

## Chapter 6

# Fragmentation of retirement markets due to differences in life expectancy

*This chapter provides evidence of the differences in life expectancy around retirement age across different socio-economic groups in selected OECD countries based on measures of education, income and occupation. Evidence shows that higher socio-economic groups live longer than those in lower socio-economic groups and these differences may be increasing over time. Fragmentation of mortality rates has implications for pensions, annuity markets and public policy. It makes it more challenging for pension funds and insurance companies to manage longevity risk. However, it also presents an opportunity to better tailor retirement solutions to the needs of different segments of society. Policy makers need to be aware of these differences to ensure that rules governing access to pensions and retirement savings do not put those in lower socio-economic groups at a disadvantage.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## Main findings

- There are significant differences in life expectancy across socio-economic groups, as measured by education, income and occupation, and there are also differences in the gradient of improvements over time in mortality and life expectancy across socio-economic groups.
- Differences in life expectancy present a challenge for pension funds and annuity providers in managing longevity risk; both in terms of establishing appropriate mortality assumptions and of effectively mitigating exposure to the risk.
- These differences also present an opportunity for pensions and insurers to expand their markets and diversify their longevity risk exposure by adapting product offerings to different segments of society.
- Policy makers should help to facilitate the measurement and management of the longevity risk exposure of pension funds and annuity providers by making accurate and timely mortality data available by socio-economic group.
- Policy makers should encourage and facilitate product innovation to meet the various needs of different market segments, though they should also ensure that the risks arising from these products are managed appropriately.
- Policy makers should be aware of these differences in mortality rates to ensure that the rules governing overall access to funds earmarked for retirement do not put lower socio-economic groups at a disadvantage, as policies defined “on average” may be regressive.

## Introduction

The growing fragmentation in mortality rates across socio-economic groups has exacerbated the problem of increases in life expectancy. These increases have been putting pressure on pension systems to provide adequate and sustainable incomes in retirement as people are not necessarily working longer but are spending more years in retirement. As long as life expectancy differs significantly across the various socio-economic groups of the population, the challenge of ensuring sufficient income in retirement cannot be only assessed “on average”.

This chapter provides evidence on the differences in life expectancy around retirement age across different socio-economic groups in selected OECD countries. The chapter also assesses the implications of this fragmentation for pensions and annuity markets and for public policy. Not only are there differences in current levels of mortality and life expectancy, but growing evidence shows that there are also differences in the gradient of improvements in mortality and life expectancy over time across socio-economic groups. In many countries, those in higher socio-economic groups have benefited from larger improvements in mortality and life expectancy over the last few decades than those in the lower socio-economic groups.

As a result of these differences, two individuals of different socio-economic groups retiring at the same age can expect very different lengths of retirement. Policies encouraging people to work longer following the average increases in life expectancy may therefore disproportionately penalise individuals in lower socio-economic groups who would be working longer but not necessarily living longer. Additionally, pension pay-out rules may have unintended consequences for total pension payments that individuals in lower socio-economic groups can expect to receive.

These differences also present challenges for pension funds and insurance companies in measuring and managing longevity risk. The actual longevity improvements experienced by pensioners and insured populations will be heavily dependent on the demographic mix of these populations. Unpredictable changes in demographics lead to higher uncertainty about the future life expectancy of these populations. Furthermore, anti-selection in annuity markets implies a higher cost of mitigating the longevity risk of annuity beneficiaries. While lower cost index-based hedges could present a solution to this problem (OECD, 2014) the uncertainty around the efficacy of these instruments due to the differences in mortality trends across socio-economic groups presents a barrier for their widespread use.

Nevertheless, these differences also present opportunities to better serve society's financial needs for retirement through increased market segmentation. Different segments of the population have different needs with respect to financing their retirement. Product innovation should better adapt to meet these diverse needs. Enhanced annuities, for example, have emerged as a solution to provide higher annuity incomes to more disadvantaged groups with lower life expectancies. Other types of products could be structured to provide unique solutions for different segments of society.

The chapter is structured as follows. The first section presents evidence of differences in mortality rates and improvements in life expectancy according to three socio-economic indicators: education, income and occupation. These differences are quite significant across all countries assessed here. The second section discusses implications of these differences for pensions and insurance. It highlights the types of challenges that pension systems and annuity providers may encounter in managing the longevity risk as a result of these differences. It also highlights that this heterogeneity presents an opportunity to innovate and provide services to better meet the varied needs of the populations according to the diverse longevity risk they face. The third section discusses issues that policy makers may need to consider. The final section concludes.

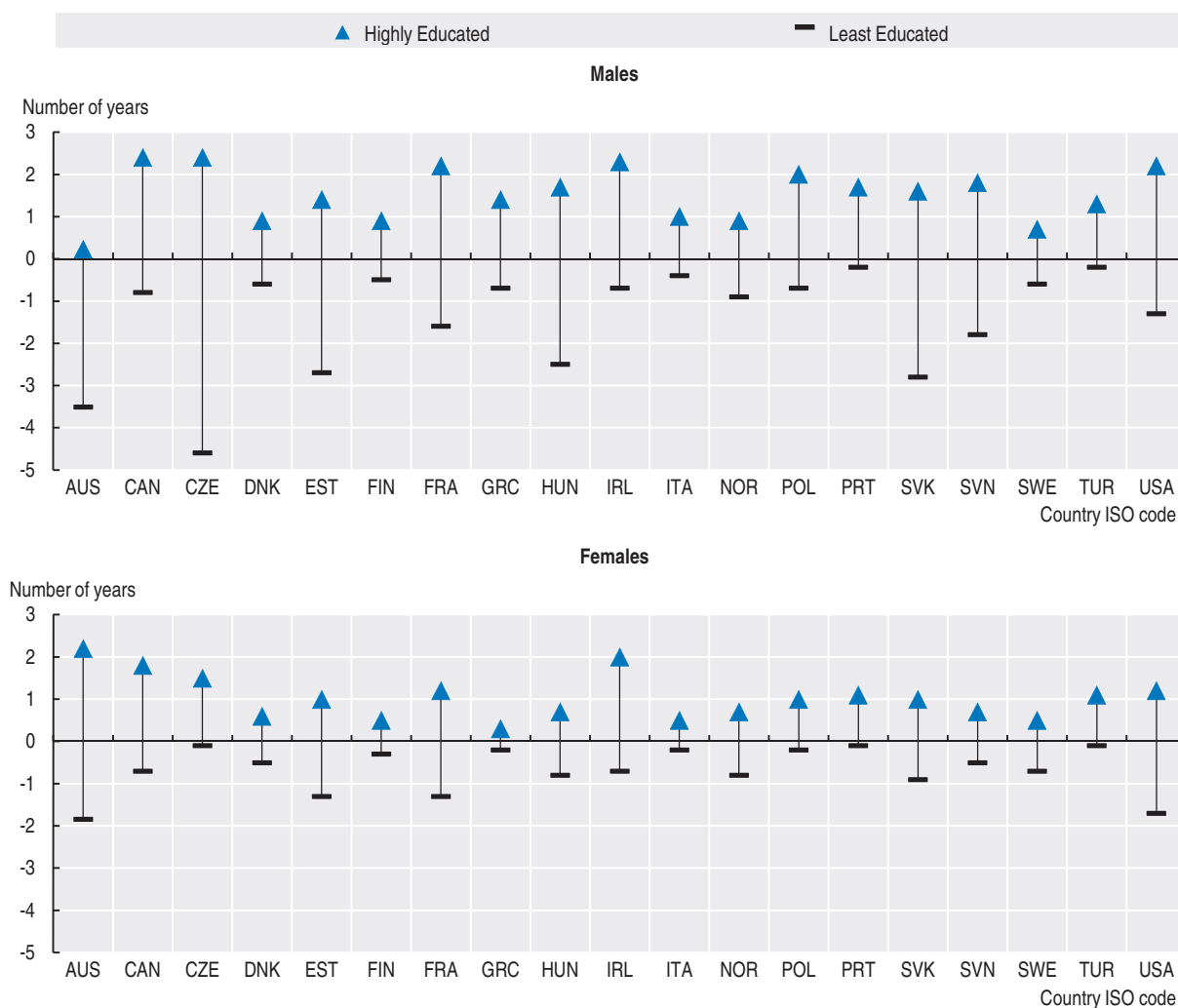
### Life expectancy according to socio-economic indicators

Countries vary with respect to the socio-economic indicators used to report mortality data. The three main types of socio-economic variables used are: education, income and occupation measures.<sup>1</sup> Life expectancies based on each of these measures are presented for selected countries. Evidence by education is presented for Australia, Canada, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Norway, Poland, Portugal, Slovak Republic, Slovenia, Sweden, Turkey and the United States. Evidence by income is presented for Australia, Canada, Chile and New Zealand. Finally, evidence by occupation is presented for England and Wales, France and Ireland. Nevertheless, as definitions of the referenced categories can vary from one country to the next, comparison of the magnitude of differences across countries remains limited.<sup>2</sup>

## Education

Education is the most common socio-economic indicator used to assess differences in mortality across population segments. As a measure of socio-economic status, education has the advantage that it is generally established early in life and therefore should not be affected by health outcomes later in life which correlate with mortality. It also can be clearly measured at an individual level. However, given the general increase in the average level of education of the population over time, assessing a trend in mortality based on absolute levels of education could be misleading, as those not completing high school, for example, would be relatively more disadvantaged today compared to a generation ago. It may therefore be preferable to establish socio-economic categories by relative levels of education for any given period in time if comparing the change in the life expectancy by educational attainment over time.

Figure 6.1. **Difference in life expectancy at age 65, by level of education, relative to the population average**



Note: Australia figures shown for age 60. Reference years and categories differ across countries and are for the latest year available, see Annex 6.A1.

Source: OECD calculations based on sources given in Annex 6.A1.

