# Investment Risk and Pensions: Impact on Individual Retirement Incomes and Government Budgets

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# FOREWORD

Pensions are inherently risky because they are long-term contracts. These contracts can involve up to four groups of actors: individuals, governments, employers and financial-services providers. Uncertainty about the future complicates planning for all these actors: if things turn out better than expected, who will reap the gains? If things turn out worse, who will bear the cost? No one wants to bear risk, but, in most cases, someone has to. Risks in pension systems have, in the past, been poorly measured or even just ignored.

This paper is part of a series that examines how different kinds of uncertainty affect retirement incomes. The first of these papers (Whitehouse, 2007) looked at life-expectancy risk: how much of the cost to retirement-income systems of longer lives will be borne by individual retirees, in the form of reduced benefits or later retirement? How should this life-expectancy risk be allocated between generations? The second (Whitehouse, 2009), looked at purchasing-power risk: examining how pension systems react to changes in costs and standards of living.

This, the fourth paper in the series on risk and pensions, analyses investment risk. It covers countries where defined-contribution pension plans are part of mandatory retirement-income provision and a number of countries where voluntary private pensions are widespread. A companion paper – D'Addio, Seisdedos and Whitehouse (2009) – measures the degree of investment risk. This paper uses these results to look at the effect of uncertainty in investment returns on individual retirement incomes and on public revenues and expenditures.

Forthcoming work will look at three further kinds of uncertainty – other than life-expectancy, inflation and investment risk – that affect pension systems:

- *Myopia risk*: many individuals are short-sighted and so they consume too much when of working age and save too little for later, especially for retirement. This would lead to low pensions and costs for taxpayers and contributors if these retirees were entitled to safety-net benefits.

- *Social and labour-market risks*: life events – such as persistent low earnings, long-term unemployment, caring for children or older relatives, divorce and widowhood – mean that workers may build up little in the way of retirement income. Again, the cost of these risks could be borne by individuals, by governments or by the contributors to pension systems.

- *Policy risk*: the political process may result in unanticipated changes in pension entitlements before or during retirement, perhaps leaving individuals with little or no time to respond by changing their labour-market or savings decisions.

# SUMMARY

The current financial and economic crisis has highlighted the importance of investment risk for pension systems. In particular, the dramatic spread of defined-contribution pension provision around the world means that investment risk has a direct effect on living standards in old age. This paper explores how uncertainty over investment returns affects individuals' retirement incomes and government budgets. The key finding is that public pensions, old-age safety net benefits and the tax system act as "automatic stabilisers" of retirement incomes in the face of investment risk in defined-contribution pension plans. However, the degree of protection offered by these policies, and therefore the exposure of individuals' retirement incomes to investment risk, varies significantly between countries.

The paper uses the OECD pension models to explore the implications of a range of possible outcomes for investment returns. (The distribution of investment returns used is derived from historical data in D'Addio, Seisdedos and Whitehouse, 2009.)

The analysis begins with the individual pension-scheme member. The results demonstrate that the overall design of the retirement-income package must be taken into account when assessing exposure of individual incomes in old age to investment performance. Many elements of pension systems are not subject to investment risk. And resource-tested benefits can act to mitigate investment risk by paying a larger benefit when returns are poor. Analysis of *net* pensions shows how taxes can also act to offset the effect of investment risk on living standards in retirement. The differences between countries in the extent to which these different factors affect exposure to investment risk are huge. Together, taxes and means-tested benefits can be termed "automatic stabilisers" for retirement incomes in the face of investment risk.

Secondly, the paper uses the OECD pension models to look at the impact of investment risk on the public finances. The corollary of the reduction in investment risk for individuals through tax and transfer policies is exposure to investment risk of the public finances. In countries with resource-tested benefits, the government has a "contingent liability" that depends on investment returns. Better performance means lower expenditure on safety-net benefits. Similarly, the tax system means that the government is effectively a "co-investor", with the individual retiree, in the defined-contribution plan. Higher returns mean more tax revenues. This effect is particularly large where the tax burden on pensions in payment is high. Adding these two effects together, governments (and so taxpayers) are in many countries significantly exposed to investment risk. This demonstrates how it is impossible to make risks go away: it is only possible to reallocate the risk between different actors in the pension system.

**JEL Classification**: D14, G11, G23

**Keywords**: pensions, investment returns

# AVANT-PROPOS

Les pensions sont assujetties intrinsèquement au risque, parce qu'il s'agit de contrats à long terme. Ces contrats peuvent comporter jusqu'à quatre groupes d'acteurs : les individus, les gouvernements, les employeurs et les fournisseurs de services financiers. L'incertitude sur l'avenir complique la planification pour l'ensemble de ces acteurs : si les choses se révèlent meilleurs que prévu, qui va récolter les gains ? Si les choses se révèlent pire encore, qui supportera le coût ? Personne ne veut assumer le risque, mais, dans la plupart des cas, quelqu'un le doit. Les risques dans les systèmes de retraite ont, dans le passé, été mal mesurés ou même tout simplement ignorés.

Ce document fait partie d'une série qui examine comment les différents types d'incertitude affectent les revenus des retraités. Le premier de ces documents (Whitehouse, 2007) a examiné le risque lié à l'espérance de vie: quelle part du coût lié à l'allongement de la vie sera supportée par les retraités, sous la forme d'une réduction des prestations de retraite ou d'un départ postposé à la retraite ? Comment doivent être répartis entre les générations les risques liés à l'allongement de la durée de vie ? Le deuxième (Whitehouse, 2009), a étudié le risque lié au pouvoir d'achat : il a examiné comment les systèmes de retraite réagissent à l'évolution des coûts et du niveau de vie.

Ce document, le quatrième de la série sur les risques et les pensions, analyse les risques d'investissement. Il couvre les pays où sont très répandus soit les régimes de retraite obligatoires à contribution définie soit les régimes de retraite volontaire des pensions privées. Un autre document – D'Addio, Seisdedos and Whitehouse (2009) – tente de mesurer le degré d'incertitude dans le rendement des placements. Le présent document utilise les résultats de ce dernier afin d'examiner l'effet de l'incertitude dans les rendements des investissements sur les revenus de retraite et sur les recettes et les dépenses publiques.

D'autres travaux (à venir) se pencheront sur trois autres types d'incertitude – différents de ceux liés à l'allongement de l'espérance de vie, à l'inflation et aux risques d'investissement – qui affectent les systèmes de retraite :

- *Risques liés à la « Myopie »* : de nombreuses personnes ont une « vue courte » et ils consomment trop quand sont en âge de travailler et mettent trop peu de côté, en particulier pour la retraite. Ces comportements pourraient être associés à de faibles revenus de retraite dans les futurs ainsi qu'à des coûts supplémentaires pour les contribuables et les cotisants aux systèmes de retraite dans le cas où les retraités ayant eu ces comportements avaient droit aux prestations de protection sociale.

- *Risques sociaux et liés au marché du travail* : des événements de la vie – tels que la persistance de faibles revenus, le chômage de longue durée, la garde d'enfants ou de parents âgés, le divorce et le veuvage – peuvent avoir un impact négatif sur les revenus de retraites de travailleurs qui en font l'expérience. Encore une fois, le coût de ces risques pourrait être supporté par les individus, par les gouvernements ou par les cotisants aux systèmes de retraite.

- *Risques politiques* : les processus politiques peuvent amener à des changements imprévus dans les droits à la pension avant ou pendant la retraite, en laissant peu ou pas de temps aux individus pour réagir en changeant leurs décisions de travail ou d'épargne.

# RÉSUMÉ

L'actuelle crise financière et économique a mis en évidence l'importance du risque d'investissement pour les systèmes de retraite. En particulier, la propagation dramatique des régimes à cotisations définies à travers le monde implique que le risque d'investissement a un effet direct sur le niveau de vie des individus pendant la retraite. Ce document analyse comment l'incertitude sur les rendements des investissements affecte les revenus de retraite des individus et les budgets des gouvernements. La conclusion principale est que les pensions publiques, les filets de sécurité mis en place pour les personnes âgées et le système fiscal jouent le rôle de « stabilisateurs automatiques » des revenus de retraite face au risque d'investissement dans des plans de retraite à cotisations définies. Cependant, le degré de protection offert par ces politiques, et donc l'exposition au risque d'investissement des revenus de retraite individuels, varie de manière significative entre les pays.

Le document utilise les modèles de pension de l'OCDE pour étudies les implications associées à une gamme de rendements des placements. (La distribution des rendements d'investissement utilisée est dérivée des données historiques selon la procédure illustrée dans D'Addio, Seisdedos et Whitehouse, 2009).

L'analyse se concentre en premier lieu sur les revenus de retraites des individus. Les résultats démontrent que la conception globale de l'ensemble des revenus de retraite doit être prise en compte lors de l'évaluation de l'exposition aux performances des investissements des revenus individuels de retraite. De nombreux éléments des systèmes de retraite ne sont pas sujets au risque d'investissement. Et les prestations sous condition de ressources peuvent atténuer le risque d'investissement moyennant le paiement d'une prestation plus élevée lorsque les rendements sont faibles. L'analyse des revenus de retraites nets d'impôts montre comment ces derniers peuvent également contribuer à compenser l'effet du risque d'investissement sur le niveau de vie pendant la retraite. Les différences entre les pays dans la mesure où ces différents facteurs influent sur l'exposition au risque d'investissement sont énormes. Ensemble, les taxes et les prestations sous conditions de ressources peuvent être qualifiées de « stabilisateurs automatiques » pour les revenus de retraite face au risque d'investissement.

Deuxièmement, le document utilise des modèles de pension de l'OCDE pour examiner l'impact du risque d'investissement risque sur les finances publiques. Le corollaire de la réduction de risque d'investissement pour les particuliers par le biais de politiques fiscales et de transfert est l'exposition aux risques d'investissement des finances publiques. Dans les pays qui ont mis en place des prestations sous condition de ressources, le gouvernement a un « passif » qui dépend du rendement du capital investi. Une meilleure performance signifie la baisse des dépenses pour des filets de sécurité. De même, le système fiscal implique que le gouvernement est effectivement un « co-investisseur », avec les retraités, dans le plan à cotisations définies. Des rendements plus élevés, impliquent des recettes fiscales plus élevées. Cet effet est particulièrement important lorsque la charge fiscale sur les droits à pension est élevée. La somme de ces deux effets signifie finalement que, les gouvernements (et donc les contribuables) sont fortement exposés au risque d'investissement dans de nombreux pays. Cela montre pourquoi et à quel point il est impossible de faire disparaître les risques : il est seulement possible de redistribuer ces risques entre les différents acteurs du système de retraite.

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**IMPACT ON INDIVIDUAL RETIREMENT INCOMES AND GOVERNMENT BUDGETS**

"It is the part of a wise man to keep himself today for tomorrow,
and not venture all his eggs in one basket."

Miguel de Cervantes (1605), *Don Quixote*.

1.      When pension schemes are funded, the value of retirement incomes is directly or indirectly affected by the performance of the investments in the fund. This investment risk has been brought into sharp focus by the recent financial crisis. In 2008, pension funds lost 23% of their value on average in OECD figures, the equivalent of USD 5.4 trillion.[1]

2.      The impact of investment risk is most obvious with defined-contribution plans, in which contributions and investment returns build up in an individual account. The accumulated capital is then used to provide an income stream during retirement. The growing importance of defined-contribution plans in providing for retirement means that many individuals' retirement incomes are directly exposed to risk and uncertainty in the return on their investments.[2] Individuals – and governments – may have nice or nasty surprises when actual returns turn out to be higher or lower than expected.

3.      Investment risk can also have important effects on retirement incomes generated by private defined-benefit plans or in public pensions (through their effect on public pension reserves). The impact on these schemes is addressed in the Annex: the main body of the paper focuses on defined-contribution plans, precisely because the link between investment returns and pensions is a direct one.

4.      To understand the impact of investment risk, it is necessary to look at the structure of retirement-income systems as a whole. Section 1 of this paper shows how the role of defined-contribution plans in the overall pension system differs between countries. Some 17 of the 36 countries that are members of the OECD and/or the EU are analysed.[3]

5.      The results of the companion paper, measuring the scale of investment risk, are summarised in section 2. These simulations are based on the long-term horizon inherent in retirement savings. They show

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1       See OECD (2009a).

2       The literature distinguishes between "risk" – where there is a random outcome with a known probability distribution – and "uncertainty" – where the random outcome has an unknown probability distribution. Since we rarely know these probability distributions with any certainty, most real-world problems involve uncertainty rather than risk. However, the literature typically assumes that probability distributions are known and so it models choices over risky outcomes (Rust, 1999). This paper interchanges the terms "risk" and "uncertainty".

3       Note that Bulgaria and Romania were not members of the EU when the research project began. Both countries have recently established mandatory defined-contribution schemes.

that, in the best 10% of outcomes for investment performance, the resulting pension would be just over 1.5 times the pension with median returns. In the worst 10% of cases, the pension would be worth just two-thirds of the value with median returns.

6.      These simulations are based on retirement-savings in defined-contribution plans alone. The next two sections, however, explore the impact of uncertainty over investment returns on individual retirement incomes in different OECD and EU countries. These calculations, which use the OECD pension models, include benefits from public pensions. Section 3 covers gross retirement incomes, while section 4 takes account of taxes and analyses net pensions. How are overall retirement incomes affected by differences in investment returns? The answer depends on the structure of the overall retirement-income package, especially the size and structure of public pension provisions.

7.      Section 5 looks at the position of governments. If investments turn out poorly, individual retirees may well be entitled to state support in the form of safety-net benefits, such as minimum pensions. These benefits, usually paid for by taxpayers through general revenues, therefore comprise a "contingent liability" on the public purse. The government is also essentially a "co-investor" with the members of defined-contribution schemes. If investments do well, the government will collect more tax revenues from pensions in payment. Given the importance of the pension system in the economy, these effects have important and growing implications for the analysis of the public finances and fiscal policy.

8.      Section 6 explores the policy implications of the analysis. Having summarised the exposure of different workers in different countries to investment risk, it looks at the design of policies to mitigate investment risk and the way in which such policies might be targeted. It also assesses regulatory policies and institutional structures that might improve *net* returns (after administrative charges).

9.      Section 7 concludes by putting investment risk into the context of the many and various risks that are inherent in pension systems. It argues that, in the face of risk and uncertainty, the best option is to diversify retirement-income provision.

## 1.      Structure of retirement-income systems

10.      Eleven of the countries studied in this paper share one feature of their pension systems: a mandatory, defined-contribution component. The other six have extensive coverage of voluntary defined-contribution pension plans. Nonetheless, the rest of the pension systems in these 17 countries differ significantly, as shown in Table 1.[4]

11.      The Table divides the pension system into three tiers. The first two, which are mandatory, are divided into a redistributive level and an insurance level. Redistributive components of pension systems – the first tier – are designed to ensure that pensioners achieve some absolute, minimum standard of living. The insurance component – the second tier – is designed to achieve some target standard of living in retirement compared with that when working. Voluntary provision, be it individual or employer-provided, makes up the third tier. These voluntary plans play a role in all countries. This paper models these schemes in six cases where coverage is broad and data on contribution rates are available.

12.      Eight of the 11 countries with mandatory, private, defined-contribution plans have a public, second-tier pension scheme in addition. The exceptions are Australia, Denmark and Mexico. The types of public, earnings-related plan varies in the other eight countries in this group of 11, although the different kinds of earnings-related provision are closely related (see Queisser and Whitehouse, 2006 and OECD, 2005, Annex I.1).

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4      See OECD (2005, 2007) for a more detailed description of this taxonomy.

13.      Estonia, Norway and the Slovak Republic have points systems. Workers earn pension points based on their individual earnings for each year of contributions. At retirement, the sum of pension points is multiplied by a pension-point value to convert them into a regular pension payment.

14.      Another variant of earnings-related schemes is notional accounts, found in three of the 11 countries with mandatory defined-contribution plans: Latvia, Poland and Sweden. These schemes record each worker's contributions in an individual account and apply a rate of return to the accounts. The accounts are "notional" in that both the incoming contributions and the interest charged to them exist only on the books of the managing institution. At retirement, the accumulated notional capital in each account is converted to a stream of pension payments using a formula based on life expectancy at the time of retirement. Since they are designed to mimic the features of funded, defined-contribution plans, they are often called "notional defined-contribution" schemes.

15.      Finally, 2 of the 11 countries provide earnings-related, public pensions through defined-benefit schemes. In these schemes, the amount a pensioner will receive depends on the number of years of contributions made throughout the working life and on some measure of individual earnings. It is interesting (for pension aficionados, at least) to note that public defined-benefit schemes are much more common among the 36 EU/OECD countries as whole – found in 21 of them – than in these 11 that have a defined-contribution component to their mandatory retirement-income provision.

16.      There is also considerable variety in the types of first-tier retirement benefits: those designed to ensure all older people have a minimum standard of living. Four of the 11 countries with mandatory defined-contribution plans have basic pension schemes, where the benefit is either flat rate, *i.e.*, the same amount is paid to every retiree, or it depends only on years of work (but not on past earnings). Additional income from other sources does not normally change basic-pension entitlement.

**Table 1.   Structure of retirement-income systems in 17 OECD/EU countries**

| | First tier: redistributive | | | Second tier: insurance | | Third tier |
|---|---|---|---|---|---|---|
| | Public | | | Public | Private | Private |
| | Resource-tested | Basic | Minimum | Type | Type | DC |
| **Mandatory DC** | | | | | | |
| Australia | ✓ | | | | DC | |
| Denmark | ✓ | ✓ | | | DC | |
| Estonia | | ✓ | | Points | DC | |
| Hungary | | | | DB | DC | |
| Latvia | | | ✓ | N.accounts | DC | |
| Lithuania | | ✓ | | DB | DC | |
| Mexico | | | ✓ | | DC | |
| Norway | | ✓ | ✓ | Points | DC | |
| Poland | | | ✓ | N.accounts | DC | |
| Slovak Republic | | | ✓ | Points | DC | |
| Sweden | | | ✓ | N.accounts | DB+DC | |
| | | | | | | |
| **Voluntary DC** | | | | | | |
| Belgium | ✓ | | ✓ | DB | | ✓ |
| Canada | ✓ | ✓ | | DB | | ✓ |
| Germany | ✓ | | | Points | | ✓ |
| Ireland | ✓ | ✓ | | | | ✓ |
| United Kingdom | ✓ | ✓ | ✓ | DB | | ✓ |
| United States | ✓ | | | DB | | ✓ |

Note:     All countries have a social-assistance safety net that protects low-income retirees. However, the "resource-tested" column is only checked when these programmes play a significant role in providing retirement incomes to full-career workers. DB = defined benefit; DC = defined contribution; N.accounts = notional accounts.

