Chapter 2

Putting Pensions on Auto-pilot: Automatic-adjustment Mechanisms and Financial Sustainability of Retirement-income Systems

This chapter analyses the automatic adjustment mechanisms introduced in public pension systems over the past 15 years. These mechanisms create automatic links between demographic or economic developments and the retirement-income system, particularly benefit levels. While these mechanisms generate greater sustainability of pension promises they normally worsen benefit adequacy. Old-age safety nets may need to be reinforced to address these concerns. Furthermore, automatic adjustment mechanisms are often complex, difficult to understand and create uncertainty over future benefits. In order for individuals to adjust to these new pension designs – by working longer or saving more in private pensions, there is a need for gradualism and transparency in the implementation. A fair and predictable burden-sharing across generations should help individuals to act pro-actively by adapting their saving and labour supply behaviour.

2.1. Introduction

The need for pension reform to meet the pressures of an ageing population and ensure the affordability of pensions has been apparent for some time. Trend increases in life expectancy, combined with declining fertility rates, in many developed countries are a challenge for public policy in general and pension systems in particular.

The combination of these demographic trends implies for many pension systems, *ceteris paribus,* a declining amount of contributions collected and an increasing amount of benefits paid. This situation has required repeated changes to pension-system parameters and rules that in general have only stabilised the system's financial situation temporarily.

These developments have prompted many countries over the past 15 years to introduce *automatic* links between demographic or economic developments and the retirement-income system. This important innovation is attractive for economic reasons as well as politically. The automaticity of adjustments means that pension financing is, to some extent, immunised against demographic and economic shocks. It provides a logical and neat rationale for changes – such as cuts in benefits – that would otherwise be politically difficult to introduce. Like other pre-commitment mechanisms in economic policymaking – in monetary and fiscal policy, for example – it is designed to ensure credibility with a clear rule: public pension schemes should not place an unexpected burden on the public finances in the future.

These automatic-adjustment mechanisms are designed, directly or indirectly, to help achieve financial sustainability. Section 2.2 shows that financial sustainability is a concept that is difficult to pin down, setting out various alternative approaches. It also discusses the time periods over which the finances should be assessed, contrasting short-term, relatively static conditions with long-term, dynamic approaches. Section 2.3 shows the different ways in which pension systems can adjust to demographic and economic changes and the policy instruments that can be used to ensure sustainability. The section also goes into greater detail on the precise design of adjustments to benefits. The concept of a public pension reserve fund as a financial buffer against demographic and economic shocks is introduced in Section 2.4. The implications for financial sustainability deriving from the various adjustment mechanisms is discussed in Section 2.5. The political economy of automatic adjustment mechanisms are discussed in Section 2.6, which sets out the attractions of this approach. Section 2.7 draws some conclusions.

2.2. Defining financial sustainability

Pension systems involve long-term social and financial commitments: promises to pay benefits during retirement to today's workers cover a period spanning many decades. The capacity to meet these promises is one of the most important issues in the design of retirement-income systems.

2.2.1. Sustainable rates of return on PAYG schemes

The starting point for the analysis of financial sustainability is the framework of Samuelson (1958), as extended by Aaron (1966). In this framework, a public pension system is affordable in the long term if on average it pays those who contribute to the system a rate of "return" equal to the growth of the labour force in real efficiency units. This is known as the Aaron-Samuelson condition (see Box 2.1 below).

Underlying this condition is the widely-shared assumption that average earnings in the economy grow over time in line with productivity gains. Employment has tended to increase in the past (with cyclical variations) but many OECD countries' workforces are projected to shrink in the future. Using data from the European Commission's (2009) *Ageing Report*, it is possible to show that cross-country differences in the sustainable rate of return on pay-as-you-go pensions are substantial. These projections suggest also that, *ceteris paribus*, the replacement rate must decline over time to achieve financial sustainability.

The Aaron-Samuelson framework, at this basic level, does not take full account of the impact of demographic change on the pension system. Population ageing that is driven by changes in fertility is implicitly accounted for by its impact on the size of the labour force. However, the effect of increasing life expectancy needs to be added in explicitly. Using data on pensionable age combined with information on developments in mortality and life expectancy, OECD (2011) estimates the "expected retirement duration", the additional years of life after normal pension age (on average) across countries and over time. This concept illustrates the length of the period over which pension benefits must be paid and it is an important determinant of the public cost of paying for pensions.

Offsetting some of the impact of longer lives on pension systems, many countries have increased pensionable ages or tightened the qualifying conditions for receiving early-retirement benefits. (These changes are extensively documented in Chapter 1 of this report and Chapters I.1 and I.3 of OECD, 2011.) However, reform measures to increase the effective age of retirement mean that increases in the number of people receiving pensions are expected to be lower than the growth of the population aged over 65: 0.8% per annum compared with 1.4% for the EU27 on average. In only two countries – Cyprus[1, 2] and Luxembourg – is the rate of growth of pension recipients expected to exceed the rate of growth of the population over 65.

Adding the change in employment (and the change in the number of pension recipients) gives an overall sustainable rate of return on pay-as-you-go pensions in the Aaron-Samuelson framework.[3] For the EU27 as a whole, this differential averages –0.9% a year, ranging from –0.2% in Denmark to less than –2% in Cyprus and Luxembourg.[4]

The Aaron-Samuelson condition set out in Box 2.1 below relates to rates of return over time, which implicitly assumes that the pension system starts out from some sort of financial equilibrium. In that case, the objective of "sustainability" over time can be met under certain conditions concerning changes in pension replacement rates relative to the rates of growth of those employed and pension recipients.[5] However, pension systems may not have a "sustainable" starting point. This can happen because of some demographic and macro-economic shocks that lead to increasing life expectancy or a very slow GDP growth. But an unsustainable starting point could also be due to too-high benefits, a too-low retirement age or too-low contributions.

Box 2.1. **The Aaron-Samuelson framework in practice**

Suppose that individuals live two periods. During the first period they work, while they spend the second period of time as retirees. Suppose also that the number of workers at time t is L_t and that their average wage is w_t.

Assume that the number of workers increases over time according to the following rule $L_t = L_{t-1}(1 + n)$ while the average wage grows according to $w_{t+1} = w_t (1 + g)$. Suppose that there is a social security programme paying benefit b in the second period and financed by a payroll tax in period 1 levied at rate c. The social security programme is financed on a pay-as-you-go (PAYG) basis such that the workers' generation will receive globally pension benefits in period t + 1 that will be paid out of the contributions of the next generation.

The total pension benefit the young generation (workers in period *t*) will receive when they retire will be equal to the total contributions paid by the next generation (worker generation in period *t* + 1) such that

$$\begin{aligned} P_{t+1} &= R_{t+1}\overline{p} = C_{t+1} = cw_{t+1}L_{t+1} \\ &= c(1+g)w_t(1+n)L_t \end{aligned} \quad (1)$$

Where $\overline{p}$ is the average pension level, which is a fraction of the wage earned in time t, $p = w_t q$, so that the replacement rate *q* is $q = \frac{p}{w_t}$; with *R* being the number of pensioners and *q* being the replacement rate. Equation (1) also expresses the budget constraint that the government faces in each period t if PAYG balance is assumed. In fact, the left-hand side of the equation represents the pension liabilities to the old-generation and the right-hand side represents the contributions paid into the system by the workers. This equality states that the total value of benefits paid is equal to the payroll tax rate times the total wage bill.*

Dividing eq. (1) by C_t, one obtains the pension rate that retirees get out of the contributions they paid when they were workers such that

$$\frac{P_{t+1}}{C_t} = \frac{C_{t+1}}{C_t} = \frac{cw_{t+1}L_{t+1} = c(1+g)w_t(1+n)L_t}{cw_tL_t = c(1+g)w_{t-1}(1+n)L_{t-1}} = (1+g)(1+n)$$

If the contribution rate is constant and the labour force participation rate is constant, this equality reduces to the standard Aaron-Samuelson condition which implies a return of approximately *n* + *g* (equal to the rate of growth of the wage bill). This condition suggests that slow labour force growth and slow productivity growth reduce the rate of return to contributions to a PAYG system.

The condition also implies that the rate of return in a funded pension system will be lower than that generated by a PAYG pension system if

$$(1+r) < (1+g)(1+n)$$

If the inequality is reversed, the rate of return in a funded pension system will be higher than that generated by a PAYG pension system.

A corollary to the Aaron-Samuelson condition is the "paradox of social insurance" in which an individual can receive a higher rate of return when participating in a PAYG pension scheme than by participating in a funded pension scheme.

The intuition behind this paradox is the following: in a fully-funded pension scheme a generation of a size L_t finances its own retirement while in a PAYG a generation of size L_t finances the retirement of a generation of a smaller size. The paradox disappears in a situation of either slow population growth or of population decline and if there is negative growth in the real wage. This also implies that for countries experiencing population ageing, low fertility and low productivity growth, pre-funded privately defined contribution pension schemes may appear a "superior" alternative.

* It can be shown that, by rearranging the terms, the static-balance condition may equivalently be written as the equality between the contribution rate and the product of the average replacement rate and the average dependency ratio of the economy.

More technical studies have explored further the Aaron-Samuelson condition (*i.e.* that the implicit rate of return on pension contributions should be equal to the rate of growth in average earnings plus the rate of growth of employment) and its stability in the face of changes in other variables (see for example Robalino and Bodor, 2009; Settergren and Mikula, 2005; Vidal-Meliá and Boado-Penas, 2012).

2.2.2. Pay-as-you-go equilibrium

The Aaron-Samuelson condition is very clearly dynamic. But the "static" situation at different points in time also matters. This is addressed by the concept of "pay as you go equilibrium". In a strong form, this requires pension contribution revenues to equal public-pension expenditures in each and every period (now and into the future). In a weaker form, this balance between contributions and benefits does not need to hold every year: for example, in times of recession, "automatic stabilisers" might be allowed to operate, with revenues falling short of expenditures. Equally, in times of rapid growth, contribution revenues may exceed spending. In the weaker form, it is important that these revenues and surpluses balance over the economic cycle: *i.e.,* the condition is imposed symmetrically in both good and bad times.

Figure 2.1 shows the relationship between contribution revenues and total expenditures using data from European Commission (2009) for 2007 and projections for 2060. In 2007, the average ratio between contribution revenues and benefit expenditures for the 23 countries shown is 88% (the blue bars). In seven cases – the Czech Republic, Estonia, Ireland, Latvia, Luxembourg, Romania and Spain – pension contribution revenues exceeded expenditure in 2007. In the nine countries at the bottom of the chart, contribution revenues covered between half and three-quarters of expenditure.

