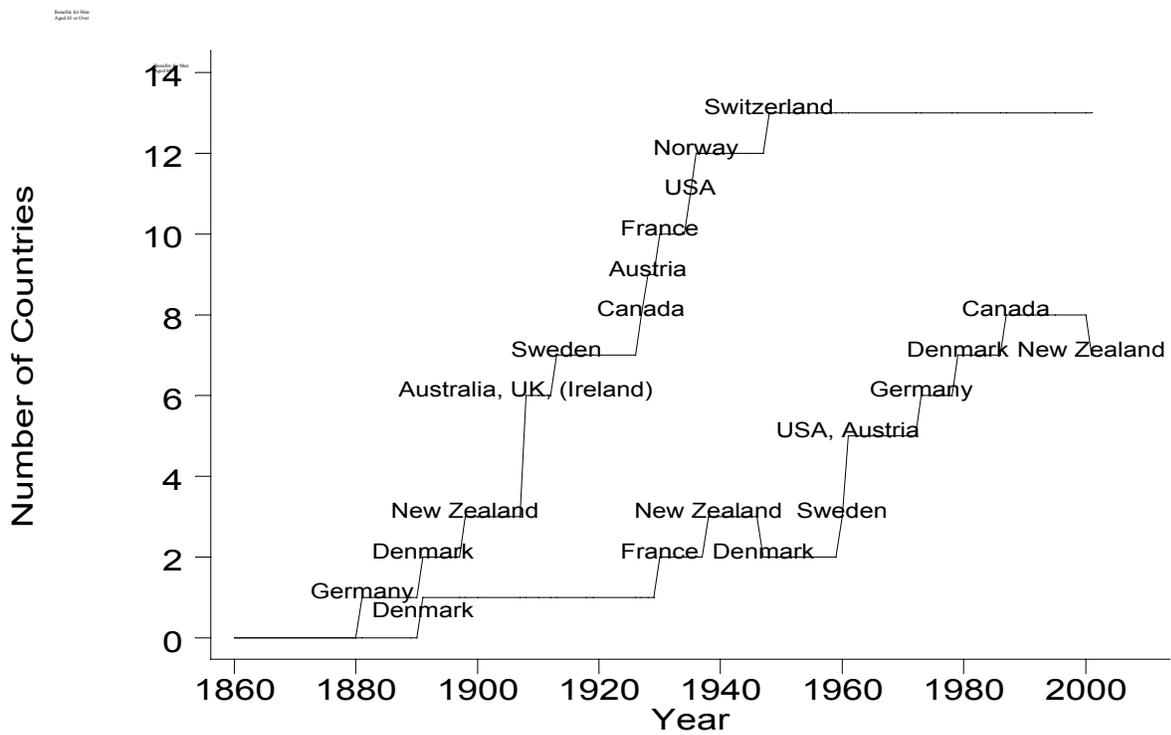


Figure 2 Countries with OAI Benefits for Men at Ages 65 or above (upper line) or Ages between 60 and 64 (lower line).

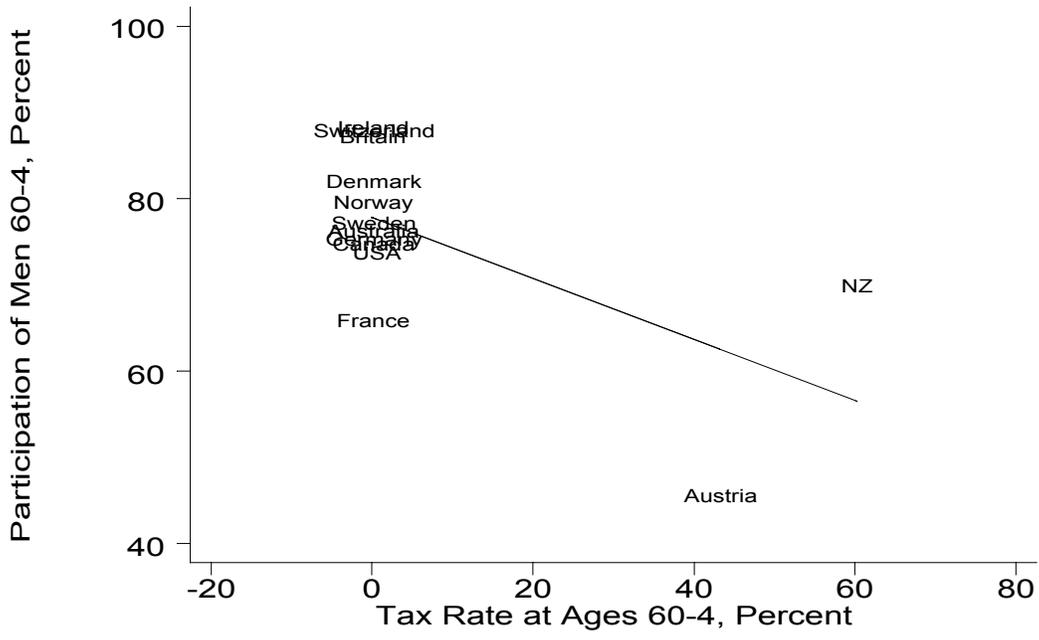


Figure 3: 1970

Cross-Section of Participation and Tax Rates for Men Aged 60-4.