*Source*:     Based on OECD (2007), Table I.1.

17.        The remaining first-tier programmes are targeted on those with low retirement incomes, paying a higher benefit to poorer pensioners and reduced or zero benefits to better-off retirees. In Australia and Denmark, these are resource-tested: the value of the entitlement depends not only on income from pensions, but also from other sources, such as earnings or savings. Six countries have minimum pensions, which are targeted only on pension income rather than on a broader measure of income.

### 1.1        *Mandatory defined-contribution plans*

18.        As well as the differences in the components other than the defined-contribution plan, the 11 countries studied in this paper also differ in the size of the required contribution to individual accounts. This is illustrated in Figure 1.

19.        At the top of the range is Denmark, where the average contribution rate to the quasi-mandatory occupational plans is 10.8%. On top of that, the modelling assumes that the 1% contribution to the "special pension", currently suspended, is restored, giving a total contribution rate of 11.8%. The defined-contribution scheme in Latvia is being phased in slowly, starting from an initial contribution rate of 2% from 2001 to 2006. It is planned to have the 10% contribution rate shown from 2010 onwards. The contribution rate is 9% in Australia and the Slovak Republic.

20.     The smallest defined-contribution plans are found in Norway and Sweden. A mandatory 2% contribution was introduced in Norway at the beginning of 2006. The rate shown for Sweden reflects the 2.5% of earnings that must be paid into a private pension plus the 2% contribution to the occupational defined-contribution plan for white-collar employees.[5]

21.     The proportion of earnings that must be paid into defined-contribution plans therefore varies in the 11 countries by a factor of six: from 2% in Norway to nearly 12% in Denmark. This is obviously an important determinant of the scale of investment risk affecting retirement incomes.

**Figure 1.  Contribution rate to defined-contribution plans in 17 OECD/EU countries**
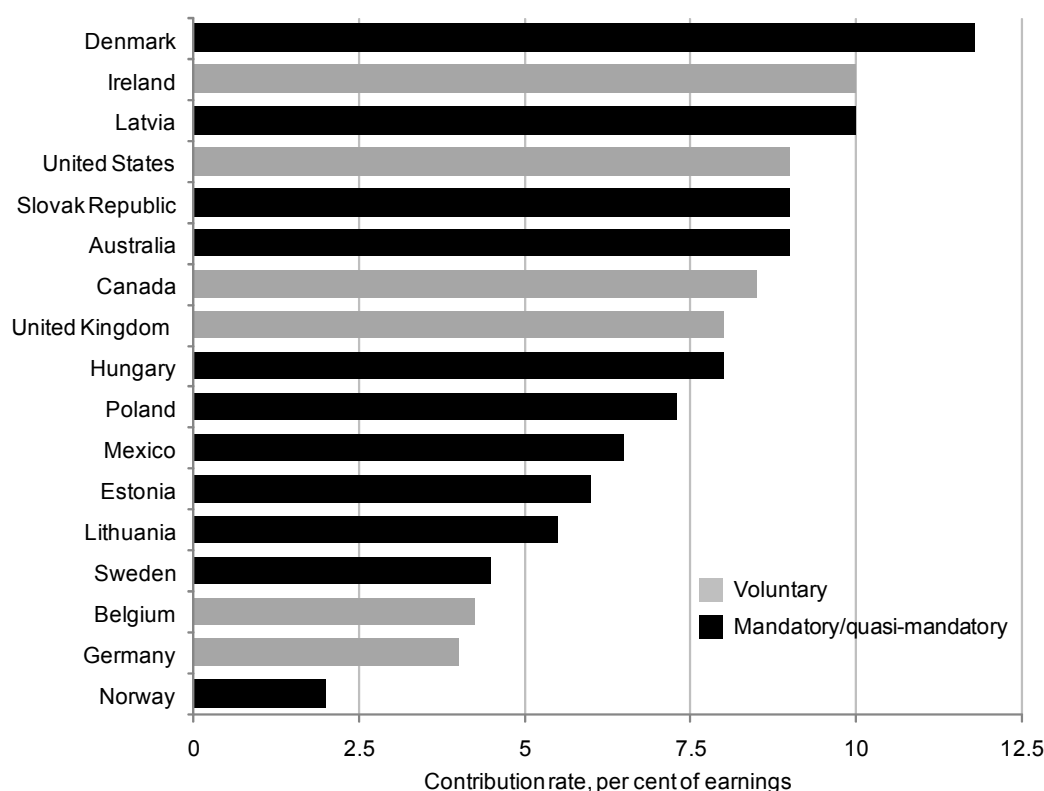


Note:     Mexico: the government makes an additional contribution of 5.5% of the minimum wage to all individuals' accounts. Latvia: the contribution rate is 4% in 2007 and will reach the long-term value of 10% from 2010. Lithuania is also phasing in the defined-contribution plan and the current contribution rate is below the 5.5% long-term value at present.

*Source*:     OECD pension models.  See OECD (2007).

## 1.2     *Voluntary defined-contribution plans[6]*

22.     Contribution rates vary between individuals in voluntary plans, so choosing an objective assumption for modelling entitlements under these schemes is difficult. Two approaches have been adopted.

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5     The occupational plan in Sweden has since moved wholly to defined-contribution provision: see OECD (2009) for an analysis of these new arrangements.

6     Defined-benefit occupational plans are common in many of these countries.  Benefits under these schemes were modelled for Canada, the United Kingdom and the United States in OECD (2005).

23.     The first is based on institutional features of national systems. In Germany, the 4% contribution rate shown in Figure 1 is the maximum that attracts the generous government subsidy and consequently much the most common contribution. The new personal accounts in the United Kingdom will automatically enrol workers into a scheme with an 8% contribution rate, split between employees, employers and the government. This is similar to the average contribution rate reported in survey data.

24.     The second approach is to consider average contribution rates from survey data. These are approximately 4.25% in Belgium, 8% in Canada, 9% in the United States and 10% in Ireland (see OECD, 2007, Part II.2).

## *1.3     Structure of the retirement-income package*

25.     Differences in the structure of pension systems are explored further by looking at the contribution the various components make to the overall pension package for full-career workers (Table 2). These calculations use the OECD pension models, which are described briefly in Box 1 (OECD, 2005, 2007, 2009a provide more detail).

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**Box 1. A brief guide to the OECD pension models**

The parameters and rules of pension schemes are complex and retirement-income systems typically have multiple components. The OECD pension models aim to calculate prospective pension entitlements promised in the future to today's workers from all mandatory parts of the pension system.

Pension entitlements that are calculated and compared are based on the parameters and rules that are currently legislated. All value parameters are those for the calendar year 2004. Changes in rules that have already been legislated, but are being phased-in gradually, are assumed to be fully in place from the start. It is assumed that the pension rules remain unchanged thereafter.

The calculations show the pension entitlements of a worker who enters the system today and has a full career, defined as uninterrupted work from age 20 until the standard pension-eligibility age. Although this is clearly unrepresentative of actual labour-market experience, it is the only assumption that can generate comparable results. Most pension systems provide credits for periods in education, military service, unemployment, child rearing etc. Simply assuming that people who are not in work are not covered during career gaps would produce misleadingly low pension entitlements for people with career gaps.

Entitlements are calculated for a single person. This is because the rules governing benefits for married couples can be very complicated and because the results depend on assumptions over both partners' career histories.

The results include all mandatory pension schemes for private-sector workers, regardless of whether plans are publicly or privately provided. Plans with near-universal coverage – more than 80% of employees – are treated as "quasi-mandatory" and so are included in the baseline results. Resource-tested benefits for which retirees may be eligible are also included and the comparisons assume that all pensioners who are entitled take up these benefits. Where there are broader means tests, taking account also of assets, the income test is taken as binding. It is assumed that the whole of income during retirement comes from the mandatory pension scheme when calculating these entitlements.

For the countries with voluntary private pensions, contribution rates have been chosen using national data sources, as set out in the text. The modelling here assumes a full career of contributions to facilitate comparisons with the countries with mandatory private pensions. Other studies – OECD (2007, Part II.2) and Antolín and Whitehouse (2008) – show the impact of less-than-complete contribution records on benefits from voluntary private pensions.

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

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

| | |
|---|---|
| Growth in average real earnings | 2% per year |
| Individual earnings | in line with economy-wide average |
| Price inflation | 2.5% per year |
| Discount rate | 2% a year |
| Mortality rates: | country-specific projections for 2040 |

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26.     To allow for the fact that pension packages change with individual earnings, the calculations are based on *weighted averages*. Pension entitlements are calculated for people earning between 30% and 300% of mean earnings. Each level of earnings is then given a weight based on its importance in the distribution of earnings. The role of the defined-contribution pension in the overall pension package will have a major effect on the degree of investment risk borne by individual retirees.

27.     Starting with the countries with mandatory defined-contribution plans, these schemes naturally play a greater role in countries with the highest contribution rates: Denmark and Latvia, for example. They also tend to be more important in the countries that do not have public, earnings-related schemes: Australia, Denmark and Mexico. In Norway and Sweden, in contrast, the defined-contribution pension is just 11% and 20% of the pension package respectively, and so investment risk is likely to be small.

28.     First-tier pension systems also play a role in determining the degree of investment risk individuals face. The value of basic pensions, like public, earnings-related scheme, will not change with investment returns. However, the value of resource-tested benefits will be affected by investment returns: a higher return means a higher defined-contribution pension and so a lower entitlement to resource-tested payments. This mitigates investment risk, particularly for low-income workers.

29.     For minimum pensions the situation is more complex. In Norway and Sweden, for example, the minimum benefit is calculated only taking account of public pension receipt, and so its value will not be affected by investment returns. In Mexico and Poland, in contrast, the minimum pension depends on all pension income, including the defined-contribution plan. So the minimum pensions in these countries will act like the resource-tested schemes discussed above as insurance against poor investment performance for lower earners.

30.     Similar reasoning explains the patterns in the retirement-income package for the six countries with voluntary private pensions. Three of the six have basic pensions. These make up virtually all of the public pension in the United Kingdom because it is assumed that people contract out of the public earnings-related scheme and so do not receive benefits from this programme. In Ireland, only the basic public pension is relevant for full-career workers. In Canada, the earnings-related public scheme plays a more important role than the basic pension. In the other three countries, earnings-related pension schemes dominate the public part of the package.

31.     The role of the voluntary defined-contribution plan in providing retirement incomes depends most strongly, of course, on the assumed contribution rate, which is highest in Ireland and the United States and lowest in Belgium and Germany. The particularly important role for the defined-contribution plan in the United Kingdom reflects the low level of the basic pension: just 15% of average earnings on the OECD's measure (compared with 30% in Ireland, for example).

**Table 2.    Structure of retirement-income packages in 17 OECD/EU countries**

| | First tier: redistributive | | | Second tier: insurance | | | Third tier |
|---|---|---|---|---|---|---|---|
| | Public | | | Public | Private | | Private |
| | Resource-Tested | Basic | Minimum | | DC | DB | |
| **Mandatory DC** | | | | | | | |
| Australia | 45.8 | | | | 54.2 | | |
| Denmark | 12.5 | 31.5 | | | 56.0 | | |
| Estonia | | 19.7 | | 47.9 | 32.4 | | |
| Hungary | | | | 65.9 | 34.1 | | |
| Latvia | | | 0.7 | 38.7 | 60.7 | | |
| Lithuania | | 37.7 | | 20.4 | 41.9 | | |
| Mexico | | | 4.3 | | 85.7 | | |
| Norway | | 30.1 | 0.4 | 58.5 | 11.1 | | |
| Poland | | | 0.3 | 48.8 | 50.9 | | |
| Slovak Republic | | | 0.2 | 45.3 | 54.5 | | |
| Sweden | | | 4.7 | 49.0 | 19.9 | 26.4 | |
| | | | | | | | |
| **Voluntary DC** | | | | | | | |
| Belgium | | | 4.2 | 74.1 | | | 21.7 |
| Canada | 2.0 | 24.1 | | 34.2 | | | 39.7 |
| Germany | 0.1 | | | 75.1 | | | 24.8 |
| Ireland | | 57.6 | | | | | 42.4 |
| United Kingdom | 0.3 | 39.8 | | | | | 59.8 |
| United States | | | | 58.2 | | | 41.8 |

Note:    Denmark: private DC includes both special pension (5.0%) and quasi-mandatory occupational (51.0%). Mexico: private DC includes the proportional contribution (83.9%) and the flat-rate contribution paid by the government (11.8%). Sweden: private DC includes the mandatory premium pension (12.2%) and the occupational DC plan (8.7%). Belgium: includes both minimum pension and minimum credits. United Kingdom: the results assume that individuals are "contracted out" of the earnings-related pension scheme – the state second pension – meaning that they forgo these benefits.

DB = defined benefit; DC = defined contribution.

*Source*:    OECD pension models.  See OECD (2007).

## 2.        Uncertainty of investment returns

32.        Table 3 shows the simulated distribution of future investment returns based on past market returns that were derived in the companion paper, D'Addio, Seisdedos and Whitehouse (2009). The median real annual return is 7.3% for the eight OECD countries studied based on market investment returns. However, the paper argued that there is a series of reasons why returns achieved by individuals on their pension funds are less than the market return (as measured by conventional indices). These factors include administrative charges, agency and governance effects and demographic change, depressing investment returns below the high levels recorded over the past two decades. As a result, a more conservative assumption for future investment returns than the record over the past quarter century is appropriate. Settling on a median of 5.0% annual real return net of charges implies that 80% of the time, the investment return on pension savings should be between 3.2% and 6.7% a year.

33.        The compound-interest effect means that differences in returns imply very large differences in retirement benefits. This is illustrated using a simple model. It assumes 40 years of contributions of 10% of earnings a year. The results are calculated with the OECD average mortality rates projected for 2040. With median investment returns, the replacement rate – pension relative to earnings – would be 87%. But the lower bound for the replacement rate (in 10% of cases) is 55% or less. Returns at the higher end of expectations would deliver, again in 10% of cases, a replacement rate of 139% or more.

**Table 3.    Distribution of simulated future investment returns: balanced portfolio**

| | | | | Percentile of distribution | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| **Market data** | | | | | | | | | |
| Rate of return | 5.5 | 6.1 | 6.6 | 7.0 | 7.3 | 7.7 | 8.0 | 8.5 | 9.0 |
| Replacement rate | 54.8 | 63.7 | 72.3 | 80.2 | 86.9 | 96.7 | 104.9 | 120.4 | 138.6 |
| **Rescaled** | | | | | | | | | |
| Rate of return | 3.2 | 3.8 | 4.3 | 4.7 | 5.0 | 5.4 | 5.7 | 6.2 | 6.7 |
| Replacement rate | 32.2 | 36.8 | 41.2 | 45.2 | 48.6 | 53.5 | 57.6 | 65.3 | 74.2 |

Note:       Based on unisex mortality rates of the OECD average projected for 2040. Assumes a contribution of 10% of earnings over a 40-year term.  Balanced portfolio is invested 50% in equities and 50% in bonds.

*Source*:      OECD pension models and OECD analysis of Datastream information.

## 3.       Investment returns and retirement incomes

34.        To quantify the effect of differences in the structure of retirement-income systems, the OECD pension models have been used to calculate pension entitlements with different levels of investment returns. The models are described briefly in Box 1 above.

35.        Previous analyses of the sensitivity of individual pensions to investment returns using the OECD pension models simply varied the assumed rate of return. The first edition of *Pensions at a Glance* looked at annual real returns from zero to 6% for six countries (OECD, 2005, Annex I.2). The second edition considered a range of 1-6% and covered eight countries (OECD, 2007). While such an approach can yield useful insights into the role of investment risk, it is silent on the likelihood (or not) of the range of different assumed returns. This is why this paper looks at the probability distribution of different rates of return.

36.        The first set of results look at the gross replacement rate: individual pension in retirement relative to earnings when working.

### 3.1       *Gross replacement rates: average earners*

37.        Figure 2 begins with the case of the average (mean) earner. The vertical axis gives the gross replacement rate and the horizontal axis, the percentiles of the simulated distribution of investment returns over the long time horizon of pension investments. Panel A presents the case of countries with mandatory defined contribution pensions, whereas panel B shows the case of countries with voluntary defined contribution plans.

38.        The greatest *absolute* level of investment risk – measured by the percentage point difference in replacement rate between high and low investment returns – is in Denmark. The baseline gross replacement rate is 93%, but very low returns (10th percentile) would reduce the replacement rate to 73%. Similarly, very high returns (at the 90th percentile of the distribution) would deliver a pension of 140% of earnings. Absolute investment risk is also large in other countries with relatively high baseline replacement rates and relatively large contributions to the private plan, such as Latvia and Poland.

39.        The baseline replacement rate in Mexico is one of the lowest of the countries under study: 53%, Mexico show the greatest relative variability with investment returns, higher even than Denmark. The replacement rate is 33% with very low returns but reaches 86% with very high returns. In the discussion that follows, the ratio of replacement rates with high and low returns – in this case 2.6 – is described as *relative* investment risk.

