Decomposing Notional Defined-Contribution Pensions: Experience of OECD Countries' Reforms

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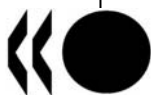**EXPERIENCE OF OECD COUNTRIES' REFORMS**

Edward Whitehouse

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SUMMARY

This paper compares notional defined-contribution pension schemes (also known as notional accounts) with two alternative designs of earnings-related pension schemes: points systems and defined-benefit plans. It examines, in detail, four economic advantages of notional accounts that deliver retirement incomes in an equitable and economically efficient manner. The issue of equity arises in the treatment of people who draw their pensions at different ages and contribute for a different number of years. The issue of economic efficiency arises because pension systems can and do distort individual decisions to work and save.

First, benefits are based on lifetime earnings, rather than a subset of "best" or "final" years' pay. Secondly, an extra year's contribution gives rise to an additional benefit. Thirdly, benefits are reduced to reflect the longer expected duration of payment for people who retire early and, similarly, increased for people who retire late. Finally, benefits are reduced as life expectancy increases, again to reflect the longer duration for which benefits would be paid.

An analysis of OECD countries' pension systems – of all different types – shows that most have already achieved most of these objectives, but without adopting notional accounts.

RESUME

Ce papier compare les systèmes de retraite à comptes notionnels avec deux systèmes alternatifs assis sur les salaires : les systèmes à points et les systèmes à cotisations définies. Il examine, en détail, quatre avantages économiques des comptes notionnels qui permettent de pourvoir des revenus de retraite dans une manière équitable et efficace du point de vue économique.

La question de l'équité se présente dans le traitement de gens qui obtiennent leurs retraites aux âges différents et contribuent pendant des périodes différentes. La question de l'efficacité économique se présente parce que les systèmes de retraite peut et en faites déforment les décisions individuelles de travail et d'épargne. Premièrement, les avantages sont fondés sur les gains tout au long de la vie, au lieu d'un sous-ensemble de salaires de « meilleures » ou «dernières l » année de travail.

Deuxièmement, le fait de cotiser pendant une année supplémentaire engendre une augmentation du montant du revenu de retraite. Troisièmement, les prestations de retraite sont réduites pour prendre en compte la plus longue durée sur laquelle s'étaleront les paiements pour les individus qui partent plus tôt à la retraite, et symétriquement elles sont augmentées pour les individus qui partent à la retraite plus tard. Enfin, les prestations de retraite sont réduites à l'augmentation de l'espérance de vie, pour prendre en compte une nouvelle fois la plus longue période sur laquelle les prestations de retraites seront versées.

Une analyse des systèmes de retraite des pays de l'OCDE – de différents types – montre que la plupart de ceux-ci ont atteint ces objectifs, sans l'adoption d'un système à comptes notionnels.

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1.   A number of countries have introduced notional defined-contribution pensions as a replacement for public pensions of the defined-benefit type.[1] Among OECD and EU countries, for example, these comprise Italy, Latvia, Poland and Sweden. There has been a great deal of interest in other countries in this approach to pension reform.

2.   The motivations for these reforms differed. Undoubtedly, matters of political economy played a role: there was a desire to change the pension system and not merely adjust parameters and rules. Also, reductions in benefits because future pensions would be linked to changes in life expectancy were seen as more palatable to the electorate than cuts in another form.

3.   This paper focuses on the economic issues in these changes. There are four main dimensions:

   1.   Benefits based on lifetime earnings, rather than a subset of "best" or "final" years' pay.

   2.   Each extra year's contribution should give rise to an additional benefit: there should be no ceiling on the number of pensionable years.

   3.   Benefits should be reduced to reflect the longer expected duration of payment for people who retire early and, similarly, should be increased for people who retire late.

   4.   Benefits should be reduced as life expectancy increases, again to reflect the longer duration for which benefits would be paid.

4.   These issues are considered in turn in sections 2-5 below. They have important implications for the equity of the pension system; in particular, treatment of people retiring at different ages or with different number of years of contributions. They also impinge on questions of economic efficiency: how can the distortions of the pension system on individual work and savings decisions be minimised?

5.   Section 1 begins the analysis with a discussion of the relationship between the three different types of earnings-related pensions. Section 6 concludes.

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1.   This paper interchanges the terms "notional accounts" and "notional defined-contribution". The schemes to which these terms refer are those that follow the formula set out in section 1 below.

1. DIFFERENT TYPES OF PENSION SCHEME

6.   Publicly provided, earnings-related pension schemes follow three broad types. It is useful to compare the inter-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.

7.   All three types of scheme are found in OECD countries. Some 17 of the 30 member countries[2] 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.

8.   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.

9.   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:

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

10.   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:

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

11.   In notional accounts, the inflow each year is wages multiplied by the contribution rate. The notional capital is increased each year by the notional interest rate, n. At retirement, the accumulated

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2.   At the time of initially drafting the paper, the OECD had 30 member countries. However, Chile, Estonia, Israel and Slovenia have all joined or will join the Organisation in 2010.

notional capital is divided by a notional annuity factor, A, sometimes called the g-value. The pension benefit can be written as:

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

12.   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-accounts contribution rate to the annuity factor (n / A).

13.   This has two implications for the comparison of these three different types of earnings-related pension scheme. First, the effective accrual rate can be calculated for pension-point schemes (the ratio of point value to cost) and notional-accounts schemes (the ratio of the contribution rate to the annuity factor). Secondly, the valorisation procedure in defined-benefit plans, the uprating policy for the pension-point value and setting the notional interest rate are exactly parallel policies. Different choices of variables have the same effect in the different types of systems. Although defined-benefit, points and notional-accounts systems can appear very different; they are in fact closely related variants of earnings-related pension schemes. The key difference is that notional-accounts schemes have a built-in mechanism to adjust benefits to changes in life expectancy, but, as discussed in detail below, this can also be achieved in defined-benefit and points schemes.

14.   Defined-contribution schemes – where the pension benefit depends on individual contributions and the investment returns that they earn – like the three earnings-related schemes discussed above, share the objective of providing income replacement during retirement. Defined-contribution plans are mandatory or quasi-mandatory in eight OECD countries. Coverage of voluntary private pensions, which are increasingly of the defined-contribution type is widespread (greater than 40% of the workforce) in a further five countries.

15.   Sections 2-4 of this paper focus on earnings-related schemes, because the issues that are raised are relevant to these types of scheme but not to defined-contribution plans. Section 5, however, does look at the evolution and spread of defined-contribution schemes in OECD countries and the implication for the sharing of life-expectancy risk between generations.