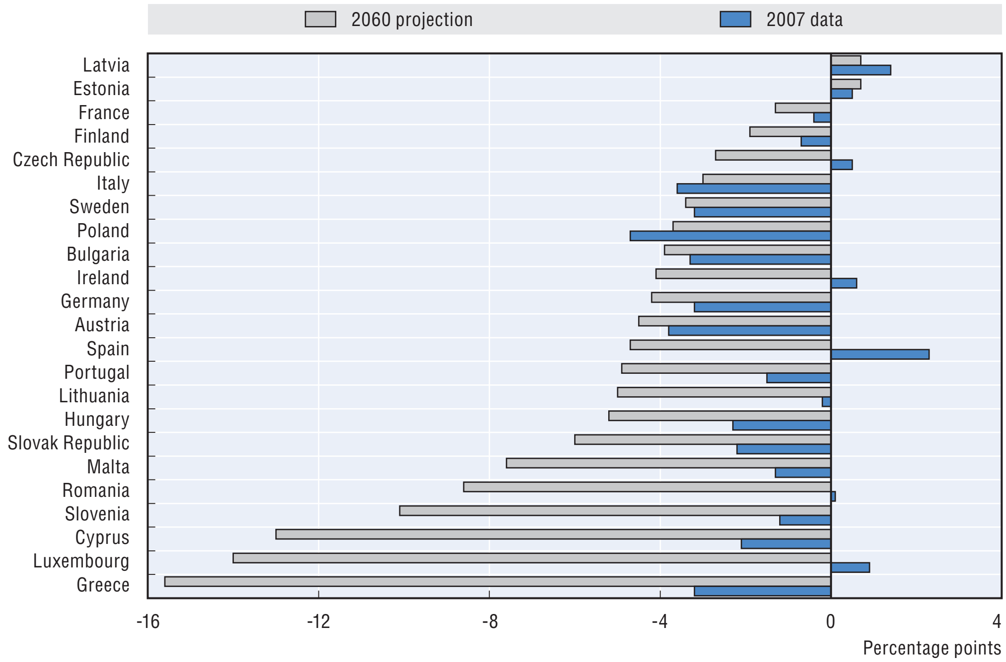
In some of these cases, this reflects a range of explicit policies. For example, some types of public pensions – especially resource-tested benefits or minimum pensions – are financed out of general government revenues. In others, the cost of credits for some periods out of paid work – caring for children or during a spell of unemployment – also comes out of the general government pot.

Nevertheless, in some countries contribution revenues increase significantly less than pension expenditures. In the absence of an explicit decision to finance part of the pension promise out of general taxation, the higher growth rate of benefits relative to contributions may be a sign of PAYG disequilibrium: benefit pay-outs that are already unsustainably high relative to contributions paid.[6]

Looking forward to 2060, the proportion of public-pension expenditures that will be financed by contributions is expected to fall from 88% to 64% on average. Only Estonia and Latvia are projected to have a pay-as-you-go surplus in 2060, compared with seven countries in 2007. In only three countries – Bulgaria, Estonia and Italy – are contribution revenues expected to grow faster than expenditures, and then only by a modest amount. In a few cases, there is only a small deterioration of revenues projected relative to spending: Austria, Finland, France, Germany, Poland and Sweden. The changes are largest in Ireland, Luxembourg, Romania and Spain. In four cases, the gap between contribution revenues and expenditures in 2060 is projected to be 10% of GDP or more, with a further six countries showing a difference of between 5% and 10% of GDP.

The relation between contribution revenues collected and pension benefits paid may be illustrated using benefit/cost ratios. These ratios illustrate the *lifetime* value of benefits

Figure 2.1. **Difference between public pension contribution revenue and pension expenditure, percentage of GDP, 2007 and 2060**



Note: Data are not provided for Denmark (with no contribution) and the United Kingdom (with only an overall contribution). For Belgium and the Netherlands – where there is an explicit pension contribution – data are not reported. Information for Ireland may be misleading: there is no separate pension contribution, so these data probably relate to the overall social-security contribution.

Source: OECD calculations based on European Commission (2009), "The 2009 Ageing Report: Economic and Budgetary Projections for the EU27 Member States (2008-2060)", *European Economy*, No. 2/2009, Tables A53 and A60.

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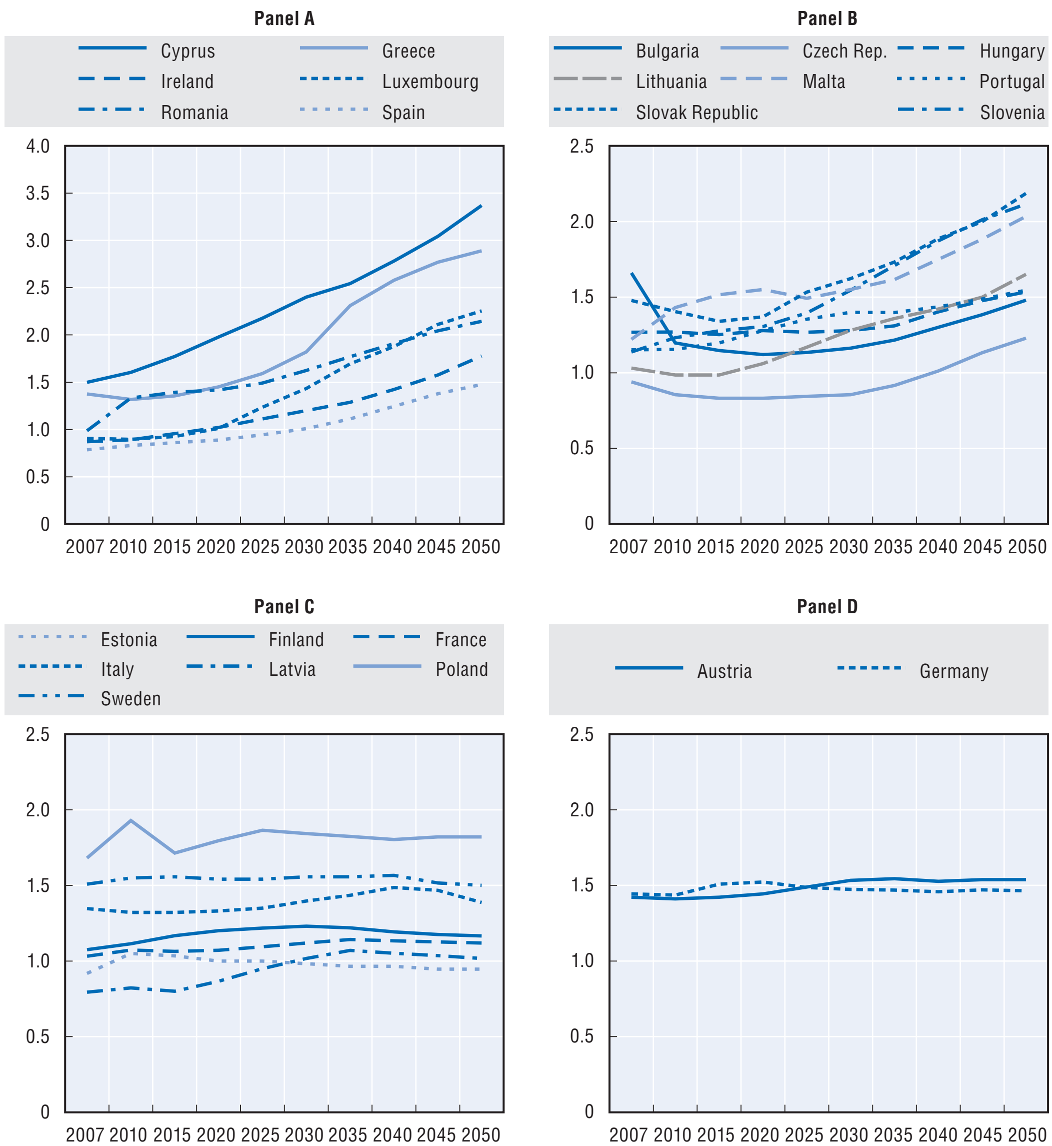
relative to the *lifetime* value of contributions. In steady-state, a benefit-cost ratio of one (with the appropriate discount rate) would indicate that the system is sustainable. Although population ageing is clearly not a steady-state, it is possible to produce sustainable benefit-cost ratios – adjusting for longer life expectancy and a smaller workforce – that will be below one (see also D'Addio and Whitehouse, 2012).

Figure 2.2 shows the ratio of public pension expenditure to contribution revenues using data for 2007 and projections through to 2060.[7] These charts are based on European Commission (2009) and thus the projections do not account for the impact of the reforms that have taken place since 2009, for example, in France, Greece, Italy and Spain. Countries have been divided into four groups based on the increase in the ratio over the projection period, starting with the largest increases in the top panel on the left and ending with the smallest increases in the bottom panel on the right.

Pension spending is currently slightly below contribution revenues in Ireland, Luxembourg, Romania and Spain. However, in Luxembourg and Romania, spending in 2060 might well be over double the revenues from contributions. For most of the countries in the bottom panels of Figure 2.2, the relationship between expenditure and revenues is projected to be broadly unchanged over the forecast period. In quite a number of these cases, expenditure is significantly larger than contribution revenues: in general, this reflects the fact that part of public spending on retirement benefits is financed out of general revenues rather than pension contributions. Indeed, it is not possible to show the

Figure 2.2. **Ratio of pension expenditure to pension contribution revenue, percentage of GDP, 2007-2060**



Source: OECD analysis of European Commission (2009), "The 2009 Ageing Report: Economic and Budgetary Projections for the EU27 Member States (2008-2060)", *European Economy*, No. 2/2009, Tables A53 and A60.

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ratio of pension expenditures to contributions for those countries – such as Belgium, Denmark, the Netherlands, Norway and the United Kingdom – where there are no separately identifiable pension contributions.

The calculation of benefit/cost ratios, however, raises a number of methodological problems. First, in about a third of EU/OECD countries there are either no contributions at all (retirement benefits are paid from general revenues) or there is no separately identifiable "pension" contribution (because it is part of an overall contribution including unemployment, industrial injury, sickness, disability etc. benefits). This limits the scope of the analysis.

Secondly, many public sources of retirement support, particularly resource-tested benefits, are explicitly not financed by contributions. Thus, the measure of sustainability used here has to exclude such benefits from the calculations. But that distorts the assessment of financial sustainability. These programmes are already significant sources of old-age incomes in many countries. And they will become more important over time as many countries have made substantial cuts in earnings-related benefits. This could lead to incorrect interpretation of the results.

Thirdly, the contributions also pay for benefits, such as those for disability and survivors, that are not included in the calculation of the benefit flow. Lastly, even if an expensive public, PAYG, earnings-related pension appears "sustainable" on this measure – *i.e.,* lifetime contribution revenues are greater than expenditures – there may still be concerns about high contribution rates and their economic impact.