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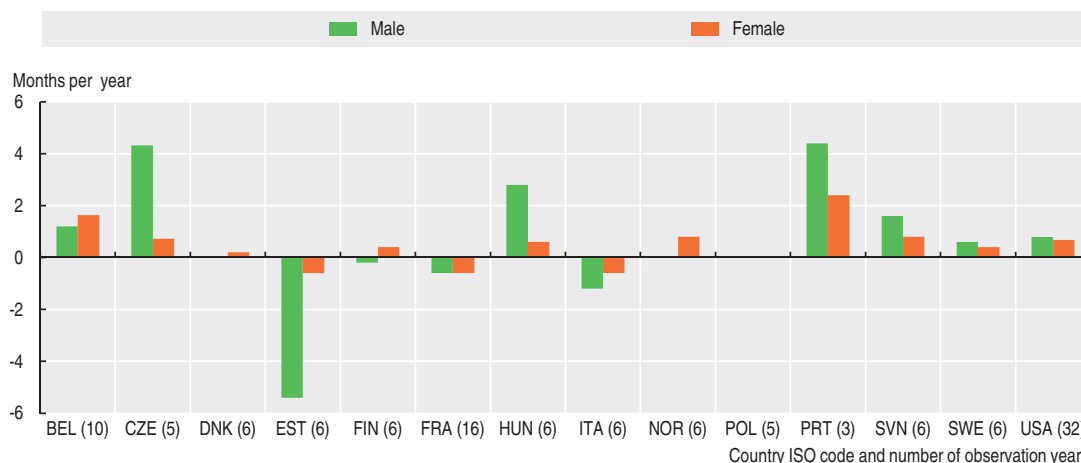
There are significant differences in life expectancy by educational attainment. Figure 6.1 shows the difference in life expectancy at age 65 between the lowest and highest categories of educational attainment for males and females compared to the population average for the OECD countries for the last year of available data.<sup>3</sup> While definitions of the highest and lowest categories of educational attainment vary by country, the most common measure is based on the International Standard Classification of Education (ISCED). For this classification, the lowest category includes education through the lower secondary level and the highest category includes tertiary education. However as a result of different category definitions, reference years and average educational attainment in each country, cross-country comparisons will not necessarily be representative of the true differences across countries. Nevertheless the differences between the highest and lowest categories indicate the magnitude of differences in life expectancy in each country across the population segments observed.<sup>4</sup>

Differences for males are generally significantly higher than for females. The only exception is Australia, where females with more than 12 years of education can expect to live four years longer than those with less than 12 years, only 0.3 more years than the difference for males. Czech males have a significant gap in life expectancy between the most and least educated. Males with a tertiary education have a life expectancy at age 65 of seven years longer than those with only lower secondary education.<sup>5</sup>

Differences in life expectancy for the least educated groups, compared to the total population, provide an indication of how disadvantaged the lowest socio-economic groups are compared to the average. For males, the largest disadvantage is observed in the Czech Republic, though Australia, Estonia, Hungary and the Slovak Republic also present rather large differences from the population average, with the lowest educated males having over two years lower life expectancy than the total population. For females, Australia and the United States present the largest differences at just less than two years lower. Highly educated males live over two years longer than the population average in Canada, the Czech Republic, Ireland, Poland and the United States. Highly educated females in Australia and Ireland enjoy the biggest advantage over the population average.

In most countries, higher educated groups have higher gains in life expectancy than the lower educated groups, indicating that not only do these groups have a higher life expectancy but also higher mortality improvements. Figure 6.2 shows how differences in life expectancy across socio-economic groups have changed over time, although the period over which data is available for most countries is relatively short (less than 10 years). Highly educated males in the Czech Republic, Hungary and Portugal have increased their life expectancy by over two months more per year than the lowest educated males. In the United States, which has the longest period of observation available, the highest quartile of educated males has gained over two years more in life expectancy than the lowest quartile over the last three decades, which equates to just over three quarters of a month per year.<sup>6</sup> However, there are some countries where inequalities in life expectancy have improved, namely in Estonia, France and Italy, with France showing an improvement of 6 months per year over a relatively longer period of 16 years.

Figure 6.2. **Additional months of life expectancy at age 65 gained per year by those in the highest category of educational attainment compared to the lowest category**



Note: The number in parenthesis refers to the number of years used to measure the difference. Reference years and categories differ across countries, see Annex 6.A1.

Source: OECD calculations based on sources given in Annex 6.A1.

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## Income

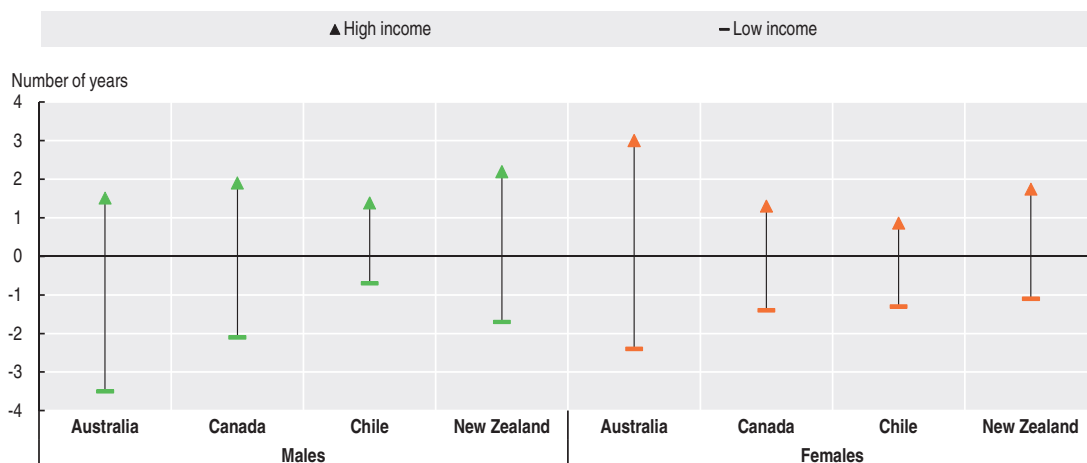
Income is a more direct measure of socio-economic status, although data is not as widely available as for education. Career average income is a better measure than income at a given point in time which could be subject to temporary shocks, for example from a decline in health, part-time work or unemployment, which could create a bias in the measurement of mortality. Wealth is also a relatively good indicator of social status and may be more stable than income; however this variable is not widely available as a measure.

The most commonly used measure for income in this context is a relative measure by average income quintiles. This is the measure used for comparison for all countries in Figure 6.3, apart from New Zealand where categories are based on tertiles of household income. For Chile, income quintiles are based on final salary rather than an average salary measure, which could potentially result in an overestimation of the difference in life expectancy across socio-economic groups. Those with the highest final salaries would also be those most likely to still be working and in good health, and therefore also be those who can expect to live longer. Lower final salaries could be due to reasons such as health problems, increasing the mortality risk for those with the lowest salary.

Differences in life expectancy across income groups are larger than across education groups for the two countries where both categorisations are available – Australia and Canada.<sup>7</sup> Shown in Figure 6.3 for the latest year of available data, Australia presents the largest gap in life expectancies between the highest and lowest income quintile of 5 years for males and 5.4 years for females. Canada and New Zealand present similar differences of around 4 years for males and 2.75 years for females. However the less dispersed categories for New Zealand likely result in an understatement of the differences across socio-economic groups compared to the differences across quintiles. Differences in Chile are approximately the same for both males and females, at just over 2 years.

Gains in life expectancy may also be higher for those with higher incomes. The only country for which life expectancy by income level is available over a given time period is New Zealand, where life expectancies are available for five periods starting in 1981-84 through 2001-04. Figure 6.4 shows that over this twenty year period, males in the highest

Figure 6.3. **Difference in life expectancy at age 65 by income group, relative to the population average**

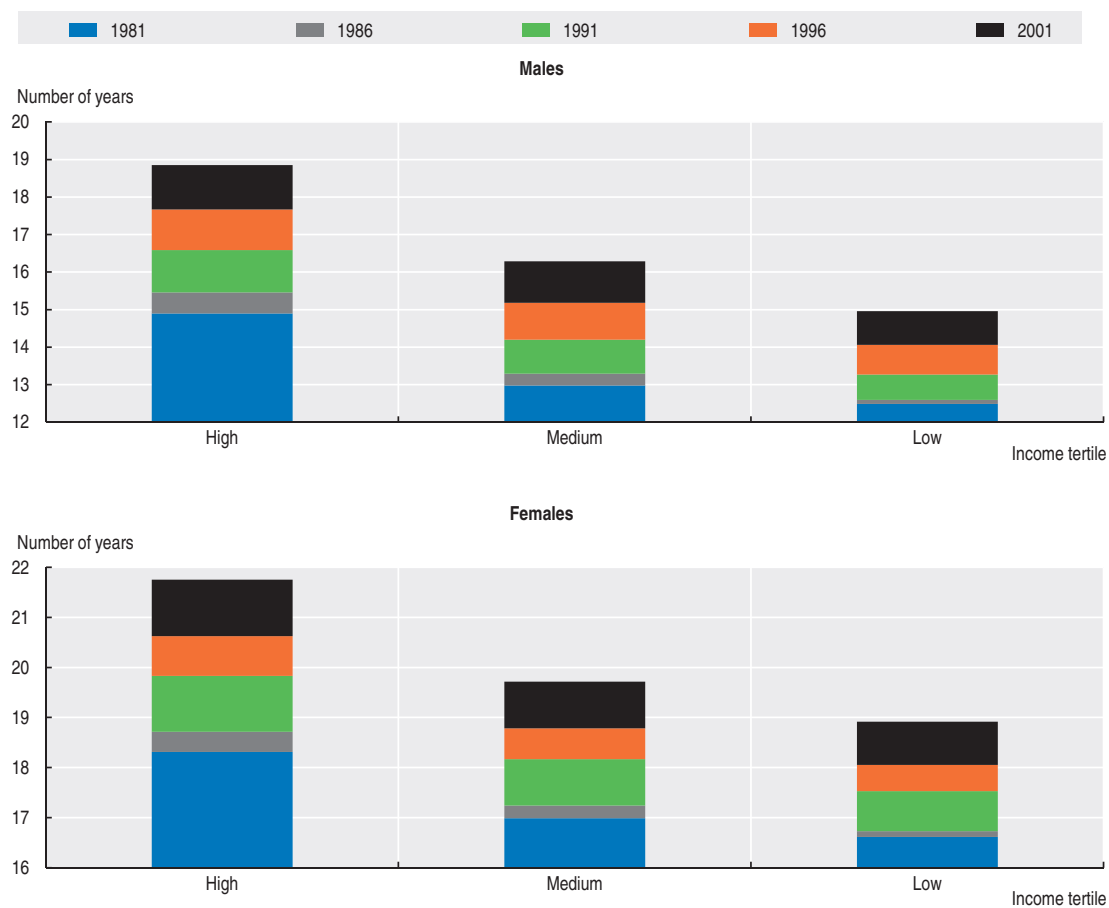


Note: Australia figures shown for age 60. The reference years and categories differ across countries and are for the latest year available, see Annex 6.A1.


Source: OECD calculations based on sources given in Annex 6.A1.

