Adequacy (1)

Pension entitlements, replacement rates and pension wealth

The adequacy of retirement incomes is a central goal of all types of pension system. The parameters and rules of pension schemes are complex and retirement-income systems typically have multiple components. This makes it difficult to compare pension systems between countries and so lessons to be learned from other countries' experiences.

This note briefly sets out a methodology for calculating prospective pension entitlements promised in the future to today's workers. This method can (and has been) applied to a wide range of countries with very different pension systems.

The entitlements shown here are prospective. It looks at theoretical values and so illustrates the way the current parameters and rules of pension systems will work for different example individuals. This can be used to assess the adequacy of future benefits.

This forward-looking analysis can be contrasted with empirical measures of pension entitlements of recent retirees. Such information, based on national administrative data, is discussed in the next note in this series: 'Adequacy (2): Pension entitlements of recent retirees'. That analysis can be thought of as 'backward-looking', since the entitlements of recent retirees depend on the past values of parameters and rules of pension systems.

The calculations are carried out using the Apex model – Analysis of Pension Entitlements across Countries – which was developed by Axia Economics with finance from the World Bank and the OECD. The modeling is implemented in the statistical and data programming environment, Stata.

The results will be provided as part of the World Bank pension indicators and database, which is described in the first briefing note in this series.

Modeling methodology

The baseline calculations show the pension entitlements of a worker who enters the system today and has a full career, defined as uninterrupted work from age 20 until the standard pension eligibility age. Although this is clearly unrepresentative of actual labor-market experience, it is the only assumption that can generate comparable results.

Many pension systems provide credits for periods in education, military service, unemployment, child rearing *etc.* Simply assuming that people who are not in work are not covered during career gaps would produce misleadingly low pension entitlements in countries with such provisions.

In many countries, workers often have incomplete contribution histories and so few are likely to achieve the replacement rates shown here. Nevertheless, this means that the flow of contributions is also limited compared with the full-career case. The replacement-rate calculations are an **indicator** of the pension system, not a forecast of individual entitlements.

This note was prepared by Edward Whitehouse. Social Protection and Labor, Human Development Network, World Bank, 1818 H Street NW, Washington, D.C. 20433; telephone +1 202 458 5267; fax +1 202 614 0471; e-mail socialprotection@worldbank.org; website: www.worldbank.org/pensions

Nonetheless, the Apex model does allow the user to alter assumptions over the length of career. It is possible to vary the age of entry to the labor market and the age at which the pension is drawn. For OECD countries and EU member states, Apex calculations can also be made for people with interruptions to paid work for reasons of caring for children or long-term unemployment. These computations include the effects of pension credits for such eventualities. (The section on social and labor-market risks in the briefing note on 'Security: Risk and Uncertainty in Retirement-Income Systems', number 9 in this series, provides results for workers with periods of long-term unemployment at different stages of their working lives.)

The calculations are forward-looking. The pension entitlements that are calculated and compared are based on the parameters and rules that are currently legislated. Changes in rules that have already been legislated, but are being phased-in gradually, are assumed to be fully in place from the start. It is assumed that the pension rules remain unchanged thereafter.

The entitlements reported in the database are for a single person. This is because the rules governing benefits for married couples can be very complicated and because the results depend on assumptions over both partners' career histories. The OECD has calculated benefits for married couples for its member countries. These models also provide information on survivors' benefits when one person in the couple dies. Future work by the OECD with the World Bank will extend this analysis to non-OECD countries.

The results include all mandatory pension schemes for private-sector workers, regardless of whether plans are publicly or privately provided. Plans with near-universal coverage – more than 80% of employees – are treated as 'quasi-mandatory' and so are included in the baseline results. (This applies to occupational schemes in Denmark, the Netherlands and Sweden, for example.)

Resource-tested benefits for which retirees may be eligible are also included and the comparisons assume that all pensioners who are entitled take up these benefits. 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 these entitlements.

The benefits from defined-contribution (DC) plans are assumed to take the form of a price-indexed life annuity. The value of this annuity is calculated at an actuarially fair price, based on country-specific population mortality data from the UN/World Bank database.

Information is also collected on taxes and contributions paid by pensioners and workers.

Economic assumptions

The comparisons are generally based upon a single set of economic assumptions for all countries to facilitate cross-national comparisons that reflect differences in pension systems and policies alone.

