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What level of pension contribution is needed to obtain an adequate retirement income?

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Executive Summary

Under automatic enrolment, employers are required to automatically enrol their employees into a qualifying pension scheme. The minimum total contribution rate is 8% of a band of earnings from £5,668 and £41,450 per annum, of which a minimum 3% must come from the employer. With over 80% of Defined Benefit (DB) schemes now closed to new members or future accruals the majority of employers are expected to select a Defined Contribution (DC) pension as their qualifying scheme.

This report analyses what ranges of retirement incomes from a DC pension different individuals might achieve by making only the minimum required level of contributions. The report also analyses the contribution rate necessary for different individuals to have a "good chance" of achieving an adequate retirement income. This report employs outputs from the PPI Individual Model adapted to use stochastic modelling techniques, based on a model developed by the Department of Mathematics at King's College London. Each individual modelled is run 100,000 times with different economic scenarios. This illustrates better the variability around investment returns and economic variables year on year.

Adequacy can be defined as to what extent individuals have a retirement income that fulfils their basic needs or to what extent retirement income allows individuals to replicate the standards of living they had while in working life. Replacement rates are a good way to assess whether pensioners may be able to replicate their working life living standards. This report uses replacement rates similar to those set out by the Pension Commission to assess the adequacy of retirement income for different individuals under different scenarios.

Retirement income from private and state pensions is uncertain. The target replacement income for a median earner is 67% of their pre-retirement earnings. In 49% of the cases generated in the modelling a median earner could reach their target replacement income with private and state pensions income, if starting to save at age 22, retiring at State Pension Age (SPA), following a traditional lifestyle investment approach and contributing at 8% of band earnings (Chart A).

Saving at the minimum contribution rate of 8% of band earnings may not be enough for some individuals. In more than half of the scenarios modelled income is below the target replacement income and in 25% of the scenarios income from private and state pensions was less than 75% of the target replacement income.

Lower earners have a higher probability of achieving their target replacement income than median or higher earners. (Chart B).

Chart A[1]

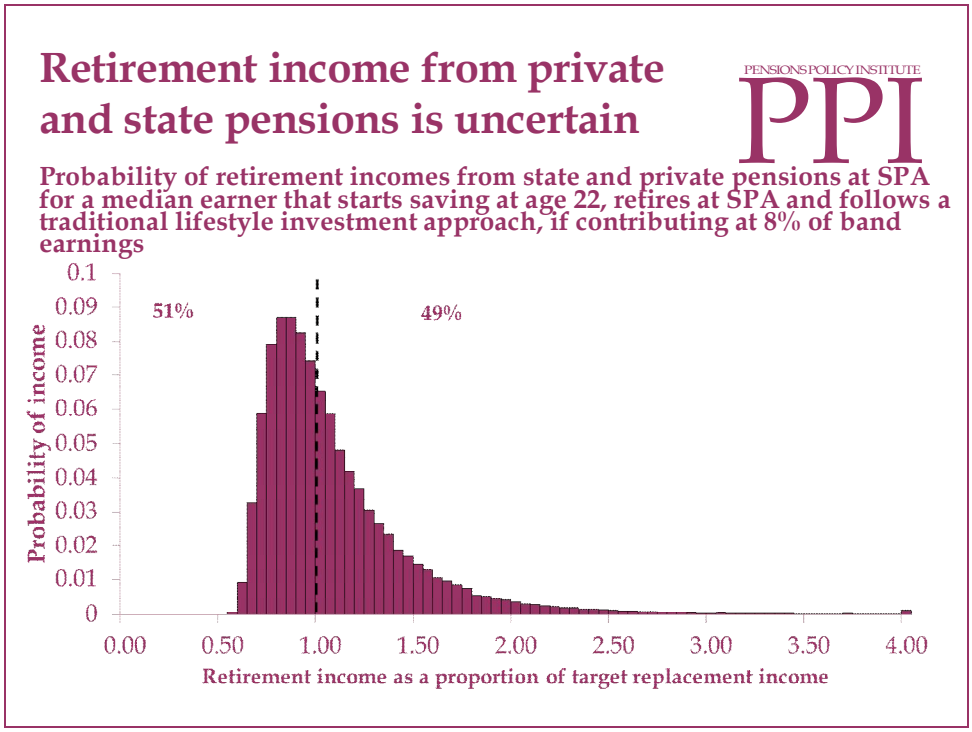
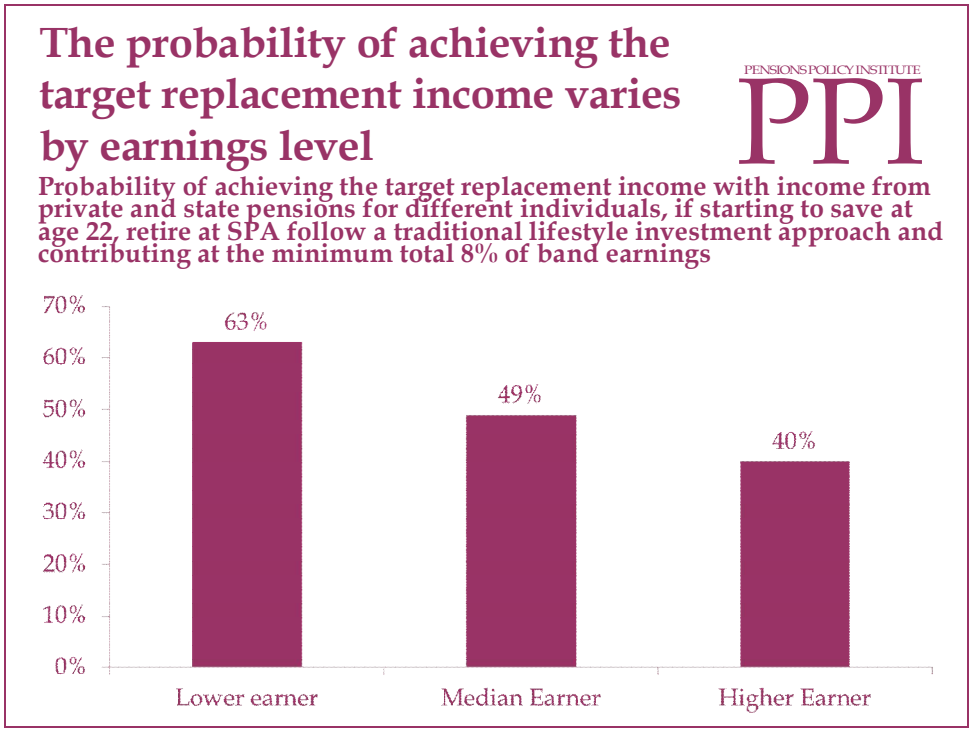


Chart B[2]

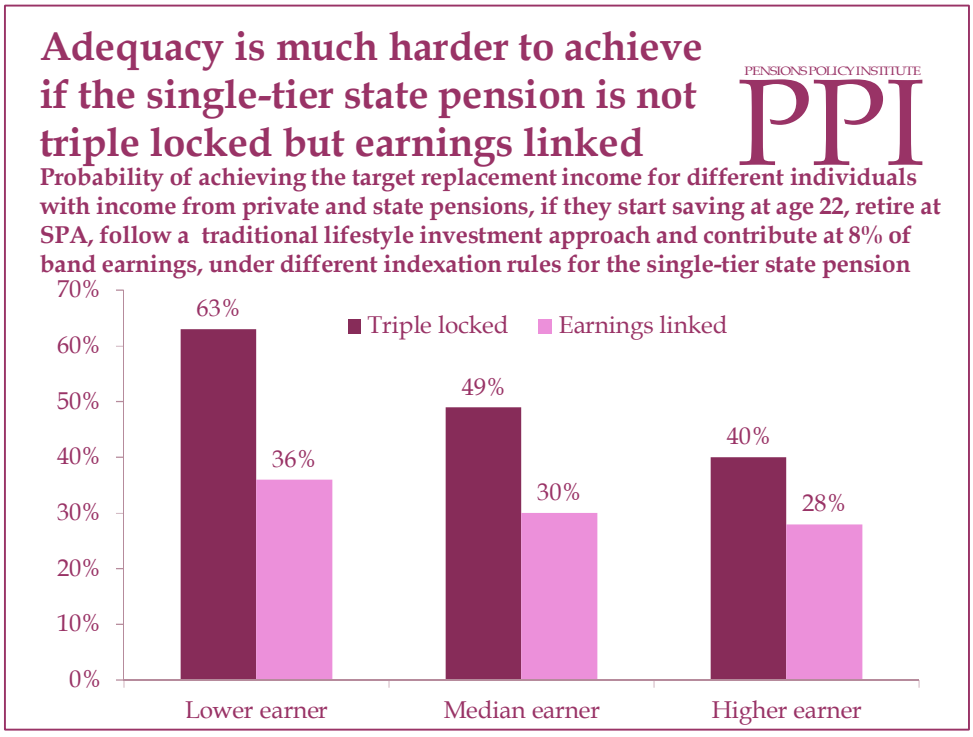


[1] PPI and King's College London modelling analysis
[2] PPI and King's College London modelling analysis

Under the baseline scenario of starting to save at age 22, retiring at SPA and following a traditional lifestyle investment approach, a lower earner has a 63% probability of achieving their target replacement income, compared to 49% for a median earner and 40% for a higher earner. Lower earners have a higher probability of achieving their target replacement rate because the single-tier state pension introduced from 2016 will represent a higher proportion of lower earners' pre-retirement earnings than for median or higher earners.

However, adequacy will be sensitive to the indexation mechanism used for the single-tier state pension. Currently, the Basic State Pension (BSP) is uprated by the triple lock of the higher of changes in average earnings, changes in the Consumer Prices Index (CPI) or 2.5%. Current legislation stipulates that the BSP must be uprated at least in line with changes in average earnings. Once the single-tier pension is introduced in 2016, it will be up to the government of the day to decide whether anything more than average earnings is needed. Adequacy is much harder to achieve if the single-tier state pension is increased in line with average earnings rather than triple locked (Chart C).

Chart C[3]



The triple lock indexation mechanism for the single-tier state pension is more generous than just average earnings because in years of low inflation or earnings growth, the single-tier pension would increase by at least 2.5%. The probability of different individuals achieving the target replacement income if

[3] PPI and King's College London modelling analysis

contributing at the legal minimum of 8% of band earnings reduces by almost a half if the single-tier state pension is indexed by average earnings.

For a lower earner, the probability of achieving their target replacement income decreases from around 63%, if the single-tier pension is uprated by the triple lock, to around 36% if the single-tier pension is uprated by average earnings. For a median earner, the probability of reaching their target replacement income decreases from around 49% to 30% and for a higher earner the probability decreases from around 40% to around 28%.

The contribution rate needed to achieve an adequate retirement income will be sensitive to investment approaches and charges. In automatic enrolment, many individuals will stay in default funds, with a pension scheme chosen by their employer. This default fund could be based on one of a number different investment approaches. Different investment approaches would entail different levels of annual management charges (AMC) applied to an individual's fund.

There are different investment approaches but this report considers retirement outcomes under three approaches. Under a traditional lifestyle investment approach, the funds in which pension contributions are invested are changed automatically depending on the length of time until the expected retirement date. Members' funds are invested in equities since early years and switched to gilts and cash as the individual approaches retirement. A first alternative approach aims to achieve lower volatility in early years at the expense of potential returns. A second alternative approach aims to reduce volatility but not at the expense of lower returns. This is done by reducing equity volatility within a traditional lifestyle approach.

The investment approach and the AMC paid, together with the indexation mechanism used for the single-tier state pension, could affect the contribution rate needed to achieve an adequate retirement income (Table D).

Table D[4]

		Single-tier triple locked		Single-tier earnings linked	
Probability of achieving the target replacement income	**Investment approach**	**AMC: 0.5%**	**AMC: 1%**	**AMC: 0.5%**	**AMC: 1%**
Two-thirds	Traditional lifestyle	11%	12%	14%	16%
	First alternative	12%	14%	16%	17%
	Second alternative	10%	12%	14%	15%
Three-quarters	Traditional lifestyle	13%	15%	17%	18%
	First alternative	14%	15%	17%	19%
	Second alternative	12%	14%	15%	17%

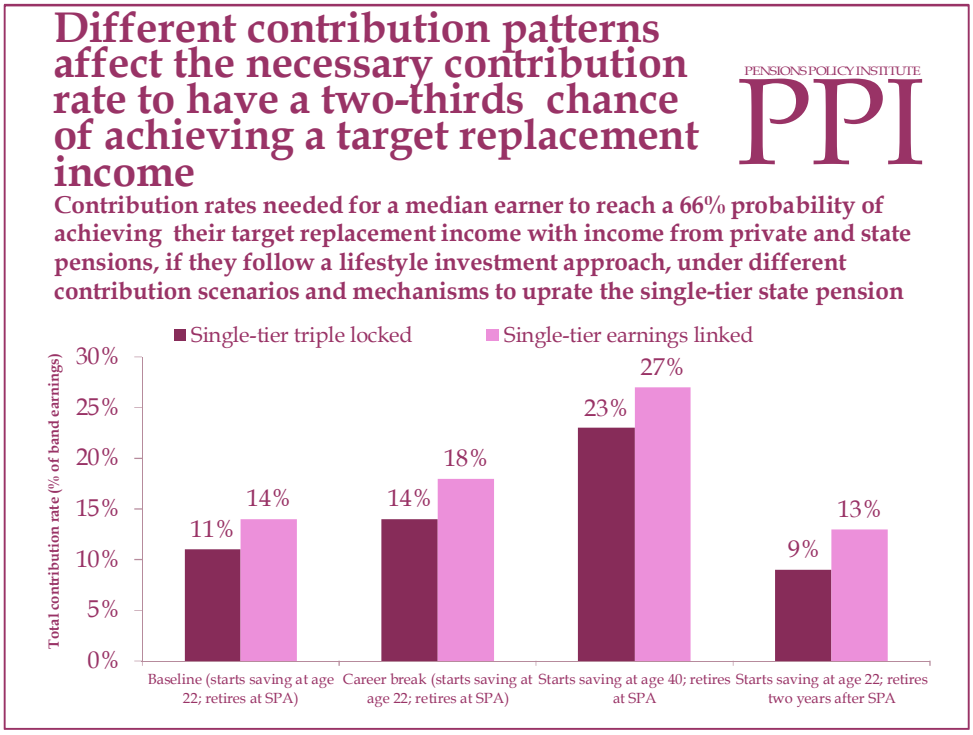
The contributions required do vary between the different stylised investment strategies modelled. However, the contributions required do not change significantly with the alternatives, generally either one percentage point higher or lower than under a traditional lifestyle approach. The contributions required are more sensitive to both charges and the indexation mechanism for the single-tier state pension.

The range of outcomes taking into account changes in all these factors is large. For example, the total contribution required to reach a two-thirds chance of achieving the target replacement income ranges from 10% in a low charging scheme with a triple locked state pension to 17% in a higher charging scheme and an earnings linked state pension.