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Figure 6.4. **Life expectancy and its evolution at age 65 in New Zealand, by income tertile**



Source: OECD calculations based on the New Zealand Census Mortality Study, Carter et al. (2010).

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income tertile gained 1.5 years more in life expectancy than those in the lowest tertile, and high income females gained 1.1 years more than those with low incomes. These results are therefore consistent with the measures by education in that they indicate that inequalities in life expectancy are increasing over time.

### Occupation

Occupation as a socio-economic indicator has the advantage that it relates more directly to mortality outcomes, since the physical environment and social and behavioural factors which influence mortality tend also to be influenced by one's occupation. Occupation is also measured at the individual level, though categorisation of every occupation can be challenging, and occupations may change over time for a given individual. Furthermore, despite the International Standard Classification of Occupations, 2012 (ISCO 2012) which defines standardised occupational categories to be used for statistical purposes, there are variations in classifications across countries, which can make comparisons on this basis more difficult.

Despite the differences in categorisations, the differences in life expectancies between the highest and lowest categories are relatively consistent for males in the three countries where figures by occupation are available, with gaps falling between 3.6 and 3.9 years, as shown in Figure 6.5 for the latest year of available data (see Annex 6.A1 for the occupational categories used). This difference is significantly lower for females in France, at just over two years, yet slightly higher for females in Ireland at 3.9 years. The magnitude of these differences compared to the measure based on educational attainment is greater in Ireland where both of these categorisations are available.

Figure 6.5. **Difference in life expectancy at age 65, by level of occupation, relative to the population average**



Note: The reference years and categories differ across countries and are for the latest year available, see Annex 6.A1.

Source: OECD calculations based on sources given in Annex 6.A1.

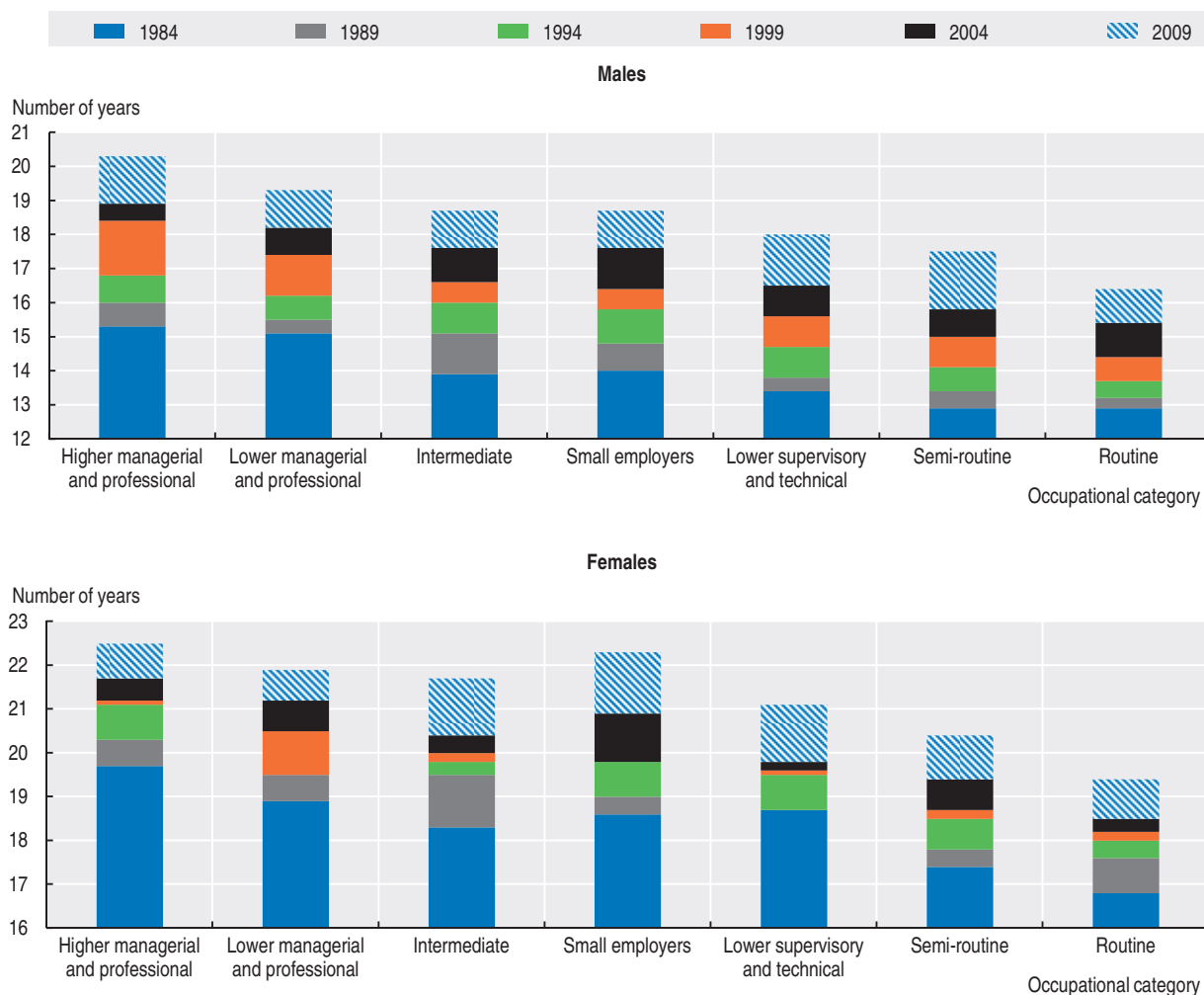
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The limited evidence available indicates that people at higher managerial and professional occupational levels have also experienced higher gains in life expectancy. Life expectancy figures by occupational level are available since the 1980s for both England and




Wales, and France, allowing for a comparison of the change in these inequalities over time. In both regions, those in the highest occupational levels have enjoyed greater gains in life expectancies than those at the lowest routine and manual occupational level. In England and Wales, shown in Figure 6.6, males in the highest category have gained 1.5 years more than those in the lowest category from 1984 to 2009, though the gains for the highest group slowed down compared to other categories over the latest period observed.

Figure 6.6. **Life expectancy and its evolution at age 65 in England and Wales, by occupational category**



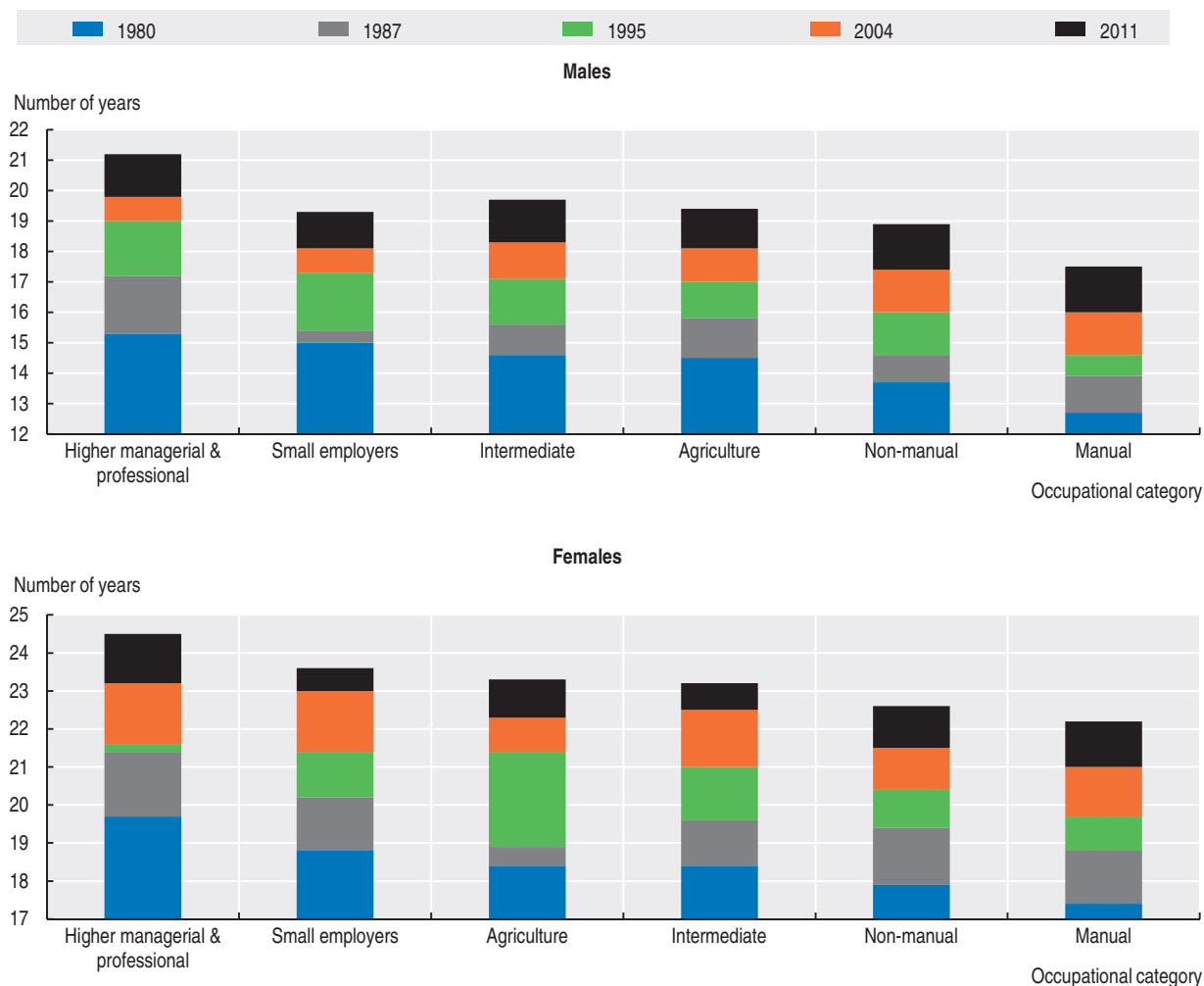
Source: UK Office of National Statistics.

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Overall, gains in life expectancy have diverged less for females across categories, though over the entire period observed those in the highest category have gained slightly more years in life expectancy compared to the lowest category.

In France, gains in life expectancy for males in the highest category relative to the lowest category have been similar to those observed in England and Wales, with this inequality increasing by 1.1 years over from 1980 to 2011 (Figure 6.7). This divergence has not been as obvious for females, with manual workers actually having gained the same

Figure 6.7. Life expectancy and its evolution in France at age 65, by occupational category



Source: Institut national de la statistique et des études économiques (INSEE).