16.   One issue not addressed in this paper is the financing of pension benefits. Defined-contribution schemes are, by definition, fully funded at all points: the liabilities of the scheme are exactly equal to the assets in the fund. Some earnings-related schemes are also pre-funded. In theory, all three types could be financed in one of three ways:

   1.   by full funding, where the aim is to have assets equal to the present value of liabilities;

   2.   by partial funding, where there are assets but these are less than liabilities by design; or

   3.   on a pay-as-you-go basis, where current revenues pay current benefits and there are no assets).

17.   For example, public, defined-benefit schemes are fully funded in Finland, partially funded in Canada and pay-as-you-go financed in about half of OECD countries, including Austria, Belgium, Greece and Italy.   Points schemes are pre-funded in Norway, for example, but pay-as-you-go financed in Germany. Notional accounts are partially funded in Sweden but pay-as-you-go financed in Sweden. The issue of the financing mechanism is separable from the microeconomic issues examined in this paper and has been treated comprehensively elsewhere: see the discussion and references in the conclusions.

2.   EARNINGS MEASURES

18.   Most OECD countries used to base individual pension entitlements under public, earnings-related schemes on individual earnings in a limited subset of "best" or "final" years' pay: of 24 countries analysed below, 15 used a subset of earnings in the past. Pension reforms since 1990 have changed this position dramatically, as illustrated in Figure 1. The charts show the number of years of contributions (either "best" or "final") taken into account in calculating pension benefits before and after pension reforms. The chart analyses the relevant types of pension scheme in each country: that is, those based on defined-benefit, points or notional-accounts formulae. It looks at all mandatory components of the pension system, including mandatory private pensions. (However, defined-contribution schemes – where benefits depend on lifetime contributions by definition – are excluded from the analysis.) Occupational plans that cover the great majority of the workforce, termed as "quasi-mandatory", are included. For example, private defined-benefit occupational plans are compulsory in Iceland and Switzerland and quasi-mandatory in the Netherlands.[3]

19.   The left-hand panel shows countries where there have been no changes to the earnings measure (except for changes arising from increases in normal pension eligibility age). This group includes seven countries where the entire career is taken into account along with Canada and the United States, where the pension is based on the best 35 years or so. However, it also includes Greece, Norway and Spain, which currently plan to continue to base pensions on 5, 20 and 15 years' earnings respectively.

20.   The right-hand panel shows countries where the earnings measure has changed. Ten countries are moving or have moved from basing pensions on between 5 and 20 years' earnings to pay over the whole career (or very close): Austria, Finland, Italy, the Netherlands (occupational plans), Poland, Portugal, the Slovak Republic, Sweden, Turkey and the United Kingdom. France is moving from the best 10 years' earnings to the best 25 years' in the public scheme and the Czech Republic to 30 years.

21.   Once these reforms are in place, most OECD countries – 19 out of 24 shown – will no longer pensions on earnings measured over a period significantly less than the whole career.

22.   This is a welcome improvement. Basing pensions on a limited number of best or final years tends to be regressive, because the people with final or best years substantially above their career-average earnings tend to be those that earn the most. Moreover, in countries with a large informal sector, such as Greece, they give a large incentive to under-report earnings in earlier years and in others, such as Austria, they reinforce distortionary systems of seniority-based pay.   Finally, basing pensions on a subset of years of earnings tends to encourage people to retire once earnings have peaked rather than move to lower-paid employment, which would reduce rather than increase their pension income.

23.   It is interesting to note that the three OECD countries that have adopted notional accounts –Italy, Poland and Sweden – started from a position of basing pensions on the final 5, 10 and 15 years' earnings respectively. However, another seven countries -- Austria, Finland, Portugal, the Netherlands, the Slovak

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3.   The analysis does not cover voluntary private pensions, which have broad coverage in Canada, Ireland, Japan, the United Kingdom and the United States.

Republic, Turkey and the United Kingdom – achieved the same result of moving from a subset to whole-career earnings while maintaining the existing structure of their pension provision.

Figure 1. Number of years of earnings used in pension calculation

1a. Countries with little or no change   1b. Countries with significant changes
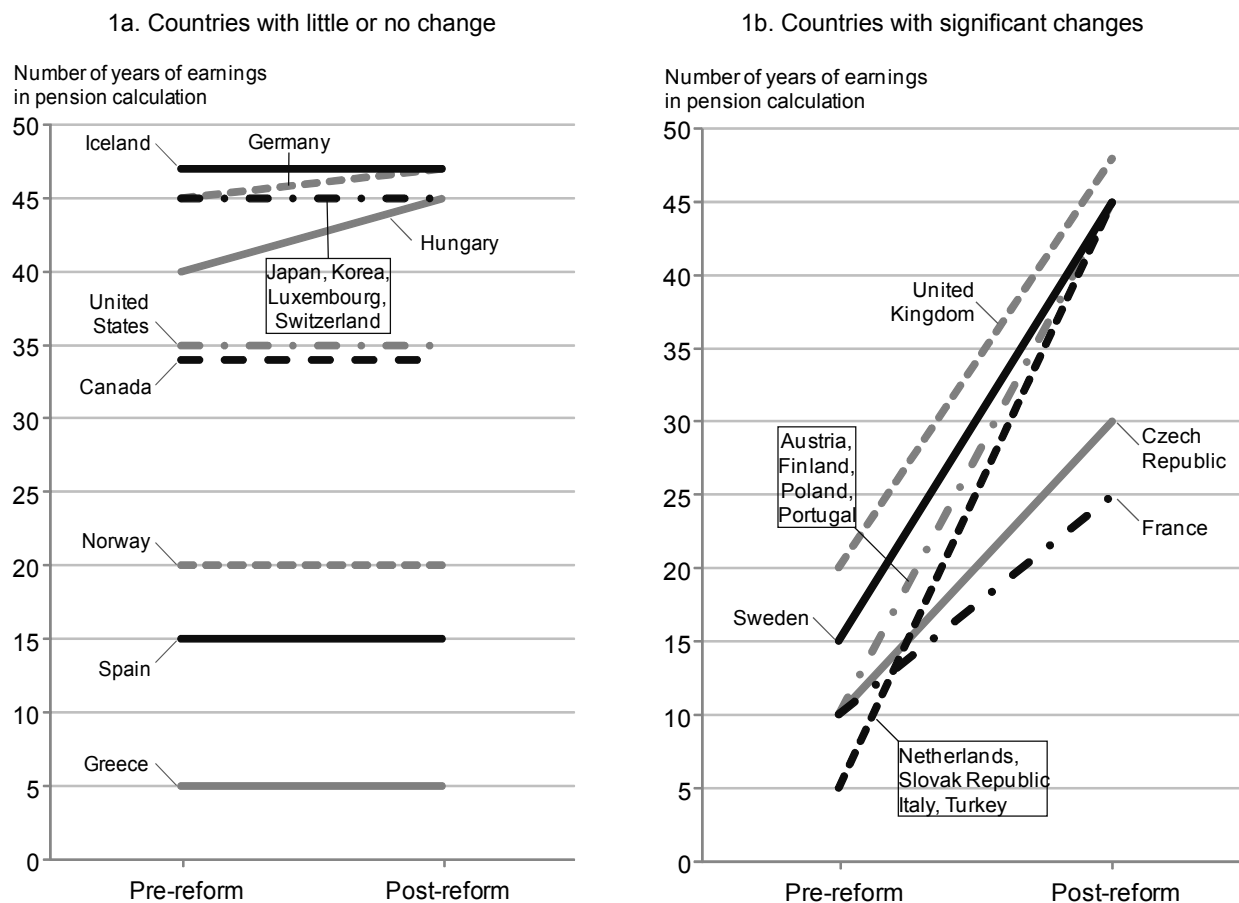
Note: based on a full career from age 20 to normal, national age of pension eligibility. Based on pension ages for men where these differ from those for women. The change in the United Kingdom from best 20 years to lifetime revalued average was introduced in 1988 and so falls outside the earliest date (1990) considered here. However, since the scheme affected was only introduced in 1978, the impact of the reform is only felt from 1998 onwards and so the reform is illustrated in the chart.