Changes in contribution patterns affect the contribution rate needed for an adequate retirement income. Whether people take career breaks, start to save later in life or decide to retire some years after their SPA affects the contribution rates needed to have a good chance of reaching an adequate retirement income. But this also depends on the indexation mechanism used to uprate the single-tier state pension. (Chart E)

[4] PPI and King's College London modelling analysis

Chart E[5]



If the single-tier state pension is uprated by the triple lock, a median earner that takes a career break needs a total contribution rate of 14% to have a two-thirds chance of reaching the target replacement income, compared to 11% under the baseline of starting to save at age 22 and retiring at SPA. The contribution rate needed increases to 23% if the median earner starts to save at age 40. If the single-tier state pension is uprated by changes in average earnings a median earner needs a total contribution rate of 18% if taking career breaks and 27% if starting to save at age 40.

By contrast, a contribution rate of 9% of band earnings will be necessary to have a three-quarters chance of reaching the target replacement income if retiring two years after SPA and the single-tier state pension is uprated by the triple lock. This increases to 13% if the single-tier state pension is uprated by changes in average earnings.

Many individuals will need to contribute more than the legal minimum.
The Government could consider a number of strategies to increase pension saving. The Government could encourage or enable the provision of information and advice to individuals, or they could provide better incentives for pension saving, so that individuals choose to save more.

However, automatic enrolment was introduced because the system of incentives to save and advice has not worked well in the past. There is also evidence that the system of incentives to save is poorly understood.

[5] PPI and King's College London modelling analysis

The Government could consider a number of inertia mechanisms to increase contribution levels such as auto-escalation where a member contribution rate increases in line with earnings increases. However, some form of compulsion by making saving into a pension mandatory might need to be considered if individuals opted-out in large numbers as a result of higher minimum contributions. The Government could also promote initiatives that encourage people to use other types of wealth to increase their retirement savings and promote initiatives to make individuals work longer.

Introduction

Once automatic enrolment into workplace pensions is fully implemented in 2018, it is estimated that there could be between 6 and 9 million new savers in workplace pensions. With over 80% of Defined Benefit (DB) schemes closed to new members or to future accrual, new savers are likely to be enrolled into Defined Contribution (DC) schemes, where contribution levels are one of the key factors that determine pension outcomes. Current contribution levels to DC schemes are low. In 2012 average employee contributions into occupational DC schemes were around 3% of salary and average employer contributions were around 7% of salary.[6] The minimum total contribution rate under automatic enrolment is 8% of a band of earnings from £5,668 and £41,450 per annum, of which a minimum 3% must come from the employer.

Against this background, this report analyses how incomes generated from these contributions compare to an income that might be considered adequate for retirement for individuals with different characteristics. This report also analyses how the required levels of contributions to achieve an adequate retirement income differ from current contribution levels, and discusses to what extent there is an adequacy gap. The analysis explicitly accounts for uncertainties in investment returns and inflation, which have an impact on retirement income adequacy.

Chapter one discusses the main approaches to measure adequacy such as poverty thresholds, minimum income standards and replacement rates. The chapter then discusses the main factors affecting retirement income from DC schemes such as the contribution rate, the history of contributions and the investment strategy followed during the accumulation phase.

Chapter two sets out the methodological approach used throughout this report to measure retirement income adequacy. The chapter then analyses the distribution of private pension outcomes and the probability of achieving the target replacement rate with income from private and state pensions for individuals with different characteristics, if contributing at the legal minimum of 8% of band earnings.

Chapter three analyses the contribution rates that would be necessary to achieve a two-thirds or three-quarters probability of reaching an adequate retirement income.

Chapter four compares the contribution rates necessary to achieve adequate retirement income levels with current contribution levels. The chapter discusses to what extent there is an adequacy gap.

[6] ONS (2013) Table 8. Weighted average figures rounded to nearest 1%.

Chapter 1: How is adequacy of retirement income measured?

This chapter discusses the main measures for retirement income adequacy. It also discusses the main factors affecting the retirement income generated in Defined Contribution pension schemes.

There are two main definitions of adequacy

There are two ways of defining adequacy in the context of retirement income:

- adequacy can be defined as to what extent retirement income allows individuals to fulfil basic needs;
- alternatively, adequacy can be defined as to what extent retirement income allows individuals to replicate the standards of living they had while in working life.

If the first definition is preferred, poverty thresholds and minimum income standards are more appropriate to assess adequacy. If the second definition is preferred, replacement rates may be more useful to assess adequacy.

Poverty thresholds

Poverty thresholds are based on establishing a given income under which people are considered to be income poor. Poverty measures can be either *absolute* or *relative*.

Absolute poverty measures establish the proportion of the population that lives below a certain poverty line that is the same across all countries and does not change. In the UK, the absolute poverty line is set at 60% of the median income in 1998/99 held constant in real terms. In developing countries, the World Bank approach of considering the proportion of people with incomes under a certain threshold such as $1 or $2 a day is an absolute measure of poverty that is used.[7]

Relative poverty measures employ a poverty line that is related to an average income level, which itself changes over time. In the UK and other OECD countries, the current relative poverty line is set at 60% of median income of the whole population.

The main advantage of absolute and relative poverty measures is that they are easy to establish and that they allow comparisons among different groups or countries. Yet, relative poverty measures are difficult to project into the future as specific assumptions on the progression of median incomes and the income of specific groups must be made.

Relative poverty measures are not based on the true income needs of people but rather on how their income compares to an arbitrarily set poverty line.

[7] See World Bank methodology at: data. worldbank.org/indicator/SI.POV.DDAY

Furthermore, relative poverty measures are sensitive to fluctuations in the economy. When median income falls, more people within a certain group may be moved above the relative poverty line, even if their income has not increased.[8]

Relative and absolute poverty measures can be considered before housing costs (BHC) or after housing costs (AHC). The rationale for differentiating between these two measures is that housing costs may represent a significant outlay for some households (for example, for those living in London), so it would be unfair to compare their income to those living in cheaper locations. However, AHC income measures may understate the improvement in the quality of living of those who decide to pay more for better quality housing. Also, housing costs may be different for pensioners as many of them could have paid off their mortgages and may have downsized. Therefore, UK Government relative income poverty measures are reported both before and after housing costs.

In 2011/2012, the relative poverty line was £172 per week for singles with no children and £256 for couples with no children, before housing costs (BHC). After housing costs (AHC) the relative poverty line was £128 per week for singles with no children and £220 per week for couples with no children.[9]

16% of pensioners (1.9 million) were in households with incomes below 60% of median income, before housing costs (BHC). 14% of pensioners (1.6 million) were in households with incomes below 60% of median income, after housing costs (AHC).[10]

Minimum income standards

Minimum income standards have been developed in the UK as an alternative to poverty thresholds.[11] They are based on feedback from a sample of the population on the types of goods and services they deem necessary to stay out of poverty. The value of this standard "basket" of goods and services is then used to assess whether a person's income is above or below this level. In 2012, the minimum income standard for a pensioner couple was £303 per week, including rent but excluding council tax and £241 per week, excluding rent and council tax.[12]

Minimum income standards are sensitive to the specific type of goods and services selected and the measures do not account for the changing income needs of those who are frail, disabled or long-term ill.[13]

[8] Price, D. (2008) p. 97 to 102.
[9] DWP (2013) Table 2.2db
[10] DWP (2013) Tables 6.1tr and 6.3tr
[11] Bradshaw et al (2008)
[12] JRF (2013)
[13] Fisher, G. (2007)

The introduction of the single-tier state pension may have an impact on the number of people below poverty thresholds

The Government has introduced the Pensions Bill 2013-14 for the consideration of Parliament which proposes the implementation of a single-tier state pension from April 2016. The new pension will replace the current Basic State Pension (BSP) and the State Second Pension (S2P). Although the specific value of the single-tier pension will be set by the Government of the day closer to the implementation date, the Government's White Paper illustrates the new single-tier pension set just above the current Guarantee Credit level, at £144 per week (in 2012/13 earnings terms).[14]

The proposed legislation requires 35 years of National Insurance Contributions (NICs) to qualify for a full single-tier state pension, compared to 30 years to qualify for the Basic State Pension under the current system. A significant proportion of future pensioners could qualify for a full single-tier pension. Therefore, some future pensioners could have incomes from their state pension alone above the relative poverty threshold of 60% of median income or the minimum income standard (Table 1).

Table 1: Comparison of single-tier pension entitlement and adequacy thresholds, £ per week[15]

	Single pensioner with no children	Couple pensioner with no children
Full single-tier pension	£144 (2012/13)	£288 (2012/13)
Relative poverty threshold (BHC)	£172 (2011/12)	£256 (2011/12)
Relative poverty threshold (AHC)	£128 (2011/12)	£220 (2011/12)
Minimum income standard (including rent but excluding council tax)[16]	N/A	£303 (2012/13)
Minimum income standard (excluding rent, council tax and water rates)[17]	N/A	£215 (2012/13)

The figures in Table 1 are based on current levels of poverty thresholds, minimum income standards and the proposed single-tier pension. The different levels of poverty thresholds and minimum income standards may change in the future, as well as the level of the future single-tier pension.

[14] DWP (2013)
[15] Rounded to nearest £. Source: DWP (2013); JRF (2013); DWP (2012) HBAI
[16] Comparable to BHC in HBAI
[17] Comparable to AHC in HBAI.

Even if a significant proportion of pensioners could be expected to have incomes above the relative poverty threshold or the minimum income standards in the future, they may not be able to replicate the standards of living they had while in working life. This is because relative poverty thresholds and minimum income standards set a minimum income level. Therefore some pensioners could have incomes that may represent a significant drop from their pre-retirement earnings.

Replacement rates may be more useful to capture whether pensioners have an income that allows them to replicate their working life living standards.

Replacement rates

Replacement rates are defined as the ratio of retirement income to working life earnings. There are two main ways of applying this measure:

- as a ratio to average earnings or
- as a ratio to earnings before retirement.

While the concept of a replacement rate may seem straightforward as it is a simple ratio of retirement income to earnings, its calculation is sensitive to what is considered as retirement income and what is considered as earnings. For example, if salary reduces in the years close to retirement, then using a definition that considers only the earnings in the year immediately before retirement may understate the replacement rate. Similarly, whether housing equity is included as income in retirement may affect the calculation of replacement rates.[18]

Despite some disagreement as to how best to define the measure of earnings and retirement income used to calculate replacement rates[19] the use of replacement rates is widespread to measure retirement income adequacy because it is a concept relatively easy to understand. As such, replacement rates have been used to inform the policy debate in the UK and elsewhere.

The work of the Pensions Commission drew extensively on the use of replacement rates to measure adequacy.[20] The Department for Work and Pensions (DWP) has recently published a paper analysing the adequacy of future pension incomes that also uses replacement rates.[21]

In the US, replacement rates were also used to analyse retirement income adequacy in the context of the Commission for Social Security.[22] Therefore, as long as some agreement can be made on the measure of earnings and income used, replacement rates can be useful to measure retirement income adequacy.

[18] Munnel (2005)
[19] McGill, Dan M., Kyle N. Brown, John J. Haley, and Sylvester J. Schieber. (2004).
[20] Pensions Commission (2004)
[21] DWP (2013)
[22] Cogan, John F. and Olivia S. Mitchell (2003)

Replacement rates may be gross or net of taxes. Gross replacement rates include the taxes and contributions that pensioners must pay. Net replacement rates exclude such taxes and contributions. In the UK, there is no accepted benchmark available for net replacement rates. In contrast, the Pensions Commission[23] analysis provides a well-known benchmark for gross analysis. In practice, as long as the differences in the tax regime are taken into account in the setting of the benchmark, the differences in the findings from using gross or net replacement rates should be minimal. Table 2 sets out the Pensions Commission target replacement rates, uprated to 2012 earnings terms and the equivalent target replacement income

Table 2: Pensions Commission target replacement rates in 2012 Earnings Terms[24]

Earnings	Target replacement rate	Target replacement income
Less than £12,136	80%	Less than £9,709
£12,136 – £22,354	70%	£8,495 – £15,647
£22,355 - £31,936	67%	£14,978 - £21,397
£31,937 – £51,098	60%	£19,162 – £30,659
Over £51,098	50%	Over £25,549

The target represents the replacement rate that different individuals should achieve to be able to replicate the standards of living they had while in working life. The target replacement rates are always less than 100% because, on average, pensioners have fewer income needs than working-age people as, for example, they do not need to commute to work on a daily basis. The target replacement rate is higher for lower earners as they may need a higher proportion of their pre-retirement earnings to be able to replicate their pre-retirement living standards.

This report and a recent DWP paper[25] use replacement rates to assess the adequacy of retirement income and they compare replacement rates to the targets set by the Pension Commission. Also, both papers calculate replacement rates by comparing retirement income to an average of pre-retirement earnings. By contrast, while this report considers retirement income at SPA and five and ten years after SPA to calculate replacement rates, the DWP paper considers the retirement income across the whole of retirement, adjusted for inflation. The DWP paper also makes an adjustment for housing costs in retirement income and income in working life.

[23] Pensions Commission (2004)
[24] PPI calculations based on Pensions Commission (2004)
[25] DWP (2013)

Box 1: The replacement rate measure used in this report

This report uses replacement rates to assess the adequacy of retirement income. Replacement rates are calculated as the ratio of retirement income in the year of retirement to the average earnings in the 10 years previous to retirement, adjusted by average earnings growth. The report also considers the retirement income five and ten years after retirement. Replacement rates are compared against the target replacement rates set out by the Pensions Commission.

The approach of this report is similar to the one adopted by the DWP to measure the adequacy of retirement income.[26]

The DWP paper uses replacement rates to assess retirement income adequacy where:

- retirement income is averaged across the whole of retirement (and adjusted for inflation);
- income in work is based on average earnings for those years in work between age 50 and SPA.

Changes in UK private sector pension provision may affect future pensioners' retirement income adequacy

DC schemes have become prevalent in the UK private sector. In the late 1960s there were over 8 million active members in DB schemes in the private sector. By 2011, there were only around 1.6 million active members in DB schemes and over 6 million active members (around 60% of all private sector active members) in DC schemes.[27]

Automatic enrolment is likely to increase the number of people saving into a DC pension

From 2012, employers are required to automatically enrol their employees into a qualifying scheme. The process is staged. Larger employers started to automatically enrol their employees in October 2012 and the process will finish in February 2018. Employees from age 22 to SPA and with earnings of at least £9,440 will be automatically enrolled, but they will have the right to opt-out. Once automatic enrolment is fully rolled out in 2018, total contributions of 8% of a band of earnings from £5,668 to £41,450 (2013/14) will be paid into the scheme, with a minimum 3% from the employer. Contributions based on band earnings will be lower when considered as a percentage of total earnings, although this will depend on the level of earnings (Table 3).

