Pension Protection Fund

Pension Protection Fund

Protecting people's futures

July 2018

Long-Term Funding Strategy Update

Contents

Foreword

Stephen Wilcox
Chief Risk Officer

The Pension Protection Fund is a long-term institution. We exist to pay the right people the right amount at the right time, whether that right time is next week or in 50 years.

"Our key funding measure – the Probability of Success – remains high, at around 91 per cent."

This Funding Strategy 'Update' describes the latest work we've done using our sophisticated mathematical models to assess how confident we can be that we remain on track to provide the right benefits to our members, current and future.

The good news is that our key funding measure – the Probability of Success – remains high, at around 91 per cent. More than nine in 10 of our modelled scenarios of the future show we'll have enough money available to pay all future benefits, with a buffer for continuing uncertainties, in 2030, the date which we currently assess as the critical date in our future.

That we expect to be in this position is testament to our prudent and effective management of our balance sheet, and our expectations that this will continue into the future. Central to these expectations is our high calibre framework of risk management. As the new Chief Risk Officer I have been delighted to see the strength of the risk management activity undertaken within our strategic objective to pursue a high calibre framework of risk management.

The analysis discussed in this report derives from our Long-Term Risk Model (LTRM). Maintained and developed inside the PPF and updated each quarter, the LTRM forms an important pillar of our Risk Management Framework. In an approach similar to that used in the capital models run by commercial financial services firms, we run many thousands of simulations to assess the possible future. These take into account how possible economic developments might contribute to schemes entering the PPF or affect the value of our invested assets. The LTRM is supported by other risk management activity around operational, market and credit risk, each of which informs our understanding of the risks we face.

The environment in which we operate has continued to evolve significantly since we published the *2016/17 Funding Strategy Update*. A summary of this evolution is discussed in section 3 of this document and is also detailed in the our 2017/18 Annual Report and Accounts. It is however worth highlighting two item. First, the PPF received the largest total value of claims in our history, with large schemes associated with Carillion and British Steel entering assessment. Second, the investing environment experienced significant turbulence in the first part of 2018.
It is testament to the way our investment strategy mitigates risk that we still exceeded our investment target.

In this context it's pleasing to report

that the overall Probability of Success has fallen by only a small amount during the year, reflecting only a slight weakening in our estimated future resilience. The full details of how the Probability of Success has changed are outlined in section 5. It is worth noting that the Board's decision to reduce the levy for 2018/19 by 10 per cent contributed to this decrease.

Despite being robust, we face many possible headwinds that could affect our ability to meet our obligations. We've estimated how big our funding deficit might become on the path to our long-term goal; in 10 per cent of modelled scenarios our current funding surplus becomes a deficit greater than £2 billion on the way to the long-term position. The claims contributing to these deficits will mostly be realised in the next few years, giving us time to re-assess our strategy before the most critical point in our development occurs.

In line with good practice, we have also carried out a number of scenario tests to assess our long-term resilience in the face of specific shocks. These include a number of macro-economic shocks, both instant and long-term. Some materially weaken our chances of having the funds we require by

2030, either because of a large number of sponsor insolvencies resulting in a claim against us, or because of larger individual claims as a result of weaker individual schemes.

A full review of the scenarios considered and their impact on our Probability of Success is provided in section 6 of this Update.

We've continued to update the underlying assumptions of the model to make sure they remain current and in line with good modelling practice. In particular, we have further aligned both the asset classes we model and their expected returns in the LTRM with the main investment return assumptions used in the organisation. More detail can be found in section 4. We have also redesigned in-house the macro-economic shocks we consider, so they reflect the scenarios in which our resilience is most tested. More details on the updated approach can be found in section 7.

As this update shows, we remain confident in our ability to fulfil our mission. However, we are not complacent. In particular there are pensions landscape developments – the emergence of schemes without a substantive sponsor and of consolidation vehicles, behavioural changes due to Pension Freedoms and changes to the legislative framework around pensions – which change the range of risks we face.

It's an intrinsic part of our business model that some of the risks we face are outside of our control and cannot be effectively managed before they materialise. Some of the funds we protect have a deficit that is larger than the reserves currently available to us. We will continue to develop our risk management framework to ensure that we understand the risks we face, are able to manage the risks we can actively influence and can develop appropriate contingency plans for when risks arise that are outside our control.

Stephen Wilcox
Chief Risk Officer
July 2018

Review of the Funding Objective

This section considers the principles behind our funding objective and whether our funding objective remains appropriate.

Our funding objective is to be self-sufficient at the funding horizon, and these concepts are discussed in more detail below. When the self-sufficiency margin and funding horizon were introduced in 2010, they were set at 10 per cent and 2030 respectively. Each year we conduct a review to assess the level of the margin and the timing of the horizon, depending on the risks we expect to be exposed to.

This year we completed a detailed review of our funding objective. The review considered a number of alternative approaches we could take to set our objective and concluded that the current objective – to be self-sufficient by our funding horizon – remains appropriate for now. However, as part of the review we enhanced our calculation of the margin and increased the number of factors we consider when determining our horizon, and this is discussed in more detail later in this section.

This section considers the principles behind our funding objective and discusses the changes introduced as a result of the review.

Our purpose

The PPF's mission is to pay the right people the right amount at the right time. To do this we must have enough funds to pay members their compensation for as long as they and their dependants live. However, the Board faces a number of risks in ensuring our assets will cover our future liabilities. These risks must be monitored and managed within a robust governance framework. Our funding objective is at the heart of our risk management and is a key part of our Funding Strategy.

Our approach to risk management

While we aren't subject to the same regulations as other financial providers such as insurers, banks, or defined benefit (DB) pension schemes, we aim for a best practice approach in risk management. We operate within a robust risk management framework, adopting many of the principles by which regulated bodies are required to function, and we constantly review and improve our framework where appropriate. Our Funding Strategy provides the impetus for a cycle of risk identification, evaluation and mitigation. As part of our annual review of the Funding Strategy, we have considered all the risks currently covered by our various risk policies and assessed which of these could and should be explicitly modelled within the Funding Strategy. This year we decided not to allow for any new risks.

While similar to an insurance company in that we offer protection

to many millions of people – members of DB pension schemes – the PPF is unique in a number of ways. A key difference is that while insurance companies in the UK are required to identify the risks they are exposed to and consider the capital needed to cover those risks, we are not required to hold capital.

However, we do carry out a process to determine our self-sufficiency margin, which can be viewed as similar to the capital required by insurers in that it is intended to cover the cost of unexpected risks. In the longer term, the fundamental question we need to address is whether or not we are able to fulfil our mission – to pay the right people the right amount at the right time. By assessing whether or not we are on track to meet our funding objective, we can test out our ability to meet this goal.

Having a clearly defined funding objective allows us to assess how we are performing relative to our overall goal, and whether we need to take action to remain on track. The funding objective is therefore a central element of the PPF's risk management framework. It also provides a way for the Board to assess the possible impact of expected (or unexpected) changes in the PPF's overall mission. By analysing the impact of a change by referencing our funding objective, we can assess the consequences of taking a particular course of action or how serious a potential risk is, and be guided as to what appropriate mitigation might be. We discuss a number of such sensitivities and scenario tests in sections 6 and 7.

If it looked likely that we would have insufficient assets to meet our liabilities at our funding horizon, the Board has two main levers it can use. The first is to increase the levy collected. The second is to alter our investment strategy to seek higher returns to repair the deficit. The Board also has the power to restrict inflation-linked increases to compensation or to ask government to reduce the level of compensation payments, though these actions would only be considered in exceptional circumstances.

What does self-sufficiency mean to us?

The PPF operates in an environment of continuous change. Over the next couple of decades to our funding horizon and beyond, we expect that the number of DB schemes will significantly reduce as schemes buy out or consolidate[1] their liabilities, or enter the PPF. In addition, the funding level for surviving schemes should improve over time as a result of the scheme funding legislative framework. This combination means that the risks we are exposed to

[1] The Government White Paper on the future of defined benefits (DB) pensions suggested one route to enhancing security for DB members was through pension schemes consolidating. Already one DB consolidator has entered the market and their arrival, together with the potential arrival of other consolidation consolidated solutions, could accelerate a reduction in the number of DB schemes in the universe, if not the number of DB members the PPF continues to protect – see section 3 for more details.

Review of the Funding Objective
continued

The fundamental question we need to address is whether or not we are able to fulfil our mission.

should have decreased markedly from today's levels. It also means the levy we could justify collecting from the remaining schemes will become small compared to our own assets and liabilities, reducing the effectiveness of this lever to recover our funding level.

We will have grown and matured as well. While our larger size will allow us to better absorb claims, as the average age of our membership increases over time we will aim to have an even lower-risk investment strategy, further reducing the scope for us to take investment risk. This lessens the effectiveness of our other main lever. Eventually, there will come a point when we will wish to have little reliance on levy or return-seeking assets and instead be self-sufficient. However, this can only occur when we are satisfied that our risk exposure has reduced substantially. We call this time our funding horizon.

The assumptions that we use to assess our liabilities and therefore our funding position reflect our best estimate of the future. By 'best estimate' we mean that it is equally likely that the future will be better or worse than we expect. If at our funding horizon our assets are exactly equal to our liabilities we will have only a 50 per cent chance of being able to meet future compensation payments in full. To increase the certainty that the PPF will be able to provide future compensation, the Board wants the PPF to be more than 100 per cent funded at our funding horizon, adding a margin to increase the likelihood of meeting compensation payments in full from the 50 per cent best estimate level. We call this the self-sufficiency margin.

We add this self-sufficiency margin to protect ourselves against the risks to which we will be exposed after we reach the funding horizon. As long as there are DB schemes, there is a risk of claims from some of these schemes. Longevity risk will continue as long as it is not hedged and we are responsible for paying compensation. There will remain a risk that failure in our risk management framework will lead to a material financial loss. There is also the risk that there may not be suitable investment options available for us to effectively hedge our liabilities, leaving a mis-matching risk.

The questions we need to address are: how material will these risks be? How well funded do we need to be to have confidence that, even if the future is worse than expected, we can still pay members their full compensation? If we can gauge this funding level correctly, and can attain it at our funding horizon, we will be self-sufficient.

Reviewing the methodology for the self-sufficiency margin

When the self-sufficiency margin was introduced, it was intended to cover two key risks which would remain after the funding horizon: the risk of people unexpectedly living longer and any future claims (beyond the funding horizon) in excess of PPF levies. Subsequent reviews of the self-sufficiency margin have led to the inclusion of additional risks we are exposed to in its calculation, such as operational risk and inflation mis-matching risk (we hold RPI-linked investments to match our CPI-linked liabilities as there isn't a liquid market in CPI-linked investments).

There are a number of other risks that we currently exclude from our self-sufficiency margin. In general, this is because such risks will be minimal by the time we reach our

Review of the Funding Objective
continued

funding horizon. As part of our risk management cycle, we should continue to consider whether the risks allowed for in the margin remain appropriate.

As part of our funding objective review we also considered the method underlying the calculation of our self-sufficiency margin. While our analysis showed that the impact of the alternatives was not significant enough to justify the extra complexity involved in carrying out the calculations, we did expand our current approach to include all scenarios modelled, rather than a sample as was previously the case.