For the reasons outlined above, these data cannot, in every case, be interpreted as a deficit of the pension system: some of the benefits included in the overall expenditure are explicitly financed from general government revenues. Moreover, the role of different components of the pension system is likely to change over time. For example, a reduction in earnings-related benefits as a result of pension reforms is likely to increase expenditures on safety-net programmes, such as basic, means-tested and minimum benefits. A useful, comprehensive definition of sustainability must take account both of the full range of benefits on the expenditure side and the full range of financing mechanisms on the revenue side.

2.2.3. Actuarial equilibrium

Instead of assessing contributions and expenditures in a single year or over an economic cycle, one can sum these over a long projection horizon. In this case the relevant concept is that of "actuarial equilibrium".

If the system is in balance over the whole period, there will be surpluses or deficits (of contribution revenues *versus* expenditures) in most years, with one or the other persisting for quite long periods. Within a PAYG system this could be achieved by linking the rate of return of the contribution of a specific cohort (and thereby the pension benefits) to the present value of future contributions. This difference between these two totals shows the so-called "financing gap" of the pension system. This longer horizon has very different implications. The current balance of the pension system may be in surplus. However, population ageing may mean that pension expenditures will exceed revenues if current contribution rates are maintained into the future. The actuarial equilibrium approach would therefore require remedial action now, while pay-as-you-go equilibrium would not.

An "actuarial" approach, therefore, considers both expenditures and contribution revenues and the balance between the two over time. This approach is popular with the World Bank and it is a standard presentation of the results from its PROST model (the Pension Reform Options Simulation Toolkit).[8]

2.3. Targets, instruments and mechanisms for implementation of automatic adjustment mechanisms

Financial sustainability is an important issue for most types of pension arrangements. This is most obvious in cases where benefits are financed on a pay-as-you-go (PAYG) basis, where current contributions pay for current benefits. In earnings-related schemes that are financed on a funded basis – where there are assets to back future pension promises – or are partially pre-funded the financial problems are reflected in solvency difficulties. This group of schemes includes private defined-benefit schemes (in the Netherlands, for example) and public programmes with reserves (such as the defined-benefit schemes in Finland and the notional-accounts scheme in Sweden).

By contrast, with pure defined-contribution schemes – where benefits depend solely on the value of contributions and on the investment returns earned – financial sustainability is not an issue, although adequacy may be. At any point in time, the value of future pension liabilities is exactly the same as the value of the assets in the funds.

The most logical approach to financial sustainability involves some form of long-term (actuarial) equilibrium. This means that the pension system is in balance over time in the long-term: the stream of expected future contributions and other revenues over a suitably long horizon (50-75 years) is enough to pay for projected benefits over that period. However, it may be possible to use proxies for this direct measure of financial sustainability in an automatic adjustment mechanism.

The question is therefore about the instruments that can be used to correct situations of "actuarial" disequilibrium. Four types of instruments might be employed:

- adjustments in the benefit level (or the value of pension benefits) which directly reduce expenditures;
- adjustments in pension eligibility ages which cut spending by reducing the duration over which pensions are paid;
- adjustment in contribution rates which increases the revenues of the scheme,[9] or
- drawing on a reserve fund, providing one exists.[10]

There are some variations on these themes. For example, contribution revenues might be increased by extending the base (raising the ceiling, levying contributions on unearned income *etc.*) rather than increasing the rate. Benefit levels can be cut in different ways: across-the board (proportionally for all) or in a targeted way (with smaller cuts for low-wage workers than for high-wage workers). Effective benefit cuts can be imposed on existing retirees by changing the policy for indexing pensions in payment. Benefit cuts on current workers can be restricted only to new pension accruals or applied to the rights already accrued.

Three of the adjustments listed above (benefits, pension ages and contributions) can be introduced on an ad-hoc, discretionary basis or they can be part of an automatic adjustment mechanism. This section covers both cases, but focuses on the latter.

2.3.1. The adjustments of benefit levels

Changing the accrual rate – the amount of pension earned for each year of contributions – is the most direct way of affecting benefits. But such a direct approach is relatively rare. Far more common are indirect changes to the benefit formula. In practice, the adjustment factors of the benefits often depend on the behaviour of some demographic indicators (such as life expectancy and the old-age dependency ratio) or economic variables (such as growth in GDP or average earnings). However, only some of these indirect approaches can be considered as *automatic* adjustment mechanisms.

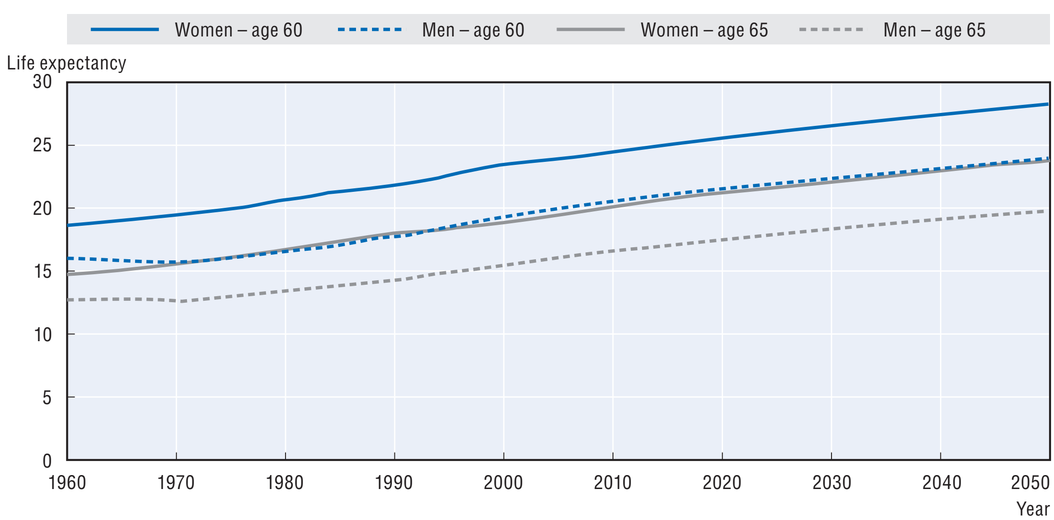
Effectively, there are three main mechanisms to adjust the benefit levels (or the value of pension benefits) in an automatic manner:

- Adjustments can be made in benefit levels to reflect changes in life expectancy.
- Adjustments can occur through valorisation of earlier years' earnings.
- Thirdly, adjustment can be made in the method of indexation of pensions in payment.

2.3.1.1. Adjustments in benefit levels to reflect changes in life expectancy

The UN demographic projections suggest further increases in life expectancy between 2010 and 2050.[11] The additional years of life expectancy at age 65 are projected to grow by 3 years for men and 3.5 years for women between 2010 and 2050 (Figure 2.3). As in the past, the lengthening of life expectancy at age 60 is greater, but by a smaller margin than observed between 1960 and 2010. Using data on pensionable age based on OECD (2011) combined with information on developments in mortality and life expectancy gives the number of additional years of life after normal pension age (on average) across countries and over time. This concept here called "expected retirement duration" illustrates the length of the period over which pension benefits must be paid. It is thus an important determinant of cost of paying for pensions.

Figure 2.3. **Life expectancy at age 60 and 65 by sex, OECD average, 1960-2050**



Source: Historical data on life expectancy from the *OECD Health Database 1960-95*. Recent data and projections of life expectancy in the future based on the *United Nations Population Division Database*, *World Population Prospects – The 2008 Revision*; and OECD (2011), *Pensions at a Glance 2011*.

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Offsetting some of the impact of longer lives on pension systems, many countries have made adjustments in benefit levels. Increases in pensionable age (see below) are in fact only one policy response to the fact that people are living longer. Around half of OECD countries have elements in their mandatory retirement-income provision that provide an automatic link between pensions entitlements and life expectancy. Table 2.1 sets out the changes that involve an automatic link between pensions and life expectancy.

Table 2.1. **Different ways of linking pension benefits automatically to life expectancy**

	Mandatory defined-contribution plan	Notional accounts scheme	Benefits linked to life expectancy	DB-to-DC shift in voluntary private provision
Australia	●			
Austria				
Belgium				
Canada			●	●
Chile	●			
Czech Republic				
Denmark				
Estonia	●			
Finland			●	
France				
Germany			●	
Greece				
Hungary				
Iceland				
Ireland				●
Israel	●			
Italy		●		
Japan			●	
Korea				
Luxembourg				
Mexico	●			
Netherlands				
New Zealand				
Norway	●	●		
Poland	●	●		
Portugal			●	
Slovak Republic	●			
Slovenia				
Spain				
Sweden	●	●		●
Switzerland				
Turkey				
United Kingdom				●
United States				●

Note: DC = defined-contribution; DB = defined-benefit.

In the context of public schemes, the link is implemented directly in some defined-benefit schemes (such as in Finland, Germany and Portugal). For example, in Finland, the "life expectancy coefficient" automatically adjusts the amount of pensions in payment as life expectancy changes. With this adjustment in force since 2010, the amount of new pension will depend on the development of life expectancy relative to the base level calculated in 2009. The change in life expectancy will be determined annually for the

62-year-old cohort using five year mortality data for people at least that old. In Portugal, the sustainability factor which determines the pension entitlement results from the relation between the average life expectancy at age 65 in 2006 and the one that will occur in the year before the pension claim. This factor applies to old-age pensions beginning from 1 January 2008 and to old-age pensions resulting from the conversion of invalidity pensions (it is applied at the date of conversion, when the pensioner reaches age 65).[12]

Still in the context of public schemes, some countries have introduced a link to life expectancy with the adoption of notional accounts (such as in Italy, Poland, Norway and Sweden, see Box 2.2).

Box 2.2. **Linking pensions to life expectancy: notional defined contribution pension systems (NDC) in Italy, Sweden and Poland**

In notional defined contribution pension systems, each worker is assigned an individual account in which contributions are recorded but not actually paid in. The system thus remains pay-as-you-go financed. At retirement, assumptions about life expectancy are used to convert the notional capital in each account into a stream of future pension payments. As life expectancy rises, for a given notional capital in each personal account the annual pension payment falls, with the aim of preserving the financial sustainability of the system. OECD countries that have introduced such systems differ, however, in the frequency with which the parameters of the notional systems are revised:

- Italy uses a "transformation coefficient", which is akin to the annuity rate in a funded defined-contribution scheme. This coefficient – which varies with the age at which the pension is claimed, with values determined according to a formula based on actuarial equivalence – is reviewed every three years in line with changes in mortality rates at different ages up to 2019 and every two years after that date.
- Poland and Sweden use an annuity divisor which is revised annually: in Sweden, the divisor is linked to individual retirement age and contemporaneous life expectancy (based on unisex mortality rates in the previous five years); in Poland, it is based on average life expectancy at retirement age.

If the contribution rate is held constant (which is generally the purpose of the switching from a "usual" PAYG toward a NDC PAYG), an automatic stabilising device may be needed to adjust financial imbalances of the pension system. The indexing rule of this kind of device is only present, however, in the Swedish pension system.

