Pensions are inherently risky because they are long-term contracts. There can be 60 years or even more from the time people first contribute to a pension and the time they draw their last benefit.

Retirement-income systems can involve up to four groups of actors: individuals, governments, employers and financial-services providers. Uncertainty about the future complicates planning for all these actors: if things turn out better than expected, who will reap the gains? If things turn out worse, who will bear the cost? No one wants to bear risk, but, in most cases, someone has to.

The recent financial crisis means that investment risk is at the forefront of the minds of the public and policymakers alike. But there is a range of risks and uncertainties in pension systems. At the macro level, pension systems are subject to a great deal of uncertainty over demographic, economic, financial and social developments. At the micro level, individuals can be affected at different stages of their lives as contributors, taxpayers, shareholders (both directly and indirectly through their assets in private pensions and other savings) and, ultimately, as beneficiaries.

As populations age and pension systems mature, these risks become increasingly significant. Moreover, recent pension reforms imply a changing allocation of different kinds of risks between the different actors in retirement-income systems.

This note sets out a range of different risks and uncertainties. It then discusses ways in which the scope and scale of these risks can be measured. Finally, it looks at who, among the different actors in the pension system bears the risk.

Types of risk and uncertainty
There are six major sources of risk and uncertainty in pension systems:

- **Demographic risk:** fertility and life expectancy, the two key drivers, are highly uncertain and past projections have often turned out to be wrong.

- **Economic and financial risk:** pension systems of all types can be affected by economic shocks which affect both sides of the pension system: revenues (through wages and employment) and expenditures (through earlier benefit claims). Investment performance of private pensions is subject to volatility.

- **Policy risk:** the political process can result in unanticipated changes in pension entitlements before or during retirement.

- **Purchasing-power/inflation risk:** changes in costs and standards of living are not adequately reflected in adjustments to pensions in payment, leaving older retirees particularly vulnerable.
Social and labor-market risks: life events — such as persistent low earnings, long-term unemployment, caring for children or older relatives, divorce, widowhood — mean individuals build up little in the way of retirement income.

Myopia risk: individuals are short-sighted and so consume too much now and save too little for later, especially for retirement.

The first two of these sources of risk are concerned with the macro picture. Demographic, financial and economic risks can hugely affect the ability of the retirement-income system to pay anticipated retirement benefits.

Often, the political process intervenes, meaning that it is uncertain who bears the costs and reaps the benefits when outcomes are unexpected. One margin over which the political process has had most influence over long periods is indexation policy and practice: the adjustment of the nominal value of pensions in payment.

The final two risks operate at the individual level. The first is that individuals, due to their personal and labour-market histories, do not build up sufficient entitlement in terms of mandatory retirement benefits. The second of this pair of risks occurs when mandatory benefits are low: individuals may not make sufficient voluntary retirement savings.

Demographic risk

Population aging is now a widespread phenomenon, as life expectancy increases and birth rates fall. Demographic risk is often (but by no means always) explicitly recognised in long-term financial projections for pension systems. This is usually achieved by presenting a range of sensitivity analyses to key parts of the forecast, such as birth-rate and life-expectancy changes.

How has demographic risk been dealt with in the past? In practice, the demographic pressures on retirement-income systems have nearly turned out to be heavier than predicted. The way in which this unexpected, additional burden has been shared has depended, in large part, on the political process. Some of the extra costs have been mitigated by reducing benefit levels or tightening eligibility conditions, such as the pension age, while some have been borne by higher taxes or contributions on people of working age. Effectively, the sharing of the demographic risk among different actors in the retirement-income system has been arbitrary.

Recent pension reforms, however, will significantly change the way in which demographic risks are shared in the future. More specifically, many (if not most) recent pension reforms involve a shift of life-expectancy risk onto individuals. This comes through four mechanisms:

Mandatory defined-contribution plans: these have now been introduced in nearly 30 countries, mainly in Latin America and Eastern Europe, but also in Australia, Hong Kong – China, Nigeria and Sweden.

Notional accounts: these have replaced traditional defined-benefit, public plans in Italy, Latvia, Poland, Russia and Sweden, for example.

