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Modelling Collective Defined Contribution Schemes

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Executive Summary

Executive Summary

- The UK government has introduced legislation within the Pensions Schemes Act which will enable companies to provide pensions with an element of risk sharing between members. The regulations required to enable these schemes to be set up has recently been delayed.
- Previous industry modelling has suggested that some of these schemes – and in particular Collective Defined Contribution (CDC) schemes – result in better outcomes for members than traditional DC schemes. However, there has also been analysis using different models that suggest that these out-performances are over-stated.
- The PPI has produced a bespoke CDC model to look at a potential CDC scheme under different assumptions, to determine whether CDC produces better results compared to DC and in what circumstances.
- In the scenarios modelled, with the assumptions used, the PPI modelled CDC scheme produces better replacement rates compared to DC in all variants assuming a mature scheme.

Executive Summary (cont.)

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- In the long term, once the scheme is mature and the scheme population is stable, CDC produces better outcomes (a replacement rate of between 27% and 30%) than DC (a replacement rate of between 12% and 21%, assuming a 10% contribution rate). The PPI modelled CDC scheme also requires a relatively low contribution rate to maintain these outcomes.
- In the short term, with no initial pre-funding (which is likely to be the case for a new scheme), the benefits of the modelled CDC scheme are similar to that of a DC scheme with an aggressive drawdown (7% per year). However, the modelled CDC scheme would be less likely to run out, and the outcomes are still higher than a DC scheme with an annuity.
- The modelled CDC scheme has a narrower distribution of outcomes than DC.
- The width of the funding gates (the target funding level for the scheme) affects the volatility of outcomes, with a narrower gate increasing the volatility.
- The median outcome is only very slightly affected by the width of the funding gate.

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Background / Introduction

Background to CDC

- The UK government has introduced legislation within the Pensions Schemes Act which will enable companies to provide pensions with an element of risk sharing between members.
- The legislation allows for the development of new structures offering collective benefits that allow for the pooling of investment, inflation and longevity risks between members within a workplace pension structure, and allows for pensions in payment to fluctuate.
- CDC will be possible when regulations are made, although the date for this has recently been postponed.
- Schemes offering collective benefits do already exist, or are in development, in a number of other countries, including the Netherlands, Nordic countries and Canada.

Previous CDC work

- In an Aon publication (Aon Hewitt (2013) *The case for collective DC)*, the report found that CDC produces outcomes ranging from a third higher to over double than that achieved from DC. This corroborated findings from an earlier report by the RSA (RSA (2013) *Collective pensions in the UK II*).
- However, in a Cardano and PPI roundtable with Dutch experts in December 2014[1], the benefit was calculated as 1% higher for CDC schemes compared to DC. There was also other disagreements on the benefits of CDC based on the technique used to compare the results.

[1] http://www.pensionspolicyinstitute.org.uk/event-reports/cardano-and-ppi-policy-seminar-the-dutch-experience-of-cdc-pensions-and-lessons-for-the-uk

Project Outline

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- The DWP commissioned the PPI to:
  - Produce two Briefing Notes on the Dutch and Canadian (New Brunswick) CDC systems and experiences.
  - Develop a CDC model (similar to the one created by Aon Hewitt (2013) *The case for collective DC*) to seek to independently replicate the approach taken by Aon, and to test the results against a wider range of counterfactuals.
- The Briefing Notes were published in October 2014.
- This presentation outlines the results from the PPI modelling using PPI's bespoke CDC model.
- Details of the PPI CDC model are given in Appendix 1.

The PPI model

- All the findings in this report are based on a specific interpretation and a particular design of CDC model. It is possible to design different models and use alternative assumptions that could lead to different outcomes.
- The PPI modelling is designed to give an indication of outcomes from a specific modelled CDC scheme, but as it was designed to closely replicate the Aon approach (which predated UK legislation) it does not match up directly against the provisions of the Pension Schemes Act 2015.
- For example PPI have used funding gates to maintain the current funding balance in the scheme, whereas the legislation requires an actuary to assess the ability of the scheme to meet its target benefits within a probability range.

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Modelling the long term

In the long term, with the assumptions used, the modelled CDC scheme produces better replacement rates compared to DC

- The models have been run on the assumption that the scheme is fully funded in the first year (as made in the Aon Hewitt model). This is representative of a mature CDC scheme that has been in operation for a number of years.
- For the CDC schemes modelled, with the assumptions used (Appendix 2), the central outcome (with funding gates 90-110%) is a replacement rate of 29%. The range of replacement rates that were achieved for other variants were between 27% and 30% (Appendix 3).
- Based on the assumptions used for the DC schemes modelled (Appendix 4), the range of replacement rates achieved are between 12% and 21% (Appendix 5).
- For the CDC and DC schemes modelled, CDC produces better replacement rates.

The modelled CDC schemes deliver a higher replacement rate compared to DC

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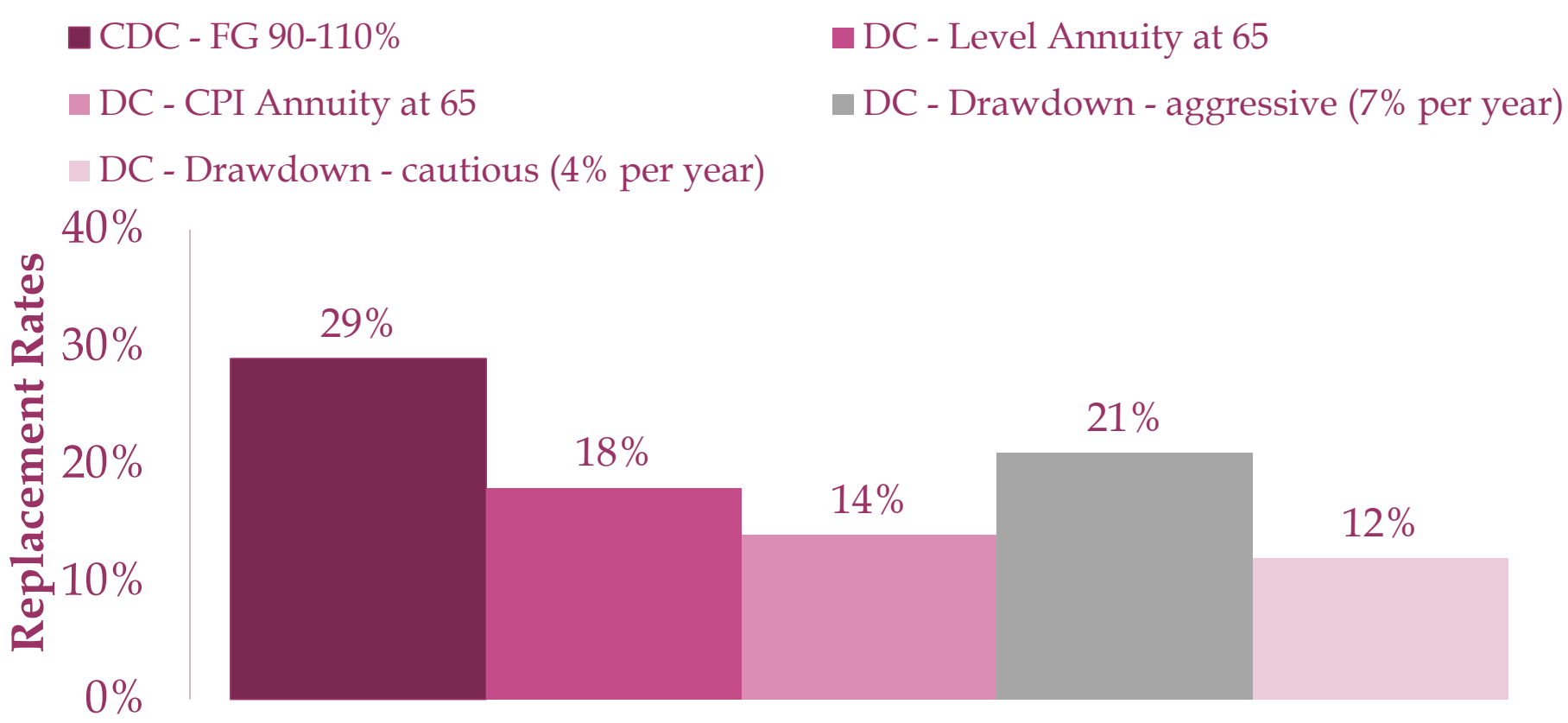
Median replacement rates in the first year after retirement based on different DC incomes invested in a lifestyle investment strategy compared the modelled CDC scheme



The modelled CDC scheme has a narrower distribution of replacement rates compared to DC

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- Modelled CDC schemes have a lower spread of outcomes compared to DC decumulation paths.
- The reason for this is a smoothing effect. For an individual in a DC scheme, a run of bad returns just before retirement heavily affects their income in retirement.
- For CDC, the funding gates allows it to absorb some of the bad returns before cutting benefits. Also, the contributions being made each year can offset some of the bad returns, whilst a retiree in a DC scheme stops making contributions.
- This smoothing also means that in good return years, not all the benefits are transferred to the retiree in CDC.