(Slope coefficient = -0.35, $t_{11} = 2.6$, Elasticity to Net-of-Tax Wage = 0.62).

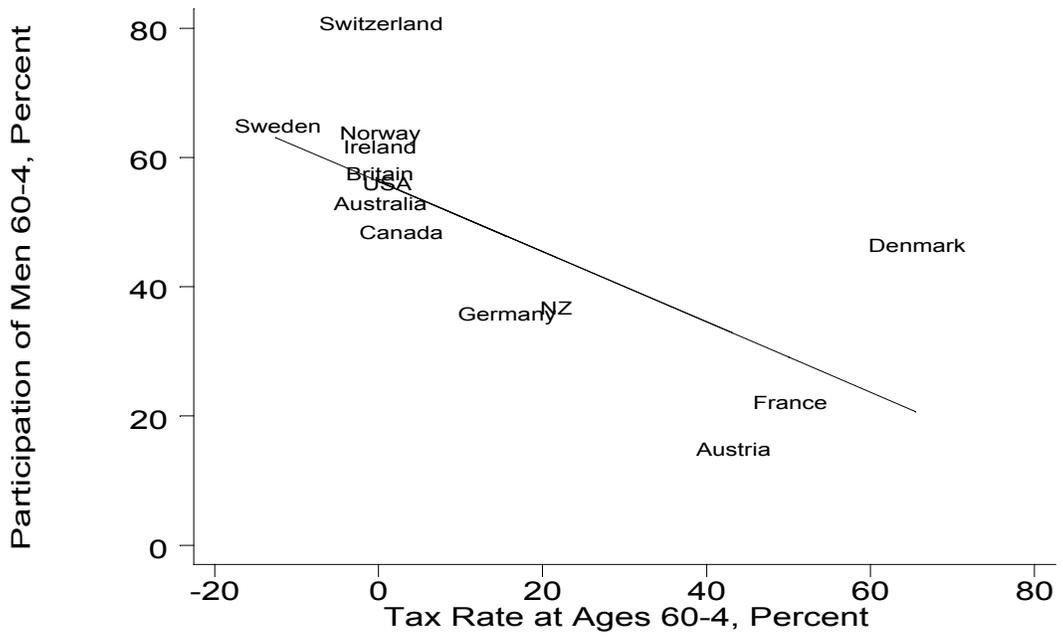


Figure 4: 1990

Cross-Section of Participation and Tax Rates for Men aged 60-4.

(Slope coefficient = -0.54, $t_{11} = -3.4$, Elasticity to Net-of-Tax Wage = 0.96).

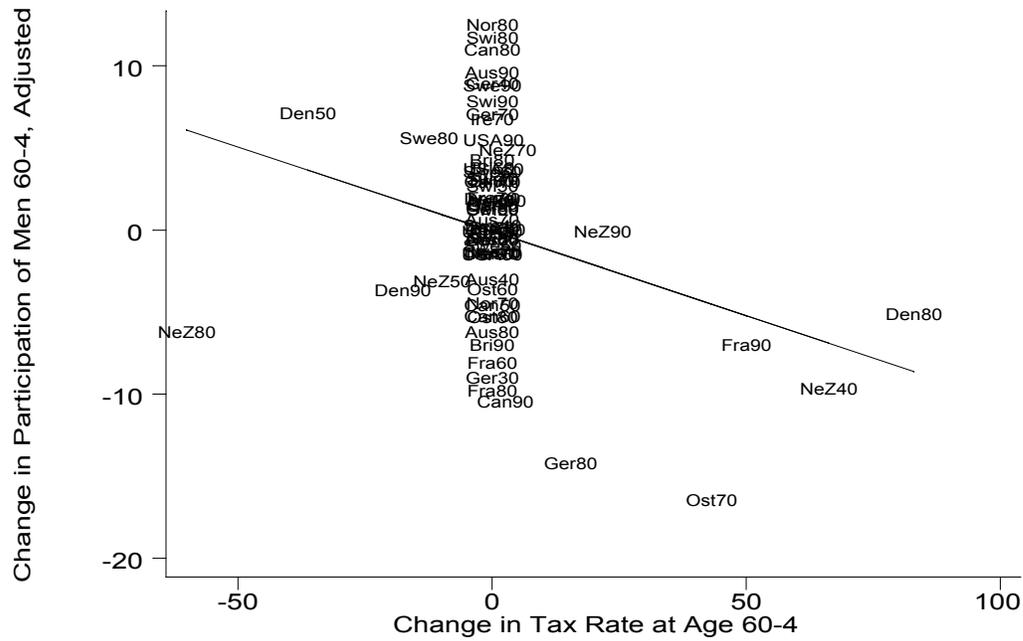


Figure 5: Men Aged 60-4 Decennial Changes in Participation and Tax Rates For All Countries and Years.

Participation changes are adjusted for year effects. ‘Aus’ refers to Australia, ‘Ost’ to Austria.

