

ANNEX I.2

*Sensitivity Analyses***1. Varying rates of return on defined-contribution pensions**

Six OECD member countries have defined-contribution (DC) pensions. Pension entitlements in DC schemes depend crucially on the rate of return earned by the contributions when they are invested. The baseline assumption of the modelling is that the real return earned by DC pensions is 3.5% per year. This is a relatively conservative assumption by historical, empirical standards. Between 1984 and 1996, real rates of return of pension funds in eight OECD countries averaged 8% per year (OECD, 1998, Table V.3).

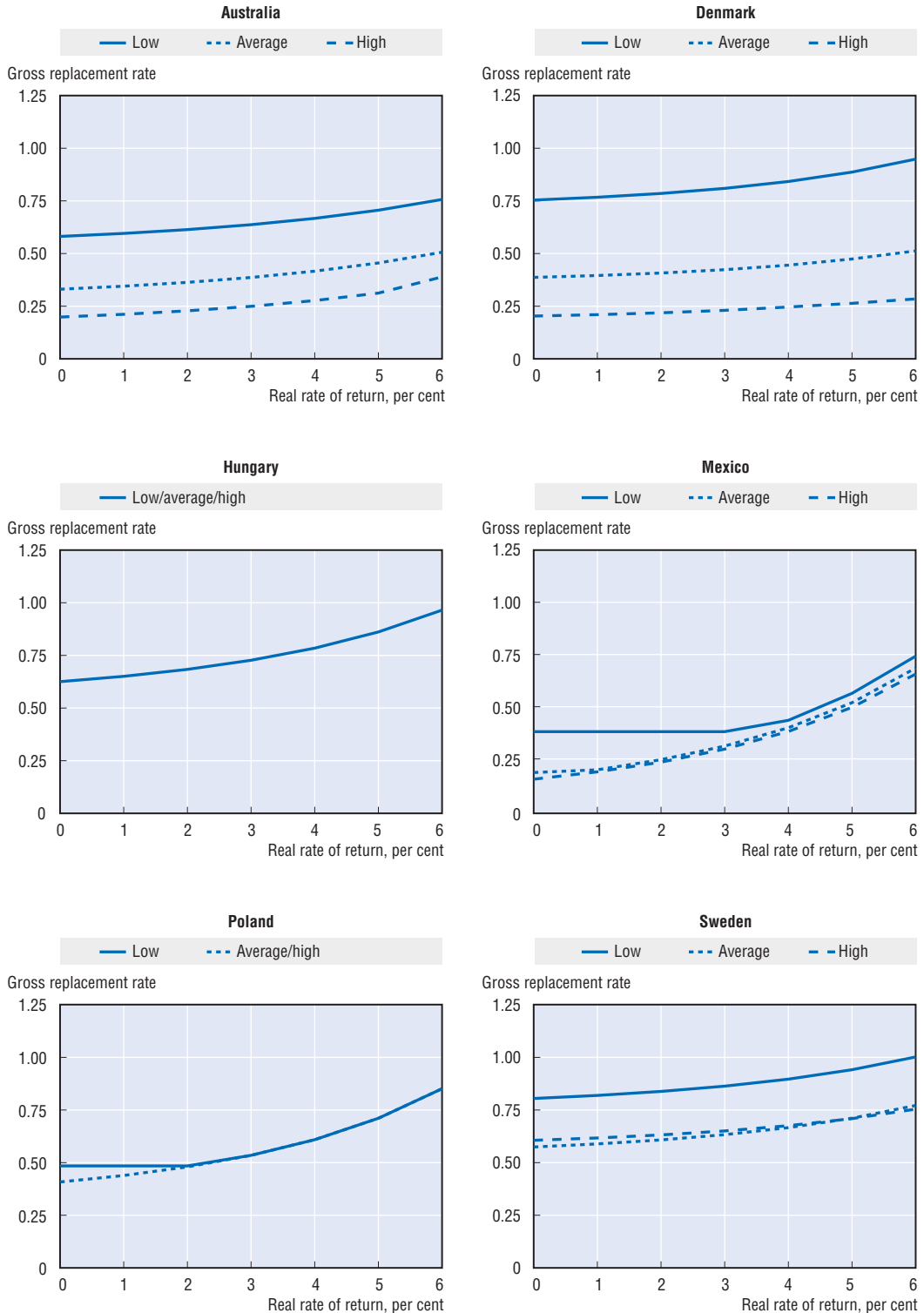
Nonetheless, some commentators argue that the risk-adjusted rate of return on defined-contribution pensions cannot exceed the riskless interest rate (for example, Bodie, 1995). This variable, which underlies the actuarial calculations in this report, is assumed to be 2%. On the other hand, other analysts argue that there is an “equity premium” that delivers higher returns than the riskless interest rate even allowing for the costs of the risk borne. These issues have generated a substantial literature.¹

