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Pensions at a Glance
Public Policies across OECD Countries

PART I

Chapter 3

Modelling Pension Entitlements

This report adopts a "microeconomic" approach to comparing retirement-income systems, looking at prospective individual entitlements under all 30 of OECD member countries' pension regimes. These microeconomic techniques were first developed for the retirement-income reviews of nine OECD countries (OECD, 2001).

This chapter outlines the details of the structure, coverage and basic economic and financial assumptions underlying the calculation of future pension entitlements on a comparative basis. It also sets out the main indicators used to compare pensions; these are shown for the 30 OECD countries in Part II.

1. Future entitlements under today's parameters and rules

The pension entitlements that are compared are those that are currently legislated. All pension system parameters reflect the situation in the year 2002.[1] Changes in rules that have already been legislated, but are being phased-in gradually, are assumed to be fully in place from the start.[2] It is assumed that the pension rules remain unchanged.[3, 4]

The calculations show the pension entitlements of a worker who enters the system today and retires after a full career. This is defined here as entering at age 20 and working until the standard pension-eligibility age, which, of course, varies between countries. The implication is that the length of career varies with the statutory retirement age: 40 years for retirement at 60, 45 years for retirement at 65.

The reason for modelling only full careers is that periods out of the labour market are covered in many countries pension systems, with credits for periods in higher education, military service, unemployment, child rearing, etc. Simply assuming that people who are not in work are not covered by the pension system during career gaps would produce inaccurate figures for pension entitlements.

The results are shown for a single person only. This is because the rules governing benefits for married couples are complex in many countries, and because the results depend on assumptions over both partners' career histories.

2. Coverage

The pension models presented here include all *mandatory* pension schemes for private-sector workers, regardless of whether they are public (*i.e.* they involve payments from government or from social security institutions, as defined in the System of National Accounts) or private.[5] Systems with near-universal coverage are also included, provided they cover at least 90% of employees. For example, such a degree of coverage of occupational plans is achieved through centralised collective bargaining in the Netherlands and in Sweden.

In Canada, Denmark, the United Kingdom and the United States, there is broad coverage of voluntary, occupational pensions and these play an important role in providing retirement incomes. However, coverage is significantly below 90%, so they have not been

included in the main results. But the results including these schemes are shown as memorandum items in the tables presented in the cross-country analysis below, and the details of the calculations are set out in the country studies.

Mandatory personal pensions, known as "individual accounts" in some countries, are also included. These are of the defined contribution type, so the pension benefit depends on contributions made and investment returns earned. The countries that have recently introduced these schemes have made them mandatory for new labour-market entrants; the majority of older workers are covered only by the old, public scheme in some of these countries.

Resource-tested benefits for which retired people may be eligible are also included. As described above, these can be means-tested, where both assets and income are taken into account, purely income-tested or withdrawn only against pension income. Leaving these benefits out of the model would give a misleading picture of the situation of low-income retirees. The comparisons assume all entitled pensioners take up these benefits.[6] Where there are broader means tests, taking account also of assets, the income test is taken as binding. It is assumed that the whole of income during retirement comes from the mandatory pension scheme when calculating pensions entitlements (or from the voluntary pension in the four countries where these are modelled).

In some OECD countries there are entirely separate schemes for civil servants and other public-sector workers.[7] Some also have special programmes for agricultural workers and the self-employed. These are not included here. The comparisons currently look only at the main national scheme for private-sector employees.

Pension entitlements are compared for workers with earnings between 0.3 times and three times the economy-wide average. This large range permits the pensions of both the poorest and richer workers to be examined, and it is sufficiently broad to include people who are employed part-time.

3. Economic variables

The comparisons are based upon a single set of economic assumptions for all 30 countries. In practice, the level of pensions received is affected by economic growth, wage growth and inflation, and these will vary across countries. A single set of assumptions, however, ensures that the outcomes of the different pension regimes are not affected by different economic conditions. In this way, differences across countries in pension levels reflect differences in pension systems and policies alone.

The baseline assumptions are:

- real earnings growth: 2% per year (given the assumption for price inflation, this implies nominal wage growth of 4.55%);
- individual earnings: assumed to grow in line with the economy-wide average. This means that, in the baseline case, the individual is assumed to remain at the same point in the earnings distribution, earning the same percentage of average earnings in every year of the working life;
- price inflation: 2.5% per year;
- real rate of return on funded, defined-contribution pensions: 3.5% per year;
- discount rate (for actuarial calculations): 2% per year;

- mortality rates: the baseline modelling uses country-specific projections (made in 2002) from the United Nations/World Bank population database for the year 2040;
- earnings distribution: composite indicators use the OECD average earnings distribution (based on 16 countries) with country-specific data used where available.