The distribution of outcomes is less spread for the modelled CDC scheme

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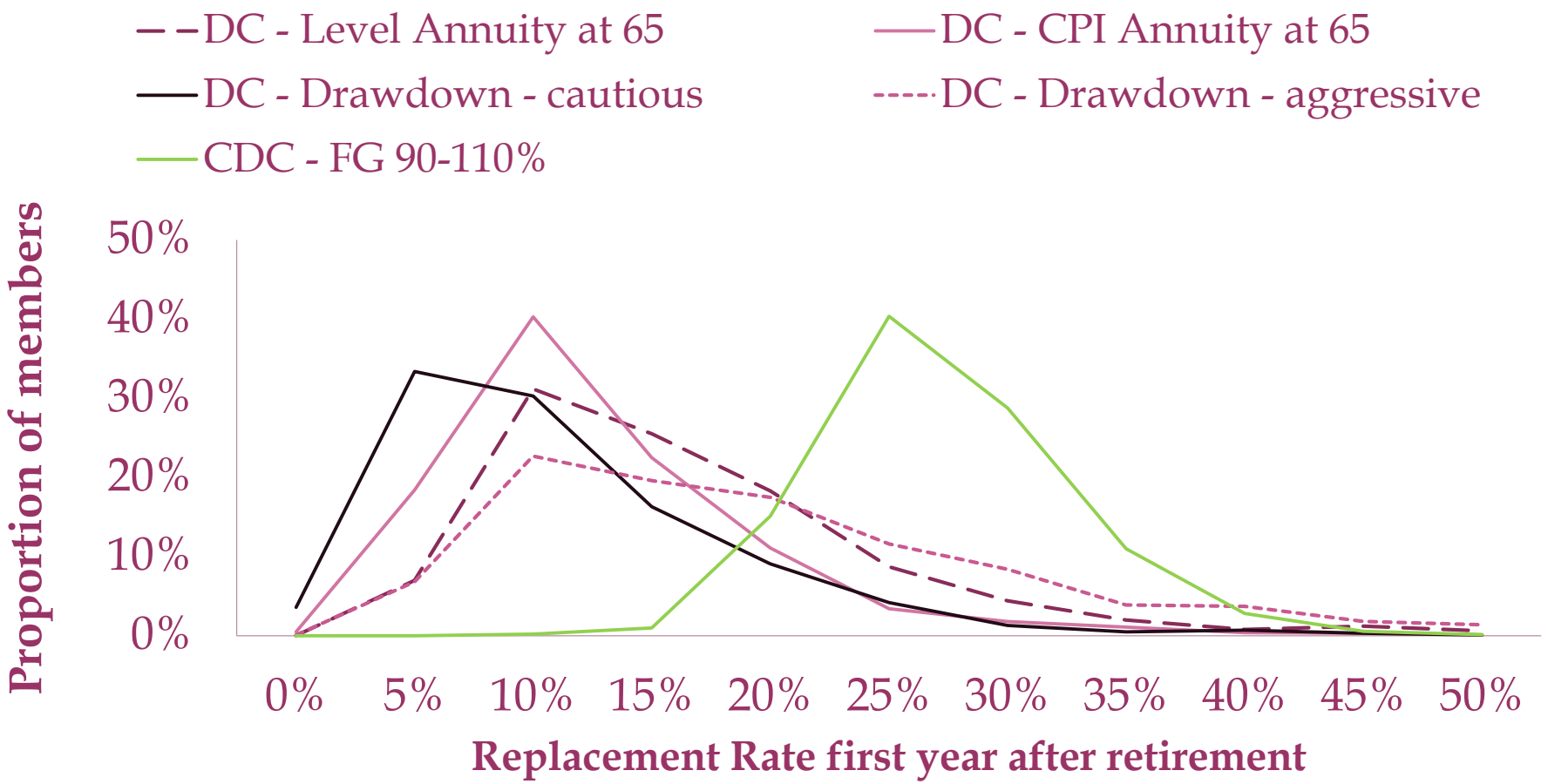
Distribution of replacement rates for each variant in the first year of retirement



The funding gate has minimal effect on the median replacement rate achieved from the modelled CDC schemes, but changes the volatility of outcomes

- Changing the funding gates in the CDC modelling does not change the median outcome significantly (Appendix 6).
- By increasing the size of the funding gates, the narrower the distribution becomes. This is caused by the extra smoothing that can occur. However, this means the funding level can move significantly below 100% and relies much more on subsidisation by the younger cohort and also hoping that future returns on assets will be positive enough to fill this gap.
- This model assumes a constant flow of new entrants. If this was not the case, the volatility of the modelled CDC schemes may increase.

Funding gates influence the distribution of outcomes

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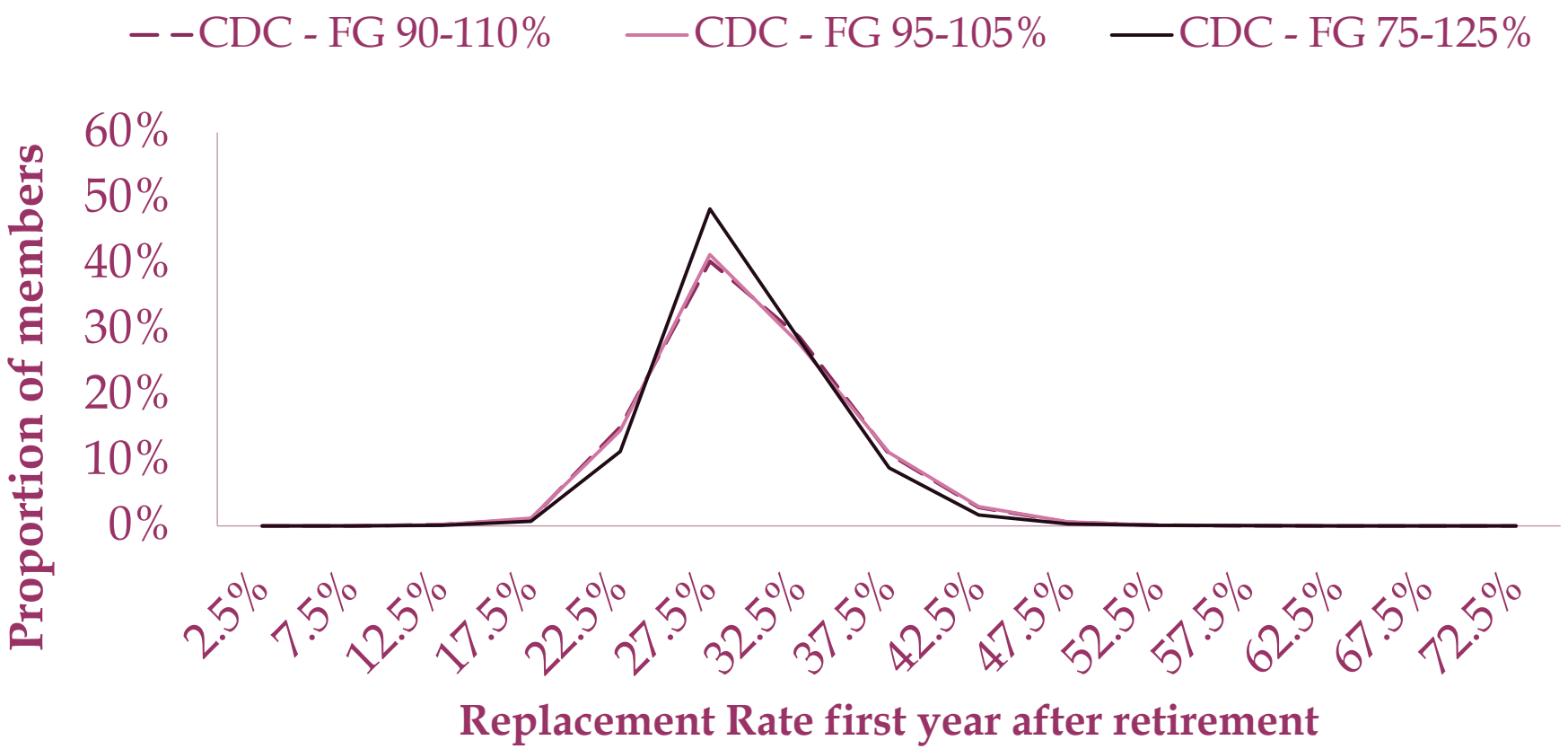
Distribution of replacement rates for each modelled CDC funding gate (FG) variant in the first year of retirement



In the long run, a 10% contribution rate is sufficient to maintain the modelled CDC scheme

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- In the long run, once the scheme has become mature, stable and fully funded, the 10% contribution rate is more than sufficient to achieve the 1% accrual per year in this modelling.
- With an initial injection to ensure the scheme is running at a fully funded level, in the model used, higher replacement rates can be achieved.
- The initial funding injection allows the CDC scheme to generate greater income from investment returns compared to a scheme where there is no initial funding and the scheme is underfunded in the first few years.
- For a new CDC scheme without initial extra funding to provide for smoothing, a higher contribution rate might be required to support a 1% accrual rate.