The baseline economic assumptions are:

Average real earnings growth	2.0% a year
Price inflation	2.5% a year
Discount rate	2.0% a year
Net real return on DC pensions	3.5% a year

Again, the Apex models allow the user to alter these assumptions. Indeed, the most recent calculations – those for Asia and the Pacific – assume different values of these variables for emerging economies, such as China and India. However, in the longer term the calculations are based on these converging on the values above assumed for developed countries.

In addition, the Apex models have been used tom investigate the impact of uncertainty in investment returns in defined-contribution schemes. This analysis is discussed in the section on investment risk in the briefing note on 'Security: Risk and Uncertainty in Retirement-Income Systems', number 9 in this series.

Country coverage

The Apex models have so far been used to model pension entitlements in around 70 countries.

The OECD maintains models for its 30 member countries: the current version of these models is based on parameters and rules for 2008. (Earlier results are also available for 1999, 2002, 2004 and 2006: see OECD, 2005, 2007, 2009 and Whitehouse, 2002, 2003.)

The OECD secretariat also maintains models for the European Union countries that are not members of the OECD with the support of the European Commission. These eight countries comprise Bulgaria, Cyprus, Estonia, Latvia, Lithuania, Malta, Romania and Slovenia. These models are also currently updated to 2008 parameters and values of the pension system.

A joint effort by the OECD secretariat, the World Bank and the OECD Korea Policy Centre has extended the analysis to 12 Asian countries. This work was published in a joint report with the World Bank: OECD (2009a). These are based on 2006 pension parameters and values, although an update to 2008 is currently underway.

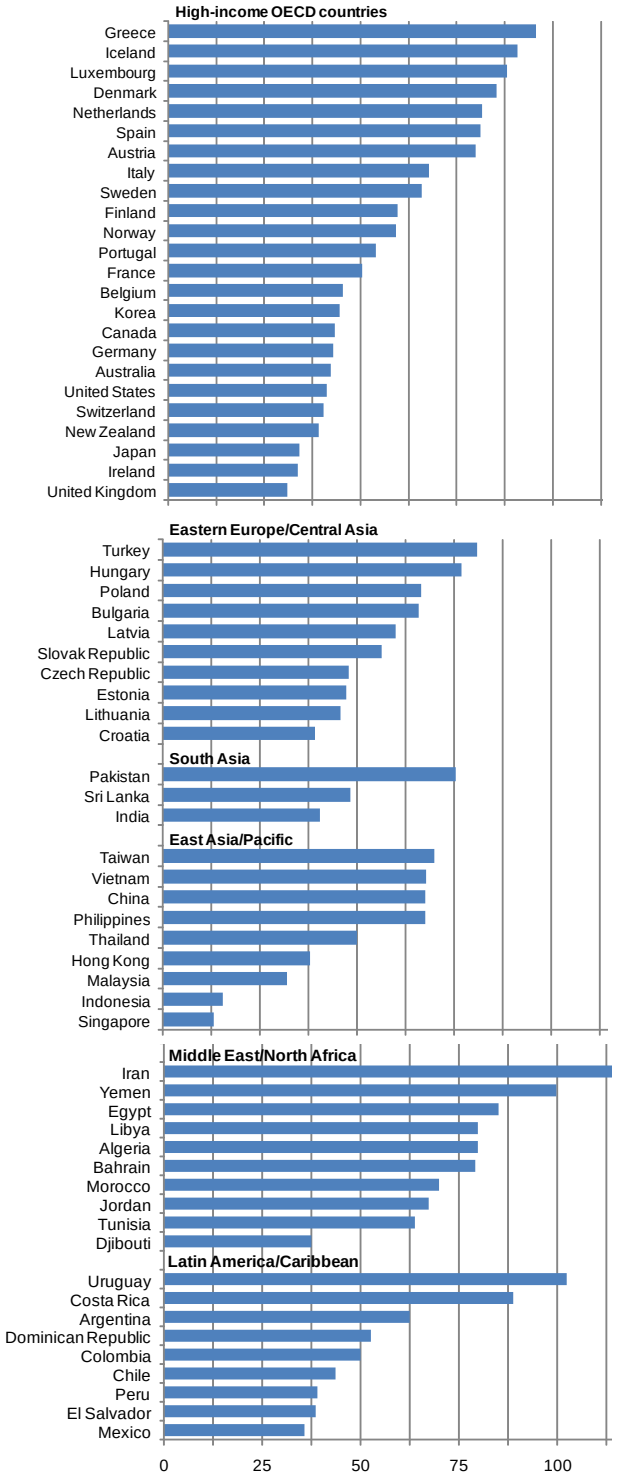
In a project financed by the ERSTE Foundation of Vienna, the World Bank used the Apex model to analyze the pension systems of eight countries in Central and Eastern Europe: Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic and Slovenia (Holzmann and Guven, 2009).