Adjusting pension entitlements in defined-benefit plans with life expectancy: Finland, Germany and Portugal.

Linking qualifying conditions, such as retirement age or number of years of contributions required, to life expectancy: Denmark and France.

To analyze the impact of these reforms on the degree to which life-expectancy risk is borne by individual retirees, it is first necessary to measure the degree of uncertainty in future life expectancy.

Analysts differ as to how life expectancy is likely to develop in the future. Optimists point to developments in biotechnology and so on. Pessimists stress the dangers of a global influenza pandemic, increasing obesity and the challenges in tackling chronic conditions of old age, such as Alzheimer’s disease.
Some OECD calculations, based on the experience of changes in mortality rates since 1945, are shown in Table 1. Starting in 2002, the central projection is an increase in life expectancy at age 65 of around 3.5 years over the next 50 years. This would increase pension costs, all other things being equal, by around 20%. However, the worst case shows an increase of only around two years, while the best case is an increase of five years.

### Life-expectancy uncertainty

<table>
<thead>
<tr>
<th>Base Distribution of projections for 2052</th>
<th>5%</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life expectancy at age 65 (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>15.1</td>
<td>20.1</td>
<td>19.1</td>
<td>18.5</td>
<td>18.0</td>
</tr>
<tr>
<td>Women</td>
<td>18.7</td>
<td>23.7</td>
<td>22.8</td>
<td>22.2</td>
<td>21.7</td>
</tr>
<tr>
<td>Change from base (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>0.0</td>
<td>+5.0</td>
<td>+4.0</td>
<td>+3.4</td>
<td>+2.9</td>
</tr>
<tr>
<td>Women</td>
<td>0.0</td>
<td>+5.0</td>
<td>+4.1</td>
<td>+3.5</td>
<td>+3.0</td>
</tr>
</tbody>
</table>

*Source: Whitehouse (2007)*

The Apex models have been used to calculate the value of pension entitlements under these different scenarios for life expectancy in the future. The models calculate two key variables: the replacement rate – pension relative to individual earnings – and pension wealth, the lifetime value of pension benefits. (The models and these indicators are described in more detail in the briefing note ‘Adequacy: Pension entitlements, replacement rates and pension wealth’, number 3 in this series.)

These two measures provide benchmarks against which national pension systems can be evaluated. One benchmark is a pure defined-benefit scheme. In this case, the replacement rate is constant (other things being equal) whatever happens to life expectancy. This means that, as life expectancy increases, pension wealth is higher. In contrast, pension wealth is constant with a pure defined-contribution scheme. The accumulated value in the account at the time of retirement is the same, but higher life expectancy means that this balance must finance a longer retirement duration, and so the replacement rate is lower.

In practice, national pension systems are made up of a number of components. The replacement rates from some parts are affected by life-expectancy changes: defined-contribution, notional-accounts and defined-benefit schemes with adjustments, as set out above. Some parts are generally not affected by changes in life expectancy: defined-benefit schemes without adjustments and basic pensions. In some cases, resource-tested schemes and minimum pensions can offset the impact of life-expectancy changes. If, for example, defined-contribution pensions are lower, entitlements to minimum pensions may be higher.

These two benchmarks underpin a measure of the degree of life-expectancy risk borne by individual retirees. This index is zero in the case where benefits per period are defined. It is 100% in the alternative case, where contributions are defined and benefits per period therefore vary with life expectancy. (Formally, pension wealth is calculated under the different scenarios for life expectancy using the actual parameters of the pension system. The change in pension wealth between the low and high life-expectancy scenarios is divided by the difference in pension wealth that would result in a hypothetical defined-contribution scheme that gives the same benefits as the country’s actual scheme in the median life-expectancy scenario.)

The results show huge diversity between countries in the way life-expectancy risk is shared (Figure 2). The chart shows results for 13 OECD countries where part of the pension system is linked to life expectancy.

