PENSIONS POLICY INSTITUTE

# PPI

# Intergenerational comparison of pension outcomes: analysis sponsored by the Resolution Foundation

This analysis has been sponsored by the Resolution Foundation (RF)

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# Introduction

The Resolution Foundation commissioned the Pensions Policy Institute (PPI) to undertake projections to be able to analyse the pension outcomes of younger generations. The work has contributed to the Resolution Foundation's report for the Intergenerational Commission As good as it gets? The adequacy of retirement income for current and future generations of pensioners.[1]

Younger workers often suggest that they will never be able to retire. Certainly, the changing pensions landscape will mean that they are unlikely to retire with the same nature of private pension coverage as current pensioners and, unlike the majority of today's pensioners, will retire with a new State Pension.

The changing nature of occupational pension provision in the UK reflects a reduction in the offering of Defined Benefit (DB) schemes and a rise in Defined Contribution (DC) schemes. There is an increase in pension participation resulting from the introduction of automatic enrolment resulting in more people accumulating pension wealth, albeit at a lower aggregate level than savers from older generations.

Pension saving is further impacted by changing working conditions, including pay levels. The weakening of pay levels for the youngest working age individuals since the financial crisis will reduce their capacity to save and will reduce the pension benefits they may accrue. Alongside increasing longevity the younger generations will also need to be able to fund a longer retirement, though they will typically have to work for longer before reaching State Pension age. However, these generalisations hide the breadth of experience that will occur by the time generations such as Millennials reach their pension age.

This analysis in this report models the pension outcomes across the differing generations, focussing upon:

- Retirement income levels
- Earnings replacement rates

The modelling undertaken aimed to quantify how the changing pension landscape has resulted in different pension outcomes for each generation through changing pensions policy and the evolving labour market. This allows for an intergenerational comparison of how the developments in the labour market, financial circumstances and the pension landscape may combine to influence pension accumulation by generation. Since the introduction of pension freedoms individuals have exhibited a wider variety of behaviours at retirement, however this does not impact the potential income that their pension saving may be capable of generating.

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[1] David Finch, Laura Gardiner (2017) As good as it gets? The adequacy of retirement income for current and future generations of pensioners

While retirement behaviour is currently changing and will change in the future to reflect evolving finances and pressures, to aid comparison between generations the behaviour of individuals at retirement has not been considered.

This paper lays out the main findings from the modelling and details the approach used to project these younger cohorts, through pension accumulation at working ages to their pension age. At their pensionable age their potential incomes that may be derived from this pension saving can be assessed against adequacy standards and their own working life incomes. These results are laid out in full in the Resolution Foundation paper As good as it gets? The adequacy of retirement income for current and future generations of pensioners.[2]

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[2] David Finch, Laura Gardiner (2017) As good as it gets? The adequacy of retirement income for current and future generations of pensioners

# Chapter one: main results - intergenerational comparisons

The full range of outcomes are included within the Resolution Foundation's report for the Intergenerational Commission As good as it gets? The adequacy of retirement income for current and future generations of pensioners.[3] [4]

> **Main Findings**
> - Average pension incomes are set to drop before recovering
> - Women's pension incomes are not projected to dip
> - Replacement rates are expected to be higher for millennials than Generation X

## Metrics considered

To interpret the results from the modelling the distribution of outcomes has been considered. Amounts are expressed in 2017 earnings terms, and replacement rates consider retirement income as a direct proportion of working age income. A replacement rate considers the income in retirement an individual may receive as a proportion of their income level prior to retirement.

Individuals have been assumed to convert pension saving into an income. Many people already choose to take a tax free lump sum or fully withdraw small pots, and since the introduction of pension freedoms more people have chosen to take alternative approaches to realising their pension savings. However for the purposes of making comparisons between generations it is most important to present a consistent metric demonstrating the potential of the pension wealth people have accumulated.