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number of years of life expectancy as those in higher managerial positions, though the speed of these gains has varied over time.

The significant differences in life expectancies at age 65 for different socio-economic groups are clear across all measures of socio-economic status: educational attainment, relative income and occupational level. Furthermore, these disparities have increased over time for most countries where data is available, resulting in an increased fragmentation of mortality.

These underlying differences and the increasing divergence of mortality present a challenge for measuring and managing the longevity risk by pension funds and annuity providers, given that this risk is heavily dependent on the demographic composition of the pensioner and annuitant populations. Solutions adapted to the various segments of society need to be found. Policy makers considering the design of the payout phase of pensions should keep these differences in mind when establishing limits which could impede lower socio-economic groups from optimising their consumption in retirement.

## Implications for pensions and insurance

The longevity risk faced by pension funds and annuity providers depends on the population segment that they cover. External factors, such as regulatory changes which influence either the demographic make-up of these populations or improvements in mortality for certain segments can change this exposure, complicating the measurement and management of the risk. These populations tend to be skewed towards the higher socio-economic groups in most countries. To the extent that the divergence of life expectancies for these groups relative to the lowest socio-economic groups continues in the future, mitigating the longevity risk for these populations could prove to be more expensive than anticipated, and could potentially result in limited reinsurance capacity for these risks. This divergence could also hinder the development of the market for longevity risk, as standardised longevity index-based instruments, which this market would require could prove to be less effective in mitigating the longevity risk for these populations.

On the upside, this heterogeneity presents an opportunity for pension funds and annuity providers to adapt their services to better meet the varied needs of the population and diversify the longevity risks they face.

### ***Diverse demographics pose a challenge for the measurement of mortality improvements for sub-populations***

The potential differences in mortality improvements across socio-economic groups pose a challenge for pension funds and annuity providers to establish appropriate mortality improvement assumptions on which to base the valuation of their liabilities. First, available data for these populations may not be of sufficient quantity – both in terms of length of historical period and volume across age groups – to establish robust mortality improvements based on these subpopulations. Secondly, even where data for the subpopulation is sufficient, measured improvements may not be representative of the expected mortality improvements of the population if the demographics of this population have shifted over time.

Setting mortality improvement assumptions requires a reasonably long historical period and sufficient volume across different age groups. As such, the mortality improvement assumptions embedded in the standard mortality tables used in many countries are based either on the general population mortality or on the mortality of several of these subpopulations combined.

Many mortality tables used by pension funds and annuity providers rely on general population data, though certain adjustments may also be made to account for expected differences. The table used for Spanish annuitants (PERM/F P) and the tables used for pensioners in Switzerland (BVG 2010, VZ 2010) are examples of tables which rely on general population data to establish the mortality improvement assumptions used to value annuity and pension liabilities. The table used for annuitants in Germany (DAV 2004) also relies on general population data, but includes an additional buffer on these improvement assumptions in recognition of the fact that annuitants tend to be from higher socio-economic groups and therefore may also experience higher improvements than the general population. Mortality improvements published by the Continuous Mortality Investigation (CMI) in the United Kingdom rely on mortality data from England and Wales rather than the entire UK population. Large geographical differences in mortality have been observed in the United Kingdom, with England and Wales having a higher life

expectancy at age 65 compared to Northern Ireland and Scotland, so this choice allows the model to reflect the specificities for the segment of the population in England and Wales, and the potentially higher mortality improvements which have been experienced by this population.

Other tables have based their assumptions on a combination of data from several pensioner or annuitant subpopulations. The Canadian Pension Mortality (CPM) study developed tables based on the population having Registered Pension Plans (RPP), covering both public and private sector plans. Recent tables developed in the United States (RP2014/MP-2015) also rely on pooled data from a number of private sector pension plans. Both of these tables therefore pool experience across different occupational sectors. As such, their accuracy for any given subsector or occupational category may be uncertain given the large differences in life expectancies observed across these categories, presenting a challenge for these plans to measure the longevity risk to which they are exposed.

The necessity of using sufficiently large data sets to develop mortality improvement assumptions presents a challenge to the ability of the resulting tables to reflect the expected mortality experience of the subpopulation. However, the underlying dataset itself may also pose problems for the measurement of accurate mortality improvement assumptions for that same population.

The demographics of annuity beneficiaries and pensioner populations may change over time as a result of external factors such as the maturing of pension systems and regulatory changes. Assessing the mortality improvements of a population whose demographics have not been stable with respect to different socio-economic groups could result in a significant mis-estimation of the expected mortality improvements going forward. Box 6.1 illustrates the potential impact of regulatory changes by providing examples in two countries, Chile and the United Kingdom.

#### **Box 6.1. Regulatory changes in Chile and the United Kingdom and their effect on mortality improvement calculations**

The 2008 Pension Reform in Chile provides an example of such an external regulatory shock on the demographic mix of the pensioner population. This reform effectively increased the coverage of the pension system for the lowest income segments of the population, dramatically increasing the proportion of low income pensioners. Given the evidence above regarding the differences in Chilean pensioner mortality across different income segments, it is clear that this influx of low income pensioners would have the effect of reducing the average life expectancy of the entire pensioner population.

In 2014-15, the pension and insurance regulators in Chile updated the mortality tables established in 2009 to better reflect mortality improvements experienced by the Chilean population, as the table in force at the time seemed to be significantly underestimating mortality improvements (OECD, 2014). While annual mortality improvements for the Chilean population had been between 2-3% over the last several decades, the improvements assessed on pensioner population data at an aggregate level were significantly below this.\* This result was directly attributed to the increase in the proportion of low income pensioners from the 2008 reform. If the mortality improvements for the new tables had been based on the pensioner mortality data, these assumptions would have significantly

\* Improvements had to be assessed at an aggregate level as there was not sufficient granularity across ages to robustly infer the differences in improvements across ages.

**Box 6.1. Regulatory changes in Chile and the United Kingdom and their effect on mortality improvement calculations (cont.)**

underestimated the life expectancy for pensioners and annuitants, resulting in insufficient provisions for annuity reserves and presenting pensioners with an increased longevity risk of running out of savings in retirement.

The recent pension freedoms granted in the United Kingdom provide a complementary example of a regulatory shock potentially changing the annuitant demographics going forward. Until 2014, 75% of the assets accumulated in a defined contribution pension plan were effectively required to be annuitised. This requirement was removed in 2014, resulting in a dramatic drop in annuity sales.

This exit from the annuity market is likely to be driven by individuals who have less to benefit from the longevity insurance that annuities provide and those who have lower life expectancies. These individuals are also more likely to come from lower income segments of the population. The Financial Conduct Authority found that in 2012 over a quarter of annuities sold to existing pension customers were for accumulated assets of under GBP 5 000, which would translate into a monthly income of less than GBP 20 per month. As these consumers now have the option to take a lump sum, it is quite likely that they will do so rather than take an income guarantee which is insufficient to keep them out of poverty. Indeed, the Financial Conduct Authority found that 90% of individuals who accessed their pensions in July-September 2015 and did not take the guaranteed annuity rate offered by their pension provider, had pension pots of less than GBP 10 000 (Financial Conduct Authority, 2016). This exit would affect the annuitant population going forward, in this case by removing the lowest wealth groups from the population, increasing the average socio-economic status for those who continue to buy annuities going forward. Basing mortality improvement assumptions on historical annuitant experience without accounting for this change would therefore be also likely to underestimate the life expectancy for annuitants going forward.

There is therefore a need to monitor mortality experience and changing demographics. Pension funds and annuity providers must be aware of the differences in the socio-economic compositions between their populations and the populations on which the mortality assumptions being used are based. Where assumptions are based on their own populations, they should ensure that the demographic mix of their pensioners or annuitants has been relatively stable so that the derived assumptions are appropriate for the population going forward. In either case, the need to monitor mortality experience and changing demographics of the underlying population is clear in order to ensure that the mortality assumptions used remain appropriate.

In addition to challenges for measuring the expected longevity risk of pension and annuity populations going forward, differences in mortality across socio-economic groups also presents challenges to the mitigation of this risk. The anti-selection common in annuity markets is a main driver of this challenge.

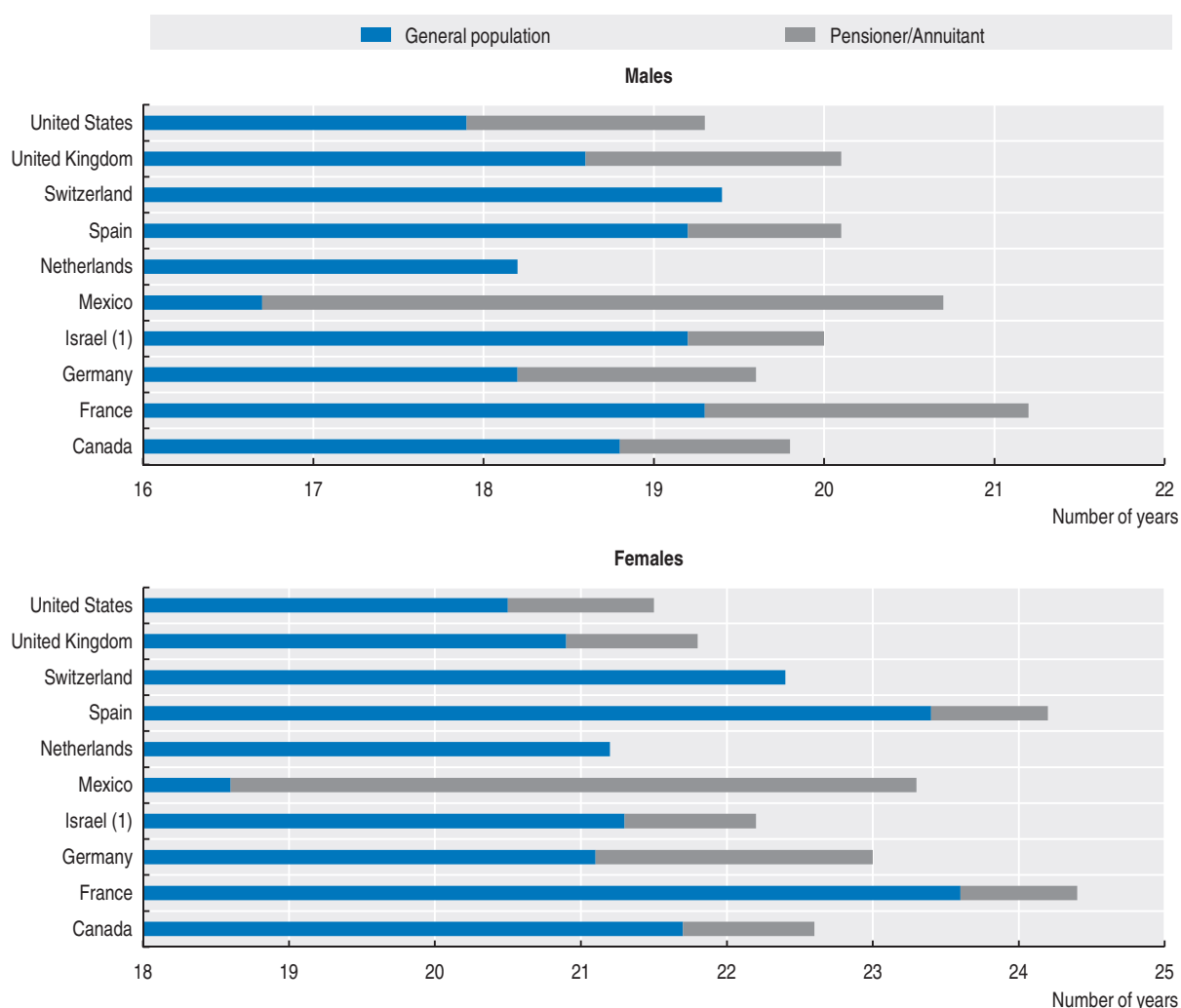
**Anti-selection in annuity markets leads to increased difficulty in risk mitigation**