Earlier World Bank work also looked at 10 countries in the Middle East and North Africa (Robalino *et al.*, 2005). These results, along with calculations for nine countries in Latin America and the Caribbean were published in the World Bank's *Pensions Panorama* (Whitehouse, 2007).

Sample results: replacement rates

The adjacent chart (Figure 1) shows calculations of the gross replacement rate: that is, the value of the pension entitlement relative to individual earnings. These results are for a worker with average earnings. In some cases, the results differ for men and women, usually because of differences in pension age between the sexes. In these cases, the results shown are for men.

Gross replacement rates 1



Source: Apex models; see OECD (2009, 2009a) and Whitehouse (2007).

The table at the end of this briefing note shows more detailed results. First, these include replacement rates at different levels of earnings: half and 1.5 times the average as well as the average. Secondly, there are results for *net* replacement rates. These calculations take account of taxes and contributions paid both on earnings when working and on pensions during retirement.

Pensioners generally do not pay social contributions (for pensions, unemployment benefits *etc.*). In some cases, pensions in payment are not taxable or they attract some sort of tax relief. In many other countries, there are tax credits for older people which mean that many or even most people do not pay income tax during retirement. Moreover, when gross replacement rates are less than 100% people will pay less tax during retirement than they did when working. This is because income-tax systems are generally progressive: people pay a higher share of their income in tax the higher is their income.

The result of all these factors is that net replacement rates tend to be rather higher than gross. And it is important to bear in mind that it is net incomes that matter for people's living standards in work and retirement.

Calculating pension wealth

Replacement rates give an indication of the size of the pension promise, but they are not comprehensive measures; they measure only the level of benefits at retirement. For a full picture, account must also be taken of life expectancy, retirement age and indexation of pensions in payment. Together, these determine for how long the pension benefit must be paid, and how its value evolves over time.

Pension wealth is the present value (or 'stock') of the lifetime flows of pension benefits. It therefore takes into account the impact of cross-country differences in life expectancy, pension-eligibility age and indexation. In defined-contribution plans, pension wealth is simply the value of accumulated contributions investment returns at the time of retirement. With defined-benefit schemes, pension wealth can be thought of as the lump sum needed to buy an annuity giving the same flow of pension payments as that promised by the scheme in question.

The calculation of pension wealth is based on standard actuarial techniques. It uses country-specific mortality rates at different ages from the UN/World Bank population database. The Apex model can provide results using mortality rates for men, women or using unisex rates. Because money today is worth more than money to be received in the future, the flow of pensions across the retirement period is discounted to the point of retirement. As noted above, the standard assumption is a real discount rate of 2%. (However, the Apex model allows the user to vary this assumption.)

Determinants of pension wealth

Figure 2 explores the interplay between the different factors affecting the value of pension wealth. The chart shows different retirement ages – from 55 to 70 – on the horizontal axis. The vertical axis gives the lifetime value of a pension flow of one unit of currency. Results are given for the same five different groups of countries analyzed above. Starting with the results at age 65, the chart shows that the lifetime value of a pension of one unit would be 17.3 on average in OECD countries. So, the lifetime value of a $1 000 annual pension would be $17 300, given the average mortality experience in the OECD-30.

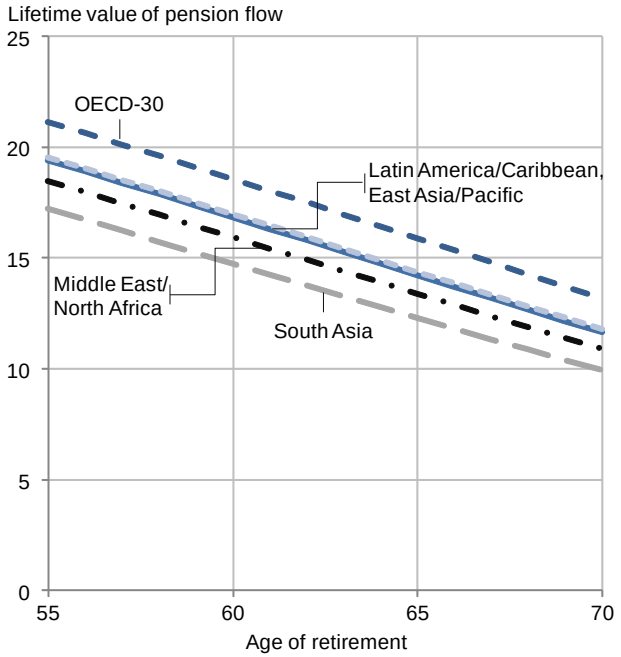
Mortality rates are the highest of the five groups of countries in South Asia. As a result, the lifetime value of a unit pension paid from age 65 is 13.1 at the average mortality rates in the region. This is 25% less than in OECD countries, due to the higher mortality rates. In between, the results for Latin America/Caribbean and East Asia/Pacific are practically the same. The lifetime pension value from age 65 is 15.5. This compares with a figure of 14.3 for the Middle East/North Africa. These cross-regional differences can be observed by reading vertically up and down the chart.