## Main findings

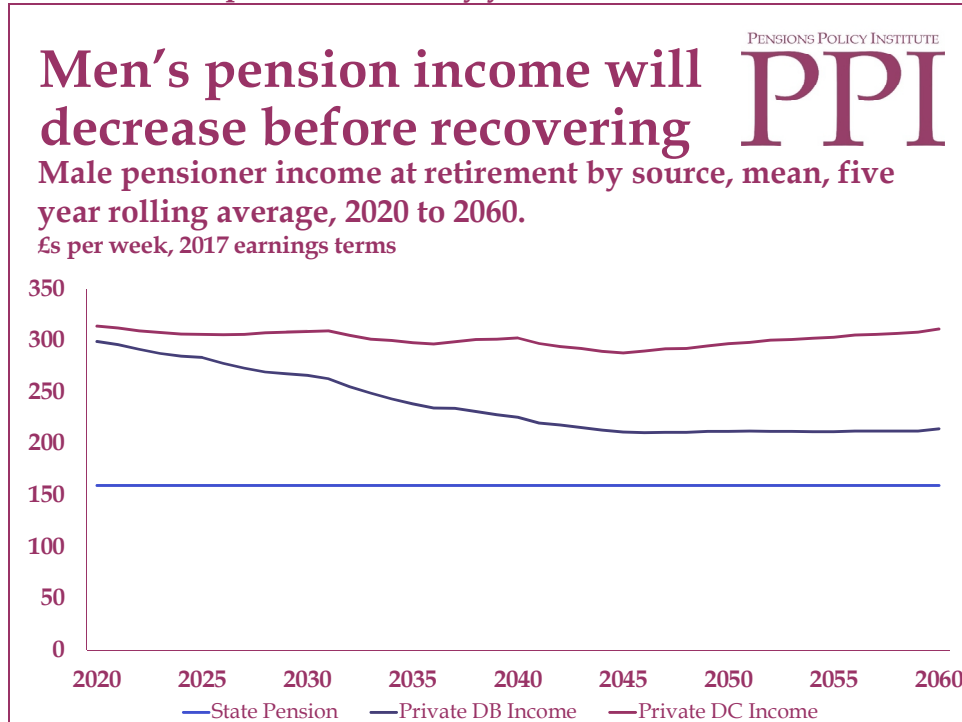### *Average pension incomes are set to drop before recovering*

Currently mean pension incomes are supported by high Defined Benefit (DB) pension incomes for many individuals. The coverage of DB schemes is projected to decrease as the private sector adopts Defined Contribution (DC) pension schemes. DB incomes are projected to nearly halve for new retirees by 2060. It is only by the 2050s that retiring individuals will have spent the majority of their working lives under the automatic enrolment regime and subject to a high level of DC coverage.

The net effect of these competing factors is that men's total pension incomes for new retirees are projected to decrease by around £25 per week (from £310 per week) over the next 25 years before recovering to around £300 per week for those retiring towards the end of the 2050s [Chart 1.1].

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[3] David Finch, Laura Gardiner (2017) Aa good as it gets? The adequacy of retirement income for current and future generations of pensioners
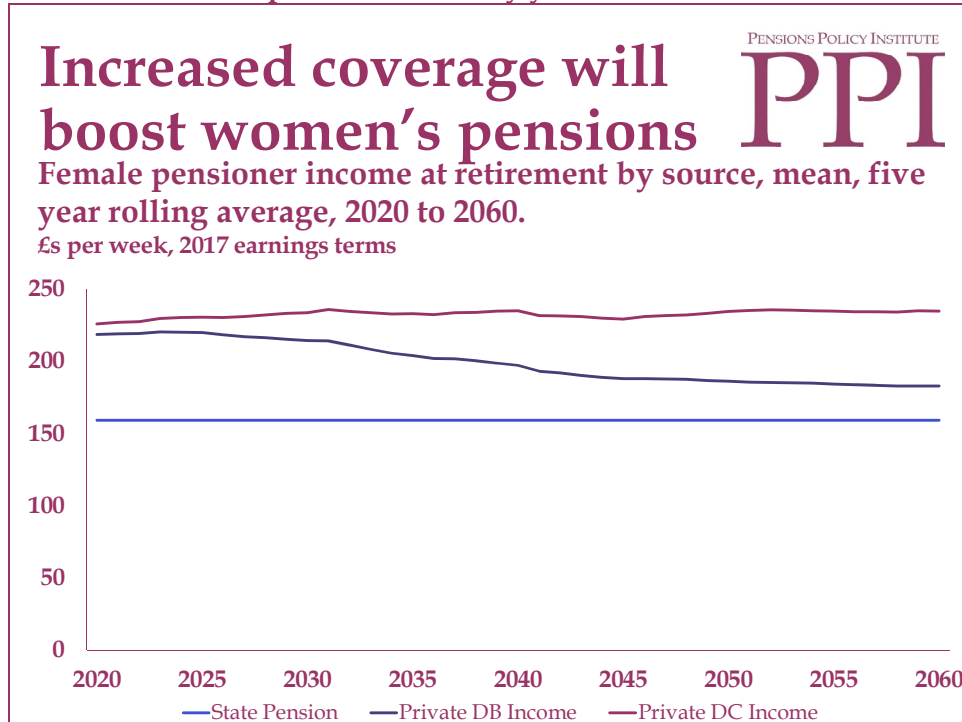[4] Full outputs of the PPI's dynamic modelling are not included below as these are an intermediate stage in the calculation and further processing was undertaken