Source: OECD (2005, 2007, 2009); Whitehouse *et al.* (2009).

3.   PENSION ACCRUALS

24.   A small number of OECD countries have limits on the number of years that can accrue pension benefits in earnings-related schemes. In Greece, for example, the maximum pension replacement rate is achieved after 35 years' contribution: only working after age 65 accrues any additional benefit. The pension entitlement in Greece may increase with additional work, but only if higher earnings replace lower earnings in the benefit formula. Similarly, the public pension scheme in the United States pays a full benefit with 35 years of contributions. There is a penalty if the pension is claimed early, but, as in Greece, extra years' contributions increase benefits solely through the mechanism of lower earnings dropping out of the benefit formula. The maximum accrual is also reached after 35 years in Spain. The limit is 40 years in Norway, but, with a normal pension age of 67, many people will reach that number of years before they get to pension age.

25.   The problem with these policies is that they discourage work once the maximum number of years has been achieved: they are economically inefficient. Also, they are in a sense "unfair": contributions are levied but no additional benefit is earned. Two OECD countries have fixed this type of problem in their pension system. In Belgium, this was achieved through a reform of the parameters and rules of the defined-benefit scheme. In Sweden, the full benefit was reached after 30 years of contributions, but this is no longer the case after the introduction of notional accounts.

## 4.   PENSION BENEFITS AND CHOICE OF RETIREMENT AGE

26.   Some 22 out of 30 OECD countries permit retirement before the standard pension age. Most reduce benefits for early retirees to reflect the longer duration over which the benefit is paid. In only three cases is there no reduction in benefits for early retirees (provided that certain qualifying conditions are met). In a further three, early retirement without reduction is possible.

27.   The size of the adjustments varies significantly, as shown in Figure 2. This chart shows the adjustments in the relevant schemes of all 30 OECD countries.[4] In three countries – Finland, France and Switzerland – the rules vary between different schemes within the pension systems, and so there are two entries in the charts. The bars show the different rates that apply. In 12 of the 33 cases, there is a range of adjustments that apply in different circumstances. The range is illustrated by the arrows in Figure 2. The chart shows the long-term parameters of the pension system, including changes that have already been legislated and are being phased in slowly. These can therefore be thought of as the parameters that would apply to a new labour-market entrants in 2008 when they come to make their retirement decisions.

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4.   Such a calculation is not relevant for defined-contribution schemes, where pensions adjust automatically for early and late retirement.

28.   In most defined-benefit and points schemes, the adjustment shown in Figure 2 is simply a parameter of the pension system, readily extracted from descriptions of scheme rules: the benefit is permanently reduced by *x*% for each year of early retirement. There are three exceptions where this is more complex – the Czech Republic, Norway and Switzerland – but it is relatively straightforward to compute the benefit adjustment for early retirement on the same basis as other countries. (The calculations are set out in the notes to Table A.1 in the Annex. Similarly, the adjustment for early and late retirement in the notional-accounts schemes of Italy and Sweden is not directly observed. (Poland does not allow early retirement.)   However, it can be calculated from the different annuity rates or factors used to convert accumulated notional capital, which in turn are based on projections of mortality rates at different ages and the discount rates employed in the annuity calculation. (Again, the calculations are discussed in the notes to Table A.1 below.)

Figure 2. Reduction in accrued pension benefits per year of early retirement, per cent
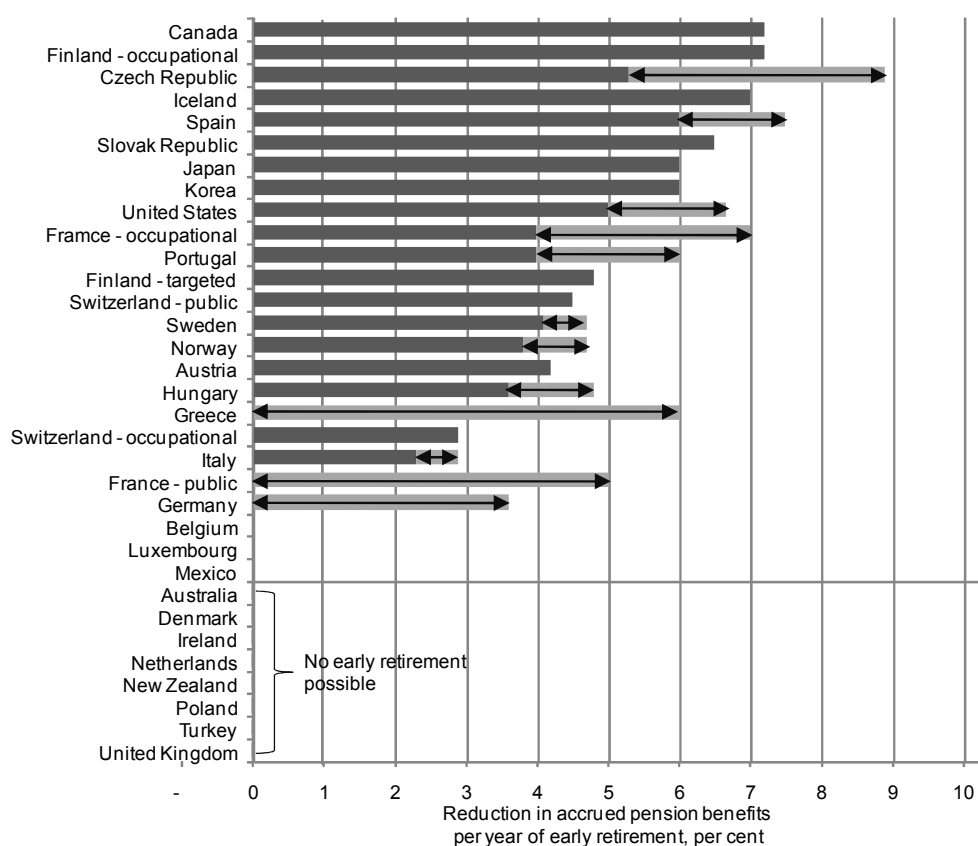
Note: arrows show cases where a range of different adjustments are possible, dependent either on the age of the individual or the number of years of contributions that have been paid.