Reviewing the methodology for the funding horizon

When the funding horizon was introduced, it was chosen as the time at which future claims on the PPF were expected to be small relative to the size of the PPF itself. While there was no formal definition of 'small' in this context, our modelling at the time showed expected claims at the 90th percentile to be less than two per cent of the PPF's liabilities and relatively stable at this level around the year 2030. The Board therefore chose 2030 to be the funding horizon. This broad definition has been used to inform the date of the funding horizon at its annual review since then.

As part our funding objective review, we explored whether we were capturing all of the risks we're exposed to when determining our funding horizon. We subsequently recommended that the Board considers extra measures that reflect our risk profile. These measures provide a more holistic view of risks to help inform the Board about the funding horizon by looking at the time they are predicted to show low risk.

Annual review of the funding horizon and margin

Considering the additional risk measures discussed, the Board has decided that the funding horizon of 2030 still remains an appropriate assumption. The Board also concluded that being able to provide future compensation payments in full with a certainty of around 90 per cent was acceptable, and we determined that a 10 per cent self-sufficiency margin at our funding horizon is required to achieve that. As a point of reference, had the Board chosen a 99.5 per cent confidence level for meeting compensation payments in full post-funding horizon, the self-sufficiency margin required would have been slightly over 50 per cent.

The Board's decision to retain the same funding horizon and self sufficiency margin as in previous years does not mean they are fixed. For example, if scheme deficits are corrected more slowly than expected (because of adverse financial conditions, or deficit recovery plans getting longer), the funding horizon may need to be extended to allow the level of risk to which we are exposed to reduce to an acceptable level.

How we measure progress against our funding objective

The two key statistics we use to monitor progress against our funding objective are the 'Probability of Success' and the 'Downside Risk'.

The Probability of Success measures our chance of being self-sufficient at the funding horizon if we continue on our current course with no change to our investment strategy or to the PPF levy formula. This is the statistic that gets the highest profile as it focuses on the likelihood of us achieving our objective. By analysing the impact of a change with reference to the Probability of Success, we can assess the consequences of taking a particular course of action or how serious a potential risk is, and be guided as to what appropriate mitigation might be. Most of the results presented in this document therefore refer to the Probability of Success.

The Downside Risk is a measure of how poorly funded we might

The Board has decided that the funding horizon of 2030 still remains an appropriate assumption.

Review of the Funding Objective
continued

become on that journey under the same assumptions. It is calculated as the deficit that is reached or exceeded in 10 per cent of modelled scenarios at some point before we reach our funding horizon. The Downside Risk provides an indicator of the level of risk that we might be exposed to on our journey towards our funding horizon.

To measure these statistics we use an internal LTRM, which projects the level of PPF assets and liabilities in future years. It generates an extensive range of asset returns, insolvency and longevity scenarios and then projects a range of PPF balance sheet outcomes. These allow for investment returns and liability changes in the PPF and for future claims and levies.

The process of using a large number of modelled scenarios to create a range of outcomes is termed stochastic, or Monte Carlo, analysis. It is widely used in the financial services industry and its primary advantage over deterministic or 'single point' forecasts is that having a distribution of outcomes allows us to assess not just our best estimate of the future but also the likelihood of specific variations from that outcome.

It is as important to exercise an appropriate degree of caution when analysing output from the LTRM as it is from any financial model. Models are not infallible; there is no guarantee that future outcomes will conform to dynamics observed in present and past data. To help assess the level of model and parameter risk we carry out multiple runs to test how sensitive the output is to changes in key assumptions (see section 6).

As well as testing individual assumptions' sensitivity to changes we carry out more fundamental stresses to the model by changing various assumptions all at once. A number of such stress tests are described in section 7.

This allows us to assess not just our best estimate of the future but also the likelihood of specific variations from that outcome.

Summary of the year's events

This section summarises the events affecting our risks over the year to 31 March 2018.

Political climate, markets and their impact on scheme funding

There is a great deal of uncertainty in our operating environment, political climate and markets, and their impact on scheme funding. There have been many significant developments in the world around the PPF since the previous *Funding Strategy Update* was published in July 2017, including Brexit negotiations, the America First policy, Work and Pensions Select Committee inquiries into the British Steel Pension Scheme and into the collapse of Carillion, and a Government White Paper on the future of DB pensions. Through changes to our operating environment, these events could have a long-term impact on how we operate and invest.

We continue to monitor such risks closely. As part of our risk management framework we also examine the possible outcomes of plausible events, such as the disruptive impact of new technologies on the sponsors of the pensions schemes we protect, and undertake reverse stress testing, which seeks to identify circumstances which could cause us to fail in our mission.

UK economic growth slowed over the year to the first quarter of 2018, with annual growth falling to 1.2 per cent, the lowest since 2012. The slowdown largely reflected slower growth in services output, in particular for consumer-facing services. Manufacturing output growth picked up, mainly reflecting the impact of the buoyant global economy on exports.

Despite the slowdown in growth, the number of underlying company insolvencies in the whole economy fell slightly to 14,631 in the year to the first quarter of 2018 from 15,012 in the first quarter of 2017. However, the number of new claims on the PPF rose from 42 in 2016/17 to 47 in 2017/18. The value of new claims rose to £1.2 billion in 2017/18 from £0.3 billion a year earlier.

Scheme funding on an s179 basis for PPF eligible schemes improved in the year to 31 March 2018, rising from 90.5 per cent to 93.1 per cent. The improvement reflected both rising gilt yields and equity markets. Conventional 15-year gilt yields rose by 7 basis points (bps) and 5-15-year index-linked gilt yields by 34bps, resulting in a 1.3 per cent fall in aggregate liabilities over the year. Meanwhile, the FTSE all-world stock market index rose by 12.7 per cent, which more than offset the impact of falling gilt prices on investment portfolios, resulting in a rise in scheme assets of 1.6 per cent.

Sponsors of DB pension schemes made deficit reduction contributions of around £15.5 billion in 2017, slightly lower than in the previous year. These

Summary of the year's events
continued

payments compare with a total deficit of schemes in deficit on an s179 basis of £218 billion as at March 2018. The recovery plans for the latest tranche of schemes shows an average plan length of 7.5 years, down from 8.5 years for the equivalent tranche three years earlier (the recovery plan length would have been expected to reduce by around three years had assumptions been borne out in practice).

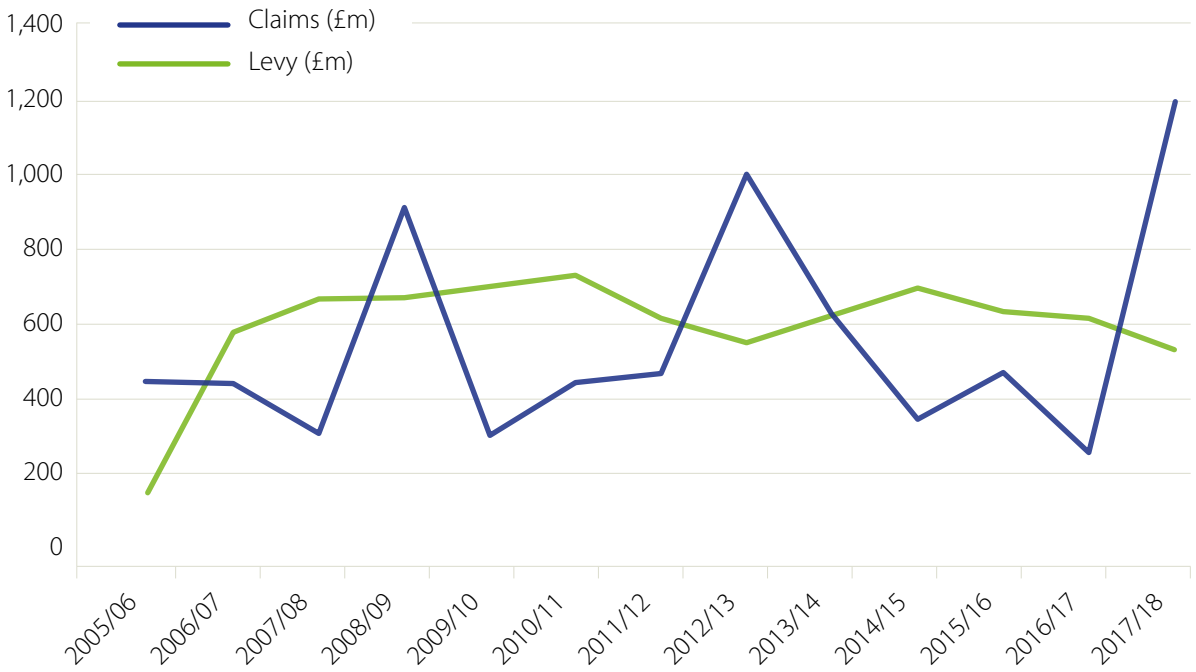
The Purple Book 2017[2] pointed to further de-risking. Of the schemes that were closed to new members, a higher proportion was also closed to future accrual. In asset allocation, we continued to see an upward trend in the bond share and a downward trend in the equity share. In 2017, 56 per cent of scheme assets were invested in bonds (up from 51 per cent in 2016), with 29 per cent in equities (slightly down from 30 per cent in 2016) and 15 per cent in 'other investments' (down from 18 per cent in 2016). Also, the proportion of schemes that are open edged lower to 12 per cent after having been unchanged for two years.

Claims and their impact on our funding

By 'claims' we mean the pension deficits that are brought into the PPF when scheme sponsors suffer insolvency.

In the year to 31 March 2018 we saw claims of £1.2 billion, which is the highest annual claim amount to date. This was the result of a small number of large claims, since the number of claims was similar to previous years.

Chart 4.1: history of claims and levy



[2] http://www.pensionprotectionfund.org.uk/About-Us/TheBoard/Documents/WEB_170407%20-%20PPF_Purple_Book_2017.pdf

In our *Annual Report and Accounts* disclosure is made for a number of contingent liabilities, as detailed in Annex S2 of that document. To ensure consistency with the *Annual Report and Accounts*, an allowance is made for those schemes described as Type II contingent liabilities in the assessment of the long-term Funding Strategy position. The definition of a Type II contingent liability from the *Annual Report and Accounts* is reproduced below:

Type II contingent liabilities are in respect of eligible schemes where:

- in the Board's judgement, as at 31 March 2018, no insolvency event has taken place, but the Board is nonetheless expecting to receive an insolvency event notice from an insolvency practitioner in the future under section 120 of the Pensions Act 2004
- the Board has sufficient data about the scheme to be able to estimate a contingent liability, and
- as at 28 February 2018, the value of the assets was, in the Board's judgement, likely to have been less than the amount of the Protected Liabilities, as defined in section 131 of the Pensions Act 2004.

Whereas in the *Annual Report and Accounts* we allow for the deficits from 'Type II schemes' as a contingent liability, we adopt a different approach in our modelling in this report. Such schemes' liabilities and assets are included on our starting balance sheet position in the model. As such, we allowed for potential future claims from nine schemes in the near future in modelling this document. At the time of writing, three of these schemes have already become insolvent after 31 March 2018. Allowance for claims and Type II Schemes is reflected in changes in our funding level over the year to the calculation date (along with other drivers such as asset performance, levy income and compensation payments). Allowing for claims over the year, schemes in assessment and 'Type II schemes', the funding level has increased from 110 per cent as at 31 March 2017 to 116 per cent as at 31 March 2018. Much of this improvement was driven by certainty being reached on the future of the British Steel Pension Scheme (BSPS). This large scheme was removed in its entirety as a Type II scheme as at 31 March 2017 and instead a small part of the scheme was recognised as in assessment as at 31 March 2018, with the remainder re-entering the universe of schemes we protect, though with a different benefit structure. For reference, the funding level excluding the 'Type II schemes' was 122 per cent at 31 March 2017 and 123 per cent as at 31 March 2018.

