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RETIREMENT BEHAVIOUR IN OECD COUNTRIES: IMPACT OF OLD-AGE PENSION SCHEMES AND OTHER SOCIAL TRANSFER PROGRAMMES

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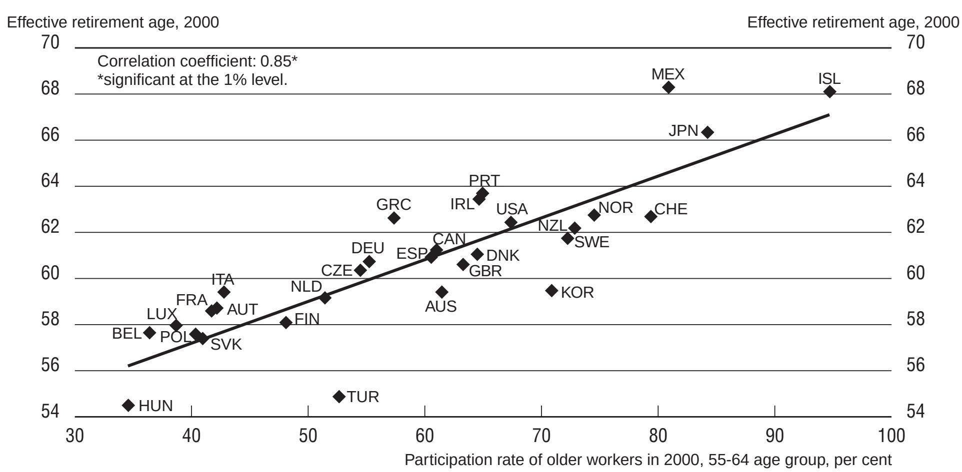
INTRODUCTION

Increasing the labour force participation and employment of older workers, not least by raising average effective retirement ages (Figure 1),[1] could ease the adjustment to ageing populations by curbing the rise in age-related spending while at the same time generating higher tax revenues to finance it.[2] It has also been argued that higher participation rates of older workers would be welfare-enhancing in many OECD countries, on both theoretical (Box 1) and empirical grounds. Even though they have stabilised or slightly increased in some cases over the recent years, effective retirement ages have declined trend-wise in most countries, and cross-country differences have widened (Burniaux *et al.*, 2003). These trends may be accounted for by a broad range of factors. Some of these directly reduce labour supply, such as wealth effects associated with rising living standards, increased demand for leisure, and policies that distort retirement

Figure 1. **Labour force participation of older workers and effective retirement age in 2000**

Men



Source: *Labour Force Statistics* (Part III) and Burniaux *et al.* (2003).

Box 1. **The gains from moving towards actuarially neutral pension systems**

Beyond the need to ensure the long-run financial viability of old-age pension systems, economic theory suggests under the most general conditions that moving towards more actuarial neutrality would improve welfare (see for instance Blanchet *et al.*, 1996).[1] Indeed, since retirement benefits must be financed through taxes, early labour market withdrawal comes at the expense of living standards over the life cycle. Actuarially non-neutral retirement schemes tend to bias the retirement decision towards excessive leisure and insufficient consumption, thereby reducing welfare.

They also raise other concerns which go beyond the scope of this paper. In particular, the design of most current Pay-As-You-Go (PAYG) schemes is not well-adapted to ongoing socioeconomic changes, such as increasing female labour force participation – ceilings and tapers for joint pensions exist in many countries – the rise in atypical forms of employment or the need for lifelong learning and labour mobility across countries (especially in Europe: Holzmann *et al.*, 2003). Stricter contribution-benefit relationships at the individual – rather than couple – level would be a step towards solving these issues.

One argument sometimes raised against actuarially neutral pension systems is the fact that they prevent any redistribution of income within generations,[2] which was a secondary goal of Pay-As-You-Go (PAYG) schemes at the time of their creation. However, existing PAYG systems do not generally redistribute income from high-wage to low-wage earners, mainly because higher replacement rates offered to the latter do not, in practice, compensate for their significantly lower life expectancy (Lindbeck and Persson, 2003). Furthermore, to a certain extent an actuarially neutral system can always be complemented by transfers aimed at redistributing income towards workers with low-wage histories and/or incomplete careers.

1. Moving to exact actuarial neutrality (*ex ante*) for all individuals would, however, prove difficult in practice. The main reason is that life expectancy differs across various population groups (males and females, blue collar and white collar workers…).
2. They may even be anti-redistributive if the existing difference in life expectancy between high and low-income earners is not taken into account in the pension benefit formula.

incentives, including through the design of welfare systems. Other factors affect supply indirectly *via* reduced labour demand, such as: *i*) declining relative productivity and wages of low-skilled older workers in times of rapid technological change (Perrachi and Welch, 1994; Lee, 2003); *ii*) limited training, leading to low earnings capacity; and, *iii*) temporary negative demand shocks leading to irreversible labour force withdrawal. Rigid age-earnings profiles, supported by specific institutional arrangements (*e.g.* high minimum wage, stringent employment protection legislation, high replacement income) affect supply directly but also reduce labour demand with indirect repercussions on supply. Some of these influences interact with each other. For instance, rigid age-earnings profiles may provide insufficient incentives to engage in training to improve skills.

This paper examines the impact of early retirement incentives embedded in pension systems and other social transfer programmes on the labour force participation of older workers. This relatively narrow focus on social protection systems is adopted for various reasons. First, in reasonably well-functioning labour and product markets, supply-side factors are major long-run determinants of labour force participation, even though in practice market imperfections also assign an influential role to demand-side factors. In this paper, a range of labour-market policies and regulations, such as tax wedges, minimum wages, employment protection legislation or active labour market policies, are indirectly taken into account to the extent that they affect labour force participation indirectly *via* their impact on unemployment ("discouraged worker" effect) but not explicitly explored.[3] Second, reducing early retirement incentives may to a certain extent contribute to easing labour demand constraints, for example by lengthening the pay-back period for investment in training. They may also reduce the risk that temporary negative demand shocks induce some older workers to withdraw irreversibly from the labour market, thereby leading to permanent labour supply effects. Third, other supply-side factors, such as living standards and/or demand for leisure, cannot plausibly account for the large differences in effective retirement ages observed in the OECD area, and even less so for the fact that these differences have widened over time.[4] This hints at a significant impact of retirement incentives embedded in social systems. Finally, adjusting these systems to better cope with ageing populations is a main policy target in OECD countries and is the main instrument available for policymakers to raise labour force participation of older workers.

This paper aims to combine the respective strengths of the two main existing macroeconometric studies of the retirement decision, namely Blöndal and Scarpetta (1998) and Johnson (2000). For this purpose, a new, very detailed panel dataset of retirement incentives is constructed. As in Johnson (2000), separate analysis is undertaken for the 55-59, 60-64 and 65+ age groups, while only the aggregate 55-64 age group was studied in Blöndal and Scarpetta (1998). The calculation of retirement incentives for these age groups also takes proper account of possibilities to combine work with the receipt of a reduced or full pension, which tend to reduce implicit taxes on continued work embedded in retirement schemes. As in Blöndal and Scarpetta (1998), and in contrast with Johnson (2000), social transfer programmes that have often been used as pathways into early retirement in a number of countries are explicitly covered. Overall, the more detailed information used in this paper should *a priori* allow richer analysis and improve the macroeconometric estimates of labour supply effects of retirement incentives.

The remainder of this paper is organised as follows. The next section assesses early retirement incentives embedded in pension schemes and other welfare systems such as unemployment, disability or special early retirement benefits that have been used as pathways into early retirement across countries and their evolution over time. The following sections, respectively: present cross-country econometric evidence about the overall impact of these schemes on the retirement decision; provide more in-depth econometric analysis, based on panel data estimates; use these econometric results to simulate the potential labour supply impact of a comprehensive set of policy reforms that could be implemented in OECD countries; discuss policy options to reduce early retirement incentives; and conclude.

EARLY RETIREMENT INCENTIVES EMBEDDED IN OLD-AGE PENSION SYSTEMS AND OTHER SOCIAL TRANSFER PROGRAMMES

Three main characteristics of old-age pension systems affect the retirement decision of older male workers. First, higher pension benefits make retirement affordable (income effect). Second, implicit marginal taxes on continuing to work tend to deter workers from remaining in the labour market ("substitution" effect). Third, even though a person could in theory borrow to finance retirement before the age of entitlement to pension benefits, this does not occur frequently in practice, for a variety of reasons. As a result, standard and early ages of eligibility to benefits also affect the retirement decision. In the following, these different parameters of pension systems are described.

Standard and early ages of entitlement to old-age pension benefits

In theory, the age of eligibility to a pension should not necessarily affect the actual age of retirement. The reason is that rational forward-looking individuals could always set their retirement age at the optimal level chosen to maximise their welfare, by trading off between consumption and leisure/retirement over their life cycle. They could borrow in capital markets if they wanted to retire before they can draw a pension, and conversely they could continue working and saving if they wanted to retire after the official age of retirement. With such behaviour the actual retirement age would be determined only by the level of pension wealth and its change or the implicit tax on continued work (see below).

However, there is evidence that actual retirement decisions do not conform to standard life-cycle models, at least on this specific point, as these cannot explain why many workers actually retire at early and standard ages (Gruber and Wise, 2002). At least four factors may account for this empirical regularity: *i*) some individuals are "liquidity constrained", which makes them unable to borrow in order to retire before pension benefits are available; *ii*) custom or accepted practice induces people to retire at "customary" ages (Lumsdaine *et al.*, 1996); *iii*) workers are myopic or information constrained, *i.e.* they do not assess accurately actuarial incentives/disincentives to continued work embedded in pension systems and thus tend to retire at the earliest age at which benefits become available; and, in some cases, *iv*) individuals may not be allowed to continue working after the standard retirement age.

The standard age of eligibility to pension benefits differs substantially across OECD countries (Table 1). It is currently set at 65 years in most of them, but ranges for males from a low of 60 in a few countries (France, Korea, Slovak Republic and Turkey) to a high of 67 in Iceland and Norway (and is gradually being raised to that age in the United States). There is somewhat wider cross-country variance in standard ages for females because some countries still keep it lower than for males, even though gradual convergence towards male levels has already started in most of them, or is scheduled to do so in the future. There are even greater cross-country differences in early eligibility ages, but interpreting their impact on actual retirement is not straightforward because pension penalties for early withdrawal also differ considerably.

In the majority of OECD countries, standard and – to a lesser extent – early retirement ages have remained constant since the late 1960s. In those countries where changes have occurred, a general pattern emerges of reductions in the 1970s-1980s, followed by few increases since the beginning of the 1990s. In New Zealand, the rapid transition from 60 to 65 in the standard retirement age during the 1990s was accompanied by an increase in the labour force participation of the 55-64 age group by over 15 percentage points – a larger rise than in any other OECD country over the past three decades.

Replacement rates and pension wealth levels

In theory, and under certain conditions, the level of public pensions should have no direct effect on labour participation. For example, if contributions to an earnings-related pension system were perceived as savings, pension benefits were equal to the amount of contributions paid (in present value terms), and the interest rate was equal to the rate of growth of total wages,[5] then pension systems should have no effect on labour supply and lifetime consumption (Aaron, 1982, Chapter 2; Disney, 1996, Chapter 7).[6] Indeed, such a scheme would simply reduce personal saving during working life by the amount of contributions paid, *i.e.* the savings rate would be low if contributions and replacement rates were high, and *vice versa*.[7]

Table 1. **Standard and early ages of entitlement to old-age pension benefits**

	Males								Females			
	Early				Standard age				Standard age			
	1969	1979	1989	2003	1969	1979	1989	2003	1969	1979	1989	2003
Australia	65	65	65	55	65	65	65	65	60	60	60	62.5
Austria	65	65	65	65	65	65	65	65	60	60	60	60
Belgium	60	60	60	60	65	65	65	65	60	60	60	63
Canada	66	65	60	60	66	65	65	65	66	65	65	65
Czech Republic	..	..	..	58.5	..	..	..	61.5	..	..	..	59.5
Denmark	67	67	67	65	67	67	67	65	67	67	67	65
Finland	65	65	60	62	65	65	65	65	65	65	65	65
France	60	60	60	60	65	65	60	60	65	65	60	60
Germany	65	63	63	63	65	65	65	65	65	65	65	65
Greece	60	60	60	60	60	60	65	65	55	55	60	65
Hungary	..	..	60	62	..	..	60	62	..	..	55	62
Iceland	67	67	67	65	67	67	67	67	..	..	..	67
Ireland	70	65	65	65	70	66	66	66	70	66	66	66
Italy	55	55	55	57	60	60	60	65	55	55	55	65
Japan	60	60	60	60	65	65	65	65	65	65	65	65
Korea	..	..	60	55	..	..	60	60	..	..	60	60
Luxembourg	62	62	60	60	65	65	65	65	62	60	65	65
Mexico	..	65	65	65	..	65	65	65	..	65	65	65
Netherlands	65	62	60	60	65	65	65	65	65	65	65	65
Norway	70	67	67	67	70	67	67	67	70	67	67	67
New Zealand	60	60	60	65	65	60	60	65	65	60	60	65
Poland	..	..	..	65	..	..	..	65	..	..	..	60
Portugal	65	65	65	55	65	65	65	65	65	62	62	65
Slovak Republic	..	..	..	60	..	..	..	60	..	..	..	57
Spain	65	60	60	60	65	65	65	65	55	65	65	65
Sweden	63	60	60	61	67	65	65	65	67	65	65	65
Switzerland	65	65	65	63	65	65	65	65	62	62	62	63
Turkey	60	55	55	60	65	55	55	60	55	50	50	55
United Kingdom	65	65	65	65	65	65	65	65	60	60	60	60
United States	62	62	62	62	65	65	65	65	65	65	65	65

Notes:

Australia: minimum retirement age (i.e. at which superannuation savings can be drawn) will increase to 60 over the period 2015-2025. Standard age for women to be increased from age 62.5 to age 65 between 2003 and 2013.