Depending on the notional rate of return used to credit individual accounts, notional defined-contribution systems will also have different implications in respect to valorisation of past earnings. In Italy, contributions are up-rated in line with the five-year moving average of nominal GDP growth, and in Sweden with earnings growth; in Poland, a new rule adopted in 2004 stipulates valorisation of notional accounts in line with real growth of the wage bill (a rule that could imply, in a context of lower growth in the labour force, significant falls in pension entitlements).

In sum, among countries with NDC schemes, there are considerable differences in how the pension accrues, how the accounts are treated and how the systems react to the imbalance.

In other contexts, the link to life expectancy in pensions has occurred in two other ways. First, many countries have introduced mandatory defined-contribution schemes to replace part or all of public pension provision (*e.g.* Chile, Estonia, Mexico, Poland, the Slovak Republic and Sweden)[13] or added compulsory contributions on top of existing arrangements – comprising Australia, Israel and Norway.[14] Secondly, there has been a marked shift from defined-benefit to defined-contribution provision in voluntary, private pensions in countries such as Canada, Ireland, the United Kingdom and the United States and in the quasi-mandatory occupational plans in Sweden.

In both NDC and some mandatory defined-contribution schemes (like Sweden's), the accumulated contributions and investment returns are converted into a pension or annuity on retirement. The rate of conversion, like the annuity rate, depends on life expectancy. As life expectancy increases, a given amount of pension capital will buy a smaller annuity, *i.e.* benefit levels *automatically* fall as life expectancy increases.The implicit target is that the value of lifetime pension benefits should remain broadly the same for the same lifetime contributions.[15] In traditional defined-benefit schemes, in contrast, the per-period pension benefit remains the same as life expectancy increases and so the lifetime value of benefits also increases.

Another major development has been the expansion of voluntary, defined-contribution pension schemes. Because the focus of this chapter is on public schemes, the link to life-expectancy in voluntary DC schemes will not be discussed in detail. However, because notional accounts schemes (also called NDC) mimic the functioning of DC schemes, it is worth considering how the link to life expectancy operates in adjusting pension benefits. When people retire in a defined-contribution plan, the accumulated contributions and investment returns may be converted from a lump sum into a regular pension payment. In many countries, regular payments can take the form of programmed withdrawals or annuities.[16] The calculation of the regular payment will be based on projected life expectancy of retirees at the time of retirement. So, pension replacement rates will automatically be lower as life expectancy increases.

2.3.1.2. Adjustments of benefit levels through valorisation

Valorisation is implemented to reflect changes in costs and standards of living between the time that the pension entitlement was earned and when it is drawn. Valorisation of past earnings may not seem obvious in pension systems, but its impact on retirement incomes is large. This is a result of the *compound-interest effect*. A generic example illustrates the impact of changes in valorisation policy. Assuming a 2% annual real wage growth and an annual price inflation of 2.5%, then nominal earnings grow by 4.55% a year. For a full-career worker (*i.e.,* someone working from age 20 to 65), valorising past earnings using a price inflation adjustment factor results in a pension benefit on retirement that is 40% lower than a pension resulting from valorisation in line with economy-wide average earnings. This example illustrates the potential importance of the choice of valorisation method interacting with the compound interest effect.

Valorisation policy, therefore, has important implications both for adequacy and sustainability of pension systems. Financial sustainability is improved by a move to a less generous valorisation procedure. The distributional impact is complex. People with steeper age-earnings profiles (who tend to have higher lifetime earnings) will lose less from a shift from wages to prices valorisation than those with relatively constant real earnings. This is because prices valorisation puts a lower weight on earlier years' earnings (which are less important for a worker with a steep age-earnings profile) than does earnings valorisation. This is the reverse of the effect of extending the period over which earnings are measured to calculate benefits.

The majority of OECD countries with earnings-related schemes valorise past earnings in line with economy-wide wage growth. However, several countries have moved away from earnings valorisation in recent years. For example, valorisation for the public scheme in France is now to prices. The policy in the main second pension for private-sector workers of increasing the cost of a pension point in line with earnings and the value of a point in line with prices has the same effect on benefits as price valorisation (see Queisser and Whitehouse, 2006 and Box 3). Finland and Portugal will valorise pensions to a mix of price inflation and earnings growth.

Important in the context of this section are also the policy on the notional interest rate in notional-accounts schemes and for uprating the value of a pension point with points schemes which as Box 2.3 illustrates are exact equivalents.

Sweden and Germany adjust the incomes before (but also after) retirement according to the average wage growth, while other countries have less generous valorisation procedures. Using the rate of per capita wage growth rather than the rate of total wage growth makes it possible for benefits to grow faster than the wage base that finances them. This may happen when the labour force declines.

However, changes in the valorisation procedure such as those described above are not automatic adjustment mechanisms. They are just one-off discretionary policy changes. By contrast, in Japan changes in valorisation are part of the automatic balance mechanism introduced by the 2004 reform to account for the demographic shocks from an ageing population.

This mechanism consists of two components: *i)* the valorisation procedure; and *ii)* the indexation of pensions in payment. Before the introduction of this mechanism, past earnings were valorised in line with average wages until the beneficiary attained the age of 65. After the age of 65 the benefit was indexed in line with inflation. The mechanism acknowledges the role exerted by declining fertility rates (which potentially reduce the base of contributors) and increasing life expectancy (which increases the period over which pensions are paid) on the cost of the PAYG system. Thus, valorisation and indexation procedures are modified taking into account the rate of decline of active contributors and the yearly rate of increase in life expectancy at age 65: the "modifier" is subtracted from the valorisation/indexation factor. The modifier is equal to the rate of decline of active participants in social security pension schemes plus the yearly rate of increase in life expectancy at age 65.[17] If the financial equilibrium is achieved with this mechanism, the system reverts to the situation without the modifier.

2.3.1.3. Adjustments of benefit levels through indexation of pensions in payment

In some cases, there is a link between valorisation (*i.e.,* pre-retirement indexation) and post-retirement indexation. Nonetheless, indexation of pensions in payment is another instrument that allows for the adjustment of benefits.

Changes in the indexation of pensions during retirement were included in many reform packages in the 1990s. 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 crisis, it has now moved fully to price indexation.[18]

Box 2.3. **Relations between different types of pension schemes**

Publicly-provided, earnings-related pension schemes follow three broad types. It is useful to compare the relationship between the three using some basic algebra. Issues are here simplified by using simple, generic versions of the three different scheme types: defined-benefit, points, and notional accounts.

All three types of scheme are found in OECD countries. More than half of OECD countries have public defined-benefit schemes and in a further three, private defined-benefit plans are either mandatory or "quasi-mandatory" (*i.e.,* they achieve near-universal coverage through industrial-relations agreements). Four OECD countries have points schemes and three have notional accounts. In seven countries, there are no public or mandatory private earnings-related schemes. Of these, three have mandatory or quasi-mandatory defined-contribution provision while two have no compulsory public or private arrangements for providing income replacement in retirement, relying instead on basic schemes (see Queisser and Whitehouse, 2006).

A simple defined-benefit plan pays a constant accrual rate, *a*, for each year of service. It is based on lifetime average revalued earnings. The pension benefit can therefore be written as:

$$DB = \sum_{i=o}^{R} w_i (1+u)^{R-i} a$$

where *w* are individual earnings in a particular year (indexed *i*), R is the year of retirement and *u* is the factor by which earlier years' earnings are revalued. In most OECD countries, this is the growth of economy-wide average earnings.

In a points system, pension points are calculated by dividing earnings by the cost of the pension point (*k*). The pension benefit then depends on the value of a point at the time of retirement, *v*. Thus, the pension benefit can be written as:

$$PP = \sum_{i=o}^{R} \frac{w_i v_R}{k_i}$$

A significant public-policy variable is the policy for uprating the value of the pension point, shown by the parameter *x* in the equation below. By re-writing the pension-point value at the time of retirement as a function of its contemporaneous value, the equation becomes:

$$PP = \sum_{i=o}^{R} \frac{w_i v_i}{k_i} (1+x)^{R-i}$$

In notional accounts, the inflow each year is wages multiplied by the contribution rate, *c*. The notional capital is increased each year by the notional interest rate, n. At retirement, the accumulated notional capital is divided by a notional annuity factor, A, sometimes called the g-value. The pension benefit can be written as:

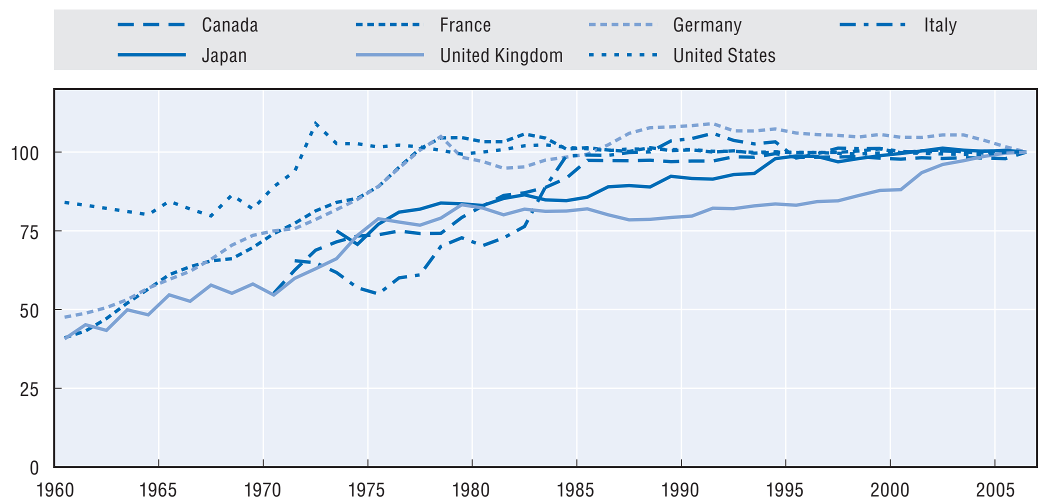
$$NA = \sum_{i=o}^{R} \frac{w_i c}{A} (1+n)^{R-i}$$

If the policy for valorising earlier years' earnings is the same as the uprating procedure for the pension point and the notional interest rate (*i.e.,* $u = x = n$), then the structure of the three equations is very similar. In this case, the accrual rate under a generic defined-benefit scheme (*a*) is equal to the ratio of the pension-point value to its cost (v/k) and to the ratio of the notional-account contribution rate to the annuity factor (c/A).

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 2.4 shows the history of pension adjustments in the seven major 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, etc.

Figure 2.4. **Impact of indexation practice on real value of pensions in payment**

(Index: 2006 = 100)



Source: Whitehouse (2009).