The chart on page 14 shows the history of claims and levies made on the PPF since its inception, taking into account recoveries, as well as expected levy collections, as published in the Levy Determination.

The Purple Book 2017 pointed to further de-risking.

Summary of the year's events
continued

Our primary objective remains to make sure we have enough resources to pay members compensation for as long as we're needed.

The number of claims we receive in the coming year will be dependent on economic factors. For example, the low interest rate environment may have helped keep some weaker sponsors afloat. However, structural changes in the economy and factors such as interest rates rising faster than expected may push highly indebted companies into insolvency (particularly smaller ones with restricted access to capital markets), resulting in us receiving more claims.

Our investment strategy

In September 2017 we published a new Statement of Investment Principles (available on our website). The Statement sets out the Board's principles and policies governing the investment of its assets, and demonstrates our commitment to managing our assets effectively and appropriately to balance the interests of both levy payers and beneficiaries alike. Our primary objective remains to make sure we have enough resources to pay members compensation for as long as we're needed. To help us achieve this we employ a bespoke Liability Driven Investment (LDI) programme alongside assets designed to out-perform liabilities by 1.8 per cent per annum.

This asset allocation is markedly different from the allocations of the majority of UK DB pension schemes. This is because we need a low risk strategy that aims to be relatively uncorrelated to the funding levels of the schemes we protect, since we need to be solvent at times when general pension schemes are significantly underfunded. However, our correlation to funding levels may increase if pension consolidation proves successful and the consolidators seek to adopt a lower-risk investment strategy than current individual schemes do. We will monitor this situation carefully and take appropriate action as necessary.

In the past year, we have continued our programme of increasing exposure to hybrid and alternative assets. These provide diversification benefits, as well as an attractive risk-adjusted return. Given our long investment horizons, we are also able to benefit from the illiquidity premium associated with less liquid assets.

Investment performance over the year to March 2018 has been good. The LDI portfolio continues to match our liabilities very closely and well within the boundaries set by the Board, while the performance of the fund as a whole has exceeded its rolling three-year performance target. However, current assumptions suggest that this is unlikely to be achievable over the medium term.

Investment insourcing

We have continued to develop our in-house investment capabilities. The majority of our LDI activity is

now done in-house, while in the past year we have also insourced the management of our Sterling cash portfolio. This gives us added control, flexibility and efficiency, which has transformed our investment function's capability.

Over the next year we plan to insource a number of other investment activities. It is important to note that any decision to insource a particular investment activity is predicated on having the right infrastructure and skills in place to meet that need, while ensuring we operate within a robust and clearly defined risk framework.

The pension protection levy

The Board's strategy for setting the levy is to keep the rules stable throughout the levy triennium unless there is such a significant change in risk that one of the following limits is expected to be breached:

- the Levy Ceiling as set out in legislation (currently just over £1 billion)
- a 25 per cent year-on-year increase in the levy we expect to collect, and
- a 25 per cent year-on-year decrease in the levy we expect to collect.

The first year of the third levy triennium began on 1 April 2018. The levy rules were updated for the new triennium, following consultation and engagement with our stakeholders.

The main changes made were:

- development of the PPF-Experian insolvency risk model, including revising how employers are allocated to scorecards, the introduction of two new scorecards and refining existing scorecards. These changes aim to improve our predictive power and ensure scorecards are better tailored to company size and type
- introduction of the use of public credit ratings for employers that have them, and the use of a credit model for regulated financial services entities. This improves our assessment of insolvency risk for some of the largest levy payers
- revision of some levy rates to further enhance the fairness of the levy framework
- simplification of the Deficit-Reduction Contributions regime
- asset and liability stress factors updated to incorporate more recent market volatility and refinements to the methodology, and
- revision of the contingent assets regime, resulting in increased levy credit for some scheme structures.

£65m

the reduction in the levy estimate from £615m in 2017/18 to £550m

Summary of the year's events
continued

The Board has set a levy estimate of £550 million for 2018/19, which is lower than the levy estimate of £615 million for 2017/18.

Events of note for the PPF over the year

British Steel Pension Scheme
See page 20.

Pension Freedoms (increase in transfers out)
Following the Pension Freedoms reform, which came into force in April 2015 there has been increased interest among DB scheme members in transferring out their benefits. Members of defined contribution (DC) schemes are no longer required to buy an annuity and can now access their pension savings in a number of ways. Since then, there has been a large increase of members of defined benefit (DB) schemes transferring their benefits to DC pots, where they can have greater flexibility in accessing their savings. Before Pension Freedoms, transfers to other pension schemes were usually below £2 billion per quarter. This increased significantly after Pension Freedoms, with quarterly transfers above £10 billion for the last three quarters to 2018 Q13. If the trend continues, it will affect the risk profile of the schemes we protect.

Collective DC schemes
See page 21.

Step-down pension legislation
Typically, step-down - pensions are additional pension amounts paid to members with the intention of smoothing the member's total pension income before and after State pension age.

There was an anomaly in the Pensions Act 2004 whereby members in receipt of a step-down pensions would continue to receive this higher amount for life if they transferred to us. Towards the end of February 2018, legislation came into force that meant the temporary nature of any step-down pension payable under a scheme's rules would also be reflected in compensation paid to members. As this change only applies to schemes entering an assessment period after the legislation came into force it does not yet impact compensation payable to members who have transferred to the PPF.

White Paper on future of DB pensions
In March 2017, the Department for Work and Pensions (DWP) published its White Paper, *Protecting Defined Benefit Pension Schemes*. While not proposing any changes specifically to the PPF, it recognised the valuable safety net we provide to the 11 million members of defined benefit pension schemes in the UK.

The proposals in the paper fall into three broad areas – protect private

[3] Source: Office for National Statistics website

pensions through a stronger Pensions Regulator (TPR), clarify scheme funding principles, and create the right conditions for, and promote the benefits of, scheme consolidation.

Recently new commercial consolidation propositions, commonly known as 'superfunds', have begun to emerge. Well-run superfund consolidators *could* help improve security for scheme members and levy payers. However, assuming they may be eligible for PPF protection, they also could pose significant new risks to the PPF, not least concentration risks which otherwise might be dispersed across multiple schemes. It is essential a robust framework of regulation is put in place to manage risks to the PPF and our levy payers.

We will continue to engage with colleagues at DWP, TPR and other stakeholders on the detailed policy work.

Slowdown in longevity improvements

Over the last few years, while life expectancy has been increasing, it has been at a lower rate than the previous trend. This has been observed for England and Wales's population data. However, members of DB schemes might be expected to exhibit different patterns of mortality than the general population as, among other things, they will typically have a higher level of wealth. So scheme members may not necessarily experience the trend with the same intensity.

Taking full account of the trend could reduce the liabilities of a typical scheme by about three per cent. If bulk annuity providers reduce their prices to allow for this trend, there could be an increase in schemes buying out their liabilities. Securing benefits in this way would improve security for scheme members, as it eliminates the risk associated with their scheme sponsor becoming insolvent, and also reduces our risk profile as the number of potential claims is reduced.

British Steel Pension Scheme (BSPS)

At the beginning of 2017/18 Tata Steel UK (the scheme sponsor) was facing insolvency with the old BSPS likely to enter PPF assessment. This was reflected in both our 2016/17 Annual Report and Accounts and our 2017 Funding Strategy Update through inclusion of the BSPS as a Type II scheme in its entirety. Following a Regulated Apportionment Arrangement, members were offered the option of transferring to a new BSPS offering less generous benefits or remaining in the old BSPS which would be expected to enter PPF assessment. Most members opted to transfer to the new BSPS or moved their benefits to other arrangements. As a result the total assets and liabilities entering assessment were markedly smaller than if the scheme had done so in its entirety.

Collective DC schemes

Royal Mail and its staff's main union have agreed in principle on introducing a Collective Defined Contribution (CDC) pension scheme. In a CDC scheme each member has a target retirement income dependent on the performance of a collective investment pot. CDC schemes aim to achieve more equitable risk sharing between employer and employee. The expectation is that the employee does not face the volatility of individual DC pots and the cost of buying an annuity, and the employer does not need to underwrite DB guarantees. Currently CDC schemes are not permitted in the UK, and would depend on the Government passing new regulations. The setting up of CDC schemes would mark a change in the pension landscape. It is unclear how the emergence of CDC pension schemes would change our risk profile.

Updated assumptions

This section discusses the model assumptions that we have updated over the year.

The main Long-Term Risk Model (LTRM) assumptions are described in Annex A1. The Board reviews the LTRM assumptions annually, and some events may also prompt out-of-cycle reviews for some assumptions.

Below we describe the most material changes made to the modelling assumptions over the last year. They are presented, broadly, in order of their impact on the probability of meeting our funding objective. However, it should be noted that the relative size of the impacts is dependent on the order in which the changes are made.

Measurement of employers' initial credit-worthiness

Our approach to modelling insolvencies requires each sponsor to be assigned a starting credit rating. For the largest schemes, where possible, we use publically available company credit ratings. Where these aren't available or for small schemes, we need a method for determining a 'notional credit rating'. To do this, we rank companies in order of their Experian failure scores. We then allocate the companies into credit rating 'buckets' to achieve a target distribution of companies across the different credit ratings.

We have updated the target distribution of credit ratings across the eligible schemes. The new distribution has been derived based on the same data that underlies the new Experian scorecard models introduced for the 2018/19 Levy Year.

Probability of insolvency given default

We model movements between credit ratings using transition probabilities based on historical data. In modelling claims made on us, we are interested in company insolvency events. Credit ratings extend down to the point that a company defaults on its financial obligations, but insolvency is not an automatic consequence of default. So we need an additional assumption, namely the probability of a company in default going on to become insolvent.

We have updated this assumption from 80 per cent to 60 per cent. This change was recommended following a review of insolvency assumptions carried out on a triennial basis by third-party insolvency specialists.

Modelling of interest rates and inflation

The Economic Scenario Generator (ESG) is a key model in the LTRM, generating thousands of scenarios for economic variables such as inflation, interest rates and asset returns. There are a number of alternative models for each key variable.

We aim to follow industry best practice in our approach to modelling. We also

need to consider our ESG Calibration Framework when reviewing ESG parameters and models. In the new models, we have moved to target rates for UK nominal gilts and inflation that are more in line with our own views than those previously available from our ESG provider. We now target UK nominal rates and inflation aligned to the Prudential Regulation Authority's (PRA) baseline scenario.

Sponsor contribution to cover a deficit

In our modelling we place a cap on deficit reduction contributions (DRCs) to represent a limit to what a company may be expected to afford to pay into a scheme. This cap was previously calculated as a proportion of the technical provision liabilities (five per cent for all schemes).

We now have access to more comprehensive data on schemes' recovery plans, which has allowed us to better analyse DRCs as a proportion of technical provisions. This showed that the previous cap was too high.

Under the new approach, the cap on DRCs is calculated as follows:

- for schemes whose recovery period exceeds 15 years, we base the cap on contribution amounts from the scheme's actual recovery plan. Such long recovery plans suggest the sponsor may be financially stressed, and the DRCs agreed with the trustees are likely to be driven by affordability constraints, and
- for all other schemes, we cap DRCs at three per cent of scheme liabilities on a technical provisions basis (reduced down from five per cent).