Austria: early age of eligibility does not incorporate special early retirement for long insurance years, which will be progressively phased out (following the 2003 reform) but could still be accessed from age 61.5 in 2003 (60 in 1969, 1979 and 1989). Standard age for women to be increased from age 60 to age 65 between 2024 and 2033.

Belgium: standard age for women scheduled to rise to age 65 by 2009.

Czech Republic: standard and minimum retirement ages are scheduled to rise gradually to reach age 62 for men and age 61 for women (with no children) in 2007.

Greece: standard age is 62 for men and 57 for women who first started to work before 1992.

Iceland: early retirement age in 2003 is still 67 for the basic pension. However most occupational pension schemes, which are progressively maturing, set the minimum retirement age at 65.

Italy: minimum retirement age is the minimum age of eligibility to a seniority pension, also equal to the minimum retirement age in the new pension system. Standard age is 60 (instead of 65) for women who first started to work before 1996.

Korea: standard age scheduled to rise from age 60 to age 65 between 2011 and 2033.

Table 1. **Standard and early ages of entitlement to old-age pension benefits** (*cont.*)

Luxembourg: early age of eligibility does not incorporate the special early retirement scheme ("pré-retraite"), which can be accessed from age 57 with 40 years of contribution.
Norway: early age of eligibility does not incorporate the special early retirement (AFP) scheme, which can be accessed from age 62 in 2003.
Poland: standard age is 55 for women with 30 years of insurance.
Slovak Republic: standard age for women varies between 53 and 57 according to number of children raised.
Switzerland: standard age for women will be 64 in 2005.
Turkey: standard age is 55 for men and 50 for women who first started to work before 1990.
United Kingdom: standard age for women will rise from age 60 to age 65 over 2010-2020 period.
United States: standard age for both men and women scheduled to rise to age 67 over 2000-2022 period.
Source: US Department of Health and Human Services, *Social Security Programs Throughout the World*, various issues.

In practice, however, redistributive elements in schemes, changes in scheme provisions, as well as demographic changes, lack of information and short time horizons, imply that public pension systems affect the distribution of income and wealth both across and within generations, thereby creating "wealth effects" on the retirement decision (Disney, 1996). Indeed, the future stream of benefits to which older workers are entitled can be regarded as a component of their total wealth, which is often called "pension wealth". Hence, the introduction of a PAYG system, or an unexpected[8] rise in the level of pension benefits not exactly offset by an increase in their contributions, raises the net pension wealth of older workers. This stimulates their demand for both consumption and leisure, thereby pushing them to retire earlier.[9] This negative effect on labour participation then fades over time as new cohorts of older workers, unaffected (or even negatively affected) by this inter-generational redistribution, replace older ones.[10]

The most straightforward indicator of the generosity of pension benefits is the replacement rate, which corresponds to the ratio of annual benefits to earnings just prior to retirement.[11] However, there is no obvious method to compute this indicator because its level varies depending on a large number of factors.[12] For the purpose of this paper, replacement rates have been constructed for illustrative cases under a set of common simplifying assumptions (Box 2). They are defined here as average *expected* replacement rates over a future five-year period, and are computed at ages 55, 60 and 65 for 22 OECD countries.[13] In order to make the calculations manageable for a wide range of countries and time periods, the taxation of earnings and benefits is omitted, *i.e.* only gross replacement rates are computed. Net replacement rates are presented in other recent OECD work by Casey *et al.* (2003), based on similar simplifying assumptions. However, they are available only for currently legislated pension systems and for a smaller number of countries (for details on differences between the present paper and Casey *et al.* (2003) in using OECD models of retirement incentives, see Duval, 2003, Box 2). As a result, they are not used here, as the primary goal of this paper is to provide new

Box 2. **Computing replacement rates: methodology and assumptions**

The replacement rate is classically defined as $R_R = P_R/Y$, where R_R is the replacement rate at age R, P_R is the pension level if retiring at age R and Y is the earnings level just before retirement. For all possible retirement ages between 55 and 70, theoretical replacement rates in both "regular" and early retirement schemes are computed for three earnings levels (60, 100 and 140 per cent of average production workers' (APW) earnings) and two household compositions (single worker and married couple with dependent spouse of same age). Thus, these calculations enable computation of average replacement rates across six different situations. In addition to replacement rates at retirement age R, average *expected* replacement rates between ages R and R + 4 are also constructed.

These calculations are made for a wide range of countries and time periods,[1] based on the following assumptions:[2]

- The worker is assumed to enter the labour market at age 20 and work full-time in the private sector without interruption until retirement.
- The age-earnings profile over the working life is assumed to be flat, *i.e.* earnings are assumed to grow in line with countrywide average earnings. A key implication is that changes in the earnings base used in the pension benefit formula are, in general, not reflected in the calculations reported in this paper.
- The reported replacement rates only cover public schemes and mandatory or quasi-mandatory (as in Finland, the Netherlands,[3] Sweden, Switzerland or the United Kingdom) private occupational schemes. Occupational schemes offered by employers on a voluntary basis are not covered.
- The tax treatment of earnings and pension benefits is omitted. The concept of gross earnings considered excludes employers' but includes employees' contributions to social security. Insofar as most OECD countries tend to apply a favourable tax treatment of pension benefits compared with gross wage earnings, gross replacement rates reported in this paper are generally lower than net replacement rates.

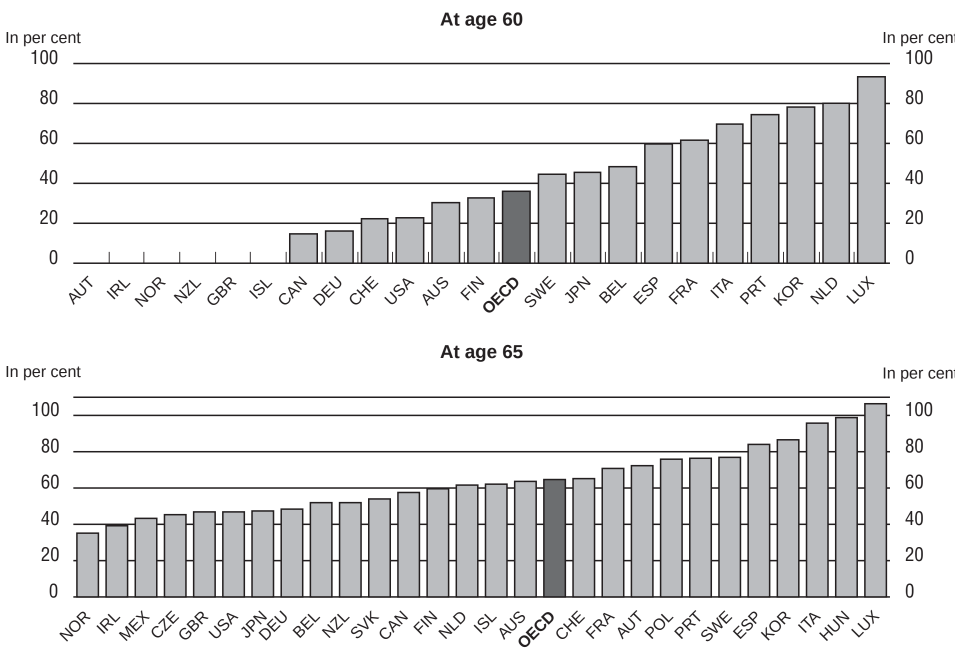
1. The periods covered are all years since: 1967 for 14 OECD countries (Australia, Canada, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, The United Kingdom and the United States), 1977 for New Zealand, 1987 for Korea, 1989 for Switzerland, 1993 for Luxembourg and Japan, 1995 for Austria, Belgium, and Iceland.
2. For further details, including regarding the sources used for past and present pension rules, see Duval (2003), Appendix 1.
3. As mentioned in the main text, in the case of Netherlands, a "typical" early retirement (VUT) scheme is considered between ages 60 and 65. However, since the early 1990s these PAYGO schemes have been progressively transformed into funded systems. As a result of these transformations, the current expected replacement rate at age 60 may be overstated.

empirical evidence regarding the impact of retirement incentives on the departure of older workers from the labour force.

At present and including recent reforms,[14] average expected gross replacement rates at ages 60 and 65 differ noticeably across OECD countries (Figure 2). At age 60, they range from 0 in those countries where the early age of eligibility is at least 65 (Austria,[15] Iceland, Ireland, New Zealand, Norway,[16] and the United Kingdom) to over 70 per cent in several countries where people can claim generous old-age pension benefits in their early sixties (Korea, Luxembourg, Netherlands,[17] Portugal, Spain). At age 65, they range from less than 40 per cent in Ireland and Norway to as high as 100 per cent in Hungary and Luxembourg.

Expected replacement rates rose in the vast majority of OECD countries between the end of the 1960s and the end of the 1980s (Figure 3). The rise at

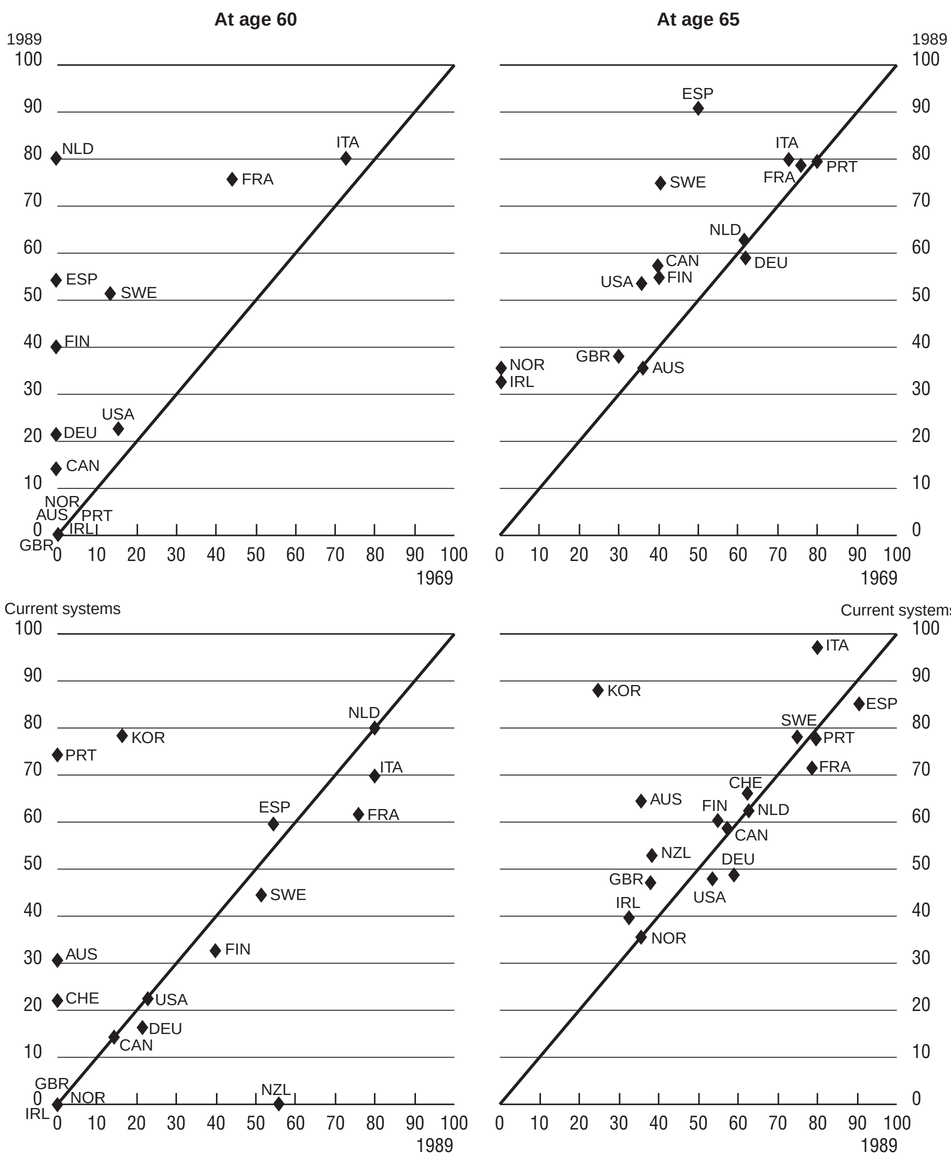
Figure 2. **Average expected replacement rates over next five years in current old-age pension systems, average across six situations (three earnings levels and two marital statuses)**



1. For the Netherlands, the calculations at age 60 are based on a "typical" VUT scheme. For the Czech Republic, Hungary, Mexico, Poland and the Slovak Republic, the calculations are done only at age 65 for a single worker with average earnings.

Source: Author's calculations.

Figure 3. **Historical changes in average expected replacement rates in old-age pension systems, average across six situations (three earnings levels and two marital statuses)**



Source: Author's calculations.

age 60 was mostly due to declines in early retirement ages (increased eligibility), while at age 65 it was mainly caused by increased pension levels. By contrast, since the beginning of the 1990s expected replacement rates have been stabilised (at age 65) and even reduced (at age 60).[18] However, these broad trends mask considerable differences across countries. While expected replacement rates remained fairly stable in some countries over the past three decades, they rose very significantly in others (Finland, the Netherlands, Spain, Sweden at age 60;[19] Finland, Spain, Sweden, and to a lesser extent Ireland and Norway at age 65), in particular at early ages.