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Modelling the short term

An initial fully funded scheme is a very strong assumption

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- The fully funded assumption may be more valid where, for example, significant assets are transferred from existing DB/DC schemes into CDC, or where an initial capital injection is provided. However, this may not be the case in the UK.
- To illustrate the importance of the fully funded assumption, the model was run with no initial funding, simulating the setting up of a new CDC scheme. Replacement rates were then generated over the same time period as used in the fully funded variants.
- The median modelled CDC scheme replacement rate was 21% in this scenario, which is equivalent to the aggressive DC drawdown strategy. However, the income from the modelled CDC scheme is less likely to run out during retirement and it has a narrower distribution of outcomes, meaning outcomes are more certain.

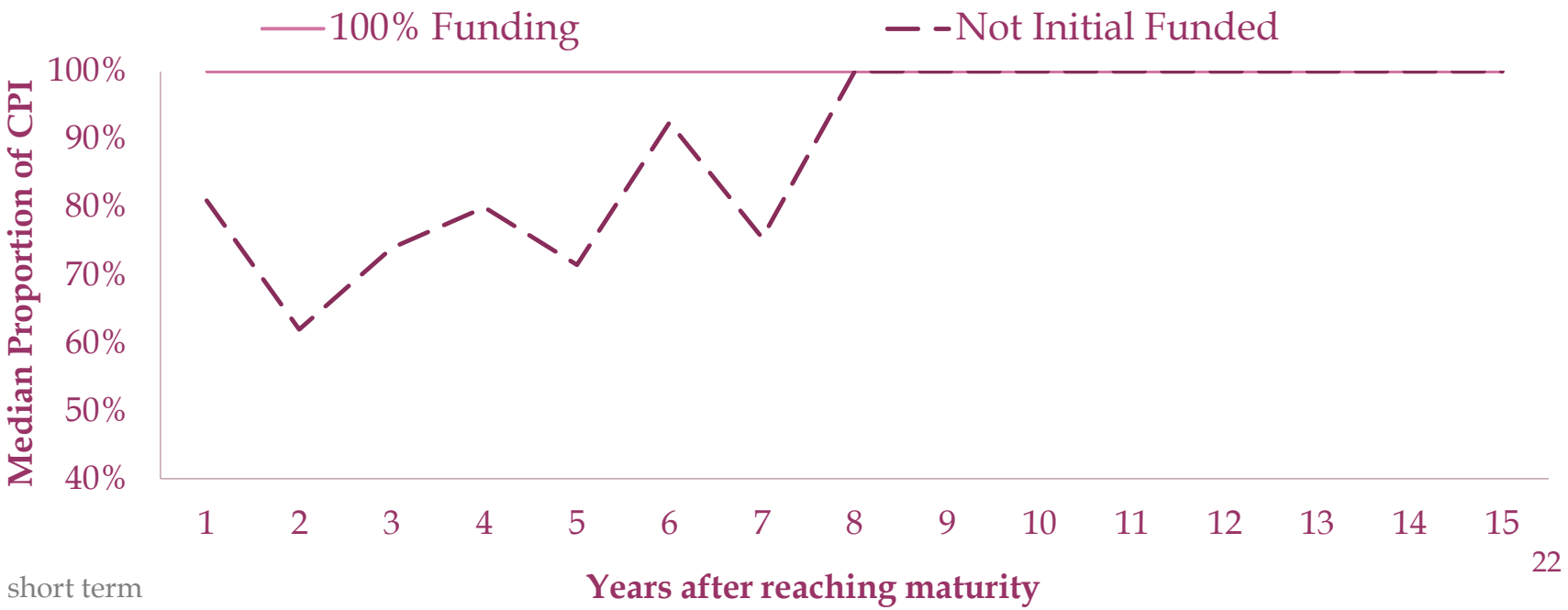
The initial funding allows the CDC scheme to access extra accruals

- In the median scenario with no initial funding, the scheme is under funded in the first few years, so the median proportion of CPI provided is less than 100% in those years.
- Having an initial 100% funded scheme allows the modelled CDC scheme to access extra accruals (larger absolute amounts generated by investment returns on the initial pre-funded assets) that would not be achieved without the funding injection. A modelled CDC scheme without this injection has a lower funding position, as the contributions are not sufficient to reach the same level and so is at greater risk of under funding in the initial years. This has a large influence on the outcomes obtained by the modelled CDC scheme.

Without an initial funding injection, the modelled CDC scheme is under funded on average in the short term

- This chart shows that the modelled non initially funded CDC scheme takes 8 years to become fully funded and provide full CPI increases.
- The fully funded scheme provides full CPI increases from the first year (caused by the 100% funded assumption)

Median proportion of CPI provided each year once the mature population has been established for the initially fully funded and not initially funded CDC variants



The '100% initial funding level' causes unequal comparisons in the short term

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- Without initial full funding, the modelled CDC scheme would require a higher initial contribution rate to enable it to meet the targeted accrual rate. In the PPI model, this is a contribution rate of 14% (Appendix 7) compared to the 10% contribution rate over the long term. For a valid comparison with DC schemes, the same contribution rate should be used in both types of schemes.
- Based on a 14% contribution rate for DC, modelled CDC outcomes are still better in most cases but the benefits are slightly smaller. The aggressive drawdown is the only DC decumulation pattern that produces outcomes similar/better compared to modelled CDC, but this is more likely to run out during retirement.

Based on a 14% contribution rate for DC schemes, the benefit of the modelled CDC scheme is reduced