Source: Table A.1 below.

29.   Returning to Figure 2, the largest standard decrements are in Canada – which is increasing the rate from 6.0 to 7.2% – and in the occupational plans in Finland (which are public, defined-benefit schemes), where it is also 7.2%. However, larger adjustments are possible in the Czech Republic (for people who retire at the earliest possible ages) and in Spain (for people with a smaller number of contribution years).   In Belgium, Luxembourg and Mexico's minimum pension, there is no benefit reduction provided qualifying conditions over the number of years of contributions are met. Similarly, reductions of 5%, 3.6% and 6.0% are applied in France, Germany and Greece respectively. But people with long careers – of 41, 45 and 37 years respectively – can retire early without a benefit reduction.

30.   The average decrement in the 25 schemes analysed at the top of the chart is 4.4% for each year of early retirement (averaging national figures, where appropriate, over different circumstances). This is just a little below the figure for the public scheme in Switzerland.

31.   It is important to bear in mind that the age range which provides an early- retirement "window" varies significantly between countries. Normal pension ages will vary between 60 and 68 in OECD countries once reforms are fully in place, with an average of 65.2 years.[5] Early pension ages – just in the 22 countries that will allow early retirement – averages 60.4 years, that is 4.7 years earlier than the normal pension age on average in these countries. (The earliest pension age – covering both the 22 countries that permit early retirement and the eight that do not – is 61.8 years.)

32.   This parameter or indicator of particular pension schemes is just one part of the overall financial incentives to retire embedded in pension systems. Working an extra year, rather than retiring early, does, in most cases, result in a smaller reduction in benefits to reflect the shorter duration over which the benefit is paid. However, it also brings other increases in pension entitlements. The first of these, like the benefit decrement, applies to pension entitlements already accrued. Deferring the pension claim for a year results in an increase in these entitlements through the parallel mechanisms of valorisation (in defined-benefit schemes), the uprating of the pension-point value (in points schemes) and the notional interest rates (in notional accounts schemes). Secondly, an extra years' contribution generally earns additional entitlement (with the exceptions outlined in section 3 on pension accruals immediately above). Thirdly, where pensions are based on a subset of earnings over the career, higher earnings may replace lower earnings in the benefit formula. (These cases were outlined in section 1 on earnings measures above.)

33.   It is also important to bear in mind that this analysis generally covers only one scheme in 23 countries and two in seven countries. The schemes analysed are those for which these benefit adjustments are relevant. The exclusions comprise defined-contribution schemes – where benefits will change with choice of retirement age automatically through the annuity calculation – and many types of social pension.

34.   The limitations of space preclude the presentation of a comprehensive analysis of financial incentives to retire, including all the different effects of working longer on pension entitlements and all the various components of retirement-income systems. Readers are referred to D'Addio, Keese and Whitehouse (2010) for such an analysis.

35.   Figure 3 shows increments for pensions for people who defer drawing their pension until after the normal pension age on the same basis as Figure 2 for early retirement. Again, details on these rules is provided in Table A.1 and its voluminous notes. In only four countries is there no possibility of deferring the pension. Of these four, Luxembourg, the Netherlands and New Zealand, allow people to combine work with receiving a pension. In Ireland, earnings while claiming pension can be subject to general means tests and the basic pension is subject to an earnings test over between ages 65 and 66.

36.   In six cases, deferral is possible but does not earn an increment to benefits already accrued. Nevertheless, in Greece people accrue additional pension at an accelerated rate. In Belgium and Italy, it is possible to combine work and pension receipt after the normal pension age without cost. However, pensions are subject to an earnings test in Turkey and in French occupational pensions, combining work and pension requires people to leave their usual job.

37.   The average increment for deferring pensions (in the 29 cases where this is possible) is 4.8%. This is above the average decrement for early retirement. The largest increments are 8.4% in Canada and

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5.   See Chomik and Whitehouse (2010) for information on pension ages in OECD countries from 1950 to 2050, including legislated changes in the future.

Japan, 8.9% in the Czech Republic, 10.4% in the United Kingdom and a maximum of 12% in Portugal for people with very long careers.

38.   Most OECD countries have taken steps to encourage people to work longer in recent pension reforms. First, a range of countries – Austria, Belgium, Denmark, France, Greece, Hungary and Italy – have tightened the qualifying conditions for early retirement: the number of years of contributions required or the eligibility age or both. The Netherlands has removed tax incentives for private, occupational early-retirement schemes. Austria, Germany, Italy and Portugal either introduced or raised the level of reductions in benefits for early retirees. Increments to benefits for late retirement were introduced or enhanced in Australia, Belgium, Spain and the United Kingdom. Four countries – the Czech Republic, Finland, France and the United States – adjusted incentives for both early and late retirement.[6]

Figure 3. Increase in accrued benefits per year of deferral of pension claim after normal age, per cent
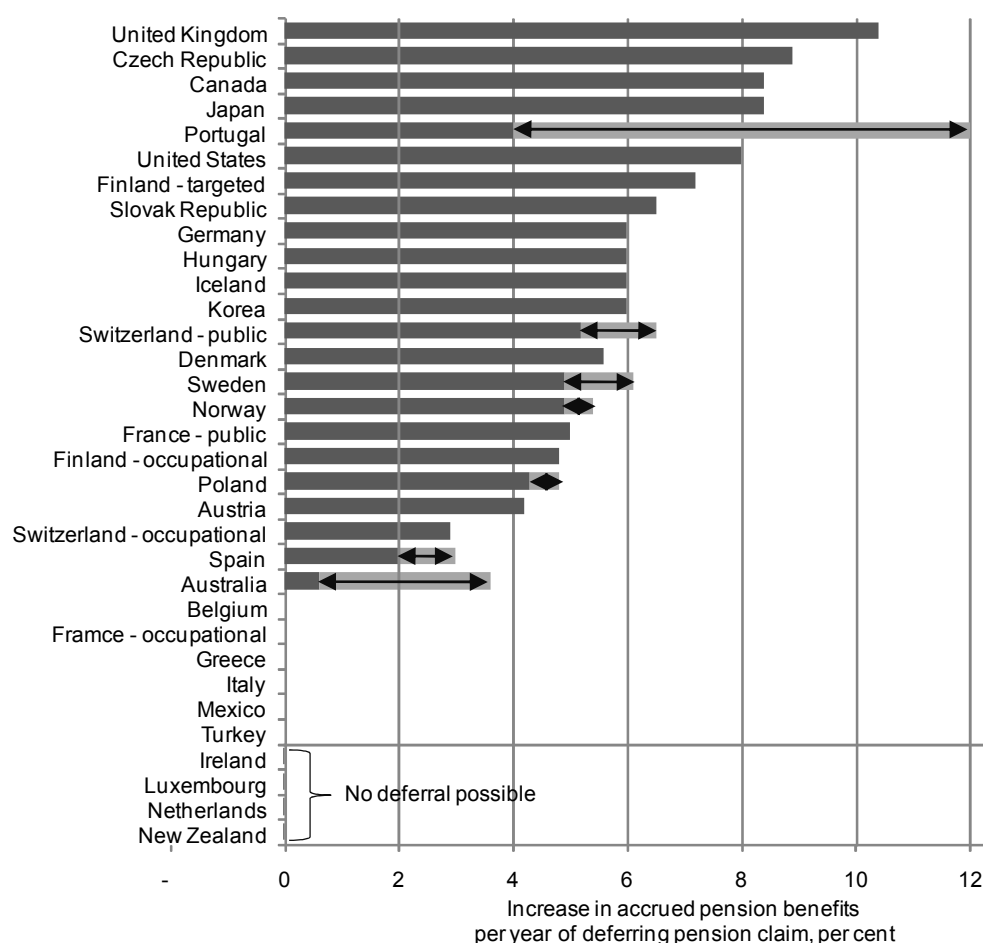
Note: arrows show cases where a range of different adjustments are possible, dependent either on the age of the individual or the number of years of contributions that have been paid.