Implicit marginal taxes on continued work in old-age pension systems

Pension wealth, defined as the present value of the future stream of pension payments to which a person is entitled over his or her remaining life-time, is a broader indicator of pension generosity than the replacement rate. Most importantly, at each age, *changes* in net pension wealth from working for an additional year (additional benefits minus additional contributions) can be regarded as an implicit marginal tax (if negative) or subsidy (if positive) on continued work.

More precisely, provided that the individual is already eligible for a pension, and that the receipt of a pension cannot be combined with earnings from work, remaining in the labour market for an additional year implies foregoing one year of benefits. If the cost in terms of foregone pensions and contributions paid is exactly offset by an increase in future pension benefits, the pension system is said to be "actuarially neutral",[20] but if this cost is not offset, there is an implicit tax on continued work.

Labour supply effects of implicit taxes on continued work created by pension schemes are theoretically ambiguous (Mitchell and Fields, 1984), as – similar to changes in wages – they produce opposite income and substitution effects.[21] In practice, however, there is overwhelming empirical evidence that substitution effects are dominant (Lazear, 1986; Lumsdaine and Mitchell, 1999), so that implicit taxes on continued work tend to bias the retirement decision towards early labour market withdrawal.

In the following, new results for implicit taxes on continuing working for five more years are presented (for a single worker with average earnings at ages 55, 60 and 65) for both normal old-age pension systems and early retirement schemes. They are based on the same assumptions used in the calculation of replacement rates, as well as on a number of additional ones (Box 3). In particular, when making his decision to withdraw from the labour market or to continue to work, the individual is assumed to expect constant economy-wide real earnings if choosing to work. While this has no impact on implicit tax rates in flat-rate schemes, it tends to over-estimate them in earnings-related ones, all the more so as the reference

Box 3. **Computing pension, social wealth and implicit taxes on continued work: methodology and assumptions***

The calculation of pension wealth levels is directly derived from the computation of replacement rates presented above. However, unlike the latter which considers six different illustrative cases, it is applied only to a single individual with APW earnings. As a first step, for each possible retirement age R between 55 and 70, the future stream of expected pension payments is computed from age R to age 105. Pension wealth is then computed as the present value of this stream using the following formula:

$$PWY_R = \sum_{A=R}^{A=105} (S_A * R_A)/(1+r)^{(A-R)}$$

where PWY_R is the pension wealth (as a share of earnings) for a single individual with APW earnings retiring at age R, R_A is the replacement rate (computed as P_A/Y) that this individual would receive at age A if he or she stops working now, r is the real discount rate, and S_A is the probability of being alive at age A conditional upon being alive at age R.

Pension wealth levels are computed for all possible retirement ages between 55 and 70. Social wealth levels are computed in a similar manner, except that the stream of payments considered is what the individual would receive through early pathways into retirement (unemployment, disability, special early retirement schemes) rather through the "regular" old-age pension system.

For the three retirement ages 55, 60 and 65, changes in pension or social wealth from working for five additional years (*i.e.* from R to R + 5) are then computed as:

$$DPWY_R = [PWY_{R+5}] * [S_{R+5}/(1+r)^5] - PWY_R - \sum_{A=R}^{A=R+4} [(S_A * C_A/Y)/(1+r)^{A-R}]$$

where C_A/Y is the sum of employees and employers rates of contributions to the old-age pension system.

The choice of five-year rather than annual changes in pension or social wealth is dictated by the fact that historical series of labour force participation statistics for older workers are available only for five-year age groups. Indeed, a possible measure of retirement incentives for each of the 55-59, 60-64 and 65-69 age groups is the change in pension or social wealth from remaining in the labour market during each of these life spans, *i.e.*, from working between ages 55 and 60, 60 and 65 and 65 and 70 respectively. When this change is negative, continuing to work for five additional years carries an implicit tax whose average over the five-year span is:

Average implicit tax on continued work beyond age R = $-DPWY_R/5$.

The calculation of levels and changes in pension wealth relies on the following assumptions:

- All of the assumptions that are made to compute replacement rates (see Box 2).

Box 3. **Computing pension, social wealth and implicit taxes on continued work: methodology and assumptions*** (*cont.*)

- When making his decision to withdraw from the labour market or to work for five additional years, the individual is assumed to expect constant economy-wide real earnings if choosing to work. This assumption has no effect on replacement rates, but it can lead to an over-estimation of implicit tax rates in some cases (*e.g.* in the "new" pension system in Italy).
- Individuals are assumed to bear the cost of employers' contributions to the old-age pension system. An alternative choice, which would have produced lower estimates of implicit taxes on continued work, would have been to consider only the share of contributions directly paid for by employees.
- Pensions are assumed to be indexed to prices. This implies a slight under-estimation of implicit taxes on continued work where/when pensions are partially or fully indexed to wages. In addition, historical modifications in pension adjustment methods are not reflected in pension wealth estimates.
- The real discount rate is set at 3 per cent. A higher (lower) rate would produce higher (lower) implicit taxes on continued work but would not affect the results qualitatively.

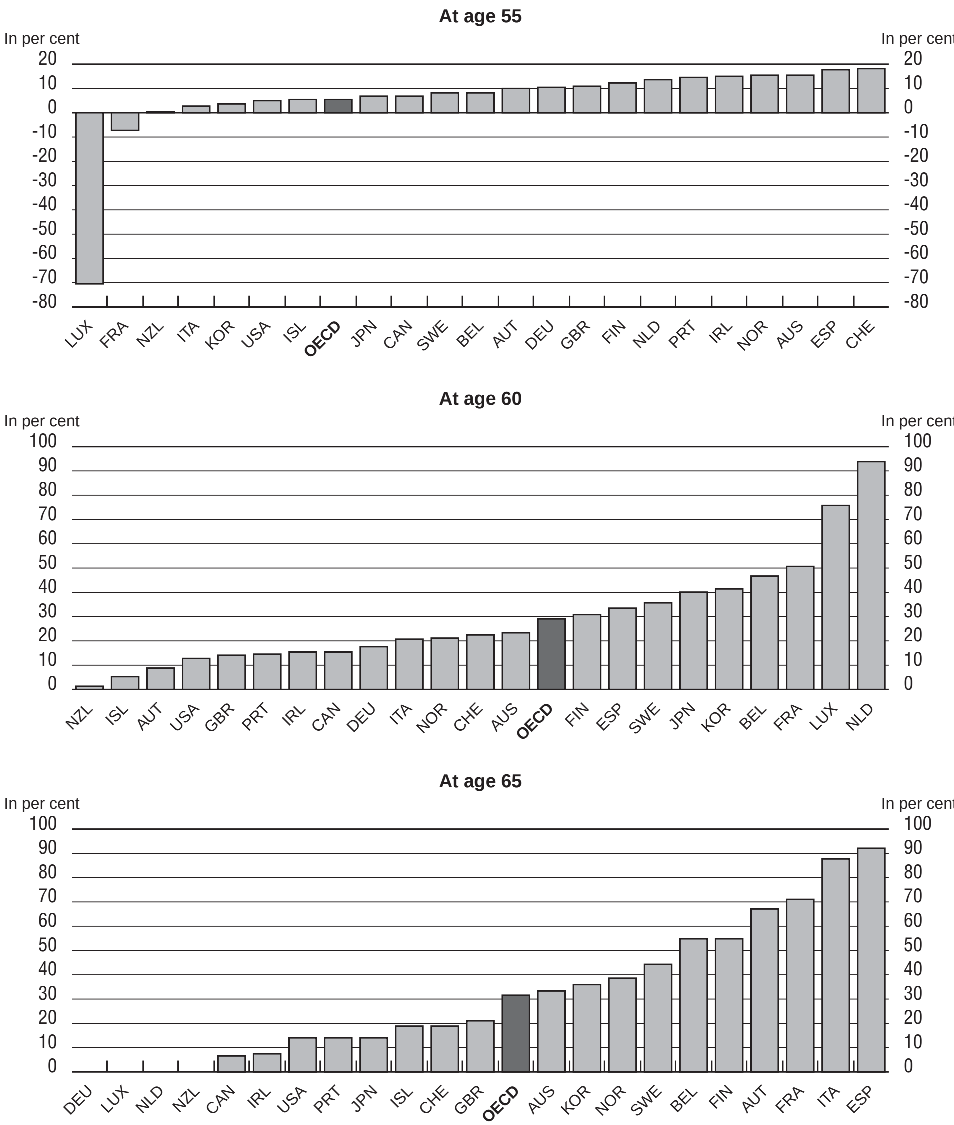
Strictly speaking, the above formula for changes in pension wealth applies only when full-time work cannot be combined with the receipt of any full or reduced pension. In those cases where/when such combination is possible, the computation of the change in pension wealth from working for five additional years incorporates the stream of pension payments that the individual would receive over this five-year period (*i.e.* PWY_{R+5} incorporates not only the stream of pension payments received from age R + 5 but also those received between ages R and R + 4). As a result, changes in pension wealth are more positive (or less negative) and implicit taxes on continued work are lower than in the case of a strict income test. In the extreme case where the receipt of a pension is not income-tested and no contributions to the old-age pension system have to be paid (*e.g.* in New Zealand from age 65), the implicit tax on continued work is simply zero.

* For further details, see Duval (2003), Appendix 2.

period for earnings used in the benefit formula is long (*e.g.* the "new" pension system in Italy).

According to Figure 4, implicit taxes created by old-age pension systems are fairly small – and even negative in a few cases (France and Luxembourg) – at early ages, but they have a clear tendency to rise as individuals age. The average implicit tax rate across 22 OECD countries is found to be below 5 per cent (10 per

Figure 4. **Average implicit tax rates on continued work over next five years in current old-age pension systems, single worker with average production worker (APW) earnings**



Source: Author's calculations.

cent excluding France and Luxembourg) at age 55, while it is above 30 per cent at ages 60 and 65.[22]

The dispersion of implicit taxes on continued work across OECD countries is very large, especially at high ages.[23] In addition, these differences usually match fairly well – though not perfectly – those in expected replacement rates (Figure 5): countries with high replacement rates often also have large implicit taxes on continued work (*e.g.* France, Luxembourg and the Netherlands at age 60, Austria, Italy and Spain at age 65), and *vice versa* (Iceland, Ireland, New Zealand, United Kingdom). Broadly speaking, implicit taxes are high in Continental European countries (with a few exceptions) compared with Nordic and English-speaking ones as well as Japan.

Like expected replacement rates, albeit to a lesser extent, implicit taxes on continued work rose through the 1970s and the 1980s, but have started to stabilise and even decline in some cases since the early 1990s (Figure 6). Increases were large in some Continental European countries (France before the 2003 reform, Netherlands) compared with English-speaking and Nordic countries, primarily for people in their early 60s. These observations are consistent with historical labour force participation patterns, *i.e.* with trend declines in older workers' participation being stronger in Continental European countries and having flattened out since the early 1990s.

Implicit marginal taxes on continued work in other social transfer programmes

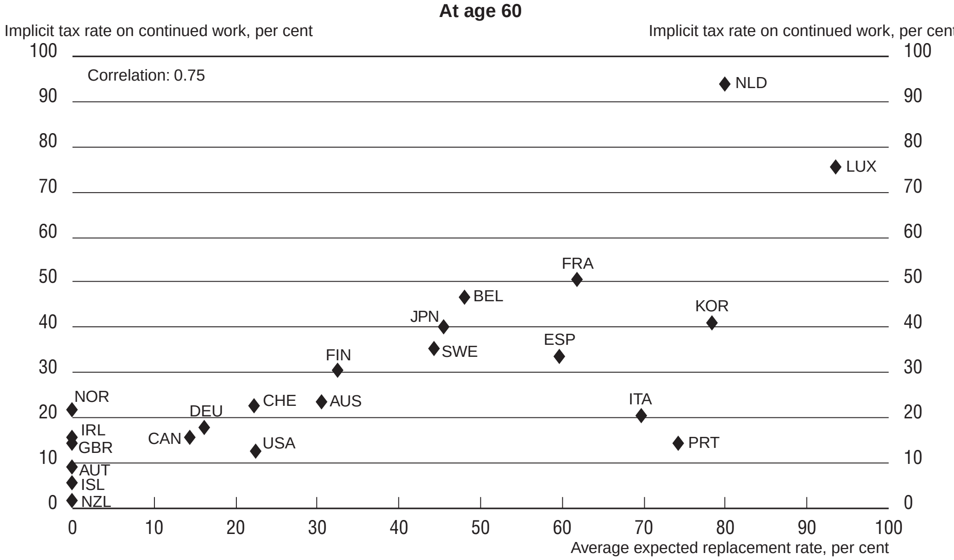
In many OECD countries, relatively easy access to various social transfer programmes has enabled certain categories of older workers to withdraw from the labour market before the early age of entitlement to old-age pension benefits. Such schemes, which include special early retirement provisions as well as unemployment-related and disability benefits (Blöndal and Scarpetta, 1998; Casey *et al.*, 2003), often entail high implicit taxes on continued work, for two main reasons: replacement rates are usually high; and pension rights continue to accrue even if, in some cases, at a reduced rate.