[26] DWP (2013)
[27] PPI (2012) Chart 2

Table 3: Equivalence between contributions as a percentage of band earnings (£5,668 to £41,450) and as a percentage of total earnings

Contribution rate as percentage of band earnings	Total earnings (£ per year)				
	£10,000	**£20,000**	**£30,000**	**£40,000**	**£50,000**
8%	3.5%	5.7%	6.5%	6.9%	5.7%
10%	4.3%	7.2%	8.1%	8.6%	7.2%
12%	5.2%	8.6%	9.7%	10.3%	8.6%
14%	6.1%	10%	11.4%	12%	10%
16%	6.9%	11.5%	13%	13.7%	11.5%
18%	7.8%	12.9%	14.6%	15.4%	12.9%
20%	8.7%	14.3%	16.2%	17.2%	14.3%

The introduction of automatic enrolment into private pensions from 2012 is likely to increase the number of people saving into a DC pension. With over 80% of DB schemes now closed to new members or future accruals the majority of employers are expected to select a DC pension as their qualifying scheme.[28]

The predominance of DC provision in the private sector may have implications for future levels of retirement income adequacy given that members in a DC scheme bear all the risks of pension provision. Also, there are different factors that may affect total savings into a DC scheme.

There are important factors affecting retirement income from a DC pension

In a typical DC scheme, a fund is built up on behalf of the member with contributions from the employer and/or the member. Retirement income will then vary depending on a number of factors, such as:

- The level of contributions.
- The consistency of contributions.
- The investment return achieved by the fund. This depends on the investment strategy of the fund as well as on the market returns on the involved investment classes.
- The charges levied against the accumulated fund.
- The type of annuity purchased to convert a pension pot into an income stream.

The level of contributions is one of the most important factors affecting total savings in a DC scheme. Following the introduction of automatic enrolment into private pensions from 2012, whether employees and employers decide to contribute at the legal minimum of 8% of band earnings or at higher rates may have a substantial impact on total pension savings. Previous PPI research has found that raising total contributions from the legal minimum of 8% of band

[28] PPF-TPR (2012)

earnings to 12% for a median earning man could increase the replacement rate from around 54% of their average earnings in the five years previous to retirement to around 63%.[29] However this estimate assumed a fixed return and did not allow for uncertainty.

Given that DC retirement income depends heavily on contributions, whether an individual has a short or long history of contributions can also affect retirement income. When considering an individual contribution history, three aspects must be taken into account:

- The age at which a member starts contributing to a DC scheme. Because contributions are used to build up a fund that achieves a certain return every year, if a member starts saving at an early age they may achieve a higher retirement income than if starting to save later in their working life.
- Whether a member has career breaks. Generally, members do not make contributions to a DC scheme while being unemployed and this may lead to a smaller pension pot.
- The age at which a member retires. All things being equal, a longer contribution history will generally help to build a large DC fund. Previous PPI research has found that a median earning man retiring two years later than their SPA could increase the replacement rate for a median earner from around 54% of their average earnings in the five years previous to retirement to around 58%. Retiring later has a twofold benefit. It increases the size of the fund and it also helps to obtain a higher retirement income because of the deferment in the purchase of an annuity.

The investment strategy may also affect total DC savings. Investment strategies in which funds are heavily invested in assets with fixed or predictable returns, such as bonds, will tend to minimise risk, however this may be at the expense of long-term returns. Investment strategies which are instead heavily invested in growth-seeking assets, such as equities, will tend to carry more risk and volatility for the member but may offer more opportunities for long-term returns. There is no optimal investment strategy for a default fund in DC. In practice a wide range of investment strategies and asset allocations are being used by pension providers and employers, both in the growth phase and in the de-risking phase ahead of retirement.

Finally, the charges applied to a DC fund can also affect retirement income. Members of DC schemes typically pay an annual management charge (AMC), which is levied against the accumulated fund every year. All other factors being equal, a higher level of management charges reduces the amount of money in the pension fund at retirement. The effect of the management charge is compounded for every year of saving, so even relatively small changes in the level of the AMC can have a significant impact on the members' fund by the time they reach retirement.

[29] PPI (2012)

How adequate are contributions?

Taking into account the key role of the contribution rate, the consistency of contributions and the investment strategy adopted by a DC scheme member to determine retirement income adequacy, this report aims to explore the following research questions in the UK context following the introduction of automatic enrolment into workplace pensions:

- What range of retirement incomes might individuals be able to achieve by making only the minimum required level of contributions? How does this compare to a pre-specified adequacy threshold?
- What level of contribution rate is required for an individual to have a "good chance" of achieving an adequate level of retirement income?

The analysis in this report will consider the adequacy of retirement income for different individuals that are automatically enrolled into a DC pension once automatic enrolment is fully rolled out in 2018 under different scenarios. Given that the single-tier state pension would be implemented by the time these individuals are automatically enrolled, replacement rates will be used to measure the adequacy of retirement income.

The next chapter lays out the methodology employed in this research. The subsequent analysis shows the probability of individuals reaching a target replacement income under different scenarios if contributing at the minimum required by the legislation. The analysis also shows the contribution rate necessary to have a good chance of achieving a target replacement income.

Summary

Adequacy can be defined as to what extent individuals have a retirement income that fulfils their basic needs or to what extent retirement income allows individuals to replicate the standards of living they had while in working life.

Poverty thresholds and minimum income standards can be useful to assess whether individuals have an income that allows them to fulfil their basic needs. The introduction of the single-tier pension from 2016 may imply that future pensioners could have incomes from their state pension above the relative poverty threshold of 60% of median income or the minimum income standard. However, being above the poverty threshold does not necessary imply that pensioners may have an income that allows them to replicate the standards of living they had while in working life.

Replacement rates may be more useful to assess whether pensioners may be able to replicate their working life living standards. This report uses replacement rates similar to those set out by the Pension Commission to assess the adequacy of retirement income for different individuals under different scenarios.

The landscape of pension provision in the private sector in the UK has changed in recent years with a majority of active members in a DC pension

scheme. With over 80% of DB schemes now closed to new members or future accruals the majority of employers are expected to select a DC pension as their qualifying scheme.

A number of factors may affect retirement income from DC pensions such as the contribution rate, the consistency of contributions, the investment strategy followed and the charges levied against the fund.

Chapter 2: How often could minimum contributions result in an adequate retirement income?

This chapter analyses the range of outcomes of individuals achieving an adequate retirement income if they contribute at the minimum level of 8% of band earnings, following the introduction of automatic enrolment.

The chapter begins by describing the different individuals and the combination of characteristics that will be considered under the baseline and alternative scenarios. The chapter then describes the methodological approach used and the results.

The different individuals modelled

The analysis in this chapter and subsequent ones is based on the modelling of scenarios. Each scenario considers the working life of a hypothetical individual who is automatically enrolled into a DC workplace pension in 2018, once automatic enrolment is fully rolled out.

The range of retirement income that individuals could achieve if being automatically enrolled into a workplace pension will vary according to different individuals' characteristics such as:

- their earnings levels during their working life;
- the investment strategy followed while contributing to a DC pension scheme and the charges levied by the scheme;
- when individuals start saving and when they decide to retire.

Taking into account these factors, three individuals with low, median and higher earnings profiles are modelled (Box 2).

Box 2: Individuals and scenarios

The low earner individual is assumed to earn at the 30th percentile of age-specific economy-wide earnings.
The median earner individual is assumed to earn at the 50th percentile of age-specific economy-wide earnings.
The higher earner individual is assumed to earn at the 70th percentile of age-specific economy-wide earnings.

Baseline scenario

Under the baseline scenario, each individual is assumed to start saving at age 22 in 2018, once automatic enrolment is fully rolled out, and to retire at their State Pension Age (SPA) in 2064.

Each individual is assumed to follow a traditional lifestyle investment approach. Under this approach, the funds in which pension contributions are invested are changed automatically depending on the length of time to the expected retirement date. Members' funds are invested in equities and switched to gilts and cash as the individual approaches retirement.

Alternative scenarios

A first alternative scenario considers each individual following an investment approach with lower volatility in early years at the expense of potential returns. Under this strategy, a fund is mostly composed of low risk assets in the years right after members start saving. The fund then switches to higher risk return-seeking assets as a member gets older, although keeping a mix of equities and gilts. The fund switches to gilts in the years close to retirement.

A second alternative scenario considers each individual following an investment approach that aims to reduce volatility but not at the expense of lower returns. This is done by reducing equity volatility within a traditional lifestyle approach. In practice, this could be achieved through active management or greater asset diversification with a progressive switch to gilts and cash as the member nears retirement. For example, Diversified Growth Funds (DGF) aim to reduce volatility by hedging different asset classes, so that when some asset values fall others increase. 70% of the FTSE 100 companies now offer Diversified Growth Funds (DGF's) as part of the fund range in their DC pension schemes.[30]

Three further scenarios model a median earner following a traditional lifestyle investment approach and:

- Taking a career break: the individual is assumed to start saving at age 22. Between the ages of 32 and 39 he/she takes time off to care for children. He/she returns part-time at age 39 earning at 50% of full-time earnings. He/she returns to full employment at age 41 and retires at his/her State Pension Age (SPA).
- Starting to save later in life: the individual is assumed to start saving at age 40.
- Retiring some years after SPA: the individual is assumed to retire two years after SPA.

Unless specified, in all different scenarios an Annual Management Charge (AMC) of 0.5% is assumed as a baseline. This is consistent with the recent Office for Fair Trading report, which found that the average AMC for new auto-enrolment schemes is 0.51% of the fund.[31] This assumes that the level of the AMC being levied on members is independent from the investment strategy approach. Some investment approaches, including the use of active management and Diversified Growth Funds, will generally carry higher charges. However, the link between charges and investment performance is complex, and so these interdependencies have not been modelled here.

Methodological approach

The analysis uses the PPI Individual Model, which has been adapted to use stochastic modelling techniques, based on a model developed by the Department of Mathematics at King's College London. The Individual Model

[30] See TowersWatson (2012) "FTSE 100 DC schemes choose Diversified Growth Funds."
[31] OFT (2013) p.19

projects future state and private pension income for hypothetical individuals with different characteristics. The outputs from this model are used to calculate the State Pension entitlement of the different individuals modelled, based on the recently announced State Pension reforms which introduce a single-tier state pension.

Investment returns from private pensions, inflation and average earnings growth are modelled stochastically allowing annual investment returns in individuals' funds to fluctuate each year. Each individual is run 100,000 times with different economic scenarios. This illustrates the variability around investment returns and economic variables year on year. Therefore, using stochastic modelling instead of fixed investment return modelling provides a measure of the uncertainty of achieving an adequate retirement income.[32]

The analysis in this report compares retirement incomes for different individuals against target replacement incomes, similar to those set out by the Pensions Commission's target replacement rates. Replacement rates are calculated as the ratio of retirement income at State Pension Age (SPA) or 5 or 10 years after SPA, to the average earnings in the 10 years previous to retirement, adjusted by average earnings growth.

The investment approaches modelled in this report
The modelling of the investment approaches used in this report is highly stylised and not intended to represent any particular fund, so the different investment approaches modelled do not aim to replicate any of the current options available in the market such as specific traditional lifestyle pension products, the National Employment Savings Trust (NEST) funds or any type of Diversified Growth Funds.[33]

The modelling in this report does not assume any behavioural effects in the different investment approaches. For example, higher or lower volatility levels do not affect member contribution rates.

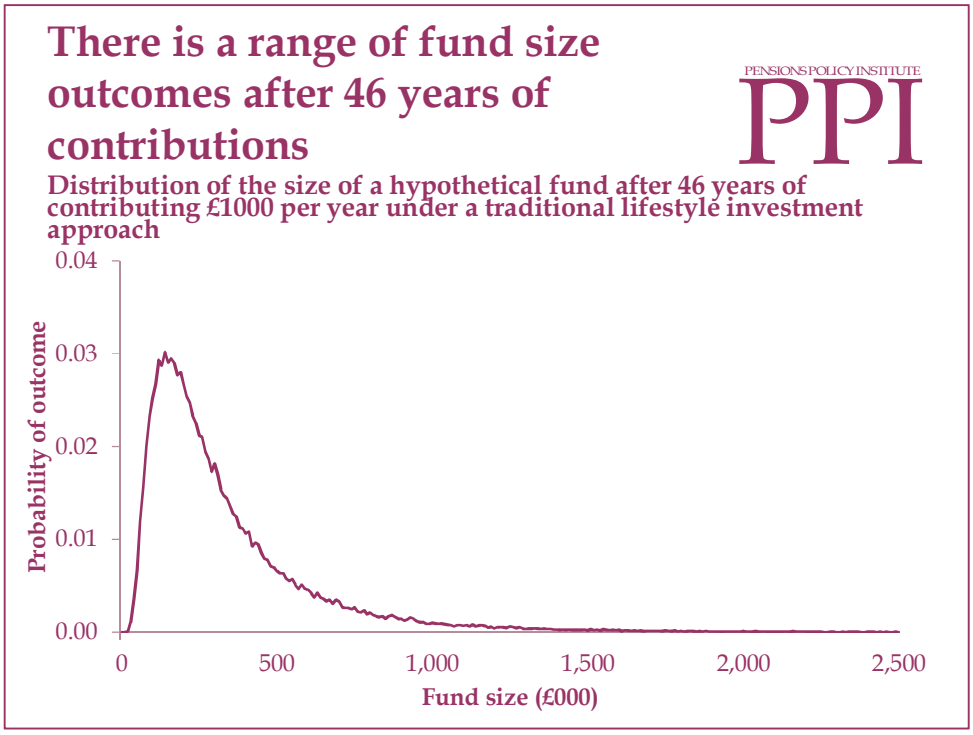
Retirement income from private pensions
This section analyses private pension incomes for different individuals if contributing at the legal minimum of 8% of band earnings. Looking at private pensions in isolation allows identifying the dispersion of incomes and their sensitivity to different earnings levels and different investment strategies.

In practice, the income from private pensions will be affected by factors such as the annuity rate used to convert an individual's pension pot into a retirement income, the evolution of earnings growth relative to investment returns and the inflation rate. To directly observe the impact of contributions on the size of an individual's pension fund, Chart 1 shows the distribution of the size of a hypothetical pension fund if £1,000 were contributed every year

[32] More details on the economic modelling can be found in Annex 1.
[33] Fore example, NEST funds use a mix of capital protection in early years and a diversified growth approach. See NEST (2012)

at the end of 46 years under a traditional lifestyle investment approach. A total of 46 years is used as this is similar to the total number of years that an individual aged 22 who is automatically enrolled in 2018 would contribute to a pension until reaching their SPA at age 68. An annual management charge (AMC) of 0.5% of the fund is assumed.

Chart 1[34]



There is a range of outcomes in the fund size after 46 years. The median fund size is around £254,800. And the size ranges from around £85,100 in the 5th percentile to £904,300 in the 95th percentile.[35]

Chart 1 illustrates the variability of fund sizes. However, the adequacy of retirement income will depend on a number of other factors as well as on the variability of the fund size. These include investment returns relative to price and earnings inflation after charges, annuity rates available at the time of retirement and inflation after retirement. In the rest of this report we therefore consider the probability of achieving the target replacement income, which takes all of these factors, and how they differ between scenarios, into account.