Individuals choosing to purchase life annuities which provide protection from longevity risk also tend to be those who have higher life expectancies than the population average, and are generally from higher than average socio-economic groups. This phenomenon is referred

to as anti-selection, meaning that these individuals are self-selected into the annuity market. Given that annuitants also tend to be from higher socio-economic groups, the evidence above indicates that they also present a greater risk of having higher than average mortality improvements. This greater risk can translate into a greater cost for annuity providers to mitigate their longevity risk. The potentially greater mortality improvements can also reduce the effectiveness of lower cost index-based solutions to mitigate this risk, presenting a real challenge for annuity providers to efficiently mitigate the longevity risk to which they are exposed.

Anti-selection in annuity markets is a common observation across most jurisdictions, particularly where the purchase of an annuity is voluntary. Figure 6.8 shows the differences in life expectancy at age 65 for the general population in each country and the annuitant or pensioner population for which the standard mortality tables are used.<sup>8</sup> This shows that it is

Figure 6.8. **General population life expectancy at age 65 compared to pensioners or annuitants**



Note: Pensioner/annuitant mortality based on the following mortality tables: Canada (CPM 2014), France (TGH/F05), Germany (DAV 04, 2nd order Aggregate Target), Israel (Pension Best Estimate), Mexico (EMMSA 09), Netherlands (AG-Prognosetafel), Spain (PERM/F P), Switzerland (BVG 2010), United Kingdom (SAPS 2), United States (RP-2014).

Source: General population figures, OECD 2013 (except Canada, 2011).

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not uncommon for annuitants or pensioners to have life expectancies at age 65 of over one year higher than the population average. The difference, however, depends in part on the underlying pension system and the nature of the liabilities being valued. This difference will be much smaller where the coverage of the pension system in question is high, as is the case in the Netherlands. In Mexico, where the coverage of individual annuities within the defined contribution system is currently rather low, the observed difference is much larger.

As discussed above, it is relatively challenging to establish appropriate mortality improvement assumptions for specific annuitant or pensioner populations. As a result, these assumptions are commonly based on the experience of a much larger population, either the general population or the pooled mortality experience of several populations. However, given the observation that pensioners and annuitants tend to be from higher socio-economic groups, there is also a greater risk that they may experience higher than average mortality improvements than a larger, more diverse, population.

This increased risk of higher than assumed improvements implies that reinsurers will need to charge an adequate risk premium to accept this risk from pension funds or annuity providers. This makes reinsuring the longevity risk for higher socio-economic groups relatively more expensive for the annuity provider or pension fund. If reinsurers are not able to diversify the longevity risk exposure that they are reinsuring, this could potentially lead to a capacity constraint for them to accept longevity risk from these segments of the population, further complicating the mitigation of this risk for annuity providers and pension funds.

Passing the longevity risk to the capital markets could be an alternative solution for annuity providers and pension funds to access additional capacity for longevity risk. However, this would require transacting with index-based longevity instruments in order to address the needs of capital markets investors for transparency and flexibility in the transaction (OECD, 2014).

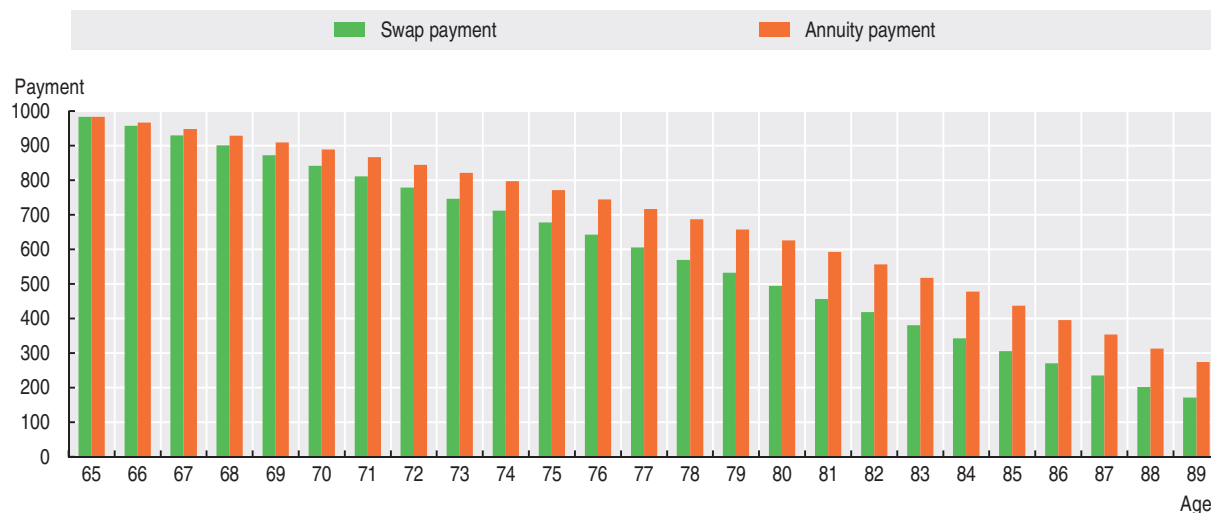
The payments from index-based longevity swaps are based on a measure of mortality which is objective and independent from the actual pensioner or annuitant population for which the longevity risk is being hedged. This index is typically based on the mortality of the general population of a given country. In exchange for a fixed and regular payment from the pension fund or annuity provider based on the expected improvements in mortality at the onset of the contract, the counterparty will return regular payments based on the actual evolution of the index of mortality. Therefore if mortality improvements for the index population turn out to be higher than expected, the annuity provider or pension fund will receive additional payments to compensate them for the additional pension or annuity payments which they would be expected to make as a result of higher than expected survival rates.

While longevity index-based instruments are more appealing to the capital markets investor, they present some drawbacks for the annuity provider or pension fund looking to hedge their longevity risk. This is mainly because index-based instruments do not provide a full transfer of the risk, and a portion of this risk is retained by the pension or annuity provider. For a standard longevity swap, the risk retained is the difference between the evolution of the index mortality and the mortality of the pensioner or annuitant population whose longevity risk is being hedged, otherwise referred to as longevity basis risk. If the pensioners or annuitants experience mortality improvements which are higher than the population on which the index is based, the payments made by the counterparty will not be sufficient to cover the additional payments owed. Given that these populations

tend to be from higher socio-economic groups, it is also likely that they will experience higher mortality improvements than the general population. A longevity swap based on an index for the general population would therefore likely be insufficient to cover higher than expected pension or annuity payments.

Based on the evidence presented in the first section of this chapter, the magnitude of this basis risk can be significant, reducing the effectiveness of the longevity swap to hedge the longevity risk of the pensioners or annuitants. Figure 6.9 demonstrates the potential impact of this divergence in mortality improvements on the ability for the swap payments to cover hedged annuitant payments for a higher socio-economic group. The illustration is based on the actual evolution in mortality for the average French male population compared to males having a higher managerial or professional occupation since 1980. If an annuity provider had hedged its longevity exposure coming from a cohort of 65 year old males in this occupational category using a longevity swap indexed to the French population, payments owed to the annuitants would have totalled approximately 15% more than the payments received from the swap over a period of 25 years.

Figure 6.9. **Hedging shortfall from an index-based swap**



Note: Annuity payments for a cohort of 65 year old French professional males and longevity swap payments indexed to the French population.  
Source: OECD calculations based on INSEE.

StatLink  <http://dx.doi.org/10.1787/888933362749>

The uncertainty around the actual magnitude of this risk and the lack of historical data on which to measure differences in mortality improvements may lead annuity providers and pension funds to be reluctant to use index-based instruments to hedge their longevity risk, presenting a barrier to the development of a market for longevity risk. Indeed, very few index-based longevity hedges have been executed. The four largest public index-based transactions have all been indexed to Dutch population mortality. Anti-selection in the Dutch market is more limited than many other jurisdictions due to the very high coverage of the quasi-mandatory private pension system. This is also evidenced in the lack of difference between the life expectancy of the general population and the insured population in Figure 6.8. Due to this high coverage, the annuitant mortality is more likely to closely follow the trends of the general population, minimising basis risk and resulting in higher hedge effectiveness. Reduced anti-selection in the Dutch market may therefore be a driver in higher volume of index-based transactions to hedge longevity risk compared to other jurisdictions.



The differences in mortality improvements across socio-economic groups increase the cost of mitigating longevity risk for annuity providers and pension funds, and present a barrier to the increased use of index-based instruments to hedge longevity risk and therefore to the development of a market for this risk. Diversifying longevity risk exposure across socio-economic groups with adapted product offerings could provide one solution to reducing the cost of mitigating longevity risk for pension funds and annuity providers.

***Heterogeneity presents an opportunity for market segmentation to diversify risk and better serve financial needs of consumers in retirement***

In light of the large heterogeneity in mortality across socio-economic groups, pension funds and annuity providers may have an opportunity to diversify their concentrated exposure to the longevity risk of higher socio-economic groups by offering benefits or products which better serve the retirement needs of the various market segments.