Source: Table A.1 below.

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6.   See Whitehouse *et al.* (2009) and Whiteford and Whitehouse (2006) for a detailed discussion of these reforms.

5. PENSION BENEFITS AND LIFE EXPECTANCY

39.   The key difference between notional accounts and the two other types of earnings-related pension is the automatic link between changes in life expectancy and the value of benefits. This feature was not shared by the simple, generic versions of defined-benefit and points schemes that were presented in section 1 above.

40.   The link between life expectancy and benefits, however, does occur in defined-contribution schemes. The accumulation of contributions and investment returns is often used to buy an annuity at the time of retirement. The value of this annuity will depend on the insurance company or other annuity provider's estimate of life expectancy. This similarity between defined-contribution and notional-accounts schemes is why notional accounts have earned the moniker of "notional-defined contribution" schemes.

41.   Under the "traditional" form of public pension provision, pension entitlements were defined by some sort of formula. In theory, at least, this meant that the annual value of the pension was the same whatever happened to life expectancy. Defined-benefit schemes dominated both public and private pension provision in OECD countries in the second half of the 20th century. Over the last decade, however, this defined-benefit paradigm has been diluted; pension systems around the world have become much more diverse.

42.   The most significant change has been the expansion of private, defined-contribution pension schemes. In some countries, these have replaced all or part of the public, defined-benefit pension scheme. In others, a requirement to contribute to the defined-contribution plan was added on top of existing state pensions. Finally, in countries with widespread, voluntary occupational pensions, employers have tended to shift these from defined-benefit to defined-contribution (or a mix of the two).[7]

43.   In defined-contribution schemes, the burden of changes in life expectancy is borne by individual retirees in the form of lower pensions. When people retire in a defined-contribution plan, the accumulated contributions and investment returns must be converted from a lump sum into a regular pension payment, known as an annuity. The calculation of the annuity will be based on projected life expectancy of retirees at the time of retirement. So, pensions will be lower as people live longer. Of course, people always have the option of working longer to compensate; this will augment benefits through additional contributions, returns on accumulated capital and a shorter expected duration of retirement.

44.   In defined-benefit schemes, in contrast, the cost of paying pensions for longer as life expectancy increases falls, in the first instance, on the pension provider: the government, for example. Ultimately, however, the cost must be financed by younger taxpayers and contributors. In practice, many recent pension reforms have cut future benefits, so some of the cost of increasing life expectancy is borne by future pensioners themselves in the form of lower pensions.

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7.   See Box 1.1 in OECD (2009) on the shift from defined-benefit to defined-contribution in private pension arrangements and Queisser, Whiteford and Whitehouse (2007) on the shift from public to private provision.

45.   Nearly half of OECD countries – 13 out of 30 – now have an automatic link between pensions and life expectancy in their retirement-income systems (Table 1). A decade ago, only one country had such a link. The spread of this policy has a strong claim as the major innovation in pension policy in recent years.

46.   First, Hungary, Poland, Mexico, the Slovak Republic and Sweden introduced private, defined-contribution plans as a substitute for all or part of their public pensions in the late 1990s. Australia and Norway added mandatory contributions to private, defined-contribution pensions on top of existing public provision. Denmark has long had defined-contribution plans covering nearly all workers (and so considered as "quasi-mandatory" in OECD analysis).

47.   Secondly, Italy, Poland and Sweden have substituted notional accounts for traditional, defined-benefit public schemes.

48.   Thirdly, some countries have retained defined-benefit or points-based public schemes while introducing a link between life expectancy and pensions. Finland, Germany and Portugal will adjust benefit levels with life expectancy. (Norway's recent reform will also have this effect, but this was announced after the analysis here was carried out.)

Table 1.   A link between life expectancy and pension has been achieved in four different ways

	Defined contribution	Notional accounts	Benefit levels	Qualifying conditions
Australia	●			
Denmark	●			●
Finland			●	
France				●
Germany			●	
Hungary	●			
Italy		●		
Mexico	●			
Norway	●			
Poland	●	●		
Portugal			●	
Slovak Republic	●			
Sweden	●	●		

Note: Covers the 13 countries OECD countries with a link to life expectancy in the pension system.

Source: Whitehouse (2007).

49.   Finally, two countries will link qualifying conditions for pensions to life expectancy: the pension age in Denmark and the number of years of contributions needed for a full pension in France.[8]

50.   To analyse the impact of these reforms on retirement incomes, it is first necessary to assess the degree of uncertainty in life expectancy in the future. The analysis is based on extrapolative methods, which have a better record of projections in the past than alternative (biological, for example) approaches. The dataset is based on mortality rates by sex and by five-year age band for the G7 countries from 1945 to 2002. The distribution of the changes in these mortality rates in the past is then used to simulate the potential changes in the future using standard Monte-Carlo techniques.

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8.   In both Denmark and France, the status of these reforms is uncertain: they are the subject of political or industrial-relations agreements. However, the policies analysed here have been announced by governments.

51.	Table 2 presents the key results. On average in the OECD countries, life expectancy at age 65 was 15.1 years for men and 18.7 years for women. The median projection is that these life expectancy figures will increase by about 3.5 years over a 50-year period, to 18.5 years for men and 22.2 years for women. However, in the best 5% of cases, life expectancy at age 65 is projected to increase by five years or more and, in the worst 5% of cases, by around two years or fewer.