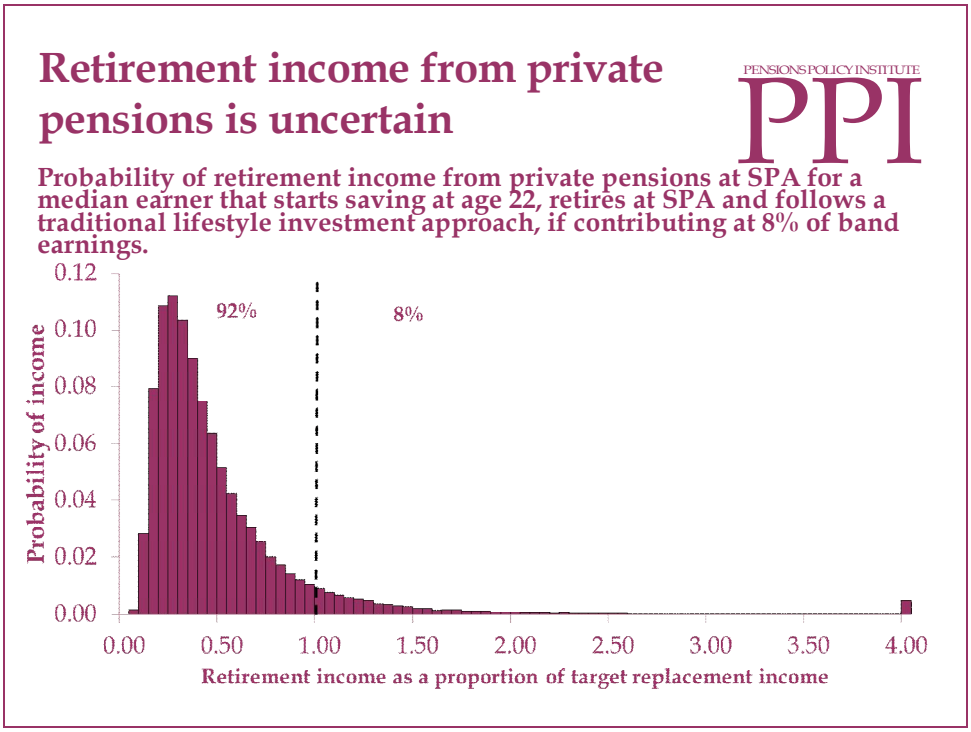
The outcome from saving into a pension is uncertain

The previous analysis indicates that the outcome from saving into a pension will be uncertain. Therefore, when taking into consideration the income from private pensions, there is a range of possible retirement incomes. Chart 2 shows the dispersion of private pension retirement incomes for a median

[34] PPI and King's College London modelling analysis
[35] Values rounded to nearest £100

earning individual under the baseline scenario of being automatically enrolled at age 22, retiring at State Pension Age (SPA) and following a traditional lifestyle investment approach, if contributing at the legal minimum of 8% of band earnings. The chart shows the probability of achieving the target replacement income through income from private pensions for the modelled individuals.

Chart 2[36]



The range of incomes is very wide. In 8% of the cases generated in the modelling, a median earner could meet their target replacement income from private pension saving alone, even at minimum contribution levels. In more than 90% of the cases generated in the modelling income is below the target replacement income, and in 25% of cases private pension income was less than 26% of the target replacement income.

Investment approaches affect private pension incomes

Different investment strategies may affect incomes from private pensions. In automatic enrolment, many individuals will stay in default funds, with a pension scheme chosen by their employer. This default fund could be based on one of a number different investment approaches.

To observe more directly the impact of alternative investment strategies, Charts 3 and 4 show the distribution of the size of a hypothetical fund after 5

[36] PPI and King's College London modelling analysis. The last bar in the chart shows the probability of a retirement income of that is four or more times the income adequacy benchmark.

and 46 years of making annual contributions of £1,000. An AMC of 0.5% of the fund is assumed.

Chart 3[37]

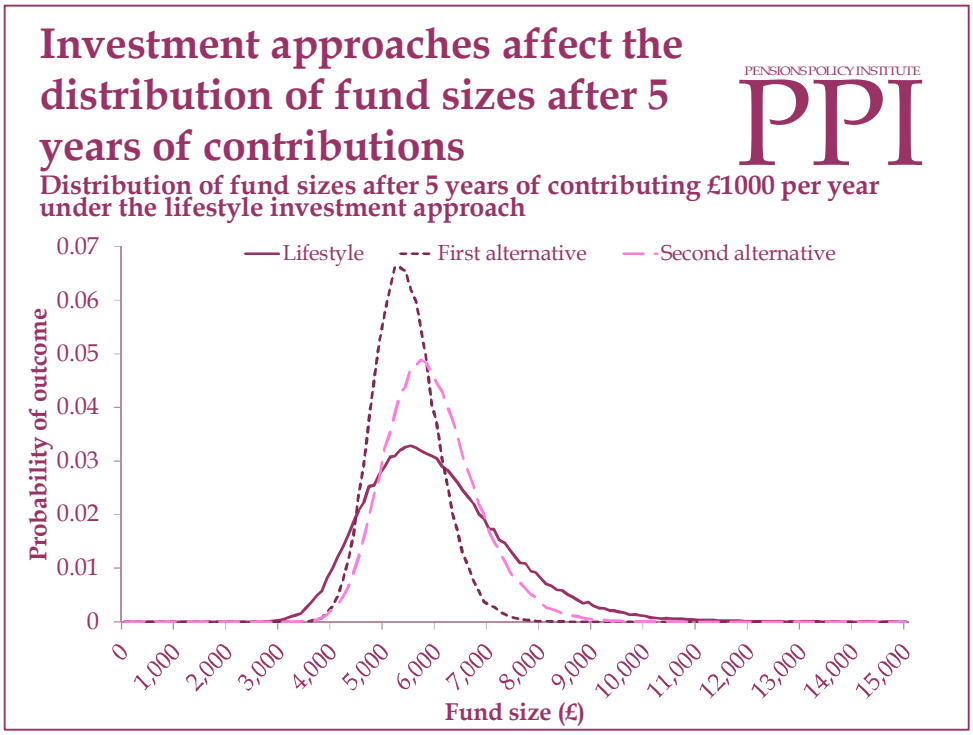
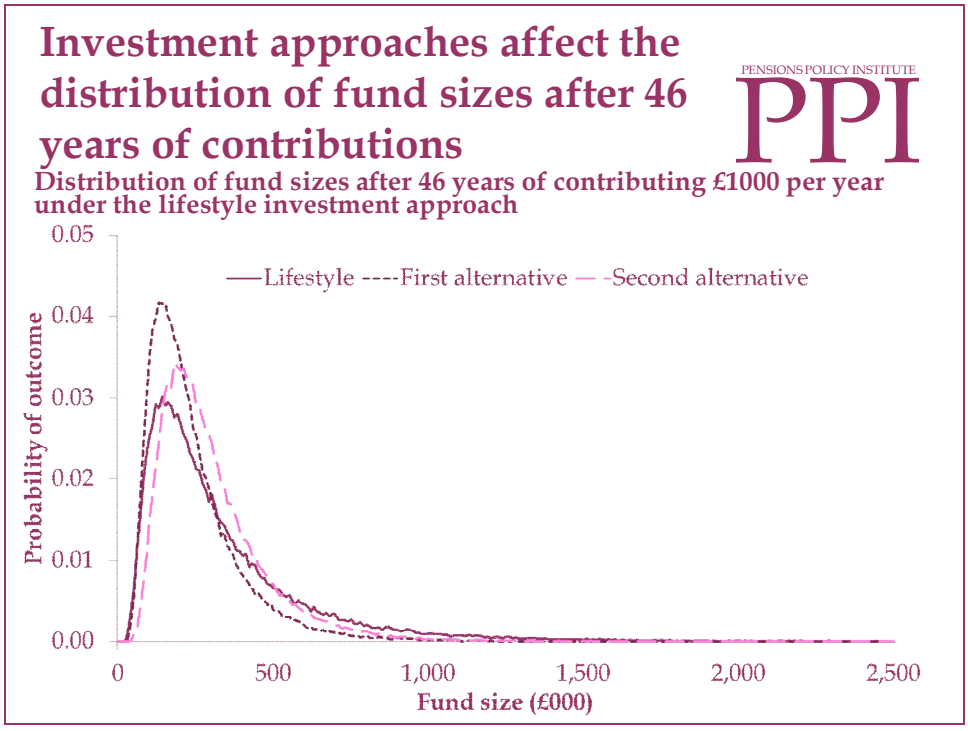


Chart 4[38]



[37] PPI and King's College London modelling analysis
[38] PPI and King's College London modelling analysis

Both of the alternative approaches provide more certainty in outcomes, with a more narrow distribution and more outcomes closer to the median outcome. Both, however, have fewer very high outcomes.

After five years of contributions the distribution of outcomes is narrower under a first alternative approach that aims to reduce volatility in early years at the expense of potential returns than under a traditional lifestyle approach. The outcomes range from around £4,500 in the 5th percentile to around £6,500 in the 95th percentile, with a median size of around £5,400. By contrast, a second alternative approach that aims to reduce volatility but not at the expense of potential returns provides a higher median size of around £5,900, but the possible outcomes range from £4,700 in the 5th percentile to £7,500 in the 95th percentile.

After 46 years of contributions, the distribution of outcomes is also narrower under a first alternative approach that aims to reduce volatility in early years at the expense of potential returns than under a traditional lifestyle approach. The outcomes range from around £84,500 in the 5th percentile to around £545,500 in the 95th percentile, with a median size of around £204,500. By contrast, a second alternative approach that aims to reduce volatility but not at the expense of potential returns provides a higher median size of around £264,000, but the possible outcomes range from £116,000 in the 5th percentile to £640,000 in the 95th percentile.

While this is a highly stylised analysis, it shows that the different investment strategies could affect the distribution of pension incomes.

Table 4 shows the variation in the income from private pensions as a proportion of target replacement income for a median earner under the baseline scenario of starting to save at age 22 and retiring at SPA, if contributing at the legal minimum of 8% of band earnings. The three different investment strategies are all assumed to have an annual management charge of 0.5%.

There is some variation in the median retirement income under the different investment approaches. The median retirement income under a traditional lifestyle approach is around 39% of the target replacement income, compared to 34% under the first alternative approach and 40% under the second alternative approach.

Table 4: Distribution of private pension retirement incomes (as a percentage of target replacement income) for a median earner that starts saving at age 22 and retires at SPA if contributing at the minimum rate of 8% of band earnings, under different investment approaches[39]

Investment approach	Median	10th percentile	90th percentile
Traditional lifestyle	39%	20%	90%
First alternative	34%	20%	63%
Second alternative	40%	23%	77%

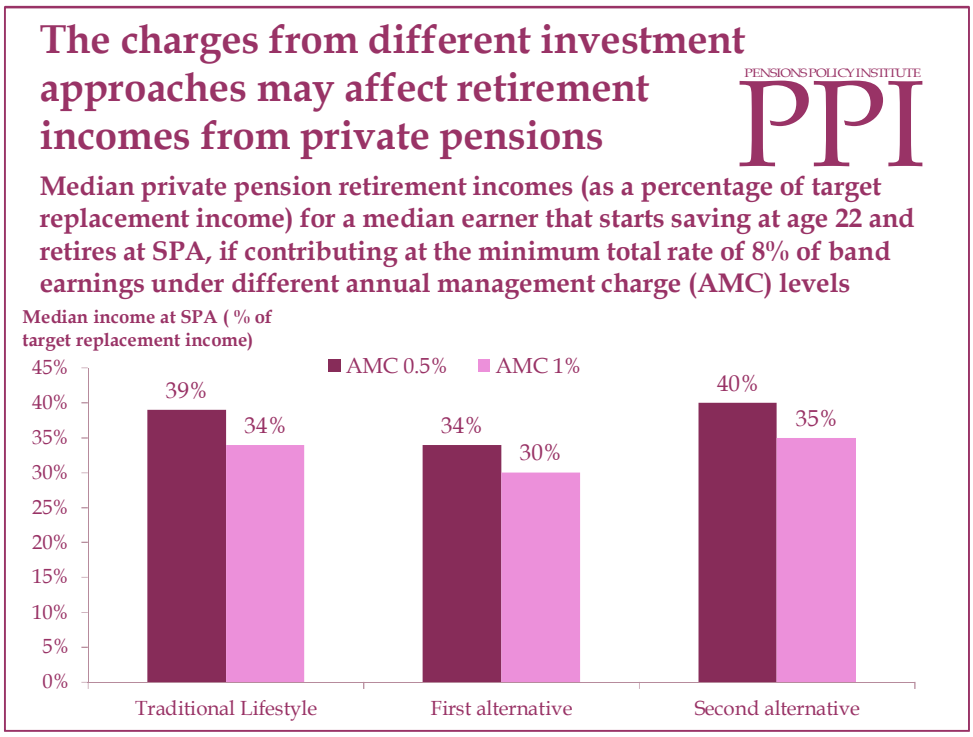
There is more variation in the range of possible retirement incomes under the different investment approaches. Under a traditional lifestyle approach retirement incomes could range from 20% of the target replacement income in the 10th percentile to around 90% in the 90th percentile. Under the first alternative approach that aims to reduce volatility in early years at the expense of potential returns there is less dispersion of possible retirement incomes compared to a traditional lifestyle approach, ranging from around 20% in the 10th percentile to around 63% in the 90th percentile. Under the second alternative approach that aims to reduce volatility but not at the expense of potential returns there is more dispersion than under the first alternative approach but less than under a traditional lifestyle approach. The possible incomes range from around 23% of the target replacement income in the 10th percentile to around 77% in the 90th percentile.

Retirement income from private pensions may be sensitive to the level of charges

In practice, different investment approaches may not only provide different levels of returns and volatility but they may also apply different levels of management charges (AMC) to a DC fund. This in turn will affect retirement incomes. For example, an investment approach that aims to reduce volatility but not at the expense of potential returns, could have higher charges than a traditional lifestyle approach.[40] Chart 5 illustrates the variation in median retirement incomes from private pensions under different investment approaches and with different annual management charges.

[39] PPI and King's College London modelling analysis.
[40] LCP (2013), p.11.

Chart 5[41]



A median earner following a traditional lifestyle approach under the baseline of starting to save at age 22 and retiring at SPA could reach a median retirement income at SPA from private pensions that would be around 39% of the target replacement income with an AMC of 0.5%. This could reduce to around 34% with an AMC of 1%.

The median income could be around 34% of the target replacement income under a first alternative approach that aims to reduce volatility at the expense of potential returns with an AMC of 0.5%, but this falls to around 30% if the AMC is 1%.

Under a second alternative approach that reduces volatility but not at the expense of potential returns, the median income would be around 40% of the target replacement income with an AMC of 0.5%, but this falls to around 35% with an AMC of 1%.

The level of AMC also has an impact on the distribution of possible retirement incomes (Table 5).

[41] PPI and King's College London modelling analysis.

Table 5: Distribution of private pension retirement incomes (as a percentage of target replacement income) for a median earner that starts saving at age 22 and retires at SPA if contributing at the minimum rate of 8% of band earnings, under different investment approaches and AMC levels[42]

Investment approach	AMC	Median	10th percentile	90th percentile
Traditional lifestyle	0.5%	39%	20%	90%
	1%	34%	18%	78%
First alternative	0.5%	34%	20%	63%
	1%	30%	18%	55%
Second alternative	0.5%	40%	23%	77%
	1%	35%	20%	66%

A higher AMC reduces the median retirement income. It also reduces the dispersion of possible retirement incomes.