Due to the small mandatory contribution in Norway – 2% of earnings – only 10% of the financial cost of longer lives is borne by retirees.
In Australia, this proportion is about 30%: although 9% of wages are paid into the defined-contribution scheme, the means-tested public pension limits the impact of longer lives on pension entitlements. The public, earnings-related pension in Hungary, which is not linked to life expectancy, will continue to provide the majority of retirement incomes.

At the other end of the spectrum, close to 100% of life-expectancy risk is borne by individual retirees in Finland and Portugal. In Poland, this is more than 100%: individual retirees are projected to have higher lifetime benefits if the shorter is life expectancy because of the way the notional-accounts pensions are calculated.

The differences between countries in the sharing of life-expectancy risk are therefore mainly a result of the structure and design of the pension package.

**Investment risk**

The expansion of defined-contribution pensions around the world exposes individuals’ retirement incomes to investment risk.

As with life-expectancy risk, the first stage of the analysis is to measure the scale of investment risk. Space precludes a presentation of that analysis here: the papers under ‘further reading below’ provide the details. Table 3, however, summarizes the key results. These are based on analysis of 25 years of data for the G7 major economies. They assume a portfolio invested 50% in equities and 50% in government bonds. These are based on simulations over a 45-year investment horizon, which is appropriate for analysis of retirement saving.

The first line of the table shows the annual rate of return. With a median of 5.0%, the results for the 10th and 90th percentile of the distribution imply that, 80% of the time, the investment return on pension savings should be between 3.2% and 6.7% a year.

The compound-interest effect means that differences in investment returns imply very large differences in retirement benefits. This is illustrated using a simple example pension plan. It assumes 40 years of contributions at a rate of 10% of earnings a year. The results, shown in the bottom line of Table 3 -- are calculated with the OECD average for mortality rates by age projected for 2040.

With median investment returns, the replacement rate – pension relative to earnings – would be 49%. But the lower bound for the replacement rate (in 10% of cases) is 32% or less. Returns at the higher end of expectations would deliver, again in 10% of cases, a replacement rate of 74% or more.

This huge difference in replacement rates – with a range varying by a factor of 2.3 – illustrates the scale and scope of investment risk with defined-contribution plans.

However, as with life-expectancy risk discussed immediately above, it is important to bear in mind that defined-contribution plans are part of a retirement-income package. This package includes some elements that are not subject to investment risk, such as basic pensions (part of the zero pillar) and public, earnings-related schemes (defined-benefit, points or notional accounts, the first pillar). Some elements of the retirement-income package can offset the impact of investment risk, such as resource-tested schemes (again part of the first pillar).

Two country examples provide a useful illustration. The range of expected outcomes for investment returns is shown across the horizontal axis, from the lowest tenth or decile at the left to the highest at the right. The vertical axis shows the pension replacement rate.

Figure 4 shows the case of an average earner in Australia. The dark area of the chart gives the replacement rate from the defined-contribution

<table>
<thead>
<tr>
<th>Rate of return (%)</th>
<th>10%</th>
<th>50%</th>
<th>90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement rate (%)</td>
<td>3.2</td>
<td>5.0</td>
<td>6.7</td>
</tr>
</tbody>
</table>

*Source: D’Addio, Seisedos and Whitehouse (2007)*
scheme at different rates of investment return. The lighter area shows entitlement to the means-tested pension. As the benefit from the defined-contribution plan is higher, entitlement to the means-tested scheme diminishes. This can be seen clearly in the chart: the slope of the replacement rate with investment outcomes is shallower for the defined-contribution scheme alone relative to the slope of the two sources of retirement income added together.

The next stage of the analysis is to add in the impact of taxes levied on pensions in payment. The after-tax replacement rate is shown by the line in Figure 4. (Taxes on contributions and investment returns are already included in the calculation of replacement rates from the defined-contribution scheme.) At the lowest three deciles of investment returns, an average earner in Australia would not be liable for income tax. However, at higher rates of return, some tax would be payable on retirement incomes.

A second example is Denmark. Here, the retirement-income system is more complex. There is a flat-rate basic pension and then two defined-contribution schemes for most workers: the ATP and occupational schemes. The latter cover more than 80% of the workforce, and so are described here as ‘quasi-mandatory’. Finally, there is a means-tested top up.