**Chart 1.1 Men's pension income by year of retirement**

**Men's pension income will decrease before recovering**

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**Male pensioner income at retirement by source, mean, five year rolling average, 2020 to 2060.**

£s per week, 2017 earnings terms



*Women's pension incomes are not projected to dip.* The low amounts of private pension wealth of current retirees is set to improve as more women in the workforce join occupational pension schemes resulting in women's average pension income consistently increasing between each cohort of future retirees [Chart 1.2].

**Chart 1.2 Women's pension income by year of retirement**

**Increased coverage will boost women's pensions**

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**Female pensioner income at retirement by source, mean, five year rolling average, 2020 to 2060.**
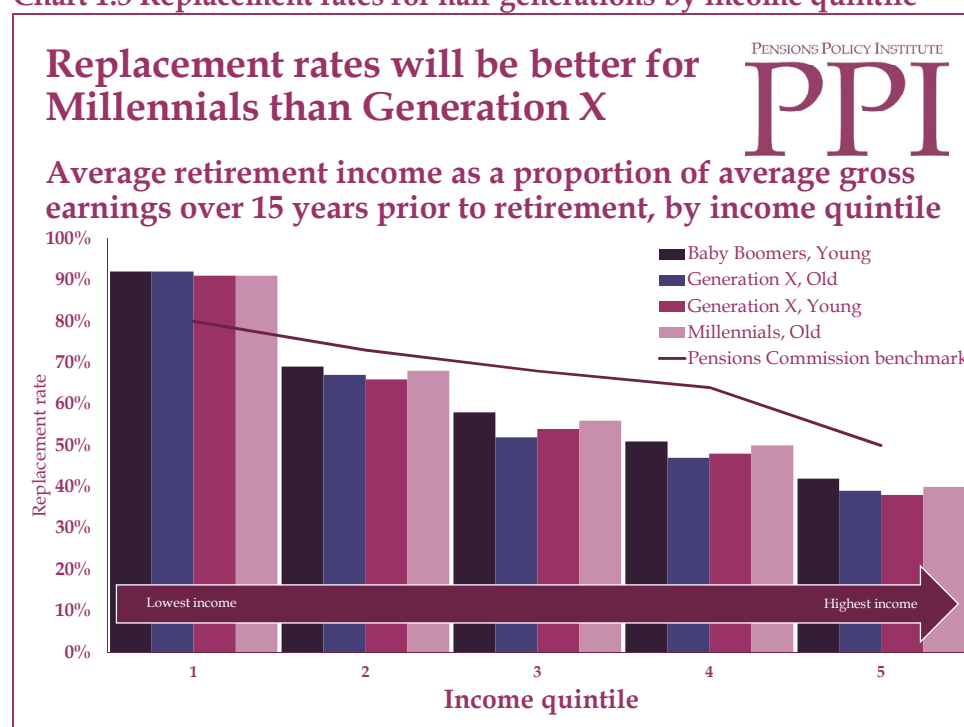
£s per week, 2017 earnings terms



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*Replacement rates are expected to be higher for millennials than Generation X*
Across the income distribution (based upon incomes prior to retirement) replacement rates are better for Millennials than Generation X [Chart 1.3]. This reflects the development of DC pensions. DB pension coverage becomes more dominated by the public sector rather than those who earn the most. The biggest increases between these generations are in the middle of the earnings distribution. This pattern is greater for men than women as men are more likely to see their private pension entitlement reduced by the change from DB to DC pensions while women tend to benefit from the increase in DC coverage.

The replacement rates for all but the lowest earners are projected to fall short of the Pensions Commission's benchmarks, however this is consistent with the replacement ratios experienced by current pensioners. Potentially lower lifetime earnings for the youngest workers may result in lower pension amounts (in current earnings terms), however the impact of this is mitigated through the calculation of a replacement ratio.