**Figure 2. Gross replacement rate by investment return: average earners**

A. Countries with mandatory private pensions



B. Countries with voluntary private pensions
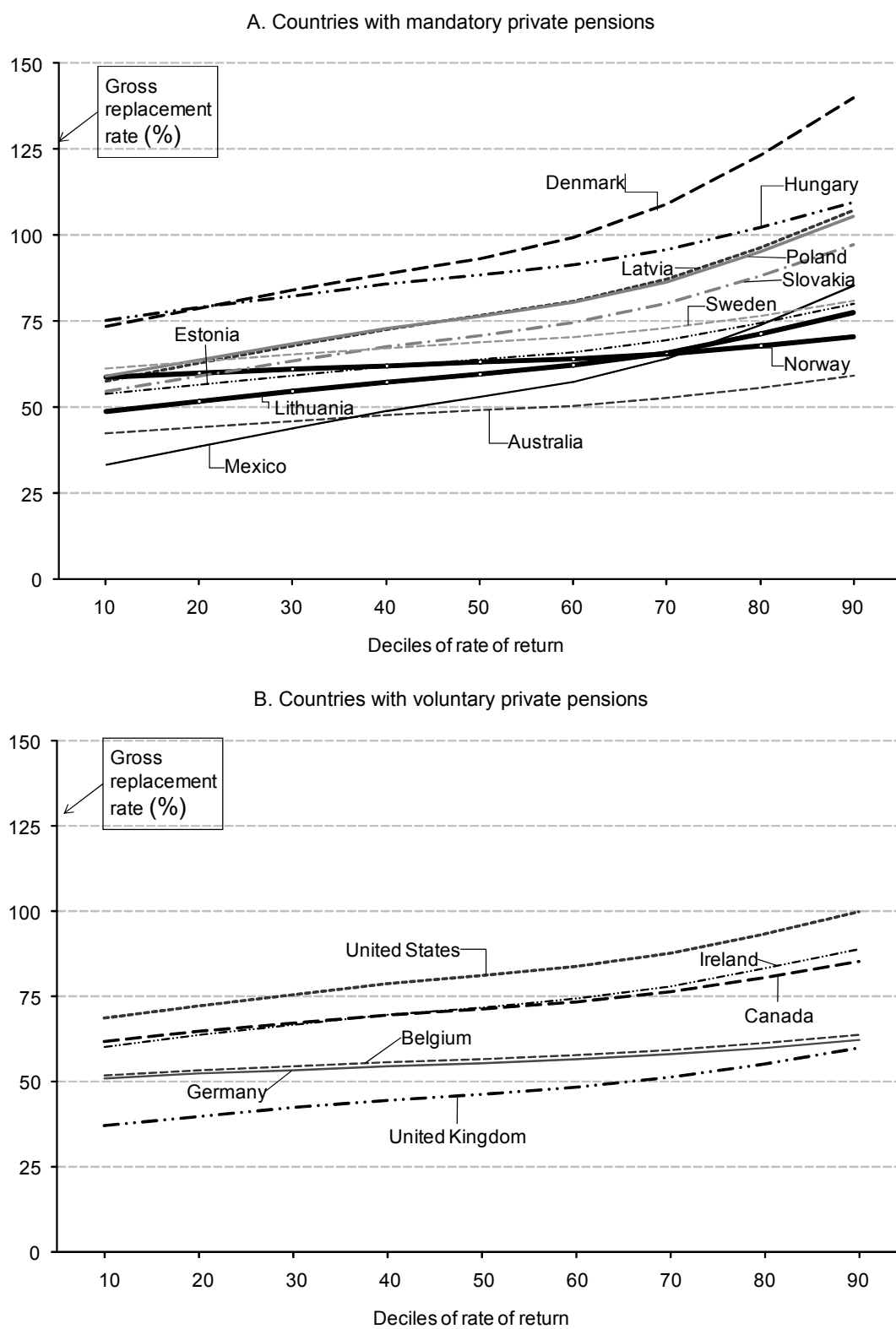


*Source*: OECD pension models.

40.	At the other end of the scale, the small contribution rate to mandatory defined-contribution plans in Norway means that the baseline replacement rate of 63% is only 7.5 percentage points higher with the best returns or 3.3 points lower with worse returns. Other countries with low investment risk, such as Estonia, Hungary, Lithuania and Sweden also have fairly low contribution rates to the defined-contribution plans. An interesting exception is Australia, which has a relatively high contribution rate of 9% but a low level of investment risk. The 49% baseline replacement rate of falls to 42% with low investment returns and increases to 59% with high returns. The reason for this is the resource-tested public pension. Any extra benefit from the defined-contribution pension is partly offset by the reduction in entitlement to the public pension (at a 40% withdrawal rate).

41.	Figure 2, panel B looks at the variability of gross replacement rates with changes in investment returns for average earners in six countries with a voluntary defined-contribution component. The baseline replacement rates are a little lower on average than for the countries with mandatory pension schemes. The United States has the highest replacement rate of these countries at the median return: 81%. The largest absolute investment risk is found in Ireland and the United States because of the relatively high contribution rate that has been assumed. The relative investment risk is highest in the United Kingdom. The low replacement rate from the public scheme means that the defined-contribution plan plays a more important role in providing retirement incomes. Belgium and Germany, where contribution rates are low, have the smallest degree of investment risk in relative and absolute terms. But even in these countries, the overall pension, including public benefits, would be 20% larger with high returns than with poor investment performance.

## 3.2	*Gross replacement rates: low earners*

42.	Figure 3 presents the same analysis as above for workers on half average (mean) earnings. Baseline replacement rates for low earners vary even more substantially than they did for average earners. The lowest replacement rate – that of Mexico (59%) – is well below half of that in Denmark (138%).

43.	In Hungary, Poland and the Slovak Republic, both the level of the replacement rate and its variability with changes in pension investment returns is exactly as it was for average earners, unlike the other countries with mandatory defined-contribution plans. The most obvious differences by earnings level are in Latvia and Mexico, where a low earner would be eligible for the minimum pension except with above-average investment returns. The replacement rate is therefore constant across much of the range of investment returns.

44.	In countries such as Australia, Denmark, Estonia and Lithuania, the pension system is much more progressive: it pays higher replacement rates overall to low earners than to average earners. In Australia, the replacement rate for a low earner at the baseline investment return is 77%, compared with 49% for an average earner. In these four countries, low earners face the same absolute level of investment risk as do average earners. But because their replacement rates are higher (due to first-tier resource-tested and/or basic schemes) they face relatively less investment risk than average earners.

**Figure 3. Gross replacement rate by investment return: low earners (50% of average)**

A. Countries with mandatory private pensions



B. Countries with voluntary private pensions
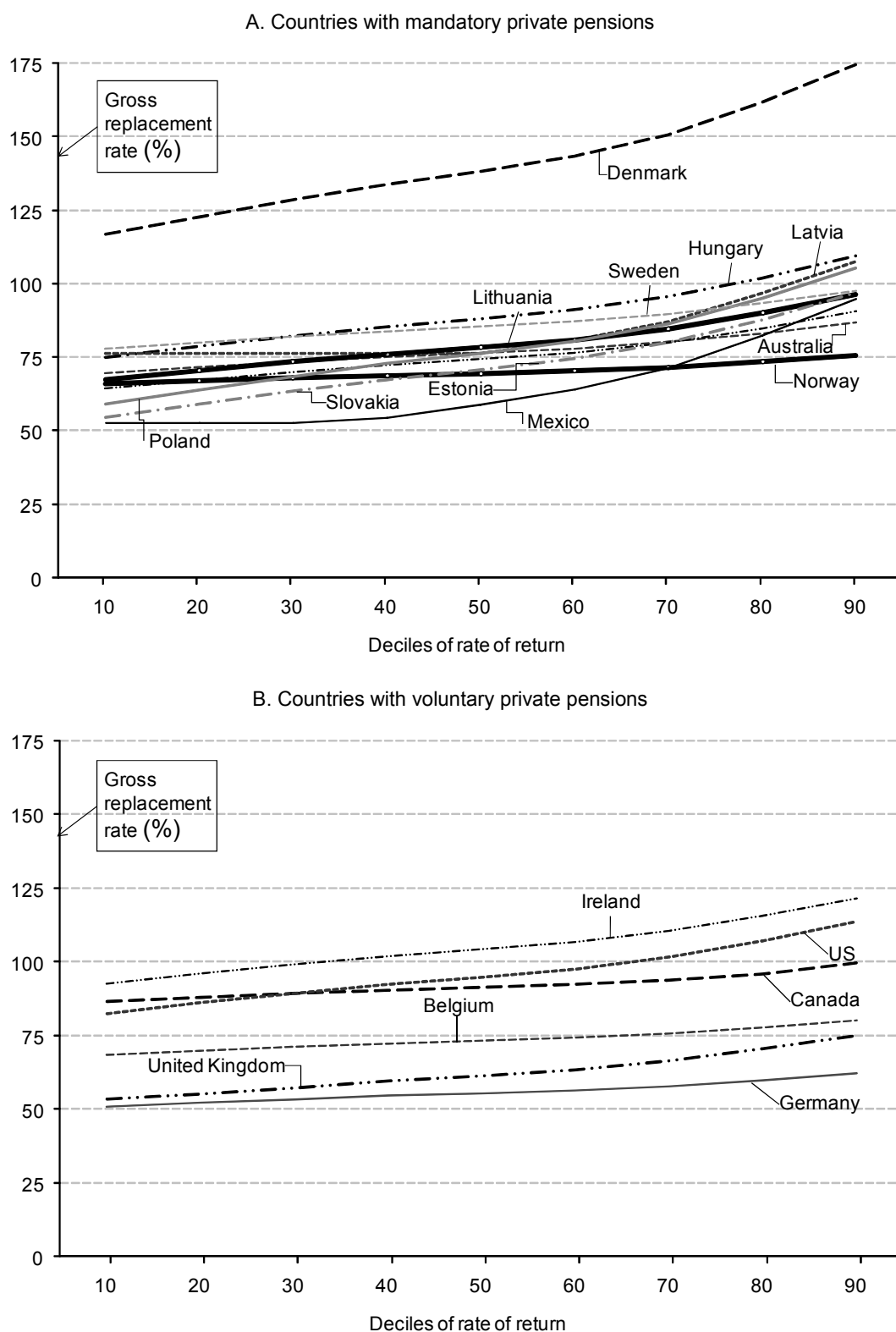


*Source*: OECD pension models.

45.        Figure 3, panel B shows that investment risk, on average, is relatively low in the six countries with voluntary defined-contribution plans. Nearly all of these countries have highly progressive pension systems: the baseline average gross replacement rate is 80% compared with 63% for average earners. Investment risk is again lowest in Belgium and Germany because of the low contribution rates. In Canada, as in Australia, the resource-test for the public pension scheme tends to reduce investment risks in replacement rates. The greatest degree of absolute and relative investment risk is in the United States. Relative investment risk is also particularly high in the United Kingdom but the baseline replacement rate is 64%, compared with 95% in the United States.

### 3.3        *Gross replacement rates: high earners*

46.        Figure 4 presents the same analysis for workers on high earnings (one-and-a-half times mean pay). Baseline replacement rates among high earners have a similar spread across countries to that for average earners. For example, the replacement rates at the median return range from 40% in Australia to 85% or more in Denmark and Hungary.

47.        Again, replacement rates increase with investment returns. Norway has the lowest level of investment risk for high earners among countries with mandatory defined-contribution plans, in both relative and absolute terms. At the other side of the spectrum, Mexico has the largest relative level of investment risk for high earners whereas Denmark has the highest absolute level of investment.

48.        In Hungary, Poland and the Slovak Republic replacement rates by investment returns do not vary with earnings. However, in most countries, the retirement-income system is progressive, meaning that replacement rates are higher for people with lower levels of earnings. The average replacement rate for the 11 countries is 69% for average earners and 66% for high earners. There are some exceptions to this rule, such as the case of Sweden, where high earners get slightly higher replacement rates than average earners.

49.        The countries with voluntary defined-contribution plans tend to have more progressive pension systems. For these six, the replacement rate for average earners is 64% compared with 56% for high earners. In three cases, this is because benefits are capped by a ceiling on pensionable earnings that is less than 150% of average earnings. These ceilings are worth 96% of average earnings in Canada, 115% in the United Kingdom and 117% in Belgium. Relative investment risk is highest in Ireland and the United Kingdom, reflecting the relatively low replacement rate from public benefits received by high earners. Again, the effect is smallest in Belgium and Germany because of low contribution rates.

**Figure 4.  Gross replacement rate by investment return: high earners (150% of average)**

A. Countries with mandatory private pensions



Deciles of rate of return

B. Countries with voluntary private pensions



Deciles of rate of return
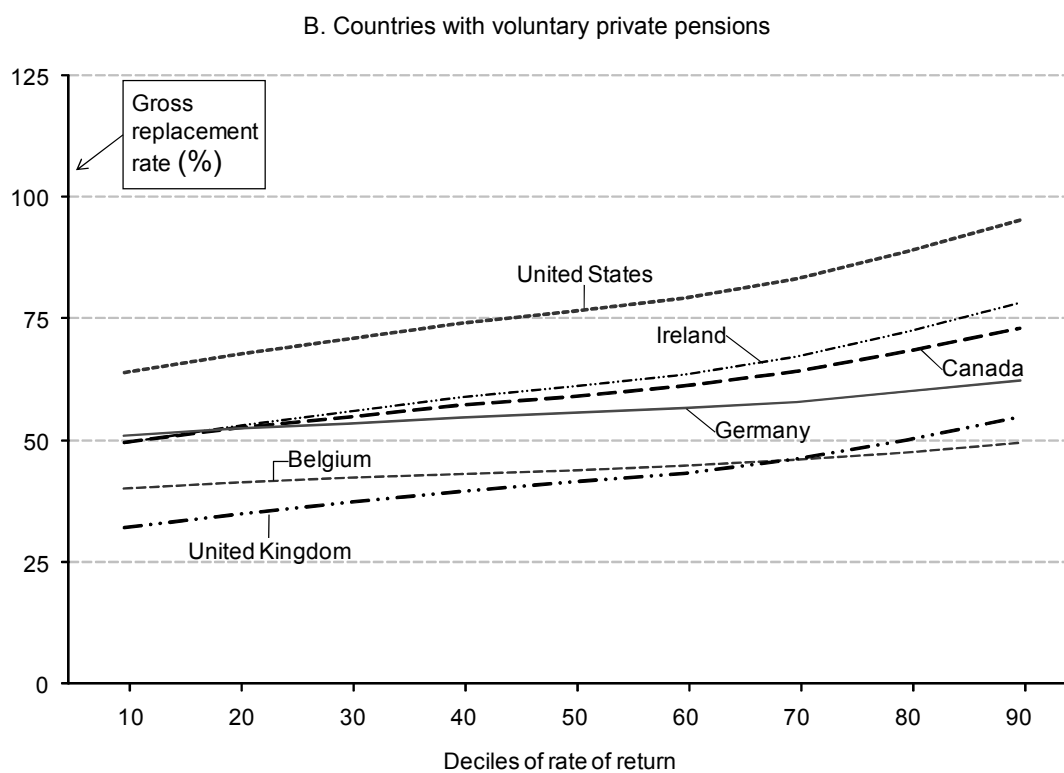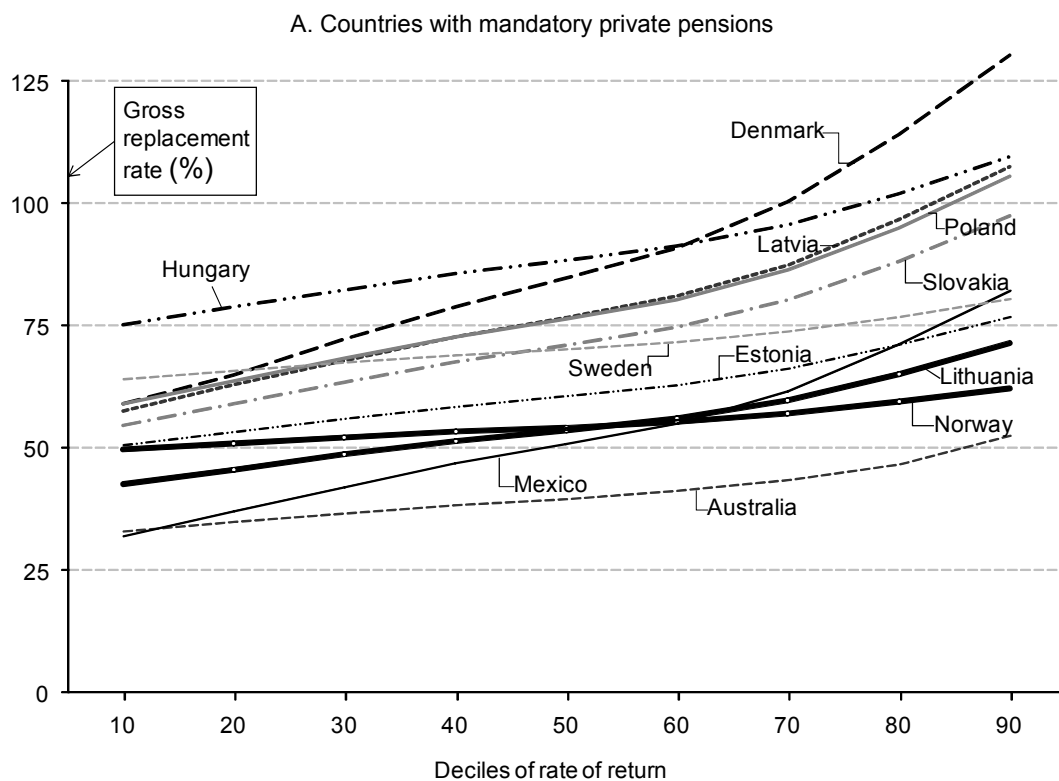
*Source*:     OECD pension models.

## 4.     Investment returns and net retirement incomes

50.     Net replacement rates, unlike gross, take account of taxes and contributions. The net replacement rate is the pension, less any taxes and contributions, relative to earnings, again after taxes and contributions. This is an important indicator for two main reasons. First, it is net incomes that determine living standards in retirement relative to when working. Secondly, taxes and contributions also affect investment risk. If the tax system is progressive, then better investment performance of defined-contribution pensions will result in a higher average effective tax rate and *vice versa*.

### 4.1     Taxes and contributions paid on retirement incomes

51.     Table 4 summarises the effects of taxes on pensions in payment on retirement incomes. The OECD pension models are used to calculate the gross entitlement to mandatory for workers on different levels of earnings, from 50% to 200% of the economy-wide average. The models then calculate the tax and contribution liability on this pension. There are, as ever, important differences between countries.

52.     At one end of the spectrum, Lithuania and the Slovak Republic do not subject pensions to tax or to any social contributions. The relatively low replacement rate in Mexico coupled with generous standard income-tax reliefs mean that pensioners are unlikely to pay any tax. Similar effects in Australia, Estonia, Ireland and Latvia mean that only higher earners would have sufficient pension rights to be liable for tax.