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Although indexation is a common practice, only in a limited number of OECD countries – Canada, Germany, Japan, Portugal and Sweden – is it "explicitly" related to the sustainability of the system. Some of these countries' practices are examined below.[19] For example, in Canada when an increase in contribution rates occurs (see Section 2.3.3), the indexation of pensions in payment is frozen for three years until the publication of the next actuarial report and the reassessment of the pension plan.

In Sweden, in addition to the life-expectancy link embedded in the calculation of the annuity, pensions in payment are indexed on real wage growth: they are adjusted according to the notional interest rate minus 1.6% (with 1.6% representing an assumption for the long-run growth of real earnings). If real wages grow at this pace, benefits are simply adjusted by the inflation rate. If real wage grow at a slower pace (less than 1.6%), the annuity will grow more slowly than inflation and in the opposite case, the annuity grows faster than the inflation rate. In a system where the indexation follows economic or wage growth, pensioners share some of the risks associated with economic fluctuations with workers.

However, the solvency of the system may also be affected by the trends in fertility rates and the size of the labour force. To account for this possibility, indexation of pensions-in-payment may also be "modified" when the automatic stabiliser built into the Swedish pension system is triggered by the evolution of the so called "balance ratio".

The balance ratio is computed as the ratio of the sum of the (current market of the value of the) buffer funds and the "contribution asset" to the pension liabilities.[20] The ratio is computed on a three-year moving average to smooth temporal variations (Kõnberg *et al.*, 2005). When this ratio is less than one, the interest rate used to calculate accruals in the individual notional account is reduced and the mechanism reduces by the same amount the indexing rate of pensions in payment. These lower rates of accrual and indexation continue until the financial balance is restored. Conversely, if the balance ratio recovers and moves above one, the opposite adjustments should be observed: higher rates of accrual and indexation. Clearly, all of the adjustment occurs on benefits and accrued benefits while the level of contributions does not change

This mechanism is expected to work with stable population and therefore may not be well suited to situations of continuous population decline. In Japan, indexation is, for example, modified to account for population ageing (see Sakamoto, 2005). As noted above, the modifier is subtracted from the indexation rate. This correction is expected to reduce the indexation rate by 0.9 percentage points per year on average. A corollary of this adjustment of the indexation rate will be the reduction of the average replacement rate from 59% in 2004 to 50% by 2023. Differently from Germany, this factor only applies to benefits and not to contribution rates. Moreover if inflation declines or if per capita disposable income declines, the nominal value of the benefits will be maintained. The law contains in fact a provision to override the automatic stabiliser.

In Germany, the sustainability factor introduced by the 2004 reform is part of the mechanism that modifies pension benefits in relation to the system dependency ratio. The system dependency ratio accounts for demographic and economic factors. In fact, it is the ratio between the number of pensioners to the number of non-pensioners, *i.e.,* the contributors plus the unemployed (Börsch-Supan and Wilke, 2006). In addition to adjusting for the differential situations of contributors and beneficiaries, the sustainability factor is linked to an "equivalised" measure of contributors to pensioners (*e.g.* two contributors on low earnings might be considered as one equivalised contributor). If this ratio increases over a year, the indexation rate of the pension benefits is reduced but the reduction is not fully applied. The reduction is determined by a sustainability parameter which tries to share the burden of pensions between the retirees and the workers. If the sustainability factor were equal to one, the burden would be borne by pensioners alone; conversely if it were equal to 0, the burden would be borne by workers alone. The factor is now equal to 25%.

Finally, in Portugal the pension reform of 2007 introduced also a new indexation rule. For the purpose of calculating the pension according to the whole contributory career, the earnings amounts registered between 1 January 2002 and 31 December 2011 are valorised by an index weighted by prices (75%) and average earnings (25%) whenever the latter outstrips prices. The annual adjustment index cannot be higher than the CPI plus 0.5%. The indexes for the calculation basis adjustment will be reassessed after 31 December 2011.

This is not, of course, a comprehensive list of all the ways in which benefits may be reduced. However, these are the only ways that can be used as an automatic-adjustment mechanism.

2.3.1.4. An illustration of the impact of life-expectancy link on pension entitlements

To illustrate the effects of life-expectancy links in five alternative scenarios of mortality between 2010 and 2050, pension entitlements have been calculated for three benchmark countries (Italy, Finland and Slovenia). While Italy has a NDC system (see Box 2.2), Finland and Slovenia have public defined-benefit schemes, with automatic adjustments for life expectancy in Finland and without them in Slovenia. The five scenarios are the median of the distribution of outcomes, the upper and lower quartiles and the 1st and 99th percentiles (see Table 2.2). The two key measures of entitlements computed are *replacement rates* and *pension wealth*.[21]

Table 2.2. **Life expectancy and annuity factors: Baseline data for 2010 and alternative projections for 2050**

	UN		OECD projection for 2050 by percentile of the distribution of projected mortality rates				
	Baseline	Projection					
	2010	2050	1st	25th	50th	75th	99th
Life expectancy at age 65 (years)							
Men	16.9	20.0	23.2	21.6	21.0	20.4	18.9
Women	20.5	24.0	26.9	25.5	24.9	24.3	22.9
Change from 2010 baseline (years)							
Men	*0.0*	*+3.1*	*+6.3*	*+4.7*	*+4.1*	*+3.5*	*+2.0*
Women	*0.0*	*+3.5*	*+6.4*	*+5.0*	*+4.4*	*+3.8*	*+2.4*
Annuity factor at age 65							
Men	13.7	15.7	17.7	16.8	16.4	16	15.1
Women	16.1	18.3	20	19.2	18.8	18.5	17.7
Unisex	14.8	16.9	18.8	17.9	17.5	17.1	16.2
Change from 2010 baseline (per cent)							
Men	*0.0*	*+14.6*	*+29.4*	*+22.4*	*+19.4*	*+16.6*	*+9.9*
Women	*0.0*	*+13.7*	*+24.4*	*+19.3*	*+17.0*	*+14.9*	*+9.7*
Unisex	*0.0*	*+14.2*	*+27.0*	*+20.9*	*+18.2*	*+15.7*	*+9.7*

Source: OECD (2011), *Pensions at a Glance 2011: Retirement-income systems in OECD and G20 countries*, OECD Publishing, Paris, Table 5.2.

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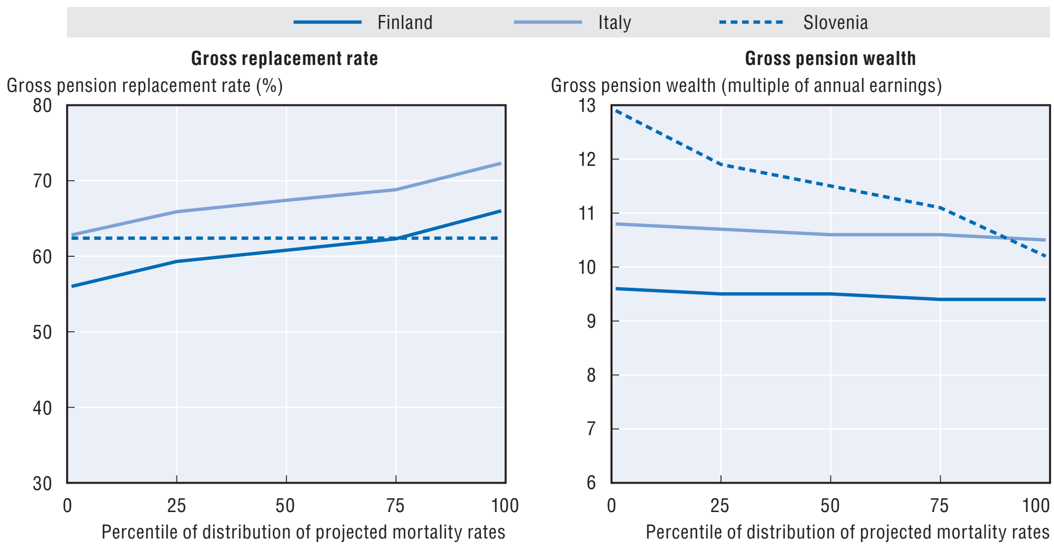
The left-hand chart in Figure 2.5 shows the replacement rate under the different mortality scenarios. All the results are for a man on average earnings. With Slovenia's defined-benefit plan, the replacement rate is constant at 62%. But in the other two cases, replacement rates are lowest at the highest life expectancy (1st percentile of the distribution) and highest with the lowest life expectancy (99th percentile). In Finland, for example, the replacement rate is 56% with the lowest mortality rates and 66% with the highest. Pension wealth is shown in the right-hand chart of Figure 2.5. In Slovenia, pension wealth is nearly 13 times annual earnings in the high-life expectancy scenario but just over ten times with low-life expectancy. There is a slight decline in pension wealth as mortality rates increase in Finland and in Italy, but this is substantially shallower than for Slovenia. For example, pension wealth is higher in Slovenia than in Italy in most cases, but if mortality improvements were especially slow, a man on average earnings in Italy would show higher pension wealth than in Slovenia.

Under a pure defined-benefit plan, replacement rates are constant while pension wealth varies with life expectancy. This is illustrated by the Slovenian case. Under a pure defined-contribution plan, the reverse is true: pension wealth is constant but the replacement rate varies with life expectancy. This is basically the situation in Italy with a NDC system. The chart also shows that an automatic link between benefits and life expectancy as in Finland's defined–benefit system has a similar effect on future benefits than an NDC system. However, the ultimate effect on financial sustainability is greater

Figure 2.5. **Pension entitlements under different life-expectancy scenarios: Man with average earnings**



Source: OECD (2011), *Pensions at a Glance 2011: Retirement-income systems in OECD and G20 countries*, OECD Publishing, Paris, Figure 5.2.

StatLink http://dx.doi.org/10.1787/888932598284

under an NDC system because benefits are also determined by the amount of contributions (via the imputed rate of return on the notional accounts).

In theory the individuals' response to such reforms should be that of working longer, but this outcome is in practice uncertain. Table 2.3 gives some indication of the extra length of work required for selected countries with a link to life expectancy in their mandatory retirement-income provision. It shows the current normal pension age and, using different projections for life expectancy in 2050, the age of claiming the pension that would deliver the same benefits.

In Finland, for example, there is no fixed retirement age for public, earnings-related benefits. However, access to resource-tested schemes – the national and guarantee pensions respectively – is restricted to age 65 and above. Under the median mortality scenario, an individual would have to work to age 66.3 years. The extra work adds to annual benefits in three ways: additional contributions; extra investment returns on accrued pension capital; and a shorter duration of retirement. In the low-mortality scenario, however, work until age 68 would be needed to maintain benefits, while a pension age of 65.9 would be sufficient in the high-mortality scenario. This pattern is broadly replicated in countries with NDC systems, such as Italy, Poland and Sweden. The extra years needed between 2010 and 2050 from Norway's current normal pension age of 67 are also similar. Typically, just less than one extra year's work will deliver the same benefit replacement rate as existed in 2010 under the high-mortality scenario, 1.5 years in the median case and around three years with the most rapid mortality improvements.