Recovery plan lengths

Our previous assumption was to add three years on to the length of recovery plans submitted by schemes. The three-year adjustment was based on an observation that, at each valuation, trustees and sponsors would tend to push out the recovery plan end-point rather than allow the recovery period to shorten naturally as planned.

The most recent data available[4], however, shows that the rate at which recovery plan end-points are being pushed out has decreased markedly. Data for the latest valuation cycle (tranche 10) shows that the average recovery plan length has reduced by 2.3 years since schemes last submitted data three years ago. Had schemes' valuation assumptions been born out in practice recovery plan lengths would have decreased by three years.

We now have access to more comprehensive data on schemes' recovery plans.

[4] http://www.thepensionsregulator.gov.uk/docs/scheme-funding-appendix-2017.pdf

Updated assumptions
continued

In light of this, we've updated our assumption and now use the recovery plan lengths submitted by schemes with no adjustment. We don't, however, allow for time between the submission date and our calculation date. In practice this will implicitly add, on average, around a year to the recovery plan lengths.

Debt recovery rate on insolvency

When a sponsoring employer becomes insolvent, a debt is due from the employer to the scheme under section 75 of the Pensions Act 1995 (determined as the buy-out deficit). If the scheme then transfers to the PPF, any assets recovered in respect of this debt also transfer to the PPF. Typically, only a small proportion of the total debt is recovered. Based on recent recovery experience from schemes in assessment, we have increased the assumed recovery rate from 3.5 per cent to five per cent of a scheme's section 75 debt amount.

Impact

The net impact of these changes is a reduction on our Probability of Success. Individually, the change with the greatest impact was the change in approach to measuring employers' initial credit-worthiness, which led to a reduction of about two per cent in the Probability of Success. Individual impacts from the other changes were each less than about one per cent. See section 5 for more details.

Modelling output – base case

This section considers the model's output in our main run of the model – our 'base case'.

In our base case, the probability of achieving self-sufficiency by the funding horizon has decreased by two per cent from 93 per cent at 31 March 2107 to 91 per cent at 31 March 2018. The Downside Risk statistic remains unchanged at £2 billion.

The small decrease in the reported Probability Of Success over the year has been driven by a number of competing factors with either beneficial or detrimental impacts.

There has been an improvement in the situation for schemes in general. Scheme funding levels (as reported by the PPF7800 index) increased over the year from 90.5 per cent to 93.1 per cent. Over the same period we have seen an improvement in the average insolvency outlook for schemes, especially the sponsors of some very material schemes, and a reduction in average recovery plan lengths submitted.

These improvements have however been more than offset by impacts from a deterioration in the economic outlook in our projections, and the decision made by the Board to reduce the amount of levy we would be targeting for collection in 2018/19. A further negative impact resulted from large changes to the factors we include on our own balance sheet for the projections.

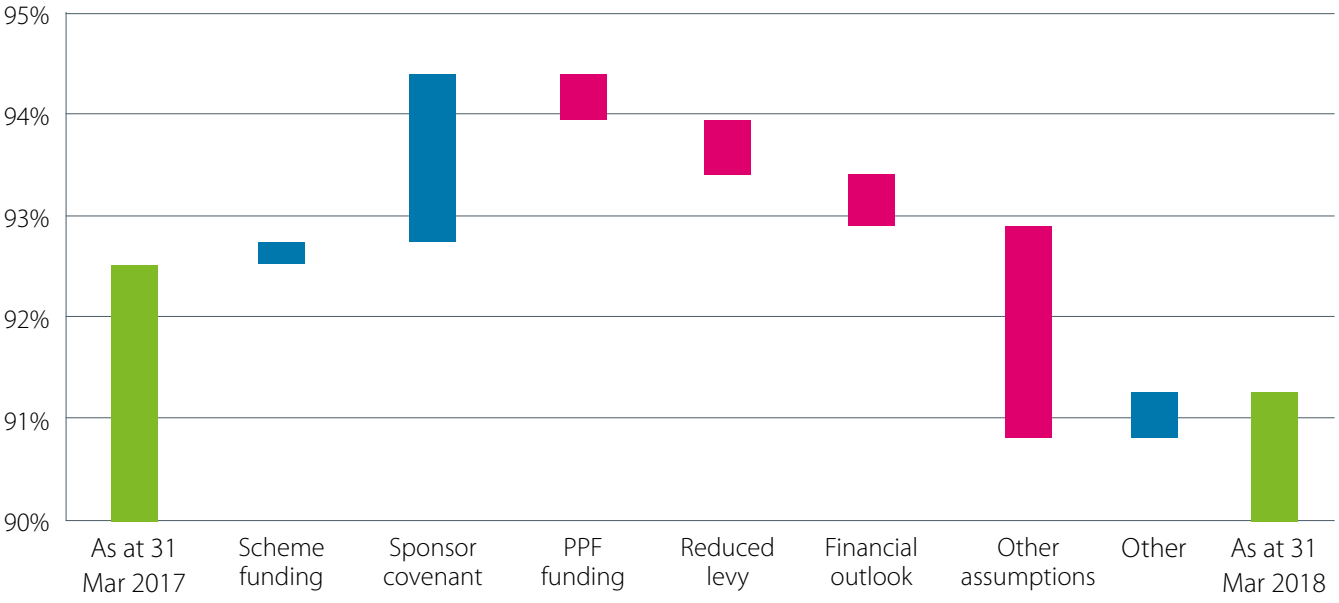
While the funding level we use for our projections has increased from 110 per cent to 116 per cent, this positive impact has been more than offset through a combination of our smaller starting size (reducing our resilience to future claims), changes to schemes recognised as Type II schemes (and therefore included in the starting position of the LTRM), and introduction of additional claims risk from the restructuring of schemes.

As detailed in section 4, the Board approved a number of key assumptions to be updated. The combined impact of the changed assumptions further reduced the Probability of Success, although this has been offset to a degree by some modelling improvements made over the year.

Modelling output – base case
continued

The following chart reconciles the Probability of Success at 31 March 2018 with the position a year earlier. The blue bars represent improvement and the pink bars represent deterioration over the year.

Chart 6.1: change in Probability of Success over the year



The following table explains what the bars represent.

Bar	Explanation
As at 31 March 2017	This is the Probability of Success at 31 March 2017, which was 93 per cent.
Scheme funding	This is the effect of scheme funding changes over the year. The funding level of the universe as reported in the PPF7800 index has increased from 90.5 per cent as at 31 March 2017 to 93.1 per cent as at 31 March 2018. As such, the risk we face has fallen and the Probability of Success has increased.
Sponsor covenant	This allows for changes in the measures of scheme security. The main element of this change was the introduction of new levy scorecards which estimate the potential for sponsors to become insolvent. It also includes stronger Technical Provisions and falling Recovery Periods. These combined to show an increase in our Probability of Success.
PPF funding	This is the effect of changes in the PPF's funding level over the year and associated impacts. The funding level we use for our projections has increased from 110 per cent to 116 per cent. However, this positive impact has been more than offset through a combination of our smaller starting size (reducing our resilience to future claims), changes to schemes recognised as Type II schemes (and therefore included in the starting position of the LTRM), and introduction of additional claims risk from the restructuring of schemes.
Reduced levy	Because of the fall in expected levy collection from £615 million to £550 million between levy years 2017/18 and 2018/19, our projections of levy fell and reduced our Probability of Success.
Financial outlook	This is the net effect of changes in market conditions over the year and changes in our expectation of potential future economic conditions. The various changes to financial assumptions are discussed in section 4. Overall, this resulted in a fall in our Probability of Success.
Other assumptions	This includes all other assumptions outlined in section 4 above.
Other	This is mainly due to refinements in modelling which increased our assessment of the Probability of Success. This is partially offset by the reduced time we have to recover deficits as we near our funding horizon.
As at 31 March 2018	This is the Probability of Success at 31 March 2018, which is 91 per cent.

Modelling output – base case
continued

Are we happy with a 91 per cent chance of success?

Each year we set ourselves a target for the Probability of Success. While many of the factors that can influence the Probability of Success are outside our control we believe that having a target allows us to better make a judgment on the delicate balance between cost to levy payers and security for members. It was on this basis that the Board decided to reduce the levy for 2018/19 by around 10 per cent to £550 million. While this decision, plus the combination of a number of other factors described above, resulted in a small reduction in the Probability of Success, over the year to March 2018 the Probability of Success remained over our target of 88 per cent.

The Board regularly monitors the Probability of Success and the Downside Risk in quarterly modelling updates. To do this it has devised a 'Red-Amber-Green' framework where a green rating indicates that the Board should be comfortable, an amber rating indicates that it should consider pulling on one of its strategic levers (discussed in section 2) and a red rating indicates that it should almost certainly be planning to pull one of its strategic levers.

As in previous years our Probability of Success is calculated on the assumption that no adjustment is made to our investment strategy or to the levy parameters other than where required by current legislation (for example the current levy cap). In other words, we assume that changing circumstances observed in our different scenarios do not result in a change to our funding strategy. However, levy collected in a particular scenario will reflect the underfunding and insolvency risks presented to the PPF in that particular scenario, consistent with the current levy determination.

The Board does have the power to restrict inflation-linked increases to compensation or to ask government to reduce the level of compensation payments. These actions would only be considered in exceptional circumstances and neither is considered in the calculation of our Probability of Success.

It might also be appropriate to review our funding framework in an unfavourable environment. For example if, as we approached our funding horizon, we found that the level of risk posed to the PPF by eligible schemes was still high relative to the size of the PPF, we would consider pushing our funding horizon further out.

Ultimately, we would like the Probability of Success to show an increasing level of confidence as we approach our funding horizon. However, to achieve the highest levels of comfort today we would

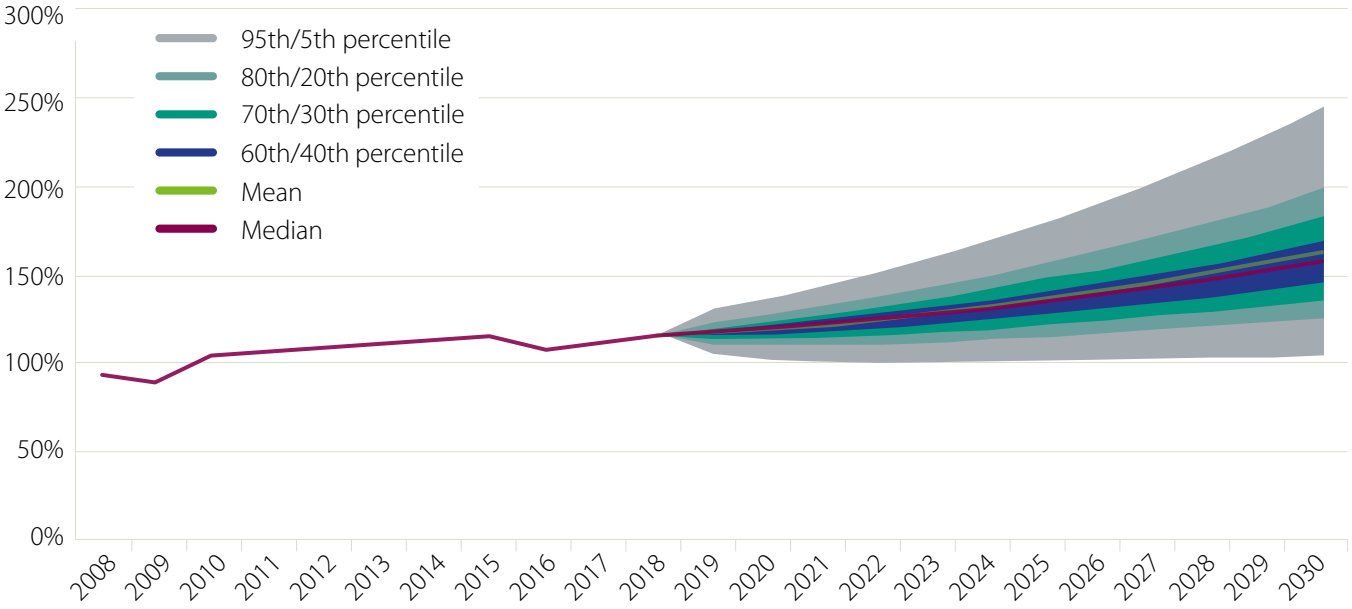
need to charge a levy running into billions of pounds a year if nothing else were to change. This would not be in the best interests of levy payers, or indeed be possible under the limits set by legislation.