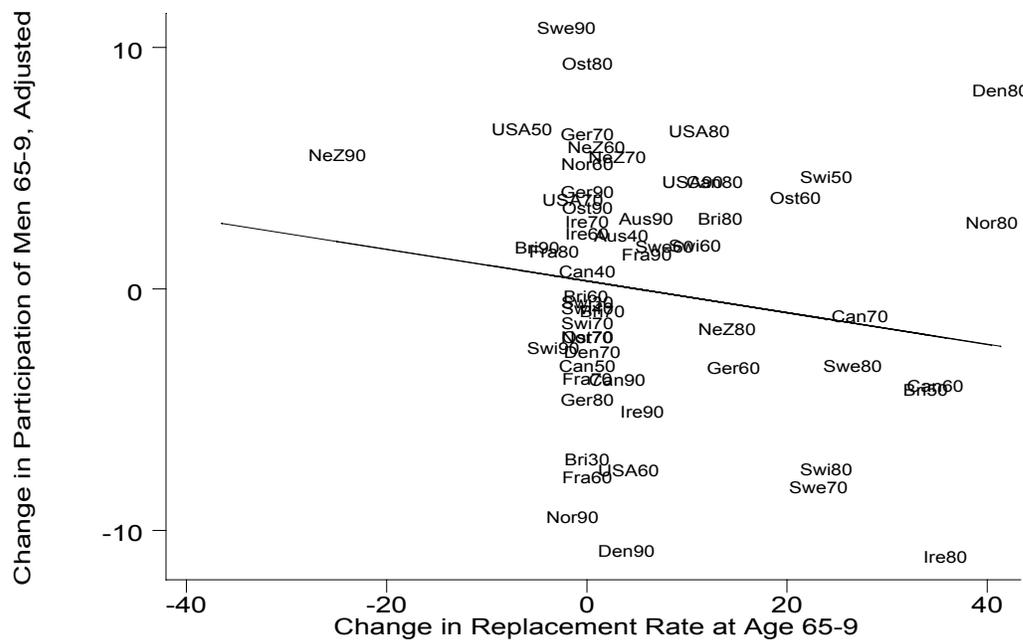


Figure 6: Men Aged 65 to 9 Decennial Changes in Participation and in Replacement Rates for All Countries and Years.

Participation changes are adjusted for year effects.

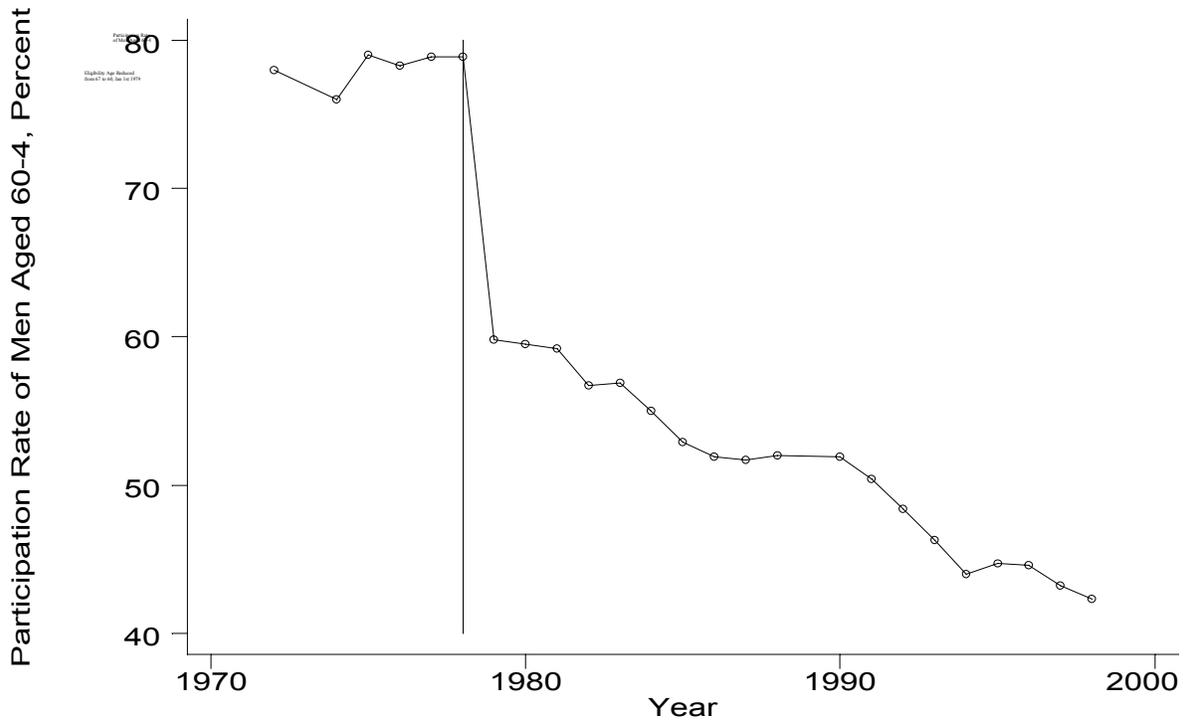


Figure 7: Denmark Participation of Men 60-4 and Date of Extension of Pension Benefits from Men Aged 67 to Men Aged 60 and above.