**Chart 1.3 Replacement rates for half generations by income quintile**



**Replacement rates will be better for Millennials than Generation X**

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**Average retirement income as a proportion of average gross earnings over 15 years prior to retirement, by income quintile**

Legend:
- Baby Boomers, Young
- Generation X, Old
- Generation X, Young
- Millennials, Old
- Pensions Commission benchmark

*Pension Commission benchmarks*
85% of men and 65% of women are at risk of not meeting the benchmark replacement ratios set out by the Pensions Commission. The difference tends to be driven by men being more likely to have a higher income. With a higher income the State Pension delivers a lower replacement amount.

At lower incomes nearly 80% of individuals are projected to meet the benchmark replacement ratio. For those with the highest 20% of incomes, less than 10% of individuals are projected to meet this benchmark.

# Chapter two: methodology - analysis of the historical pension savings

The aim of the historical analysis was to inform the starting point of the projection including the base populations within each generation, and helps to set the assumptions used in the projection of this data. The circumstances of pension accumulation of each generation has been analysed using a variety of data sources. This work considers the employment patterns and pension scheme membership through working ages to discern trends which will influence differences between the generations, including the systematic differences in job turnover and pension participation.

Analysis has been undertaken of historical work patterns and earnings levels using the Annual Survey of Hours and Earnings (ASHE)[5] and New Earnings Survey (NES)[6] longitudinal datasets. More recently the survey has included information on pension scheme membership and contribution rates.

The Occupational Pension Scheme Survey (OPSS)[7] provides further detail of historical workplace pension schemes including coverage by scheme type and aggregated contribution rate information. While first published in 1958 it has been more regularly updated since the mid-1970s.

Other survey data (such as the English Longitudinal Survey of Aging (ELSA)[8]) and modelling by other organisations (such as Pensim2 projections by the Department for Work and Pensions (DWP)[9]) have been used for validation and assumption setting.

## Coverage

The ASHE and NES datasets are a 1% sample of employees who are subject to National Insurance with information being reported by employers. Individuals earning below the lower earnings threshold may be reported by an employer, however there is no obligation and such information may be missing.

A number of individuals cannot be analysed adequately using this approach where they go unreported, specifically:
- Those who do not work;
- Those who work abroad;
- The self-employed;
- Those earning below the Lower Earning Limit;

[5] Office for National Statistics. (2018). Annual Survey of Hours and Earnings, 1997-2017: Secure Access. [data collection]. 11th Edition. UK Data Service. SN: 6689, http://doi.org/10.5255/UKDA-SN-6689-10

[6] Office for National Statistics. (2011). New Earnings Survey, 1986-2002: Secure Access. [data collection]. UK Data Service. SN: 6704, http://doi.org/10.5255/UKDA-SN-6704-1

[7] Office for National Statistics. (2017). Occupational Pension Schemes Survey

[8] Marmot, M., Oldfield, Z., Clemens, S., Blake, M., Phelps, A., Nazroo, J., Steptoe, A., Rogers, N., Banks, J., Oskala, A. (2017). English Longitudinal Study of Ageing: Waves 0-7, 1998-2015. [data collection]. 27th Edition. UK Data Service. SN: 5050, http://doi.org/10.5255/UKDA-SN-5050-14

[9] Emmerson, Reed, Shepherd (2004) *An assessment of Pensim2*

- Those who are unreported by employers; and
- Anyone subject to exclusion through misreporting.

Individuals who have been omitted from the data for a high proportion of years are unlikely to have had much access to an occupational pension scheme through their working life. They are more likely to be dependent upon other sources of income in retirement and can be considered out of scope for this analysis.

Where there is only very limited information forming a patchy work history for an individual they have been excluded from the analysis as there are too few data points to infer an appropriate work pattern. This impacts a greater number of younger individuals where there are fewer years of historical records.

### Earnings

Employment histories can be derived from the data where they appear within the dataset. Transition probabilities of being in employment are derived from longitudinal analysis of the NES and ASHE datasets. The analysis includes transition rates between private and public sector employment between which the pension provision is increasingly divergent, with public sector pension provision maintaining Defined Benefit (DB) schemes and private sector pension coverage generally turning to Defined Contribution (DC) schemes.

The impact of the financial crisis has been to reduce earning levels. This is expected to depress the lifetime earnings of Millennials and may result in them being the first generation to record lifetime earnings below that of the generation before them.[10]

### Pension coverage

Employee membership of pension schemes has increased since the staging of Automatic enrolment. This has presented as a significant increase in the membership of DC schemes, particularly amongst Millennials and Generation X. Prior to the introduction of AE, occupational pension scheme membership rates had tended to stabilise as people pass through their thirties.