Given the uncertainty about future rates of return on DC pensions, pension entitlements have been modelled using a wide range of real returns, from zero to 6%. The total pension entitlement is shown in Figure I.2.1 including all pension sources. The figures show the replacement rate for low, average and high earners (defined as earning half, average and twice average) under different assumptions for the real rate of return.

Overall pension entitlements in countries with substantial DC schemes are most sensitive to earnings in Mexico. This is because other countries have more substantial public pensions (which, of course, do not vary with the rate of return) than the Mexican minimum pension. A high rate of return (6%) would virtually double the value of Mexican pension entitlements relative to the baseline assumption (of 3.5%). The effect of a lower return than in the baseline is similar: a rate of return of zero cuts benefits by one half compared with the baseline for average and high earners. Low earners, however, are protected from the effects of a lower rate of return by the minimum pension. A similar effect can be observed for low earners in Poland.

Pension entitlements in other countries are less sensitive to the rate of return. In Hungary, for example, the pension is only 25% higher with the maximum rate of return. This is because two-thirds of the pension package under the baseline assumptions comes from the public pension (Table 7.2). In Australia, the effect of the rate of return is muted by the means test in the public pension system. Even high earners are entitled to some age pension. This means that, for each extra dollar of income from the defined-contribution

Figure I.2.1. **Total gross replacement rates for low, average and high earners by rate of return on defined-contribution pensions**
As a proportion of individual earnings



Source: OECD pension models.

plan, 40 cents of age pension is withdrawn. Similarly, in Sweden, the income-tested guarantee pension covers both the low and average-income earner on the baseline assumptions. This, coupled with the relatively small contribution to the two defined-contribution schemes, means that the overall pension benefit is least sensitive to the rate of return in Sweden of all the six countries with mandatory defined-contribution plans.

Most of the countries with mandatory DC plans have various types of guarantees of either the pension value or the rate of return that individual accounts earn. These guarantees are additional to the protection afforded by various public pension programmes, including minimum pensions.² They are financed in many different ways, including resources within the pension fund, the capital of the pension-fund manager, a central guarantee fund and the government's general budget.

Hungary and Mexico offer absolute guarantees of the pension level. Conditional on a contribution history of 15 years, the government in Hungary guarantees that the annuity bought from the DC accumulation will be at least 25% of the benefit under the public, earnings-related pension scheme. Mexico transferred all workers to the new private scheme. The guarantee is that the government will make up the difference if the annuity provided by the private scheme is lower than the benefit that they would have received under the old regime. Indeed, most people nearing retirement at present are virtually certain to trigger the guarantee.

Poland provides a different kind of guarantee: on the rate of return earned by a particular pension fund relative to the rates of return earned by other pension funds. The guarantee is that returns are at least the smaller of 50% of all funds' average nominal return and the average nominal return minus 4%. Hungary also has a relative rate-of-return guarantee: that the return must be better than 15 percentage points below the return on an index of government bonds.