No attempt is made here to be comprehensive in the coverage of these programmes. Rather, in order to provide a rough assessment of early retirement incentives arising from them, a "typical early retirement route" is modelled under the following simplifying assumptions:

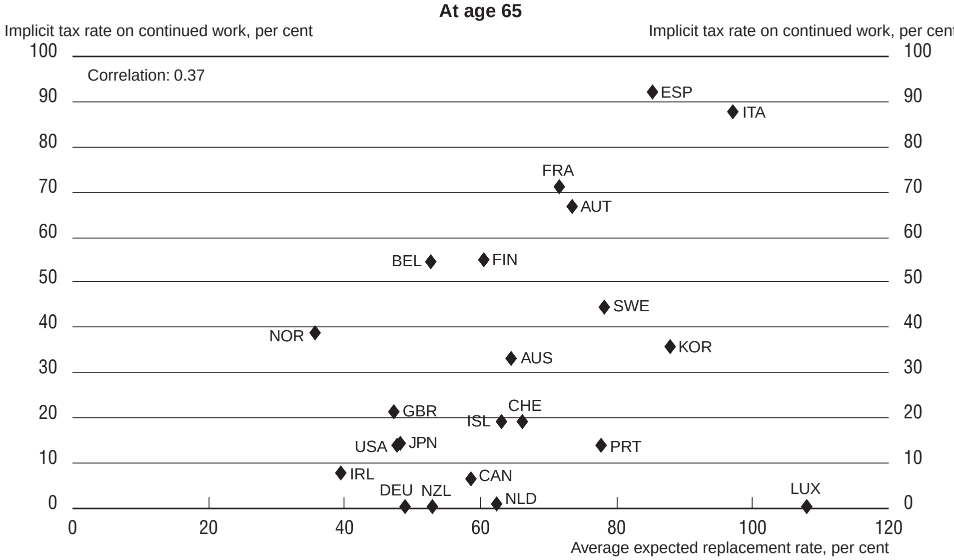
- In those countries where unemployment-related benefits can be used de facto to bridge the time until people are entitled to an old-age pension,[24] implicit taxes on continued work are computed for the same illustrative cases as for old-age pension schemes.
- Where unemployment-related schemes cannot be used effectively as an early retirement device but other schemes are available,[25] the latter are considered.

Figure 5. **Average expected replacement rates and implicit tax rates on continued work in current old-age pension systems**

At age 60

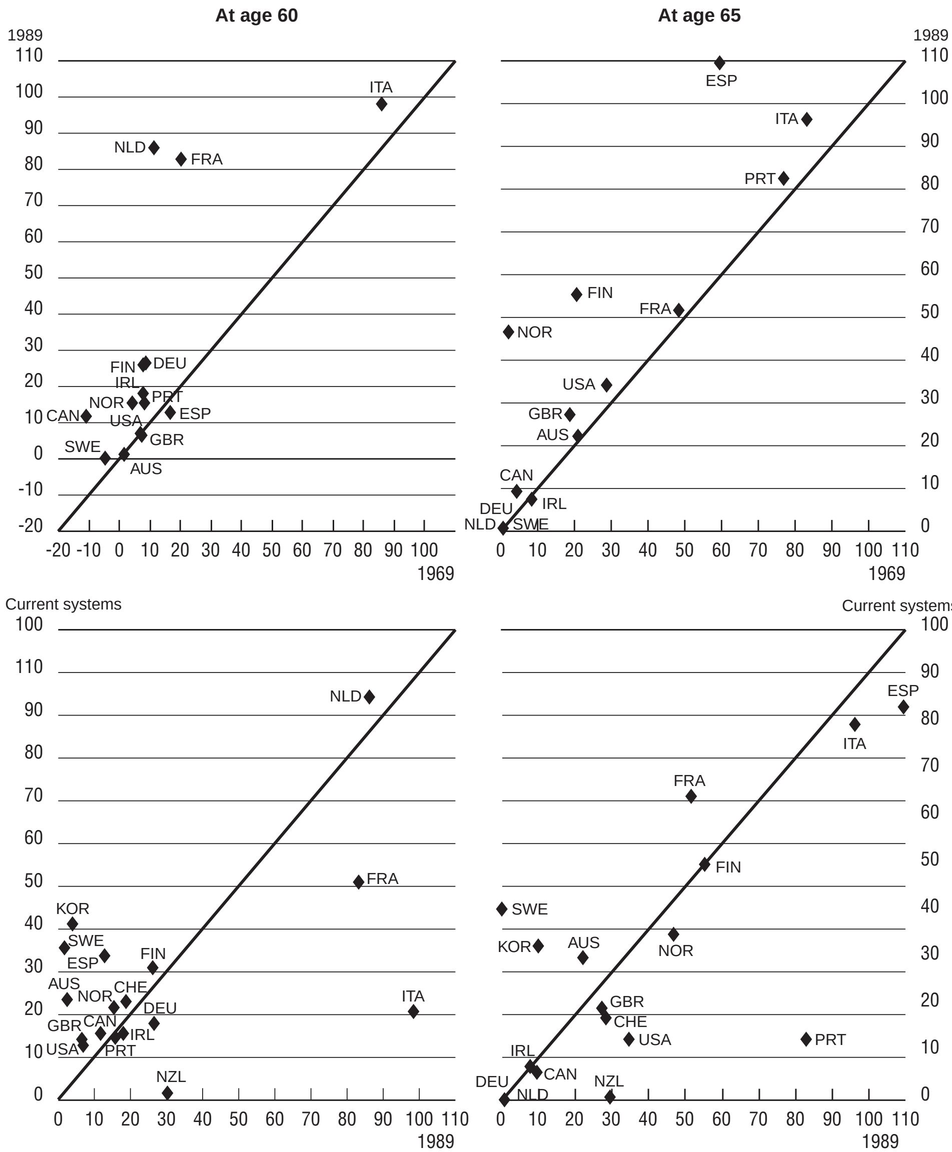


At age 65



Source: Author's calculations.

Figure 6. **Historical changes in average implicit tax rates on continued work in old-age pension systems, single worker with APW earnings**



Source: Author's calculations.

- Where no social transfer programme can be used to withdraw from the labour market before the minimum pensionable age,[26] the "early retirement route" is simply the old-age pension pathway into retirement.

It should be stressed, for at least two reasons, that the implicit tax on continued work obtained using the above methodology provides only a rough estimate of the magnitude of retirement incentives embedded in early retirement schemes. First, the focus on a single "early retirement route" leaves aside the participation effects of a number of other social transfer programmes that may actually be used as early retirement devices. Second, the actual strictness of eligibility criteria for these programmes is imperfectly reflected in the calculations. For instance, even in those countries for which it has been assumed that retirement on account of disability is not – or no longer, as in Sweden – an available option, due to the official strictness of eligibility criteria, the share of disability benefit status in non employment actually grew significantly during the second half of the 1990s (*e.g.* Australia, Sweden, United States: see OECD, 2003b).

Keeping these caveats in mind, the results are broadly in line with those obtained for old-age pension schemes. First, the dispersion of implicit tax rates in the "early retirement route" is very large across OECD countries (Figures 7 and 8, Panels B). Second, implicit tax rates rose throughout most of the 1970s and the 1980s, especially at age 55, as early retirement schemes were created and/or were becoming more generous. However, this expansion has come to a halt since the early 1990s, and has even been reversed in some countries (*e.g.* Sweden, or Finland more recently).

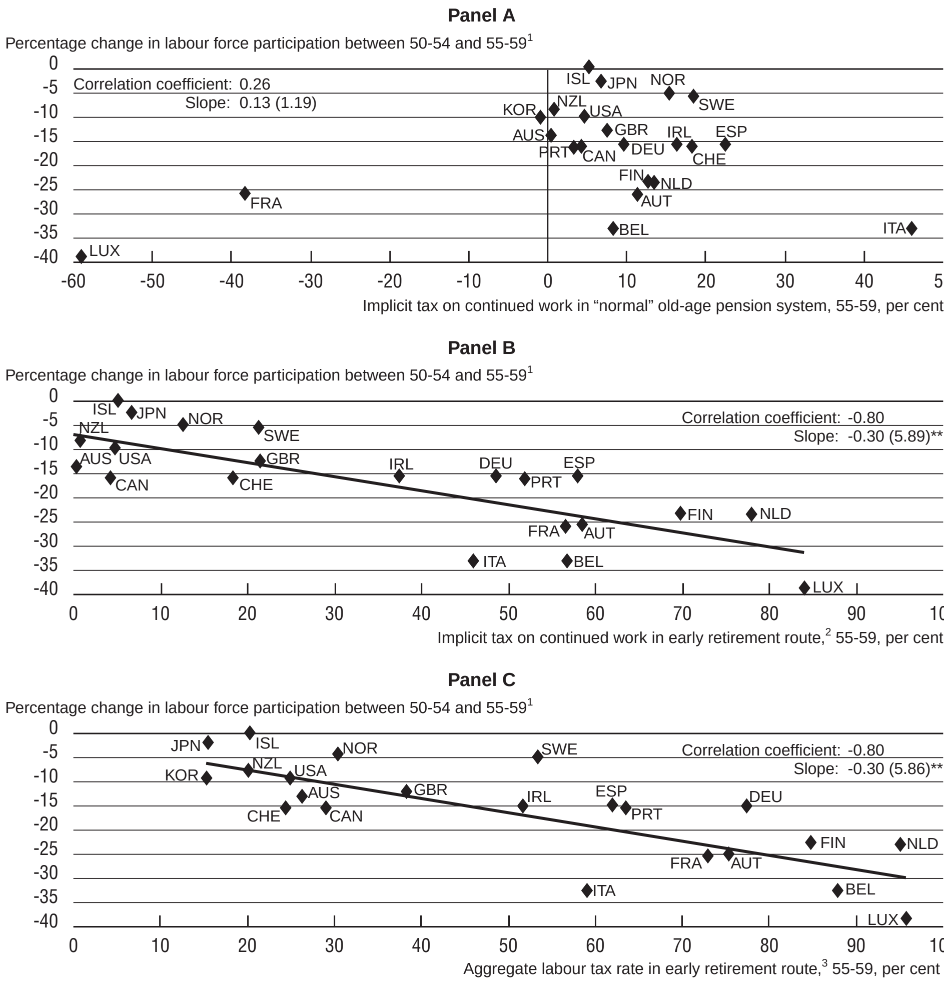
EFFECTS OF IMPLICIT TAX RATES ON LABOUR MARKET PARTICIPATION OF OLDER WORKERS: PRELIMINARY CROSS-COUNTRY EVIDENCE

Effects of implicit tax rates on continued work

The implicit tax on continued work is a key summary indicator of retirement incentives embedded in pension systems and early retirement schemes, because it captures some of the effects of both eligibility ages and the generosity of benefits. C*eteris paribus*, the higher the replacement rate, the higher is the "opportunity cost" of, and the implicit tax on, continued work (Figure 5 and Box 4). Similarly, the higher the minimum pensionable age, the lower is the implicit tax on continued work before this age, *ceteris paribus*.[27] Thus, there is a rationale for focusing primarily on implicit taxes on continued work when assessing participation effects of retirement incentives embedded in pension schemes.

As an illustration of potential participation effects of retirement incentives embedded in "regular" pension schemes, Panels A in Figures 7 and 8 plot, for two age spans (55-59 and 60-64), the fall in male labour force participation an implicit

Figure 7. **Fall in male labour force participation between 50-54 and 55-59 and implicit tax rates on continued work, 1999 (single worker APW earnings)**

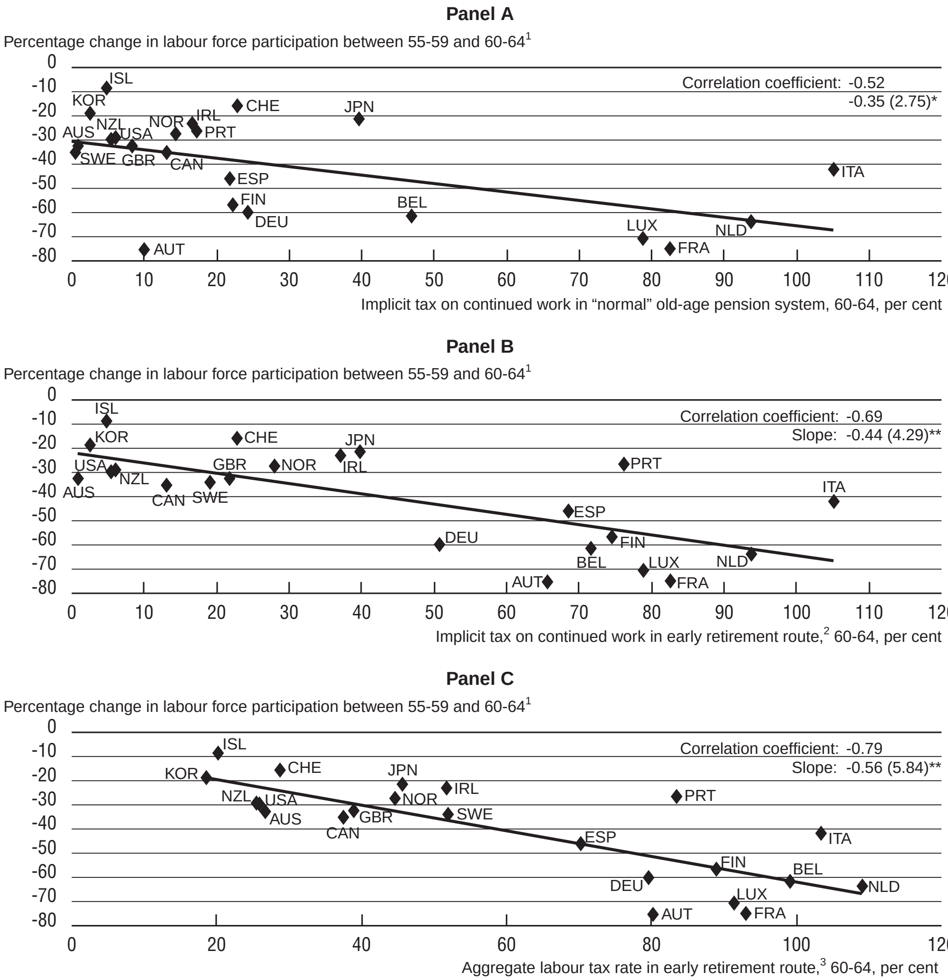


Notes: t-statistics in parentheses. * significant at the 5 per cent level; ** significant at the 1 per cent level.