DB pension coverage, unlike DC, has not shown a significant increase of membership as a result of automatic enrolment. This is largely due to many employers with DB schemes, particularly in the public sector, defaulting individuals into their pension scheme prior to automatic enrolment, and those employers who needed to introduce a pension scheme to fulfil their automatic enrolment obligations tended to choose a DC offering. DB membership has declined in successive generations, with both the number of open schemes decreasing and the number of employees who are active members of DB pension schemes. Scheme membership of individuals in their early thirties has decreased from over 50% of employees from the Baby Boomer generation, to around 40% for Generation X and is currently around 30% for Millennials.

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[10] Laura Gardiner (2016) Stagnation generation? The case for renewing the intergenerational contract

**Contribution rates**

*Accrual of occupational Defined Contribution pension wealth:* The ASHE dataset has only recorded DC contribution rates since 2005. Historical contribution rates prior to this date is not included on the record. An assumption around these earlier contribution rates has been made based upon information on occupational schemes recorded in the Occupational Pension Schemes Survey (OPSS). Contribution rates have been randomly assigned to reflect historical average contribution rates (as reported in OPSS), and also the variation between different employers.[11]

*Accrual of occupational Defined Benefit pension entitlement:* To assess the DB entitlement of an individual, the contribution level is not necessary, there is only a dependency upon earnings and accrual rates. Earnings levels are used when an individual is within DB coverage which are obtained from the ASHE data, however accrual rates are not available. Over time DB schemes have changed, and the nature of the DB scheme is assumed to have changed. The scheme designed is modelled to have changed after 2012, to reflect the implementation of the reforms proposed by Lord Hutton.[12] Active membership of DB pension schemes is dominated by the public sector. In 2016 there were 5.7 million active pension scheme members in the public sector, assumed to be members of a DB scheme, and 1.3 million active members of private sector DB schemes.[13]

DB accrual has therefore been modelled as:
- Prior to 2012 accrual is assumed to be 80th (with an additional cash benefit which does not contribute to retirement income) based upon a final salary of scheme membership.
- After 2012 accrual is assumed to be 60th (with no additional cash benefit however 25% of the pension value may be taken as a tax free lump sum) based upon average salary throughout scheme membership.

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[11] Office for National Statistics. (2017). Occupational Pension Schemes Survey
[12] Independent Public Service Pensions Commission (2011) Independent Public Service Pensions Commission: Final Report
[13] Office for National Statistics. (2017). Occupational Pension Schemes Survey

# Chapter three: methodology - projection of pension outcomes

The projection of individuals through working life and into retirement was designed to allow comparison of the potential outcome of cohorts of individuals. The assumptions made allow for the landscape changes through the impact of policy and the projected career trajectories of each generation.

Future economic conditions have been projected using a deterministic model. The use of a stochastic process was not anticipated to increase understanding of the systematic cohort differences. While it could help to quantify the uncertainty of outcome to be experienced by the different generations it would only have a limited impact upon the relative level of pension saving that each generation may be able to achieve, affecting all individuals who were currently subject to investment and inflation risk. It should be noted that the timing of any future recession or financial crisis would have different impacts between generations as a result of sequence risk, however this is outside of the scope of this modelling.

The projection of the accrual of pension entitlement and lifetime pension amounts was undertaken using developments in two models.

### Projection through working life

The projection of an individual throughout working life was undertaken using the *Resolution Foundation's lifetime model*. This projects the most recent (2016) Annual Survey of Hours and Earnings (ASHE) dataset for individuals over working ages.

The model projects an individual's employment situation through working ages along a career trajectory. This career trajectory is defined using transition probabilities based upon an individual's age, year of birth and known work history to date. The dependency upon work history necessitates the exclusion of individuals who have been in employment for less than 20% of their working life. It is assumed that such individuals will not be reliant upon private pension income in retirement, instead having a greater dependency upon either the State or familial support. The transition probabilities are calculated from the longitudinal historical information available within the dataset using logit regressions.

Earnings levels are applied to those in work based upon their position within the earnings distribution. This distribution is projected assuming an overall growth in earnings consistent with long term Office for Budget Responsibility (OBR) projections of 4.3% per year.[14]

Historical pension participation has been modelled where the information is not available upon the dataset through the random allocation of membership to match historical averages and membership levels. Prior to 1997 pension

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[14] OBR (2017) Fiscal Sustainability report

information is not recorded, from 1997- 2004 membership and scheme type but not contribution rates are detailed, and only from 2005 is there a full contribution history.