Paradoxically, despite the observed anti-selection in annuity markets, the stated preference for traditional annuity products has been shown to be negatively correlated with education and income, two key indicators of socio-economic status (e.g. Agnew et al., 2008). This implies that there may exist an opportunity for traditional annuity products to adapt their pricing and risk profile to better target middle to lower socio-economic groups, and that product features have room to adapt from the traditional model to appeal more to higher socio-economic groups. Lower socio-economic groups may have a higher need for the consumption protection that standard annuities can offer, while higher socio-economic groups may have a higher desire for flexibility and/or market participation than the traditional model offers.

The enhanced annuity market in the United Kingdom seems to have successfully segmented the market to offer higher levels of income to individuals having lower life expectancies and therefore presenting lower longevity risk. These types of products are offered to individuals presenting certain health or behavioural factors which are correlated with lower life expectancies, such as smoking, obesity or cardiovascular disease. These types of risk factors have also been shown to be more prevalent for those in lower socio-economic classes. At the end of 2014, enhanced annuities made up 28% of the total market for annuities, demonstrating that these types of products can capture a significant portion of the total market (Gatzert and Klotzki, 2015). Providers offering both standard and enhanced annuities may be better able to diversify the longevity risk that they face by capturing a broader segment of the population. Nevertheless, enhanced annuities are not widely available in jurisdictions outside of the United Kingdom.

For the higher socio-economic segments, annuity products offering market participation may be more appealing. One reason put forward to explain the decreased preference for traditional annuities by higher socio-economic groups is that this segment of individuals has more familiarity with investing in markets. They may therefore prefer to retain control of their investment due to optimism and overconfidence in their abilities to generate higher returns than a traditional annuity could offer (e.g. Agnew and Szykman, 2010). Indeed, the average premiums for investment-linked annuity products in the United States in 2012 were nearly 40% higher than the average premium for a fixed payment annuity product, indicating that they were bought by wealthier people on average.<sup>9</sup> These types of products also tend to offer a certain level of liquidity, even during the payout phase, allowing the consumer to maintain access to their assets. The Guaranteed Minimum Withdrawal Benefit for Life allows this liquidity, and is the most popular annuity-type guarantee offered

with variable annuity products in the United States, with over 40% of assets backing these products having this type of benefit in 2012 (The Geneva Association, 2013).

Opportunities such as these to adapt product designs to better meet the needs of different socio-economic segments and expand into different markets are clear given the diversity and divergence of mortality across these segments and the varying levels of longevity protection needed in retirement. Diversifying longevity risk exposure across these segments may help to facilitate the management of this risk for pension funds and annuity providers going forward.

### **Considerations for policy makers**

Differences in mortality across socio-economic groups have implications for policy makers concerned with ensuring that the retirement financing needs are met for all segments of society. First, policy makers should consider ways to facilitate the measurement and management of longevity risk given the challenges faced by pensions and insurance providers outlined above. Second, product innovation and adaptation for the different market segments should be encouraged. However, policy makers must also make sure that providers measure and manage any new risks coming from these products and that the products remain accessible and suitable for the targeted population segment. Finally, mortality differences have more wide-reaching implications with respect to the rules governing access to pension money in retirement, and policy makers should establish these rules to ensure that lower socio-economic groups are not unnecessarily put at a disadvantage with respect to this access given their lower life expectancies.

#### ***Facilitating the measurement and management of longevity risk***

To facilitate the management and mitigation of longevity risk, policy makers have an interest in ensuring that mortality data by socio-economic indicators is widely available in a timely and accessible manner. The key obstacle outlined above for pensions and insurance providers to measure and manage their longevity risk is the lack of adequate mortality data linked to the different socio-economic indicators identified. National statistics institutes or, alternatively, actuarial associations could be in charge of making such data available.

Having access to mortality data by socio-economic groups would help to overcome the difficulties pensions and insurers have in measuring expected mortality assumptions and the longevity risk they face. Despite the well-known differences in mortality across socio-economic groups, detailed mortality data is not easily accessible in many countries. This presents a challenge to establish mortality improvement assumptions reflective of the particular population in question and to measure the expected differences in these improvements compared to the population average.

#### ***Encouraging the development of sustainable products to meet the needs of different segments of society***

Policy makers should also consider ways to encourage the development of sustainable products to finance retirement which are adapted to the needs of the different segments of society. To take enhanced annuities as an example, despite the potential for these products to serve the needs of lower socio-economic groups for protection against investment and longevity risk, they are not widely available outside of the United Kingdom. Barriers cited as a reason for this include inflexible reserve requirements, legal or regulatory challenges

and insufficient demand to achieve the volume of sales necessary to create a sustainable business line. Policy makers could therefore ensure that the related rules and regulations accommodate such products by creating incentives for providers to compete and innovate, but they must also make sure that the risks of these products are appropriately managed.

Inflexible reserve requirements could make certain types of products unprofitable for insurance companies to offer. For example, insurers in the United States are required to hold reserves based on standard mortality assumptions unless the mortality for the insured is greater than 25% lower than the standard rates (Drinkwater et al., 2006). This requirement could make insurance companies unwilling to offer enhanced annuities for individuals having lower life expectancies because they would have to hold the same level of reserves as for standard annuities.

There may also be legal barriers to using certain risk factors for pricing annuity products, which could impede increased market segmentation for annuity products. Policy makers should ensure that increased market segmentation does not result in discrimination, but likewise should not impose legal restrictions which could prevent access to annuity products for certain segments of society. Gender, for example, has not been allowed to be used for pricing annuity products in the European Union since 2012 on the grounds that it is discriminatory. This ban would be expected to increase the price that males would pay for the equivalent annuity product. To the extent that this leads to males opting out of the market because they see annuities as too expensive relative to the length of time they expect to live, this could further increase the price to reflect the higher life expectancies of those continuing to purchase annuities. Indeed, evidence in Germany, where gender-based pricing of annuities has been forbidden since 2006, indicates that prices following the ban were much closer to the prices which had been charged to females before the reform (von Gaudecker and Webber, 2006). Bans on market segmentation may therefore not result in any benefit for society and can result in an exclusion of certain groups from the market.

Policy makers must carefully consider the costs and benefits in allowing or banning certain risk factors to be used for the pricing of annuity products. Drawing the line between acceptable segmentation and discrimination is not always easy, particularly where risk factors are strongly correlated with race or ethnicity. For example it is common practice in the United Kingdom to segment markets by postcode, which can be a proxy for socio-economic status. In the United States, on the other hand, a postcode could be viewed as a proxy for race and thereby seen as discriminatory. Factors having a more direct and causal link such as health problems or behavioural factors such as smoking may therefore be a preferable basis for market segmentation.

The lack of demand for annuity products could also present a barrier for further product innovation and market segmentation, as annuity providers need volume in order to have a sufficient pooling of risk and for products to be sustainable. In general, the demand for annuity products remains low in most jurisdictions. One main driver of the development of enhanced annuities in the United Kingdom seems to be the existence of the requirement to annuitise a portion of assets accumulated at retirement. Making the annuity offer more attractive to individuals who had lower life expectancies was a strategy for annuity providers to gain additional market share.

Nevertheless, consumers also need to be aware of the different products available and how to access the products in order to generate demand. In the United Kingdom, the lack of consumer engagement in the selection of their annuity product presented a barrier for

the uptake of enhanced annuities, even for individuals who could have received a better income from them. The majority of consumers who could benefit from these products remained unaware of their existence and/or did not take advantage of the opportunity to purchase an enhanced annuity instead of a standard annuity. A third of individuals were not aware that purchasing an enhanced annuity was an option, and of the 60% of individuals taking an annuity from their existing pension provider, only 5% took an enhanced annuity (Financial Conduct Authority, 2014). The Financial Conduct Authority has taken numerous measures to try to address this problem, including requiring that pension providers inform their customers of their right to shop around (the Open Market Option) and are now considering requiring pension providers to show side-by-side comparisons of annuity quotes to encourage consumers to compare prices and select the best annuity product for them. Firms are also required to direct their consumers to the Pension Wise information service provided by the government for additional information and guidance.

The provision of information may therefore be the most important tool for policy makers to use to encourage a demand for innovative products to meet the needs of various segments of society in retirement. Individuals need to be informed of their options and the potential benefits of the various financial strategies they can employ for their retirement given their socio-economic level and situation. More importantly, however, this information needs to be easily accessible and simple to understand for consumers to be able to use it effectively to inform their decisions.

While encouraging product innovation is important, policy makers must also ensure that providers are appropriately managing any new risks presented by these products. Variable annuity products targeted to higher socio-economic groups for example, offered increased flexibility and market participation combined with the guarantees which significantly increased the risk exposure of the annuity providers offering these products. The financial crisis revealed that not all variable annuity providers were appropriately managing these risks, however, with several pulling out of the market as a result. Variable annuity providers have since de-risked these products, reducing somewhat the flexibility they offer, and in many jurisdictions providers are required to submit a clearly defined hedging strategy to the regulators to demonstrate that they are effectively managing the risks. Risk-based reserve and solvency requirements are also increasingly being imposed to ensure that sufficient capital is being held to cover the risks presented by different types of products.

### ***Ensuring that rules governing access to pensions do not put lower socio-economic groups at a disadvantage***

More broadly, given the differences in mortality across socio-economic groups, policy makers should ensure that the general rules governing the access to pensions and retirement savings do not put those in lower socio-economic groups that have lower life expectancies at a disadvantage. Age is often used as a reference to define limits around the ability to access money which has been earmarked for retirement, either for the amount received or the time at which it can be accessed. These limits are increasingly being linked to the realised increases in life expectancy which, as shown above, have not been equal across all socio-economic groups. Lower socio-economic groups may therefore be more limited in the amount of pension income they can expect to receive and the relative length of time they spend in retirement compared to higher socio-economic groups, and this disadvantage may be increasing over time.

Maximum limits imposed on the level of programmed withdrawals from retirement savings which are based on average life expectancy for the population could lead to lower socio-economic groups being allowed to withdraw less over their lifetime than those in higher socio-economic groups. These limits can be established based on life expectancy at the beginning of withdrawal or updated each year to reflect life expectancy conditional on surviving another year, and can account for future improvements in mortality (cohort life expectancy) or not (period life expectancy). Given the lower life expectancy of lower socio-economic groups, under such rules they would expect to withdraw a smaller proportion of their retirement savings over their lifetime compared to higher socio-economic groups. This difference could be worsened if limits are based on cohort life expectancies to the extent that lower socio-economic groups tend to also have lower mortality improvements.