Obviously, paying a pension from an earlier age means a greater expected lifetime value of benefits. For Latin America/Caribbean and East Asia/ Pacific, the lifetime value of the pension from age

55 would be 20.9 and 18.3 from age 60, compared with 15.5 from age 65.

The pattern is the same across the different regions. Let a retirement age of 65 and the average mortality rates of Latin America/Caribbean and East Asia/Pacific be the baseline. Because of lower mortality rates (and so longer life expectancy) in the OECD countries, pension wealth would be the same (on average) if the retirement age were 68. Conversely, lower retirement ages – of 63 in Middle East/North Africa and 61 in South Asia on average – would deliver the same pension wealth as the baseline regions. These figures are found in the chart by reading horizontally, left and right.

Pension wealth: retirement age **2**



Source: Apex models

Sample results: pension wealth

Examples results for selected major economies in Asia and in OECD countries are shown in Table 3. Like the replacement rate, pension wealth is normalized to individual earnings. The results show the lifetime flow of pension benefits as a multiple of annual individual earnings.

In the 30 OECD countries, pension wealth for a man with average earnings is 9.3 times annual pay. For women, it is slightly higher, at 10.8 times. This is mainly because of women's longer life expectancy (although a small part is explained by some countries that still plan to have lower pension ages for women than men in the long term).

The results for the Asian economies show much larger variation than in the OECD, with relatively low pension wealth in Indonesia and a high level in China, for example.

Differential mortality

An important caveat in interpreting these results arises because of the coverage of the pension system. In the OECD countries, an average of 70% of the working-age population is a member of the pension system, equivalent to more than 90% of people who are economically active (see the World Bank Pensions Indicators and Database note on 'Coverage', number 2 in the series).

Pension wealth: average earner **3**

	Pension wealth (multiple of individual earnings)	
	Men	Women
China	16.4	20.1
India	6.2	6.6
Indonesia	2.6	2.6
Malaysia	6.4	6.4
Pakistan	10.7	12.5
Philippines	8.3	9.5
Thailand	8.7	10.2
Vietnam	15.1	16.9
Canada	6.6	7.7
France	8.8	10.2
Germany	7.2	8.5
Italy	10.0	10.7
Japan	5.7	6.4
United Kingdom	4.2	4.8
United States	5.9	6.8
OECD-30 average	9.3	10.8

Source: Apex models

In South Asia, coverage of the pension system is just 7.5% of the working-age population or 13% of the economically active. Coverage is higher on average in East/Asia Pacific than in South Asia: 18% of people of working age or 35% of labor-market participants. But this is still well short of the experience in OECD countries.

The results in Table 3 are based on population mortality data. This is not a problem when analyzing OECD countries that have near-universal coverage. However, the groups that are covered by the pension system outside the OECD are a minority, and a privileged one. Their life expectancy is therefore higher than that of the population as a whole. The Table therefore understates the differences in expected retirement duration between OECD and non-OECD countries and so the differences in pension wealth.

Sources and further reading

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Gross and net replacement rates