Under a traditional lifestyle investment approach with an AMC of 0.5%, a median earner could reach a median retirement income from private pensions that would be around 39% of the target replacement income, and the range of possible retirement income outcomes would vary from 20% in the 10th percentile to 90% in the 90th percentile. By contrast, if the AMC is 1%, then the median retirement income reduces to 34% of the target replacement income, with the dispersion of possible retirement incomes ranging from 18% to 78% of the target replacement income.

Under a first alternative approach with an AMC of 0.5%, a median earner could reach a median retirement income from private pensions that would be around 34% of the target replacement income, and the range of possible retirement income outcomes would vary from 20% in the 10th percentile to 63% in the 90th percentile. By contrast, if the AMC is 1%, then the median retirement income reduces to 30% of the target replacement income, with the dispersion of possible retirement incomes ranging from 18% to 55% of the target replacement income.

Under a second alternative approach with an AMC of 0.5%, a median earner could reach a median retirement income from private pensions that would be around 40% of the target replacement income, and the range of possible retirement income outcomes would vary from 23% in the 10th percentile to 77% in the 90th percentile. By contrast, if the AMC is 1%, then the median retirement income reduces to 35% of the target replacement income, with the dispersion of possible retirement incomes ranging from 20% to 66% of the target replacement income.

[42] PPI and King's College London modelling analysis.

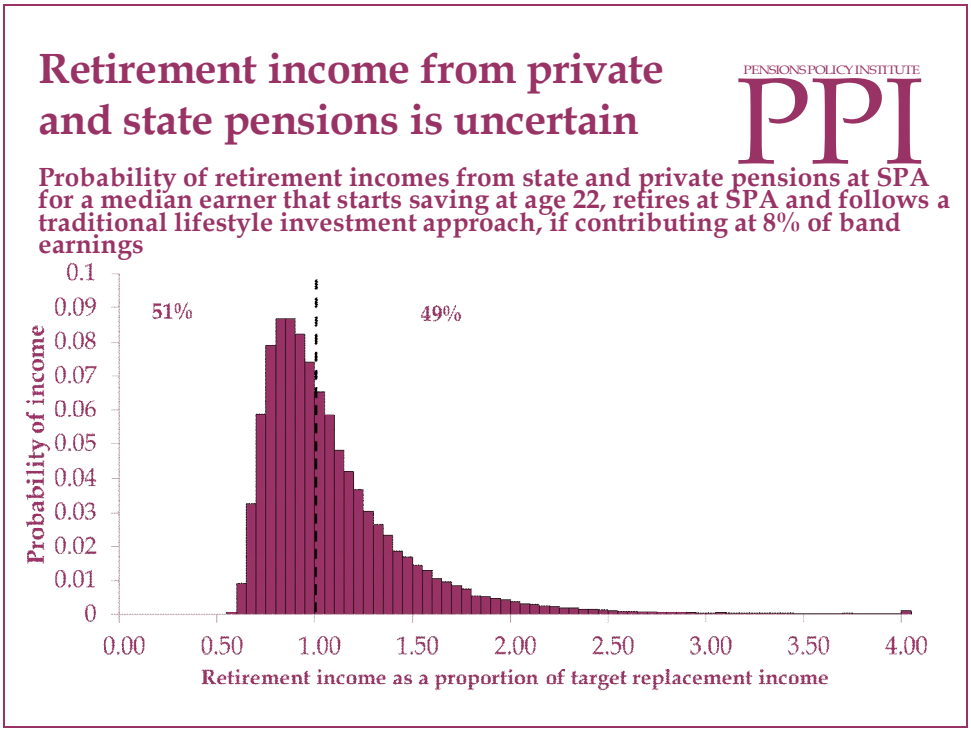
The adequacy of total retirement income

In order to gauge whether the level of private pension income generated is enough to achieve an adequate retirement income, income from state pensions must also be taken into account. Therefore, this section analyses the adequacy of total retirement income, including the income from private pensions and from the single-tier state pension for different individuals if contributing at the legal minimum of 8% of band earnings.

There is a wide range of total retirement incomes

Chart 6 shows the distribution of possible total retirement incomes from private and state pensions for a median earner under the baseline scenario of being automatically enrolled at age 22, retiring at SPA and following a traditional lifestyle investment approach, if contributing at the legal minimum of 8% of band earnings. The analysis assumes that the single-tier pension is uprated by the triple lock of the higher of changes in average earnings, the Consumer Prices Index (CPI) or 2.5%, the mechanism that is currently being used to uprate the Basic State Pension. This is also consistent with the Government's White Paper on the single-tier state pension published on 14 January 2013, which used the triple lock to uprate the single-tier pension every year. The level of the single-tier state pension for each case modelled will depend on the evolution of earnings and inflation growth.

Chart 6[43]



[43] PPI and King's College London modelling analysis. The last bar represents the sum of the probabilities of achieving a retirement income that is four times the target replacement income or higher

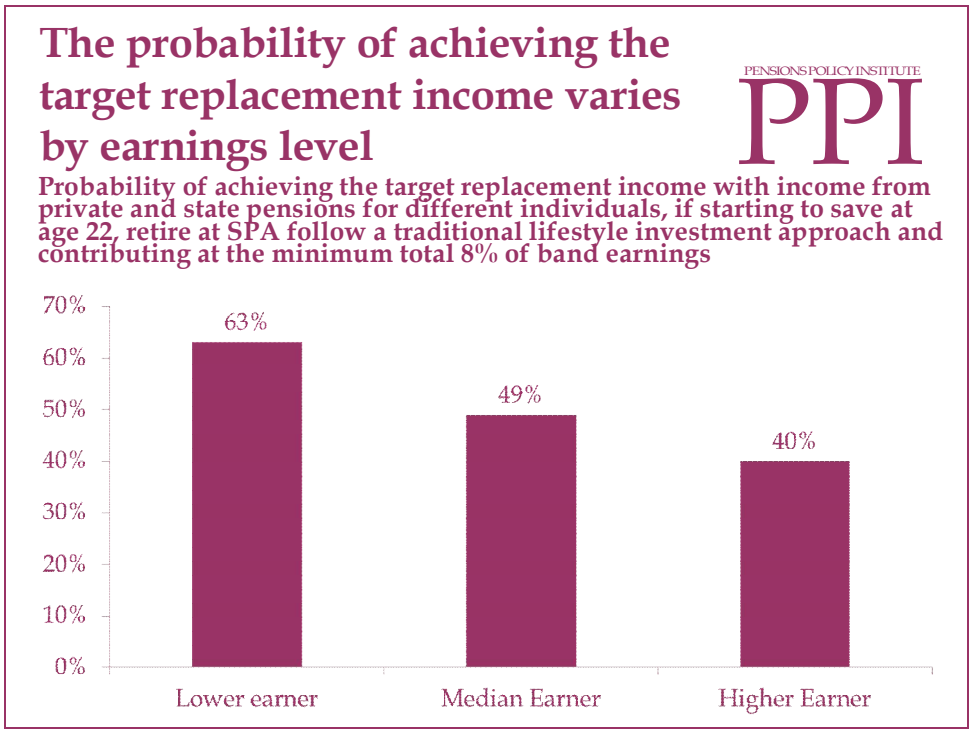
In 49% of the cases generated in the modelling a median earner reaches their target replacement income with income from private pensions and from the single-tier state pension combined. In more than half of the scenarios modelled income is below the target replacement income and in 25% of the scenarios income from private and state pensions was less than 75% of the target replacement income.

Chart 6 also shows that there is a 0% probability of a median earner having a retirement income that is less than 55% of their target replacement income. This is because the income from private and state pensions will represent at least 55% of a median earner's target replacement income.

Lower earners are more likely to achieve their target replacement income

Under the baseline scenario, the probability of individuals achieving their target replacement income through their state and private pensions varies according to their earnings profile. Lower earners have a higher probability of achieving their target replacement income than median or higher earners. This is because the single-tier state pension represents a higher proportion of lower earners' pre-retirement earnings than for median or higher earners (Chart 7).

Chart 7[44]



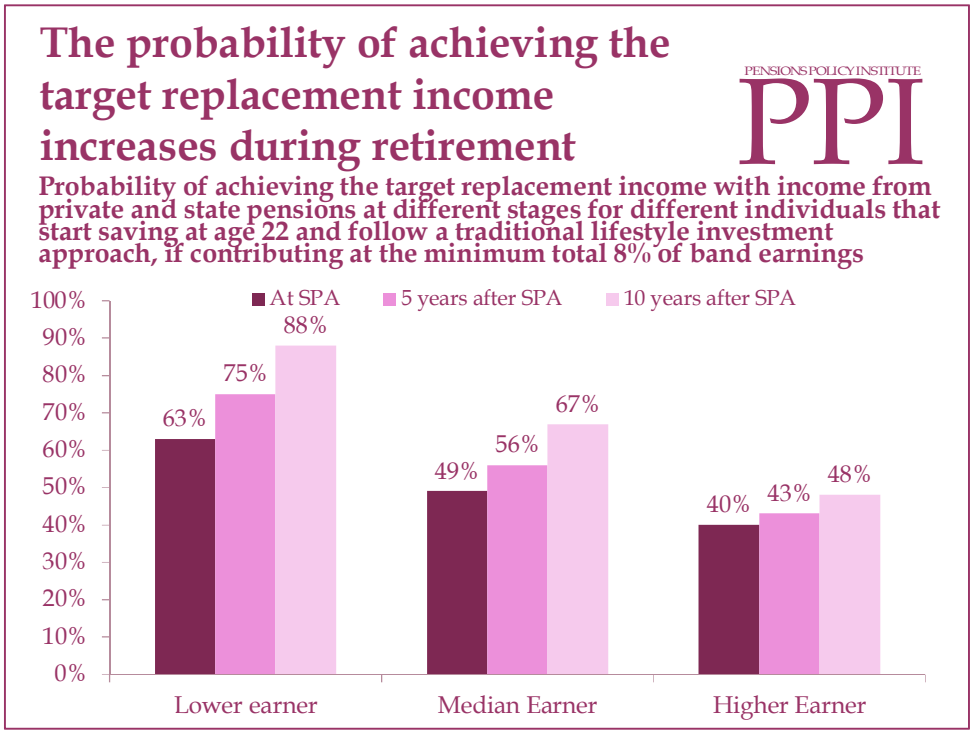
Under the baseline scenario of starting to save at age 22, retiring at SPA and following a traditional lifestyle investment approach, a lower earner has a 63% probability of achieving their target replacement income, compared to 49% for a median earner and to 40% for a higher earner.

[44] PPI and King's College London modelling analysis.

The probability of achieving a target replacement income may increase in the years after retirement

Individuals are more likely to have an income above their target replacement income level 5 and 10 years after SPA. This is because of the triple locked indexation of the single-tier state pension, which increases the value of the single pension relative to target replacement income levels over time. The model also assumes that the target replacement income increases in line with changes in the Consumer Prices Index (Chart 8).

Chart 8[45]



A lower earner has a 63% probability of achieving their target replacement income at SPA, but this increases to around 88% 10 years after retirement. This compares to around 40% for a higher earner at SPA and 48% 10 years after retirement.

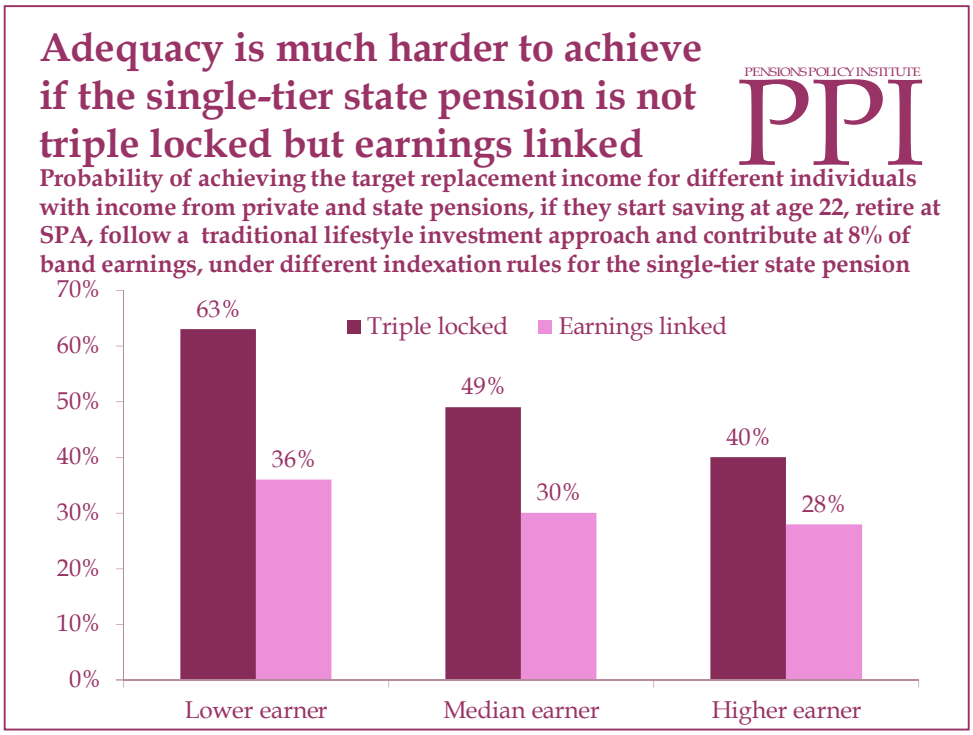
The indexation of the single-tier pension may affect individuals' chances of reaching their target replacement income

The triple lock indexation mechanism for the single-tier state pension is more generous than just average earnings because in years of low inflation or earnings growth, the single-tier pension would increase by at least 2.5%. Current legislation stipulates that the Basic State Pension must be uprated at least in line with changes in average earnings. Once the single-tier pension is introduced in 2016, it will be up to the government of the day to decide whether anything more than average earnings is needed.

[45] PPI and King's College London modelling analysis.

Whether the single-tier state pension is indexed by the triple lock or just by average earnings can affect the future adequacy of total retirement income for different individuals (Chart 9).

Chart 9[46]



The probability of achieving the target replacement income for the different individuals under the baseline scenario of starting to save at age 22, retiring at SPA and following a traditional lifestyle investment approach reduces significantly if the single-tier state pension is uprated only by changes in average earnings.