1. (Pr55-59 – Pr50-54)/Pr50-54, per cent.
2. The early retirement route is modelled as the unemployment benefits/assistance pathway into retirement with the exception of Ireland, where the modelling refers to the pre-retirement allowance, and Luxembourg, where disability benefits were considered given their widespread incidence among pensioners. In those countries where it was considered that no early retirement scheme could be widely used to withdraw from the labour market before the minimum pensionable age (Australia, Canada, Iceland, Italy, Japan, Korea, New Zealand, Norway, Sweden, Switzerland and the United States) the retirement scheme considered in the chart is simply the "regular" old-age pension system.
3. The aggregate labour tax rate is computed as the sum of two components: the usual labour tax wedge; the implicit tax on continued work in the early retirement route (less the rate of contribution to the old-age pension system so as to eliminate double counting) expressed as a percentage of total labour cost.

Source: Author's calculations.

Figure 8. **Fall in male labour force participation between 55-59 and 60-64 and implicit tax rates on continued work, 1999 (single worker APW earnings)**



Notes: t-statistics in parentheses. * significant at the 5 per cent level; ** significant at the 1 per cent level.

1. (Pr60-64 – Pr55-59)/Pr55-59, per cent.
2. The early retirement route is modelled as the unemployment benefits/assistance pathway into retirement with the exception of Ireland and the Netherlands, where the modelling refers to the pre-retirement allowance and a "typical" VUT scheme, respectively; and Luxembourg, where disability benefits were considered given their widespread incidence among pensioners. In those countries where it was considered that no early retirement scheme could be widely used to withdraw from the labour market before the minimum pensionable age (Australia, Canada, Iceland, Italy, Japan, Korea, New Zealand, Norway, Sweden, Switzerland and the United States) the retirement scheme considered in the chart is simply the "regular" old-age pension system.
3. The aggregate labour tax rate is computed as the sum of two components: the usual labour tax wedge; the implicit tax on continued work in the early retirement route (less the rate of contribution to the old-age pension system so as to eliminate double counting) expressed as a percentage of total labour cost.

Source: Author's calculations.

Box 4. **Theoretical relationship between replacement rates and implicit taxes on continued work**

The existence of a direct link between the magnitude of the implicit tax rate on continued work and the level of the replacement rate is rather intuitive: the higher the replacement rate, the higher the opportunity cost of continuing working, *i.e.* the higher the implicit tax on continued work, *ceteris paribus*. The calculations presented below establish this link more formally and show that it is in fact more complex than this simple intuition suggests. For clarity purposes, it is assumed by convention that R = 0. In addition, the survival function is assumed to be computed from R to infinity and the mortality rate at each age is supposed to be constant and equal to $p = p_A$. As shown above, these assumptions were not made when computing actual pension wealth levels, but they greatly simplify the demonstration. The level of pension wealth of an individual currently eligible to a pension can thus be written as:

$$PWY(0) = \sum_{A=0}^{\infty} (S_A * R_A)/(1+r)^A$$

Where R_A is the replacement rate and S_A is the value of the survival function at age A.

Given the assumption of a constant mortality rate at each age, the survival function is:

$$S_A = \prod_{i=1}^{i=A} (1-p) \approx \prod_{i=1}^{i=A} 1/(1+p) \approx 1/(1+p)^A$$

Combining these two equations, and incorporating the fact that R_A is constant ($R_A = R$) because pensions are assumed to be indexed on prices, we obtain:

$$PWY_0 \approx \sum_{A=0}^{\infty} R_A/(1+r+p)^A \approx R*[1+1/(r+p)]$$

Let us assume that pension rights accrue at rate a, so that $P_{R+1} = (1+a)P_R$, and that no pension can be received before full retirement (*i.e.*, there is a strict income test). The present value (*i.e.*, at age R = 0) of the pension wealth of the individual if he defers the receipt of his pension by one year is:

$$PWY_1/(1+r+p) \approx \sum_{A=1}^{\infty} [R_A*(1+a)/(1+r+p)^{A-1}]/(1+r+p) \approx R*(1+a)/(r+p)$$

The implicit tax on continuing working for one year is:

Implicit tax = $-[(1+r+p)*PWY_1 - PWY_0 - c] = R*[(r+p)(1+c)-a]/(r+p)$

Box 4. **Theoretical relationship between replacement rates and implicit taxes on continued work** (*cont.*)

This equation states that when $a < (r+p)(1+c)$, *i.e.*, when the accrual rate is below the "actuarially neutral" level, there is an implicit tax on continued work whose magnitude is positively related to the level of the replacement rate.

measure of labour market withdrawal against the corresponding implicit tax on continuing working for five more years.[28] The fall in labour force participation over the age span 55-59 appears to be unrelated to the implicit tax on continued work between ages 55 and 60 (Figure 7, Panel A). This finding should come as no surprise, insofar as implicit taxes in regular pension schemes are usually low and fairly similar across countries at age 55 (with the exception of France and Luxembourg), while differences in participation rates are large. By contrast, there is a significant bivariate correlation between the fall in labour force participation over the age span 60-64 and the implicit tax on continued work between 60 and 65 (Figure 8, Panel A). Both labour market withdrawal and implicit taxes are generally higher in Continental European countries than in Japan, Korea, English-speaking and Nordic countries.

While no clear link emerges between the fall in male labour force participation over the age span 55-59 and the implicit tax in "regular" pension systems (Figure 7, Panel A), a strong relationship emerges when the early retirement route is considered (Figure 7, Panel B). For the 60-64 age group, taking into account early retirement schemes brings a more limited improvement to the cross-country relationship between labour force participation and implicit tax rates (Figure 8, Panel B). These results hint at larger participation effects of early retirement programmes on workers in the 55-59 age group than on those in the 60-64 age group, whose retirement decision seems to be comparatively more influenced by regular pension schemes. Taken at face value, the estimated slope coefficients suggest that a 10 percentage points decline in the implicit tax rate reduces the fall in participation rates between two consecutive (five-year) age groups of older workers by 3 to 4 percentage points, depending on the age group considered.

Effects of "aggregate" labour tax rates

A broader, aggregate, labour tax rate may also be computed as the sum of two components: *i*) the implicit tax on continued work (on a gross basis, *i.e.* less the rate of contribution to the old-age pension system so as to eliminate double counting) expressed as a percentage of total labour costs (rather than as a percentage of gross wage earnings); and, *ii*) the standard labour tax rate (including pension contributions), also expressed as a percentage of total labour costs.[29] As shown in Figures 7 and 8 (Panels C), the cross-country correlation is increased (in absolute value) for the 60-64 age group when the implicit tax on continued work is replaced by this aggregate labour tax rate.[30] This finding suggests that even though they are not covered in this paper, labour taxes may also have a negative impact on labour force participation of male older workers, consistent with a dominant substitution effect.

PANEL DATA ECONOMETRIC ANALYSIS OF DETERMINANTS OF THE LABOUR FORCE PARTICIPATION OF OLDER WORKERS

Previous studies

A broad range of microeconometric studies of the retirement decision have been conducted over the past decade for a number of OECD countries (for a summary of individual country results, see for instance, Blöndal and Scarpetta, 1998; Gruber and Wise, 1999, 2002). They confirm that among a variety of factors – such as individual and household characteristics, wage earnings, retirement incentives embedded in old-age pension and early retirement schemes affect the labour supply of older workers. This result is also supported at the macroeconomic level by a variety of country case studies (see for instance the country-specific papers in Gruber and Wise, 1999). The latter are based on the idea that historical changes in old-age pension benefits rules offer "natural experiments" to study the participation effects of early retirement incentives.[31]

Comparatively, panel data macroeconometric evidence remains fairly limited. Blöndal and Scarpetta (1998) find effects of old-age pension and early retirement schemes on the labour force participation of older men aged 55-64 in a panel of 15 countries from 1971 to 1995. Johnson (2000) investigates old-age pension systems only and reaches similar conclusions for males in the 60-64 and 65+ age groups in a panel containing data for 13 countries at approximately ten-year intervals from 1880 to 1990. However, in both studies participation effects of early retirement incentives are found to be relatively moderate: for instance, for the 60-64 age group, Johnson estimates that only around 11 per cent of the decline in average participation rates from 1920 to 1990 can be explained by old-age pension variables.

The econometric analysis presented below combines the respective strengths of both studies, and as a result should *a priori* improve the estimates and allow richer analysis of the participation effects of retirement schemes. As in Johnson (2000), the calculation of implicit tax rates takes proper account of the possibilities to combine work with the receipt of a reduced or full pension. For instance, when benefits are not income-tested and no contributions to the pension system have to be paid, the implicit tax is simply zero because the stream of future payments is the same whether individuals keep working or not (Box 3). In this vein, less strict income testing has been traditionally at the root of low implicit taxes on continued work in the Swedish and Japanese pension systems, two countries with significantly above-average participation rates of older workers. Also as in Johnson (2000), separate analysis is undertaken for the 55-59, 60-64 and 65+ age groups, while only the aggregate 55-64 age group was studied in Blöndal and Scarpetta (1998). There are several reasons for breaking up older males into three different age groups: *i*) the narrower the age band considered, the smaller the "demographic bias" involved in older males' participation trends;[32] *ii*) isolating the 55-59 age group allows more precise analysis of the participation effects of early retirement schemes, because the latter affect *a priori* to a lesser extent the 60-64 age group; and, *iii*) the implicit horizon for the retirement decision is shorter and, thus, probably more realistic in practice (individuals are implicitly assumed to decide whether they retire immediately or remain in the labour market for five additional years, rather than ten in Blöndal and Scarpetta, 1998). Finally, as in Blöndal and Scarpetta (1998), early retirement schemes are covered, which should significantly improve the analysis of the labour force participation of the 55-59 and – to a lesser extent – 60-64 age groups compared with Johnson (2000).

The estimated equation

For each of the 55-59, 60-64 and 65+ age groups separately, the equation adopted is estimated for a panel dataset of 22 OECD countries over the period 1967-1999.[33] The specification is as follows:

$$\Delta(PRM)_{it} / PRM_{it} * 100 = \beta_1 \times \mathrm{TAX}_{it} + \beta_2 \times (\mathrm{STANDARD\ AGE})_{it} + \beta_3 \times \mathrm{UR}_{it} + a_i + \gamma_t + \varepsilon_{it}$$

where i and t are country and time suffices, $\Delta(PRM)_{it} / PRM_{it} * 100$ is the difference in male labour force participation rates between two consecutive age groups (in per cent), TAX is the implicit tax on continued work, STANDARD AGE is the standard retirement age (included only in the regressions estimated for the 60-64 and 65+ age groups) and UR is the unemployment rate of prime-age workers.

In each of the three equations, the dependent variable is the same as in Figures 7 and 8, *i.e.* the difference in labour force participation rates of older men between two consecutive age groups. Therefore these equations implicitly model withdrawal from the labour market, and thus the retirement decision, rather than the level of participation *per se*. The latter may be influenced by a number of other factors, including irreversible withdrawal from the labour market at earlier ages.[34]

The main explanatory variable characterising early retirement incentives is the implicit tax on continued work in the "early retirement route", as defined above. Another candidate would be the replacement rate (or, alternatively, the level of pension wealth), so as to capture income/wealth effects on the retirement decision. But, in practice, its strong correlation with the implicit tax rate makes it impossible to include both variables within the same regression.[35] Keeping this caveat in mind, it should be said that the implicit tax on continued work *per se* sums up various dimensions of retirement incentives, such as the pension accrual rate but also the availability and generosity of benefits. Therefore, part of the wealth effects which could have entered the estimated equation in a straightforward way, *via* a replacement rate or a pension wealth variable are, at least partly, indirectly captured by the implicit tax rate variable. In addition, in order to test for the existence of "customary" and/or "liquidity" effects, the standard retirement age is introduced as a separate explanatory variable in the regressions for the 60-64 and 65+ age groups.[36]

It should be stressed that incorporating implicit taxes on continued work in the estimated equation is implicitly consistent with the option value model of the retirement decision.[37] Indeed, most of the cross-country and time-series variance in option values of postponing retirement comes *a priori* from corresponding variance in implicit taxes on continued work, to the extent that changes in wage rates and preferences are likely to be comparatively smaller and less frequent. However, no attempt is made below at estimating a full option value model, mainly because of data limitations, particularly in a cross-country dimension.[38]

Discouragement effects among older workers associated with low employment opportunities are captured by the unemployment rate. Since the latter is jointly determined with participation, a potential endogeneity issue arises which is dealt with by using the unemployment rate of prime-age workers instead of the old-age unemployment rate. Insofar as the unemployment rate is negatively correlated with activity, this variable may also capture business cycle effects, in addition to discouragement effects.