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	Gross replacement rates			Net replacement rates		
	Individual earnings (% of average)			Individual earnings (% of average)		
	50%	100%	150%	50%	100%	150%
High-income OECD						
Australia	68.7	42.4	33.7	81.7	54.5	42.6
Austria	80.1	80.1	77.9	90.4	90.3	87.9
Belgium	65.5	45.5	35.1	88.2	67.2	49.7
Canada	74.9	43.3	28.9	87.7	56.6	39.0
Denmark	129.2	85.5	74.8	142.1	96.2	88.4
Finland	68.0	59.7	59.7	74.4	65.7	67.2
France	58.2	50.5	45.8	72.1	62.4	57.4
Germany	43.0	43.0	43.0	59.1	61.3	60.9
Greece	95.7	95.7	95.7	113.6	110.6	107.3
Iceland	114.1	91.0	88.0	114.4	95.8	92.7
Ireland	67.6	33.8	22.5	67.6	39.7	30.1
Italy	67.9	67.9	67.9	74.8	74.8	76.6
Japan	47.2	34.1	29.7	51.6	38.9	34.2
Korea	66.6	44.6	36.0	71.4	49.2	41.4
Luxembourg	99.5	88.1	84.4	107.3	96.5	93.5
Netherlands	80.2	81.7	82.2	97.7	102.3	98.5
New Zealand	78.2	39.1	26.1	80.1	41.4	29.2
Norway	66.3	59.3	50.0	76.8	69.2	60.8
Portugal	56.2	54.1	53.4	64.6	68.6	71.2
Spain	81.2	81.2	81.2	82.1	84.7	85.3
Sweden	78.3	66.0	79.1	80.7	68.5	83.9
Switzerland	62.5	40.5	27.6	79.4	53.5	35.9
United Kingdom	52.0	31.0	21.8	64.8	41.3	29.7
United States	55.2	41.2	36.5	63.4	47.6	42.2
East Asia/Pacific						
China	87.6	67.6	61.0	95.2	73.5	68.6
Hong Kong	35.4	38.0	32.0	37.2	40.9	36.2
Indonesia	15.4	15.4	15.4	16.1	16.3	16.3
Malaysia	31.9	31.9	31.9	35.9	35.9	35.9
Philippines	95.0	67.5	58.3	111.4	82.7	73.8
Singapore	13.1	13.1	11.0	16.3	16.6	14.3
Taiwan	70.0	70.0	60.3	71.8	73.2	64.1
Thailand	50.0	50.0	50.0	52.6	52.6	52.6
Vietnam	67.8	67.8	67.8	75.4	75.2	76.1
South Asia						
India	67.1	40.4	31.3	76.3	46.4	38.8
Pakistan	80.0	75.4	50.3	80.8	76.2	50.8
Sri Lanka	48.3	48.3	48.3	52.5	52.5	52.5

Source: Apex models

Gross and net replacement rates

4a

	Gross replacement rates			Net replacement rates		
	Individual earnings (% of average)			Individual earnings (% of average)		
	50%	100%	150%	50%	100%	150%
Eastern Europe/Central Asia						
Bulgaria	65.8	65.8	65.8	78.2	77.8	77.0
Croatia	48.4	39.3	36.3	66.5	61.4	59.9
Czech Republic	76.3	47.8	35.0	91.8	61.7	47.4
Estonia	57.2	47.3	44.0	67.7	59.3	53.4
Hungary	76.9	76.9	76.9	93.9	104.4	99.2
Latvia	59.9	59.9	59.9	80.2	76.6	72.7
Lithuania	60.4	45.8	41.0	73.6	59.7	54.6
Poland	66.5	66.5	66.5	80.5	81.1	81.4
Slovak Republic	56.4	56.4	56.4	66.3	72.7	74.9
Turkey	80.9	80.9	80.9	112.9	116.2	119.1
Latin America/Caribbean						
Argentina	104.6	62.6	48.6	119.2	73.7	57.8
Chile	44.9	43.8	43.8	53.3	53.5	54.5
Colombia	100.0	50.0	46.1	108.8	54.4	50.2
Costa Rica	89.0	89.0	89.0	102.9	103.1	103.1
Dominican Republic	105.3	52.6	35.1	111.8	55.9	37.3
El Salvador	64.1	38.7	38.7	65.1	39.3	41.2
Mexico	53.0	35.9	34.4	53.7	38.2	39.6
Peru	49.4	39.1	39.1	54.8	43.9	46.4
Uruguay	102.6	102.6	90.5	125.1	125.4	110.8
Middle East/North Africa						
Algeria	80.0	80.0	80.0	89.6	89.1	88.8
Bahrain	84.0	79.2	79.2	88.4	83.4	83.4
Djibouti	42.5	37.5	37.5	48.7	43.4	44.7
Egypt	90.5	85.3	79.6	117.5	119.8	111.0
Iran	132.0	115.5	115.5	141.9	124.2	126.5
Jordan	69.6	67.5	67.5	77.5	76.1	77.2
Libya	80.0	80.0	80.0	89.0	91.2	93.6
Morocco	70.0	70.0	70.0	72.6	74.1	75.2
Tunisia	64.0	64.0	64.0	73.1	72.7	73.5
Yemen	100.0	100.0	100.0	106.2	106.3	106.3

Source: Apex models