The effect of these guarantees on individual pension entitlements is impossible to model with any reasonable precision, because it depends both on the performance of capital-markets as a whole and the outcomes delivered by particular pension funds.³

2. Varying real rates of growth of economy-wide average earnings

In the great majority of the earnings-related pension systems in OECD member countries, earlier years' earnings are adjusted (or "valorised") in line with economy-wide average earnings when calculating benefits (Table 2.2 in Chapter 2). In these cases, the results (for replacement rates, pension wealth, etc.) are insensitive to variations in the assumption for economy-wide wage growth. If wages grow faster than the baseline assumption, then earlier years' earnings will be revalued by a larger amount, leaving the replacement rate and other indicators unchanged.

However, a small number of countries valorise earnings in a less generous way than adjusting individual earlier years' earnings in line with economy-wide earnings growth. In Belgium, the French public scheme, Korea and Spain, earlier years' earnings are valorised in line with prices. In Portugal, valorisation is mixed: 75% to prices and 25% to earnings with a maximum uplift of 0.5% per year.

There are policies in points and notional-accounts schemes that are the parallel of valorisation in DB plans. In the French occupational plan, the uprating policy for the value of the pension point (which has the same effect as valorisation in defined-benefit schemes)

is also linked to prices. In Poland, the notional interest rate (again the parallel of valorisation) is currently prices plus 75% of growth in the real wage bill. In all these cases, the value of pension entitlements is sensitive to the assumption for economy-wide average earnings growth. Faster growth of earnings means that pension entitlements of earlier years fall further behind individual wages, meaning that replacement rate and relative pension level are lower.

Figure I.2.2 shows pension replacement rates at different assumptions for average earnings growth, ranging from zero to 3% per year. (The baseline assumption is for 2% annual earnings growth.) Replacement rates are shown for low, average and high earners (that is, half, average and double average pay).

In Belgium and Portugal, low-income workers are protected from the effects of variations in earnings growth by minimum pension credits and minimum pensions respectively. Overall, pensions are most sensitive to this assumption in Belgium. This is because the public pension is based on lifetime average earnings, which maximises the impact. In the French public scheme, in contrast, the earnings measure is the best 25 years and in Spain, it is the final 15 years. This mutes the impact compared with Belgium. In Poland and Portugal, the sensitivity is lessened by the partial valorisation to earnings. At average earnings, the effect of earnings growth of three rather than 2% is to cut the replacement rate by 15% in Belgium, 13% in Poland and Portugal, 12% in France and 6% in Spain.

3. Varying individual career earnings paths

The great majority of OECD countries use lifetime average earnings to calculate earnings-related pension benefits. This, coupled with a policy of earnings valorisation of earlier years' pay, means that pension entitlements are insensitive to the shape of the individual career earnings path. An individual with a steeper age-earnings profile will receive the same benefit relative to lifetime average revalued earnings. In some countries, however, pension benefits are calculated based on a limited number of best or final years' pay. In the French public scheme, benefits are currently based on the best 20 years' earnings, which will gradually move to 25 years. Similarly, Norwegian pensions are based on the best 20 years' points. In Spain, the earnings measure is the final 15 years. Finally, results are also shown for Belgium, which uses lifetime average pay, to show the effect of a policy of prices valorisation in isolation.