As in Australia, the mean-tested scheme reduces the sensitivity of the overall retirement-income package to investment returns. It is in the impact of taxes that Denmark differs. Even at low investment returns, a significant amount of the pension is due in tax. The proportion paid in tax increases with investment returns.

Comparing the curve for the basic plus defined-contribution schemes is steeper than for these schemes plus the means-tested benefit. And once taxes are taken into account, the curve is shallower still.

These examples illustrate the complexities involved in analyzing the impact of different investment returns on retirement incomes. As with life-expectancy risk, it is useful to summarize exposure to investment risk in an index.

The results of such an analysis are presented for 17 OECD and EU countries in Figure 6. In 11 of these, defined-contribution pensions are mandatory or quasi-mandatory. In the other seven – Belgium, Canada, Ireland, Germany, the United Kingdom and the United States – private pensions have broad coverage.

These results again show the case of an average earner. The index is designed so that a result of 100% indicates that all of the pension is subject to investment risk. Mexico scores 100%: an average earner would not be entitled to the minimum pension even at the lowest investment returns. Figures less than 100% reflect elements of the retirement-income package that are not subject to investment risk or offset the impact of investment risk.
risk (through means-tested benefits). The largest degree of investment risk, after Mexico, is found in Denmark and four Eastern European countries. (Formally, the index is calculated by assuming a small increment to investment returns from the median case. The resulting change in actual retirement-income entitlements in a particular country’s pension system is then compared with the change that would occur with a hypothetical defined-contribution plan that would produce the same level of benefit at the baseline. Dividing the two changes gives the index.)

Ireland and the United Kingdom have relatively small public pension programs, and so the voluntary defined-contribution plans play an important role in providing incomes in old age. Contributions to defined-contribution schemes are relatively small on average in the voluntary schemes in Belgium and Germany and the mandatory scheme in Norway. However, Australia has a relatively high contribution rate to its scheme – 9% of earnings – but the means-tested scheme means that individuals bear relatively little investment risk.

The chart shows investment risk both before and after the impact of taxes. In Canada, Lithuania, Mexico and the Slovak Republic, pensions are either not taxed or tax credits for older people mean that an average earner would not be liable for income tax during retirement. In other cases, income taxes reduce the degree of investment risk borne by individuals. The effect is significant, not only in the examples of Australia and Denmark set out above, but also in Hungary and Ireland.

In most countries, there are differences in exposure to investment risk across the earnings range. Many of these are significant (Figure 7).
Mexico is an outlier: the lowest earners are heavily insured against investment risk by the minimum pension. In contrast, earners higher up the scale derive all their retirement income from defined-contribution plans at all or nearly all the different investment returns analyzed.

In Canada, Ireland, Lithuania, Norway and the United Kingdom, basic pensions mean that investment-risk exposure increases with incomes. The same is true of the means-tested schemes which have broad coverage in Australia, Canada and Denmark. In the United Kingdom, the public, earnings-related scheme has a progressive formula, meaning that a greater part of low-income worker’s pensions come from these schemes that do not involve investment risk.

In contrast, there is no variation in exposure to investment risk with earnings in Germany, Hungary, Latvia, Poland and the Slovak Republic (not shown here). This is generally because safety-net benefits are set at a low level relative to the pensions from earnings-related and defined-contribution schemes, even for low earners.

**Social and labor-market risks**

Social and labour-market risks are the various uncertainties in individuals’ lives that might affect pension entitlements in the long term, in addition to their short-term effects on living standards. There are four key social and labour-market risks:

- **Low earnings**: pension entitlements for people with persistently low earnings are calculated using the Apex models, which give replacement rates for workers at different pay levels. These results are included in the World Bank Pensions Indicators and Database: see the briefing note, number 3 in this series on ‘Adequacy: Pension entitlements, replacement rates and pension wealth’.

- **Widowhood**: analysis of income-distribution data shows that women, especially older female pensioners, are at high risk of poverty. The Apex models have been extended to look at survivors’ benefits, with results available for the 38 OECD and/or EU countries. The results of this analysis will be added at a later stage to the World Bank Pensions Indicators and Database.