Changes in these baseline assumptions will obviously affect the resulting pension entitlements. A sensitivity analysis of the effect of these assumptions is presented in Annex I.2. This analysis allows, for example, for economy-wide earnings growth of between zero and 3% per year, for returns on defined-contribution schemes of between zero and 6% per year and for individual earnings that grow faster than the economy-wide average by up to two percentage points per year or slower by up to one percentage point per year.

The real rate of return on defined-contribution pensions is assumed to be net of administrative charges. In practice, this assumption might disguise genuine differences in administrative fees between countries.[8]

The calculations assume the following for the pay-out of pension benefits: when DC benefits are received upon retirement, they are paid in the form of a price-indexed life annuity at an actuarially-fair price.[9] This is calculated from mortality data. Because of improvements in life expectancy, someone retiring at a given age after having contributed a given amount to a DC scheme will in the future receive a lower pension than a person retiring today would receive. Similarly, the notional annuity rate in notional accounts schemes is calculated from mortality data using the indexation rules and discounting assumptions employed by the respective country.

4. Average earnings data

It is difficult to produce data on average earnings that are consistent across countries. Consequently, the OECD's average production worker series is currently the only one available for all 30 member countries. The series shows average earnings for full-time adult workers in manufacturing.[10] The data for 2002 are shown in Table 3.1. For comparison across countries, earnings are also shown in US dollars. The conversions are calculated using the average market exchange rate for 2002 and the exchange rate calculated using purchasing power parities (that is, the exchange rate that equalises the cost of a standard basket of goods and services between countries).

5. Taxes and social security contributions

The information on taxes and social security contributions on which the calculations of the net indicators are based can be found in each country study (Part II). The studies describe the tax and social security contribution regimes in each country as they applied to pensioners in 2002.[11] General provisions and the tax treatment of workers for 2002 can be found in the OECD report *Taxing Wages* (2003). The conventions used in that report, such as which payments are considered taxes, are followed here.

6. Indicators and results

The basic indicators used in this report are:

- the *replacement rate*: pension entitlements as a share of individual lifetime average earnings;
- the *relative pension level*: pension entitlements as a share of average economy-wide earnings; and
- *pension wealth*: the discounted stream of future pension payments.

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Table 3.1. **Earnings of the average production worker, 2002**

National currency and USD at market and purchasing-power-parity exchange rates

	Earnings of average production worker			Exchange rates with USD	
	National currency	USD, market	USD, PPPs	Market	PPPs
Australia	48 568	26 377	35 727	1.84	1.36
Austria	23 881	22 506	25 840	1.06	0.92
Belgium	30 629	28 865	33 739	1.06	0.91
Canada	38 867	24 756	32 521	1.57	1.20
Czech Republic	206 412	6 306	14 542	32.73	14.19
Denmark	304 925	38 675	35 915	7.88	8.49
Finland	27 682	26 088	27 947	1.06	0.99
France	21 978	20 712	23 766	1.06	0.92
Germany	32 902	31 007	34 252	1.06	0.96
Greece	11 395	10 739	15 144	1.06	0.75
Hungary	1 077 816	4 187	9 279	257.45	116.16
Iceland	2 567 086	28 028	27 053	91.59	94.89
Ireland	25 477	24 010	24 864	1.06	1.02
Italy	21 408	20 175	26 337	1.06	0.81
Japan	4 254 270	33 966	29 012	125.25	146.64
Korea	22 885 416	18 293	31 299	1 251.05	731.18
Luxembourg	31 358	29 552	31 671	1.06	0.99
Mexico	59 702	6 180	9 123	9.66	6.54
Netherlands	30 575	28 814	32 561	1.06	0.94
New Zealand	39 912	18 450	27 118	2.16	1.47
Norway	292 200	36 591	32 183	7.99	9.08
Poland	26 352	6 456	13 905	4.08	1.90
Portugal	8 410	7 926	12 093	1.06	0.70
Slovak Republic	137 316	3 031	8 819	45.30	15.57
Spain	16 360	15 418	21 214	1.06	0.77
Sweden	237 820	24 465	24 076	9.72	9.88
Switzerland	64 169	41 219	33 128	1.56	1.94
Turkey	9 938 274 440	6 571	14 977	1 512 342.00	663 575.48
United Kingdom	19 420	29 133	30 091	0.67	0.65
United States	32 360	32 360	32 360	1.00	1.00

PPP: Purchasing Power Parities.