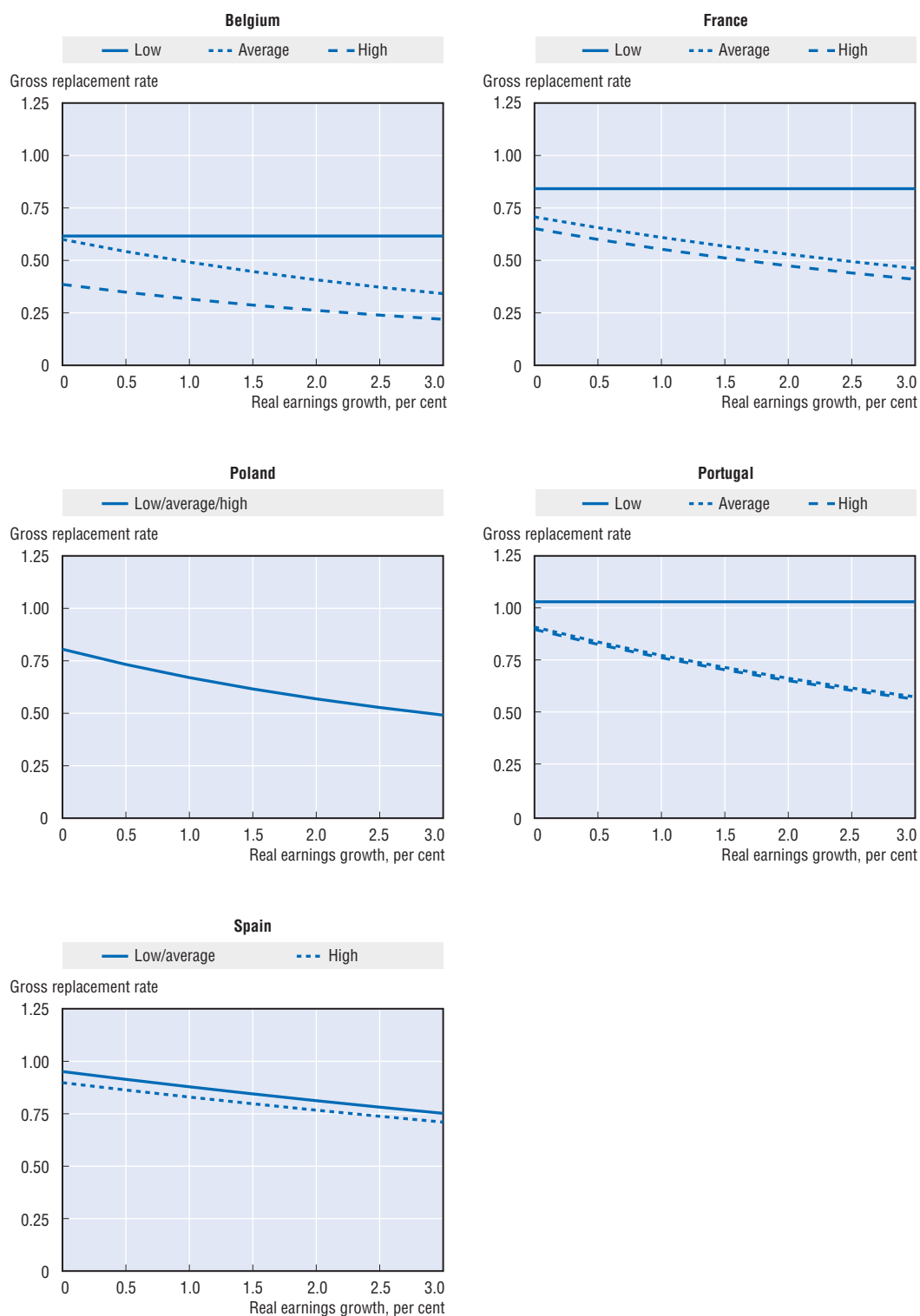
Figure I.2.3 shows how pension entitlements vary with individual earnings growth relative to the economy-wide average. The baseline results assume that individual earnings growth over the career tracks the economy-wide average, implying that the baseline assumption is zero in these figures.⁴ As in the previous sensitivity analyses, low and high earners are defined as half and double the average.

The impact of career earnings profiles is most marked in Spain because Spain has the shortest period over which pensionable earnings are measured. Individual earnings growth of 1% ahead of average earnings across the career gives a pension 16% larger than the baseline assumption that individual earnings grow in line with the average.

The effect is also quite large for the average earner in Norway, where the averaging period is 20 years. However, it is muted for high earners by the effect of the pension ceiling and for low earners by the basic and resource-tested benefits.