- **Caring responsibilities**: many countries offer credits for periods spent out of paid work due to caring responsibilities. The Apex models have also been extended to analyze the impact of absence from the labor market caring for children for periods of one to 15 years. Again, these results are currently only available for the 38 OECD/EU countries and these will be added to the World Bank Pensions Indicators and Database in a subsequent revision.

- **Divorce**: like survivorship and caring responsibilities, divorce is mainly a risk factor for women’s old-age incomes. While some countries have rules for pensions splitting on divorce, many do not. There is also the problem that many people may re-marry after divorce. It is not, therefore, possible to model the impact of divorce on pension entitlements in the Apex framework. However, the OECD has collected information on the pension treatment of divorce in the 38 OECD/EU countries in descriptive form.

- **Unemployment**: periods of unemployment can affect pension entitlements. However, many countries provide protection through pension credits or redistributive features of their retirement-income systems.

### Pensions and unemployment

Again, the Apex models have been extended to look at the impact of periods of unemployment on the pension. Of particular policy concern is the impact of long-term unemployment: a short period of unemployment is never going to have a substantial effect on pension entitlements. The two groups most vulnerable to long-term unemployment lie at either end of the age spectrum: youths and older workers.

Starting with the younger age group, Figure 8 compares the pension of a full-career worker (from age 20 to the national standard pension eligibility age) with those of an individual entering
the pension system five years later (that is, at age 25). The choice of a five-year range is designed to show a meaningful potential impact on future retirement incomes. (The calculations use the standard assumptions outlined in the briefing note ‘Adequacy: Pension entitlements, replacement rates and pension wealth’, number 3 in this series).

Figure 8 looks at the case of an average earner. The left-hand panel shows the proportionate change in the pension entitlement moving from an assumption of entry at age 20 to age 25. The right-hand panel shows the level of the gross replacement rate for entry at age 25.

Entry at age 25 rather than age 20, of course, means that there are five years missing from an individual’s contribution history. With a typical pension age of 65, then this means a shortening of the contribution record from 45 to 40 years, a reduction of 11%. This 11% figure provides a useful benchmark against which to judge the reduction in replacement rates resulting from a late start in the working life. Austria and Korea, for example, show a reduction in replacement rates of this percentage.

In ten countries, the reduction is larger than this benchmark number. In many of them – Bulgaria, Hungary, Latvia, the Slovak Republic and Slovenia, for example – pension ages are 62 or 63, and so the five missing years are a slightly higher proportion of an overall career than in countries with normal pension ages of 65 or higher.

Eight of the ten countries with the largest proportional reduction in pension entitlements have mandatory private pensions. With a defined-contribution scheme, the compound-interest effect means that early years’ contributions are especially important in determining retirement incomes. This is because these contributions have a longer period over which investment returns can accumulate. Defined-contribution schemes are often as a result described as ‘front-loaded’. This explains the position of Bulgaria, Hungary, Iceland, Latvia, Mexico, Poland, Romania and the Slovak Republic in the left-hand chart of Figure 8.

**Impact of late transition into work for an average earner**

*Source: Apex models*
In contrast, most earnings-related schemes (of whichever variety) tend to accrue at a similar rate across the career. Some, however, are ‘back-loaded’, meaning that accruals in later years are larger relative to earnings in earlier years. A key factor in this is the valorization of earlier years’ earnings to adjust for changes in costs and standards of living between the time a pension entitlement is earned and when the benefit is drawn. With valorization of earlier years’ pension accruals to the growth of average earnings, benefits are evenly loaded across the career. But with prices valorization (either full or in part), then earlier years’ earnings are less important in determining pension benefits. This is effectively the opposite of a compound-interest effect. This phenomenon explains why pension reductions in Belgium and Finland are smaller than the benchmark discussed above.

At the top of the chart are seven countries where a five-year delay in entry into the pension system does not affect entitlements. In some of these – Canada, Ireland and New Zealand, for example – entitlement to basic pensions is not affected by the missing contribution years.