Other influences on the retirement decision are controlled for using country and time fixed effects. In particular, as in Johnson (2000), secular retirement trends, such as increasing demand for leisure over time and/or wealth effects stemming from rising living standards, are captured by time dummies. These time fixed effects may also absorb all shocks common to all countries, such as irreversible withdrawal from the labour market by laid-off workers in the aftermath of the two oil shocks of the 1970s.[39]

However, other potential determinants of older workers' participation may vary both across countries and over time. For instance, an omitted variable which affects the retirement decision is the presence of pension schemes offered by employers on a voluntary basis, especially in those countries where such plans are prominent, *e.g.* Australia, Canada or the United States. There is indeed ample empirical evidence that large disincentives to work are embedded in some of these schemes (Kotlikoff and Wise, 1987; Stock and Wise, 1990).[40] No account is also made for the fact that retiring often results from a joint decision made in a household context (see for instance Coile, 2003). Other determinants, while not being explicitly covered by the analysis, may still be captured indirectly – to a limited extent – by other variables in the regressions. For instance, the rigidity of age-earnings profiles is supported by specific institutional arrangements (such as high minimum wage or stringent employment protection legislation) that may also affect the unemployment rate of prime-age workers, a variable included in the regressions. Similarly, the low incidence of training for older workers may partially result from the fact that high implicit taxes lower the expected retirement age. But in any event, some omitted variable bias cannot be completely ruled out. In addition, implicit taxes are measured imprecisely, in part because of the number of simplifying assumptions underlying the calculations (Box 3), and also because the illustrative worker considered in the modelling may not be fully representative of the typical worker.[41, 42]

Econometric results

For each of the 55-59, 60-64 and 65+ age groups, Table 2 presents three alternative regressions. Model A incorporates country-specific time trends rather than common time fixed effects in order to better capture country-specific retirement trends.[43] As expected, implicit taxes on continued work, and the unemployment rate of prime age males are negatively signed and statistically significant. The standard retirement age appears to affect positively the labour force participation of workers aged 65 and over but, more surprisingly, it is not significant for the 60-64 age group. However, there is evidence that country-specific time trends unduly capture part of the participation effects of implicit taxes on continued work. Indeed, a simple regression of the estimated coefficients of country-specific time trends on a variable[44] representative of the magnitude of implicit taxes yields significant results at the 5 per cent level for each of the three age groups: the larger the incentive to retire early in a country, the larger the estimated coefficient of its (negative) specific time trend. This finding is likely to reflect the fact that changes in participation rates induced by abrupt changes in implicit taxes are usually gradual, and may thus be better captured by simple time trends.

Since Model A probably understates the coefficients of implicit taxes on continued work, in Model B country-specific time trends are replaced by common time fixed effects. All variables remain correctly signed and significant (including the standard retirement age for the 60-64 age group), but the coefficients of implicit taxes are larger, and do not differ significantly across age groups.[45] Finally, Model C is the same as Model B, except that it is based on a more restrictive assumption regarding the source of heteroskedasticity:[46] the econometric results

Table 2. **Panel data estimates of the labour force participation of older workers**

	Model A			Model B			Model C		
Dependent variable:	(Pr55-59 – Pr50-54)/ Pr50-54, in per cent	(Pr60-64 – Pr55-59)/ (Pr55-59), in per cent	(Pr65-69 – Pr60-64)/ Pr60-64, in per cent	(Pr55-59 – Pr50-54)/ Pr50-54, in per cent	(Pr60-64 – Pr55-59)/ (Pr55-59), in per cent	(Pr65-69 – Pr60-64)/ Pr60-64, in per cent	(Pr55-59 – Pr50-54)/ Pr50-54, in per cent	(Pr60-64 – Pr55-59) /(Pr55-59), in per cent	(Pr65-69 – Pr60-64)/ Pr60-64, in per cent
Implict tax on continued work	–0.06	–0.06	–0.13	–0.11	–0.17	–0.15	–0.09	–0.12	–0.1
	(4.23)**	(3.54)**	(5.43)**	(7.15)**	(4.88)**	(4.88)**	(8.98)**	(5.16)**	(5.65)**
Unemployment rate	–0.16	–0.77	–0.34	–0.12	–0.9	–0.53	–0.15	–1.07	–0.29
	(2.97)**	(7.85)**	(3.32)**	(1.88)	(5.95)**	(3.98)**	(3.25)**	(10.28)**	(3.01)**
Standard retirement age		–0.14	2.41		1.63	1.17		1.27	1.27
		(0.39)	(6.08)**		(3.29)**	(3.70)**		(3.40)**	(6.22)**
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country specific time trends	Yes	Yes	Yes	No	No	No	No	No	No
Time fixed effects	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Observations	431	431	431	484	471	471	484	471	471
R-squared	0.93	0.95	0.87	0.92	0.89	0.8			

Notes:
Absolute value of t-statistics in brackets. * significant at the 5 per cent level; ** significant at the 1 per cent level.
All regressions include country fixed effects (significantly different from zero in all specifications).
Equation A: balanced panel dataset and robust standard errors.
Equations B: unbalanced panel dataset and robust standard errors.
Equations C: unbalanced panel dataset and generalised least squares used to correct for groupwise (countrywise) heteroskedasticity.
Source: Author's calculations.

remained broadly unchanged, except that the coefficients on implicit taxes are somewhat smaller.[47]

The preferred specification (Model B) suggests that, on average, a 10 percentage point decline in the implicit tax rate reduces the fall in participation rates between two consecutive (five-year) age groups of older workers by about 1½ percentage points. This result is consistent with existing panel data estimates at the macroeconomic level. In particular, estimated participation elasticities are fairly similar to those estimated for the 60-64 age group in Johnson (2000) and are somewhat larger than in Blöndal and Scarpetta (1998).[48] In addition, the explanatory power of the regressions compares favourably with these two previous studies.

However, these participation elasticities with respect to implicit tax rates are two to three times lower than those found in the simple cross-country regressions presented above[49] (Figures 7 and 8, Panels B) or in the microeconomic literature. For instance, in Gruber and Wise (2002), simulations using option value models estimated on separate microeconomic panel datasets for Belgium, France and the Netherlands suggest that a three-year delay in eligibility ages to old-age and early retirement schemes would raise the labour force participation of the 55-64 age group by about 20 percentage points in each of these countries. While past experience suggests a more moderate outcome for instance, the five-year increase in eligibility ages in New Zealand throughout the 1990s led to a 15 percentage points increase in labour force participation, it nonetheless points to significantly larger effects than in the regressions above.

The low elasticities typically found in panel data estimates may result from the difficulty to disentangle short and long-run effects and/or from the fact that historical changes in implicit tax rates – on which panel data (within) estimates are based – are measured with more error than current implicit tax rates levels. Therefore, it cannot be ruled out, as suggested by Johnson (2000), that simple cross-country regressions actually better capture the long-run participation elasticities of implicit tax rates.

POLICY SIMULATIONS REGARDING THE EFFECT OF PENSION REFORMS ON LABOUR FORCE PARTICIPATION OF OLDER WORKERS

The coefficients in the preferred specification Model B can be used to simulate the long-run participation effects of three possible pension reforms: *i*) a removal of early retirement schemes; *ii*) a move towards actuarial neutrality of old-age pension systems; *iii*) a convergence of standard retirement ages to 67 (*i.e.* currently the highest age level among OECD countries). The three reforms are simulated cumulatively, beginning with the removal of early retirement systems (scenario Reform 1). Then, the shift of old-age pension systems to actuarial fairness is simulated by removing the remaining implicit tax on continued work and the corresponding impact on participation (scenario Reform 2). Finally, the impact on participation of the change of standard retirement age is estimated. The detailed methodology is discussed in Burniaux *et al.* (2003), Annex 7. However, insofar as panel data estimates may underestimate the "true" long-run participation elasticities with respect to implicit tax rates, they are used here to simulate a "low-case" policy scenario. Alternatively, coefficients from simple bivariate regressions reported in Figures 7 and 8, whose magnitude is more in line with the elasticities typically found in the micro-econometric literature, are used to construct a "high-case" scenario.

The starting point for these simulations is projected labour force participation of older workers in 2025. This projection incorporates future demographic developments as well as the anticipated effects of recently enacted pension reforms that have not yet been fully implemented (*e.g.* the transition to the "new" pension system in Italy).[50] All country details and underlying assumptions are provided in Burniaux *et al.* (2003).[51] The results, expressed as differences in participation rates (in percentage points) compared with the baseline projections, are presented in Table 3 for the 55-64, 65+ and 55+ age groups. It is instructive that even in the high case scenario, these policy simulations suggest that combining the three reforms mentioned above would not be sufficient to bring participation rates in low-participation countries (*e.g.* Belgium, France) back to their levels of the late 1960s, nor would it be enough to reach the levels currently observed in high-participation countries such as Iceland or Japan. This result probably reflects the fact that a number of influences on the retirement decision have been omitted from the empirical analysis presented above, including a range of country-specific institutional, cultural and historical factors.[52]

Removing early retirement schemes where they are still being used extensively would yield sizeable participation effects on the 55-64 age group (Reform 1). This mainly concerns Continental European countries, such as Austria, Belgium, France, Germany, Luxembourg, Netherlands, Portugal or Spain. For these eight countries and Finland, simulations point to an average impact of almost 6 percentage points in the low case scenario and above 15 points in the high case one. The labour force participation of the 55+ age group would be less affected (3 and 7.7 percentage points respectively), due to a limited effect on the 65+.

Such removal of early pathways into retirement would leave older workers facing only the incentives embedded in old-age pension systems. If the latter then moved towards actuarial neutrality, the impact on the labour force participation of the 55+ age group would be even larger than that of removing early retirement schemes, mainly because the 65+ age group would be more clearly affected[53] (Reform 2). In countries where early retirement schemes are not widespread but old-age pension systems are still far from actuarial neutrality, such as

Table 3. **Participation effects of three policy scenarios for older workers**

Panel A. 55-64

	2025, projected[1]	Reform 1: Early schemes removed		Reform 2: Actuarial fairness		Reform 3: Standard age to 67	Total	
		Low case	High case	Low case	High case		Low case	High case
	Level	In percentage points						
Australia	48.0	0.0	0.0	2.2	5.5	1.0	3.2	6.5
Austria	31.4	5.2	13.5	6.2	16.4	7.0	18.4	36.9
Belgium	32.1	4.1	10.8	2.6	6.9	0.8	7.5	18.5
Canada	53.6	0.0	0.0	1.5	3.5	1.2	2.6	4.7
Czech Republic	38.0	. .	. .	. .	. .	2.3	2.3	2.3
Denmark	55.8	. .	. .	. .	. .	1.2	. .	. .
Finland	49.0	4.4	11.2	2.8	7.2	1.1	8.3	19.6
France	40.8	3.5	9.1	2.4	6.0	3.5	9.3	18.7
Germany	52.2	4.4	11.3	1.9	5.0	1.2	7.5	17.4
Greece	55.4	. .	. .	. .	. .	1.0	. .	. .
Hungary	23.8	. .	. .	. .	. .	1.3	. .	. .
Iceland	82.8	0.0	0.0	0.9	2.3	0.0	0.9	2.3
Ireland	67.8	3.6	9.2	2.3	6.1	0.6	6.6	15.9
Italy	43.4	0.0	0.0	1.0	2.4	0.8	1.8	3.2
Japan	67.8	0.0	0.0	3.0	7.2	1.2	4.2	8.4
Korea	50.7	0.0	0.0	2.4	5.6	3.5	5.9	9.1
Luxembourg	40.8	11.1	29.4	–0.9	–1.9	0.9	11.1	28.4
Mexico	62.3	. .	. .	. .	. .	1.0	. .	. .
Netherlands	48.5	4.4	11.5	6.8	18.2	1.1	12.3	30.8
New Zealand	62.0	0.0	0.0	0.1	0.3	1.2	1.3	1.5
Norway	72.2	1.0	2.2	2.8	7.0	0.0	3.8	9.2
Poland	29.3	. .	. .	. .	. .	1.3	. .	. .
Portugal	57.5	6.7	17.3	2.0	5.4	1.0	9.7	23.7
Slovak Republic	24.0	. .	. .	. .	. .	2.6	. .	. .
Spain	54.0	4.8	12.3	3.2	8.5	1.0	9.0	21.8
Sweden	64.2	0.0	0.0	2.9	7.0	1.2	4.2	8.3
Switzerland	66.5	0.0	0.0	3.1	7.7	1.7	4.7	9.3
Turkey	24.5	. .	. .	. .	. .	1.6	. .	. .
United Kingdom	54.5	1.6	4.1	1.6	4.1	1.1	4.4	9.4
United States	60.4	0.0	0.0	1.2	2.9	0.0	1.2	2.9
OECD average[2]	**50.4**	**2.5**	**6.5**	**2.4**	**6.1**	**1.4**	**6.1**	**14.0**

1. Projected participation rates incorporate future demographic developments as well as the anticipated effects of recently legislated pension reforms that have not yet been fully implemented (*e.g.* the transition to the "new" system in Italy). See Burniaux *et al.* (2003).
2. Unweighted average.

Source: Author's calculations.