**Table 4.     Average effective tax rates paid on mandatory pensions by level of pre-retirement earnings**

| Countries with: | Individual earnings when working (multiple of economy-wide average) | | | | |
|---|---|---|---|---|---|
| | 0.5 | 0.75 | 1 | 1.5 | 2 |
| **Mandatory DC** | | | | | |
| Australia | 0.0 | 0.0 | 0.0 | 3.2 | 7.6 |
| Denmark | 31.3 | 32.1 | 32.9 | 34.6 | 39.0 |
| Estonia | 0.0 | 0.0 | 0.0 | 1.9 | 7.3 |
| Hungary | 0.4 | 8.4 | 12.8 | 25.5 | 28.6 |
| Latvia | 0.0 | 0.0 | 4.1 | 11.1 | 14.6 |
| Lithuania | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mexico | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Norway | 11.9 | 15.7 | 18.3 | 21.0 | 22.2 |
| Poland | 13.6 | 15.6 | 16.5 | 17.5 | 18.0 |
| Slovak Republic | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sweden | 24.5 | 26.6 | 28.1 | 30.2 | 35.4 |
| | | | | | |
| **Voluntary DC** | | | | | |
| Belgium | 4.3 | 8.9 | 24.5 | 28.9 | 28.9 |
| Canada | 0 | 0.5 | 1.2 | 1.1 | 0.9 |
| Germany | 11.0 | 17.4 | 21.4 | 26.6 | 26.7 |
| Ireland | 0.0 | 0.0 | 3.2 | 10.3 | 15.1 |
| United Kingdom | 0.7 | 2.3 | 5.2 | 9.1 | 11.5 |
| United States | 2.8 | 4.9 | 6.9 | 9.2 | 10.3 |

*Source*:     OECD pension models.

53.     At the other end of the scale, the three Scandinavian countries have high tax burdens overall and pensioners, even low-income pensioners, are included in the tax net. Taxes and contributions on retirement benefits are also relatively high in Belgium, Germany and Poland. In contrast, additional tax reliefs for older people in Ireland, the United Kingdom and the United States mean that pensioners bear a relatively light fiscal burden.

54.     Table 5 shows the same analysis as Table 4 but for workers. The net replacement rate depends on the average percentage of pension paid in taxes and contributions compared with the proportion of earnings paid when working. In the Nordic countries, the differences between the two are relatively small. But in Australia, Canada, Estonia, Latvia, Lithuania and the Slovak Republic, average earners would pay little or no tax on their pension entitlement. However, while working, around 20-25% of pay would go in taxes and contributions.

**Table 5.   Average effective tax rates paid by workers by earnings**

| Countries with: | Individual earnings (multiple of economy-wide average) | | | | |
|---|---|---|---|---|---|
| | 0.5 | 0.75 | 1 | 1.5 | 2 |
| **Mandatory DC** | | | | | |
| Australia | 15.3 | 21.0 | 23.7 | 29.0 | 33.9 |
| Denmark | 38.0 | 39.6 | 41.2 | 48.0 | 51.7 |
| Estonia | 16.1 | 20.1 | 22.0 | 24.0 | 25.0 |
| Hungary | 19.2 | 26.0 | 34.4 | 41.9 | 44.3 |
| Latvia | 25.3 | 27.0 | 27.9 | 28.8 | 29.2 |
| Lithuania | 12.6 | 19.8 | 23.4 | 27.0 | 28.8 |
| Mexico | 9.8 | 11.0 | 13.1 | 17.5 | 21.8 |
| Norway | 24.0 | 27.6 | 30.1 | 36.5 | 39.7 |
| Poland | 29.0 | 30.9 | 31.8 | 32.7 | 34.9 |
| Slovak Republic | 14.5 | 19.6 | 22.2 | 24.8 | 26.0 |
| Sweden | 26.6 | 29.3 | 30.3 | 37.2 | 42.0 |
| | | | | | |
| **Voluntary DC** | | | | | |
| Belgium | 25.9 | 37.6 | 41.9 | 47.5 | 50.6 |
| Canada | 15.6 | 20.8 | 24.8 | 27.3 | 29.1 |
| Germany | 32.4 | 38.8 | 43.5 | 48.4 | 48.2 |
| Ireland | 1.2 | 12.2 | 15.7 | 26.1 | 30.7 |
| United Kingdom | 19.7 | 24.1 | 26.3 | 28.4 | 31.5 |
| United States | 18.1 | 21.8 | 23.6 | 27.3 | 30.2 |

*Source*:     OECD tax-benefit models.  See OECD (2006).

## 4.2     *Net replacement rates: average earners*

55.     Figure 5 shows how *net* replacement rates vary with changes in investment returns for workers on average earnings. The vertical axis gives the net replacement rate and the horizontal axis, the percentiles of the simulated distribution of investment returns over the long time horizon of pension investments.

**Figure 5. Net replacement rate by investment return: average earners**

A. Countries with mandatory private pensions



B. Countries with voluntary private pensions
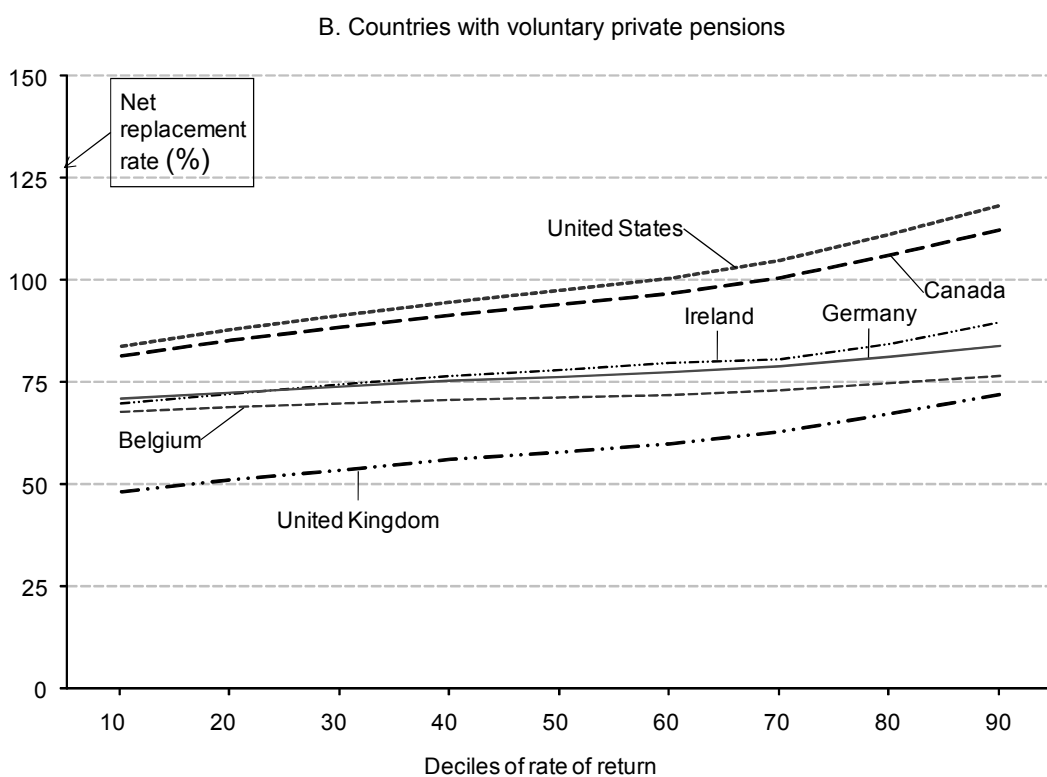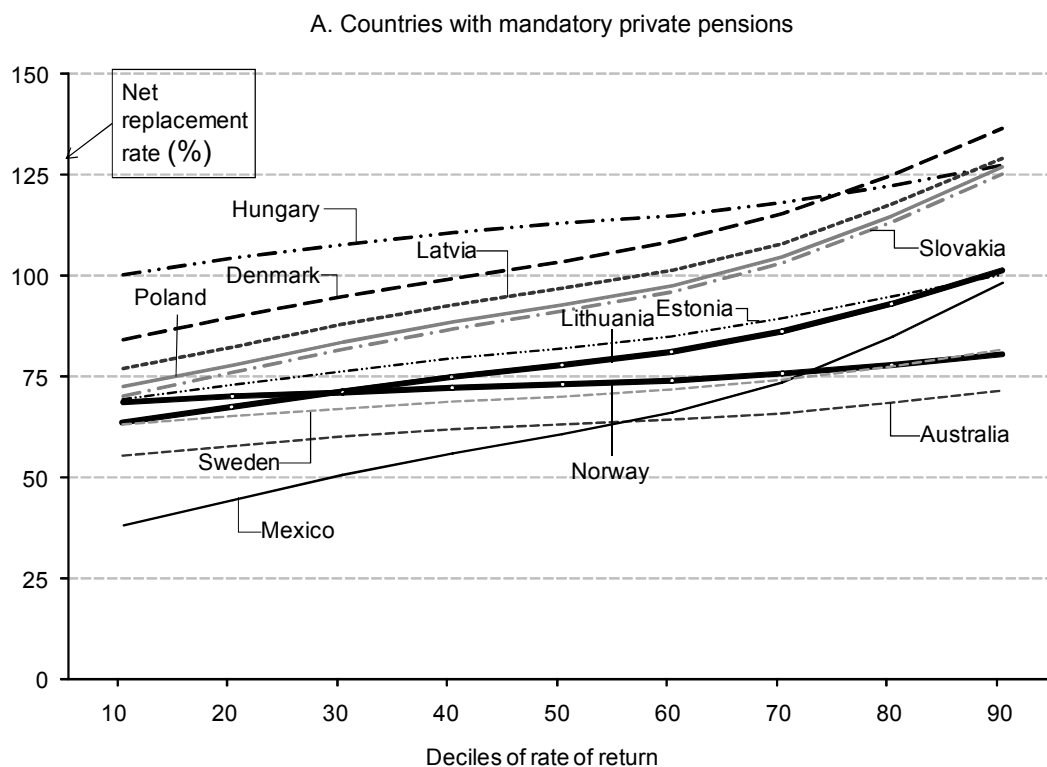


*Source*:     OECD pension models.

56.     Due to the interaction between the retirement-income and personal-tax systems, baseline net replacement rates tend to be higher than their counterpart gross replacement rates. For average earners, the difference between baseline replacement rates in gross and net terms is substantial in countries such as Estonia, Hungary, Latvia, Lithuania and the Slovak Republic (around 20 percentage points). Sweden, on the other hand, has the lowest difference, with the net replacement rate less than two percentage points higher than the gross replacement rate. This reflects the relatively high tax burden on retirement incomes and the fact that the tax burden on earnings is not much greater than that on pensions (Tables 3 and 4).

57.     Denmark, Mexico, Latvia, Poland and the Slovak Republic have the greatest variability in net replacement rates among the countries with mandatory defined contribution pensions. The country with the highest relative level of net investment risk for average earners is Mexico. The Slovak Republic has the largest absolute investment risk for average earners measured on a net basis. Norway has the lowest absolute and relative level of investment risk for average earners again reflecting the relatively low contribution rate to the mandatory defined-contribution plan.

58.     The lower panel of Figure 5 shows baseline net replacement rates for average earners in countries with voluntary defined-contribution provision. They tend to be significantly lower than gross replacement rates. On average, there is a larger difference between gross and net rates here than observed in countries with mandatory defined-contribution. Germany has the largest difference between these two rates and Ireland the smallest for any level of earnings among countries with voluntary schemes.

### 4.3     *Net replacement rates: low earners*

59.     Figure 6 presents the analysis of net replacement rates by changes in investment returns, for workers on low earnings, again defined as half of the mean.

60.     Baseline net replacement rates for low earners vary between 65% in Mexico to 151% in Demark. The pension system, in interaction with the tax and benefit system, tends to be progressive: net replacement rates are higher for individuals with lower earnings. There are three exceptions. First, Hungary has baseline net replacement rates for average earners (113%) and high earners (111%) above those of low earners (106%). This is because gross replacement rates are constant across the earnings range but the impact of taxes on earnings and pensions varies. Similarly, baseline net replacement rates in the Slovak Republic for high (94%) and average earners (91%) are above those of low earners (83%) because pensions are not taxed while taxes and contributions levied on earnings when working increase with earnings. Finally, high earners have a higher net replacement rate than average earners (77% versus 70%) in Sweden.

61.     Baseline net replacement rates for low earners tend to be well above the counterpart gross replacement rates, as was the situation with average earners. This is, of course, because taxes and contributions payable on pensions are lower than those paid on earnings when working. Latvia has the largest difference (26 percentage points) between the gross and net rates for low earners. In Sweden, relatively high taxes on both pensions and earnings mean that this differential is just 1.5 percentage points.

62.     Net replacement rates for low earners increase as the level of investment return increases, with the exception of Mexico and Latvia. In these countries, low earners would be eligible for the minimum pension unless investment returns are at or above the median. This means that much of the time, retirement incomes do not vary with investment returns.

**Figure 6. Net replacement rate by investment return: low earners (50% of average)**

A. Countries with mandatory private pensions



Deciles of rate of return

B. Countries with voluntary private pensions



Deciles of rate of return
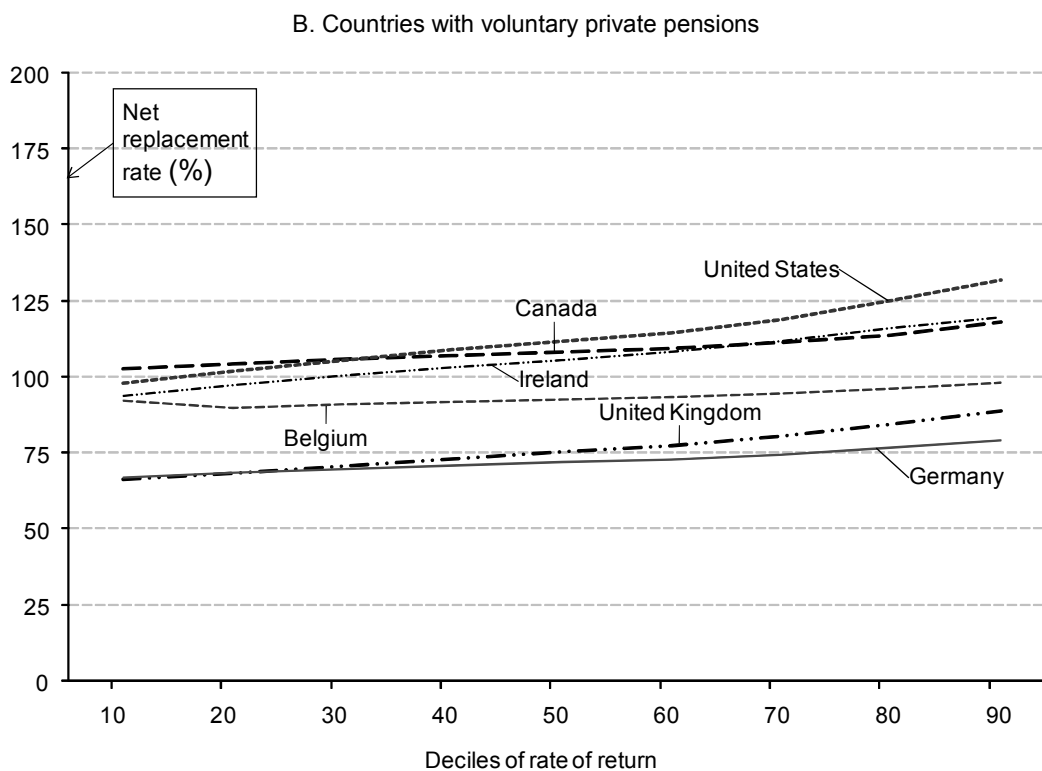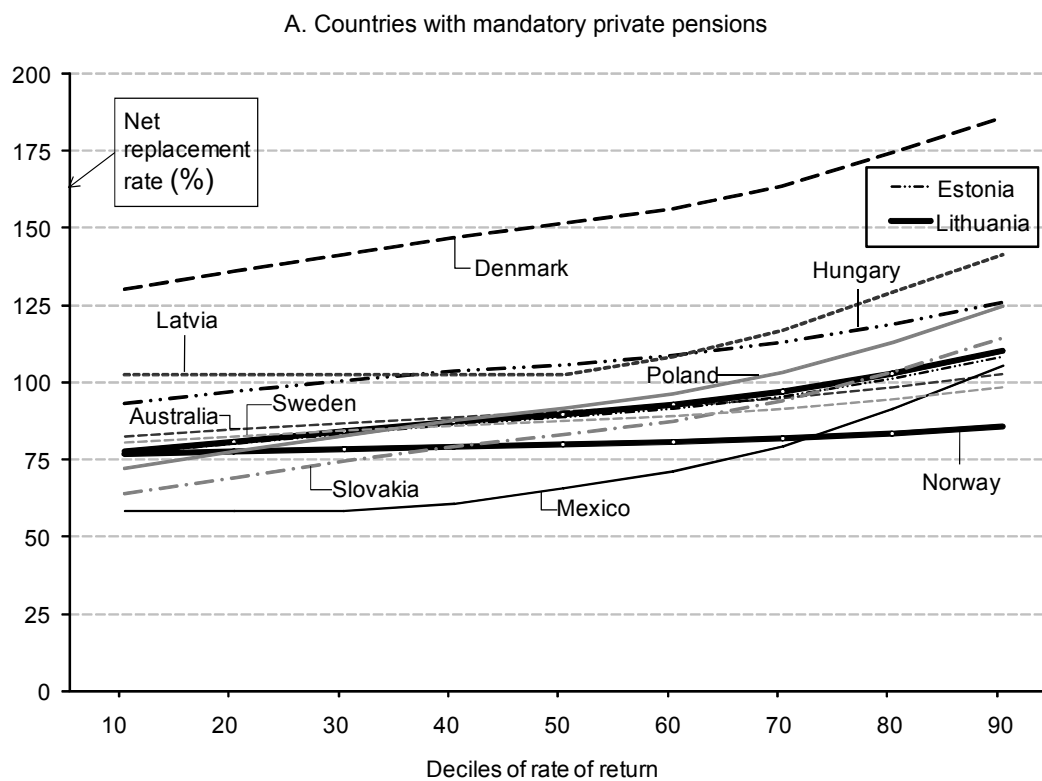
*Source*: OECD pension models.

63.     Denmark has the highest absolute variability of across the simulated investment return distribution (56 percentage points) while the Slovak Republic has the highest relative variability (80%). At the other end of the spectrum, Latvia has the lowest absolute and relative variability of return for low earners.

64.     The lower panel of Figure 6 shows the analysis for countries with voluntary defined-contribution schemes. Both absolute and relative investment risk for low earners, measured on a net basis, tends to be lower among these countries than among those with mandatory plans.

## 4.4     *Net replacement rates: high earners*

65.     Figure 7 shows how net replacement rates change with investment returns for workers on high earnings, again defined as 150% of the mean. Baseline net replacement rates for high earners vary between 39% in Mexico and 98.5% in Hungary. They are well above the gross replacement rates: differences range from around 10 percentage points in Mexico and Sweden to around 35 percentage points in the cases of Australia, Lithuania and the Slovak Republic.