Table 2.   Life expectancy at age 65 in 2002, distribution of 50-year projections and change from baseline

	Baseline	Distribution of projections (2052)				
	(2002)	5%	25%	Median	75%	95%
Additional life expectancy (years)						
Men	15.1	20.1	19.1	18.5	18.0	17.1
Women	18.7	23.7	22.8	22.2	21.7	20.9
Change (years)						
Men	0.0	+5.0	+4.0	+3.4	+2.9	+2.0
Women	0.0	+5.0	+4.1	+3.5	+3.0	+2.2
Total life expectancy (years						
Men	80.1	85.1	84.1	83.5	83.0	82.1
Women	83.7	88.7	87.8	87.2	86.7	85.9

Source:	Whitehouse (2007). Estimates for future changes are based on past history of G7 countries since 1945 using the Human Mortality Database (University of California, Berkeley and Max Planck Institute for Demographic Research).

52.	Before proceeding further, it is necessary to define two different types of risk and uncertainty related to how long people live. The first, here called "longevity risk" applies to the period of retirement and to individuals. If there were no annuities (provided by defined-contribution plans or, implicitly, by earnings-related schemes), then people, people might outlive their retirement capital. This is because how long *individuals* live is uncertain. However, the average length of life of a given *cohort* of individuals is also uncertain, and this is here called "life-expectancy risk". During retirement, this risk is borne by the pension or the annuity provider. However, there may also be changes in life expectancy in the period between paying pension contributions and drawing benefits.

53.	Two indicators of pension entitlements are important to the analysis of life-expectancy risk. First, the pension *replacement rate* shows the value of the pension entitlement per period relative to the earnings of an individual. Secondly, *pension wealth* shows the lifetime value of pension benefits at the point of retirement.

54.	In defined-benefit and points schemes, life-expectancy risk is borne by pension providers. Either governments or employers (in the case of occupational schemes) guarantee a level of benefits regardless of what happens to life expectancy, in theory, at least. Ultimately, of course, the larger pension cost of longer life expectancy is passed on to taxpayers or shareholders. In these schemes, the replacement rate is constant whatever happens to life expectancy. But pension wealth increases as lives get longer because of the longer duration for which the benefit is paid. This defined-benefit scheme is here used as a theoretical benchmark. In practice, of course, governments and pension providers have repeatedly changed pension systems meaning that some of the cost of longer lives has been met by reducing benefits.

55.	In defined-contribution and notional-accounts schemes, in contrast, the life-expectancy risk is borne by the individual. Up to the point of retirement, increases in projected life expectancy translate into lower benefits. In these schemes, pension wealth is constant whatever happens to life expectancy of the

cohort. But replacement rates are lower as life expectancy increases, conditional on the same age of withdrawal of the pension.

56.   These two measures – replacement rates and pension wealth – provide benchmarks against which national pension systems can be evaluated. In practice, national pension systems are made up of a number of components. The replacement rates from some parts are affected by life-expectancy changes: defined-contribution, notional-accounts and defined-benefit schemes with adjustments, as set out above. Some parts are generally not affected by changes in life expectancy: defined-benefit schemes without adjustments and basic pensions. In some cases, resource-tested schemes and minimum pensions can offset the impact of life-expectancy changes. If, for example, defined-contribution pensions are lower, entitlements to minimum pensions may be higher. The analysis that follows covers all of the different components of retirement-income provision.

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

58.   The results show huge diversity between countries in the way life-expectancy risk is shared (Figure 4). The chart shows results for 13 OECD countries where part of the pension system is linked to life expectancy. To repeat, this is a comprehensive analysis of pension systems covering all mandatory and quasi-mandatory schemes in each country. It is based on calculations of pension entitlements for people earning between 30% and 300% of the national average. These results are then weighted by the distribution of earnings and averaged.

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

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

61.   The differences between countries in the sharing of life-expectancy risk are therefore mainly a result of the structure and design of the pension package, of which the option of notional accounts *versus* other forms of earnings-related pension provision (defined-benefits or points) is only a part.

Figure 4. Who bears life-expectancy risk in mandatory pension programmes?

(percentage of total life-expectancy risk borne by individual retirees)
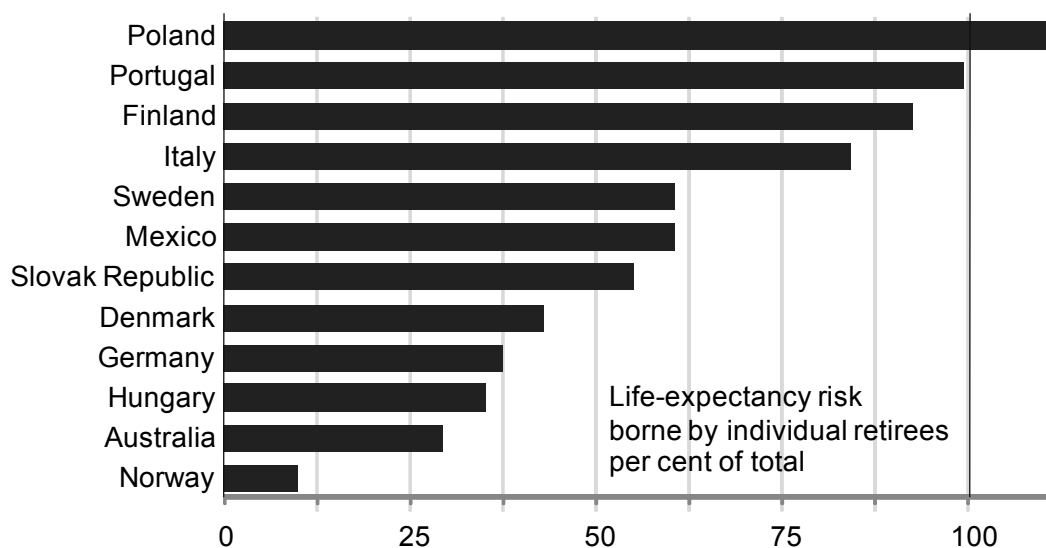
Note: based on weighted averages of pension entitlements and pension wealth calculated using the OECD pension models: see OECD (2009) for a discussion of these concepts.

Source: Whitehouse (2007).

6.   CONCLUSIONS

62.   This paper has looked at the three different designs of earnings-related pension schemes found in OECD countries: defined-benefit, points and notional accounts (or notional defined-contribution) schemes. It then examined four significant advantages of notional-accounts pension schemes that affect the economic efficiency and equity of the pension system. The first three of these are:

1.   Benefits are based on lifetime earnings, rather than a subset of "best" or "final" years' pay.

2.   Each extra year's contribution gives rise to an additional benefit.

3.   Benefits are reduced, for a given age of claiming the pension, to reflect the longer expected duration of payment for people who retire early and, similarly, increased for people who retire late. Alternatively, people have to work longer to achieve the same benefit level as life expectancy increases.