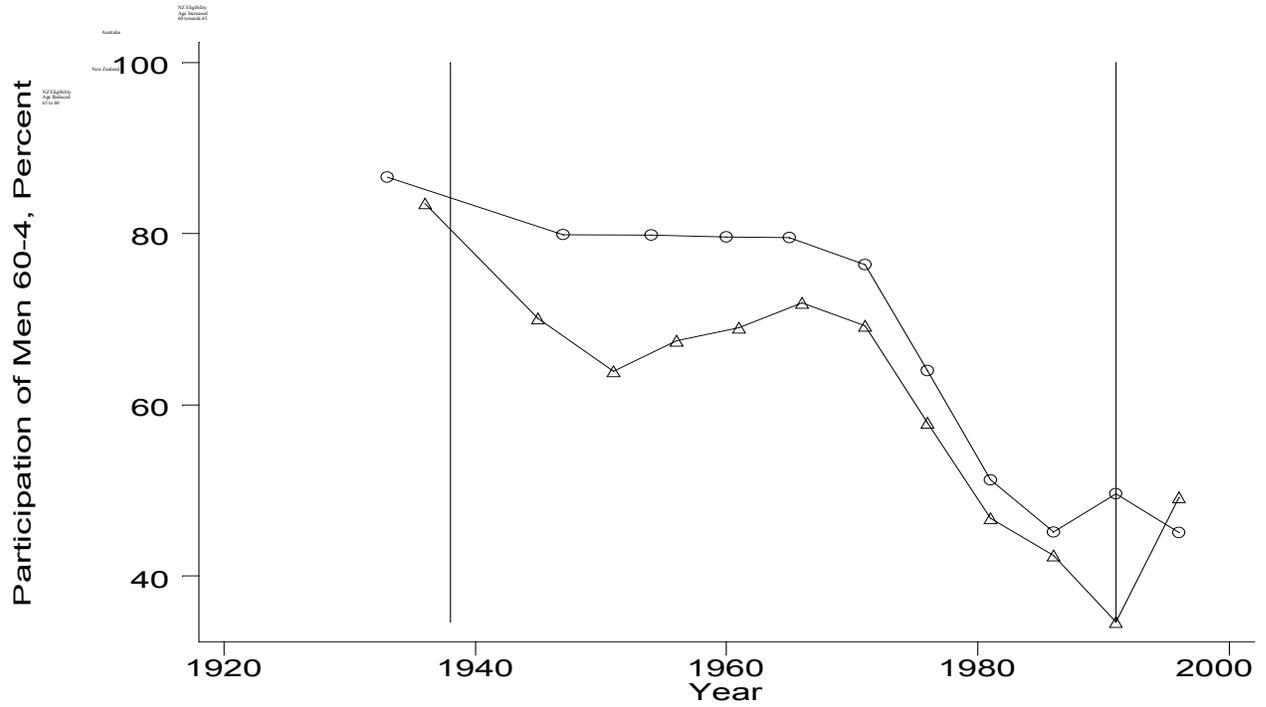


Figure 8: Australia and New Zealand Participation Rates of Men 60-4 with dates of New Zealand Extension (1938) and Withdrawal (1991-) of Benefits to Men Aged 60.

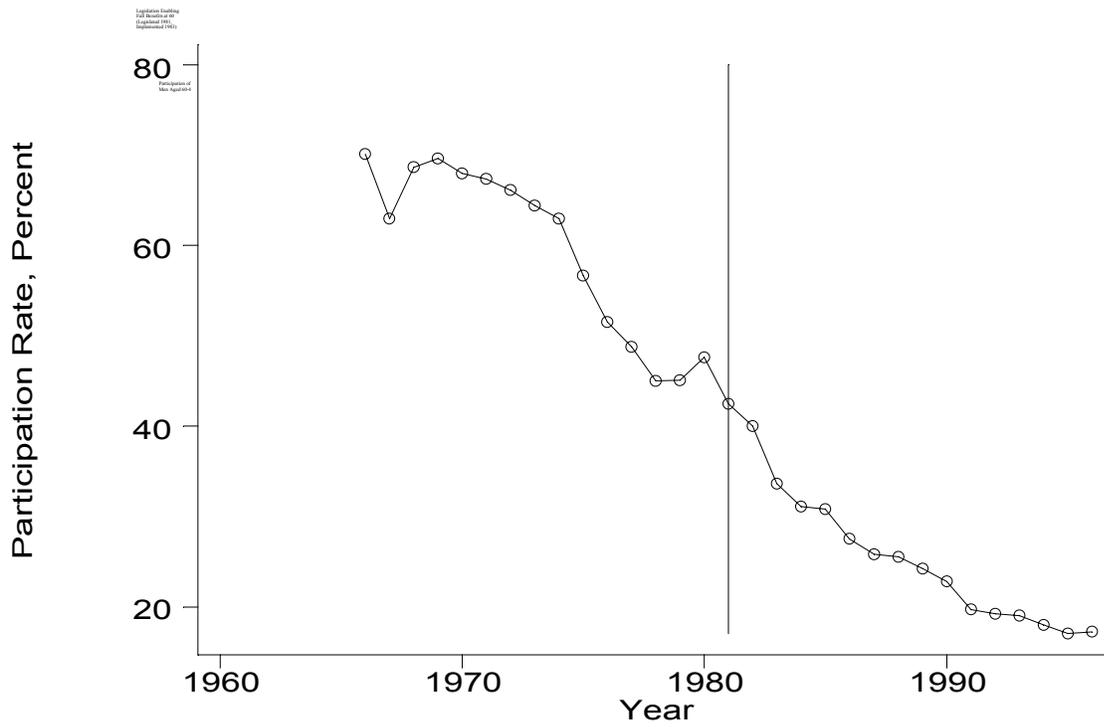


Figure 9: France Participation Rate of Men 60-4 and Legislation allowing Retirement at 60 on Full Benefits (1981). This law came into effect in 1983.