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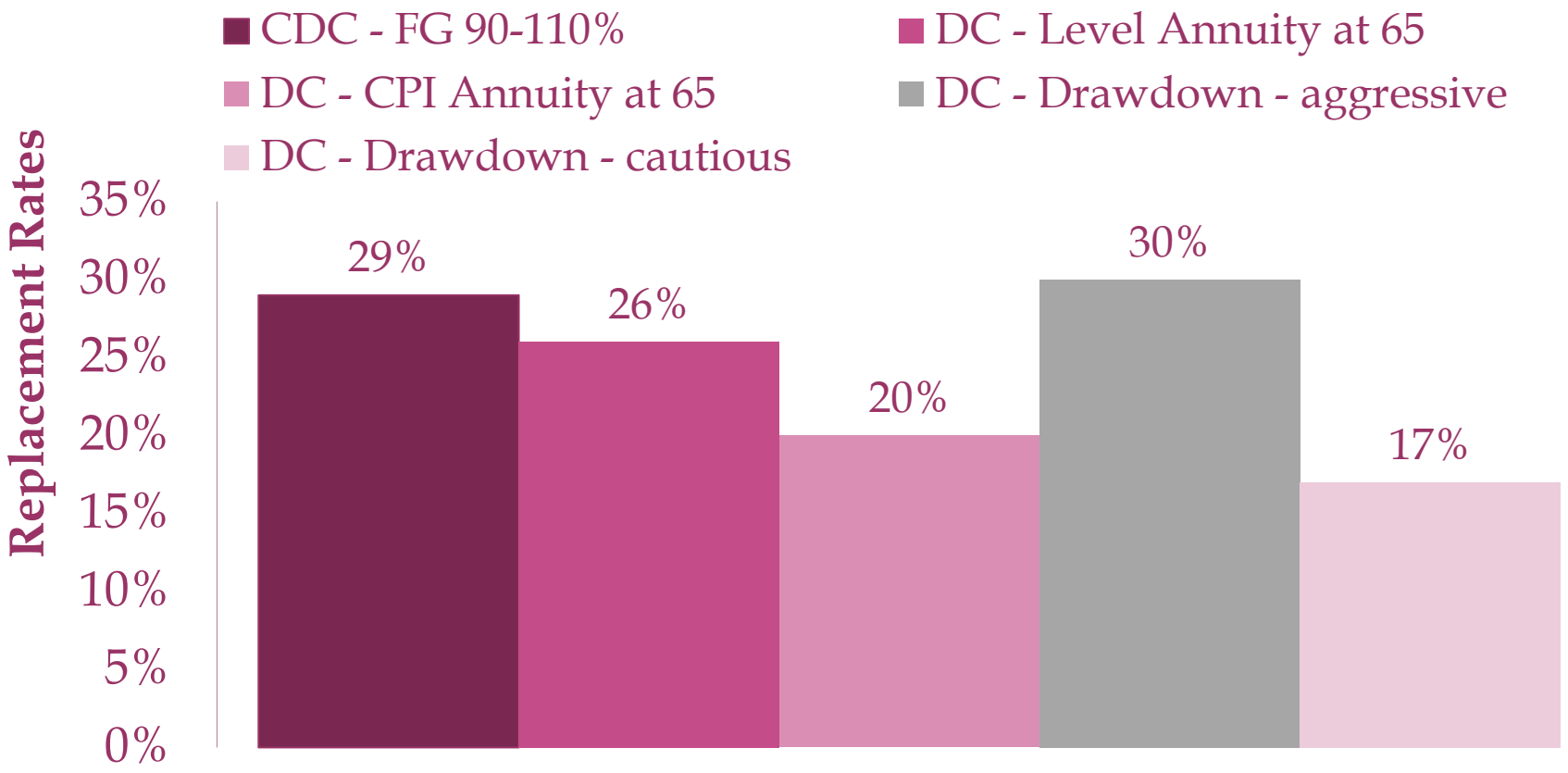
Median replacement rates in the first year after retirement based on different DC incomes on a contribution rate equivalent to the 100% funded CDC scheme (14% contributions) compared to a modelled CDC scheme



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Summary of results

The design of the CDC scheme used in the PPI model allows it to achieve better outcomes

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There are several design factors identified which can contribute to the modelled CDC scheme achieving better outcomes than DC:

- With drawdown, there are no future contributions after retirement and the amount left to earn investment returns decreases. By contrast, in the modelled CDC scheme, returns can be earned on the whole asset pool aggregated across individuals.
- As the returns on equities vary more than on gilts, in years of low equity returns pre-retirement the modelled CDC scheme is affected to a lesser extent than DC, which is 100% invested in equities pre-retirement.
- Post-retirement the modelled CDC schemes can remain invested in 60% equities and continue to benefit from the higher returns, while in DC drawdown schemes, funds are de-risked to reduce the equity exposure.
- In the modelled CDC scheme, assets taken by the retired cohort are being replaced by new entrants. In drawdown, the core asset amount is reducing, thus the return on this amount is also reducing.
- The size of the modelled CDC schemes are large, with a mature population. This means there can be cross subsidisation as the younger cohort fund the retired and continuous new entrants ensure the funding level is sufficient.

The assumptions used in the CDC model are also responsible for the better outcomes

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There are several assumptions which contribute to the modelled CDC scheme achieving better outcomes than DC:

- The CDC model responds to low return years by cutting the benefits paid. With drawdown, a constant drawdown assumption is made, so in low return years, drawdown will deplete at the same rate, reducing assets faster, thus reducing future returns.
- As only people aged over 40 are considered, the contributions received are significantly higher than those that would be received from younger members. Additionally, mortality is only considered after retirement so these contributions are guaranteed in this model.
- If we assume the model is not fully funded in the first year, median outcomes are reduced. It would take a longer time to reach the same outcomes as a fully funded CDC scheme. The results are heavily dependent on what we assume the starting position to be.

Summary of key findings

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- In the scenarios modelled, with the assumptions used, the modelled CDC scheme produces at least equal or (in most cases) better replacement rates compared to DC in all variants.
- **In the long term**, a modelled CDC scheme which is mature, large and fully funded may achieve a better replacement rate compared to DC. A 10% contribution rate was also sufficient to maintain this scheme.
- **In the short term**, if there is no initial funding injection, the modelled CDC scheme can be underfunded. The replacement rate outcomes, after the same period of time as the fully funded modelled CDC scheme, are still better than a CPI linked annuity and is similar to the outcomes of aggressive drawdown. However, the CDC scheme does benefit compared to drawdown in that it is less likely to run out so it can be considered to be more secure.

Further findings from the modelling

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- With the same assumptions used for the modelled CDC and DC, modelled CDC outcomes are less spread compared to DC.
- The width of the modelled CDC funding gates affects the volatility of outcomes, with a narrower gate increasing the volatility.
- The median modelled CDC outcome is only very slightly affected by the width of the funding gate.

Conclusions

- Based on the options modelled:
  - The modelled CDC scheme produced long-term outcomes ranging from 40% higher to over double that of the DC variants modelled compared to our central modelled CDC scenario (funding gate 90-110%).
  - But the size of the advantage depends on a number of assumption, including initial funding levels. In a model with no pre-funding, the modelled CDC scheme produces outcomes similar to an aggressive drawdown. However, the modelled CDC scheme would be less likely to run out, and the outcomes are still higher than in a DC scheme with an annuity.
  - CDC produces less volatile outcomes than DC.