Where modelled, pension contributions towards Defined Contribution (DC) pension saving and benefit accrual for Defined Benefit (DB) schemes are assumed to apply to individuals who are in employment, subject to coverage. Public sector coverage is assumed to be by DB schemes. Historical coverage levels in the private sector are derived from the Occupational Pension Scheme Survey (OPSS) data [Table 3.1] within the private sector.

**Table 3.1: Historical numbers of private sector scheme members**[15]

| Pension scheme type | Number of members (thousands) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1995** | **1991** | **1987** | **1983** | **1979** | **1975** | **1971** |
| **Defined benefit** | 5,080 | 5,580 | 5,280 | 5,420 | 5,900 | 5,600 | 6,200 |
| *Of which* <br> • *Final salary* <br> • *Career average* | *5,010* <br> *70* | *5,510* <br> *70* | | | | | |
| **Defined Contribution** | 1,100 | 900 | 480 | 330 | 200 | 100 | 100 |
| **Other or no pension** | 20 | 20 | 40 | 40 | - | 100 | 200 |
| **Total** | **6,200** | **6,500** | **5,800** | **5,790** | **6,100** | **5,800** | **6,500** |

*Totals may not sum due to rounding. Survey methodology and rounding has changed between surveys.*

Future scheme coverage for the public sector is assumed to continue as DB schemes. Within the private sector the decline of DB schemes is projected to continue and DC schemes will cover 80% of the private sector following the staging of automatic enrolment.

Individuals are assumed to maintain their membership of a pension scheme while they remain in that period of employment. On changing jobs, based upon the transitions probabilities identified above, they may become members of a new pension scheme.

Historical DC contribution rates, where uninformed by the ASHE data (before 2005), have been taken at a representative contribution rates taken from OPSS data for both employee and employer contribution rates to DC pension schemes [Tables 3.2, 3.3].

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[15] Government Actuary (1980-2000). Occupational Pension Schemes 1979, 1983, 1987, 1991, 1995

**Table 3.2: Historical employee contribution rates to occupational DC pension schemes**[16]

| Contribution rate | Number of members (thousands) | | | |
| --- | --- | --- | --- | --- |
| | 2010 | 2005 | 2000 | 1995 |
| 0% to 2% | 0 | 0 | 0 | 35 |
| 2% to 3% | 100 | 200 | 200 | 165 |
| 3% to 4% | 200 | 100 | 200 | 155 |
| 4% to 5% | 100 | 100 | 0 | 75 |
| 5% to 6% | 100 | 100 | 100 | 145 |
| 6% to 7% | 100 | 0 | 0 | 25 |
| 7% or more | 0 | 0 | 0 | 20 |
| Employee's share of National Insurance contracted-out rebate | | | | 175 |
| Non-contributory or other basis | 300 | 200 | 100 | 305 |
| No response | 0 | 100 | 300 | 0 |
| Total | 900 | 900 | 900 | 1,100 |

*Totals may not sum due to rounding. Survey methodology and rounding has changed between surveys.*

**Table 3.3: Historical employer contribution rates to occupational DC pension schemes**[17]

| Contribution rate | Number of members (thousands) | | | |
| --- | --- | --- | --- | --- |
| | 2010 | 2005 | 2000 | 1995 |
| 0% to 4% | 100 | 100 | 200 | 410 |
| 4% to 6% | 400 | 400 | 300 | 250 |
| 6% to 8% | | 200 | 0 | 100 |
| 8% to 10% | 200 | 100 | 0 | 90 |
| 10% or more | 100 | 0 | 0 | 130 |
| Discretionary contributions | | | | 120 |
| No response | | 100 | 300 | |
| Total | 900 | 900 | 900 | 1,100 |

*Totals may not sum due to rounding. Survey methodology and rounding has changed between surveys.*

[16] Government Actuary and Office for National Statistics (2000-2016). Occupational Pension Schemes 1995, 2000, 2005, 2010
[17] Government Actuary and Office for National Statistics (2000-2016). Occupational Pension Schemes 1995, 2000, 2005, 2010

Future contribution rates reflect the phasing of automatic enrolment. This results in two notable features relating to DC contribution levels in the projection:

- It has introduced a distinct group of schemes offering minimum contribution levels prescribed by automatic enrolment, which is lower than the contribution rates associated with historical schemes. The number of schemes offering contribution levels above this minimum appears to not be impacted by the introduction of automatic enrolment; any levelling down of existing schemes is outweighed by new savers introduced at these higher contribution rates. This has resulted in a two-tier DC offering;[18]
- The lowest level of scheme contributions are projected to rise in line with the phasing of minimum contribution rates (2% of band salary at the projection date). This minimum is legislated to increase to 5% of band salary in 2018 and 8% of band salary from 2019.