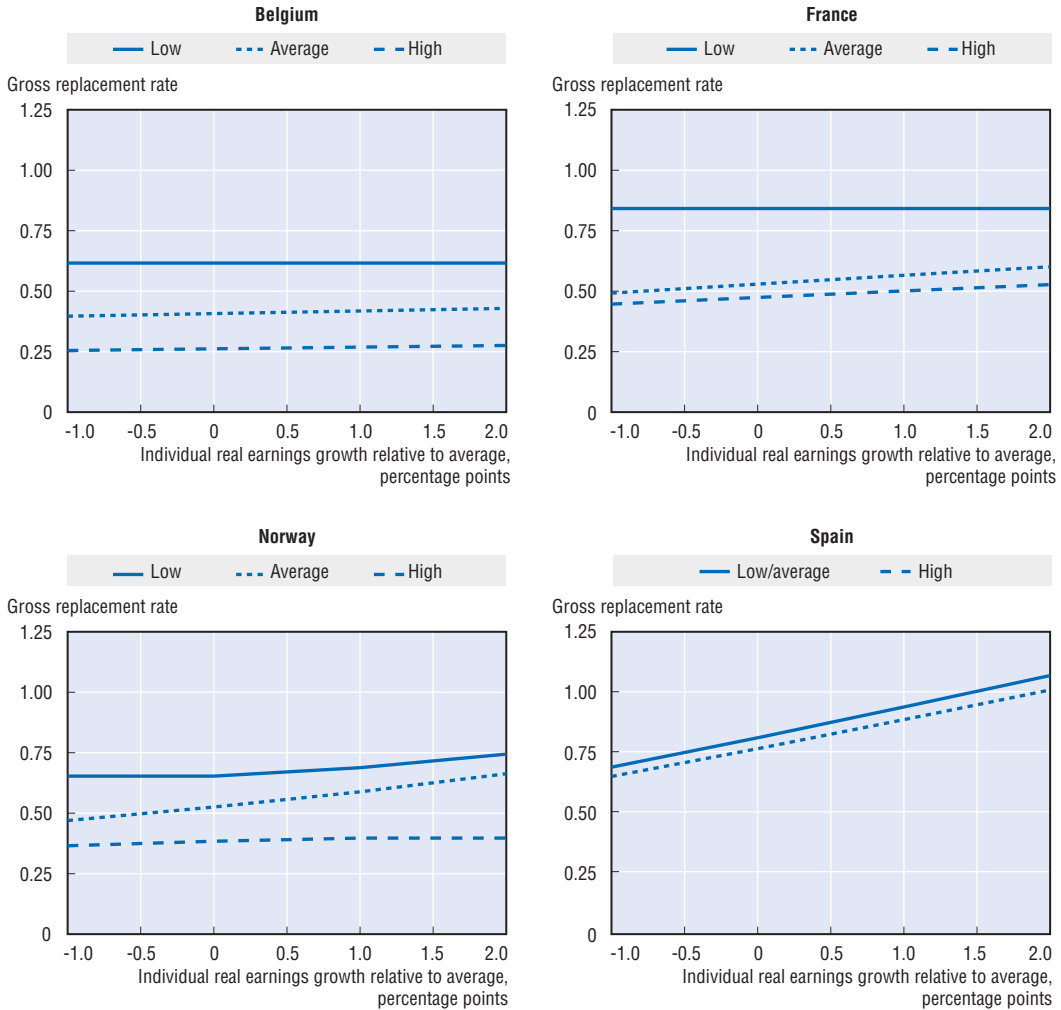
Figure I.2.2. **Total gross replacement rates for low, average and high earners by rate of growth of economy-wide average earnings**

As a proportion of individual earnings



Source: OECD pension models.

Figure I.2.3. **Total gross replacement rates for low, average and high earners by rate of growth of individual earnings relative to average earnings**
As a proportion of individual earnings



Source: OECD pension models.

In France, the impact on the average and high earners is of similar magnitude: around 6% higher benefits if individual earnings growth is 1% a year ahead of the average. This is because only the public scheme uses a less-than-full-career averaging period. The occupational plan, based on points, uses lifetime earnings.

Finally, the results for Belgium show that prices valorisation has only a small effect on the sensitivity of the results to individual career earnings trajectories. What impact there is can be explained by the fact that a steeper age-earnings profile gives greater weight to individual earnings towards the end of the career reducing the cost of prices valorisation on benefits.