Table 3. **Participation effects of three policy scenarios for older workers** (*cont.*)

Panel B. 65 and over

	2025, projected[1]	Reform 1		Reform 2		Reform 3	Total	
		Early schemes removed		Actuarial fairness		Standard age to 67		
		Low case	High case	Low case	High case		Low case	High case
	Level	In percentage points						
Australia	7.4	0.0	0.0	2.6	3.7	1.3	3.8	5.0
Austria	3.2	1.5	3.3	3.9	7.4	4.6	9.9	15.3
Belgium	2.6	0.6	1.5	2.7	4.9	0.6	3.9	7.1
Canada	6.7	0.0	0.0	0.8	1.3	1.4	2.1	2.7
Czech Republic	4.3	. .	. .	. .	. .	2.5	2.5	2.5
Denmark	1.1	. .	. .	. .	. .	0.9	. .	. .
Finland	4.5	0.7	1.7	3.8	5.9	1.0	5.4	8.6
France	2.1	0.2	0.4	3.4	5.4	2.9	6.4	8.8
Germany	3.7	0.7	1.7	0.4	1.0	1.0	2.1	3.8
Greece	9.1	. .	. .	. .	. .	1.5	. .	. .
Hungary	1.8	. .	. .	. .	. .	1.3	. .	. .
Iceland	19.6	0.0	0.0	2.5	3.1	0.0	2.5	3.1
Ireland	10.6	1.1	2.5	1.4	2.5	0.9	3.3	5.9
Italy	8.4	0.0	0.0	5.1	6.0	1.2	6.3	7.2
Japan	17.5	0.0	0.0	3.1	5.6	2.1	5.2	7.7
Korea	20.3	0.0	0.0	4.6	7.6	7.2	11.7	14.8
Luxembourg	3.2	0.9	2.3	0.6	1.8	0.9	2.4	5.0
Mexico	32.7	. .	. .	. .	. .	2.6	. .	. .
Netherlands	5.7	0.5	1.4	2.6	7.0	1.2	4.3	9.6
New Zealand	12.8	0.0	0.0	0.0	0.1	1.8	1.9	1.9
Norway	6.2	1.5	1.8	4.4	5.7	0.0	5.8	7.5
Poland	5.8	. .	. .	. .	. .	1.7	. .	. .
Portugal	28.6	4.5	11.4	2.6	5.3	2.2	9.3	18.9
Slovak Republic	1.0	. .	. .	. .	. .	1.8	. .	. .
Spain	3.1	0.5	1.2	7.4	10.4	1.1	9.0	12.7
Sweden	1.7	0.0	0.0	3.8	4.5	1.3	5.1	5.8
Switzerland	10.4	0.0	0.0	2.4	3.9	2.2	4.7	6.1
Turkey	14.0	. .	. .	. .	. .	4.5	. .	. .
United Kingdom	7.5	0.4	1.0	1.9	2.7	1.4	3.7	5.1
United States	16.8	0.0	0.0	1.7	2.6	0.0	1.7	2.6
OECD average[2]	**9.1**	**0.6**	**1.4**	**2.8**	**4.5**	**1.8**	**4.9**	**7.6**

1. Projected participation rates incorporate future demographic developments as well as the anticipated effects of recently legislated pension reforms that have not yet been fully implemented (*e.g.* the transition to the "new" system in Italy). See Burniaux *et al.* (2003).
2. Unweighted average.

Source: Author's calculations.

Korea or Japan, the working life would also be lengthened (compared with baseline projections) by moving towards actuarial neutrality.

The third policy simulation presented in Table 3 is a convergence of standard retirement ages to 67 for both males and females (Reform 3). This stimulates participation by creating "liquidity" and/or "customary" effects on the retirement decision, which come over and above those *via* implicit tax rates. Reform 3 in Table 3 only concerns this channel. The results should be interpreted as the additional impact of raising the standard age – and the early age simultaneously by the same number of years[54] – once early retirement schemes are removed and the pension system is actuarially neutral. The effects on the 55+ age group appear to be sizeable in those countries where the standard retirement age is currently low (Czech Republic, France, Hungary, Korea, Slovak Republic, Turkey) and/or where it is significantly lower for females (Poland, Slovak Republic, Turkey).[55]

POLICY DISCUSSION

The previous section implicitly suggests that closing early pathways into retirement is the most straightforward step towards reducing implicit tax rates, for two main reasons: *i*) it would leave older workers in their late fifties and early sixties facing only the – significantly lower retirement incentives embedded in old-age pension systems; and *ii*) reforming old-age pension systems could well have fairly small participation effects if the access to early retirement schemes for people without special needs is not removed, as more workers would otherwise retire through these schemes. Likewise, reforming only some pathways into early retirement is likely to be ineffective because workers may leave the labour market *via* other schemes. Even though it is sometimes argued that early retirement systems help cover the risk of exclusion from the labour market at high ages, and may thus be particularly valuable when such risk is high and/or when workers are highly risk averse (Blanchet *et al.*, 1996), these schemes also create large disincentives to continued work, so that it remains unclear in practice whether all early pensioners can be considered as permanently excluded from the job market. Developing the employment chances of the elderly remains the first-best solution to deal with the exclusion problem.

Nevertheless, suppressing early retirement schemes would not be sufficient to bring implicit tax rates down to zero, because old-age pension schemes also entail implicit taxes on continued work, especially in some (mostly Continental European) countries and at high ages. To achieve a reduction in implicit tax rates embedded in old-age pension schemes, the most straightforward way is to adjust appropriately the value of pension benefits in case of anticipated and deferred retirement. While such adjustments currently apply in a number of OECD countries, they are usually below actuarially neutral levels.

In particular, many PAYG schemes do not provide actuarial bonuses for deferred retirement beyond the standard age (*e.g.* the flat-rate systems in Australia, New Zealand or the United Kingdom, but also, most importantly, the more generous earnings-related schemes in France[56] and Netherlands until recently, or Norway), thereby discouraging work at high ages. For instance, assuming for simplicity a constant mortality rate of 3 per cent at each age, a real interest rate of 3 per cent, and contribution rate to the old-age pension system of 17 per cent, a rough calculation suggests that this bonus would have to be approximately equal to 7 per cent for the pension system to be neutral (see formula in Box 4). And since the assumption of a constant mortality rate does not hold in practice, the actuarial bonus for deferred retirement should rise steadily with age in order to compensate for increasing mortality risks.

Implicit taxes on continued work could also be reduced by expanding the possibilities for older people to combine work with the receipt of a pension, which remain limited in most OECD countries. The key advantage of such an option, compared with setting appropriate actuarial adjustments for anticipated and deferred retirement is that it provides an easier and, at the same time as effective way to reduce implicit tax rates on continued work at high ages. However, its impact on effective retirement ages might be smaller in practice,[57] because it makes earlier retirement affordable for otherwise "liquidity constrained" individuals. This presumption is corroborated by available empirical evidence, which suggests that past experiences in removing retirement earnings tests have rarely been followed by large pickups in the labour supply of the targeted age groups (Gruber and Orszag, 2000). In addition, to the extent that late retirement is often associated with individual characteristics such as high skills, high wages and above-average health (Peracchi and Welch, 1994; Haider and Loughran, 2001), letting older workers combine work with the receipt of a pension may, in practice, raise a vertical equity issue.

Another policy option available to policymakers (not tackled in this paper) is to encourage progressive retirement. In terms of hours worked, the labour supply effects of gradual retirement may actually not be very large, because some incumbent workers choose to work part-time, while they would work full-time under more rigid work schedules. However welfare is *a priori* improved. Indeed, since the marginal utility of work probably declines only gradually, "staged" retirement seems to be a route by which individuals may benefit from staying longer in the labour market. General lack of flexibility in working-time arrangements can be detrimental to part-time work at high ages, but some specific characteristics of old-age pension systems may also play an important role. For instance, pension benefits formulae based on previous income prior to retirement and/or the lack of pension coverage for part-timers[58] may deter older workers from taking up part-time work. Furthermore, explicit partial retirement schemes by which individuals can draw reduced retirement benefits while continuing to work part-time before the standard entitlement age to a full pension, are still not widespread across OECD countries (Denmark, Finland or the Netherlands are among the exceptions). Such schemes should be properly structured so as to limit their cost, while at the same time providing sufficient incentives to work part-time.[59] In this respect, an actuarially neutral system of gradual retirement may be thought of as an appropriate benchmark.

CONCLUSION

The analysis presented in this paper has shown that there is currently wide dispersion across OECD countries in implicit tax rates on continued work embedded in old-age pension systems and other social transfer programmes: they are high in most Continental European Countries, compared with Japan, Korea, English-speaking and Nordic countries. Simple cross-country correlations suggest that such taxes induce older male workers to anticipate their retirement decision. This finding is confirmed by panel data econometric estimates, for each of the 55-59, 60-64 and 65+ age groups. For the 55-59 age group, there is clear evidence that these effects result from a number of social transfer programmes, which have been used *de facto* as early retirement schemes, rather than from old-age pension systems themselves. For the 60-64 and 65+ age groups, eligibility ages also appear to have a specific impact on the retirement decision, probably reflecting liquidity and/or customary effects. Furthermore, the prevalence of unemployment is also found to be a significant – albeit smaller compared with retirement incentives – influence on retirement behaviour, possibly reflecting "discouraged worker" effects. This suggests that policies to reduce structural unemployment, which go beyond the scope of this paper, may also contribute to raise the labour market attachment of older workers.

As in previous studies, the estimated participation effects of implicit tax rates are significantly lower than those found in microeconometric analyses of the retirement decision. In addition, past changes in implicit tax rates and standard retirement ages are found to explain only a third of the trend decline in older males' labour force participation in OECD countries over the last three decades.[60] This suggests that other determinants, such as preferences for leisure or "demand-side" factors, may have also played an important role in driving down participation rates. Nevertheless, even with these relatively low participation elasticities, the potential impact of policy reforms on labour force participation is found to be fairly large, given the magnitude of retirement incentives still embedded in a number of old-age pension schemes and other social transfer programmes. In addition, moving towards more actuarial neutrality of retirement schemes would reduce the current bias towards early labour market withdrawal, thereby improving welfare.

NOTES

1. In principle, there is no straightforward relationship between the share of the labour force participating in the labour market and the effective age at which participants retire. For instance, even if participation is higher in a country than another, the effective retirement age may still be lower if labour market participants withdraw earlier. However, as shown in Figure 1, there is actually a very strong cross-country relationship between both variables: countries with lower participation rates of older workers tend to have lower effective retirement ages. Therefore, increasing the effective retirement age and raising the labour force participation of older workers appear to go hand in hand in practice.
2. For instance, under a set of simplifying assumptions, among which the potential participation rate of the 55-64 age group is equal to that of the 25-54 age group, Herbertsson and Orszag (2003) estimate that the loss of output which can be attributed to early retirement was equal to 7 per cent of GDP on average in the OECD area in 2001. There were wide differences across countries, with the output cost ranging from 1.6 per cent of GDP in Iceland to as high as 16.5 per cent in Hungary. Under the assumption that the potential participation rate of the 55-64 age group is 10 per cent below rather than equal to that of the 25-54 age group, these output cost estimates decrease by 25 per cent on average, but still remain large.
3. For some recent considerations on these factors, see for instance OECD (2003a).
4. For instance, despite being ranked among the highest OECD countries in terms of GDP per capita, Japan and the United States have significantly above-average participation rates for older workers. Similarly, demand for leisure is unlikely to differ drastically across OECD countries given their economic and socio-cultural integration. However, these factors may have contributed to a common trend decline in participation rates of older workers within OECD countries over the past decades, at least to the extent that they have dominated the opposite effects of higher life expectancy and improved health status. For instance, Johnson (2000) provides evidence of negative participation effects of rising living standards for a panel of developed countries, while Costa (1997) suggests similar effects from rising demand for leisure – associated with declining relative prices and improving quality of leisure goods. Nevertheless, these explanations for declining effective retirement ages in the OECD area are not fully convincing. Indeed, they would imply a concomitant trend increase in leisure time during working life. Yet, over the last three decades declines in working time have been modest compared with those in effective retirement ages.
5. If, as is often the case in practice, the real interest rate is higher than the growth rate of real wages, pension wealth is lower under a PAYG system that under a funded system or in the absence of any pension scheme. Therefore, the existence of a PAYG system reduces consumption and pushes individuals to work longer.

6. Lifetime retirement models also rely on the assumption that individuals have a long planning horizon in making their labour supply decisions and fully recognise the value of accumulating entitlements to future benefits associated with contributions paid.
7. Even if the amount of contributions is so high that it exceeds desired saving, such PAYG scheme would still not affect labour supply behaviour as long as individuals can borrow at the same rate used to compute pension benefits.
8. Expected increases in the generosity of pension benefits yield smaller labour supply effects than unexpected ones. The farther in advance changes in scheme provisions are announced, the more workers increase their consumption and reduce their savings in anticipation of future pension wealth gains (Feldstein, 1974), the smaller the increase in their total wealth and the corresponding impact on their retirement decision.
9. The more workers care about the welfare of their descendants and realise that the cost of higher benefits will have to be borne by them, the more changes in the generosity of benefits are offset by changes in bequests, and the smaller the "wealth effect" on labour supply.
10. Anderson *et al.* (1997) suggest that the large unanticipated increase in the level of social benefits that took place in the United States during the 1970s created windfall gains in the value of retirement assets of those nearing retirement, thus inducing some of them to anticipate their retirement decision. Unlike older workers, younger cohorts were less affected because they had time to adjust their savings patterns to reflect these windfalls.
11. Earnings just prior to retirement are assumed to be a reasonable proxy for expected earnings from work, which in theory should be used in the calculation.
12. For instance, in flat-rate pension systems, these factors may include household composition and the amount of other income and/or assets. In earnings-related pension schemes, they usually include *inter alia* the length of the working life and other periods to be credited for pension purposes (such as education, child care or unemployment), as well as the age-earnings profile over the worker's career. Furthermore, these schemes may differ across sectors and/or types of jobs.
13. Unlike expected replacement rates, simple replacement rates at specific retirement ages could have been misleading. For instance, if in two countries the minimum eligibility age is 65, a worker retiring at age 64 receives no benefit and his/her replacement rate is zero in both cases. Yet, after waiting for a year, he/she may receive a significantly higher pension in one country than in the other. Therefore, considering simple replacement rates at specific ages would incorrectly suggest that both schemes are equally unattractive. Comparatively, average expected replacement rates over a five-year period provide a more accurate picture.
14. These figures refer to the "steady state" of current pension systems. As a consequence, they incorporate all future effects of recently enacted reforms (*e.g.* Austria, France, Italy, Sweden). In addition, in those countries where old-age pension systems are not yet mature (*e.g.* Korea, Norway to a lesser extent), or where new components of the system will mature only gradually (*e.g.* the Superannuation Guarantee scheme in Australia, to which participation became mandatory only in 1992), the figures reported in Figure 2 are the replacement rates provided by these systems once they reach maturity. Not incorporated in the calculations are the projected rise in the standard retirement age from 60 to 65 in Korea (as part of the 1998 reform), the future increase in the minimum retirement age (*i.e.* at which superannuation savings can be drawn) from 55 to 60 over

the period 2015-2025 in Australia, as well as the projected rise in the minimum retirement age from 60 to 65 in Japan (as part of the 2000 reform which came into law in April 2002). For further details, see Duval (2003), Appendix 3.