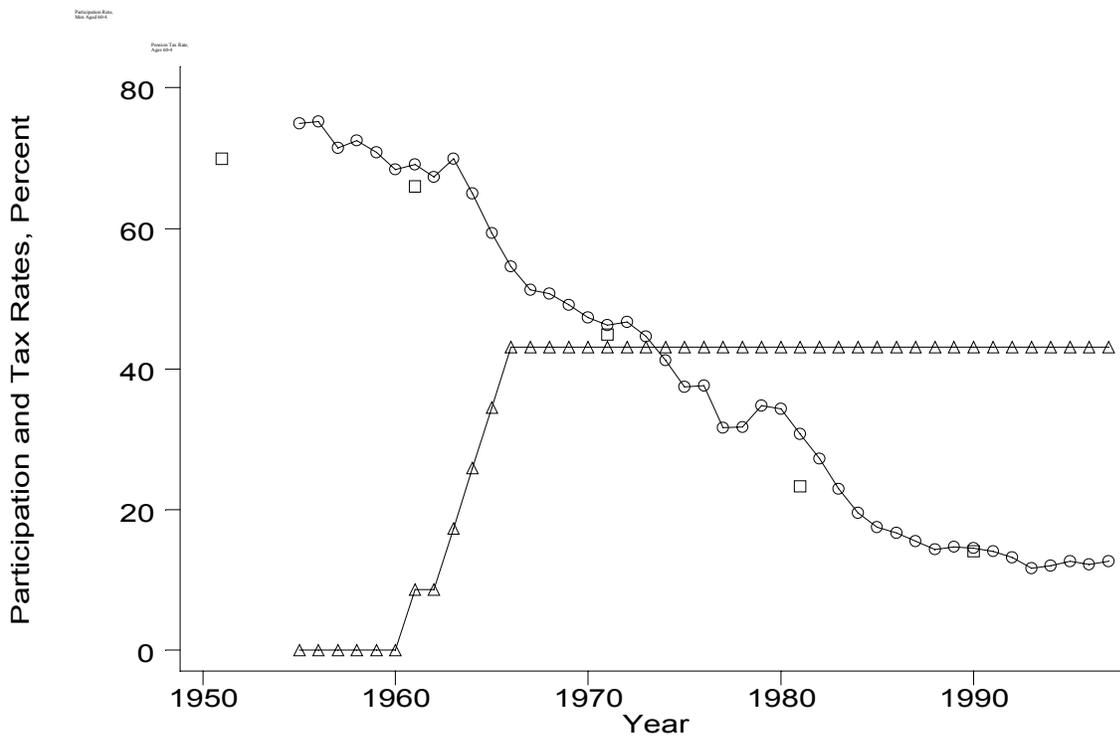


Figure 10: Austria Participation of Men 60-4 and Tax Rate in the 60-4 Age Group.
(Squares: Census participation rate.)