4. Varying number of jobs in defined-benefit occupational pension schemes

Some results in the main body of this report include defined-benefit (DB) occupational schemes; these are discussed in detail after the country studies. DB occupational plans

tend to use final salary as the earnings measure for calculating benefits. The earnings measure has a much greater effect on benefits in occupational schemes than in national pension plans because the relevant “final” salary is that with a particular employer and so not usually the same as earnings just before retirement. The value of benefits is therefore eroded substantially for people who leave their employer before retirement. It is unrealistic to assume that people remain with the same employer all of their working life when this is not and never has been common. Moreover, this assumption exaggerates the value of pension benefits from occupational plans enormously.

In the United Kingdom, pensions of “early leavers” must be uprated in line with price inflation, but this still can reduce benefits (compared with the growth of accrued pension rights for people staying until retirement in line with their own earnings).⁵ In Canada and the United States, there is not even this limited degree of protection of the pension rights of early leavers.

The baseline results assume that individuals join four different pension schemes even though they are covered by occupational pensions for all of their career.

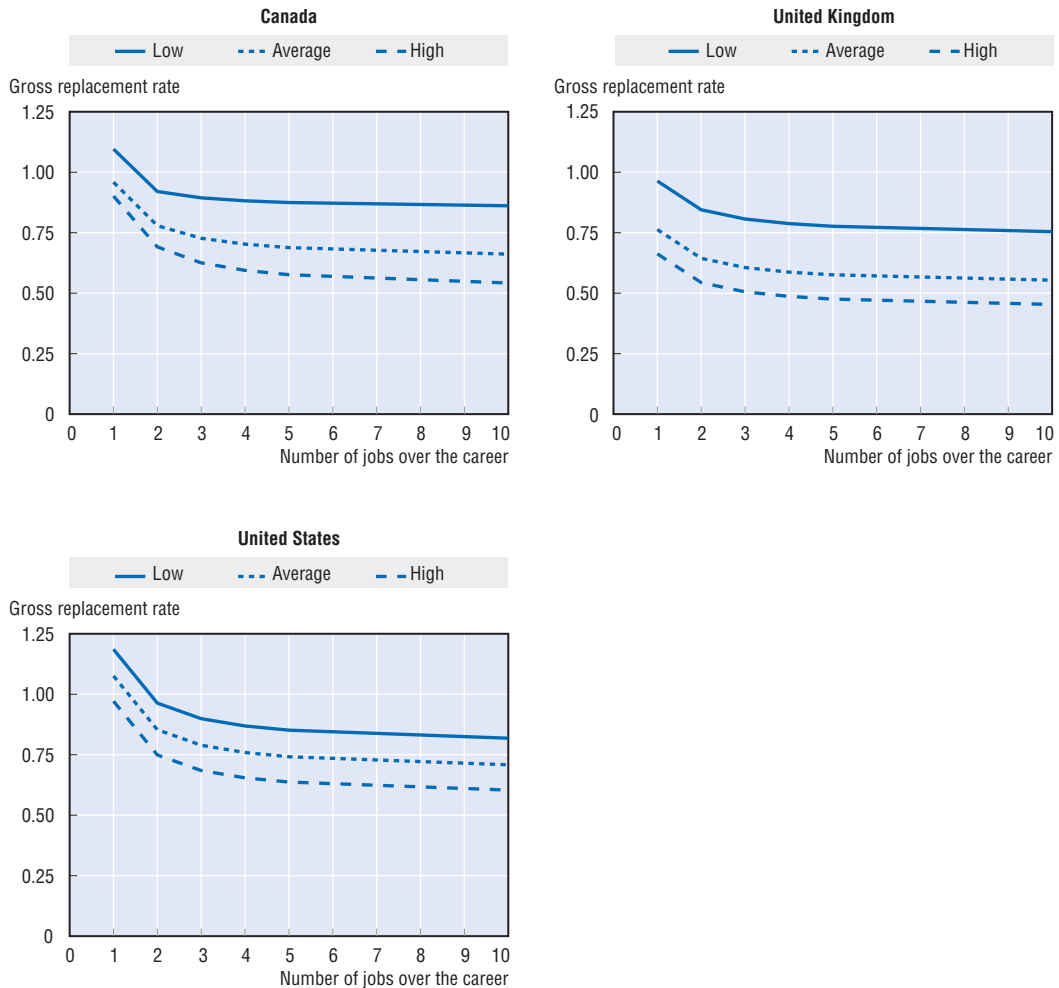
There are two main problems with using these data as an indication of the length of time people spend in a particular occupational pension plan. First, they relate to incomplete tenures in the current job, not final tenures (when people change jobs). This problem, known as “right-censoring” in econometric analysis of duration data, means that it is impossible to know the distribution of completed tenures in advance. Secondly, the job-tenure pattern of members of final-salary occupational pensions differs from that of the population as a whole; the survey data cited above cannot distinguish whether people are members of occupational plans or not. Indeed, many analysts have viewed final-salary pensions as a device for employers to reducing costly mobility of their employees.⁶