In other cases where the difference is zero, people entering the pension system at age 25 will still generate a full contribution history in the eyes of the pension system, because 35 years’ contributions in Spain and the United States and 40 years’ worth in Canada and Portugal generate the maximum entitlement.

The average reduction in pension for five missing years of contributions at a young age is 8% for the countries shown. The gross pension replacement rate falls from an average of 59.3% to 54.1% for all of the countries analysed.

The reductions tend to be smaller in countries, such as Australia, Japan, Norway, the Netherlands and the United Kingdom, where basic and/or resource-tested benefits play an important role in retirement-income provision.
Turning to older workers, Figure 9 explores the impact on pension entitlements for workers losing their jobs five years before the normal pension age. It is assumed that the worker remains unemployed until drawing old-age benefits from the normal pension age: that is, it is not assumed that people take early-retirement benefits where these are available. The calculations take full account of credits provided for periods on unemployment insurance and assistance benefits. (The parameters and rules of pension credits for unemployment are set out in detail in the 'Country profiles' in OECD *Pensions at a Glance*.) Up to the point of late-in-life unemployment, it is assumed that workers have had a full contribution history.

The results in Figure 9 follow the same pattern as Figure 8 for younger workers above. The largest proportional reduction in benefits (left-hand panel) are in countries, such as Bulgaria, Latvia and the Slovak Republic, that provide little or no pension credits for periods of unemployment. In Finland, there are comprehensive credits for unemployment and unemployment-insurance benefits are not duration-limited as they are for younger workers. The reason for the relatively large pension loss for people being unemployed from age 60 to 65 is that they miss out on the relatively large pension accruals at older ages: 4.5% of earnings for ages 63-67, 1.9% for ages 53-62 compared with 1.5% up to and including age 52.

At the other end of the scale, there is no reduction in benefits in a similar set of countries as in the analysis for younger workers. This is either because these countries have basic pension schemes or people with a full contribution history from age 20 to five years before the normal pension age have already accrued the maximum public pension rights.

The average reduction in benefits for all the countries is 7%. Most countries show a loss of pension rights of less than the benchmark of around 11% which might be expected for an individual with five years missing from a full contribution history of around 45 years.

These sample results are designed to illustrate the range of career paths that the Apex models can use to generate results for pension entitlements. This analysis will be reflected in future versions of the World Bank Pension Indicators and Database.

**Diversification**

In the face of the various risks and uncertainties involved in pension provision, the best option for individuals and for governments on their behalf is to diversify provision. This is the thinking behind the World Bank’s multi-pillar framework.

The indicators of diversification are designed to show how pension provision is split between providers – public and private – and between sources of financing, pre-funding and pay-as-you-go. (Pay-as-you-go financing means that current contributions pay for current benefits. Pre-funding means that assets are accumulated to meet future pension liabilities.)

One measure uses the Apex models to look at the balance between public and private provision. This is again based on a calculation of pension wealth, as discussed previously. Pension wealth from the different components of the retirement-income system (of which there are up to six in the countries analyzed here) is divided into public and private sources.

The structure of the pension package varies, particularly with individual earnings. The modeling of entitlements, therefore, is carried out for workers earnings between 30% and 300% of the economy-wide average. These are then combined with data on the distribution of earnings to produce a weighted average, with the weights reflecting the fact that there are more people on low earnings than there are high earners.

The results of this analysis are presented in Figure 10. The black bars show the proportion of the retirement-income package coming from public benefits (the zero and first pillars in the World Bank taxonomy).

The second category is mandatory private pensions (the second pillar). This also includes quasi-mandatory schemes that cover more than 80% of the workforce. These schemes are of the
Security defined-contribution type, except in Iceland, the Netherlands and Switzerland.

The third and final category is voluntary private pensions. Although there remain defined-benefit occupational plans in many countries, a defined-contribution scheme has been modeled as such plans have become much more common for private-sector workers. The contribution rate chosen is either the average observed in survey data or the contribution rate set in schemes with automatic enrolment or the maximum that attracts the most favorable tax treatment. Voluntary private pensions have only been modeled for countries where coverage of these schemes is broad. (The main exception is Japan, where occupational schemes have broad coverage, but information on the parameters and rules of these schemes is not available.)