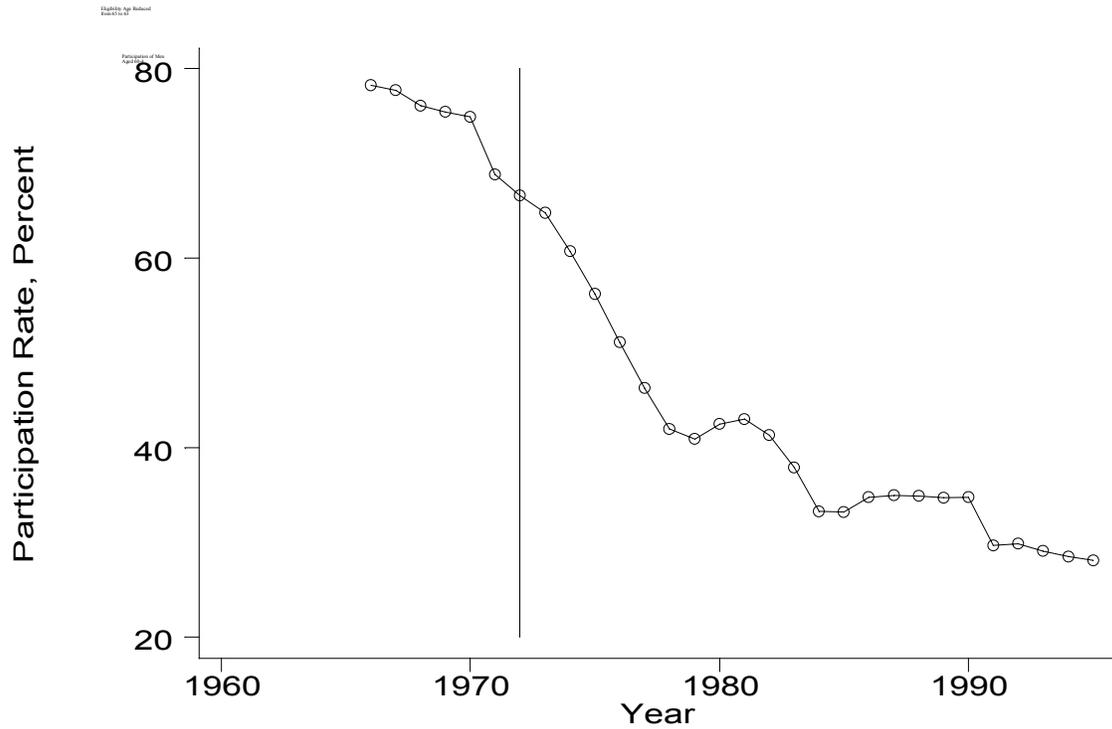


Figure 11: Germany

Participation Rate of Men Aged 60-4 and date of Benefit Extension from Men 65 and above to Men 63 and above.

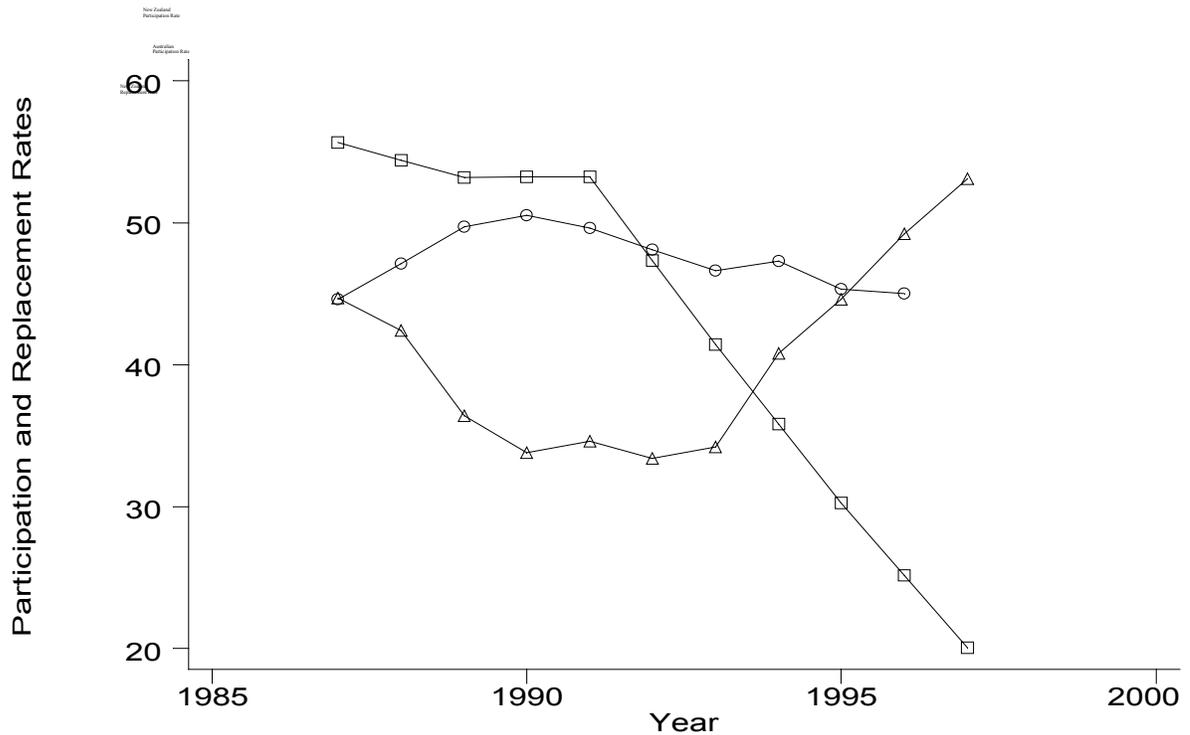


Figure 12: Australia and New Zealand

Participation of Men 60-4 and Replacement Rate for Men in this Age Group.

The replacement rate in Australia at ages 60-4 was zero throughout this period.