66.     Among these countries, both absolute and relative net investment risk increases with earnings (24.2 percentage points and 38% among high earners; 24.1 percentage points and 36% among average earners; 18.6 percentage points and 23% among low earners). Among high earners, Mexico has the highest relative net investment risk (90%). The Slovak Republic has the largest absolute level of net investment risk (36.1 percentage points). In contrast, Norway has the lowest absolute and relative investment risk, measured in net terms, for high earners (8.2 percentage points and 13.1%, respectively).

67.     Among the countries with voluntary private pensions, both absolute and relative investment risk also tend to increase with earnings. Both absolute and relative investment risk, measured in net terms, tends to be lower in countries with voluntary as opposed to mandatory private pensions.

**Figure 7. Net replacement rate by investment return: high earners (150% of average)**

A. Countries with mandatory private pensions



B. Countries with voluntary private pensions
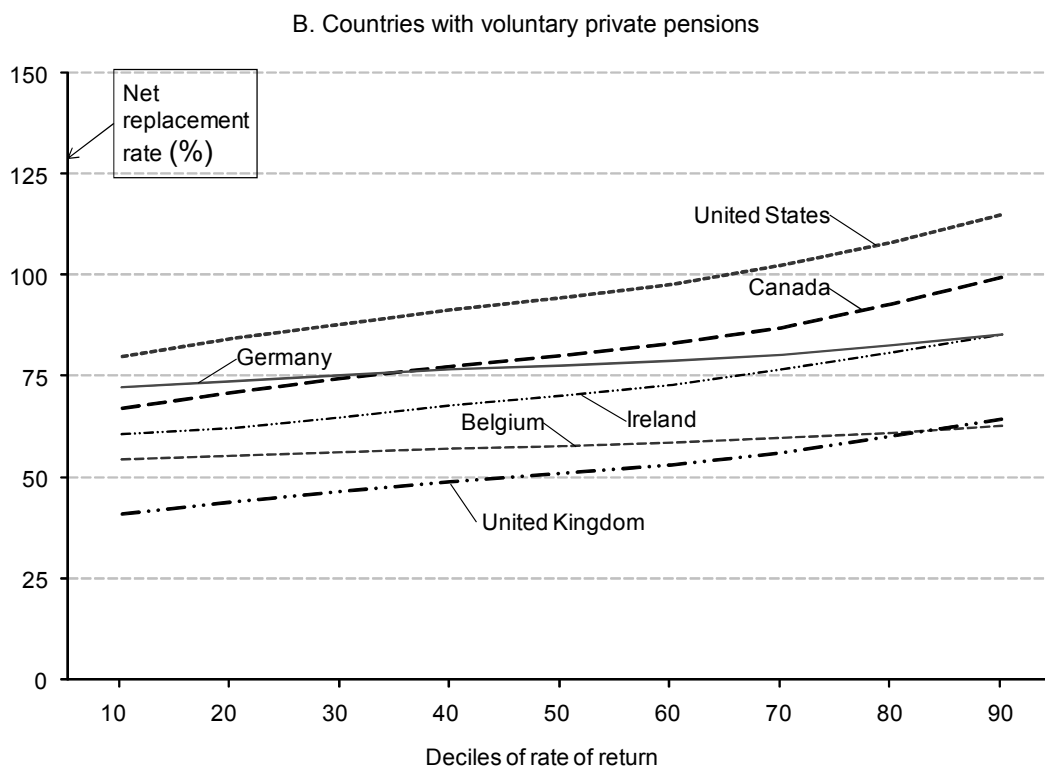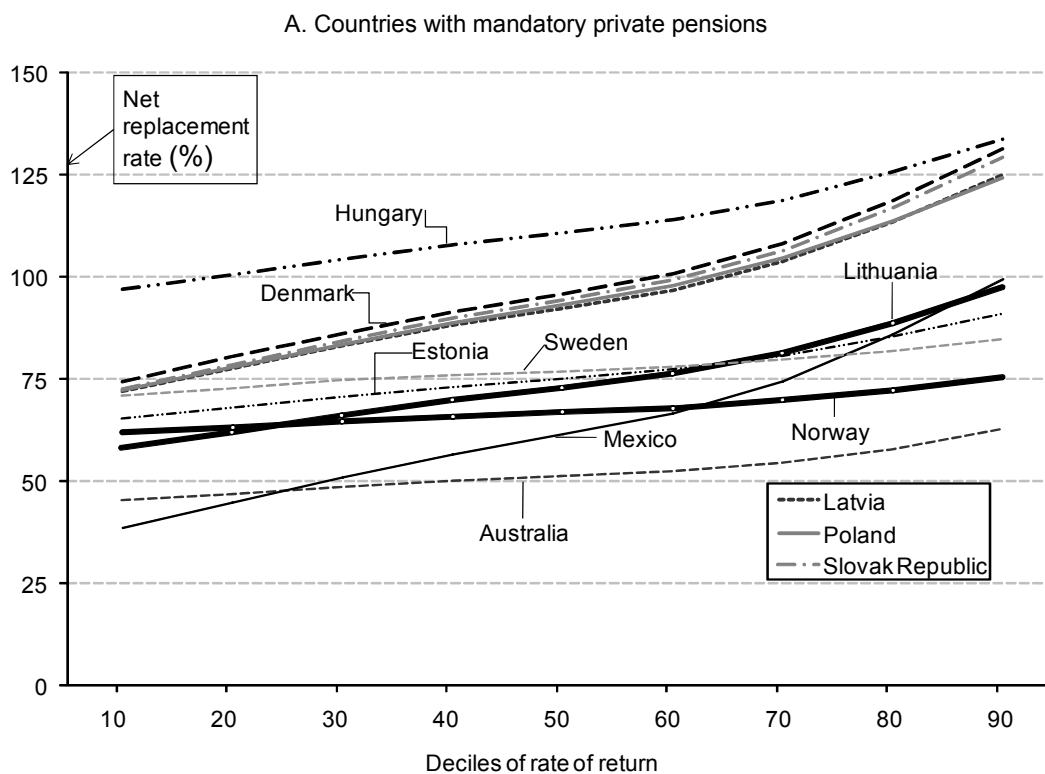


*Source*:     OECD pension models.

## 5.        Investment returns and the public purse

68.        Sections 3 and 4 of this paper have shown how the value of individual pensions depends, to a greater or lesser extent, on the rate of return of the assets in which contributions are invested. This was illustrated with calculations for 11 countries with defined-contribution components to their mandatory pension systems and for six countries where voluntary private pensions are widespread.

69.        The rate of return on investments, however, has broader effects on the public budget. This section considers, first, how public pension expenditures might vary with the rate of return on defined-contribution plans and, secondly, how tax revenues might change.

### 5.1        *Contingent government liabilities: investment risk and public pension spending*
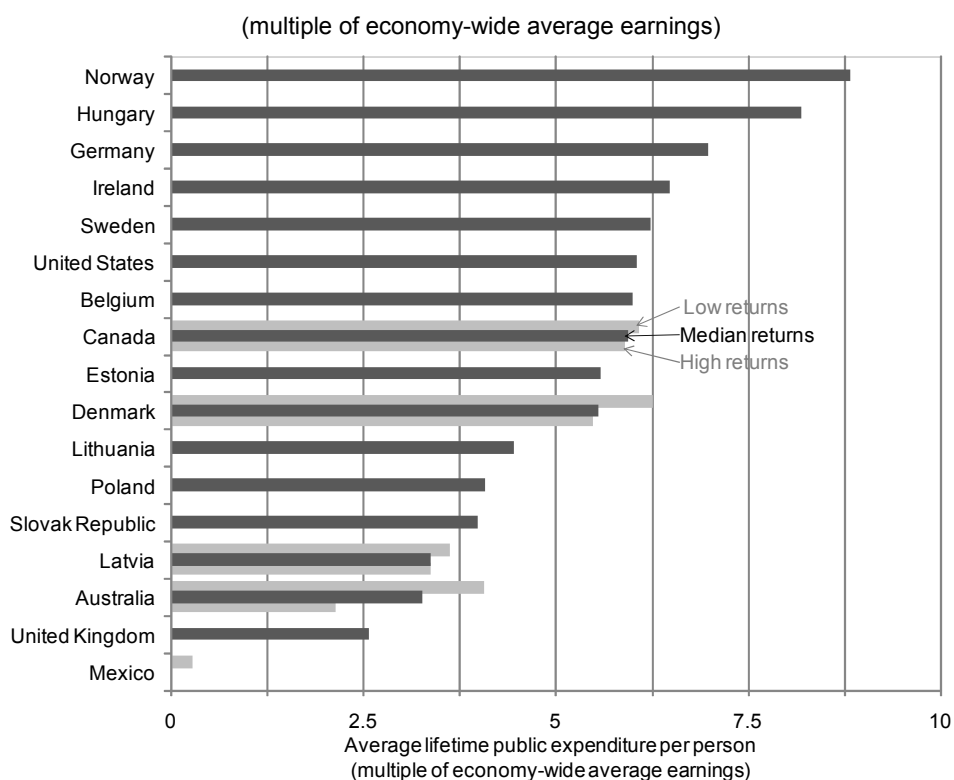
70.        Governments have an implicit and, in many cases, an explicit liability to provide retirement incomes contingent on the investment returns of private pensions. Usually, there are systems of minimum pensions or social-assistance schemes requiring government to top-up low defined-contribution pensions. Low pensions might result because contributions are paid from a low earnings base or the contribution period in the formal pension system is incomplete. With voluntary schemes, it may be that people have significant gaps in their contribution records. However, low investment returns would also increase expenditure on safety–net retirement benefits.[7]

71.        Figure 8 shows how average expenditure on public retirement-income programmes is expected to vary with the different rates of return on investments in defined-contribution schemes that were simulated in D'Addio, Seisdedos and Whitehouse (2008) and summarised in section 2 of this paper. The results are again calculated for workers at different levels of earnings. The weighted average of these results, based on earnings-distribution data, are then calculated. These lifetime pension entitlements are normalised to average earnings in the economy.

72.        Among the countries studied, public pension expenditures are the highest in Norway, which is unsurprising given the small role of mandatory private pensions along with the relatively high target replacement rates (for public and private pensions) in all the Nordic countries. Hungary has both high public pension spending and a relatively large contribution to private pensions: the overall target replacement rate is large. However, other countries that have introduced mandatory defined-contribution plans as a substitute for public pensions – the Baltic States, Poland and the Slovak Republic – have cut public benefits much further.

73.        Public pension entitlements do not vary with investment returns in most of the countries analysed. In most cases, this is because these public pensions are earnings-related or flat-rate benefits. Furthermore, safety-net benefits are below the level at which full-career workers – even those with very low earnings – would be entitled. In Norway and Sweden, the minimum pension benefit depends only on entitlements under the earnings-related scheme and so the performance of the defined-contribution plans does not affect benefits.

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7        Note that this paper focuses on capital-market uncertainty. It does not therefore cover the idiosyncratic risk of the failure of an individual pension fund. Nor does it consider catastrophic, systemic risks, such as a government defaulting on its bonds (see the discussion in Heller, 1998). (This had a devastating effect on pension funds in Argentina, for example. Nonetheless, this means that the recent nationalisation of pension funds was less dramatic than pained in the media.)

**Figure 8. Average lifetime expenditure on public pensions per head**

(multiple of economy-wide average earnings)



Average lifetime public expenditure per person
(multiple of economy-wide average earnings)

*Source*:    OECD pension models.

74.     In five cases, however, aggregate public spending on retirement benefits is affected by the level of pension coming from defined-contribution plans. The impact is shown in more detail in Figure 9. The effect is most pronounced in Australia. This is because the resource-tested scheme currently covers 75% of retirees. For many of these people, public benefits are reduced by 40% of any extra defined-contribution pension. The impact is also significant in Denmark where resource-tested benefits are currently paid to 67% of people of pension age.

75.     In contrast, investment returns have to be very low in Latvia and Mexico before the minimum pension kicks in for full-career workers. In Latvia, public pension spending is dominated by the notional-accounts scheme, which is invariant to investment returns.

**Figure 9. Average lifetime expenditure on public pensions per head by decile of rate of return on investments for defined-contribution plans, Australia, Canada, Denmark, Latvia, Mexico**

(multiple of economy-wide average earnings)
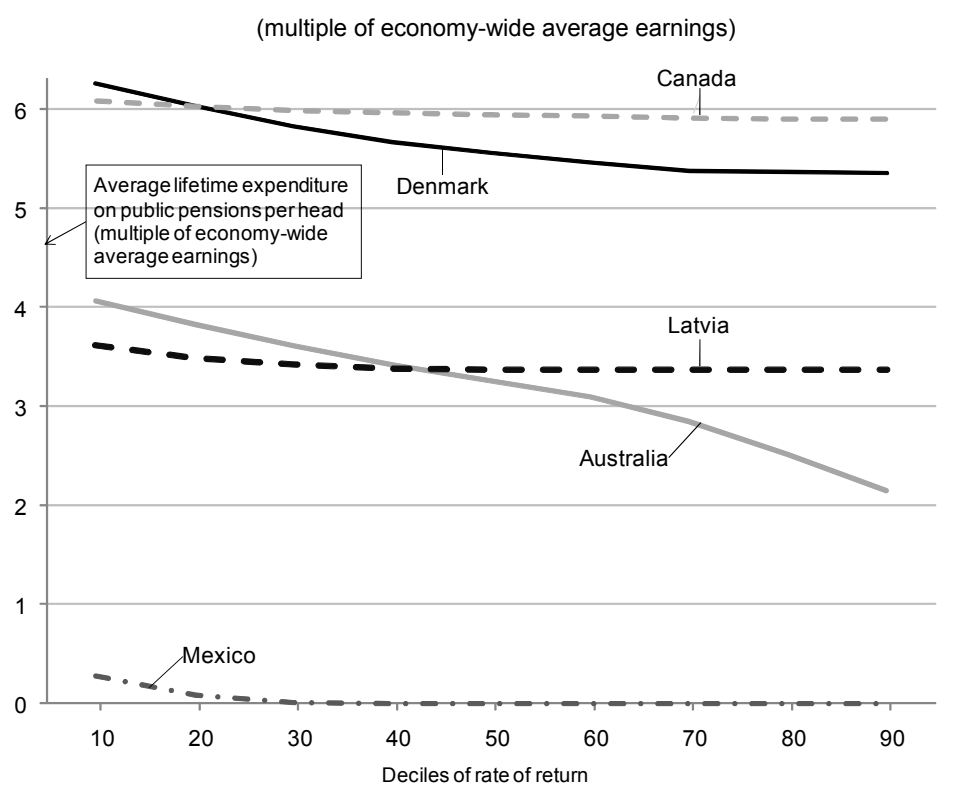


*Source*:    OECD pension models.

## 5.2    *Government as a co-investor: investment risk and tax revenues*

76.        The second effect of the rate of return on the government's finances occurs through the tax rather than the retirement-income system. As discussed in section 4.1, nearly all of the 17 countries under study levy personal income taxes on pensions in payment. Some also require health or social security contributions. This means that tax and contribution revenues increase if capital-market returns are higher. The government is implicitly acting as a "co-investor" with the members of defined-contribution pension schemes.

77.        Personal income taxes in all OECD and EU countries are progressive, meaning that the proportion of income paid in income tax increases as income increases. In more technical terms, marginal income tax rates exceed average rates. This means that a higher rate of return on defined-contribution pensions increases tax revenues more than proportionally than the increase in pension benefit. Not only is the government an implicit co-investor, but it has an even greater interest than the individual worker in high investment returns.

78.        Figure 10 looks at the present value of taxes paid by former full-career workers on their retirement incomes. It shows how these tax revenues vary with changes in the rate of return on defined-contribution pension schemes. As with the calculations of pension spending, the results cover workers at all different levels of earnings. The weighted average of these results, using earnings-distribution data, is computed. The lifetime value of tax payments is then normalised to average earnings in the economy.

**Figure 10.** **Average tax revenues per full-career worker over retirement period**

(multiple of annual economy-wide average earnings)

A. Countries with mandatory private pensions
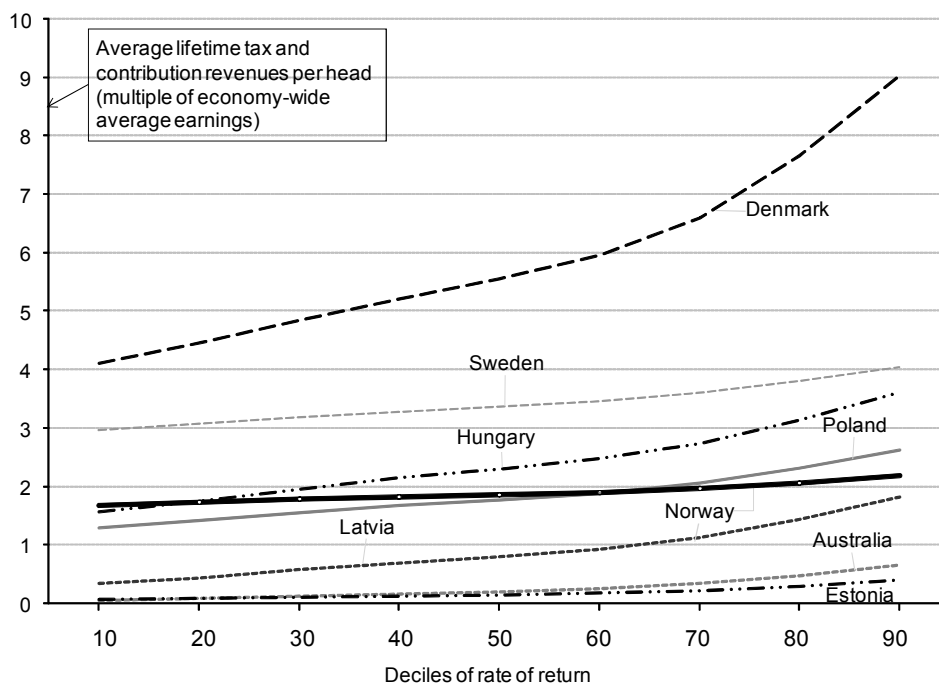


B. Countries with voluntary private pensions
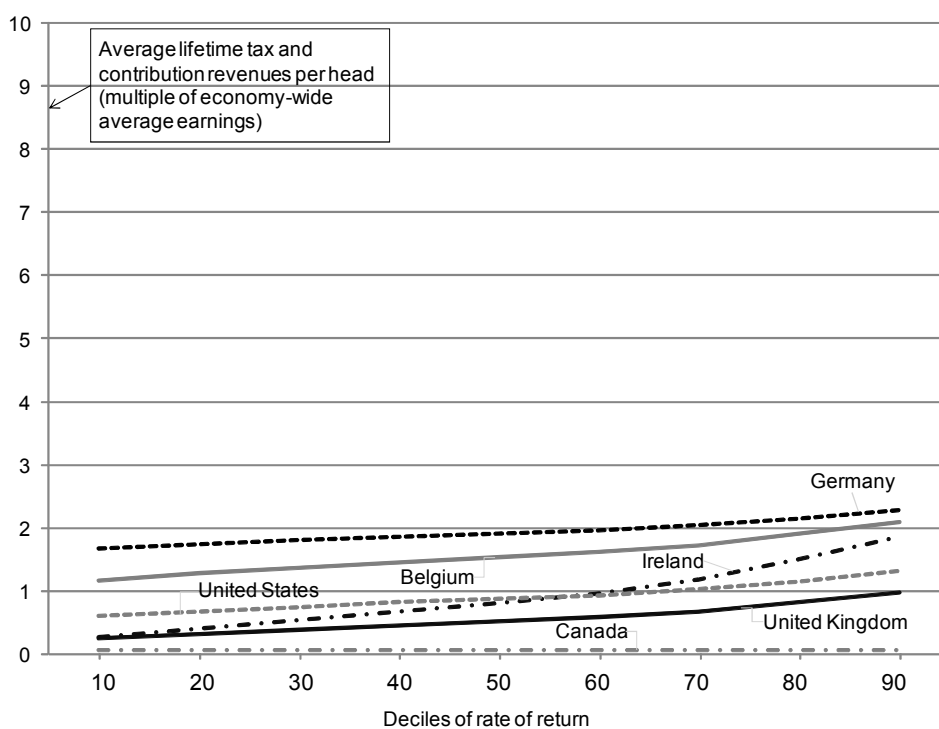


*Source*: OECD pension models.