63.   The analysis has looked at notional-accounts and two alternative types of public pension scheme that provide earnings-related pensions: defined-benefit and points schemes. The discussion has deliberately steered away from the heated debate about the financing of future pension benefits: whether, and to what extent, these should be pre-funded or provided on a pay-as-you-basis. All three types of scheme – defined-benefit, points and notional accounts – can, in principle, and often are, in practice,

financed through full or partial pre-funding or pay-as-you-go mechanisms. This issue is separable from those addressed in this paper.

64.   The analysis here as looked at different types of pension scheme from the perspective of an individual member.[9] It has therefore focused on issues of economic efficiency – the extent to which the pension system distorts decisions to work and save – and on fairness: the equal treatment of people who choose different retirement ages and contribute for varying number of years. For example, pensions based on best or final earnings encourage people to leave the labour market once earnings have peaked (item 1 in the list above). Early retirement is also encouraged by schemes that do not give additional pension benefits for an additional year of contributions once a certain number of years has been reached (item 2). Many schemes encourage early retirement by having reductions in benefits for early pension claim that are too low or they discourage later retirement by providing small increments for deferring the pension claim (item 3). These distortions to incentives to work and retire have been shown to have a significant effect on individual retirement decisions.[10] All of these factors also give rise to substantial inequities between different individuals. The people who benefit from pensions based on best or final earnings tend to be the better off. And if early retirement is encouraged through caps on the number of contribution years that earn benefits or small or zero reductions in benefits, then people who do not retire at the earliest possibility opportunity are penalised.

65.   Notional accounts are an example of good practice in all of these areas. However, well designed pension schemes of the alternative types – defined-benefit or points – share these characteristics. Pension reforms in OECD countries mean that most of them have now moved from final or best earnings to whole-career pay for calculating benefits. Many countries have fixed the problems caused by ceilings to the number of pensionable years and they have introduced or enhanced the reductions in benefits for early retirement and increments for late retirement. This has the important implication that the microeconomic benefits of moving to notional accounts – on economic efficiency and fairness – are minimal or even negative in almost all OECD countries. There are only four – Belgium, Greece, Luxembourg and Spain – whose pension schemes fall significantly short of best practice in at least two of the areas analysed. Moreover, many OECD countries have retirement-income systems to which notional-accounts principles are simply not applicable: Australia, Denmark, Ireland, the Netherlands, New Zealand and the United Kingdom, for example.

66.   The final issue considered in this paper was:

   4.   Benefits should be linked automatically to life expectancy as a way of spreading the costs of longer lives between generations and helping the long-term financial sustainability of the pension system.

67.   This final issue needs to be treated separately from the other three because what constitutes best or good practice is less clear cut. 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. After all, living longer is desirable. A longer life and a larger lifetime pension payout due to increased life expectancy confers a double advantage. The optimum amount of life-expectancy risk that individual retirees should bear is therefore not zero. The obvious next question is, should 100% of the risk be shifted onto the pensions of new retirees? The issue is complex because each individual has a lifecycle that includes periods as a

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9.   The individual's perspective is not the only one that matters. Many studies have looked at the position of pension schemes in aggregate; see, *inter alia*, Valdés Prieto (2000), Breyer (2004) and Robalino and Bodor (2009). However, it is not possible to review this literature here.

10.   See D'Addio, Keese and Whitehouse (2010), Blöndal and Scarpetta (1999), Gruber and Wise (1998, 1999) and Casey *et al.* (2003).

contributor and as a beneficiary. There is a trade-off: greater certainty over retirement benefits *versus* greater certainty over the amount of contributions or taxes paid when working.

68.   Moreover, life-expectancy risk is but one of many risks involved in pension systems. With defined-contribution pensions, the value of retirement income is also subject to investment risk. 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.

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

70.   The final message of this paper is that analysis of pension policy cannot be piecemeal: looking alone at one component scheme of the overall system of retirement-income provision. For example, the earnings-related part of retirement-income provision may embody the principles of equity and economic efficiency. But this work can easily be undone for a sizeable part of the workforce that are entitled to means-tested, income-tested or pension-tested benefits. For them, there is often no incentives to remain in work beyond the earliest possible age or to save voluntarily for their retirement or these incentives a severely curtailed. A comprehensive approach to pension-policy analysis, covering all the different parts of the system, is essential.

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ANNEX. PENSION BENEFITS AND CHOICE OF RETIREMENT AGE

Table A.1. Treatment of early and late retirees in OECD countries by pension scheme (long-term parameters and rules; mandatory schemes except defined-contribution plans)

Country	Scheme	Early age	Reduction	Normal age	Increase
Australia	Targeted	na		67	0.6-3.6%[1]
Austria	Defined benefit	62M/60F	4.2%	65	4.2%
Belgium	Defined benefit	60[2]	0	65	0
Canada	Defined benefit[3]	60	7.2%	65	8.4%
Czech Republic	Defined benefit	60M/59-60F[4]	5.3/8.9%[5]	65M/62-65F[4]	8.9%[5]
Denmark	Basic/targeted	na		67	5.6%[6]
Finland	Targeted	62	4.8%	65	7.2%
	Defined benefit	62	7.2%/0[7]	65	0/4.8%[8]
France	Public	56-60[9]	0/5.0%	65	5.0%
	Occupational	55	4.0-7.0%[10]	60	0
Germany	Points	63	3.6%/0[11]	67	6.0%
Greece	Defined benefit	any age/55/60[12]	0/6.0%[12]	65	0[13]
Hungary	Defined benefit	63	3.6%/4.8%[14]	65	6.0%
Iceland	Occupational	62	7.0%[15]	67	6.0%
Ireland	Basic/targeted	na		66/65	na
Italy	Notional accounts	any age/61[16]	2.3-2.9%[17]	65M/60F	0/2.6-2.9%[17]
Japan	Basic/defined-benefit	60	6%	65	8.4%
Korea	Defined benefit	60	6%	65	6%
Luxembourg	Defined benefit	57/60[18]	0	65	na
Mexico	Minimum	60[19]	0	65	0
Netherlands	Basic	na		65	na
New Zealand	Basic	na		65	na
Norway	Defined benefit	62	3.8-4.7%[20]	67	4.9-5.4%[20]
Poland	Notional accounts	na		65M/60F	4.3-4.8%M/ 3.7-4.2%F[21]
Portugal	Defined benefit	55	4.0-6.0%[22]	65	4.0-12.0%[23]
Slovak Republic	Points	60[24]	6.5%	62	6.5%
Spain	Defined benefit	61	6-7.5%[25]	65	2.0/3.0%[26]
Sweden	Notional accounts	61	4.1-4.7%[27]	65	4.9-6.1%[27]
Switzerland	Public	63M/62F	4.5%[28]	65M/64F	5.2-6.5%
	Occupational	60M/59F[29]	2.9%[30]	65/64	2.9%[30]
Turkey	Defined benefit	na		65	0
United Kingdom	Basic/defined benefit	na		68	10.4%[31]
United States	Defined benefit	62	5.0/6.7%[32]	67	8.0%

Source: Author's calculations using OECD pension models; OECD (2009, 2010); national officials. See also Queisser and Whitehouse (2006) for a more detailed discussion.