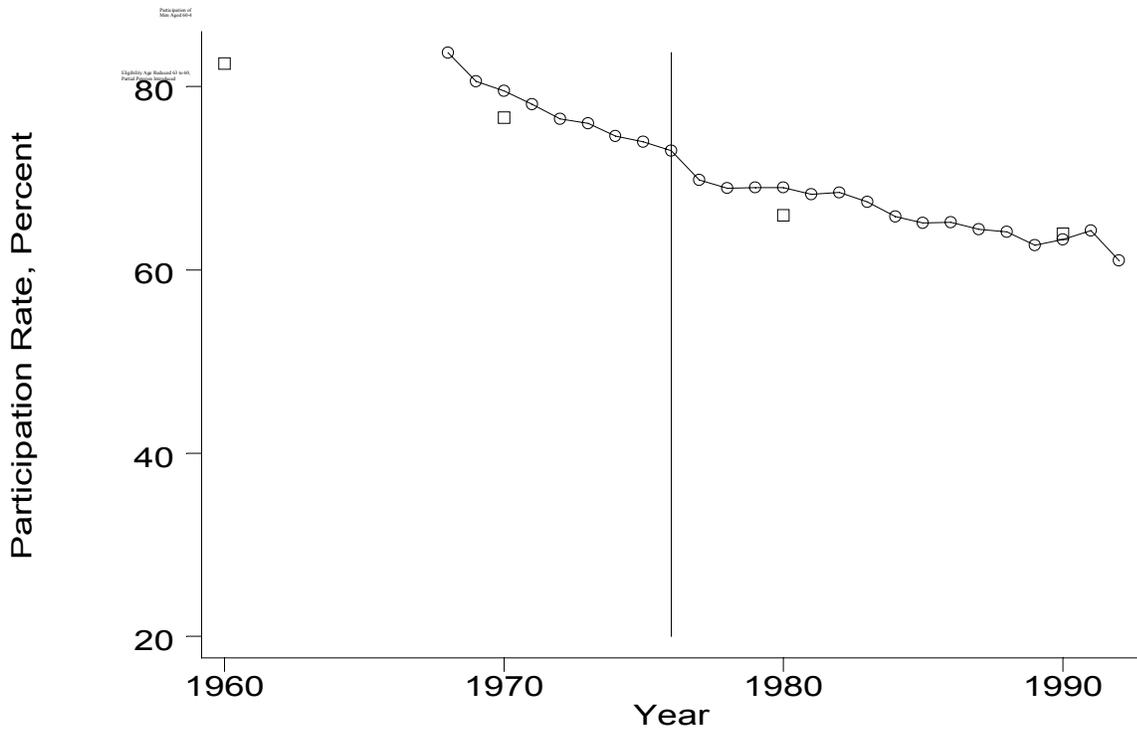


Figure 13: Sweden Participation of Men 60-4 and Reduction in Eligibility Age from 63 to 60.
 (Circles: Annual Data Squares: Census Data).

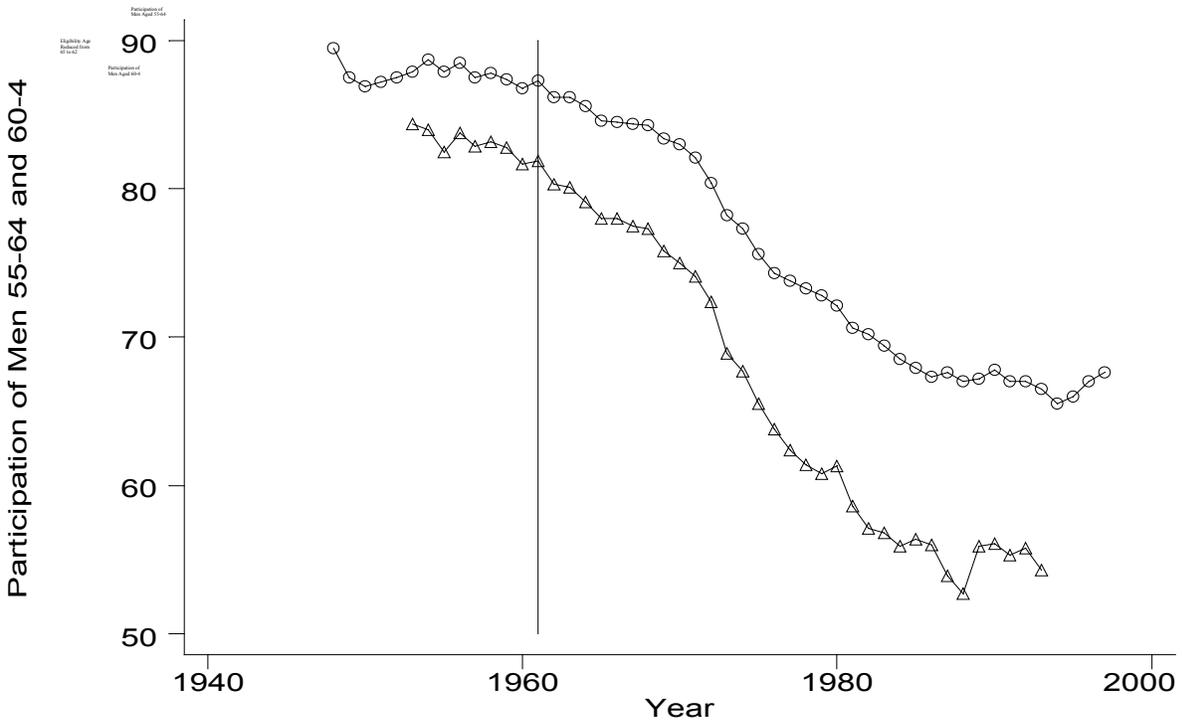


Figure 14: USA Participation Rates of Men 55-64 and of Men 60-4, showing Date of Introduction of OAI Benefits at Age 62 (1961).