79.      In three countries, the aggregate tax take from pensions is zero in all cases. In Lithuania and the Slovak Republic, this is because pensions in payment are exempt from tax. Pensions are theoretically subject to tax in Mexico, but the complex system of credits means that older people are not projected, under current fiscal rules, to be liable for tax on mandatory pensions.

80.      By far the largest effect of investment returns on pension tax revenues is in Denmark, reflecting both the large contribution rate and the high average tax rates during retirement, even on people who had low earnings when working. The impact is also fairly large in Hungary, Latvia and Poland. In Australia and Estonia, tax reliefs for older people mean that few workers can expect to pay taxes in retirement, and so the effect of investment returns on tax revenue is small.

81.      For the countries with voluntary private pensions, the impact of different investment returns on revenues is generally fairly small. Among this group, the effect is largest in Ireland: at low returns, revenues are expected to be relatively lower than in the United States, but higher with good investment performance. In practice, the aggregate effect will be smaller still relative to countries with mandatory private pensions because coverage of voluntary private pensions is generally less than 50% (see Antolín and Whitehouse, 2008).

## 5.3      *Investment risk and governments*

82.      Investment risk in private pensions affects the government's finances in two ways: through liabilities for paying resource-tested benefits and through the taxes paid on pensions during retirement. Having discussed the two mechanisms separately, here we draw these results together to show the overall effect on the public purse. The figures show tax revenues per head less public spending per head through the retirement period, again as a multiple of economy-wide annual average earnings. Here, the results are normalised such that net effect on the public purse is zero at the median rate of return. They therefore show the change in the overall position of the public finances as the rate of return varies.

83.      The presentation of these results is complicated by the fact that Denmark is an outlier. Panel A of Figure 11 therefore shows the data for Denmark (the black line) against the range of results for other countries (grey shaded area). With returns in the top decile, for example, the public finances improve in Denmark by 3.5 times average earnings per head over the lifetime of retirees. The highest figure recorded in other countries is just 1.5 times. Similarly, returns in the lowest decile increases spending on resource-tested benefits and reduces tax revenues per head by 2.2 times average earnings, again more than double the effect shown in any of the other countries studied. Indeed, the detailed modelling results show that tax revenues balance public pension spending at the median rate of return and with high investment returns, the government collects more in aggregate on taxes on pensions than it pays out in public benefits.

84.      Panels B-D of Figure 11 show the position in other countries, with a smaller vertical scale to allow the differences between them to be seen. Among those with mandatory private pensions, the impact is largest in Australia, Hungary and Latvia. It is a similarly large in Ireland, where private pensions are voluntary.

85.      In Australia, the effect is mainly due to changes in public expenditure on the means-tested pension with investment returns. In Hungary and Latvia, the results are driven wholly or mainly by taxes on pensions in payment.

86.      In contrast, investment returns have no effect on the public purse in Lithuania and the Slovak Republic, because means-tested benefits are not a significant part of the retirement-income package and pensions in payment are not taxed. The effect is also fairly small in Canada and Estonia.

87.     Many of the other countries are bunched together. In Belgium, Germany, Sweden, the United Kingdom and the United States, for example, the public finances are improved by a factor of 30-60% of annual economy-wide average earnings at high returns compared with the median. Similarly, they are worse by 25-35% of average earnings with the lowest decile of returns than at the median.

**Figure 11.     Overall effect on public finances of different rates of return**

(Lifetime tax revenues less public pension spending per head over retirement period,
multiple of annual economy-wide average earnings)
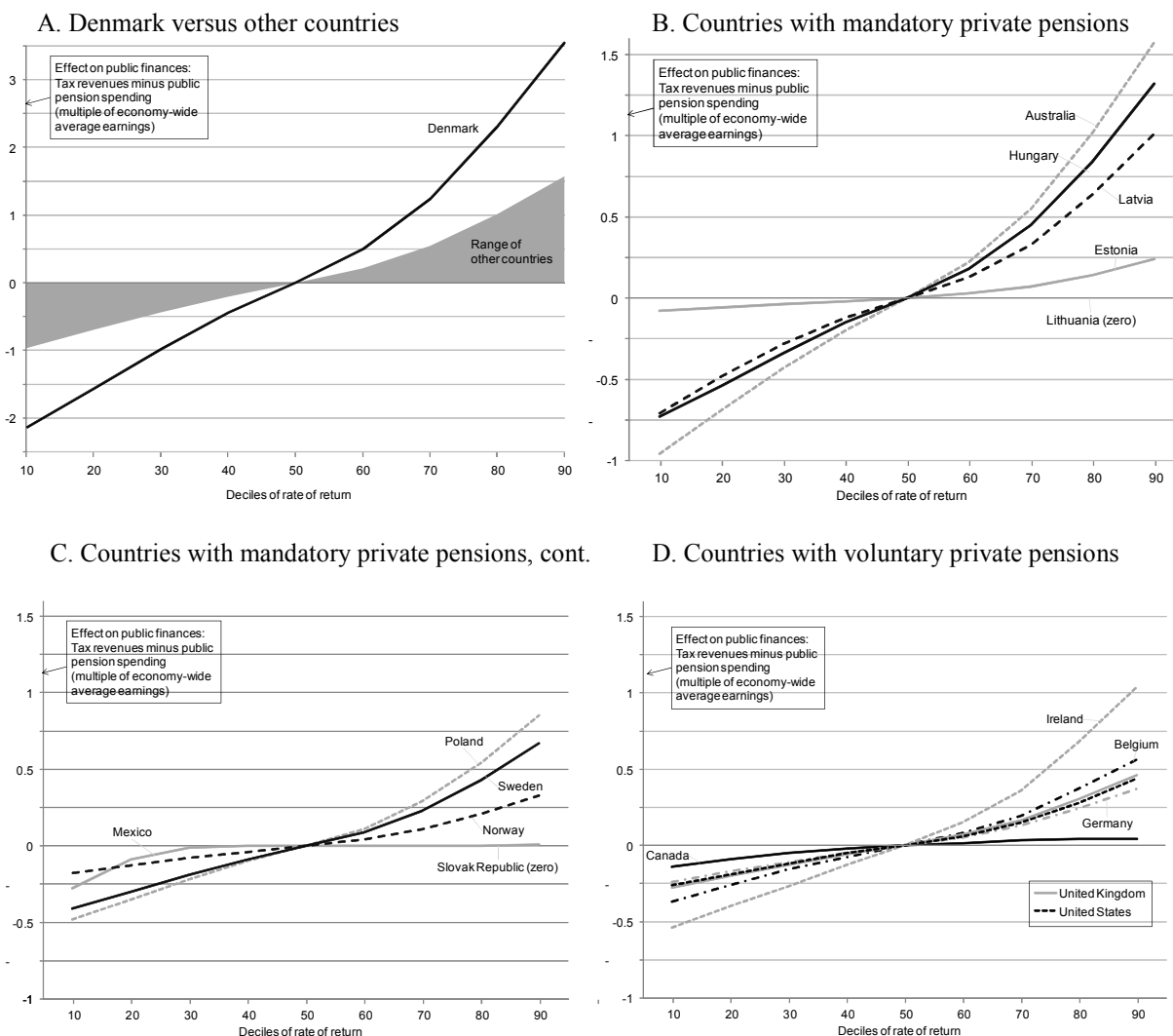


*Source*:     OECD pension models.

## 6.     Policy implications

88.     Defined-contribution pensions play a large and growing role in preparing for retirement. In these plans, contributions and investment returns build up in an individual account. The accumulated capital is then used to provide an income stream during retirement. This means that individuals' retirement incomes are directly exposed to risk and uncertainty in the return on investments, a link highlighted by the recent financial crisis. This has important implications for pension policy. This paper has studied the experience of 17 countries: 11 with mandatory defined-contribution pensions and 6 with widespread coverage of voluntary plans.

*6.1     The growing role of defined-contribution pensions*

89.     Four developments have driven the expansion of defined-contribution provision in the 36 countries that are members of the OECD, the European Union or both.

- First, Estonia, Hungary, Latvia, Lithuania, Mexico, Poland, the Slovak Republic and Sweden have recently introduced mandatory private pensions as a substitute for part of public, earnings-related pension provision. Outside the OECD – especially in Latin America and Eastern Europe and Central Asia – this policy has been still more common.

- Secondly, Australia and Norway have added a mandate for a private pension on top of existing public retirement-income provision.

- Thirdly, many countries have scaled back their public pensions, leaving a greater role for voluntary, private savings, much of which involves individual accounts.

- Finally, countries with a long history of employer pension provision have seen a shift in these private, occupational plans from defined-benefit to defined-contribution plans. These changes have been relatively rapid in the United Kingdom and the United States and rather slower in Canada and Ireland.[8]

90.     The likely reasons for these developments vary. In some, the shift to defined-contribution provision was mandatory, and so it is rooted in public policy. In the transition economies of Central and Eastern Europe, there was clearly a desire to break with the past in many areas. By privatising part of the pension system, countries such as Hungary, Poland and the Slovak Republic moved from monolithic, public to mixed, public-private provision of retirement incomes.

91.     In Australia, the mandatory defined-contribution plan had its roots in an industrial-relations agreement that exchanged wage restraint for employer pension contributions. Underlying this deal was a desire to extend pension coverage beyond the half of the labour force covered by voluntary plans.

92.     The shift from defined-benefit to defined-contribution occupational plans (in countries with widespread voluntary private pensions) is generally put down to changes in regulation, accounting standards and tax rules in combination with volatility in capital markets (see Antolín and Whitehouse, 2008, and OECD, 2009a, Part I.1).

93.     The central message of this experience is clear: many, if not most, governments are convinced that defined-contribution pension plans have to be a central part of the retirement-income package of their citizens in the future.

*6.2     The scale and scope of investment risk*

94.     With the financial crisis, short-term falls in the value of assets in which pension funds invest much of their portfolios – such as equities and bonds – have dominated headlines for throughout much of 2008 and 2009. However, pensions are a long-term investment and it is over this horizon that investment performance was analysed.

95.     The degree of investment risk was measured in the companion paper (D'Addio, Seisdedos and Whitehouse, 2009) using historical data on returns on equities and bonds in major OECD economies. The

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8       See OECD (2007), Part II.2 for a more detailed analysis.

results show a median real return of 7.3% a year on a portfolio equally weighted between equities and bonds (averaging across the countries studied).

96.     It might be expected that over a long period, the degree of uncertainty in investment returns would be small. After all, a few bad years in the market are likely to be offset by a boom. Nevertheless, the degree of uncertainty, even with the relatively long investment horizons of pensions, is found to be large. Assuming that the distribution of returns in the future is the same as that in the past, people who begin saving for retirement now should allow for a 10% chance that they earn an annual return of less than 5.5% on their pension savings. On a more positive note, in 10% of cases the return is expected to exceed 9.0%. Compounded over a period of 40 years or more, such differences in returns amount to enormous sums of money.

97.     However, there is a series of reasons why returns achieved by individuals on their pension funds are less than the market return (as measured by conventional indices).

- *Administrative charges* – during both during the accumulation stage, when assets build up in the fund, and on withdrawal as an annuity – reduce returns in practice by between 1.25% and 2% a year.

- *Tracking error,* which has a number of causes, is an inevitable part of the investment process. Again, this means actual returns are less than the market returns even for indexed funds.

- There are *agency* and *governance* effects that might also lead to shortfalls in investment returns. These have been (tentatively) estimated to cut annual returns by 1% or more.

- *Demographic ageing* might depress future investment returns, although the OECD does not subscribe to the view that there will be a "meltdown" in asset prices.

98.     This paper adopts a much more conservative assumption for future investment returns than the 7.3% recorded over the past quarter century, imposing the assumption of a median future return of 5.0% a year. The distribution of investment returns is assumed to match that recorded in the past. Rescaling the investment risk to this median implies that 80% of the time, the investment return on pension savings should be between 3.2% and 6.7% a year (see section 2 above).

99.     The compound-interest effect means that these differences in returns imply very large differences in retirement benefits. This was illustrated above using assuming 40 years of contributions of 10% of earnings a year. At the baseline assumption of 5.0% annual investment returns, the replacement rate – pension relative to earnings – would be 48.6%. But the lower bound for the replacement rate (in 10% of cases) is 32.2%. Returns at the higher end of expectations would deliver, again in 10% of cases, a replacement rate of 74.2% or more. This differential is huge: it encompasses a retirement that might be termed "comfortable" and one that might be described as "borderline poverty".

### 6.3     *Investment-risk exposure and the design of the retirement-income system*

100.     The shift in the retirement-income package to include defined-contribution plans has diversified sources of income, but has it reduced the "riskiness" of the total pension package? It is useful to think of the whole pension package as a kind of "portfolio". Some elements are linked to returns in capital markets, while others depend on public policies and macroeconomic variables, such as changes in average earnings.

101.     At one end of the spectrum, individuals in some countries have a portfolio dominated by public, earnings-related pensions that are designed to deliver similar replacement rates to workers on different

levels of earnings. The effect of such a scheme is to offer individuals an asset in which they can invest, whose returns are linked to something other than capital-market performance. This facet of pay-as-you-go public pensions is clearest in notional-accounts schemes. The interest rate applied to contributions – a parameter of the system – is GDP growth in Italy, the growth of the covered wage bill in Poland and average-earnings growth in Sweden.

102.     In defined-benefit public pension schemes, the procedure for revaluing individual earnings to reflect changes in prices and average earnings has an exactly analogous effect (see Queisser and Whitehouse, 2006). For example, this valorisation is average-earnings growth in 15 out of the 30 OECD countries. In thinking about investment risk, these schemes are essentially the same as a contribution to a savings plan in which returns are equal to the growth in economy-wide average earnings.

103.     Continuing the portfolio analogy, what are the benefits of diversifying retirement provision between a public, earnings-related scheme (with effective returns equal average-earnings growth) and a defined-contribution plan (with capital-market returns)? The answer depends on the correlation between investment returns and earnings growth, which is explored in Table 6. The investment return data are based on a balanced portfolio, divided 50:50 between equities and bonds. The Table shows that there is no significant relationship between earnings growth and investment returns, either for a portfolio of domestic assets or for one invested in all eight countries. A negative correlation would provide a strong case for diversification between pay-as-you-go and funded pensions. However, the absence of correlation means that it is still possible to diversify pension provision and improve the trade-off between risk and return.

**Table 6.   Correlation between real earnings growth and real return on balanced portfolio**

(Correlation coefficient and p-value in per cent)

| Investment portfolio | Canada | France | Germany | Italy | Japan | Sweden | United Kingdom | United States |
|---|---|---|---|---|---|---|---|---|
| Domestic | 21.2 | -9.7 | -8.6 | -22.0 | 8.3 | 12.4 | -28.2 | 3.5 |
|  | (34.4) | (66.9) | (76.1) | (38.1) | (69.2) | (58.2) | (15.3) | (86.1) |
| OECD-8 | 16.3 | -26.0 | -14.6 | 1.9 | -15.2 | 8.8 | -11.6 | 4.8 |
|  | (47.0) | (24.2) | (60.3) | (93.4) | (50.0) | (69.7) | (60.8) | (83.3) |

*Source*:     OECD Main Economic Indicators database and OECD analysis of Datastream information.

104.     As an alternative to providing an earnings-related public pension, diversifying the retirement-income package might also be achieved with first-tier, redistributive schemes, such as basic or minimum pensions. Basic pensions pay the same amount of money to all who are eligible. They are therefore worth more in replacement-rate terms to lower earners than pure earnings-related schemes. Minimum pensions are paid only to retirees with low incomes.

105.     There is, of course, a broader range of factors affecting the optimum design of the public component in a retirement-income system that incorporates a defined-contribution element. The first is the fiscal cost of the public scheme. By targeting benefits on low earners, basic pensions tend to be cheaper than earnings-related schemes. And resource-tested benefits or minimum pensions tend to be cheaper still. This can be demonstrated empirically. The ten OECD countries where first-tier, redistributive schemes dominate the retirement-income package spend an average of 5.4% of GDP on public pensions compared with 9.7% of GDP in the 10 countries where second-tier, earnings-related benefits are most important.[9]

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9     The data are from the OECD pension models: see the indicator on the "Structure of the pension package" in OECD (2007) and OECD (2009a). The figures for public pension spending are taken from the OECD

106.    Linked to the fiscal cost is the second criterion: who should be protected from investment risk and to what extent should they be protected? A pure earnings-related scheme (giving everyone the same replacement rate) offers the same *relative* degree of protection to all workers. In contrast, a basic pension offers the same *absolute* level of insurance to all workers.[10] There is clearly a question of the underlying objectives of the pension system here, which can only be answered through the political process. But there is also the issue of the optimum allocation of risk. The best outcome should be one in which the people who bear risk are those best able to do so. If low earners are less able to bear investment risk than higher earners, then a basic pension scheme would improve the allocation relative to an earnings-related plan.