15. This does not incorporate early retirement due to long insurance years, which can be accessed from age 61.5 with a 69.5 per cent replacement rate for the theoretical worker considered.

16. This does not incorporate the early retirement (AFP) scheme, which can be accessed from age 62 with a 34.5 per cent replacement rate for the theoretical worker considered.

17. In the case of Netherlands, the modelling at age 60 refers to a "typical" early retirement (VUT) scheme. However since the early 1990s these PAYG schemes have been progressively transformed into less generous, fully-funded, systems. More recently, a government plan was presented to Parliament, which proposed to abolish the preferential fiscal treatment of early retirement schemes. As a result of these transformations, the current expected replacement rate at age 60 may be overstated.

18. Australia and Korea are two exceptions (Figure 3). However, in both countries, higher replacement rates in current pension systems (at their steady state) compared with the late 1980s reflect their maturation (the Superannuation Guarantee Scheme in Australia, the National Pension Scheme in Korea: see Duval, 2003, Appendix 3), rather than an increased generosity in benefit payments.

19. Three countries for which Figure 3 also shows an increase in replacement rates at age 60 are Australia, Korea and Portugal. However this increase did not affect participation patterns over the past decades, either because it is too recent (Portugal, following the 2002 pension reform which lowered the minimum retirement age from age 65 to 55) or has not yet occurred (Australia and Korea, where pension schemes are not yet mature: see above).

20. This definition refers to actuarial neutrality *at the margin* (*i.e.* for an additional year of work). Actuarial neutrality *on average* (*i.e.* over the life cycle of the individual) is achieved when the (present) value of pension benefits received during retirement is equal to the (present) value of contributions paid during the working life.

21. As suggested by Lazear (1986), over and above the usual wage rate, the implicit tax/subsidy on continued work can be regarded as a component of the "true wage". From this perspective, a rise in the implicit tax on continued work – due for instance to a cut in the pension accrual rate – is equivalent to a fall in the wage rate, producing opposite substitution and income effects: the lower financial gain from postponing retirement reduces the opportunity cost of retiring earlier (negative substitution effect) but, at the same time, provides lower income for each future year of work, thereby inducing later retirement (positive income effect).

22. Implicit tax rates at age 65 are actually higher than at age 60 in the majority of OECD countries. Nevertheless they are very low in those countries where it is possible to combine work with the receipt of a full or reduced pension (see Box 3), which lowers the OECD average (*e.g.* Canada, Germany, Luxembourg, Netherlands, New Zealand).

23. Excluding France and Luxembourg – where high implicit subsidies on continued work tend to inflate variance across countries at age 55 –, the cross-country dispersion of implicit tax rates is almost four times as high at age 60 as at age 55, and is about 50 per cent higher at age 65 than at age 60.

24. Belgium, Finland, France, Germany, Netherlands, Portugal, Spain, United Kingdom.

25. Austria and Luxembourg (where disability benefits were considered given their widespread incidence among pensioners), as well as Ireland and Norway (where the modelling refers to the pre-retirement allowance and the special early retirement programme, respectively).

26. Australia, Canada, Iceland, Italy, Japan, Korea, New Zealand, Switzerland, United States.

27. To see this, one can consider a purely illustrative country in which the pensionable age would be 100. Whatever the generosity of future benefits and the pension accrual rate between 60 and 65, pension wealth would be very low at both ages because pension flows to be received far into the future would be heavily discounted. Therefore, the change in pension wealth from continuing working between 60 and 65 would also be very small.

28. Strictly speaking, people in the 50-54 and 55-59 age groups in 1999 belong to different birth cohorts. As a consequence, as computed in Figure 7, the difference in participation between these two age groups reflects not only a participation effect but also a cohort effect. However, in practice, the latter is very small compared with the former. Therefore, using the difference in participation within a given cohort (*i.e.* the participation rate of the 55-59 age group in 1999 less the participation rate of the 50-54 age group in 1994) would leave Figure 7 unaffected. The same applies to Figure 8 (55-59 and 60-64 age groups).

29. The standard labour tax rate for single workers with average production worker (APW) earnings is computed using the OECD tax models. Insofar as it is an average tax rate, the aggregate labour tax rate should also be viewed as an average rather than as a marginal tax. Moreover, the tax treatment of pension benefits is omitted from the calculations. Their incorporation would lower the aggregate labour tax rate, *ceteris paribus*.

30. However, the difference between slope coefficients in Panels B and C is not significant at the 5 per cent level.

31. For instance, when early and standard retirement ages are lowered and/or when early retirement benefits are allowed or extended, the social wealth of older workers and the implicit tax on continued work tend to rise. Therefore, historical experiences showing the effective age of retirement plummeting following benefit extensions (such as Germany and France respectively in the aftermath of the 1972 and 1981 reforms) or, conversely, soaring following benefit restrictions (New Zealand during the 1990s), can be interpreted as evidence of a powerful effect of retirement incentives on the labour supply of older workers.

32. To see how considering large age-bands tends to bias the analysis of participation trends, one can consider a hypothetical country where (different) participation rates of both the 55-59 and 60-64 age groups would have remained constant over past decades. A *priori*, one would expect the participation rate of the aggregate 55-64 age group to have also been stable. Yet it would actually show a decline, because population ageing increases the weight of older age groups with lower participation rates. In this hypothetical example, considering the 55-59 and 60-64 age groups separately would remove part of this demographic bias.

33. In eight of these countries, time series for participation rates and explanatory variables are actually shorter (see Box 2), implying that panel datasets used in the estimates are unbalanced.

34. For instance, despite no implicit tax on continued work beyond age 65, the participation rate of the 65-69 age group in Luxembourg ranks among the lowest in the OECD area, partially because high implicit taxes at earlier ages induce massive retirement before age 65. Despite these concerns about a specification in levels, such an equation has been tested with results that in qualitative terms resemble those of the preferred specification in first differences.
35. Including both the replacement rate and the implicit tax on continued work in the regressions would raise a multicollinearity issue – the cross-country correlation coefficient between both variables in 1999 is, for instance, above 0.8 for the 60-64 age group – and bias the estimated coefficients.
36. Not surprisingly, the standard – as well as the early – retirement age proved to be insignificant for the 55-59 age group.
37. Stock and Wise (1990), based on Lazear's intuition (1979) that by delaying retirement, individuals retain the option to retire at a later date under potentially more advantageous terms. For a brief overview of this model, see Duval (2003), Appendix 5.
38. Earnings over the past and potential future years of work, as well as the marginal utility of leisure, would be required to estimate the full model.
39. To a certain extent, such shocks reflect business cycles and are, therefore, already captured by the unemployment rate. However, time fixed effects were found to be significantly different from zero at the 5 per cent level in all regressions below.
40. However, they may affect more the age of departure from a particular firm than labour force withdrawal *per se*, especially when prior knowledge of their characteristics enables workers to smooth consumption and labour supply over the life cycle.
41. For instance, theoretical replacement rates computed for Spain are significantly higher than actual average replacement rates. One reason for this gap is the assumption of an uninterrupted career used in the modelling, which does not hold in practice in Spain due to persistently high unemployment until very recently. In addition, the calculation of implicit tax rates implicitly assumes that all workers are covered by the old-age pension system. As a result, it does not capture the trend increase in pension coverage experienced in a number of OECD countries over the past three decades.
42. There could also be a problem of reverse causality on two grounds: *i*) (older) voters with a strong preference for retirement may push towards lower eligibility ages and higher implicit tax rates; *ii*) the deterioration of employment opportunities of older workers may force them out of the labour market, thereby inducing governments to improve the generosity of pension systems and other social transfer programmes. However, Johnson (2000) suggests that the latter bias may be small in practice. Looking at major past changes in scheme provisions in a number of OECD countries, he finds that they have preceded, not followed, declines in older workers' participation.
43. In order to obtain meaningful coefficients for country-specific time trends, Model A is estimated on a balanced (14 countries over the period 1967-1999) rather than an unbalanced (14 countries and eight other for which time series for participation rates and explanatory variables are much shorter) panel dataset.
44. This variable takes the values 0, 1 and 2 for those countries where retirement incentives embedded in old-age pension and early retirement schemes are classified respectively as low (Australia, Canada, Ireland, Norway, Sweden, United States), moderate (Germany, Portugal, Spain, United Kingdom) and large (Finland, France, Italy, Netherlands) on the basis of their implicit tax rates.

45. The coefficients are not statistically different at the 5 per cent level. However, the point estimate is smaller for the 55-59 age group. This finding comes as no surprise, given the difficulty to capture the complex influence of early retirement schemes on the retirement decision through a single quantitative variable. In particular, no account is made for the number of existing retirement routes and for the degree of strictness with which eligibility criteria (*e.g.* for granting disability pensions) are applied in practice.
46. More specifically, Model C corrects for country-wise heteroskedasticity (using Feasible Generalised Least Squares) rather than for individual heteroskedasticity (using the Huber/White/sandwich estimator of variance) as in Model B.
47. In order to assess the potential impact of demographic trends on the labour force attachment of older workers, specifications including the share of prime-age workers (aged 25-54) in total working-age population (aged 15-64) as an explanatory variable were also estimated. A *priori*, usual cohort-crowding effects would suggest a positive effect: the larger the number of prime-age workers compared with older ones, the higher the relative wage rate of the latter and the higher their labour force participation rate – to the extent that the substitution effect dominates the income effect. However, this demographic variable was found to have a significantly negative effect for both the 55-59 and 60-64 age groups. The rationale behind this result remains unclear. One possibility is that the increase in the share of prime-age, better educated workers which occurred throughout the 1970s and the 1980s deteriorated the employment opportunities of less educated older workers, all the more so in the presence of rigid age-earnings profiles. In any event, the coefficients of all other variables (implicit taxes, the standard retirement age and the unemployment rate) were insensitive to the introduction of this demographic variable.
48. The elasticities derived in Blöndal and Scarpetta (1998) are not directly comparable to those presented in Table 2, because the dependent variable was the participation level of the 55-64 age group rather than the fall in participation between two consecutive age groups. However, in practice, the potential impact of cuts in implicit tax rates on the labour force participation of the 55-64 age group, as calculated using Model B, appear to be larger than those simulated in Blöndal and Scarpetta (1998). This result comes as no surprise given the more disaggregated analysis adopted in the present paper.
49. At first glance, the latter should be inflated by an omitted variable bias, but this intuition does not appear to be confirmed by the data. In particular, the unemployment rate variable is barely significant at the 5 per cent level and does not reduce the implicit tax rate coefficient in a cross-country regression.
50. In some cases -most importantly Korea, the projection also includes the future impact of the maturation of pension schemes.
51. For countries not covered in the modelling of early retirement incentives (Czech Republic, Denmark, Greece, Hungary, Mexico, Poland, Slovak Republic, Turkey), no attempt is made at assessing the future effects of recent reforms and/or the maturation of pension systems on implicit tax rates and labour force participation. However, the impact of recent or projected changes in standard retirement ages is incorporated (Czech Republic, Greece, Turkey and Denmark).
52. Another reason for this finding may be that all the policy simulations presented in Table 3 assume no impact on the labour force participation of workers aged under 55, which is unlikely to be true. Yet since the dependent variable in all regressions is the difference in participation rates between two consecutive age groups, the initial level

at age 55 plays an important role in the simulations. For instance, the low labour market attachment of the 50-54 age group in Italy explains to a large extent why participation rates of workers aged 55 and over remain relatively low in both baseline projections and reform scenario.

53. The population aged 65 and over is larger in size than that aged between 55 and 64 in all OECD countries, and in some cases significantly so (1.7 times in France in 2000). Therefore increases in the labour market attachment of the 65+ age group have disproportionately large impacts on the labour force participation rate of the 55+ age group.

54. The early age was significant at the 5 per cent level in Model B, when the standard age was excluded. However it was left out of the final estimates, due both to multicollinearity problems and the higher level of statistical significance of the standard age. Therefore, even though it was not possible to separate the effects of both eligibility ages, there is indication that the early age also affects labour force participation, mostly through liquidity effects.

55. However, it remains unclear whether an increase in early and standard retirement ages, in an already actuarially neutral pension system, would be desirable. Indeed, to the extent that its impact on the retirement decision mainly comes from "liquidity" rather than "customary" effects, it would merely raise participation by forcing liquidity-constrained individuals to remain in the labour market longer than they wish to. In this context raising eligibility ages to benefits would not be welfare-enhancing.

56. The 2003 pension reform created a 3 per cent actuarial adjustment for deferred retirement.

57. By contrast, its impact on welfare might be larger because it helps to reduce a capital market imperfection.

58. Some countries apply entitlement rules based on a minimum number of hours (Denmark, Ireland) or a minimum income (Austria, Spain, Ireland, Germany, the United Kingdom), under which contributions to state pension schemes are not allowed. In addition, private occupational schemes do not always admit part-time workers (*e.g.* in almost a third of cases in the United Kingdom according to Ginn and Arber, 1998).

59. For instance, the partial pension system which prevailed in Sweden between 1976 and 2001 proved to be excessively costly (Disney, 1996), not least because it went far beyond actuarial neutrality by subsidising heavily part-time work.

60. This figure is a simple arithmetic average of contributions found for the 14 OECD countries for which lengthy time series of participation rates are available, using the coefficients in Model B. It reaches 40 per cent when the whole model (including the effect of rising unemployment rates in a number of continental European countries) is considered.

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