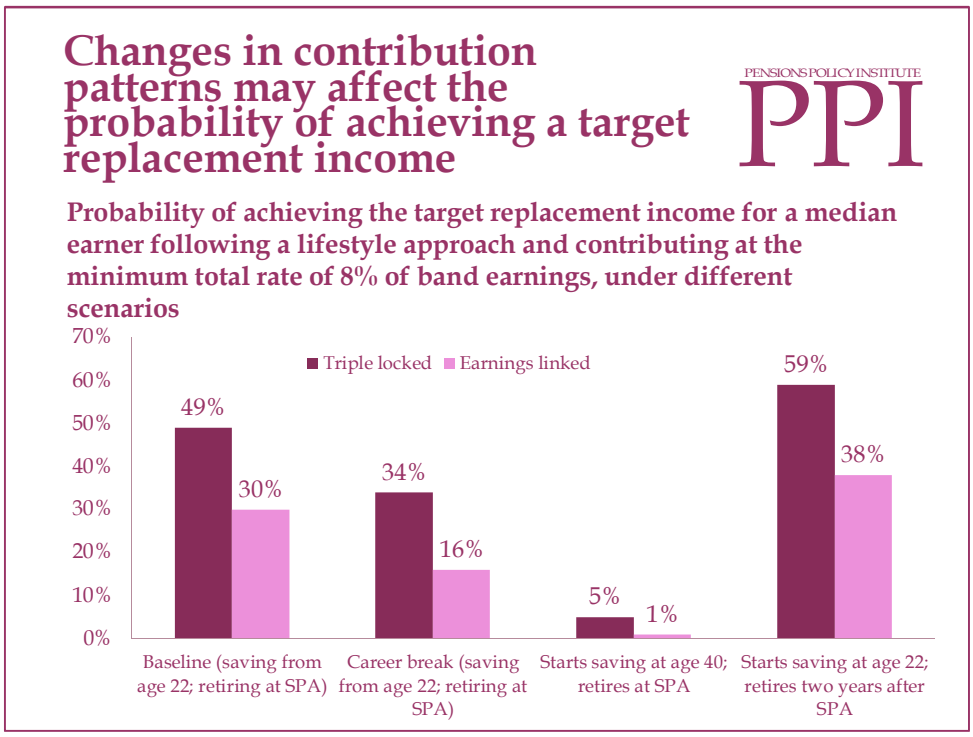
For a lower earner, the probability of achieving their target replacement income decreases from around 63%, if the single-tier state pension is uprated by the triple lock to around 36% if the single-tier pension is uprated by changes in average earnings. For a median earner the probability of achieving the target replacement income decreases from 49% to 30% and for a higher earner the probability decreases from around 40% to 28%.

Changes in contribution patterns affect retirement income adequacy

Different changes in contribution patterns such as taking career breaks, starting to save later in life or retiring some years after SPA may affect the probability of reaching a target replacement income with income from private and state pensions. The effect will also depend on whether the single-tier state pension is uprated by the triple lock or by just changes in average earnings (Chart 10).

[46] PPI and King's College London modelling analysis.

Chart 10[47]



Under the baseline scenario and with the single-tier state pension uprated by the triple lock, a median earner starting to save at age 22, retiring at SPA and following a traditional lifestyle approach may reach a 49% probability of achieving their target replacement income. This falls to 30% if the single-tier state pension is uprated by changes in average earnings.

If the median earner starts saving at age 22 but takes a career break from age 32 to 39, the probability of achieving their target replacement income at SPA falls to around 34%, compared to 49% under the baseline. However, this falls to 16% if the single-tier state pension is uprated by average earnings, a reduction of more than a half compared to the outcome with triple lock indexation for the single-tier state pension.

If the median earner starts to save at age 40 instead of 22, the probability of achieving their target replacement income falls to around 5% if the single-tier state pension is uprated by the triple lock, compared to 49% under the baseline. The probability of achieving the target replacement income falls to around 1% if the single-tier state pension is uprated by the triple lock.

By contrast, if the median earner decides to retire two years after their SPA, the probability of achieving their target replacement income increases to around 59%, compared to 49% under the baseline, if the triple lock is used to uprate the single-tier state pension. However, the probability falls to around 38% if changes in average earnings are used to uprate the single-tier state

[47] PPI and King's College London modelling analysis.

pension; a reduction of more than a third compared to the outcome under triple lock indexation for the single-tier state pension.

Summary

This chapter has found that there is variation in incomes from private pensions and in the adequacy of incomes from private and state pensions under different scenarios. For example:

- There is a wide range of retirement incomes from private pensions alone. In 8% of the cases generated in the modelling, median earning individuals could meet their target replacement income from private pension saving alone, even at minimum contribution levels. However, in 25% of the cases private pension income provides individuals with less than 26% of the target replacement income.
- There is variation in the range of possible retirement incomes from private pensions alone under different investment approaches. Under a traditional lifestyle approach retirement incomes could range from 20% of the target replacement income in the 10th percentile to around 90% in the 90th percentile. Under the first alternative approach that aims to reduce volatility in early years at the expense of potential returns there is less dispersion of possible retirement incomes compared to a traditional lifestyle approach, ranging from around 20% in the 10th percentile to around 63% in the 90th percentile. Under the second alternative approach that aims to reduce volatility but not at the expense of potential returns there is more dispersion than under the first alternative approach but less than under a traditional lifestyle approach. The possible incomes range from around 23% of the target replacement income in the 10th percentile to around 77% in the 90th percentile.
- Retirement incomes are also sensitive to the level of charges paid. For example, a median earner following a traditional lifestyle approach under the baseline of starting to save at age 22 and retiring at SPA could reach a median retirement income at SPA from private pensions that would be around 39% of the target replacement income with an AMC of 0.5%. This could reduce to around 34% with an AMC of 1%. The level of the AMC paid also has an impact on the distribution of possible retirement incomes.
- There is a wide range of total retirement incomes and in 49% of the cases generated in the modelling a median earner reaches their target replacement income with income from private and state pensions.
- Lower earners are more likely to achieve their target replacement income. This is because the single-tier state pension represents a higher proportion of lower earners' pre-retirement earnings than for median or higher earners.
- The probability of achieving the target replacement income increases in the years after retirement, mainly due to the indexation mechanism for the single-tier state pension. However, whether the single-tier state pension is indexed to average earnings or to the triple lock of the

higher of average earnings, changes in the Consumer Prices Index or 2.5% from 2016 onwards may affect the adequacy of total retirement income in the future.

- Changes in contribution patterns such as taking career breaks or starting to save later in life affect the adequacy of total retirement income. The effect will also depend on whether the single-tier state pension is uprated by the triple lock or by changes in average earnings alone. Under the baseline scenario of starting to save at age 22, retiring at SPA and with the single-tier state pension uprated by the triple lock, a median earner could have a 49% probability of achieving their target replacement income. This falls to around 30% if the single-tier state pension is uprated by changes in average earnings.
- Taking career breaks and starting to save at age 40 reduce the probability of achieving the target replacement rate. By contrast, retiring two years after SPA increases the probability of a median earner achieving their target replacement income to 59% if the single-tier pension is triple locked and to 38% if it is earnings-linked

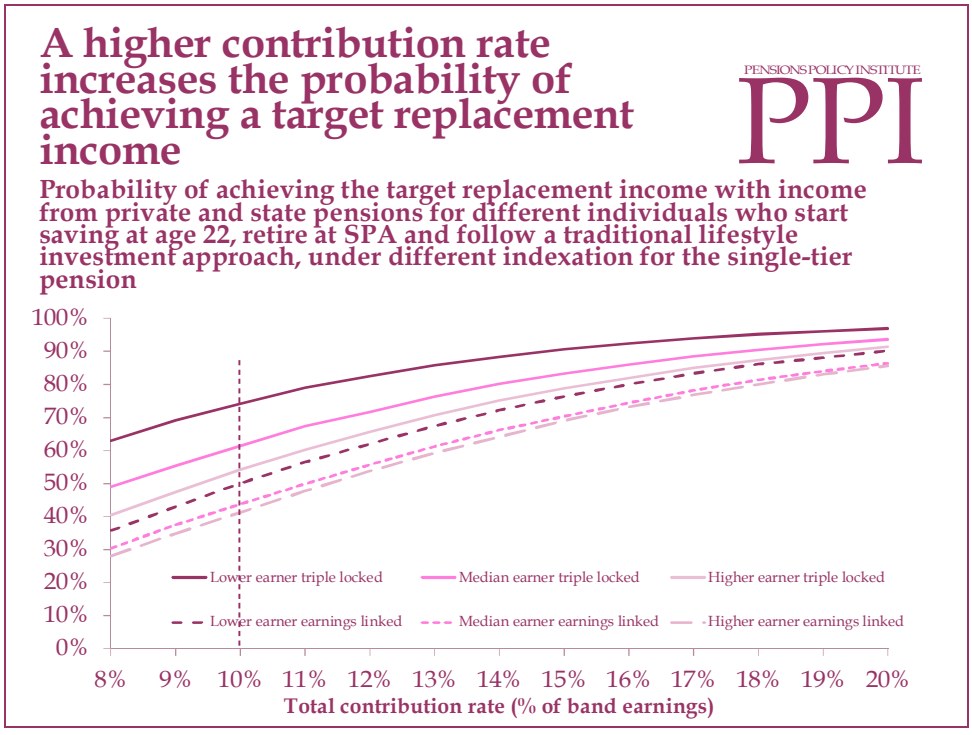
Chapter 3: What contribution rates would be necessary to achieve an adequate retirement income?

Chapter 2 has highlighted that contributing at the minimum of 8% of band earnings may not be enough to have a good chance of achieving the target replacement income. This chapter analyses the contribution rates that would be necessary for different individuals to have a good chance of achieving their target replacement income considering their total retirement income from state and private pensions. The analysis considers different scenarios of investment approach, earnings levels and changes in contribution patterns.

A higher contribution rate increases the probability of achieving a target replacement income, but this will depend on the indexation mechanism for the single-tier state pension

The contribution rate is one of the main factors affecting the adequacy of total retirement income from state and private pensions. For all the different individuals, under the baseline scenario of an individual starting to save at age 22, following a traditional lifestyle investment approach and retiring at SPA, a higher contribution rate is likely to increase the probability of reaching their target replacement rate. However, this is affected by the indexation mechanism used to uprate the single-tier state pension (Chart 11).

Chart 11[48]

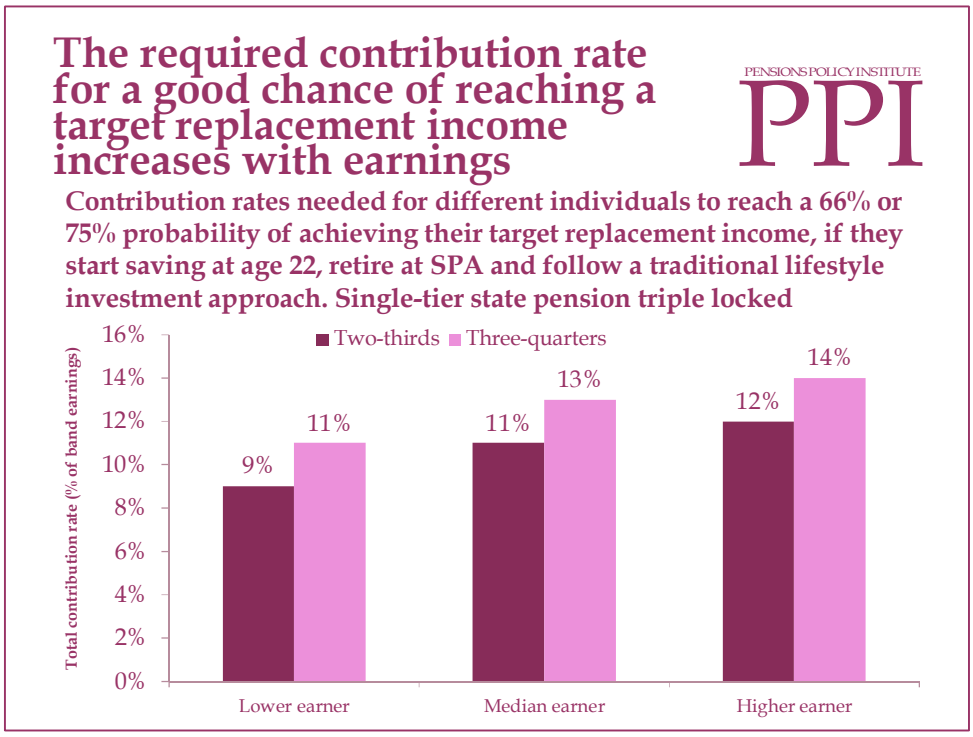


[48] PPI and King's College London modelling analysis.

A lower earner contributing at 10% of band earnings has a 74% probability of achieving their target replacement income at State Pension Age (SPA) if the single-tier state pension is uprated by the triple lock of the higher of changes in average earnings, CPI or 2.5%. However this falls to 50% if changes in average earnings are used to uprate the single-tier pension.

Individuals will need different contribution rate levels to achieve a two-thirds (66%) or three-quarters (75%) chance of reaching their target replacement income if the triple lock is used to uprate the single-tier pension (Chart 12).

Chart 12[49]



A lower earner will need a total contribution rate of 9% of band earnings to have a two-thirds (66%) probability of achieving their target replacement income. By contrast, a median earner will need to contribute at least 11% of band earnings and a higher earner will need to contribute at least 12% of band earnings to have a two-thirds probability of achieving their target replacement income.

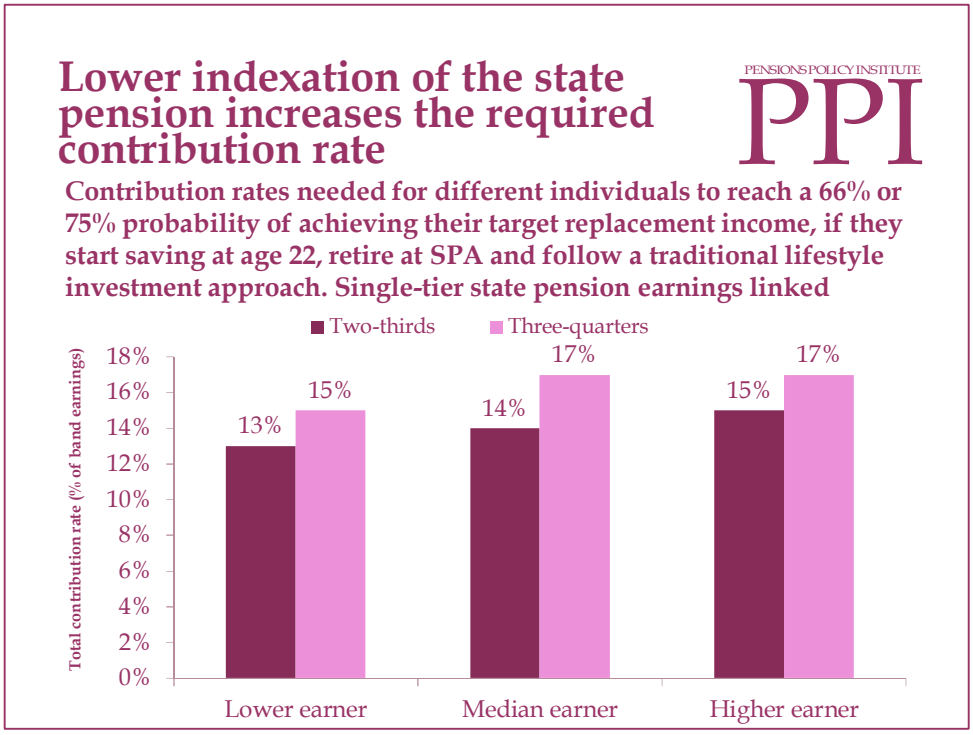
A lower earner will need a total contribution rate of 11% of band earnings to have a three-quarters (75%) chance of achieving their target replacement income. By contrast, a median earner will need to contribute 12% of band earnings and a higher earner will need to contribute 14%.