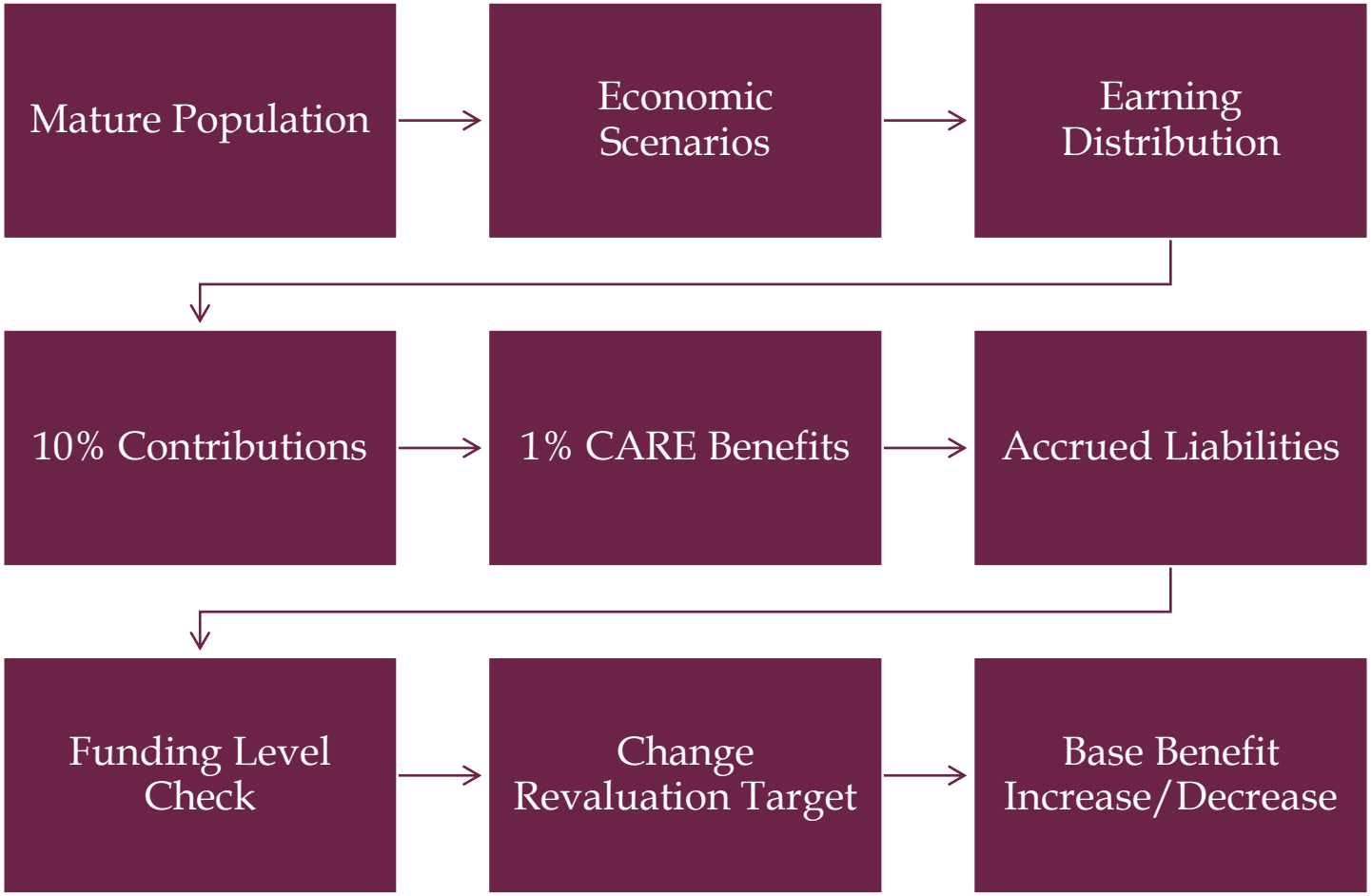
Appendices

- Appendix 1 – CDC Model
- Appendix 2 – CDC assumptions and variations
- Appendix 3 – CDC replacement rates
- Appendix 4 – DC assumptions and variations
- Appendix 5 – DC replacement rates
- Appendix 6 – Funding gates
- Appendix 7 – Equivalent funding rates
- Appendix 8 – Outcome distribution
- Appendix 9 – Funding gates / outcome distribution
- Appendix 10 – Consistent investment strategies
- Appendix 11 – Mean base benefit cut
- Appendix 12 – AON Hewitt

Additional analysis, for information

Appendix 1

CDC Model Flow



Appendix 1

The CDC Model

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- In order to start the projection with a mature population, the model runs from 1958 to 2060, with 1000 new entrants each year. From 1958 to 2013, individuals from 40 to 65 accrue pension rights, thus by 2014 individuals from 65 to 96 are being paid pensions (individuals above age 96 make up 1% of the retired population at this point and so the absence of individuals at these higher ages at the beginning of the projection is assumed to have little effect on the final outcomes).
- Scenarios are brought in from the "Economic Scenario Generator", which are fixed for all variants. It provides economic data for things such as CPI, Gilt yields, earnings, equity returns etc. for all future years. These vary by year and for each scenario. Historical data is used for years before 2015.
- From 2014 onwards, liabilities are evaluated yearly and subjected to a funding check against the assets. Liabilities are valued at gilt yields and indexed at CPI.
- The model CDC scheme includes 10% contribution rate, and targets 1% CARE benefits (revalued at CPI).

Appendix 1

The CDC Model (cont.)

- The assets and liabilities are evaluated each year and the funding level is required to be between the upper and lower funding gates. The model attempts to increase benefits by 100% of CPI at the start of the year. If the funding level is too low, the liabilities are recalculated using different revaluation targets (CPI – 1% etc.).
- If the funding level is still too low, a lower revaluation target is sought until the funding level is met. If the target falls to 0 revaluation, and the funding level is still not met, then a percentage cut is made to the base benefits. The new lower level of base benefits is the level which enables the funding criteria to be met.
- The base benefits are carried forward to the following year, i.e. the new benefit level becomes the new normal.
- Replacement rates are output from the year 2039 to 2048.

The Pensions Policy Institute is grateful for input from Gary Heslop of APR LLP.

Appendix 2

CDC Assumptions

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Baseline Assumptions

- **Investment strategy**: 60% equities, 40% bonds
- **Charges**: 0.5% Annual Management Charge
- **Contribution rate**: 10% of salary in that year
- **Accrual Rate**: 1%
- **Lower age of membership**: 40
- **Mortality**: No mortality pre-65, after age 65 S1PMA life tables with improvers are applied
- **Funding level at start**: 100%
- **Revaluation target:** Reset to 1 at the beginning of each year (i.e. 100% of CPI is given at the start of each year subject to the funding level)
- **Replacement rates:** Calculated as the CDC retirement income (excludes any other income e.g. state pension) divided by the income just before retirement (uprated by CPI)
- **Discount rate**: Actuarial best estimate

Appendix 2

CDC Variants

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Baseline: Funding gates 90-110%

Variants

- **Variant 1**: Funding gates 95-105%
- **Variant 2**: Funding gates 75-125%
- **Variant 3**: Funding gates 90-110%, 8% contributions
- **Variant 4**: Funding gates 90-110%, 5% contributions
- **Variant 5**: Funding gates 90-110%, 75% initial funding
- **Variant 6**: Aon comparison – this is a comparison to the results published by Aon Hewitt (Aon Hewitt (2013) *The case for collective DC)*. The assumptions which have been changed, compared to our baseline assumptions, to match AON are:
  - The revaluation target is not reset, it is carried over from the previous year and works out the revaluation target from that point.
  - Gilt discount rate.
  - 90-110% funding gate.

Appendix 3

CDC schemes can deliver a replacement rate between 27-30% in the first year of retirement with 10% contributions during working life

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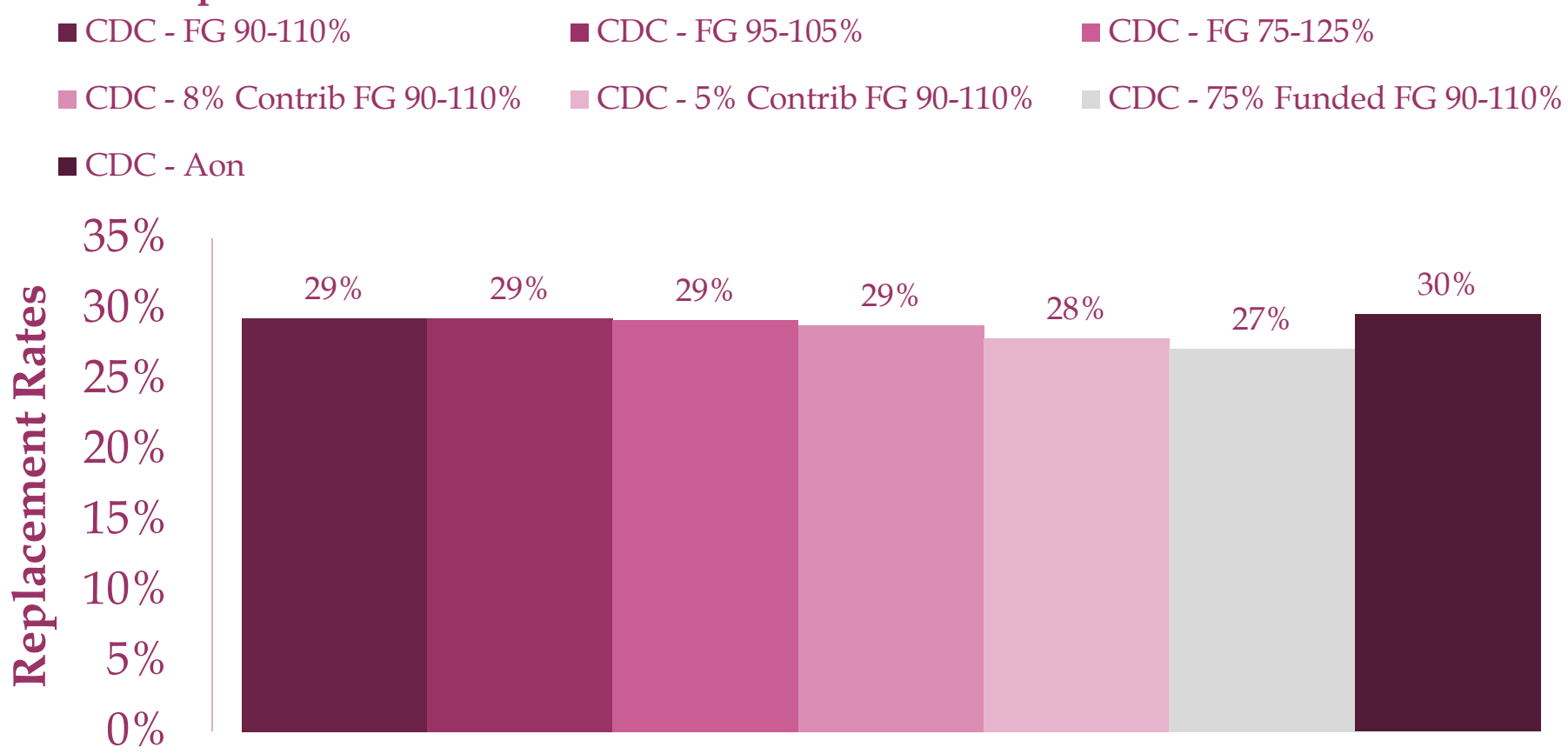
Median replacement rates for the first year after retirement based on different CDC assumptions



Appendix 4

DC Assumptions

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- **Investment strategy:** Lifestyle glide-path (40% still saved in equities post-retirement for drawdown strategies)
- **Charges**: 0.5% annual management charge
- **Contribution rate**: 10% of salary in that year
- **Lower age of membership**: 40
- **Mortality**: No mortality pre-65, after age 65 S1PMA life tables with improvers are applied
- **Replacement rates:** Calculated as the DC retirement income (excludes any other income e.g. state pension) divided by the income just before retirement (uprated by CPI).