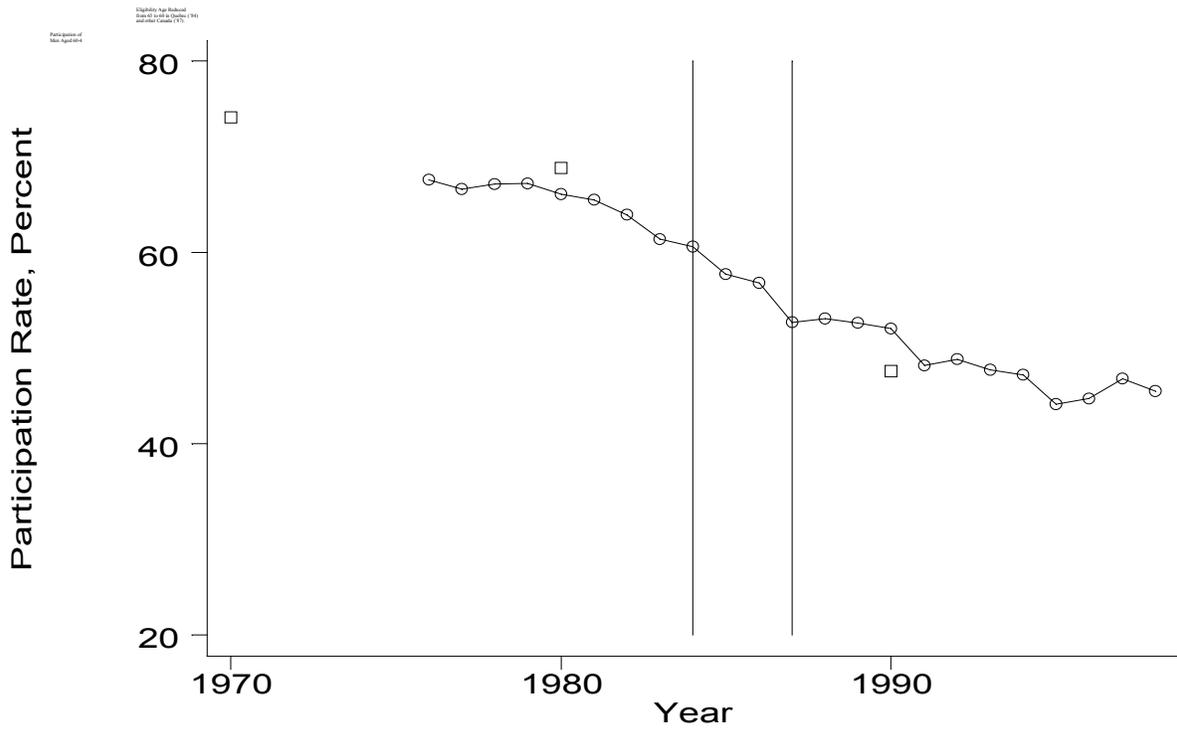


Figure 15: Canada Participation of Men 60-4 and Reduction of Eligibility Age to 60 in Quebec (1984) and the rest of Canada (1987). (Squares denote Census participation rates.)

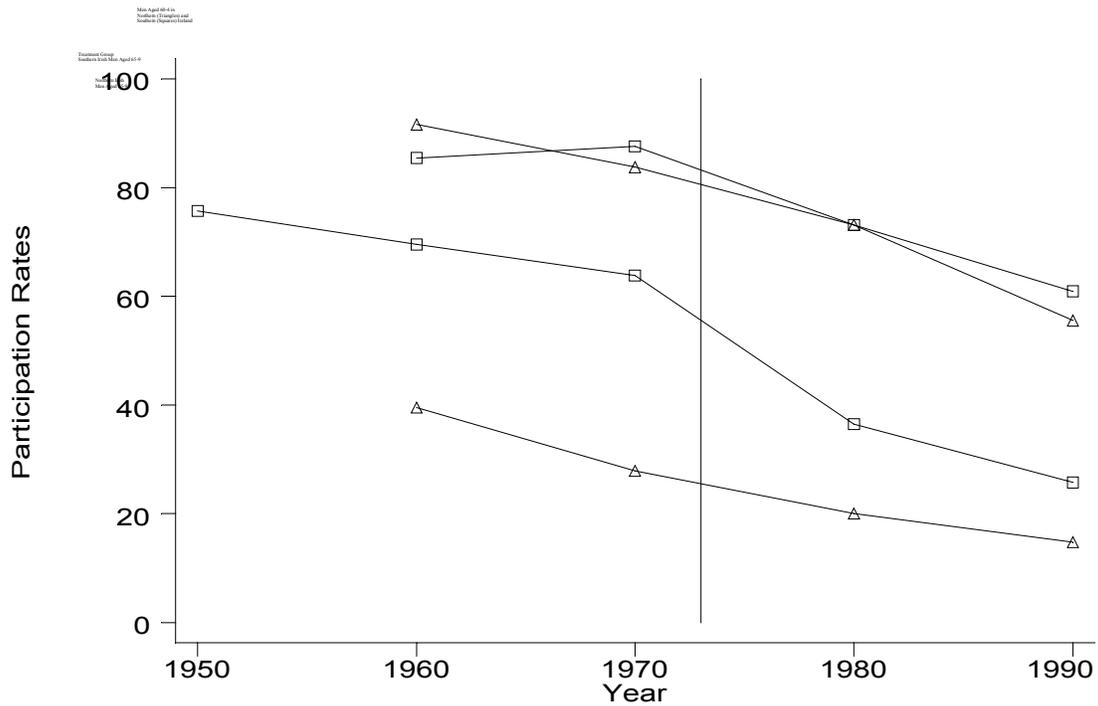


Figure 16 Participation of Men 60-4 and 65-9 in the Republic of Ireland and Northern Ireland (U.K.).

Pensions were extended to men 65-9 in Ireland in 1973-8; the eligibility age has remained 60-4 in the U.K. since 1946.