Similarly, any mandatory annuitisation based on the actuarially fair values for the population average would provide lower total levels of lifetime income for lower socio-economic groups. Annuity factors calculated on health or behavioural factors, like the income provided by enhanced annuities is calculated, would help to resolve this problem as certain risk factors are also more prevalent in lower socio-economic groups, and calculating the annuity rate taking these factors into account would result in a higher level of income.

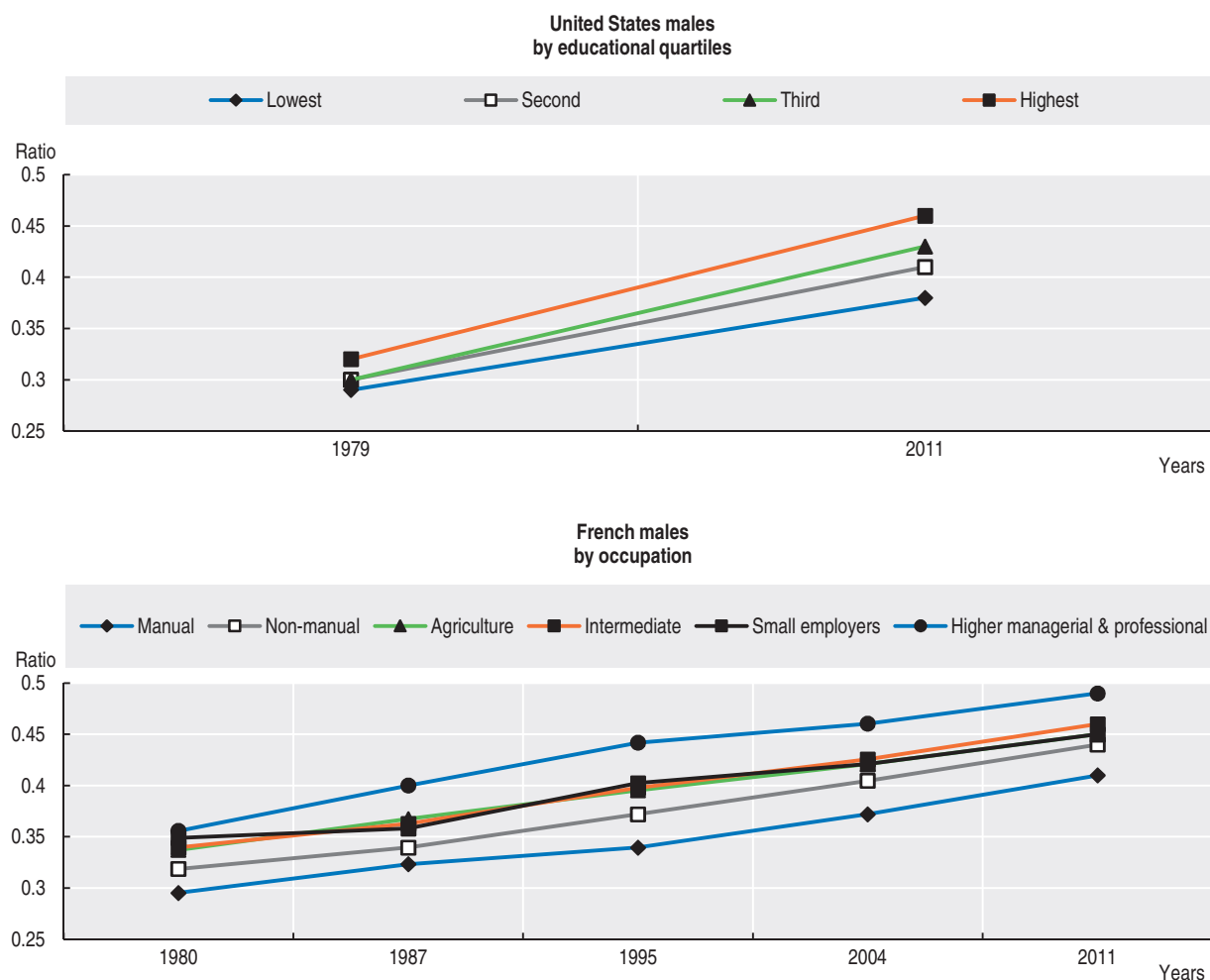
The age at which money earmarked for pensions can be accessed can also be linked to age or life expectancy, either through indirect incentives or explicit limits, and thereby can influence the age at which individuals are able to retire. For example, tax penalties can be imposed if retirement savings are accessed before a certain minimum age, effectively imposing a minimum retirement age on individuals. Alternatively, minimum age limits at which a full pension can be accessed can explicitly be imposed. Both of these approaches can directly impact the ratio of years spent in retirement to the years spent working and contributing.

The increasingly prevalent policy of linking these age limits to realised increases in life expectancy intends to maintain the proportion of life spent in retirement relatively constant, as the longer individuals live the longer they will need to work and contribute to finance the longer retirement. However, given the differences in life expectancy across socio-economic groups, lower groups will be allowed a lower proportion of their lifetime in retirement than higher groups as a result of such policies. Furthermore, to the extent that they also experience lower than average mortality improvements, these ratios would be expected to diverge over time, increasing the relative disadvantage for lower socio-economic groups.

This disparity and divergence is illustrated in Figure 6.10 for males in the United States and France. Figure 6.10 shows the evolution of this ratio over time with actual data keeping the years contributing constant assuming that individuals began working at age 22 and retired at age 65. For the least educated group in the United States, this ratio increased from 0.29 to 0.38 from 1979 to 2011, whereas it increased from 0.32 to 0.46 for the most educated. In France, the ratio went from 0.3 to 0.41 for manual workers between 1980 and 2011 and from 0.36 to 0.49 for higher managers and professionals.

The divergence in these ratios across socio-economic groups shows that higher socio-economic groups are spending an increasingly longer proportion of time in retirement relative to lower socio-economic groups. In order to keep this ratio constant across socio-economic groups, those in higher socio-economic classes would need to work and

Figure 6.10. Ratio of years in retirement to contribution years, United States and France



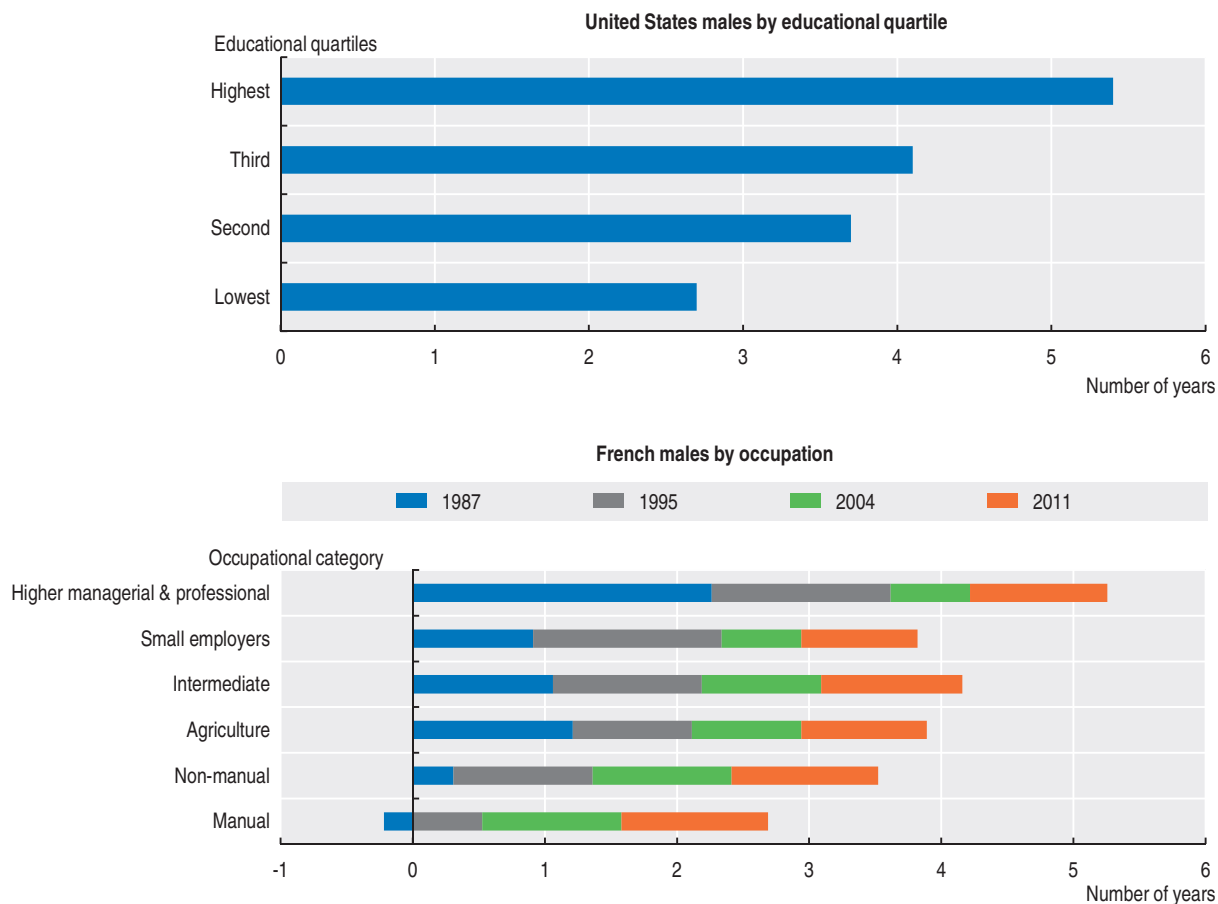
Note: Assumes age of entry into the labour force at 22, retirement at age 65, and is conditional on survival to age 65.

Source: OECD calculations based on Sanzenbacher et al. (2015) for the United States, and INSEE for France.

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contribute for a longer period of time. Figure 6.11 shows the additional number of years beyond age 65 that each class would be required to work to maintain this ratio at a constant level across time, assumed to be 0.3 for the United States and 0.33 for France.<sup>10</sup> In the United States, those in the highest socio-economic class would have to work 5.4 additional years, whereas those in the lowest class would only have to work 2.7 additional years, since life expectancy improved for the latter group by 2.1 years less than for those with the highest education. If we further assume that those with the lowest educational attainment also began working at an earlier age of 18, this would reduce the age at which these individuals should retire by nearly one additional year. Therefore to maintain a ratio of years in retirement to years working of 0.3 in 2011, the highest educated males would need to work until age 70.4, whereas the lowest educated could retire at age 66.8, 3.6 years earlier. For the case of France, the manual workers could retire at age 67.5 in 2011 while those in higher managerial and professional roles would need to work 2.8 years longer until age 70.3. Assuming manual workers enter the labour force at the age of 18, however, they would be able to retire even earlier at age 66.5.