The analysis that follows therefore considers a range of different job tenures. In each case, the working life is divided equally between a number of different jobs, ranging from one to 10. A full career with a single employer for an average earner would give an overall replacement rate (including public pensions) of 109% in the United States, 96% in Canada and 76% in the United Kingdom (Figure I.2.4).

Already with two jobs over the career, the overall pension would be 16% lower in the United Kingdom and around 20% lower in both Canada and the United States. This difference is because of the preservation rules in the United Kingdom, which require price indexation of benefits between leaving a job and drawing the pension.

Greater job mobility (that two career jobs) reduces pension benefits still further. However, once the number of jobs is five or more, the loss of pension rights with greater mobility becomes negligible. Pension benefits relative to a full career with a single employer are around 25% lower in the United Kingdom and 30% lower in Canada and the United States. In Canada, the public schemes (basic, resource-tested and earnings-related) mean that low-income workers do not see much effect from increased job mobility on overall pension entitlement. This is also the case because of the progressive structure of the public, earnings-related schemes in the United Kingdom and the United States and the basic pension in the former. However, the relationship is not as strong as it is in Canada.

Figure I.2.4. **Total gross replacement rates for low, average and high earners by the number of jobs over the career**
As a proportion of individual earnings



Source: OECD pension models.

Notes

1. See, *inter alia*, Blanchard (1993), Constantinides, Donaldson and Mehra (1998), Jagannathan and Kocherlakota (1996) and Mehra and Prescott (1985).
2. See Palacios and Whitehouse (2000) on the types of guarantee provided by different countries and their financing.
3. There are also important implications for the public finances from these explicit (as well as implicit) guarantees of pension outcomes in a defined-contribution world. See Pennachi (1998) for a discussion.
4. See the section "What Do True Age-earnings Profiles Look Like?" in Disney and Whitehouse (1999) for a discussion of different assumptions.
5. Employers in the United Kingdom were prohibited from simply returning employees' pension contributions if they left before normal retirement age from 1975. Benefits had to be "preserved" in the scheme, but their value was related to salary at the time of leaving and not adjusted for inflation. Preserved pensions accrued after 1985 were required to be up-rated in line with prices, up to a ceiling of 5%; in 1990 this was extended to the whole pension, not just the part accrued after 1985. See Whitehouse (1998) for a discussion.
6. Examples include Lazear (1981, 1985), Viscusi (1985) and Ippolito (1991). See Palacios and Whitehouse (2004), Section 2 in Chapter 3 for a detailed survey.

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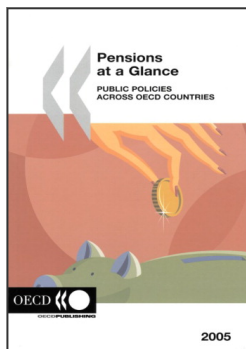
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