Individual contribution rates are assumed to be constant (subject to the staging of minimum contributions) while an employee remains in a pension scheme, only changing when they change jobs.

The investment return earned upon pension funds reflects a real investment return against projected future RPI increases.[19] To reflect long term differing attitudes to risk and the impact that this may have upon return 25% of individuals are modelled to achieve a long term rate of return around 0.5% above and below this central rate of return.

### Projection beyond working ages

The projection of an individual after pension age was undertaken using the *Pension Policy Institute's Dynamic model*. This projects a cohort of individuals, taken from the Resolution Foundation's lifetime model.

While the individuals projected have complex decisions and a range of actions they may take as a result of Freedom and Choice the modelling has assumed that their retirement actions are:

- Take State Pension at State Pension age (SPa).
- Access private pension at SPa:
  - ➢ Defined Benefit entitlements are assumed to be taken as income; a Pension Commencement Lump Sum (PCLS) is not taken where it would impact future income.
  - ➢ Defined Contribution pension savings are assumed to be converted to a level annuity without taking a PCLS.

New State Pension income is uprated by the triple lock to the end of the current parliament and is earnings linked after that, reflecting current legislation.

This approach to private pension savings recognises the potential income that the pension savings afford. While this may not reflect the actual decisions and

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[18] Institute for Fiscal Studies (2016) Automatic enrolment: the story so far
[19] Office of Budget Responsibility use a long term RPI increase of 3% (Fiscal Sustainability Report 2017), so the investment return represents a long term rate of return of 5.6%.

hence incomes of future pensioners, it does deliver metrics which are suitable for comparison between generations.

Annuity rates have been derived using ONS life expectancy data[20] combined with the interest rate projections from the OBR which they expect to trend to their long term rates around the mid-2030s.[21]

### *Calibration of the projection*

The assumptions detailed above were refined throughout the project. This is a product of calibrating projected outcomes against known data and existing projections to ensure that the projection produces results consistent with the real world.

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[20] Office for National Statistics (2017) National life tables
[21] Office of Budget Responsibility (2017) Fiscal Sustainability Report

# Chapter four: further results - sensitivities

A number of sensitivities have been run to help validate the output and consider how sensitive the results are to plausible future scenarios.

### Maintaining the triple lock

If the triple lock is to be maintained beyond the term of this current parliament it is assumed that there will be a premium above earnings of 0.34% in the long term growth of both the new State Pension and basic State Pension. For those with lower incomes the State Pension is projected to provide the majority of their retirement income. For low earning Millennials this could boost their future replacement ratio by around 7% with more limited gains for higher earners.

Overall the triple lock may increase the proportion of pensioners who may achieve the Pension Commission's benchmark income levels from around 23% to around 30% with greatest benefit to the youngest cohorts.

### Reduced automatic enrolment coverage

This sensitivity is designed to consider the implication of a higher rate of future opt-out from workplace pensions, stemming from increases to contribution amounts and disengagement with pensions. The rate of active membership in the private sector is projected to be 65% rather than 80% in the central scenario.

This has very little impact in the pension incomes of the highest earners who are less likely to be brought into pensions through automatic enrolment. At lower levels of earnings this impacts a greater number of individuals. However there is little impact in the number of people who may meet benchmark replacement rates. This is primarily due to the low amount of pension saving an individual who is saving purely through a low contribution automatic enrolment scheme may achieve.

### Low future growth

With uncertainty of future economic conditions, including the potential impact of Brexit, a low growth sensitivity has been produced to be able to understand a more pessimistic outlook where annual earnings growth is reduced by 1% in real terms. Where results are reported in earnings terms the impact of this appears minimal. While reduced lifetime earnings produces lower, nominal, pension outcomes the impact of discounting these figures at a lower earnings growth means the results remain aligned with earnings.

### Higher future investment returns

This analysis was undertaken to understand the impact of a higher future investment return for Defined Contribution (DC) savings. This more closely aligns the investment return assumption to the assumption that has been used in projections by the Department for Work and Pensions using their Pensim2 model.

The impact is to raise average DC pension income by around 25% for those retiring in the 2050s. Furthermore it results in the increase in DC pension coverage better balancing the decline in DB pensions in the private sector. The

decrease to average pension incomes for those retiring in the 2030s is reduced and millennials will experience a higher pension income than present retirees.