Projections of our funding level

At 31 March 2018 our funding level stood at 123 per cent, ignoring the Type II Schemes discussed in section 3. While 123 per cent is above our target to be 110 per cent funded at our funding horizon, this level of funding does not mean we have achieved our funding objective of being self-sufficient. This is because self-sufficiency is measured only at the funding horizon and there is a material chance that our funding level could fall before that time. Indeed, there are schemes to which we offer protection that have a current deficit which would be enough to wipe out our current surplus were they to make a claim.

The following fan chart shows the history of our funding level as well as our base case projection beyond 2018. The starting point of the projection (31 March 2018) includes Type II Schemes resulting in an increase in funding level at this time, largely as a result of the BSPS moving from being classed as a Type II Scheme in the 2017 Update to part of the scheme entering assessment

Chart 6.2: history and projection of PPF's funding level



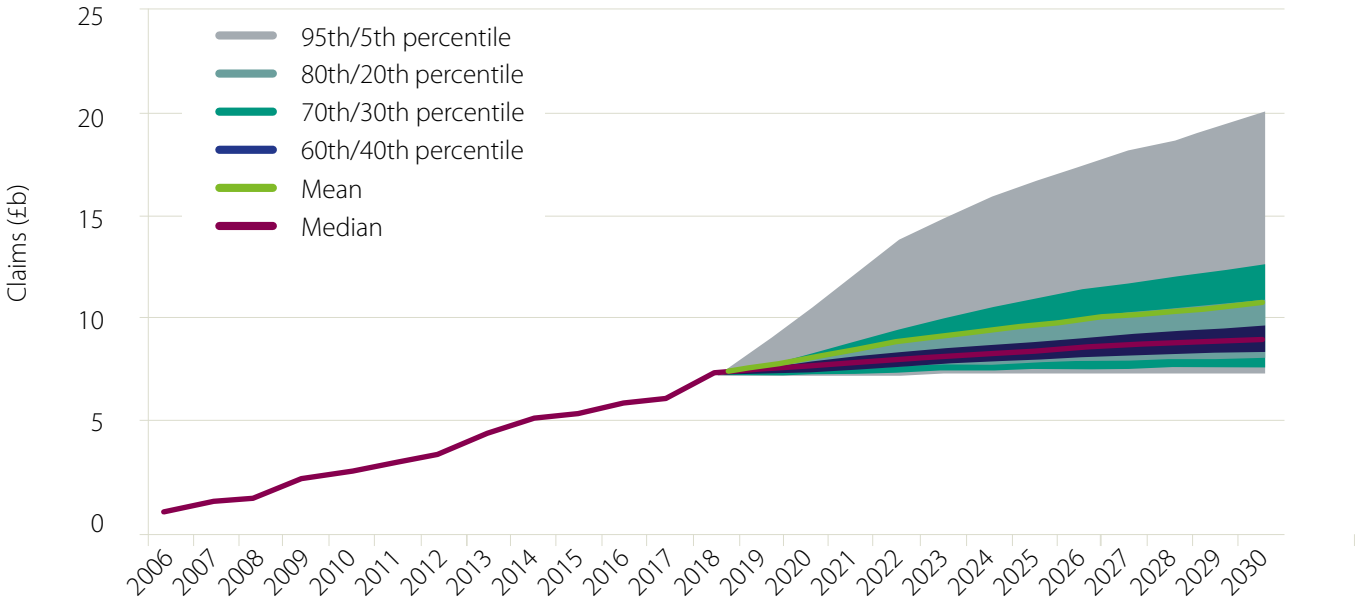
with the remainder of the assets and liabilities transferring to a new and better funded scheme with an amended benefit structure. As also mentioned above, the assumption in our projections is that the PPF does not respond to changing circumstances, so there is no change to levy or investment strategy in scenarios where the funding level is high or low. Neither does it allow for the possibility of any reduction in indexation or level of compensation. This is because the model is used to inform current strategy rather than predict future strategy.

Projections of claims

The following fan chart shows the cumulative deficit of schemes that make a claim on the PPF, measured at the point at which the sponsoring employer(s) is (are) modelled to experience an insolvency event. In reality there would be a delay before the assets and liabilities actually transferred to the PPF. The level of claims being made on the PPF in future years is one of the main factors that could lead to a decline in funding, and this is largely outside of our control.

The chart includes the cumulative history of claims to 31 March 2018, but this history does not include allowance for schemes included in the *Annual Report and Accounts* as Type II contingent liabilities, as these are not realised claims. Similarly, because of the approach we take to Type II Schemes, no claims from schemes included in the accounts as Type II contingent liabilities are included in the projections, as the assets and liabilities from these schemes have already been recognised on the PPF's starting balance sheet for the purposes of the projections.

Chart 6.3: history and projection of cumulative deficits of schemes entering the PPF



Modelling output – base case
continued

Given the importance of projected claims experience on our chances of successfully achieving our funding objective, it's important to assess alternatives to the base case assumptions and to test the robustness of our funding against adverse economic outcomes. The projected size of pension scheme deficits and the underlying trend within our base case that deficits will decrease during the period to our funding horizon are key determinants in the PPF's projected claims experience. We have carried out various sensitivity and stress tests in which we adjust the assumptions from our base case to reflect different possible views of the future. We describe a number of these tests in sections 6 and 7.

Projections of levy

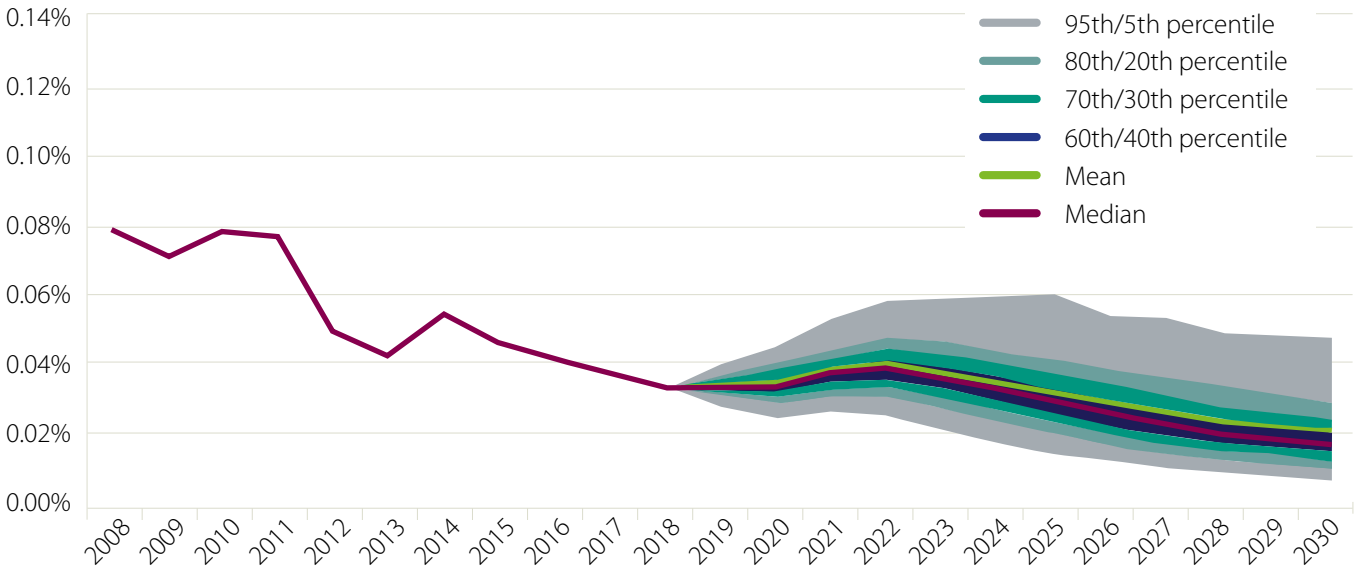
PPF levies are for the most part risk-based, in the sense that they depend explicitly on the size of schemes' deficits, the risk associated with their investment strategies and the strength of sponsoring employers. We would therefore expect that as schemes repair their funding deficits and reduce their holding of return-seeking assets, the PPF levy will reduce both in absolute terms and as a percentage of their liabilities.

The following chart shows how the levy has changed as a percentage of protected schemes' PPF liabilities to 31 March 2018, and how it is projected to change in future years.

As we assume that the formula underlying the levy calculation is unchanged over time, other than in circumstances where legislative limits would be breached, the shape of the above chart is a function of:

- schemes repairing their deficits in the long-term and thereby reducing their levies, and
- in the short term the fact that the levy is calculated using a 'five year average' deficit, whereas the scheme liabilities are calculated on prevailing yields. When a 'good' year falls out of the calculation and is replaced by a worse year, the levy rises proportionately. For example we

Chart 6.4: history and projection of levy as proportion of scheme's PPF liabilities



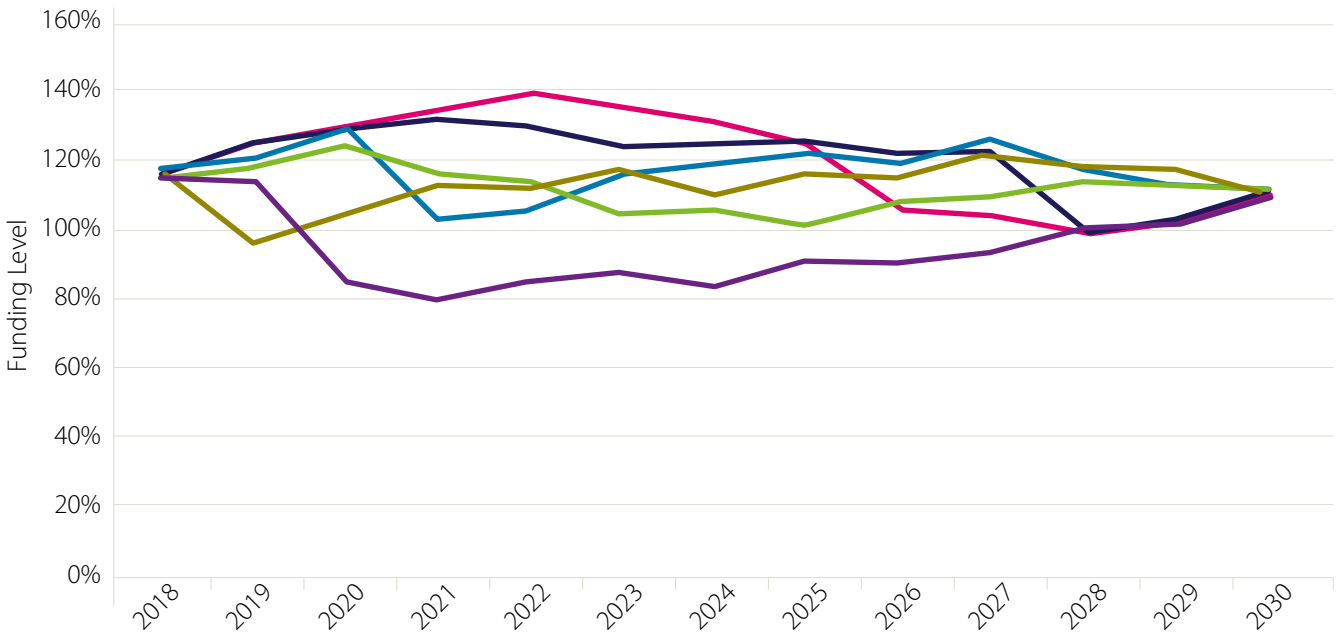
model interest rates rising in the short to medium term, which will cause liabilities to fall. The averaging means this will impact levies less quickly than scheme liabilities, which has the effect of pushing up the ratio during this period of rising interest rates.