107.    A third issue is that of "moral hazard". With minimum pensions, low earners will know that will receive the same overall retirement income regardless of the performance of the defined-contribution component. At the very least, therefore, they have no interest in how their money is invested. At the worst, they will opt for the most risky investments. (The moral-hazard issue is discussed further below.)

108.    In sum, there is empirical support for the idea that greater use of defined-contribution pensions can diversify retirement-income risks relative to a system based solely on public, earnings-related provision. However, it is clear is that there is no reason why all individuals should be equally exposed to investment risk. There is a case for richer individuals to face greater investment risk than lower earners.

### 6.4    *Investment-risk exposure in practice*

109.    Countries with defined-contribution pension plans differ substantially in the design of the overall retirement-income package. Most have some sort of earnings-related pension in addition: the exceptions are Australia, Denmark and Mexico. All have redistributive benefits in addition, but these differ hugely in scope and design. For example, some resource-tested schemes are affected by the value of defined-contribution pensions, other minimum pensions and basic schemes are not.

110.    The OECD pension models were used in this paper to calculate the overall retirement-income level with different rates of return. Figure 12 quantifies the investment risk faced by individuals as a proportion of the overall retirement-income package. The chart, which is based on calculations for people on average earnings, presents investment risk as an index. A measure of zero would indicate that pensions were entirely unaffected by capital-market performance, while a score of 100% would show that all of retirement income was susceptible to this source of uncertainty.

111.    Countries are ranked according to the degree of investment risk faced by average earner in gross terms, shown by the darker bar (where pensions of average earners are not taxed) and by the sum of the two bars in other cases. In Mexico, the whole pension is subject to investment risk because an average earner would only be entitled to a defined-contribution pension. Investment risk is also very significant in gross terms in Denmark, Latvia and the Slovak Republic. In Lithuania and the United Kingdom, around half of the pension is affected by investment returns. The lowest figures are for Belgium, Germany and Norway, where the rate of contribution to private pensions that has been modelled is very low.

112.    However, contribution rates for private pensions do not explain all the pattern of investment risks faced by average earners in different countries. For example, contributions are 9% or 10% of earnings are mandatory in Australia, Latvia and the Slovak Republic, and the typical contribution rate to voluntary

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social expenditure database: see OECD (2007), Table II.1.3 and the indicator on "Pension expenditure" in OECD (2009a).

10      Samwick (2007) discusses how a move to a more progressive benefit formula – at the limit, to a basic pension – might serve as insurance in a retirement-income system with mandatory defined-contribution plans.

plans in Ireland and the United States is around this level. Nevertheless, investment risk differs significantly. Of these countries it is lowest in Australia, because the value of the means-tested public pension will vary as different investment returns produce different levels of retirement incomes from the defined-contribution schemes. It is highest in Latvia, with a relatively low minimum pension and the Slovak Republic, which has no minimum pension.

**Figure 12. Investment risks faced by average earners**
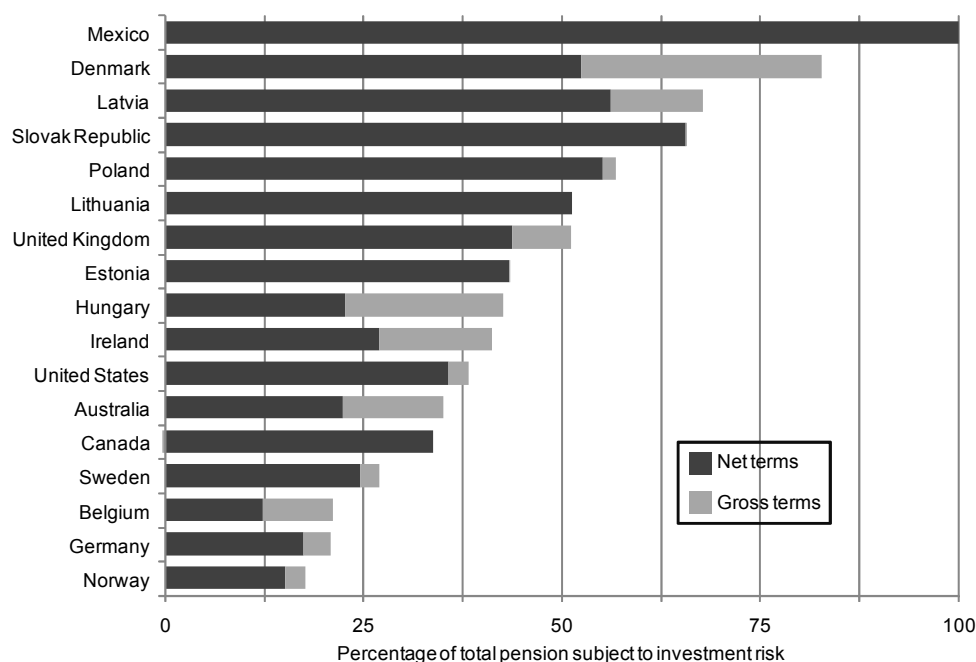


Note:    The value of pension entitlements in gross and net terms is calculated at the median real return of 5.0% and at a slightly higher return (5.1%). The change in the value of the gross and net pension is then compared with the change that would be expected had the whole of the pension come from a defined-contribution plan delivering the same replacement rate at a real return of 5.0%.

*Source*:    OECD pension models.

113.    The role of the tax system as a stabiliser of retirement incomes against investment risk is also shown in Figure 12. The dark bars show the degree of exposure of net (after tax) pensions to investment risk. The impact is much the largest in Denmark because of the high proportion of pension paid in taxes. Investment risk affects over 80% of gross retirement income but a little over 50% of net pensions of average earners. The net level is similar to Lithuania and below that in Latvia, Poland and the Slovak Republic. The impact of taxes paid in retirement in investment risk is also significant in Australia, Hungary, Ireland and Latvia.

114.    Figures 13 and 14 extend the analysis to look at the role of investment risk for people at different levels of earnings. The first set of charts looks at gross pensions, the second net retirement incomes. In most countries, there are differences in exposure to investment risk across the earnings range and many are significant. Mexico is an outlier: the lowest earners are heavily insured against investment risk by the minimum pension, while most earners derive all their retirement income from defined-contribution plans. In Canada, Ireland, Lithuania, Norway and the United Kingdom, basic pensions mean that investment-risk exposure increases with incomes. The same is true of the means-tested schemes which have broad coverage in Australia, Canada and Denmark. In the United Kingdom and the United States, the public,

earnings-related scheme has a progressive formula, meaning that a greater part of low-income worker's pensions come from these schemes that do not involve investment risk.

**Figure 13.     Investment risks by earnings level: gross terms**



Australia, Canada, Denmark, Ireland and Norway

Belgium, Lithuania, Mexico and United Kingdom

Estonia, Latvia, Poland and United States

Germany, Hungary, Slovak Republic and Sweden
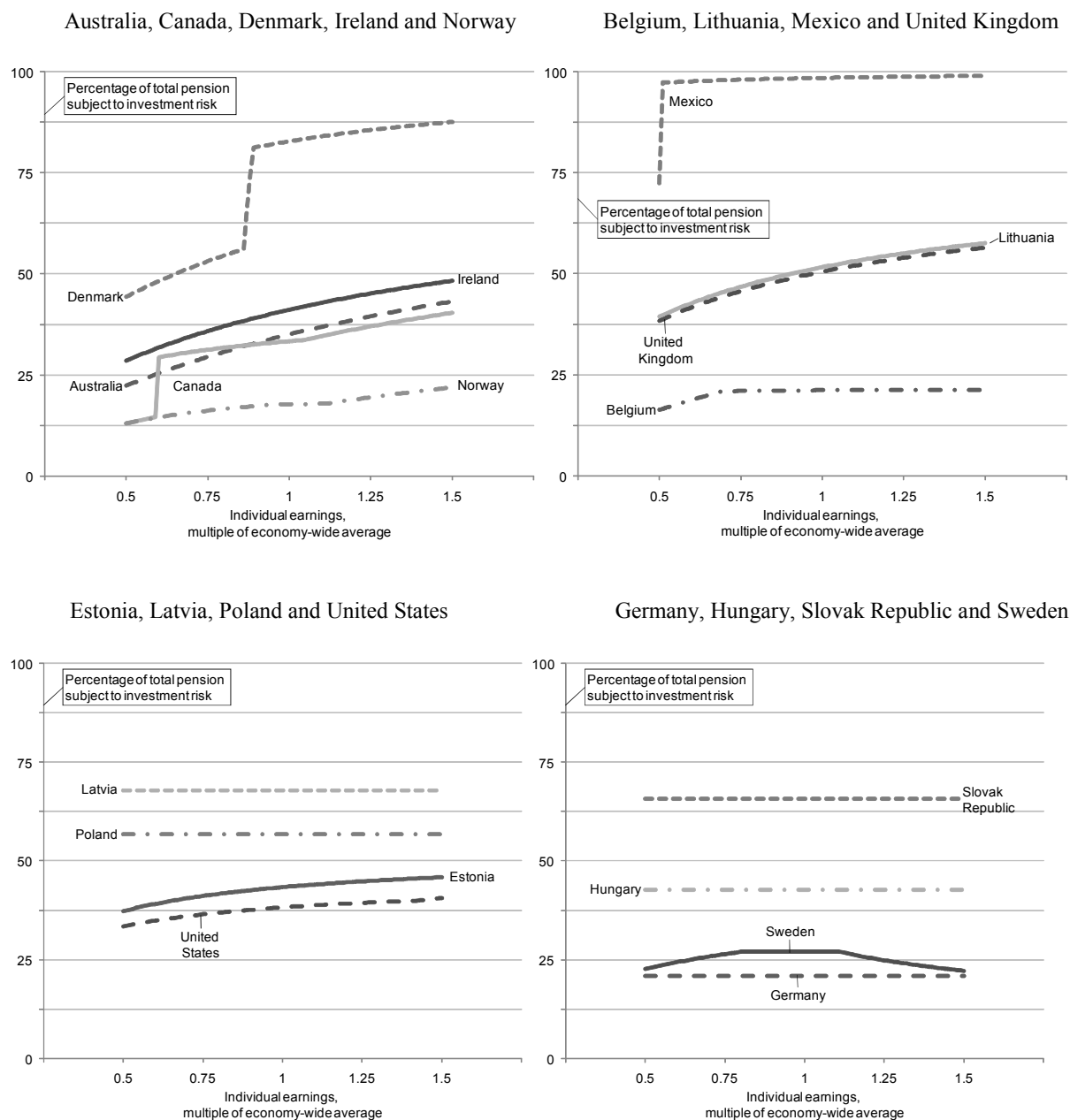
*Source*:     OECD pension models.

115.     In contrast, there is no variation in exposure to investment risk with earnings in Germany, Hungary, Latvia, Poland and the Slovak Republic. This is generally because safety-net benefits are set at a low level relative to the pensions from earnings-related and defined-contribution schemes, even for low earners. Sweden uniquely has higher investment risk on mid earners: low earners are protected by the

income-tested pension while higher earners have more of their pension package coming from the defined-benefit occupational plan.

116.    In addition to the overall design of the retirement-income package, public policy also affects exposure to investment risk through the tax system. If the tax system is progressive, then better investment performance will result in a higher average effective tax rate. The reverse is also true: the blow of poorer returns might be lessened by a lower tax burden.

117.    The effect of the tax system on exposure to investment risk is illustrated in Figure 14, which shows how the *net* pension changes with a marginal increase in investment returns. Countries, of course, differ enormously in their tax as well as their pension policies. The Scandinavian countries – Denmark, Norway and Sweden – have high tax burdens overall, including on pensioners. This offsets much of the effect of investment risk on *net* retirement incomes across the earnings range. In other countries, such as Australia, Canada, Ireland and the United Kingdom, tax reliefs and the lower overall retirement income (relative to the Scandinavian countries) means that only higher-income retirees are likely to pay tax on their benefits. This means that the insurance role of the tax system in offsetting the effect of investment risk is limited to these people.

**Figure 14.     Investment risks by earnings level: net terms**

Australia, Canada, Denmark, Ireland and Norway

Belgium, Lithuania, Mexico and United Kingdom

Estonia, Latvia, Poland and United States

Germany, Hungary, Slovak Republic and Sweden
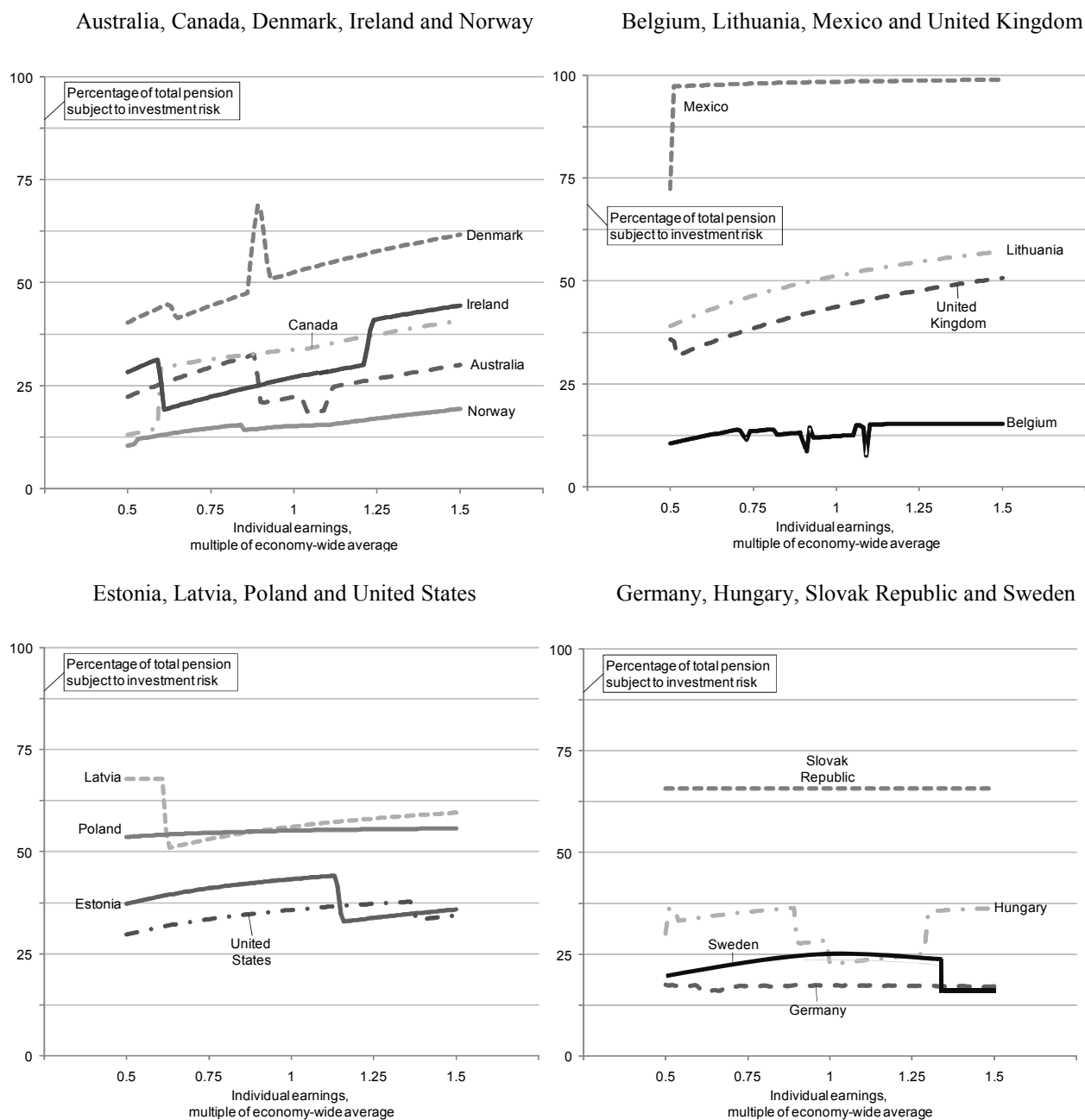
*Source*:     OECD pension models.

## 6.5     *Investment-risk exposure and regulatory policies*

118.     Differences in eventual incomes from defined-contribution pension schemes depend hugely on whether investors are lucky or not. It is hardly surprising that governments have looked to see if they can "tilt the playing field" to make low rates of return on pension saving less likely.

119.     Adequate regulation and supervision of pension funds and their investments is essential to ensure decent investment returns. At the very minimum, regulations must ensure the prudent diversification of

investments between different assets and avoid concentration of holdings. Some countries have gone further and put quantitative restrictions on pension-fund portfolios.[11] This approach may be justified in some countries, especially if the defined-contribution pension is an important part of the retirement-income package or national capital markets are not well developed. But it also has risks. The evidence from OECD countries shows that those with such quantitative restrictions have seen poorer investment performance than those with more liberal rules based around the "prudent-person" principle.

120.    Concern over capital-market volatility has led to numerous proposals for guarantees in systems with defined-contribution pension plans. There are two general types of guarantee. The first is a guarantee of a minimum retirement income. This works indirectly: the minimum pension is provided independently of the defined-contribution arrangement, generally by the government. These schemes were discussed in sections 6.3 and 6.4 above.

121.    The second type of guarantee works directly within the defined-contribution plan by promising that investment returns reach some minimum level.

122.    In Germany and Japan, for example, individuals are guaranteed that they, at least, get their contributions back: hence the name "principal guarantee". This is equivalent to promising a nominal interest rate of zero. Denmark and Switzerland have positive nominal interest-rate guarantees: 1.5% in Denmark and 2.25% in Switzerland (in 2004). In Iceland, the guarantee is a *real* interest rate of 3.5%.

123.    The major policy issue with guarantees of any sort is that of "moral hazard": when individuals are insured against a particular risk they take less care to avoid it. In the case of defined-contribution pensions, the problem is that individuals with a guarantee will opt for a riskier investment portfolio.[12] To avoid moral hazard, investment choices in systems with guarantees should be limited. In Denmark, Iceland and Switzerland, for example, the portfolio is typically fixed by the plan sponsor.

124.    However, such a restriction of choice imposes a cost on individuals. Because people differ in their circumstances, their preferences (especially over risk) and their portfolios, they naturally differ in their preferred investments of their pension assets. There are two policies that could preserve flexibility whilst avoiding the moral-hazard problem. The first would allow investment choice for people who opted out of the guarantee. The second would guarantee a return on a standard portfolio rather than the assets in which pension funds were actually invested (Lachance and Mitchell, 2003a,b).