Notes: Where pension ages for men and women differ they are shown as M/F. "na" means that early retirement or deferral of pension is not available. Schemes where the concept of these adjustments – particularly defined-contribution plans -- are irrelevant are not included. Some countries have legislated changes to some parameters that are not yet in effect: the Table shows the long-term position with all such reforms fully in place. Data have been rounded to one decimal place. The ability to combine work and

pension receipt (particularly after normal pension ages) is common. More detail on country pension systems can be found in OECD (2009). Calculations for late retirement assume a maximum retirement age of 70.

1. The pension bonus is paid as a one-off, lump sum. It is calculated as 9.4% of age-pension entitlement at the time of retirement multiplied by the number of years of deferral squared. The unisex annuity factor for Australia varies from 16.5 at age 65 to 14.3 at age 69. This can be used to calculate the value of the pension bonus as a proportion of the age-pension benefit stream. The result is then comparable with the adjustments to benefits applied in other countries. The values shown are annualized for 1 and 5 years of deferral respectively. With 3 years' deferral, for example, the bonus is equivalent to an increase in age pension of 1.8% per year of deferral.

2. Early retirement with no actuarial reduction is possible once 35 years contributions have been made.

3. Only the earnings-related pension (not the basic or targeted benefits) can be drawn early.

4. Pension age for women varies with the number of children that they have had.

5. The adjustments are defined as a 3.6% reduction in the total accrual total accrual factor for the first two years of early retirement and 6% thereafter. An increment of 6% is applied for each year of late retirement. The figures shown here are calculated for a full-career worker, who would have a total accrual factor of 67.5% at age 65.

6. The adjustment is based on the reciprocal of life expectancy at the age at which the pension is drawn. Projected life expectancy at age 68 for 2040 is 17.9 years.

7. The adjustment applies for one year from 62 to 63. There is then no adjustment but instead accelerated accrual in the earnings-related scheme of 4.5% of earnings per year of contributions compared with 1.5% at most ages.

8. There is no adjustment until age 68 because of accelerated accrual in the earnings-related scheme (see note 7). The adjustment shown applies from age 68 onwards.

9. A full pension will require 41 years of contributions. Individuals can retire from age 60 if this contribution requirement is met without benefit reduction. Retirement before the age of 60 is permitted for workers with long careers, again without reduction: This ranges from retirement at 56 for people with 42 years' contribution and entry to the labour market before age 16 to retirement at 59 for people with 40 years' contributions and labour-market entry before age 17.

10. A full benefit requires 40 years of contributions. For each missing year, the benefit is reduced by 4% for the first three years and 5% for the next two. Retirement before age 60 is subject to a reduction of 7% per year, but this reduction is smaller for people with 35 years or more contributions.

11. Early retirement from 63 is possible with 35 years' contributions subject to the 3.6% reduction. Early retirement at age 65 (rather than 67) is allowed without actuarial reduction for people with 45 years of contributions.

12. Retirement is allowed at 60 with 15 years' contribution and 55 with 35 years of contributions subject to the 6% reduction per year earlier than 65. Retirement is possible at any age after 37 years of contributions with no reduction. The recently announced reform will restrict early retirement to age 60 with 40 years of contributions and apply the 6% reduction for each year of early retirement.

13. There is accelerated accrual (3.3% per year compared with 2% at younger ages) during the deferral period but no increment to already accrued benefits.

14. Early retirement requires 37 years of contributions.

15. Adjustment varies between schemes, but 7% is the typical reduction.

16. Retirement at any age is possible with 40 years' contributions and from age 61 with 36 years; contributions.

17. Adjustment for early retirement has been calculated from government-provided 'transformation coefficients' – used to convert notional capital into pension benefits – projected for 2048. After age 65, the transformation coefficient is constant and hence the increment in benefits for men retiring late is zero.

18. Retirement at age 57 requires 40 years of actual (compulsory or voluntary) contributions. With 40 years of actual or credited contribution years, early retirement is possible at age 60.

19. Early retirement is conditional on 1250 weekly contributions (approximately 25 years).

20. Calculated from government-provided figures for life-expectancy divisors. For late retirement, higher increments are provided after age 70.

21. Calculated from projected (unisex) life expectancy at ages 66-70 for men and 60-65 for women.

22. Adjustment for early retirement is at a rate of 6% per year. However, with more than 30 years' contributions at the time of early retirement, the number of years over which the pension is adjusted is cut by one year for each complete 3 years of contributions beyond 30 years. The 4% rate is therefore an average over three years for a person with at least 30 years of contributions.

23. The increment for late retirement depends on the number of contributions years. This ranges from 4% for people with 15-24 years' and 12% for people with more than 40 years' contributions.

24. Early retirement is also conditional on pension entitlement exceeding 1.2 times the subsistence minimum.

25.   The size of the reduction depends on the number of years of contributions made: 7.5% (30-34 years), 7% (35-37 years), 6.5% (38 39 years), and 6% (more than 40 years).

26.   The size of the increment depends on the number of years of contributions: 2% for fewer than 40 years and 3% with 40 years or more contributions.

27.   The implicit adjustments are calculated from the annuity calculations using projected mortality rates for 2040, the 1.6% discount rate specified in legislation and indexation of pensions in payment to wage growth minus 1.6%. They also take account of the distribution of the account balances of people who die before claiming the pension using the same mortality rates.

28.   A full pension requires 44 years of contributions for men and 43 years for women. The specified adjustment for early retirement is 6.8%. But, for a full-career worker, approximately 2.3 percentage points of this reflects a missing year of contributions; the actuarial adjustment is the residual.

29.   Early-retirement provisions vary between schemes: these ages are the legal minimum.

30.   Individuals' accumulated rights from contributions and a government-set interest rate are converted into an annuity at the time of retirement. The annuity rate at age 65 will fall to 6.8%. Each year of early retirement results in a reduction in the annuity rate of 0.2 percentage points. For late retirement, schemes are free to set their own rules but the government's guidance is to have the same 0.2 percentage point change in benefits for each year of late retirement.

31.   A lump-sum payment of deferred pension plus interest can now also be claimed instead of a pension increment.

32.   The reduction is 6.67% for the first 3 years of early retirement and 5% thereafter.