Pathways to achieving success

In an ideal world we'd like to follow a smooth trajectory from the current time to successfully achieving our funding objective at our funding horizon. However, rarely do circumstances play out as expected, and there are factors outside of our control, such as large unexpected claims, that can materially impact our funding position. As such, a strong funding position in the medium-term is no guarantee that the funding objective will be met in the long-term. Conversely, by retaining our current funding strategy it is possible to recover from a poor funding position in the medium-term if conditions are favourable in the years immediately preceding our funding horizon. As may be expected, our modelling illustrates that the path to achieving our funding objective is seldom the smooth trajectory we might hope for, but rather contains highs and lows along the journey.

The following chart illustrates the funding position over time for a number of different economic scenarios, all of which reach a funding level of 110 per cent at our funding horizon. There is a slight difference in the starting funding level of these projections because of the way we allow for stochastic projections of mortality in our modelling.

Chart 6.5: example pathways to achieving our funding target



Sensitivity of base case

This section considers how the model's output changes in response to changes in certain key assumptions.

The modelling output has been tested for sensitivity to an extensive range of modelling assumptions. A selection of the more significant sensitivity tests is shown below.

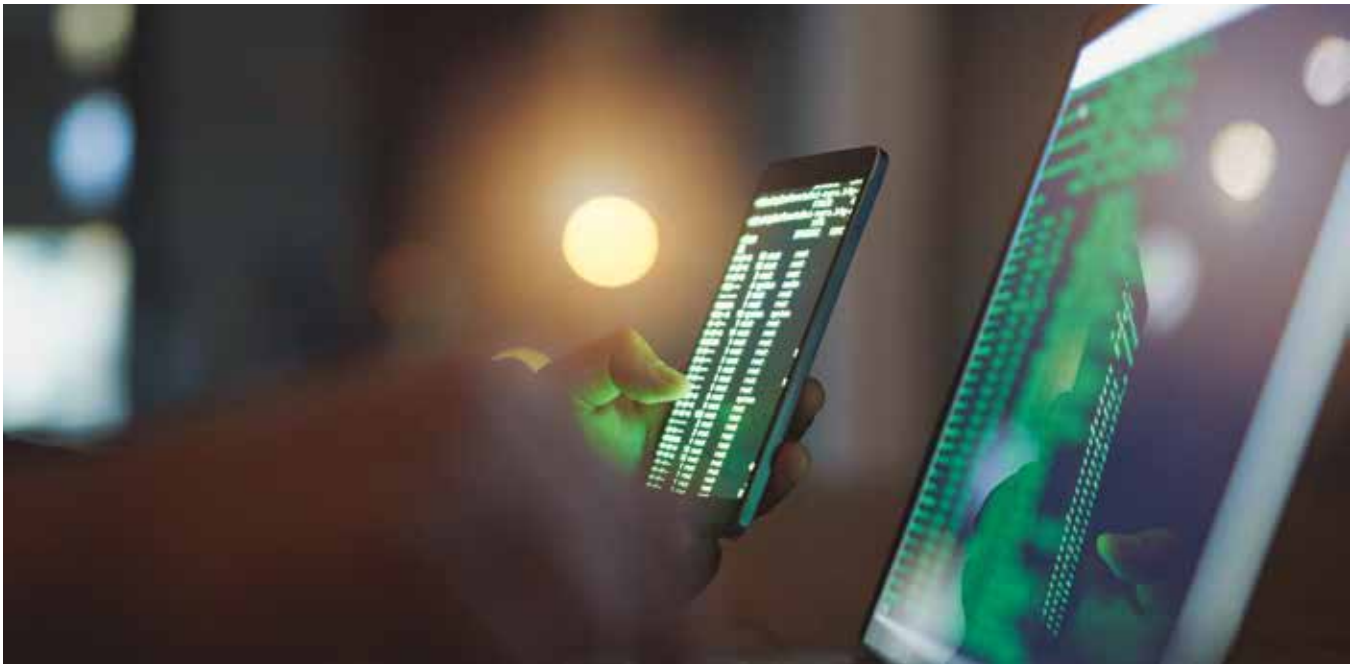
The sensitivity tests aim to provide an insight into how the probability of meeting our funding objective and the Downside Risk might be affected if future experience is not as expected relative to the base case, best-estimate assumptions. The scenarios illustrated are broadly the same as those in last year's Funding Strategy Update document.

The sensitivity tests do not necessarily respond in a linear way to changes in the underlying assumptions. For example, if the initial PPF funding level reduces by 10 per cent, the probability of meeting our funding objective reduces by six percentage points. If the initial PPF funding level reduces by 20 per cent, the probability of meeting our funding objective reduces by 18 percentage points.

We have two main strategic levers – our investment policy and our levy – that we could pull should future experience be unfavourable compared to our base case assumptions. For example, asset returns of 1.0 percentage point per annum less than our base case, best-estimate assumptions would lead to a six percentage point reduction in our Probability of Success if we took no action. In this scenario, though, one option available to the Board would be to adopt a more risky investment strategy with higher expected returns. However, this would come at the cost of a higher Downside Risk as the number of scenarios in which adverse asset returns were expected would increase.

The Board monitors the Probability of Success through a Red-Amber-Green (RAG) framework where a green rating indicates that the Board should be comfortable, an amber rating indicates that it should consider pulling on one of its strategic levers and a red rating indicates that it almost certainly should be planning to pull one of its strategic levers. One element of one of our Key Performance Indicators (KPIs) for the year 2017/18 was to highlight when a breach of 88 per cent was likely. The boundary between the green and amber ratings was also taken as 88 per cent for the year. An increase in the lower bound for the green rating (from 87 per cent the previous year) and a decrease in the Probability of Success over the year (from 93 percent to 91 per cent) means that, whereas last year only a single sensitivity showed the rating fall from its green status to an amber one, this year a number of the sensitivities would see such a decrease. This is despite the fact that the impact of

Sensitivity of base case
continued



It is also important to consider the impact of multiple concurrent risks which would be more likely to happen in reality.

the sensitivities themselves is broadly unchanged from last year.

With the exception of the continued low interest rate sensitivity, the sensitivities described look at one risk factor in isolation. This is to demonstrate how the best-estimate assumption we have selected sits within a range of plausible alternatives, such as the distribution used for sponsor credit ratings, or how resilient we may be to a relatively extreme outcome such as a large unexpected claim.

However, these scenarios are illustrative only and it is also important to consider the impact of multiple concurrent risks which would be more likely to happen in reality. The overall impact can be more or less than the simple sum of the individual impacts we have explored in isolation. Also, certain risks may be correlated. For example a reduction in asset returns is likely to lead to a decrease in scheme funding levels and higher claims. Furthermore, the reduced asset returns may well occur as a result of a difficult economic environment, which could also lead to a higher rate of insolvencies for struggling sponsors, again leading to higher claims. To assess the potential impact of plausible combinations of different risks, we also perform scenario or stress testing, as described in the following section.

Table 7.1: results of sensitivity tests

Assumption	Probability of meeting Funding Objective (changes given in percentage points)	Downside risk
Base case	91%	£2b
Scheme s179 funding levels reduce by 10 percentage points as a result of decrease in asset values	-5	+£4b
Recovery plans five years longer	-1	+£1b
Technical Provision levels targeted by schemes reduced by 10% (relative to s179 basis) leading to lower DRC amounts	-2	+£1b
Schemes close to new accruals immediately	<1 improvement	<£1b improvement
Sponsor credit rating falls by one rating notch	-2	+£2b
Simulated large claim (immediate claim with liabilities of £10b and assets of £5b)	-9	+£6b
Initial PPF funding reduced by 10 percentage points as a result of decrease in asset values	-6	+£4b
Size of the PPF increases by 20% (assets and liabilities)	<1 improvement	< £1b improvement
PPF levies lower by 10%	<1 worsening	<£1b worsening
Reduction in asset returns of 1.0 perentage points pa (excluding cash and government bonds)	-6	+£2b
CPI is 50 basis points pa lower than best-estimate (difference between RPI and CPI widens from 1.0% to 1.5%)	+3	-£1b
CPI is 50 basis points p.a. higher than best-estimate (difference between RPI and CPI narrows from 1.0% to 0.5%)	-5	+£2b
Continued low interest rate[4]	-5	+£3b
Longevity sensitivity (probability of death in any single year (qx) reduced by 20%)	-5	+£5b

[4] Under our base case assumptions, interest rates are expected to rise. In the continued low interest rate sensitivity we hold the shape of the nominal and real interest rate curves constant through the course of the projections. This is achieved by targeting the long and short end of the yield curve at current levels, while still allowing for variation around those targets. This sensitivity is similar to a stress test in that there is a secondary impact on the total return on other assets such as equity and bonds.

Scenario testing

This section considers how our results differ under a number of scenarios.

To explore the extent to which our funding strategy is sensitive to a change in the Board's best view of the future we look at stresses to a number of assumptions on asset returns, bond yields and insolvency experience. This kind of stress, or scenario, testing can also reveal how resilient the PPF is to different economic shocks, and the severity of a shock big enough to jeopardise our funding objective.

For recent Funding Strategy updates we have adopted a system of scenario tests to help explore the possible outcomes should further evidence arise to challenge our base case assumptions, with the scenarios chosen intended to reflect potential events which, based on the economic and political conditions at the time, are unlikely but still plausible. This year we have chosen to explore some scenarios that have been created to elicit a more extreme impact on the likelihood of us achieving our funding objective.

This year we have analysed the impact of three scenarios: the 2017 PRA Annual Cyclical Scenario (PRA ACS), a global recession scenario combined with a UK trade shock (Global Recession with UK Trade Shock), and a scenario of low growth and low interest rates over the long-term (Low Growth – Low Yields). For the PRA ACS and 'Global Recession with UK Trade Shock' scenarios, the stresses are applied primarily to the first five years of the projections and thereafter converge relatively quickly to the baseline scenario. For the Low Growth – Low Yields scenario, the stresses on both yields and asset returns persist throughout the entire projection.