Appendix 4

DC Variants

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Variants

- Level annuity at age 65
- CPI linked annuity at age 65 (annuity income increases by CPI)
- Aggressive drawdown (7%)
- Cautious drawdown (4%)

Appendix 5

DC schemes can deliver a replacement rate between 12-21% in the first year of retirement with 10% contributions during working life

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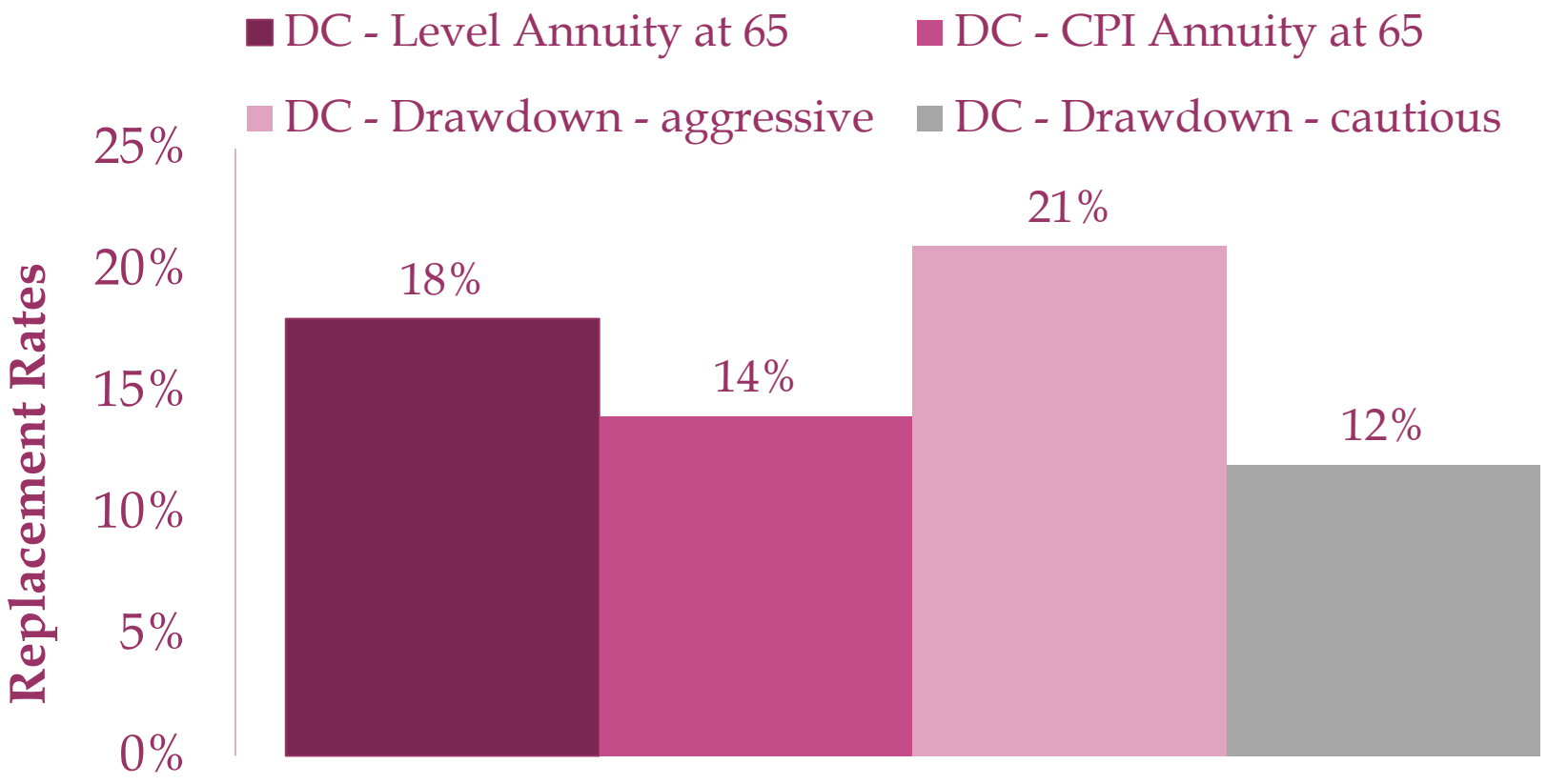
Median replacement rates in the first year after retirement based on different DC incomes invested in a lifestyle investment strategy



Appendix 6

The funding gate changes the distribution with minimal changes in outcomes

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	CDC - FG 90-110%	CDC - FG 95-105%	CDC - FG 75-125%	CDC – 8% Contrib	CDC – 5% Contrib	CDC – 75% funded	CDC – Aon
Median Replacement Rates	29.3%	29.3%	29.2%	28.8%	27.9%	27.2%	29.6%
	Proportion of years						
More than CPI Increase	25.0%	30.5%	18.0%	22.3%	18.4%	12.9%	49.0%
CPI Increase	54.0%	42.2%	70.0%	53.8%	52.5%	50.9%	2.9%
Less than CPI Increase (including base benefit cuts)	21.0%	27.3%	12.0%	23.9%	29.1%	36.2%	48.0%
Mean Base Benefit cuts across all years	0.2%	0.2%	0.1%	0.3%	0.9%	0.7%	0.1%

Appendix 7
The contribution rate equivalent to a fully funded modelled CDC scheme has been calculated as 14%

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- The contribution rate required for a non initially funded scheme in the short term to meet the required accrual rate is higher compared to a fully funded scheme.
- The initial contribution rate required over the build up of a CDC scheme before the membership becomes stable as a fully funded scheme **(i.e. in the short term)** has been assessed at 14%
  - This is based upon the contribution required to be made by an individual to fully meet their own pension liability at retirement (in the same year that the funding injection is made).
  - The liability is calculated as the cost of a CPI linked annuity at the expected accrued level.
  - The difference is due to the timing effect of the accruing of benefits against the increase in earnings and investment returns.

Appendix 8

Distribution of outcomes with different assumptions

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Distribution of replacement rates for the variants used in the modelling

Replacement Rate	CDC - FG 90-110%	CDC - FG 95-105%	CDC - FG 75-125%	CDC – 8% Contrib	CDC – 5% Contrib	CDC – 75% funded	CDC - AON
Less than 20%	1%	1%	1%	2%	6%	5%	2%
20-25%	15%	15%	11%	19%	24%	27%	15%
25-30%	40%	41%	49%	40%	38%	43%	36%
30-35%	29%	28%	28%	26%	23%	19%	31%
35-40%	11%	11%	9%	10%	7%	5%	12%
40%+	4%	4%	2%	3%	2%	1%	4%