# Appendix one: overview of the models

### Resolution Foundation lifetime model

The Resolution Foundation has developed a new model that allows the projection of individual earnings trajectories based on panel data on employee pay, the New Earnings Survey / Annual Survey of Hours and Earnings (NESASHE) panel dataset. This data provides longitudinal information on a 1 per cent sample of employees in Great Britain since 1975.

### Data

There are some limitations of this dataset, such as the data including employees who spend only a portion of their working life in Great Britain, and a higher-than-expected prevalence of gaps in what appear to be otherwise-consistent employment histories. We conduct interpolation to fill those gaps, and we restrict the data to include only those who spend at least twenty per cent of their working life in employment. A further limitation is that employers are also only required to submit information for employees earning enough to pay National Insurance, although large employers may submit information about employees with lower rates of pay.

NESASHE provides different levels of detail regarding occupational pensions in different years of the survey. It allows the identification of the type of scheme since 1997, but only provides information about contribution rates since 2005. Employee pension coverage and contribution rates are aligned with data from the historic series of the Occupational Pension Scheme Survey in years before 2005.

### Projections of pay and pension saving

Future earnings trajectories are calculated by applying a range of transition probabilities calculated from a series of logit regressions. The first step involves predicting whether an individual will be in work or not based on their age, birth year and past work history. If in work, or moving back into work, they are then allocated to an earnings quintile based on similar historical information. These transition probabilities are then applied to individuals to project forward an earnings path in each future year to retirement. In each year, individuals are ranked within quintiles and assigned a level of pay based on their overall position in the earnings distribution and the equivalent rate of pay in the 2016 data. These earnings levels are later uprated in line with a given overall earnings growth assumption (4.3 per cent nominal in our central scenario).

Future occupational pension coverage and contribution rates are projected forward from the 2016 data. An individual's saving pattern only changes when they move job in the projection period. As auto-enrolment rolls out both coverage and contribution rates are assumed to rise, with a differential applied so that higher-than-minimum contributors keep doing so in future years. This lifetime earnings and pensions contribution information is then summarised and provided to the Pensions Policy Institute (PPI) to produce a projection of retirement income.

### PPI dynamic model

The PPI dynamic model projects retirement cash flow outcomes for individuals. For this project, it has been used with a deterministic retirement approach, assuming that individuals retire at their State Pension age.

The model is usually applied to English Longitudinal Study of Ageing data, but has been amended to allow profiles derived from New Earnings Survey / Annual Survey of Hours and Earnings (NESASHE) data by the Resolution Foundation to be projected through their retirement. Here we provide an overview of modelling approach.

Economic assumptions are derived from those published by the OBR in their Economic and Fiscal Outlook and Fiscal Sustainability Report. The model is capable of projecting variations on the current pension system framework, and incorporating behavioural assumptions.

The projection of an individual takes in:
- Private pension accrual to State Pension age
- Retirement income from private pension
- Retirement income from State Pension
- Means tested benefits in retirement, including pensions credit
- Individual taxation

### Private pension accrual to State Pension age

An individual's current pension wealth is derived from NESASHE data and projected using the Resolution Foundation's lifetime model to their State Pension age. For DC entitlement, this is subject to economic assumptions taken from OBR and an assumed portfolio composition as well as deductions from charges (assumed AMC at 0.5%).

### Retirement income from private pension

It is assumed that the individuals do not access private pension saving until SPa. Individuals are assumed to take their full Defined Benefit (DB) pension entitlement as income and convert the entirety of Defined Contribution (DC) saving into a level annuity. This reflects the theoretical income that the pension saving can achieve to better make comparisons between generations.

### Retirement income from State Pension

Individuals receive their State Pension at their SPa as currently announced and legislated for. The two tier state pension system is in place for those reaching SPa until 2016, thereafter the single-tier pension is introduced for those reaching SPa after that date.

It is assumed that the individuals qualify for a full single-tier pension if they retire after April 2016. A foundation pension based on basic State Pension (bSP) and additional State Pension as set out above is calculated for those who reach SPa after the introduction of the new State Pension (nSP). If the foundation amount is greater than the nSP level the individual is assumed to receive a CPI linked "protected amount".

The basic State Pension and new State Pension are uprated by the 'triple-lock' until the end of the current parliament after which the triple lock is replaced by an earnings link.

# Acknowledgements and Contact Details