Figure 6.11. **Additional contribution years required to maintain a constant ratio of years in retirement to contribution years**



Note: Shows additional years beyond age 65, assumes age of entry into the labour force at 22 and is conditional on survival to age 65.

Source: OECD calculations based on Sanzenbacher et al. (2015) for the United States, and INSEE for France.

StatLink  <http://dx.doi.org/10.1787/888933362762>

Policy makers should therefore consider keeping the ratio of years in retirement to years contributing equal across socio-economic groups and constant over time. Policies basing the age at which full pension can be accessed on average life expectancy will result in lower socio-economic classes spending fewer years in retirement compared to years spent working, and linking this age to increases in average life expectancy can further put these groups at a disadvantage. To the extent that lower socio-economic groups begin working earlier, for example if everyone begins working after completing their education, basing the age at which full pension can be accessed on the number of years working and contributing, as well as life expectancy, would help indirectly to reduce the discrepancy. With this policy, those beginning to work at an earlier age could also retire at an earlier age maintaining the ratio of years in retirement to years contributing equal across different socio-economic groups and constant over time. Other distributional mechanisms could also serve to offset the relative disadvantage of lower socio-economic groups, however, so policy makers need to consider these benefits as well for any solution. Attention should also be paid to any adverse incentives such policies could create, for example to retire early. However, these solutions do not necessarily address the problem with respect to the divergence of life expectancies over time, a much more challenging issue for pension policy makers to tackle.

## Conclusions

The fragmentation of mortality across socio-economic groups, both with respect to the level of mortality, but also with respect to the mortality improvements experienced over time, presents significant challenges for pensions funds and insurance companies to manage the longevity risk they face.

The first challenge relates to establishing appropriate mortality assumptions for their pensioner and annuitant populations. Given the large quantity of data necessary to determine expected trends in mortality and life expectancy, these assumptions are usually based on a larger population which may not be as representative of the demographics of the population to which the assumptions are applied. Furthermore, external shocks such as regulatory changes can impact the socio-economic mix of these populations, complicating the measurement of improvements in mortality even where sufficient data exist.

The second challenge these differences present relates to the mitigation of the longevity risk exposure of pension funds and annuity providers. The exposure of these entities tends to be more concentrated towards higher socio-economic groups, meaning that there is also an increased risk that mortality improvements will be higher than those experienced by the population as a whole. This increased risk implies that a higher risk premium would be demanded by reinsurers to accept to take this risk from the pension funds and annuity providers. To the extent that longevity risk also remains concentrated in higher socio-economic groups, reinsurance capacity could potentially become limited. While using index-based instruments to pass this risk to the capital markets could potentially offer additional capacity at a lower cost, pension funds and annuity providers may be reluctant use these instruments because of the differences in expected mortality improvements across socio-economic groups and the longevity basis risk that this implies.

Policy makers could help to facilitate the measurement and management of the longevity risk exposure of pension funds and annuity providers by making accurate and timely mortality data available by socio-economic groups. These data could provide a benchmark which entities could use to establish their own assumptions, and make it easier to assess the risk that certain segments will have higher improvements in mortality.

Despite the challenges coming from the differences in life expectancies, these differences also present an opportunity for pensions and insurers to expand their markets and diversify their longevity risk by adapting product offerings to different segments of society. Enhanced annuities in particular offer a retirement financing solution for lower socio-economic groups, who are also more likely to have certain health problems or behavioural risk factors such as smoking. More flexible product offerings such as variable annuities may be more adapted to higher socio-economic groups.

Policy makers should encourage and facilitate product innovation to meet the various needs of different market segments, though they should also ensure that the risks arising from these products are managed appropriately. Attention should be paid in particular to the risk factors which are allowed to be used by annuity providers to price their products, as overly restrictive requirements could result in the exclusion of certain groups from the market. Policy makers could also help to encourage competition for the business of lower socio-economic groups in particular by helping consumers gain easy access to information regarding their options to finance their retirement, which would encourage the demand for products which best meet their needs.



The differences in mortality across socio-economic groups, however, have broader implications with respect to how the overall access to funds earmarked for retirement is governed, as policies defined “on average” may be regressive. Rules referencing average life expectancies to establish the amount of allowable income or the age at which funds can be accessed can result in lower socio-economic groups spending less time and receiving less money in retirement. To the extent that these groups also experience lower than average mortality improvements, linking these rules to the changes in average life expectancy could exacerbate the disadvantage of lower socio-economic groups over time. One approach could be to keep the ratio of years in retirement to years contributing equal across socio-economic groups and constant over time.

This dilemma is not a simple problem for pension policy makers to resolve, and any solution will undoubtedly be complex. However policymakers must be aware of this fragmentation of mortality across socio-economic groups so as to not worsen the disadvantage of lower groups with respect to the amount of pension they can expect to receive in retirement. To assist with this, the next step in the research agenda of the OECD is to estimate and quantify the potential impact of differences in mortality and life expectancy (in both levels and gradients) by socio-economic factors on the well-being of retirees. The ultimate solution will be to target the causes of these differences in order to reduce this mortality disadvantage for the future.

## Notes

1. For a detailed discussion on the use of these measures as a proxy for socio-economic status see Groenwald et al., 2008.
2. See Annex 6.A1 for the definitions of the categories used for each country.
3. Except for Australia where figures are based on life expectancy at age 60.
4. The OECD is preparing more comparable estimates of inequalities in life expectancy by education based on consistent assumptions and data treatments across a large number of OECD countries. Murin et al. 2016 explains the problems with the data and proposes consistent procedures to produce better quality figures of inequalities in life expectancy by education. The main trends and tendencies highlighted in this paper will not change.
5. Figures for the Czech Republic are based on 2012 due to observed inconsistencies in the latest available data for 2013.
6. Bosworth et al. (2016) also found that the inequalities in life expectancy at age 50 with respect to both educational attainment and income have increased for both genders when comparing the cohort born in 1920 and the cohort in 1940.
7. The educational categories used for Australia are less dispersed so likely result in a smaller difference than the comparable figures in Canada.
8. Period life expectancy is shown, which does not account for future expected improvements in mortality.
9. Based on figures provided by LIMRA in an OECD survey on annuity products.
10. These represent the average ratios observed in the United States and France in 1979 and 1980, respectively.

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## ANNEX 6.A1

*Sources and details of life expectancy figures*

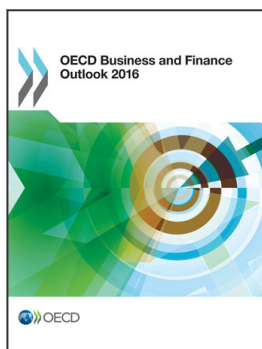
	Socio-economic indicator	Categories available	Period(s)	Source
<b>Australia</b>	Education	12 years > 12 years	2001-09	(Clark & Leigh, 2011), derived from the Household, Income and Labour Dynamics in Australia (HILDA) survey
	Income	Low Quintile High Quintile	2001-09	
<b>Belgium</b>	Education	No Diploma Primary Low secondary High secondary Tertiary	Change 1991-> 2001	(Deboosere, Gadeyne, & Van Oyen, 2009)
<b>Canada</b>	Education	< Secondary Secondary Post-secondary University degree	1991-2006	CANSIM, Statistics Canada
	Income	1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile		
<b>Chile</b>	Income	1st Quintile 2nd Quintile 3rd Quintile 4th Quintile 5th Quintile	2008-13	Superintendencia de Pensiones, Chile
<b>Czech Republic</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2007; 2008; 2009; 2010; 2011; 2012	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>Denmark</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2007; 2008; 2009; 2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>England and Wales</b>	Occupation	Routine Semi-routine Lower supervisory & technical Small employers Intermediate Lower managerial and professional Higher managerial and professional	1982-86; 1987-91; 1992-96; 1997-2001; 2002-06; 2007-11	Office of National Statistics, 2015
<b>Estonia</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2007; 2008; 2009; 2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment

## 6. FRAGMENTATION OF RETIREMENT MARKETS DUE TO DIFFERENCES IN LIFE EXPECTANCY

	Socio-economic indicator	Categories available	Period(s)	Source
<b>Finland</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2007; 2008; 2009; 2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>France</b>	Occupation	Unemployed Manual Non-manual Agriculture Intermediate Small employers Higher managerial and professional	1976-84; 1983-91; 1991-999; 2000-08; 2009-13	INSEE, 2016
	Education	No diploma Lower secondary Vocational diploma High school Tertiary	1991-99; 2000-08; 2009-13	
<b>Greece</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>Hungary</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2007; 2008; 2009; 2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>Ireland</b>	Education	Primary Secondary Third	2006-07	Central Statistics Office Ireland, 2010
	Occupation	Unskilled Semi-skilled Skilled manual Non-manual Managerial and technical Professional		
<b>Italy</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2007; 2008; 2009; 2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>New Zealand</b>	Income	Low Medium High	1981; 1986; 1991; 1996; 2001	New Zealand Census Mortality Study, University of Otago Wellington
<b>Norway</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2007; 2008; 2009; 2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>Poland</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2008; 2009; 2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>Portugal</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>Slovak Republic</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>Slovenia</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2007; 2008; 2009; 2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>Sweden</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2007; 2008; 2009; 2010; 2011; 2012; 2013	Eurostat Database, Life expectancy by age, sex and educational attainment

## 6. FRAGMENTATION OF RETIREMENT MARKETS DUE TO DIFFERENCES IN LIFE EXPECTANCY

	Socio-economic indicator	Categories available	Period(s)	Source
<b>Turkey</b>	Education	ISCED Levels 0-2 ISCED Levels 3-4 ISCED Levels 5-8	2010; 2011; 2012	Eurostat Database, Life expectancy by age, sex and educational attainment
<b>United States</b>	Education	1st quartile 2nd quartile 3rd quartile 4th quartile	1979; 2011	(Sanzenbacher, Webb, Cosgrove, & Orlova, 2015) from the National Longitudinal Mortality Study



**From:**  
**OECD Business and Finance Outlook 2016**

**Access the complete publication at:**  
<http://dx.doi.org/10.1787/9789264257573-en>

**Please cite this chapter as:**

OECD (2016), "Fragmentation of retirement markets due to differences in life expectancy", in *OECD Business and Finance Outlook 2016*, OECD Publishing, Paris.

DOI: <http://dx.doi.org/10.1787/9789264257573-11-en>

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