In the Slovak Republic, the extra years of work required are fewer, reflecting the significance of elements of the pension package not linked to life expectancy. In Portugal, the extra years of work needed to offset life-expectancy-related reductions in benefits are also small. This reflects the large increments to accrued benefits for people working after the normal pension age. This can be as high as 12.0%, well above the OECD average of 4.8%.

Table 2.3. **Pension ages needed to equalise benefits in 2010 and 2050 under different mortality scenarios: Man on average earnings, selected countries**

	Current normal pension age	Pension age delivering equal replacement rate in 2050		
		Low mortality	Median mortality	High mortality
Chile	65	68.8	66.2	65.7
Estonia	63	64.2	63.7	63.3
Finland	65	68.8	67.3	65.7
Italy	65	69.1	67.3	65.8
Mexico	65	68.7	66.2	65.7
Norway	67	70.9	69.6	67.7
Poland	65	68.7	67.7	65.7
Portugal	65	67.3	66.4	65.4
Slovak Republic	62	63.6	63.1	62.4
Sweden	65	68.8	67.4	65.7

Note: The figures have been updated from those published in OECD (2011) because of the update of mortality data.
Source: OECD pension models.

StatLink http://dx.doi.org/10.1787/888932598911

2.3.2. Pensionable age and other eligibility criteria

Increases in pensionable age – the second instrument to achieve "actuarial equilibrium" have become increasingly common: more than half of OECD countries are increasing the statutory pension age (see Chapter 1 in this report and Chapter 1 in OECD, 2011). In most cases the increases are expected to take place according to schedules fixed by the law. Normal pension ages will vary between 60 and (around) 69 in OECD countries once reforms are fully in place, with an average of 65.6 and 65 years for men and women respectively in 2050.

In the context of defined-benefit schemes, there are two unambiguously positive effects from increasing pensionable age. First, the benefit will be paid for a shorter period thereby reducing the cost over the individual's lifetime. Secondly, people will be working longer and thus contribute more to the system. Offsetting this, the extra pension component of social contributions will mean that people will usually have a larger benefit entitlement. The degree of offset depends on the implicit return on those additional contributions. If a system pays a high return, then the cost of the extra benefits will outweigh the extra pension contribution revenues over time.[22]

With notional accounts and defined-contribution plans, the relevant pension schemes' finances are unchanged with an increase in the pension age. The shorter duration over which benefits are paid is reflected automatically in a higher per-period benefit. Furthermore, the additional contributions match the additional accrual of benefits.[23]

In all three types of pension schemes, there may be an offset to expenditure savings from a higher pension age. This is because people who would have retired on an old-age pension may now effectively leave the labour market *early* through other pathways, such as unemployment, long-term sickness or disability benefits. These effects are difficult to quantify. Working in the opposite direction, people working longer and accruing higher benefits might reduce the burden of paying safety-net benefits to retirees who had low earnings.

2.3.2.1. Linking pensionable age to life expectancy?

A link between benefit levels and life expectancy is a common feature of the pension reforms of OECD countries as noted above. Advocates of these reforms have argued that individuals will respond by working longer as successive cohorts live longer and benefits for a given retirement age are consequently lower.

While the majority of OECD countries have put in place gradual increases in the retirement age, an explicit link between pensionable age and life expectancy is still rare.[24] Denmark, for example, has indexed retirement age to life expectancy. Legal provisions have been introduced that allow the retirement age to be indexed in line with the increases in life expectancy after an initial increase of the retirement age to 67. The eventual increases will result from a review of life expectancy done on five-year intervals starting from 2015. However, previous approval of the Danish Parliament is required for any increase in the retirement age.

Greece and Italy have also recently introduced reforms that will index the retirement age on life expectancy from, respectively, 2021 and 2013. In Greece, the 2010 reform has introduced a mechanism that indexes both the statutory retirement age (65 years) and the minimum retirement age (60 years) to life expectancy from 2021 onward.

In Italy, the 2011 pension reform has speeded up the introduction of the link between life expectancy and retirement age. Initially foreseen in 2009 (and made operational in 2010), the indexation to life expectancy will start in 2013 (instead of 2015) and will be reviewed every three years. From 2019 the review will take place every two years, in order to align the revision of eligibility conditions with the revision of conversion coefficients in the NDC system. The age threshold for being entitled to the means-tested social allowance will be also indexed to life expectancy.

France has a sort of automatic adjustment mechanism too, though it operates via maintaining constant the ratio between the duration of activity and the expected duration of retirement (⅔ and ⅓). A review of life expectancy should trigger a change in the length of the contribution period.

Finally in the Czech republic, to account for increases in life expectancy the standard retirement age will be gradually increased by 2 month per year of birth without any upper limit for men (and later on for women too) under the latest pension reform. The pension eligibility age for women will be increased by 4 months and from 2019 by 6 months to be unified with men (fully for individuals born in 1975 at the age 66 years and 8 months).

2.3.3. Contribution rates

The third instrument mentioned is designed to generate extra revenues for the pension system through increases in contribution rates. Public schemes are often financed from employer and employee social security contributions (*i.e.,* taxes on wages) or from general government revenues. On average in OECD countries, contributions for public pensions raise revenues equivalent to about 70% of public expenditure on pensions. Thus, in most cases, there is some element of general revenue in the financing of benefits.[25]

With a national defined-benefit scheme, such a change has the expected, positive effect on the scheme's finances. With notional accounts, however, this is not the case. There is a short-term boost to government revenues under notional accounts, for example, but this will be balanced by a broadly equivalent increase in future benefit expenditures (again, depending on the degree of "actuarial fairness" in the detailed design of the scheme).

Increases in the contribution rate are very often unpopular measures and can have adverse economic effects. There are potential offsets in economic behaviour in all three types of pension systems. Higher employee contributions will have the effect of an increase in taxes and may therefore reduce labour supply. Higher employer contributions increase employers' labour costs and so may reduce labour demand. In both of these cases, employment will be lower, offsetting some of the revenues raised by higher contributions.

As noted above, most countries have ruled out increases in contribution rates explicitly or implicitly (by adopting notional accounts). However, there are some examples where changes in contribution rates are used in combination with measures on the benefits side of the equation: three countries have mechanisms in place to increase contribution. In one country, Japan, this mechanism is temporary: in fact contribution rates will increase until 2017. In Canada, the contribution rate may be increased conditional on: *i)* the Canada Pension Plan showing in its actuarial report that the legislated rate is lower than the minimum contribution rate required for the sustainability of the plan; and *ii)* that the federal and provincial ministers do not reach agreement on an alternative solution.

In Germany, the sustainability factor is not used only to index initial benefits but also to increase contribution rates. One parameter of the new formula (*i.e.* α) allows the weight of the adjustment to be shared between pensioners and contributors. This parameter has been set equal to 0.25 by the German pension reform because this value would allow payroll taxes not to increase beyond 20% by 2020 and 22% by 2022. Hence, Germany is the only country where there is effectively an automatic link between contribution rates and the pension system's finances.

2.4. Automatic adjustment mechanisms and the use of a buffer fund

In theory, all earnings-related schemes can be financed in one of three ways:

- by *full funding*, where the aim is to have assets equal to the present value of liabilities;
- by *partial funding*, where there are assets but these are less than liabilities by design; or
- on a *pay-as-you-go* basis, where current revenues pay current benefits and there are no assets.

Public, defined-benefit schemes are partially funded by design in Canada and Finland. They are pay-as-you-go financed in about half of OECD countries, including Austria, Belgium, France, Greece and Italy, although some have put aside temporary reserves to meet future pension liabilities. The former point scheme in Norway was partially funded, for example, but pay-as-you-go financed in Germany. Notional accounts are partially funded in Poland and Sweden, but pay-as-you-go financed in Italy.

As illustrated in Figure 2.6 below, nearly half of OECD countries have built up public pension reserves to help pay for state pensions in the future, either by design or on a temporary basis. In these countries, public pension reserves were worth nearly 10% of GDP on average in 2009, some USD 5.4 trillion.

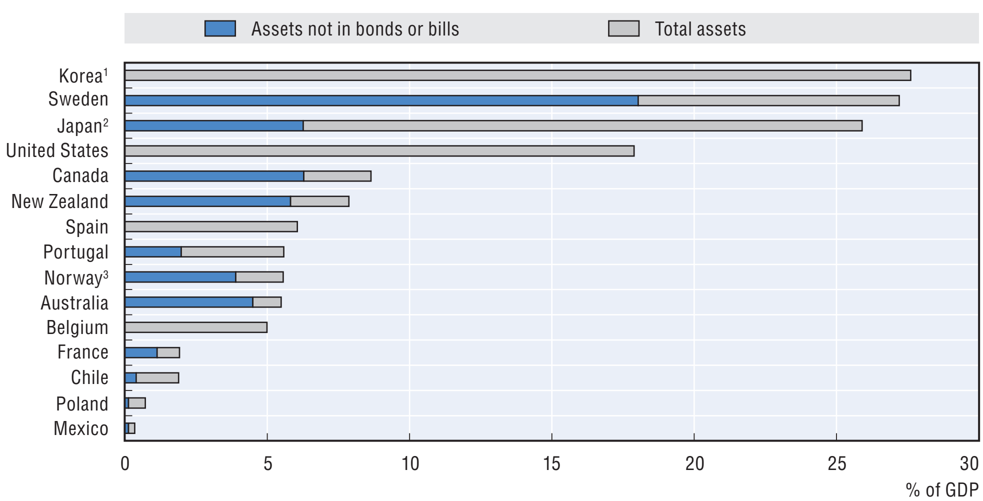
"Pre-funding" with public reserves can be used in any PAYG system and not just in those with built-in automatic adjustment mechanisms. Indeed, pre-funding with public reserves tries to avoid two problems that might otherwise occur. First, a worse treatment of large cohorts of retirees (*e.g.* the baby-boom generation); and second, an excessive reduction of the benefits provided by PAYG pension schemes, that would be necessary to maintain a balanced budget in the absence, for example, of an increase in the contribution rates. Different options are possible to set up and finance public reserve funds.[26]

In France, the Pension Reserve Fund (FRR) was introduced in 1999 and is fed by different sources of revenues (*e.g.* taxes but also the surplus of the National Old-Age Insurance). In the Netherlands, the reserve fund AOW was created in 1997. It is fed by the surplus of the fiscal year. In both countries, the respective funds are expected to contribute to pensions financing from 2020. In the case of Sweden, a mechanism for pre-financing has been "inherited" from the past. Indeed, the "old" pension system had accumulated large reserves since the 1960s. Even if the main purpose of these funds was not that of creating a pre-financing mechanism, a significant portion of the funds is still available.