125.    A second policy issue with guarantees is transparency, which is profoundly affected by the design of the guarantee. The central question is: who should pay for the guarantee? The cost of the guarantee could be borne by the pension-scheme members. For example, Feldstein and Liebman (2001) proposed to allow individuals to choose self-financed guarantees from a menu of investment options.[13] This approach means that the cost of guarantees is transparent to members and it avoids relatively risk-preferent individuals from subsidising the more risk averse.

126.    An alternative would be for the government (*i.e.*, future taxpayers) to finance the guarantee. The risk here is that the government does not accurately cost the guarantee and take this contingent liability into account in fiscal planning. Moreover, Lachance and Mitchell (2003b) point out that the guarantee would be most likely to be triggered precisely when economic conditions are "bleak", for example, when economy

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11    See OECD (2009b) for evidence on current regulations and the discussion in D'Addio, Seisdedos and Whitehouse (2009) on the policy issues.

12    See Bodie and Merton (1993) and Smetters (2002).

13    See also Feldstein and Ranguelova (2001a,b) and Smetters (2002).

and capital markets were both in a state of collapse. Taxpayers might then be unwilling to shoulder the burden of the guarantee.

127.     The current financial and economic crisis is a case in point. Pension funds lost 23% of their value in OECD countries in 2008. But the OECD predicts that the economies of its member countries will shrink by nearly 4.5% in 2009 and growth will not resume until 2011. Budget deficits are projected to increase from 1.4% of GDP in 2007 (before the crisis hit) to 8.7% of GDP in 2010.

### 6.6     *Public policies and ensuring an efficient retirement-savings market*

128.     The most obvious and easiest to measure impact of market (in)efficiency on defined-contribution pensions is through administrative charges. The minimum government policy should be a requirement for funds to disclose charges in a standard format. This will help consumers make informed comparisons between different funds. Regulators can make the task easier by producing "league tables" of charges. It is also important that consumers are aware of the effect of charges on their investments. For example, over the life of a pension policy, a charge of 1% of assets per year adds up to a reduction of 20% in retirement benefits. Few investors appear to be aware of the major impact that fees can have on eventual retirement incomes.

129.     A further step is to ensure that all providers stick to a common charge structure. This makes it easier to compare fees between them. Unregulated charging regimes can be very complex and confusing. A regulated fee structure, in contrast, can mean there is a single "price" that consumers can compare across providers. And a single proportional charge, on assets or contributions, means that the relative cost of choosing a different provider does not vary with earnings or contributions.

130.     A few countries have gone still further and put a cap on the amount that pension managers are allowed to charge. The risk with this approach is that governments set the "wrong" ceiling. Too high a limit would be ineffectual. Too low a ceiling might mean that fund managers could not cover their costs, thereby restricting competition and choice. It could even lead to the failure of weaker providers, undermining public confidence in the system. Ceilings all too often become a *de facto* minimum charge as well as the legal maximum. Price competition, beyond meeting the regulatory requirement, might be curtailed.

131.     A second set of policies related address the costs of administering pensions directly. A number of countries have attempted to curtail excessive marketing costs and reduce the "churn" of members between different providers. This strategy has reduced average charges in a range of countries where defined-contribution pensions are managed by competing private-sector providers.

132.     More recent pension reforms and proposals have instead opted for a different institutional structure for pension provision, involving a single, centralised body. This was the approach adopted by the government of the United Kingdom in its response to the Turner Commission's (2005) report on pension reform. Sweden also operates a clearing-house for collecting contributions, record-keeping and transferring money to private providers to reduce costs.

133.     Public policies have a profound impact on the governance and management of pension assets and so on the returns that pension funds earn. There is some evidence of "agency problems", arising from the misalignment of individuals' objectives for their retirement savings and the incentives and actions of those who manage them (see D'Addio, Seisdedos and Whitehouse, 2009). Improving pension-fund governance is one way to improve the returns pension funds actually deliver. It is important also that individuals have some investment choice, but also the ability to make informed decisions.

**7.  Conclusions**

134.    The financial crisis has profoundly affected pension funds, with an average 23% loss on investments in 2008. This has highlighted the importance of investment risk in a range of countries where defined-contribution pensions are widespread. The problems of the crisis are set out and policy responses evaluated in OECD (2009a), Part I.1. The focus of this paper is on the long term, the time horizon which is central to pension policy-making. The main analysis has looked at defined-contribution plans, where retirement incomes are directly affected by investment returns.

135.    The case for a role for defined-contribution plans in providing part of retirement incomes is straightforward. Indeed, it is neatly summarised by the counsel to avoid having all one's eggs in one basket, given that there are risks in all types of pension systems:

- Schemes that are based on individual earnings leave individuals open to the risk that their earnings are not as high as they hoped;

- Schemes based on public transfers impose the risk that governments (or rather voters) change their minds about what is a reasonable retirement income and pay lower pension benefits than expected;

- Occupational plans, under which employers promise to pay retirement benefits to ex-employees, run the risk that pension funds might be unable to meet their obligations; and

- Defined-contribution pension plans are subject to investment risk.

136.    In the face of risk, it is easy to show that the best approach for an individual – and, by extension, for a government seeking to do the best thing for its citizens – is to use a mixture of sources of retirement incomes. This is why the OECD has long advocated a *diversified approach* to retirement-income provision, arguing that "diversity has many virtues" (OECD, 1998, p. 55). This report, on *Maintaining Prosperity in an Ageing Society*, went on to say that "each of the elements of the system has its own strengthens and weaknesses and a flexible balance among them not only diversifies risk but also offers a better balance of burden-sharing between generations". More recently, the OECD (2009a) has echoed the slogan of the Polish pension reform and argued for "security through diversity" in pension policy.[14] Similarly, the World Bank (1994) has put the case for a pension system based on multiple "pillars", which have different providers, financing mechanisms and benefit formulae (see also Holzmann and Hinz, 2005), as has the European Commission.

137.    Nevertheless, there are caveats to the conclusion that diversification is always a good thing. The case for relying more on private investments to supplement earnings-related pension systems relies on the absence of a positive correlation between investment returns and earnings growth. It might also be mitigated if the cost of administering multiple retirement-income programmes is high. Finally, defined-contribution pensions may put too much risk on individuals who are not able to cope with that risk.

138.    Increased exposure of individuals' retirement incomes to investment risk is a fact of life in the 17 countries studied in this paper, countries that make up very nearly half of the membership of the OECD and the European Union. The issue for individuals, pension providers and governments is how best to manage investment risk. The advice of Cervantes cited at the opening of the paper – "Don't put all your eggs in one basket" – is now such a commonplace that its origin is often forgotten. But these words are as much, if not more, valid today.

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14    See Chlon, Góra and Rutkowski (1999).

**ANNEX:**

**INVESTMENT RISK WITH DIFFERENT TYPES OF PENSION PLAN**

139.     In defined-contribution pension plans, contributions are paid into an individual account and invested in financial assets. At retirement, the accumulation of contributions and investment returns is typically converted into a stream of pension payments: an "annuity". This means that the value of the pension is uncertain as investment returns directly affect benefits: the individual bears the investment risk.

140.     The link between investment risk and individuals' retirement incomes is more complex with other kinds of pre-funding of pensions.

**A.1     Public pension reserves**

141.     Most public pension schemes are financed on a pay-as-you-go basis, where today's contributions pay for today's benefits. Nine OECD countries have public pension reserves that were worth around 5% or more of national income in 2007: Australia, Canada, Ireland, Japan, Korea, New Zealand, Norway, Sweden and the United States.[15] However, the fund in the United States is invested entirely in government bonds. This is arguably a circular way of financing pensions on a pay-as-you-go basis – whereby current contributions pay for current benefits – because the contributions going into the reserve are merely lent to the government to finance current spending on other programmes. Similarly, government bonds make up over 80% of the portfolio of Korea's reserve and over 60% of Japan's. In contrast, the government bond share is 35-40% in Norway and Sweden and less than 20% in New Zealand and Ireland.

142.     In theory, individuals do not bear the investment risk related to these reserves: benefits are defined and so should not be affected by the returns earned on the assets. In the first instance, the government bears the investment risk, but this, of course, must then be passed on to taxpayers and contributors. Nonetheless, there is at least the potential that individual retirees might be affected by investment risk. Better-than-expected performance of the fund could lead to political pressure for higher benefits. Similarly, worse-than-expected performance might prompt taxpayers and contributors to press for lower benefits (rather than having to pay higher taxes and contributions).

143.     These scenarios are firmly within the realms of politics: while economics provides a guide to the size of investment risk, it cannot predict who bears the risk. It is important, however, to note that many public pension reserves are invested wholly in government bonds and in many more, bonds dominate their portfolios. This should involve a smaller degree of investment risk than with private pension plans (at the price, of course, of a lower expected return).

144.     A further risk with public pension reserves has been illustrated during the financial and economic crisis. Ireland and Norway will tap the funds to pay for bank recapitalisation and economic stimulus through public works.[16]

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15     See OECD (2009b), Chapter 3 and the indicator of "Assets in private pension funds and public reserves" in OECD (2009a).  Iglesias and Palacios (2000) and Palacios (2002) discuss related policy issues.

16     See OECD (2009a), Part I.1.

## A.2    Private, defined-benefit plans

145.    Defined-benefit, private pension plans are also subject to investment risk. In theory, the benefits in these schemes are protected or defined and so the individual retiree does not bear any investment risk. The employer, as sponsor of the scheme, is responsible for covering any shortfall in the investments backing the pension promise. The key variable affected by investment returns with defined-contribution plans is the accumulated capital at retirement (and hence the value of the pension). With defined-benefit schemes, the value that varies is the contribution rate to the plan.

146.    The effect is illustrated in Table A.1 using the simulated investment returns derived in D'Addio, Seisdedos and Whitehouse (2009) and summarised in section 2 above. The upper panel uses the distribution of historical gross returns, the lower panel the lower panel the results rescaled to reflect administrative charges, the effects of ageing etc. The analysis is carried out in a way to ensure comparability with those for defined-contribution plans. Thus, Table A.1 takes the same baseline at the median return.

147.    With historical results, a 10% contribution rate would be sufficient to finance a defined benefit worth 86.9% of individual earnings. Under the rescaled assumption for investment returns of 5.0% at the median, the replacement rate that can be financed with median investment returns is 48.6%. In this scenario for future investment returns, the contribution rate necessary to finance benefits would be 15.1% rather than 10% with very low investment returns. It would fall to 6.5% if investments performed very well.

**Table A.1. Distribution of rates of return and required contribution rates**

| Percentile of distribution | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
|---|---|---|---|---|---|---|---|---|---|
| **Simulations based on historical data** | | | | | | | | | |
| Rate of return | 5.5 | 6.1 | 6.6 | 7.0 | 7.3 | 7.7 | 8.0 | 8.5 | 9.0 |
| Replacement rate | 86.9 | 86.9 | 86.9 | 86.9 | 86.9 | 86.9 | 86.9 | 86.9 | 86.9 |
| Contribution rate | 15.8 | 13.6 | 12.0 | 10.8 | 10.0 | 9.0 | 8.3 | 7.2 | 6.3 |
| | | | | | | | | | |
| **Simulations based on rescaled data** | | | | | | | | | |
| Rate of return | 1.7 | 2.3 | 2.8 | 3.2 | 3.5 | 3.8 | 4.2 | 4.7 | 5.2 |
| Replacement rate | 48.6 | 48.6 | 48.6 | 48.6 | 48.6 | 48.6 | 48.6 | 48.6 | 48.6 |
| Contribution rate | 15.1 | 13.2 | 11.8 | 10.7 | 10.0 | 9.1 | 8.4 | 7.4 | 6.5 |

Note:    based on unisex mortality rates of the OECD average projected for 2040. Assumes a contribution of 10% of earnings over a 40-year term in the median case and calculates the contribution required to match that replacement rate with different out-turns for investment returns.

*Source:*    OECD pension models.

148.    In theory, with benefits defined, the extra contributions needed if a plan faces a shortfall are made by sponsoring employers. Indeed, it has been shown that the health of the finances of defined-benefit plans in the United States is reflected in the stock-market value of the sponsoring firm's shares. This occurs despite the legal separation between pension funds and firms (see Jin, Merton and Bodie, 2006). In contrast, other analysts have pointed out that the ability to default on defined-benefit pensions should be taken into account in the valuation of firms, a concept that Treynor (1977) called the "pension put".

149.    In practice, employers often pass investment risk onto other actors in the pension plan using various mechanisms. For example, changes in the rules of occupational pension plans, which affect

workers' future retirement benefits, are common.[17] However, the ultimate transfer of investment risk from sponsor to members is the closure of the defined-benefit scheme and, usually, its replacement by some form of defined-contribution provision.[18]

150.     The new regulatory regime in the Netherlands formalises the way in which investment risks can be transferred from the pension fund to its members, both active workers and retirees. The new rules, introduced in 2007, aim to ensure that schemes have sufficient funds to secure guaranteed payments. These guaranteed pensions are, in practice, *nominal* benefits (Bikker and Vlaar, 2006). There has never been a legal requirement for Dutch occupational schemes – 99% of which are of the defined-benefit type – to index pensions in payment. Pension funds are simply obliged to state what their intended policy is.

151.     The indexation policy and practice of Dutch pension funds has broader effect: not just on the purchasing power of pensions in payment. To reduce the cost of providing pensions as equity prices and bond yields declined in the early 2000s, many plans moved from basing benefits on final salary to the average salary over the career. The indexation rules that apply to pensions in payment must also be used to adjust earlier years' earnings in the benefit calculation to reflect changes in costs and standards of living between the time that pension rights were earned and when individuals retire. (This process is commonly called valorisation or revaluation: see OECD, 2009a, part III for a discussion.) Thus, the value of pensions of both workers and retirees are affected by indexation practices.

152.     In the wake of the financial crisis, a series of large plans have announced increases for 2009 less than their stated indexation policy (which is earnings growth for most plans). The Central Planning Bureau has estimated that then loss for workers in their 50s (from indexation cuts and contribution increases) will be around 10% of pension benefits, with smaller losses for younger workers. This reduction comes on top of indexation in the period 2003-06 that fell 3% behind wage growth and 2% behind price inflation as pension funds recovered from the 2000-02 stock-market crash (Dutch Central Bank, 2007). Thus, workers bear a great deal of investment risk in the defined-benefit schemes in the Netherlands: through contribution rates, pre-retirement valorisation and post-retirement indexation of benefits.

153.     The profound impact of these policies is illustrated in Table A.2. With valorisation to growth in earnings, the replacement rate at the time of retirement would be 70%. However, a career with no valorisation would produce a 34% lower pension, giving a replacement rate of 46.2%. With no valorisation at all, the replacement rate would be just 18.2%.

154.     Pension wealth depends both on the replacement rate at the time of retirement and how pensions are indexed during retirement. With earnings valorisation and indexation, lifetime pension benefits would be worth nearly 14 times individual annual earnings at the time of retirement. Price indexation alone would reduce pension wealth by nearly 20%, but price indexation *and* valorisation results in pension wealth almost by one half, to 7.5 times earnings. The unlikely case of no valorisation or indexation would reduce pension wealth to 17% of its value where both procedures are linked to earnings growth.

155.     These calculations demonstrate that valorisation and indexation account for the great bulk of the value of the pension.

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17     See Mitchell and Dykes (2000) on the United States, for example. The annual surveys of the National Association of Pension Funds in the United Kingdom also report frequent changes in rules in defined-benefit occupational plans.

18     See OECD (2007), Part II.2 and Antolín and Whitehouse (2008).

**Table A.2. Replacement rates and pension wealth**
**by valorisation and indexation procedures in the Netherlands**

| Valorisation and indexation | Replacement rate (% of individual earnings) | Pension wealth (multiple of individual earnings) |
|---|---|---|
| Earnings | 70.0 | 13.9 |
| Prices | 46.2 | 7.5 |
| None | 18.2 | 2.3 |

Note: The modelling uses the standard OECD assumptions of 2% annual growth in real earnings and 2.5% price inflation.

*Source:* OECD pension models.

## A.3 Public-sector guarantees of private pension benefits

156. The uncertain allocation of investment risk between sponsoring employers and individual workers is not the end of the story with defined-benefit occupational plans. Governments are also often involved. Insurance programmes that back-up companies' defined-benefit pension promises – such as the Pension Protection Fund (PPF) in the United Kingdom and the Pension Benefit Guaranty Corporation (PBGC) in the United States – are built on the idea of risk-pooling between occupational pension schemes. The latter pay a levy to the insurance provider, which then uses the accumulated assets to finance shortfalls in cases where plans cannot meet their pension liabilities. [19]

157. However, these schemes can also call on taxpayers. The PBGC, established in the 1970s, faces huge liabilities concentrated in small range of industries, such as airlines, steel and car manufacture. Although its funds, financed by a levy on occupational plans, are currently sufficient to meet liabilities, it may well be that some form of government subsidy will be needed in the future. The PPF was set up more recently, but the scale of the potential government liability with respect to occupational pension plans was recently extended by a legal judgement. A government information leaflet stated that occupational pensions "should be safe", which was interpreted as a public liability for compensation in the case of failure of such schemes.

## A.4 Investment risk in different pension schemes

158. There is an obvious parallel between defined-benefit occupational plans and the role of reserve funds for public pensions. In theory, the investment risk is borne by the sponsor in both cases. But, in practice, this risk may be passed on to individual retirees. In the case of employer-sponsored defined-benefit schemes, the distribution of investment risk is not governed by the political process but by the logic of industrial relations: negotiations between employers and representatives of employees and pensioners.

159. Investment risk in funded, defined-benefit schemes is difficult to allocate between the main actors: contributing workers, retirees, the sponsoring employer and insurance programmes. Moreover, the degree of investment risk taken on is at the discretion of the sponsor, subject to regulations, such as minimum funding requirements, tax rules etc.

160. The issue of investment risk in defined-benefit schemes is primarily a regulatory issue. With public pension reserves, the impact of investment risk will depend on politics.

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19 Stewart (2007) provides a survey of guarantee schemes in Canada, Germany, Japan, Sweden, Switzerland, the United Kingdom and the United States. See also McCarthy and Neuberger (2005), Nugée and Persaud (2006) and Sweeting (2006) on the United Kingdom; and Bodie (1996) and Bulow (1982) on the United States.

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