The lower contribution rate needed for a lower earner to have a good chance of achieving their target replacement income is related to the fact that the full

[49] PPI and King's College London modelling analysis.

single-tier pension will represent a higher proportion of a lower earner pre-retirement income than for a median or higher earner. Therefore, a lower earner will need to contribute less to a private pension than a median earner or a higher earner to top up their retirement income and reach their target replacement income. However, if the single-tier state pension is uprated by changes in average earnings, individuals will need higher contribution rates to have a good chance of reaching their target replacement income (Chart 13).

Chart 13[50]



A lower earner will need a contribution rate of 13% of band earnings to have a two-thirds chance of reaching their target replacement income with the income from state and private pensions if the single-tier state pension is uprated by changes in average earnings, compared to 9% if the single-tier pension is uprated by the triple lock. By contrast median and higher earners will need a total contribution rate of 14% and 15%, compared to 11% and 12% if the single-tier state pension is uprated by the triple lock.

A lower earner will need a total contribution rate of 15% of band earnings to have a three-quarters chance of achieving their target replacement income if the single-tier state pension is uprated by changes in average earnings. By contrast, median and higher earners will need to contribute 17% of band earnings each to have a three-quarters chance of reaching their target replacement income, compared to 14% and 15% if the single-tier state pension is uprated by the triple lock.

[50] PPI and King's College London modelling analysis.

Different investment approaches affect the contribution rate needed to achieve an adequate retirement income

Different investment approaches would entail different levels of annual management charges (AMC) applied to an individual's fund. This, along with the indexation mechanism used for the single-tier state pension, could affect the contribution rate needed to achieve an adequate retirement income. Table 6 illustrates this variation by focusing on a median earner that starts saving at age 22 and retires at SPA under different levels of AMC and under different indexation mechanisms for the single-tier state pension.

Table 6: Total contribution rates needed (as a % of band earnings) to reach a two-thirds or three-quarters probability of achieving the target replacement income at SPA with income from private and state pensions for a median earner that starts saving at age 22 and retires at SPA[51]

		Single-tier triple locked		Single-tier earnings linked	
Probability of achieving the target replacement income	**Investment approach**	**AMC: 0.5%**	**AMC: 1%**	**AMC: 0.5%**	**AMC: 1%**
Two-thirds	Traditional lifestyle	11%	12%	14%	16%
	First alternative	12%	14%	16%	17%
	Second alternative	10%	12%	14%	15%
Three-quarters	Traditional lifestyle	13%	15%	17%	18%
	First alternative	14%	15%	17%	19%
	Second alternative	12%	14%	15%	17%

The contributions required do vary between the different stylised investment strategies modelled. However, the contributions required do not change significantly with the alternatives, generally either one percentage point higher or lower than under a traditional lifestyle approach. The contributions required are more sensitive to both charges and the indexation mechanism for the single-tier state pension.

The range of outcomes taking into account changes in all these factors is large. For example, the total contribution required to reach a two-thirds chance of achieving the target replacement income ranges from 10% in a low charging scheme with a triple locked state pension to 17% in a higher charging scheme

[51] PPI and King's College London modelling analysis

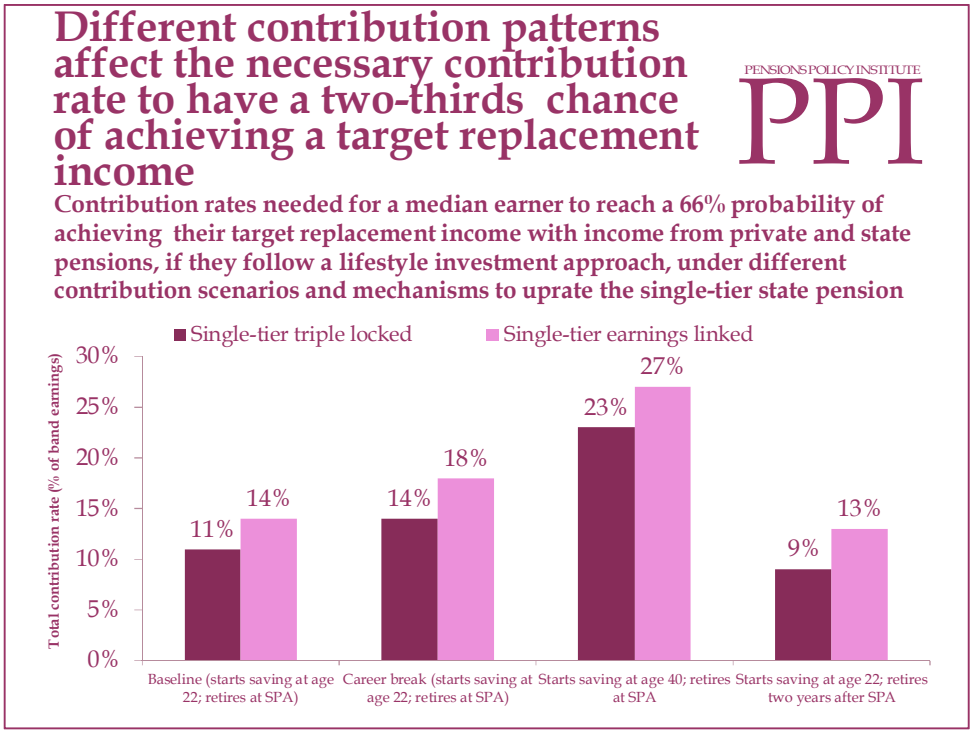
using a different investment approach and where the state pension is earnings linked.

The contribution rates needed to have a three-quarters chance of achieving the target replacement income are higher under all investment approaches and levels of AMC.

Changes in contribution patterns will affect the contribution rate necessary to have a good chance of achieving the target replacement income

Changes in contribution patterns such as taking career breaks, starting to save later in life and retiring two years after an individual's SPA may affect the probability of an individual reaching their target replacement income. Consequently, individuals will need different contribution rates to have a two-thirds chance of reaching their target replacement income. This will also be affected by the indexation mechanism used to uprate the single-tier state pension (Chart 14).

Chart 14[52]



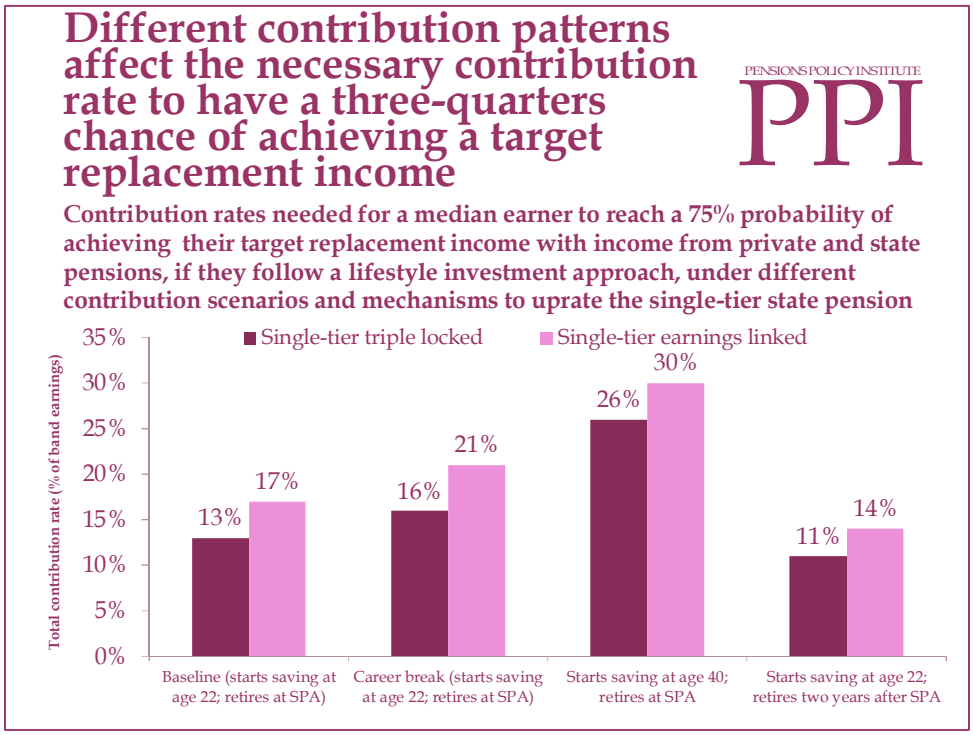
If the single-tier state pension is uprated by the triple lock, a median earner needs a total contribution rate of 11% of band earnings to have a two-thirds chance of reaching their target replacement income, under the baseline scenario of starting to save at age 22 and retiring at SPA. If the median earner takes a career break the contribution rate necessary to have a two-thirds chance of reaching the target replacement income increases to 14%, and to 23% if the median earner starts saving at age 40. By contrast, if the median earner

[52] PPI and King's College London modelling analysis.

starts to save at age 22 but retires two years after their SPA, they will need a total contribution rate of 9% to have a two-thirds chance of reaching their target replacement income, compared to 9% under the baseline scenario.
If the single-tier state pension is uprated by changes in average earnings, a median earner will need higher levels of contributions to have a two-thirds chance of reaching their target replacement income. Under the baseline scenario of starting saving at age 22 and retiring at SPA, the contribution rate needed will be 14%, compared to 11% if the triple lock is used to uprate the single-tier pension. If the median earner takes career breaks they will need a total contribution rate of 18% and of 27% if the median earner starts saving at age 40 and retires at SPA. By contrast, if the median earner starts saving at age 22 and retires two years after their SPA, they will need a total contribution rate of 13% of band earnings, compared to 14% under the baseline scenario.

Individuals will also need different contribution rates to have a three-quarters chance of reaching their target replacement income (Chart 15).

Chart 15[53]



If the single-tier state pension is uprated by the triple lock, a median earner needs a total contribution rate of 13% of band earnings to have a three-quarters chance of reaching their target replacement income, under the baseline scenario of starting to save at age 22 and retiring at SPA. If the median earner takes a career break the contribution rate necessary to have a three-quarters chance of reaching the target replacement income increases to 16%, and to 26% if the median earner starts saving at age 40. By contrast, if the

[53] PPI and King's College London modelling analysis.

median earner starts to save at age 22 but retires two years after their SPA, they will need a total contribution rate of 11% to have a two-thirds chance of reaching their target replacement income, compared to 13% under the baseline scenario.

If the single-tier state pension is uprated by changes in average earnings, a median earner will need higher levels of contributions to have a three-quarters chance of reaching their target replacement income. Under the baseline scenario of starting saving at age 22 and retiring at SPA, the contribution rate needed will be 17%, compared to 13% if the triple lock is used to uprate the single-tier pension. If the median earner takes career breaks they will need a total contribution rate of 21% and of 30% if the median earner starts saving at age 40 and retires at SPA. By contrast, if the median earner starts saving at age 22 and retires two years after their SPA, they will need a total contribution rate of 14% of band earnings, compared to 17% under the baseline scenario.

Summary

This chapter has found that the contribution rate needed to have a good chance of achieving the target replacement income will depend on different factors such as individuals' earnings levels, the investment approach followed and the level of charges paid, the indexation mechanism used to uprate the single-tier pension and changes in contribution patterns.

- Lower earners need lower contribution rates than median and higher earners to have a good chance of reaching their target replacement income. But this depends on the indexation mechanism used for the single-tier state pension.
- If the single-tier state pension is uprated by the triple lock, a lower earner will need a total contribution rate of 11% of band earnings to have a three-quarters chance of achieving their target replacement income. By contrast, a median earner will need to contribute 13% of band earnings and a higher earner will need to contribute 14%. This compares to 15% for a lower earner and 17% for median and higher earners if the single-tier state pension is uprated by changes in average earnings only.
- Different investment approaches and the charges associated with them will affect the total contribution rate needed to have a good chance of achieving the target replacement income with the income from private and state pensions. But this will also depend on the indexation mechanism used for the single-tier state pension.
- Changes in contribution patterns affect the contribution rate needed to have a good chance of reaching the target replacement income. For example, if the single-tier pension is triple locked, a median earner that takes career breaks needs a total contribution rate of 14% to have a two-thirds chance of reaching their target replacement income, compared to 11% under the baseline without career breaks. However the contribution rate necessary to have a two-thirds chance increases

to 18% if the single-tier state pension is uprated by average earnings, compared to 14% under the baseline.

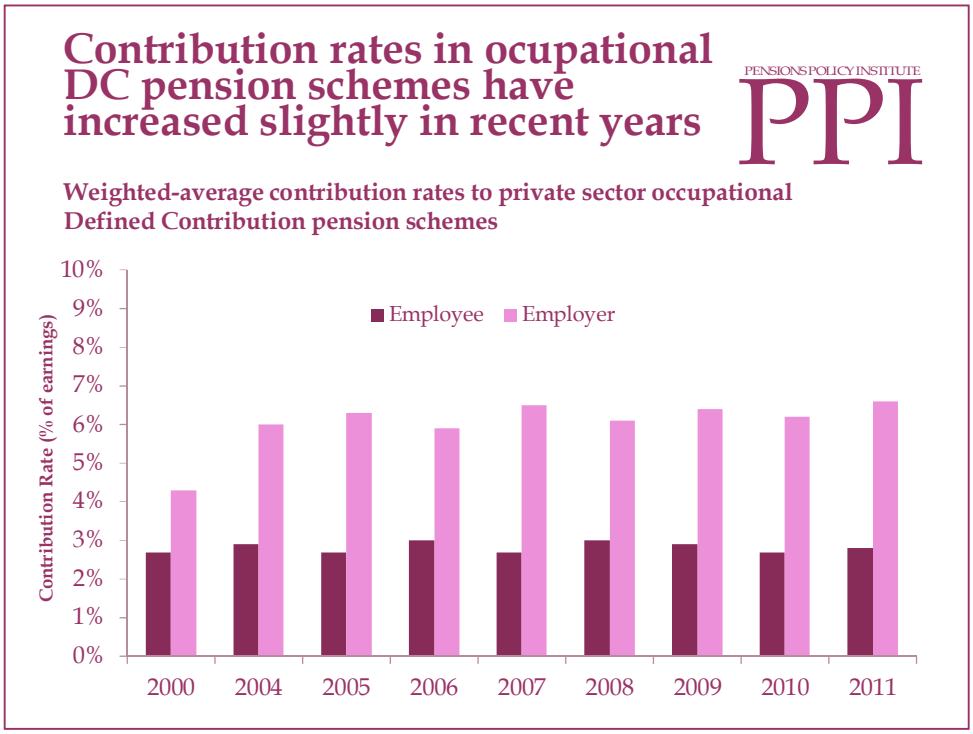
Chapter 4: Is there an adequacy gap?

The previous two chapters analysed retirement incomes from private pensions and the adequacy of total retirement income from private and state pensions. The chapters also analysed the contribution rate needed to have a good chance of achieving the target replacement income with the income from private and state pensions. This chapter elaborates on the findings of the previous two chapters by comparing the findings with current contribution rates.

Current contribution rates are low

The analysis in this report has shown that the contribution rate could have a significant impact on the adequacy of future pensioners' retirement income. Analysis has also shown that total contribution rates would have to be above 8% of band earnings to have a good chance of achieving different individuals' target replacement rate. Contribution rates to UK occupational DC schemes have increased in recent years, mainly due to an increase in employers' contributions. However they are still relatively low (Chart 16).