In the United States, the Social Security Act of 1935 created the OASDI (Old Age, Survivors and Disability Insurance). The surpluses of the system feed into the reserve fund, which are primarily invested in special Treasury bonds. According to the most recent projections from the Chief Actuary, the reserves should begin to be drawn down from 2015 and be exhausted at some point in the 2030s.

More than half of the total reserves shown in Figure 2.6 are accounted for by the social-security trust fund in the United States although, relative to national income, the US reserves are smaller than those of Japan, Korea and Sweden.

Figure 2.6. **Assets in public pension reserves, 2010, per cent of GDP**



1. The breakdown of assets is not available for Korea.
2. Data for Japan refers to 2009.
3. The "Government Pension Fund – Global" in Norway is not included in the chart. The capital in the "Government Pension Fund – Global" was 113 per cent of GDP in 2009. The use of the fund is however not directly tied to the pension system, but to the government finances in general through a fiscal rule.

Source: Table A27 in the Statistical Annex to this volume.

StatLink http://dx.doi.org/10.1787/888932598303

The figure also illustrates an important element in assessing the degree of pre-funding of pension liabilities. Overall, an average of 60% of these reserves is invested in bonds and bills. In some cases, such as the United States, all of the so-called assets of the reserves are government IOUs.

The blue bars in Figure 2.6 show the assets of pension-reserve funds that are invested in assets other than government bonds. The residual, apart from bonds and bills, is worth just 3.7% of GDP on average. That amounts to less than six months of pension spending. Furthermore, some countries such as France and Ireland have run down part of their reserve funds recently to pay for some of the effects of the crisis. Public pension reserves are also very small or non-existing in the other 17 OECD countries.

The limited role of public-pension reserves contrasts with the far more significant pre-funding of pension liabilities in private pension plans. The assets accumulated by OECD pension funds amounted to USD 19.2 trillion in 2010, or just over two-thirds of annual GDP (OECD, 2011).

It is no accident that, in both cases where the long-term health of the pension system is evaluated – Canada and Sweden – there is also a large public pension reserve fund. With most OECD countries experiencing a rapid population ageing, there are strong arguments to put money aside now to avoid large rises in taxes and contributions in the future. One approach is to assess the finances of the pension system over a long horizon and then set the parameters – contribution rates, benefit levels, pension ages etc. – such that the system is in equilibrium. With ageing, this should mean that the system runs surpluses now that will be drawn down in the future to pay for an older population's benefits. The scale of these surpluses will, of course, vary with the economic cycle.

2.5. Implications for financial sustainability

Most of the mechanisms discussed in this chapter are based, in practice, on current variables, such as life expectancy at the normal pensionable age, the system dependency ratio (number of pensioners relative to number of contributors), growth in average earnings, employment or GDP. Only in two cases (Sweden and Canada) are long-term projections of the finances of the pension system taken into account. This difference in the timing over which the assessment of financial sustainability is made is crucial. For it is only if the future financial path of the pension system is taken into account that preparations can be made now for anticipated changes, such as population ageing. In other cases, much of the remedial action occurs later: when current workers claim their benefits, for example.

Moreover, automatic adjustment mechanisms are not themselves a guarantee that pensions systems will achieve and maintain financial sustainability. This is the case even though there are rules that allow the system to adapt to changes, either demographic or economic, and even though the system's adjustment is not left to any political discretionary changes. This is true both for countries with automatic adjustment mechanisms in defined-benefits and for those that have NDC schemes. (See *e.g.* Barr and Diamond, 2011.)

This happens because in PAYG pension systems financial sustainability depends on the evolution of the dependency ratio and thereby on the evolution of the number of contributors and pensioners – and on the decisions to work and to retire. (See the analysis presented in Section 2.2 and more particular Figure 2.2.)

Automatic adjustment mechanisms which affect benefit levels may also influence the supply of labour. Projections of pension expenditures by the European Commission suggest that in most of the countries that have, for example, introduced NDC schemes the cost-containing effect of these systems will require a significant extension of working lives and increase in employment rates (see European Commission, 2009). In other cases, the cost-containment effect will be achieved with reductions of benefits. Both the extension of working lives and alternative forms of savings can help to strike a balance between adequate benefit levels and sustainable contributory burdens.

As a corollary, therefore, those pension systems that take into account both the stock and the flow of contributors, now and in the future, will be more in a position to face the challenges of financial sustainability in the long-term. Measures that promote effectively longer working lives are therefore crucial for the long-term sustainability of these innovative pension reforms.[27]

Moreover, automatic adjustment mechanisms in pension system are too recent to make it possible to assess their performance in the long-term. For example, while the predicted impact of the various automatic adjustment mechanisms linked to life expectancy may look similar, the evolution of life expectancy is uncertain. Therefore, only when these mechanisms have been working for longer periods of time, will it be possible to shed more light on their actual effect on the value of pensions, on the supply of labour and on the sharing of risks and burdens across generations.

Automatic adjustment mechanisms most often imply that the financial costs of longer lives will be shared between generations subject to a rule, rather than spreading the burden through potentially divisive political battles. Traditionally, pension benefits typically depend on the number of years of contributions and a measure of individual earnings. In theory, at least, this meant that the annual value of the pension was the same whatever happened to life expectancy. However, this defined-benefit paradigm that dominated both public and private pension provision in the second half of the 20th century has been diluted. Pension systems around the world have become much more diverse.

Increasing life expectancy suggests that future benefits need to be cut, contributions raised or working lives prolonged to financially sustain pension systems. Living longer is desirable. A longer life and a larger lifetime pension payout due to increased life expectancy confer a double advantage. Therefore some link between pensions and life expectancy may be optimal. It is hard to see why people approaching retirement should not bear at least some of the cost of their generation living longer than previous generations.

The rapid spread of these adjustments has a strong claim to be the most important innovation of pension policy in recent years (see *e.g.* Bosworth and Weaver, 2011; Turner, 2009; Billig and Millette 2009). These changes have important implications for the way the cost of providing for pensions as life expectancy increases is shared. Increasingly, this will be borne by individual retirees in the form of lower benefits.

A key question is then: should all of the cost of longer lives be shifted onto new retirees, in the form of lower benefits or a requirement to work longer for the same benefit? The issue is complex because each individual has a lifecycle that includes periods as a contributor and as a beneficiary. The optimum is therefore unlikely to be a complete link between pensions and life expectancy. The determination of the optimum link, if any, would need a deeper study.

Having said that, why have countries overwhelmingly chosen to link benefit levels to life expectancy rather than pension age? If people simply continue to retire at the same age as present, then benefits will fall as life expectancy grows. The idea is that people will work longer to make up the shortfall. However, there is virtually no mechanism in place to ensure that they do so.

A link of pension age to life expectancy might make at least as much or more intuitive sense to voters as a benefit link. For example, it may be better suited to countries with redistributive public pension programmes, such as Belgium, the Czech Republic, Canada, Ireland, Korea, and the United Kingdom.

However, what constitutes best or good practice is less clear cut. There is clearly a trade-off: greater certainty over the retirement age and/or benefits *versus* greater certainty over the amount of contributions or taxes paid when working.

Life-expectancy risk is but one of many risks involved in pension systems. For example, with defined-contribution pensions, where financial sustainability is not an issue, the value of retirement income is also subject to investment risk.[28] The recent economic and financial crisis has shown that losses can be substantial (OECD, 2009) – in particular for people close to retirement whose remaining working life is not long enough to enable them to recover their pension wealth losses (D'Addio and Whitehouse, 2010; Antolín and Stewart, 2009; and Yermo and Severinson, 2010). Also, other objectives of the retirement-income system – such as ensuring low earners have an adequate standard of living in retirement – may conflict. Reducing already small pensions to reflect increases in life expectancy might risk a resurgence of old-age poverty.

Together, these factors suggest that individual retirees should bear some but not all life-expectancy risk. However, further work is needed to analyse the optimum sharing of risks between generations.

The key message of this chapter is that analysis of pension policy should not adopt a piecemeal approach. A comprehensive approach, covering all the different parts of the system is essential. On balance, a link between pension ages and life expectancy, rather than benefit levels, could be the preferred solution. This can, however, act in concert with benefit links in notional accounts, defined-contribution plans and through adjustments in other earnings-related schemes.

2.6. Political economy of automatic adjustment mechanisms

All reforms aimed at addressing the sustainability of pension system are politically contentious as they are perceived to reduce earned entitlements and are thus very likely to encounter strong opposition from some interest groups. For example, the reduction of pension benefits may be opposed both by current retirees and workers close to retirement. Similarly, an increase in the contribution rates or in the pension age may give rise to opposition from both young and old people, as witnessed recently in a number of European countries undertaking pension reforms.

Therefore, policy makers have often tried to make some changes very difficult to understand or they have delayed their introduction to a moment where governments will have ended their mandate. A more extreme solution that some countries have chosen is to exclude the majority of current workers from the reforms and focus implementation only on young and future workers.

It is also clear that solutions in this domain are not easy because as population ages, the electorate ages too. The resistance to such reforms is therefore deemed to increase in the future. In this context, automatic adjustments represent an attractive alternative. They are in fact designed to protect the pension system's long-term health from short-term political pressures. Thus, the political risk of a pension reform is largely reduced. For example, in those situations where there is a link between life expectancy and benefit levels, an increase of life expectancy will automatically drive a reduction of benefits because of its inclusion in the formula.

One crucial aspect for the "political" acceptance of this kind of mechanism is, however, the *way it is designed*. First, the mechanism may be activated on the realization of an outcome that is either projection-based or trend-based. Projections are extrapolated on the basis of specific assumptions that hold over relatively long periods of time. The effect of forecasting errors and uncertainty may compound over time and may induce substantial differences in the variables that one tries to control. By contrast, mechanisms based on trend realisations rest on actual data. However, this solution is not without problems either, because such mechanisms may display a high degree of volatility and may confound short-term and long-term effects.

Second, the *strength of the mechanism* may differ according to whether the automatic adjustment mechanisms are implemented in the perspective of preventing a situation of crisis, or in contrast, in the perspective of solving a crisis. In the former case, clearly the mechanisms are set up to work for the longer term and may give better results than those set up in emergency situations.

Third, the *frequency of the review* of pension sustainability matters. Infrequent reviews tend to drive larger changes in the parameters triggered by the mechanism than those required by shorter-term review. For example, in Italy the review of the transformation coefficients to account for longer life expectancy was originally fixed to ten years (but never implemented in practice). The outcome of this review would have likely encountered stronger opposition than if it had happened on a shorter basis – the modifications induced would have certainly been larger. The recent reform in Italy shortened in fact the frequency of the review to three years from 2010 until 2019 and to two years afterwards.