Appendix 9

Funding gates influence the distribution of outcomes

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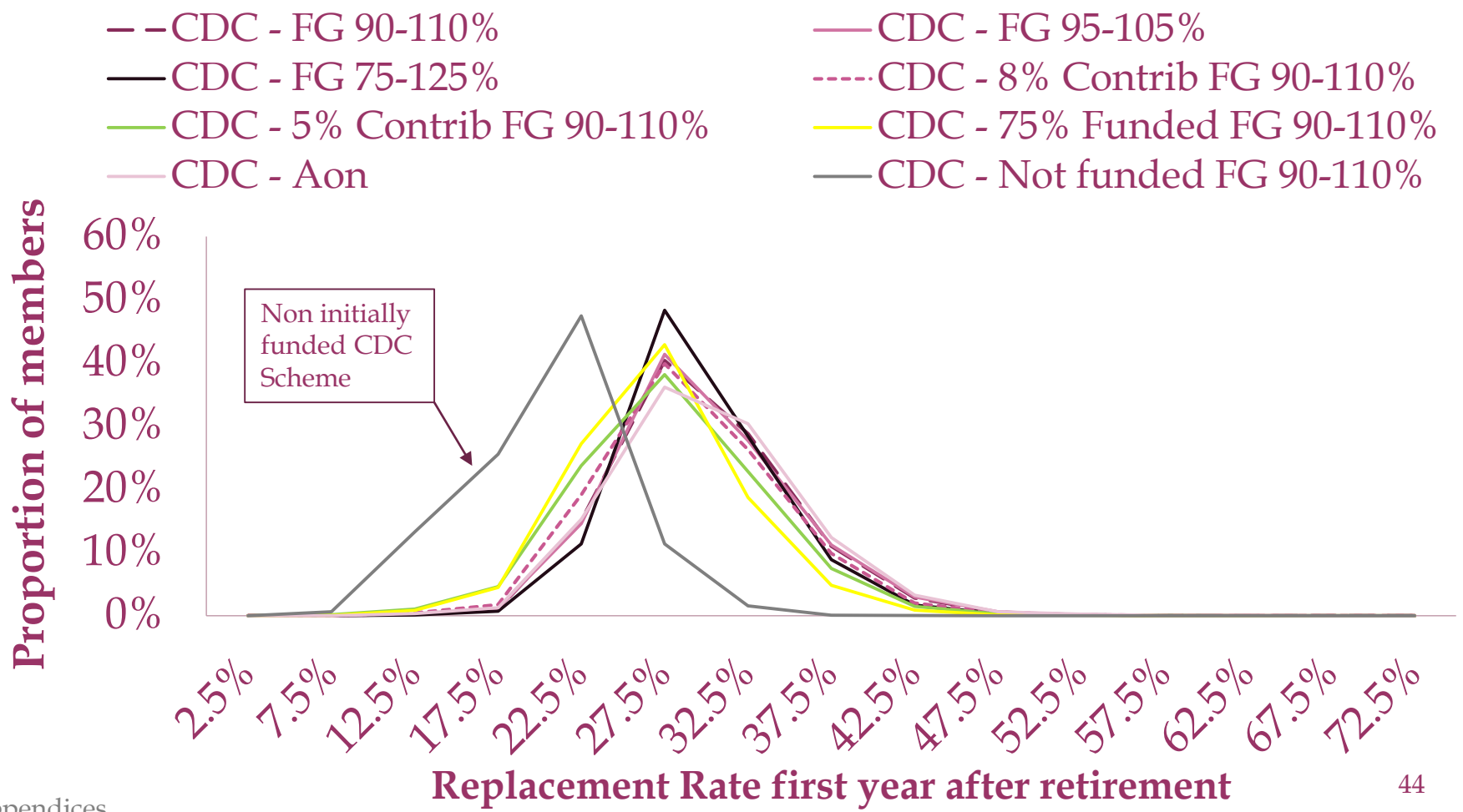
Distribution of replacement rates for each variant in the first year of retirement



Appendix 10

With the effect of different investment strategies removed, the CDC model outperforms DC to an even greater extent

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- The modelled CDC schemes have 60% invested in equities and 40% invested in bonds throughout.
- DC schemes are assumed to follow a lifestyle glide path. Initially invested entirely in equities and de-risked approaching retirement to 40% in equities and 60% in bonds (which is maintained over any drawdown period).
- To remove the effect of different investment strategies, the DC schemes were run using the same investment profile as the CDC schemes.
- The modelled CDC schemes further outperform DC if the same investment strategy is used for the DC scheme.

Appendix 10

With the effect of different investment strategies removed, the CDC model outperforms DC to an even greater extent

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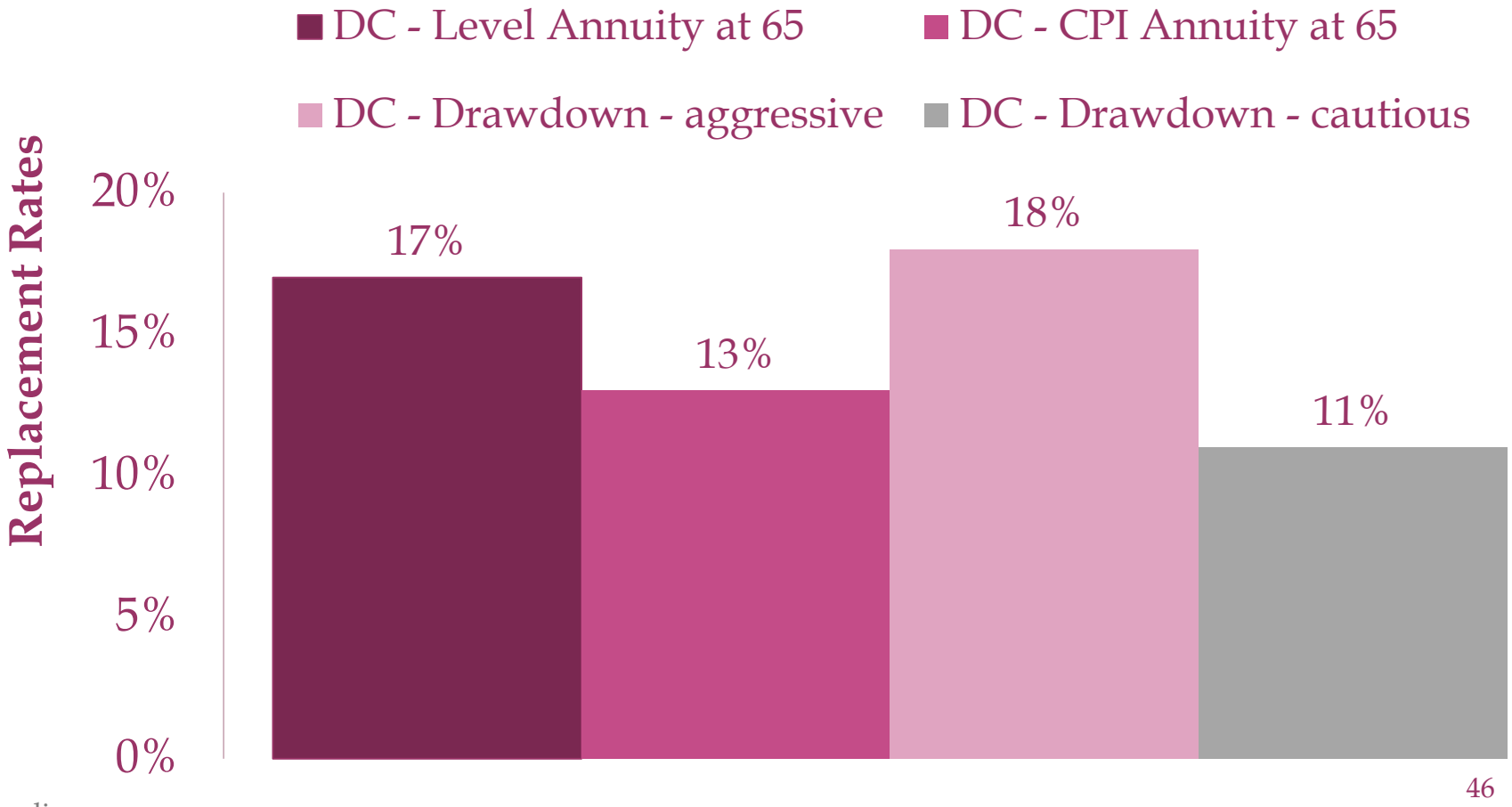
Median replacement rates in the first year after retirement based on different DC incomes on the same investment strategy as CDC



Appendix 11

Mean base benefit cuts

- In cases where reducing the amount of inflation given in that year is not sufficient to bring the funding level between the funding gates, the base benefit is then cut i.e. benefits are cut more than inflation.
- The next slide shows the mean base benefit cut, when there is a cut to the base benefit (i.e. excluding years where there is no cut).
- This is not directly comparable to the benefit cut shown in the table shown previously. Appendix 7 shows the mean cut averaged over all years (including those years with no benefit cut).
- The slide after the mean base benefit cut shows the proportion of CPI given for each year i.e. 100% means benefits were increased by 100% of CPI. If it is less than 100%, then the full amount of CPI was not given, which means benefits did not increase in line with inflation.