The results show major differences between countries. The model results show that mandatory private pensions, for a worker entering the labor market today, are expected to make up more than half of retirement incomes in Iceland, Latvia, Mexico and the Slovak Republic. The same is true of quasi-mandatory occupational schemes in Denmark and the Netherlands.

These results are forward-looking: they consider the position of a worker entering the labor market today. An alternative measure looks at the incomes of older people today. This uses standard income-distribution data on the sources of income. Figure 11 shows results for OECD countries. It gives the proportion of retirement incomes that comes from ‘capital’, which is predominantly private pensions but also includes individuals’ non-pension savings. The calculation excludes income from work: that is, earnings or self-employment income.

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analysis, using the Apex models, is a better indicator of the current policy stance in terms of diversification between public and private provision.

To an extent, the distinction between public and private provision is the same as the distinction between pre-funding and pay-as-you-go as financing mechanisms. Private schemes are generally pre-funded. The main exception is ‘book-reserve’ financing, whereby companies that sponsor defined-benefit schemes maintain reserves in their balance sheets rather than having a separate pension fund. This form of financing is common in Germany.

Most countries where defined-benefit schemes are common have pension regulatory agencies that try to ensure that the assets in the fund match the liabilities. Declining values of assets as a result of the recent financial crisis means that many defined-benefit plans faced large deficits. Nevertheless, the rules require that these deficits are plugged.

While most public pension schemes are pay-as-you-go, there are exceptions. Many countries have built up public pension reserves to finance future liabilities. Figure 12 shows the value of these reserves in the 16 out of the 30 OECD countries that have such pre-funding. In Denmark and Poland, the reserves are worth just 0.3% of gross domestic product (GDP). This compares with figures of over 30% of GDP in Sweden and over 70% in Finland.

However, to compute a split between pre-funding and pay-as-you-go financing requires more information. Unlike private defined-benefit schemes, reserves are rarely designed to cover the whole of future liabilities. (Here, Finland is an exception.) For example, Canada aims to keep its reserves at a level of around one third of future liabilities, a mix of pre-funding and pay-as-you-go. Some countries, such as Australia, Ireland and New Zealand, have established reserve funds now with the aim of drawing these reserves down in the near future. These three countries are all currently demographically young relative to other OECD countries. Moreover, Ireland has used much of the reserve to recapitalize its banks after the financial crisis and New Zealand has suspended contributions to the reserve for ten years (see OECD, 2009, for details).

Another issue is the investment policy of these reserve funds. The fund in the United States, for example, is invested entirely in government bonds. Many people have argued that this is simply a circular way of financing pensions on a pay-as-you-go basis. This is because the contributions that go into the reserve are merely lent to the government to finance current spending on other programs. Government bonds also make up over 80% of the portfolio of Korea’s public pension reserve and over 60% of Japan’s. (However, the government bond share is just 35-40% in Norway and Sweden and less than 20% in New Zealand and Ireland.)
available. There is, therefore, no single composite indicator that can be calculated at present. However, information on the balance between different components of the pension system (Figure 10) and on the size of public pension reserves (Figure 12) will be included in the World Bank Pensions Indicators and Database.

**Purchasing-power risk**

Most OECD and EU countries have legislated for the indexation of pensions in payment to offset the impact of inflation on the real value of retirement benefits. These policies are important in ensuring that pensions are adequate not only at the time of drawing the pension but also during the retirement period. Outside the OECD and EU, formal indexation procedures are fairly rare. Adjustments to pensions in payment are either discretionary – where there are rules requiring periodic increases but no set procedure to determine the amount of adjustment – or ad hoc, where adjustments occur sporadically at the whim of public-pension agencies or governments.