Chart 16[54]



In 2011, total average employer and employee contribution rates in private sector DC occupational schemes were around 9% of salary, this compares to around 7% in 2000. A total contribution rate of 9% of salary, which is equivalent to 12% of band earnings for a median earner with annual earnings of £23,000, may not be enough to reach a good chance of achieving the target replacement rate. This is especially the case for median and higher earners.

[54] ONS (2013) Table 8.1

The introduction of automatic enrolment could affect the average contribution rate. This is because automatically enrolling all qualifying employees will represent a higher cost for employers in terms of contributions and administrative costs. Some employers could still decide to keep or even increase current contribution rate levels. However, some employers offering a pension for the first time could decide to offer the minimum contribution rate and some employers with an existing pension scheme offer the legal minimum contribution rate to new automatically-enrolled members.[55]

There are a number of ways in which the Government could help individuals to achieve an adequate retirement income

The Government could consider a number of strategies to increase pension saving:

- The Government could encourage or enable the provision of information and advice to individuals. Individuals that have access to advice are more likely to know how much they need to save and when they can expect to retire.[56] Given that individuals are likely to be automatically enrolled in a DC pension where the final pension outcome will depend on a number of factors such as the investment strategy and the charges paid, individuals could maximise their savings by choosing the type of pension products more convenient for them. Professional advice may play an important role in providing individuals information about what pension products are more adequate for their needs.
- The Government could provide better incentives for pension saving, so that individuals choose to save more. However, recent PPI research has shown that incentives to save such as pension tax relief is poorly understood and that the majority of tax relief goes to higher rate tax payers.[57]

Automatic enrolment was introduced because the system of incentives to save and advice has not worked well in the past. Therefore the Government could also consider a number of other alternative strategies to maximise individuals' chances of having an adequate retirement income:

- Initiatives based on inertia could impact on individuals' saving decisions. For example, increasing minimum contribution levels or implementing initiatives such as "save more tomorrow" and "auto-escalation," which commit individuals to increase contribution levels as their salary increases.[58]
- However, higher minimum contribution rates could lead to large numbers of people opting-out of pension saving, contradicting the goal of the automatic enrolment policy. Therefore, some form of compulsion by making saving into a workplace pension mandatory

[55] Johnson et al (2010)
[56] Unbiased.co.uk (2012)
[57] PPI (2013)
[58] Thaler and Bernartzi (2004)

might need to be considered if large numbers of people opt-out as a result of higher minimum contributions.

- Promote initiatives that encourage individuals to use other types of wealth (e.g. housing equity) to increase their retirement savings.
- Promote initiatives for individuals to work longer. The Government has already taken some measures in this respect such as the elimination of the Default Retirement Age (DRA) and the legislated and planned increases in the State Pension Age (SPA).

Summary

This chapter has found that:

- Contribution rates to workplace pension schemes are generally too low to provide an adequate retirement income. This is particularly important for median and higher earners.
- Upon the introduction of automatic enrolment, some employers could decide to maintain or increase contribution rates. But some others could also lower contribution rates to the legal minimum.
- There are a number of strategies that the Government could consider to make individuals save more. For example, the Government could encourage or enable the provision of information and advice to individuals, or they could provide better incentives for pension saving, so that individuals choose to save more.
- The Government could also consider a number of inertia mechanisms to increase contribution levels such as auto-escalation where a member contribution rate increases in line with earnings. However, some form of compulsion by making saving into a pension mandatory might need to be considered if individuals opted-out in large numbers as a result of higher minimum contributions. The Government could also promote initiatives that encourage people to use other types of wealth to increase their retirement savings and promote initiatives to make individuals work longer.

Annex 1: Technical Annex

Introduction
The case studies presented in this report were produced by the PPI using a model developed by the PPI in collaboration with Dr John Armstrong and Professor Teemu Pennanen of King's College London. This annex describes the method and assumptions used in producing the analysis and a brief discussion of its limitations.

The individuals used in this report are hypothetical and have highly stylised characteristics. The results are highly dependent upon the assumptions made and as such, should not be used in the provision of financial advice.

Method
The results presented in the report were achieved by combining pre-determined individual work and saving patterns and investment approaches with 100,000 randomly generated economic scenarios.

For each economic scenario, an individual's target replacement income was calculated using the target replacement rates set out by the Pensions Commission in 2004 (see chapter 1). Pre-retirement income was taken to be the average of the individual's last 10 years of earnings, adjusted to be expressed in constant earnings terms.

The individual's post-retirement income was then calculated as the sum of their state and private pension entitlements. No allowance was made for any other benefits that the individual may be entitled to. For ease of comparison, retirement incomes in each year of the individual's retirement have been expressed as a proportion of their target replacement income.

The retirement incomes from each economic scenario were considered together in order to illustrate the full range of potential outcomes. Note that in the presentation of the results, no allowance has been made for individual mortality i.e. the probability that an individual's income is greater than their target replacement income is actually the probability that the target is satisfied, given that the individual is still alive at that point.

State pension
Each of the individuals was assumed to be entitled to the full single-tier state pension once they reach state pension age, taken to be £144 per week in 2012. This was then uprated in future years in line with either average earnings growth, or the triple lock index; i.e. the greater of average earnings growth, CPI inflation or 2.5%. The results in this report are presented using both types of indexation.

Private pension
At retirement the individual's private pension entitlement is calculated by assuming that they use 75% of their total pension saving to purchase a single-life level annuity. The remaining 25% is assumed to be taken as a tax-free lump sum and not included in the income adequacy calculation.

The single-life level annuity factor is calculated using PMA92 life tables combined with the Continuous Mortality Investigation's medium cohort projection of mortality improvement. The discount rate is the long-term gilt yield at the time of retirement, modelled as a random variable in each scenario. In addition to this, a 4% expense charge is assumed at the point of annuitisation.

Individual characteristics
Unless otherwise stated, all individuals are assumed to start work in 2018 at age 22, working each year of their life until retirement at their state pension age (SPA) of 68 in 2058.

All individuals are assumed to be auto-enrolled in 2018 when contributions have been fully phased in. The contribution rates given in this report are employer and employee contributions combined, expressed as a percentage of band earnings.

A number of different individual characteristics have been considered in this report in order to illustrate their potential impact on individual outcomes.

Earnings level
Individuals are described in this report as 'low', 'median' or 'high' earners. These individuals are considered to earn at the 30th, 50th and 70th percentiles of economy-wide age-specific earnings levels in each year that they are in work.

Career break
Career breaks are considered to take place between ages 32 and 39 before returning to work part-time (50% of full-time earnings) for two years until age 41, when they recommence full-time work.

Start saving at age 40
In this scenario, the individual is auto-enrolled at age 40 in 2018 and has no prior pension saving. This individual reaches their SPA of 67 in 2039.

Investment approach
Three alternative investment approaches have been considered in this report:

- Traditional lifestyle approach: Assets are 100% invested in equities until the individual is 10 years from retirement. At this point the individual's fund undergoes a gradual transition until it reaches 75% gilts and 25% cash in the year of retirement.
- First alternative approach: This approach aims to reduce fund volatility in early years by investing 2/3rd of the fund in gilts and 1/3rd in

equities. Over a period of 25 years this transitions to a fund of 1/6th gilts and 5/6th equity. For the final 10 years before retirement the fund transitions gradually into 75% gilts and 25% cash as in the traditional lifestyle approach.

- Second alternative approach: This approach aims to reflect reduced fund volatility achieved through, for example, greater diversification and/or active fund management. Since the precise investment strategies of funds that follow this approach (e.g. 'diversified growth funds') are not known, we must rely on market research.[59] We therefore model them by, using the same asset allocation as under the traditional lifestyle approach, but with the volatility of equity returns reduced by 1/3rd. In order to reflect the reduced volatility, the transition period into 75% gilts and 25% cash has been reduced from 10 to 5 years.

Charges

Provider annual management charges of 0.5% and 1.0% have been considered in this report. In addition to this, a charge has been applied to each asset class in order to reflect typical fund manager total expense ratios taken from LCP (2013).

Limitations of analysis

Care should be taken when interpreting the results in this report. In particular, one of the main limitations is that individuals are not considered to change their behaviour in response to investment performance. For example, if investments are performing poorly, an individual may choose to increase their contribution rate and vice versa. It is a result of this that such a wide dispersion of potential outcomes is observed.

Monte Carlo simulation can be a powerful tool when trying to gain an understanding of the distribution of possible future outcomes. However, in common with other projection techniques, it is highly dependent on the assumptions made about the future. In this case, the choice of distribution and parameters of the underlying variables, the investment returns of equities, gilts and cash are important to the results.

Economic scenarios

This section provides a description of the model used to generate the economic scenarios for this project.

The model is based upon a combination of PPI economic assumptions and analysis of historical data. Table A1 summarises: the risk factors that were modelled; the sources of historical data used and; the PPI's long-term economic assumptions.

[59] Spence Johnson (2013)

Table A1: Model risk factors

Abbreviation	Description
	Source of historical data
	Long term assumptions
G	Nominal GDP.
	ONS quarterly data from 30/06/1955 to present.[60]
	Annual GDP growth of 4.0%
P	CPI.
	ONS monthly data from 29/02/1988 to present.[61] Data from 31/01/1950 to 31/01/1989 derived from ONS RPI data using the methodology described by O'Neill and Ralph[62].
	Annual CPI growth of 2.0%
W	Average Weekly Earnings
	ONS monthly data from 31/01/2000 to present.[63] Rescaled valued from ONS Average Earnings Index from 31/01/1963 to 31/12/1999[64].
	Annual average earnings growth of 4.4%
Y^l	Long term yields.
	End of month FTSE Actuaries 15 Year Gilts Index from 30/11/1998 to present.[65] Low coupon 15 year gilts yields from 31/12/1975 to 31/10/1998.[66]
	Nominal return on gilts of 4%
Y^s	Money market yields.
	End of month 3 Month BBA Libor from 30/1/1987 to present.[67]
	Nominal return on gilts of 4%
S	Stock returns.
	End of month FTSE All share total return index from 31/12/1985 to present.[68]
	Nominal return on equities of 7%

Using these variables, a six dimensional process, x_t is defined.

[60] Source Bloomberg L.P
[61] Source Bloomberg L.P
[62] Robert O'Neill and Jeff Ralph, Office for National Statistics (2013)
[63] Source Bloomberg L.P
[64] Source Bloomberg L.P
[65] Source Bloomberg L.P
[66] Data from the Heriot-Watt/Institute and Faculty of Actuaries Gilt Database
[67] Source Bloomberg L.P
[68] Source Bloomberg L.P

$$x_t = \begin{bmatrix} \ln G_t - \ln G_{t-12} \\ \ln(P_t - \ln P_{t-12} + 0.02) \\ \ln W_t - \ln W_{t-12} \\ \ln\left(e^{Y_t^l} - 1\right) \\ \ln\left(e^{Y_t^s} - 1\right) \\ \ln S_t \end{bmatrix}$$

Where t denotes time in months.

The development of the vector x_t is modelled by the first order stochastic difference equation:

$$\Delta x_t = A x_{t-1} + a + \varepsilon_t$$

Where A is a 6 by 6 matrix, a is a six dimensional vector and ε_t are independent multivariate Gaussian random variables with zero mean. The values of A and a and the volatilities and correlation of the ε_t are given in table A2. The matrix A and the covariance matrix of the ε_t were determined by calibrating against the historical data. The coefficients of a were then selected to match the long term economic assumptions.

It follows that the values of x_t will have a multivariate normal distribution. Simulated investment returns will, however, be non-Gaussian partly because of the nonlinear transformations above. Moreover, the yields are nonlinearly related to bond investments.

The first component and third components of x_t give the annual growth rates of GDP and wages, respectively. The fourth and fifth components are transformed yields. The transformation applied ensures that the yields are always positive in simulations. Similarly the second component gives a transformed growth rate of CPI. In this case, the transformation applied ensures that inflation never drops below -2% in the simulations. This figure was selected to be twice the maximum rate of deflation ever found in the historical data. More sophisticated transformations of the CPI that allow for arbitrarily negative deflation could be considered instead, but seem unnecessary for the purposes of this paper.

Table A2: Model parameters

The matrix A

	G	P	W	Y^l	Y^s	S
G	0.0000	-0.0026	0.0000	0.0010	-0.0006	0.0000
P	0.0000	-0.0383	0.3936	0.0000	0.0000	0.0000
W	0.1028	0.0000	-0.3759	-0.0010	0.0020	0.0000
Y^l	0.0000	0.0000	0.0000	-0.0055	0.0000	0.0000
Y^s	6.4361	0.0000	0.0000	0.0000	-0.0348	0.0000
S	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

The vector a'

G	P	W	Y^l	Y^s	S
-0.0101	-0.1406	0.0085	0.0220	-0.1190	0.0058

Annual volatility of ε_t

G	P	W	Y^l	Y^s	S
0.41	0.09	1.20	1.34	1.25	0.73

Correlation matrix of ε_t

	G	P	W	Y^l	Y^s	S
G	1.00	-0.01	0.11	0.07	0.10	0.13
P	-0.01	1.00	0.02	0.06	0.04	-0.04
W	0.11	0.02	1.00	0.15	0.07	-0.02
Y^l	0.07	0.06	0.15	1.00	0.30	-0.12
Y^s	0.10	0.04	0.07	0.30	1.00	-0.12
S	0.13	-0.04	-0.02	-0.12	-0.12	1.00

Monthly log-returns on bond and money market investments are given by

$$R_t^j = Y^j/12 - D^j \Delta Y_t^j \qquad j = l, s$$

Where D is the duration of the investment class, $D^l = 12.25$ and $D^s = 0.125$.

For a general reference on multivariate time series analysis see Lütkepohl[69]. Other applications of the modelling approach presented here can be found, for example, in Koivu, Pennanen and Ranne[70] and Aro and Pennanen (2005)[71].

Modelling of the triple lock

An important result from the report is the impact that state pension uprating policy could potentially have on retirement income adequacy.

This report considers two scenarios for state pension uprating:

- The state pension continues to be uprated in line with the triple lock i.e. the greater of CPI, average earnings growth or 2.5%.
- The state pension is uprated in line with average earnings growth only.

The triple lock index is calculated in each year of each economic scenario using the simulated values of CPI and average earnings growth produced by the

[69] Lütkepohl (2006)
[70] M.Koivu, T.Pennanen and A.Rann (2005)
[71] H.Aro and T.Pennanen (forthcoming)

model. Table A3 summarises the projected triple lock index and state pension levels.

Table A3: Summary of triple lock and state pension outcomes

Triple lock				
Mean triple lock growth	4.8%			
Mean triple lock excess over earnings	0.4%			
Annual state pension level (£p.a) expressed in 2012 earnings terms				
Year	**Mean**	**5th percentile**	**Median**	**95th percentile**
2012 (year 1)	£7,488	-	-	-
2022 (year 10)	£7,800	£7,500	£7,700	£8,500
2032 (year 20)	£8,300	£7,500	£8,100	£9,700
2042 (year 30)	£8,700	£7,600	£8,400	£10,600
2052 (year 40)	£9,125	£7,700	£8,800	£11,700
2062 (year 50)	£9,600	£7,800	£9,200	£12,900

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