Appendix 11

The mean base benefit cut for years where there are cuts are all very similar in size

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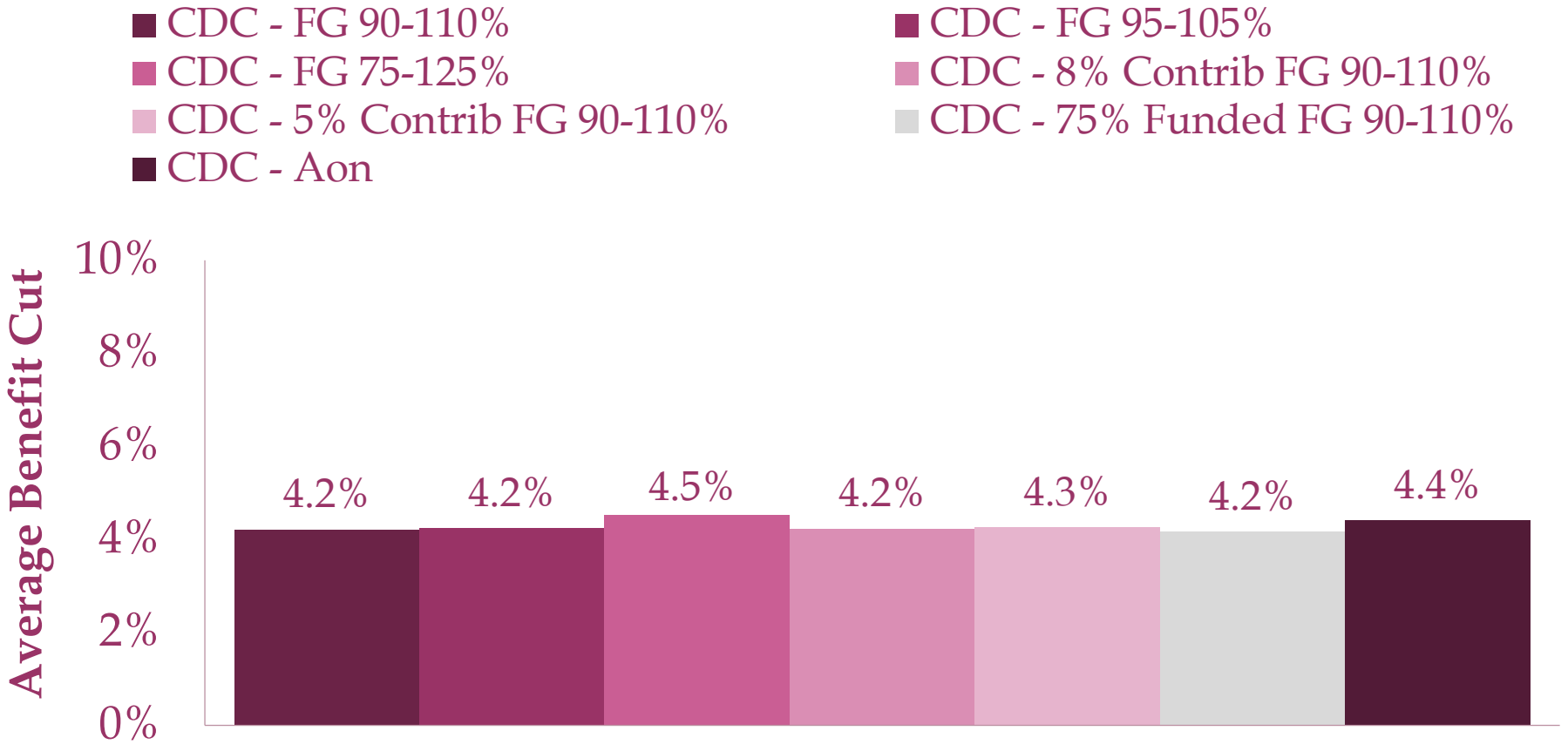
Mean real base benefit cut for each variant (when there is a benefit cut)



Appendix 11

Wider funding gates allows more chance of the full CPI being provided

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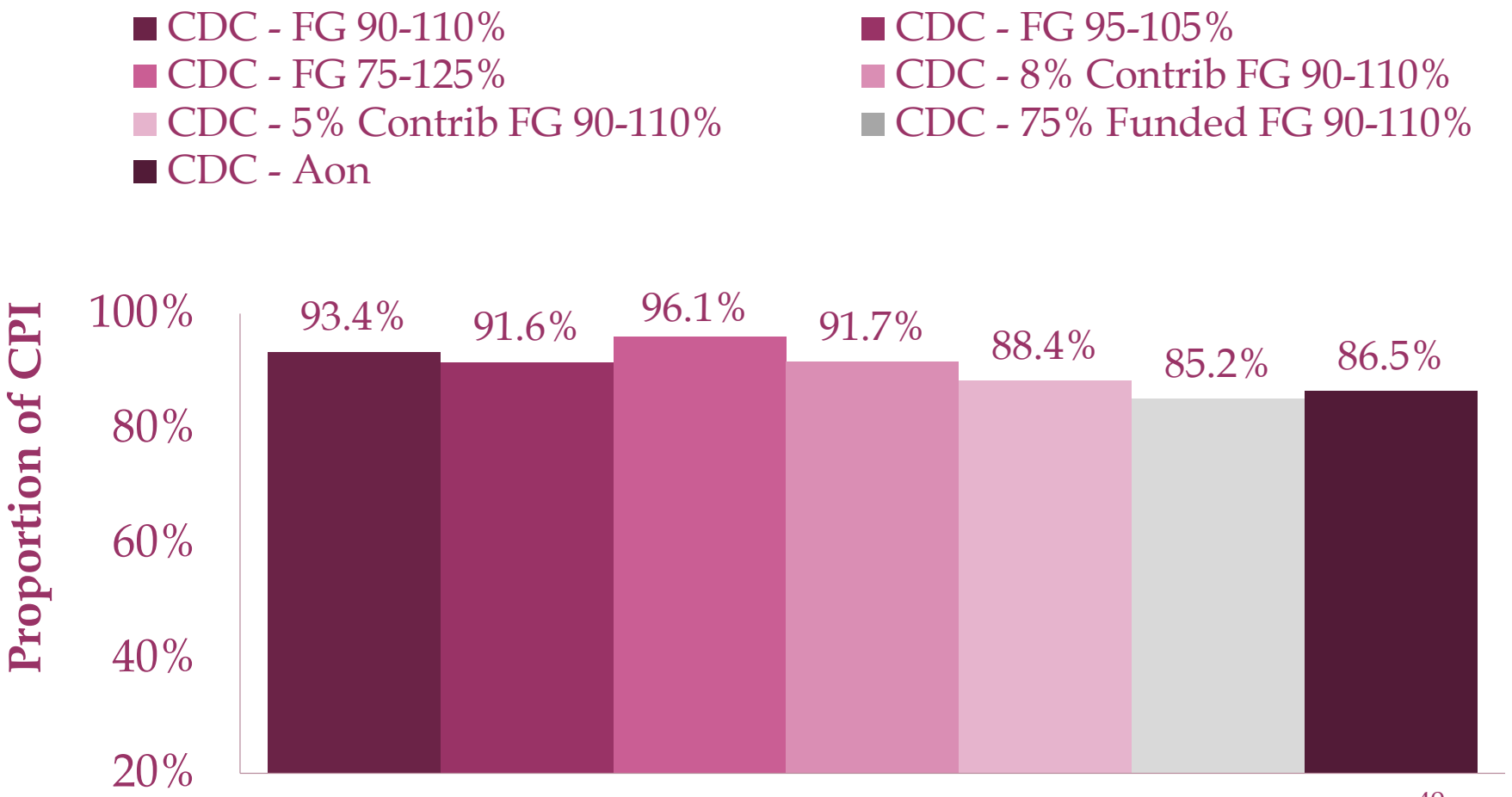
Mean proportion of years where at least CPI increases were given



Appendix 12

The PPI model produces a similar replacement rate to Aon Hewitt when similar assumptions are used

- Chart 9 of the Aon published results looks at the median replacement rate with a funding gate of 90-110% and with 60% of assets invested in equities and 40% in bonds (as with our simulations). The median replacement rate reported for their CDC simulation was 33% (Aon Hewitt (2013) *The case for collective DC)*.
- When the assumptions are set similar to AON, the PPI's model produces a median replacement rate of 29.6% in the first year of retirement.
- The other variants modelled have different results as liabilities are discounted by an actuarial best estimate (which is higher than gilt yields). Also, in the PPI model, the revaluation target is reset to 100% every year whereas the AON version carries forward the revaluation target from the previous year (i.e. if 50% of CPI was provided in the previous year, the AON model used 50% of CPI the next year as the starting point, whilst the PPI model starts from 100% of CPI).

Appendix 12

CDC outperforms DC to a lesser extent compared to AON Hewitt's reported results

PENSIONS POLICY INSTITUTE
PPI

- From the PPI model using the baseline assumptions, in the first year of retirement CDC outcomes are at least 40% higher than DC. Aon includes a 50% contingent spouse pension in the DC and CDC schemes, which we have not included.
- If we compare our CDC result against Aon's reported median DC lifestyle outcome (20%), CDC produces results approximately 48% higher than DC. Aon found this result to be 66%.