Source: Earnings data from OECD (2003), *Taxing Wages*, OECD, Paris. Exchange rates are averages for 2002 from IMF database.

The *replacement rate* can be interpreted as an indicator of the *insurance* role of a pension system, since it shows to what extent pension systems aim to preserve the previous, personal standard of living of a worker moving from employment into retirement. Often, the replacement rate is expressed as the ratio of the pension over the final earnings a worker had before retirement. However, the indicator used here shows the pension benefit as a share of *individual lifetime average earnings* (revalued in line with economy-wide earnings growth). Under the baseline assumptions, workers earn the same percentage of economy-wide average earnings throughout their career, meaning that their individual earnings track the assumed growth in economy-wide earnings. In this case, lifetime average revalued earnings and individual final earnings are identical.[12] If people move up the earnings distribution as they get older, then their earnings just before retirement will be higher than they were on average over their lifetime. In that case, replacement rates calculated on individual final earnings will be lower than when calculated on the basis of individual lifetime average revalued earnings. The sensitivity analysis in Annex I.2 illustrates the effects of different individual career earnings profiles on pension entitlements in several countries.

Box 3.1. **Modelling pensions**

X starts working at age 20 and works continuously until he retires at age 65. He starts out with an annual salary of USD 10 000. This corresponds to 75% of economy-wide average earnings at that time. His earnings grow by 2% each year. Economy-wide earnings grow at the same rate. X thus earns 75% of average earnings over his entire career.

When X retires, all his past salaries are increased in line with the growth in economy-wide average earnings between the time that they were earned and the retirement age. The procedure of adjusting past salaries is called "valorization" in this report. In this case, valorisation is linked to economy-wide average earnings growth. X's lifetime average revalued salary, which is the earnings measure used in the pension calculation, is USD 23 900.

The explanation is as follows. Taking *i* as the number of years since labour-market entry, valorisation means that each year's earnings are increased by $1.02^{(44-i)}$. Each year, X's earnings increase by a constant amount, so at any given time, they are equal to earnings at entry age (USD 10 000) multiplied by 1.02^{i}. So, in each and every year of the working life, revalued earnings are first-year earnings multiplied by $1.02^{44-I} \times 1.02^{i}$, giving average lifetime revalued earnings of USD 10 000 × 1.02^{44} = USD 23 900.

The pension system has an accrual rate of 1.5% of earnings per year. X's gross pension is thus 45 × 0.015 × USD 23 900 = USD 16 130. His **gross replacement rate** is USD 16 130/ USD 23 900 = 67.5%.

On his gross pension, X has to pay 10% in taxes and health insurance contributions. The net pension is therefore USD 16 130 × (100 – 10)% = USD 14 510. While he was working, X had to pay 20% in taxes and social security contributions, meaning that his net earnings at the time of retirement were USD 19 120. His **net replacement rate** is therefore USD 14 510/USD 19 120 = 75.9%.

To assess his pension level relative to average earnings, X divides his gross pension entitlement by gross average economy-wide earnings in the year of retirement. X's earnings at retirement are USD 23 900, while the economy wide average is USD 31 790 (since X earns 75% of the average). Thus, X's **gross relative pension level** is USD 16 130/USD 31 790 = 50.8%.

The net relative pension level is calculated in the same way but using the taxes and social security contributions that X pays as a pensioner and those paid by a worker on average gross earnings. Workers on average gross earnings pay 25% in taxes and social security contributions, giving net average earnings of USD 31 790 × (100 – 25)% = USD 24 840. Therefore, X's **net relative pension level** is USD 14 510/USD 24 840 = 60.9%.

When X retires, male life expectancy at age 65 will be 83 years in his country, giving an expected retirement duration of 18 years. X's pension wealth is the discounted stream of pension payments during retirement, weighted by the probability that he will still be alive at that particular age. The discount rate is designed to reflect the fact that money received in the future is worth less than money received today; the rate used is 2% per year. The calculation also allows for the post-retirement adjustment of pension benefits: in this case, X's pension is increased annually in line with price inflation. The actuarial calculations show that the present value of pension benefits is 14.8 times the annual flow (which is less than the 18 years expected duration of retirement because future benefits are discounted). His **gross pension wealth** is thus USD 16 130 × 14.8 = USD 238 720. Usually, this is expressed as a multiple of economy-wide average earnings, giving gross pension wealth of USD 238 720/ USD 31 790 = 7.5. **Net pension wealth** is calculated in a similar way.