For each of the scenarios we have modelled our levy was fixed at £550 million. This is to isolate the impact of the scenarios on the Probability of Success, which may otherwise be influenced by the dynamic way in which we model the levy collections.

In a continuation of the approach taken for the three scenario tests discussed in last year's Update, this year we have again adopted a fully stochastic approach from the projection date. To achieve this we calibrated our Economic Scenario Generator to produce scenarios that, on average, follow the desired target paths of the variables under the three scenario tests.

These scenario tests were carried out as at 31 December 2017 and the impacts presented relate to movements against the baseline scenario at that date. While there are some differences between that baseline scenario and the baseline scenario as at 31 March 2018 that forms the basis of the results discussed in this Update, we don't believe these differences would be

This kind of stress, or scenario, testing can also reveal how resilient the PPF is to different economic shocks.

enough to influence the impacts observed. Further details on the three scenarios are provided below.

PRA Annual Cyclical Scenario

In line with previous years, we have explored one scenario consistent with the Annual Cyclical Scenario (ACS) published by the Prudential Regulatory Authority (PRA) in 2017[5]. This scenario is used by financial institutions operating in the UK to stress-test their capital adequacy and covers the period to the end of 2021.

While there are differences between the PPF's stress testing and what is required of insurers and banks (for example the PPF considers the impact of stress tests on its long-term funding position, whereas regulated entities look at a shorter-term impact), we believe the PRA ACS scenario provides a useful benchmark for creating a stress which is disruptive for the economy and plausible.

The PRA ACS is a scenario of global recession featuring a particularly sharp slowdown in China's growth with associated tumbling property prices. In this scenario, global risk aversion rises, resulting in large falls in asset prices, with global equity markets falling sharply in the first year of the projection.

Overall, the 2017 PRA ACS is a more severe stress than the 2016 scenario because of heightened vulnerability to the continuation of rapid Chinese credit growth. In particular, the 2017 scenario sees global GDP fall by 2.4 per cent (compared with 1.9 per cent in the 2016 scenario) and UK GDP fall by 4.7 per cent (compared with 4.3 per cent in the 2016 scenario).

[5] More detail can be found here:
https://www.bankofengland.co.uk/news/2017/march/2017-stress-test-scenarios-explained
https://www.bankofengland.co.uk/-/media/boe/files/stress-testing/2017/stress-testing-the-uk-banking-system-key-elements-of-the-2017-stress-test.pdf?

Scenario testing
continued

In this scenario the UK economy behaves differently from the rest of the developed world. A significant increase in the risk premium of Sterling-denominated assets results in the pound falling relative to other major currencies. As a consequence, UK inflation rises sharply and this prompts the Bank of England to rapidly increase interest rates to four per cent to bring inflation under control. This contrasts with a further loosening of monetary policy in the US and Eurozone where, in response to sluggish growth, interest rates continue to languish throughout the first five years of the projection.

In the first year of the projection, global and UK equity markets fall by 39 and 45 per cent respectively, while commercial real estate prices in the UK fall by between 30 and 35 per cent over the first two years of the projection. While some of these losses are recovered by the projection's fifth year, UK equities underperform the base case by a cumulative 34 per cent and overseas equities by 17 per cent.

The PRA only gives projections for some of the key asset classes, such as UK and US equities and commercial and residential property. Alternative assets such as private equity, alternative credit, infrastructure, farmland and absolute return play a significant role in our own asset allocation and an increasing role for pension funds more generally. In the stress test the returns for these assets have been linked to overseas equity returns.

The following table gives the Probability of Success and Downside Risk under the modified base case and PRA ACS scenarios.

In the PRA ACS scenario, an initial

Table 8.1: impact of PRA anchor stress compared with December 2017 base case

Probability of meeting Funding Objective	**Downside Risk**
-5 percentage points	<£1b improvement

shock to GDP leads to falls in asset values and a greater number of insolvencies. As a result of the way we model insolvencies – they are linked to the UK equities performance as a proxy for the health of the UK economy in general – this fall in asset values results in a greater number of insolvencies.

However, this coincides with a rapid increase in gilts yields, lowering the assessed liabilities of those schemes making a claim. As such, in the early part of the projection the increase in the number of claims is offset by improvements in scheme funding which results from the reduction in the value of schemes liabilities and an associated fall in claim amounts. The impact on the aggregate claim amount over the course of this scenario is therefore negligible – it is the timing of the claims that is critical. Lower claim amounts experienced early in the projection are offset by higher claim amounts later in the projection, as compared to the baseline. We are less able to recover from the impact of larger claims at this stage, and this is what causes a reduction in our Probability of Success.

Overall, the PRA ACS scenario's impact on the Probability of Success and Downside Risk is limited. This is because our investment returns relative to our liabilities are only 0.1 percentage points lower than in the base case scenario over the projection period. This suggests that the PPF balance sheet is resilient to a stress test like the PRA ACS where poor performance of the UK economy and growth assets is in part offset by the increase in interest rates. In such a scenario we need to continue monitoring the situation carefully, even when the apparent 'bad times' have run their course.

Global Recession with UK Trade Shock

This scenario combines a global recession and the UK trading with the rest of the world without the benefit of bilateral trade deals for a period. It is described in greater detail below.

The first element of the scenario is that the global economy enters a recession. Global equities suffer sustained losses in the first three years of the projection (under-performing base case expectations by 24 per cent by year three of the projection).

The second element of the scenario is that, in the absence of bilateral trade deals between the UK and the rest of the world, trade is carried out under standard World Trade Organisation (WTO) tariffs for a period of time. The immediate consequences are threefold. First, the drag on UK companies caused by tariffs causes UK equities to be hit worse by recession than global markets (down

This suggests that the PPF balance sheet is resilient to a stress where poor performance of the UK economy and growth assets is in part offset by the increase in interest rates.

Scenario testing
continued

33 per cent by year three). Second, rating agencies downgrade UK sovereign and corporate credits, and thirdly Sterling falls in value relative to other currencies.

In the short term, the effect of WTO tariffs and weaker Sterling results in a sustained period of higher inflation, with real yields falling (-2 percentage points relative to base case) before recovering to base case levels by the fifth year of the projection. After that, as a result of weakened domestic demand and impaired growth, UK Retail Price Index (RPI) inflation falls back below base case levels in the longer term. After a slow and steady fall for the first six years of the projection (to one per cent below base case levels), yields on 10-year UK gilts slowly recover but remain on average 0.5 percentage points below base case expectations throughout the projection.

The following table gives the Probability of Success and Downside Risk of this scenario:

This scenario is a much more severe stress test than the PRA ACS. Because interest rates stay low, both the number and size of claims increase. On average the annual aggregate claim amount more than doubles when compared to the base case. Investment returns are also depressed. Over the projection period PPF investment returns relative to liabilities are 1.2 percentage points lower than in the base case scenario. The compounding effect of both on and off balance sheet influences explains the very severe impact of this scenario.

Low Growth – Low Yields

This scenario is a stressed version of the PRA Biennial Exploratory Scenario (PRA BES)[5]. The PRA BES is intended to complement the PRA ACS by stressing the long-term profitability of banks in an environment of persistently depressed interest rates and mildly sub-par global economic growth. The Low Growth – Low Yields scenario amplifies the PRA BES by combining it with a scenario where returns on growth assets are severely depressed.

Table 8.2: impact of Global Recession with UK Trade Shock scenario compared with the December 2017 base case

Probability of meeting Funding Objective	**Downside Risk**
-16 percentage points	+£13b

Against a global backdrop that sees continued weak productivity growth, and world trade volumes 30 per cent below the level implied by an extrapolation of its pre-financial crisis trend, the UK bank rate is cut to zero and yields on 10-year nominal gilts stay at or below current levels (1.1 per cent-1.2 per cent) throughout the projection. Across the second half of the projection, UK yields are on average two percentage points lower than in the base case. This picture is mirrored in the Eurozone with yields on German 10-year bunds staying below 0.40 per cent, while in the US, after an initial sharp fall of 80bps, yields on 10-year Treasuries drift further down to 1.2 per cent by the end of the projection.

Compared to their performance in the base case scenario, equity indices are severely depressed, with an annualised risk premium 2.7 percentage points lower than in the base case scenario. The results of this scenario are shown below:

The Low Growth – Low Yields scenario is the most severe of the three stresses. In this scenario, claims on average are four times higher than under the base case scenario. In addition, PPF investment performance relative to liabilities is 3.8 percentage points pa lower than under the base case scenario.

As table 8.3 shows, the impact on the Probability of Success and Downside Risk is dramatic. However, it should be noted that we also think this is the least likely scenario. Like all the other scenarios the Low Growth – Low Yield scenario assumes our funding strategy does not change. Presented with such adverse conditions, the Board would be likely to consider if our current funding horizon remained appropriate. Extending our funding horizon would help the Probability Of Successful recovery.

Table 8.3: impact of the Low Growth – Low Yield scenario compared with the base case

Probability of meeting Funding Objective	**Downside Risk**
-32 percentage points	+£23b

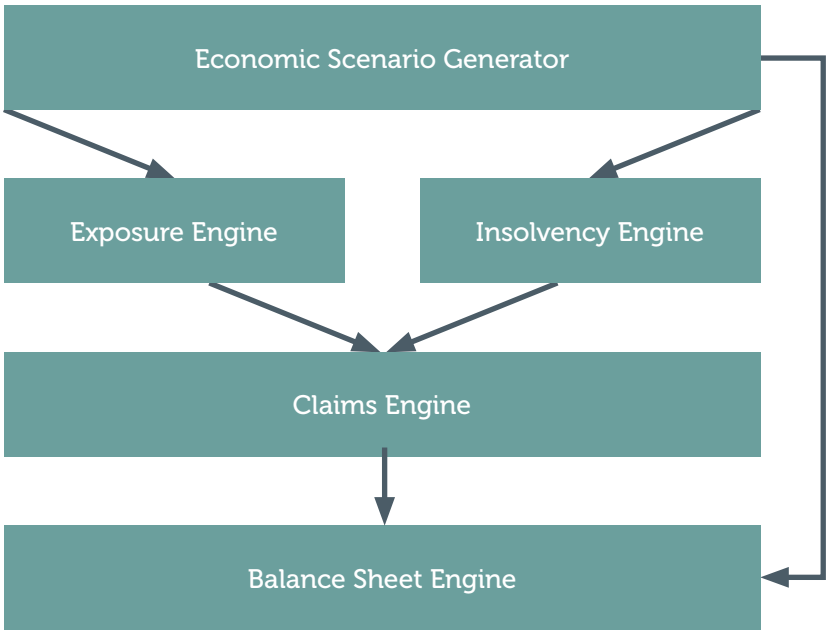
Annex A1

Further detail on modelling

This annex gives an overview of the model and its various components.

1. Overview of our model

Our internal model consists of a series of component models, variously written in VBA, Excel, and R or S+ as appropriate. Each engine covers a different feature of the calculations, and the engines are linked together to mimic the chain of events that ultimately lead to the PPF having assets or liabilities on its balance sheet. The following diagram shows how our model is built from its constituent parts, and more detail on each part is provided below.