Changes in the indexation of pensions during retirement have featured in many recent pension-reform packages. Most of these involve a move to a less generous procedure to reduce costs. For example, Hungary used to index pensions to earnings growth, but moved to a 50:50 split of earnings and price indexation in the reform of the late 1990s. To plug the government’s growing deficit resulting from the financial and economic crisis, it will now move to price indexation, although above-inflation rises in pension payments will take place if economic growth is rapid. Other countries that have changed indexation policy for pensions in payment have all moved to a less generous policy (provided real earnings are growing). These include Finland (from 50:50 between earnings and prices to 80% prices and 20% earnings), France (wages to prices), Poland (various changes, most recently from 20:80 earnings and prices to purely prices) and the Slovak Republic (fully to wages to 50:50 wages and prices).

However, governments frequently override indexation rules. Often, this appears to operate in a pro-cyclical way: pension increases are larger than the rules require when the public finances are healthy while increases are postponed or reduced in times of fiscal constraint.

Figure 13 shows the history of pension adjustments in the seven major developed economies, going back to 1960 where data are available. For ease of comparison across time, changes in pension values have been converted to an index fixed at 100 in 2006.

It is important to note that this chart does not show the average pension received by retirees in a particular year. The aim is to isolate the effect of indexation policies and practices on pensions from financial and economic conditions, pension reforms and so on.

The real value of pensions in payment increased in the early part of the period in most countries, but then the growth came to an end. In France and Germany, for example, real benefits more than doubled between 1960 and 1978, with annual real increases in pensions of around 5%. But, since 1978, real pensions have been broadly flat in both countries. In others countries, the growth of real pensions came to a halt later: 1984 in Italy, 1986 in Canada and 1994 in Japan. In the United States, the growth of real pensions was concentrated in a five-year period with no real increases since price...
indexation of benefits was introduced in 1973. The picture in the United Kingdom is rather different. Although it shares with other countries rapid real growth in pensions in the 1960s and 1970s, a period of level pension values ensued until the mid-1990s.

Figure 13 demonstrates that adjustments of pensions in payment in practice are often at variance with policies of automatic indexation. Pension uprating is a classic example of ad-hoc policymaking that introduces a substantial degree of political risk in the purchasing power of retirement incomes.

Unfortunately, it is difficult to summarize this analysis in a single indicator, as was possible with investment risk and life-expectancy risk above. One possible way is to look over time at the distribution of real changes in pensions per year. Figure 14 provides an example, using the case of Egypt.

The black line in the upper chart shows the annual rate of inflation in Egypt. This has varied from a low of less than 2.5% to a maximum of over 25%. Pension increases have typically been ‘round numbers’. There was a 12-year run of annual increases of 10% ending in 2004, although inflation was generally lower. In the 1980s, however, increases often failed to keep pace with inflation.

The lower chart shows the increases in real terms (that is, the difference between the pension adjustment and the inflation rate as shown in the upper chart). A potential measure of the degree of inflation risk borne by retirees is to look at the volatility in this time series. Such an analysis – for Egypt and the G7 countries – is presented in Table 14.

The Table shows the average annual adjustment to pensions in payment in real terms. These are for selected time periods: for the G7, they are periods over which real increases have been small and/or policies of formal indexation of pensions to price inflation have been in place.

Annual real changes in the G7 countries, Germany and the United Kingdom apart, are very close to zero. The volatility of annual changes in pensions – measured using the standard deviation – is greatest in Japan and the United Kingdom. However, the variability of annual changes in Egypt is many times larger than the G7 countries. Although the average real increase is positive,
Security

Retirees bear a substantial degree of inflation risk as the purchasing power of their pension benefits varies substantially year-on-year.

This analysis is presented here for the first time. It is therefore preliminary at this stage, but more work will be carried out in the future: in particular, expanding the range of countries studied. An indicator, along the lines proposed here, will then be developed for the World Bank Pensions Indicators and Database.

Conclusions
The analysis of the different risks and uncertainties inherent in retirement-income provision is generally piecemeal or at an embryonic stage. This briefing note has set out some indicators that will be included in the World Bank pension database. But it has also looked set out areas in which further research is needed. Risk and uncertainty have, in the past, been poorly measured or just ignored. This has to change.

Sources and further reading