Another component of the design of automatic adjustment mechanisms is *the speed of the adjustment*. The faster the speed of the adjustment (for example, a rise in retirement age that occurs in 5 rather than in 20 years), the higher is the probability of strong opposition. Political pressures may still arise in the presence of automatic adjustment mechanisms when the affected groups realise what this means for their benefit or retirement age. In some countries, legislators have intervened and overridden the adjustment mechanisms.

A fifth essential characteristic of the design is the degree of *automaticity*. The degree to which adjustments to pension systems are, in practice, automatic, varies significantly. There have been examples of delays in implementation and, in other cases the heat of the political debate has not been reduced by agreement on the technicalities of these adjustments.

A sixth important feature is about the *distribution of losses*, *i.e.* who will support the adjustments deriving from the triggering of the mechanism. In terms of political risk, the consequences will be different depending on whether they affect current or future retirees more.

Finally, an important feature of the design of automatic adjustment mechanisms is the provision of some form of protection for the most vulnerable. Safety-nets have provided great support to those on low incomes in many OECD countries in the aftermath of the crisis.

In conclusion, automatic adjustment mechanisms may be very difficult to implement for various reasons. Pressure from interest groups and social norms concerning benefit entitlement may interfere with the design of the mechanisms and their functioning. In other cases, lack of time, funding or expertise may lead to delays in the introduction of the mechanism. Politicians may also decide to suspend or to change the way such mechanisms will be implemented once they have been announced – as for example in Germany and Sweden in the aftermath of the crisis to maintain the pensioners' living standards (see *e.g.* Scherman, 2009).

2.7. Summary and conclusions

Population ageing – mainly driven by increasing life expectancy, declining fertility rates and larger cohorts approaching retirement – exerts an increasing fiscal pressure on the public budgets of most OECD countries. A major political challenge is therefore how to balance the financial sustainability of pension systems and the adequacy of retirement incomes, by noting, nonetheless that unsustainable pension systems will not be able to deliver any generous benefit promise. In parallel, pension systems delivering inadequate benefits may call for future actions to cover the needs of the most vulnerable and may become unsustainable in their turn.

The analysis of financially sustainable designs for pension systems is complex. It is also necessarily incomplete. The majority of the approaches considered impose the condition that public pensions should be financed by contributions on wages. While this has conventionally been the case, there are good reasons to reconsider this practice. It makes sense to consider the two flows separately. First, what is the profile of public expenditure on pensions over time? Secondly, how should this be financed? By "contributions" or by general revenues? For example, there may be concerns that pension contributions – effectively a tax on wages – may have negative effects on work incentives. It might make sense instead to finance public pension benefits out of some other revenue source: consumption taxes, for example. Public pensions are to some extent a matter of tax and transfer policy: taxes, paid by all age groups, and transfers, paid to older people.

Concerns over sustainability have led many OECD countries to introduce a variety of mechanisms that try to automatically stabilise expenditures of public pension systems. Their action focuses typically on the automatic adjustment of pension benefits, pension age and – more rarely – contribution rates with demographic variables or some measure of the pension system's financial health.

The choice between the instruments analysed in this report has significant implications because it involves trade-offs with other objectives of the pension system.

Starting with the implications of the different mechanisms considered for financial sustainability, it is possible that the cuts in benefits imposed by automatic adjustment mechanisms in order to achieve financial equilibrium might eventually result in a benefit level too low for retirees to live on. This situation may lead to substantial erosion of pension benefits as long as population ages. One shortcoming of the mechanisms is in fact that they try to maintain the contribution rate constant by making all the adjustments fall on the benefit side. Most countries have safety-net benefits for low-income retirees: extra spending on these benefits might offset much of the savings made elsewhere.

There is scope for pension ages to rise in many OECD countries. However, at some point, again, increasing pension ages further must reach a limit where it is unreasonable to expect most people to be able to continue working – although views on where that limit lies may differ significantly (see on this Whitehouse and Zaidi, 2008 and D'Addio and Queisser, 2011). Moreover, increases in pension ages alone may be insufficient to ensure that people work longer if there are other barriers (on the demand side, for example) to older workers finding and retaining jobs (OECD, 2011).

Similarly, there is a limit to increases in contribution rates. Indeed, some countries have adopted automatic adjustment mechanisms specifically to exclude or restrict future increases in contribution rates.

Automatic adjustment mechanisms are often very complex and difficult to understand. Moreover, because they often make pension promises depend on some future economic or demographic developments, their implications (and potentially the individual losses they can cause) are not fully known today.

A clear information strategy about the probable future cuts in benefits related to increasing life expectancy or slower economic growth might, however, have important repercussions on the acceptance of the mechanisms. Workers, especially those near retirement, might strongly oppose these changes because they would have neither the time nor the capacity to adapt to the new situation.

Automatic adjustment mechanisms do not necessarily address the behavioural challenges faced by countries today: how to entice people to work longer or to save more? People faced with lower benefits may choose to work longer to increase their pension entitlements, but there is no mechanism ensuring that they will actually do so.

Any automatic adjustment mechanism in place today, or implemented in response to the recent crisis, might in fact pose problems in terms of adequacy of future benefits and the capacity of systems to protect the living standards of beneficiaries. What will be the destiny of systems based on such rules? There is no doubt that as at present, there will be pressure to intervene to correct the systemic failures of such systems and even remove automatic stabilisers if they are perceived to be functioning badly.

It is important that the question of the *adequacy* of benefits, and thus of the social sustainability of pension systems, will not be left out of the debate. Maintaining financial and actuarial balance might be pursued together with a set of rules or principles to ensure that benefit levels would remain adequate.

Nevertheless, automatic adjustment mechanisms that are designed and implemented so that changes occur gradually, that they are transparent and share the possible burden fairly across generations might help individuals to act pro-actively by adapting their saving and labour supply behaviours.

Notes

1. Footnote by Turkey: The information in this document with reference to "Cyprus" relates to the Southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognizes the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

2. Footnote by all the European Union member states of the OECD and the European Commission: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.
3. The Aaron-Samuelson framework, however, is not universally applicable to different countries. It requires that public pensions are financed from public-pension contributions levied on earnings. Denmark and Australia, for example, does not levy contributions to pay for public pensions. Ireland and the United Kingdom levy an overall "social-security" contribution designed to finance a range of benefits.
4. The standard Aaron-Samuelson condition implies a return of approximately $n + g$ (equal to the rate of growth of the wage bill).
5. In fact it is easy to show that in a PAYG system, under the hypothesis of constant total output, if the labour force shrinks, the total contributions (c*w*L) paid into the system will also decrease. A contemporaneous increase in the number of pensioners and in their average life expectancy implies that the total pension bill will increase. This, clearly, might create a deficit in the pension-fund. To maintain its balance, there are only two options: either to reduce the average pension or to raise the contribution rate.
6. Unfortunately, the lack of suitable data does not allow one to disentangle the effects of intended cross-subsidies out of general revenues from pay-as-you-go disequilibrium.
7. The distinction between "sustainability" and "affordability" is also important and relevant. This introduces some important nuances. Increases in public pension spending over time might be paid for, but only if – with pay-as-you-go schemes – younger generations are willing to shoulder a growing burden of contributions and taxes. It is unclear what exact assumptions have been used in the projections for contribution revenues, but in most cases they are based on unchanged contribution rates. Evidence on equilibrium contribution rates would very likely require an increase from the current rate needed to pay for pensions. The policy issue then becomes whether such projected increases are affordable to future workers.
8. Another favoured concept of the World Bank is "implicit pension debt" (IPD). This effectively measures the present value of the liabilities of the public pension system to pay future benefits that have already been accrued. Holzmann *et al.* (2004) discuss the concept in more detail and provide calculations for 35 countries. It is not possible to calculate IPD estimates from the data provided to the Ageing Working Group (European Commission, 2009).
9. Governments could use other means to finance the deficit between pension liabilities and contributions (*e.g.* by shifting the costs onto future generations, or by other government revenues such as direct or indirect taxes). But these are not properly speaking "automatic stabilisers" of pension systems. This chapter will therefore not discuss these options.
10. As it is explained in Section 2.4, some OECD countries have set up reserve (or buffer) funds designed to help the funding of public pension schemes in "critical" times, for example when the baby-boom generations will reach retirement and/or the contributors' basis will start to erode.
11. This analysis uses the figures from the United Nations population division for OECD countries (*World Population Prospects – 2008 Revision*) as in OECD (2011).
12. See OECD (2011).
13. Further details can be found in OECD (2011) and Whitehouse (2007, 2009). Hungary introduced mandatory defined-contribution plans in 1998 but has now effectively abolished them: see Chapter 3 in this volume for a detailed discussion.
14. The existing arrangements have different forms. For example, Australia's public pension is a non-contributory, flat-rate payment funded from general revenue. It is not related to past employment. A mandatory defined contribution scheme, Superannuation Guarantee, was introduced in 1992. It is funded by employers and employees and based on time spent in the workforce.
15. Other features of the pension system may also help to provide good work incentives. See for example the analysis in Chapter 3 in OECD (2011).
16. See Chapter 6 in this volume for a full discussion of the different ways of structuring the payout phase of DC pension plans.
17. An approximation is used for the increase in life expectancy, *i.e.* a constant adjustment of 0.3 per cent per year.

18. Other countries have changed indexation policy for pensions in payment moving 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 100% prices) and the Slovak Republic (100% wages to 50:50 wages and prices).
19. In many cases, changes in the indexation mechanisms mean that the purchasing power of pensions is preserved, but that pensioners are not participating in the increasing standards of living enjoyed by workers. When poverty thresholds are set in relation to household income, price indexation leads to higher relative poverty rates among pensioners as the economy grows.
20. The contribution asset in a given year is the result of the product of contribution rates by the expected turnover duration. The turnover duration is computed as the difference between the earnings-weighted average age of persons contributing to the system and the pension-weighted average age of beneficiaries receiving annuities from the system. This expected turnover duration represents the average number of years during which the system can finance current pension liabilities. Estimates for 2010 put the expected turnover duration at 31.6 years.
21. The effect of life expectancy on these two variables is shown net of the additional effect that increases in life expectancy have in Italy's NDC system, because of higher age at retirement and (assuming continuous careers) longer contribution periods and therefore higher pension wealth at retirement.
22. There are other taxes and contributions that still benefit the public purse, but the focus here is just on the pension system.
23. Exactly in the defined-contribution case and under certain assumptions of "actuarial fairness" in the case of notional accounts: see Queisser and Whitehouse, 2006.
24. See also Chapter 1 in this volume for a more exhaustive list.
25. See the indicators of "Public expenditure on pensions" and "Contributions" in OECD (2011) or their equivalents in OECD (2009).
26. For a detailed discussion see Yermo (2008).
27. See D'Addio *et al.* (2010); and D'Addio and Whitehouse (2012).
28. Decreases in interest rates also affect the solvency of DB schemes. See on this OECD (2009).

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