Economic Scenario Generator
The projection process begins in the Economic Scenario Generator (ESG) which produces 2,000 economic scenarios. Each scenario is a set of projected paths for asset returns, nominal and real yields, and inflation rates. These are produced by an Economic Scenario Generator (ESG) package provided by a third-party (Moody's Analytics), and adapted for use by the PPF. Each economic scenario is paired with one of 2,000 mortality files, assuming mortality rates are not correlated with the economic scenario.

Insolvency Engine
Insolvencies are modelled in the Insolvency Engine by assigning a credit rating to each company (as detailed in section 4) and using transition probabilities to model credit ratings changing over time. We have 500 scenarios for credit risk, with the transition rates varying in each. Each credit risk scenario is mapped to each of the 2,000 economic scenarios, providing a million scenarios in all.

Exposure Engine
Scheme funding is modelled in the Exposure Engine, which captures how assets move in response to asset returns and sponsor contributions, and how schemes' liabilities move in response to changes in interest rates, inflation and longevity. We model benefits paid out to pensioners, and an allowance is made for accruals of new benefits (where appropriate) and contributions.

Claims Engine
The outputs of the Insolvency Engine and Exposure Engine feed through into the Claims Engine which produces the distribution of claims on the PPF and projected levy from eligible schemes. The levy responds to the inherent risk in the universe in line with the levy determination rules in force. A scheme is deemed to make a claim on the PPF where an insolvency event occurs and the scheme's liabilities, assessed on the s179 basis in force at the time of the calculations, are more than its assets.

Balance Sheet Engine
Liabilities (on the PPF's internal funding basis) and assets from claims then feed through the Balance Sheet Engine which projects the returns on the PPF's investments and investment hedge, and models levy collections, expenses and PPF compensation payment. The result is a distribution of PPF balance sheet outcomes over a chosen projection period that takes account of all primary funding risks.

Our key risk metrics – the Probability of Success and the Downside Risk – are derived at this stage. The former is the proportion of the one million scenarios that lead to a PPF funding level at the funding horizon (currently 2030) of at least 100 per cent, plus at least an additional margin for

Annex A1
continued

uncertainties after the funding horizon (currently 10 per cent of liabilities). The Downside Risk is the greatest deficit experienced at any time point within the period to the funding horizon, measured at the 10th percentile of all scenarios.

2. Assumptions

The LTRM is a complex model that includes more than 50 underlying assumptions, which are reviewed annually by the Board. For details on the latest assumption review, see section 4.

Below we describe the most material assumptions, as measured by their potential impact on our main funding metric, the Probability of Success. We split them into five categories:

- funding framework
- PPF characteristics
- economics and investment returns
- pension scheme characteristics, and
- sponsor solvency.

Funding framework

Assumption	Description
Funding horizon	We target self-sufficiency at the funding horizon. The Funding Strategy Dashboard helps the Board set the funding horizon, as described in section 2.
Self-sufficiency margin	The target for self-sufficiency is set as a percentage margin over the liabilities, which is held to cover the remaining risks after we reach the funding horizon. For more details, see section 2.

PPF characteristics

Assumption	Description
PPF asset allocation	We assume that our assets are invested in line with the current strategic asset allocation until the funding horizon. We also have a hedging strategy which seeks to remove the inflation and interest rate risk from our balance sheet. At a point in the future when a post-funding horizon investment strategy has been determined, we may want to model a phased change from the current investment strategy to the expected future one.
PPF levy	We model the PPF levy to vary over time in response to a scheme's underfunding and insolvency risk and also the evolution of its investment strategy (reflecting the methodology in the current levy determination). We calibrate the LTRM Levy Scaling Factor to the latest levy collection estimate. That scaling factor is then held constant throughout the projection.
Investment policy during assessment	Schemes in assessment start to align their asset allocation with that of the PPF even before they are transferred. For the largest schemes, we may start hedging their liabilities even before they enter assessment. In the LTRM we assume schemes switch immediately to the PPF's investment policy at the time of the claim.
Expenses	Liabilities from projected claims include the expense loading disclosed in the *Annual Report and Accounts*, plus an allowance for wind-up costs. The expense loading represents the capitalised value of the PPF's future administration and investment costs for a transferring scheme. The wind-up component represents the one-off cost of winding up a scheme.

Annex A1
continued

Economics and investment returns

Assumption	Description
Economic Scenario Generator (ESG) calibration	This is not an assumption as such, but a set of models that are used to calibrate the Economic Scenario Generator. The ESG package includes a choice of models for real and nominal yields, credit, inflation and asset returns. Each model has a set of parameters which can be calibrated to target features of the underlying economic variable, such as mean or standard deviation. In particular, the interest rate projections are calibrated to bond yields observed in the market at the start of the projection, and to a forecast of long-term yields. The forecast is derived internally in a way that is consistent with our own views and the 2018 baseline forecast published by the Prudential Regulatory Authority (PRA). This is an independent projection that is in line with our internal views. We use standard stochastic models for interest rates – the displaced extended two-factor Black-Karasinski model for nominal interest rates, and the two-factor Hull White model for real interest rates. Both of these models assume mean reversion.
Asset outperformance, volatility and correlations for main asset classes	The ESG creates 2,000 scenarios for every relevant asset class. The main statistics of the distributions – the mean, the standard deviation, and the correlation with other asset classes – are taken from the standard calibration of the ESG (provided by Moody's Analytics) and adjusted where the Board has a different view to our provider's central one. This does not mean that the Board believes our provider's views are incorrect, and Moody's Analytics is keen to stress that the standard calibration of its tool is not the most appropriate for all purposes. One reason for the Board choosing to make an adjustment may be where we wish to reflect our particular asset holdings, rather than take a general view from our ESG provider.
Asset outperformance, volatility and correlations for alternative and HAIL assets	We derive our own projections for hedge funds, private equity, unlisted infrastructure, farmland/timberland, minimum variance equities, alternative credit, absolute return bonds, emerging market debt, high yield bonds and for assets that fall under the 'HAIL' category. HAIL assets are hybrid assets which generate long–dated cash flows, typically from project finance and real estate assets. HAIL assets have liability matching and credit risk characteristics. We use standard statistical techniques to arrive at projections for these asset classes that have the desirable statistical properties (i.e. mean return, standard deviation and correlation with other asset classes).
Modelling Consumer Price Index (CPI)	The PPF has its own internal model for projecting CPI. It is a regression model that forecasts the RPI-CPI inflation wedge as a function of projected RPI, house price inflation, and short-term interest rates.

Pension scheme characteristics

Assumption	Description
Unfunded liability driven investment (LDI)	We assume that a proportion of overall liabilities of the universe of eligible schemes are hedged through unfunded LDI assets (for example swaps). We also assume that only the largest schemes hold unfunded LDI assets.
Sponsor deficit reduction contributions (DRCs) to cover a deficit on past accrual	We assume that schemes' current deficit recovery plans will remain in place over the longer term, with any new emerging deficit being re-spread. This means that, as the average recovery plan duration is nine years, in a scenario without any significant adverse experience, deficits are likely to be removed within our funding horizon. We also allow for the affordability of the DRCs either by setting a cap as a proportion of the scheme's liabilities or based on the scheme's actual DRC plan.
Recovery of section 75 debt from employer	We have data on liabilities of each scheme on the Technical provisions (TP) and s179 bases. Instead of trying to infer the TP basis that each scheme will use in the future, the model assumes that the ratio between the TP and s179 bases for a scheme is constant through time. As the model projects the s179 liabilities, we can then estimate the TPs and hence the DRCs.
Standard scheme	We don't hold individual member data for the eligible schemes, so we assume that all schemes start the projections with the same distribution for member ages and pension amounts, and the same split of pensions between different accrual periods (i.e. Pre-'97 vs. Post-'97) as that of a 'standard scheme'. In practice we use nine standard schemes for combinations of membership types (actives, deferreds and pensioners) and scheme status (open, closed, paid-up), which are scaled up for each individual scheme as applicable. Our modelling assumes that members retire exactly at Normal Retirement Age (NRA), whereas in practice some members opt for early or late retirement. The standard scheme is calibrated to ensure average ages are consistent with data for the PPF universe.
Post-retirement mortality	As we don't use individual member data in the LTRM, mortality assumptions are not member-specific. We align our assumption with the one in the *Annual Report and Accounts* for schemes in assessment where individual member data is not available. The assumption in this case is based on average member profiles (although very large schemes that would distort the average PPF profile may be excluded).

Annex A1
continued

Sponsor solvency

Assumption	Description
Measurement of employers' initial credit-worthiness	For the large schemes we assess the initial creditworthiness of the sponsor(s) by looking up current credit ratings or market implied ratings. For the smaller schemes we use the failure scores provided for levy purposes and map these to a hypothetical credit rating.
Future changes in credit rating	We model credit ratings as changing over time, the probabilities of transition being provided by Moody's Analytics and reviewed by the PPF. Insolvencies are also assumed to be correlated with equity market conditions. When equity markets deteriorate, sponsor insolvency rates generally move upward, and vice versa. The matrix only allows for companies defaulting, so a further assumption is needed because qualifying insolvency events are the trigger for assessing claims on the PPF (i.e. the ratio of insolvency given default).
Allowance for low security schemes	Schemes that we think are certain to enter the PPF in the very near future are added to the PPF balance sheet with immediate effect, even where allowance may not have been made for these schemes in the *Annual Reports and Accounts*, which is more of a snapshot.
Multi-employer schemes	For simplicity we model all schemes with multiple employers as 'last man standing'. In reality some schemes segregate when the employers leave. However, the majority of eligible schemes are actually 'last man standing', or likely to behave as such on insolvency.
Relationship between insolvency and default	Not all employer defaults will lead to insolvency so we make an assumption on what percentage of employer defaults result in insolvency.

3. Data inputs

The data inputs for running the LTRM can be split into three broad categories as described in the table below:

Category	Data type	Data source
Scheme data	Individual scheme data on: • asset value and asset allocation • liabilities (on s179 and TP bases) • membership classes and numbers • scheme status (open, closed, paid-up) • information on sponsors • recovery plan • schemes to exclude from the projections/add to the starting PPF balance sheet.	Scheme data supplied to TPR by schemes in Exchange. This data is reviewed and cleaned internally by the PPF for levy invoicing purposes. Internal information on schemes that are in assessment or that are Type-II schemes (as described in section 3). Recovery plan information supplied by TPR.
Employer data	Individual employer data: • industrial sector • credit worthiness • number of employees • schemes it sponsors • relationship with scheme (participating/largest employer, guarantor).	Credit risk information from credit rating agencies for the largest schemes. Credit scores from Experian.
Financial data	The ESG is calibrated to the initial real and nominal yield curves each quarter. Historical financial information.	The ESG package we subscribe to provides the initial yield curves. The PPF systems hold historical financial information for levy purposes.

4. Assurance and future development

Our internal model is continuously subject to refinement and validation. We also commission an external review of the model every three years. The latest was carried out in 2015. Some developments and improvements were recommended, and we implemented those we considered proportionate. A new external review is due in 2018, and we expect it will be completed later this year.

The LTRM has been continuously refined and enhanced since it was first developed in 2010. We're investigating whether the current structure of the model (including its functionality, programming language and platform) is still appropriate, or if a partial or total overhaul would be a cost-effective means of better meeting stakeholder requirements.

A committee within the PPF is responsible for ensuring that the model is kept up to date and monitoring the implementation of model improvements. We maintain a model development list to capture proposed refinement to the model's capabilities and make sure it remains up to date in respect of changes both within the PPF and in the wider pensions universe.