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The *relative pension level* is best seen as an indicator of pension *adequacy*, since it shows what benefit level a pensioner will receive in relation to the average wage earner in the respective country. Individual replacement rates may be quite high, but the pensioner may still receive only a small fraction of economy-wide average earnings. If, for example, a low-income worker – who earned only 30% of economy-wide average earnings – has a replacement rate of 100%, the benefit will only amount to 30% of economy-wide average earnings. For an average-wage earner, the replacement rate and the relative pension level will be the same.

To compare countries which use different earnings measures, pension entitlements for all countries are presented as a proportion of individual lifetime average earnings revalued in line with growth in economy-wide average earnings. Most OECD earnings-related pension schemes use individual lifetime average pay revalued in line with economy-wide average earnings – the exact same – as the earnings measure to calculate pensions (Table 2.2). However, for a few countries, the replacement rates presented here look different from those calculated using the earnings measure from the rules of the national pension systems.

Pension wealth is an indicator that takes into account all future pension payments to a retiree. It therefore depends not only on the level of pensions paid, but also how long they are paid for. The number of years that someone can expect to receive a pension will depend both on the age of retirement and life expectancy at that age (see Box 3.1). The way that benefits are adjusted to price and/or wage growth during the period of payment will also influence pension wealth. The details of calculating pension wealth are set out in Chapter 6.

Notes

1. This year was chosen because it was the latest year for which the OECD tax models were available.
2. In some cases where there has been systemic change, such as in the Slovak Republic and Sweden, the modelling calculates what the parameters of the new system would have been had it been in place in 2002. This ensures that tax rules and average earnings data are the right match for the parameter values. In a few other cases, such as France and the United Kingdom, structural reforms were included even though they were legislated after 2002.
3. McHale (1999) studies the impact of reforms on future pension entitlements in the G7 countries. Diamond (1997) argues that pension systems can be excessively responsive to short-term fiscal conditions (given the limited ability of the elderly to absorb these changes).
4. This "steady-state" assumption is also applied to "value" parameters, such as the level of ceilings or basic pensions. These are assumed to remain at the same level relative to average earnings.
5. It is, of course, possible to separate out the different components of the pension package and look at public pensions alone. The charts in the country studies and Table 7.2 in Chapter 7 show the contribution to total pension benefits made by different parts of the package.
6. People might not claim a benefit to which they are entitled for a number of reasons, including ignorance of entitlement, stigma, and administrative "hassle". These are unlikely to apply to basic or earnings-related public pensions. However, the situation can be different for resource-tested old-age pensions, including social assistance and minimum pension guarantees. There is, for example, evidence from the United Kingdom that take-up can be lower than 70% (see Department of Work and Pensions, 2003). See also Hernanz, Malherbert and Pellizzari (2004).
7. See Palacios and Whitehouse (2005) for a survey of pension provision for public-sector workers.
8. See Whitehouse (2000) and Whitehouse (2001).
9. Studies of voluntary annuity markets in the United Kingdom and the United States have shown that annuities pay out less than they would if insurance companies were to base their calculations on the relevant interest rates and projected population mortality. This does not mean that prices are "actuarially unfair" since they reflect the longer life expectancy of people who choose to buy an annuity. In mandatory annuity markets, which are relevant to the mandatory DC schemes modelled in this report, prices are much closer to the actuarially fair level (Finkelstein and Poterba, 2002, 2004).

10. OECD (2005) contains a special feature on the relationship between earnings of the average production worker on the OECD definition and averages of earnings calculated across broader groups of workers.

11. The modelling assumes that tax systems and social-security contributions remain unchanged in the future. This implicitly means that "value" parameters, such as tax allowances or contribution ceilings, are adjusted annually in line with average earnings, while "rate" parameters, such as the personal income tax schedule and social security contribution rates, remain unchanged.

12. Individual earnings in any time period i can be expressed as a multiple of earnings in the base period (w0): $w_i = w_0\ (1 + g)^i$, where w is earnings and g is the growth of (individual and economy-wide) earnings. Revaluing pay in line with earnings growth gives for each period: $w_i = w_0\ (1 + g)^i\ (1 + g)^{R-i}$. This is constant over time and so final and lifetime average revalued earnings are equal in this case.

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