

PPF Long-Term Funding Strategy Update

as at 31 March 2016

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2: Foreword



On 23 June, the UK electorate voted to leave the European Union. Markets have been volatile as a result, and there may be a longer term impact on the future growth in the UK and EU economies, as well as on the health of individual companies and their defined benefit (DB) pension schemes. While we will continue to monitor the situation closely for any developments that may impact our organisation and funding strategy, we believe that our long-standing low risk investment approach and hedging strategy means we are well placed to cope with uncertain and volatile markets.

Our funding strategy describes the framework within which we make our financial decisions and how we assess the financial risks to the Fund. Each year we update the strategy with the latest financial information and consideration of the risks to our funding objectives. While the work to update the strategy took place before the referendum we remain confident that the funding strategy remains appropriate in the current uncertainty.

The 2015/16 financial year was characterised by low interest rates in the developed world, and continuing market volatility. The number of claims on the PPF was lower than last year though their total value increased from £322 million to £476 million. This was mainly due to the well-publicised BHS claim which came during Q1 2016.

UK gilt yields were fairly flat over the year while equities suffered from two shake-outs, thereby reducing the funding levels of the DB schemes that the PPF covers. Average scheme funding levels remained low and well below 100 per cent. This shows that we need to remain vigilant to the risks that the universe of DB schemes present to us. Through our PPF 7800 Index we continue to monitor scheme underfunding against a PPF benchmark and reflecting the moves in gilts and the significant volatility in markets generally during the 2015/16 financial year, it ended the financial year showing a deficit of £302 billion.

As in previous years we continued to improve our modelling and apply best practice. Part of this was to ask KPMG to perform an audit of the model, which I am happy to say they deemed well suited for the purposes for which the PPF uses it. Most of their recommendations have now been carried out. We continued to improve our modelling of interest rates, as well as improving the modelling of the credit quality of the largest scheme deficits that we insure. As described in this funding update, we continued to perform sensitivity analysis for changes in key assumptions, as well as scenario analyses including the Prudential Regulatory Authority 'Anchor' scenario. The PRA scenario this year was particularly relevant for the risks that the PPF runs, and we are considering running this particular scenario on an annual basis.

As reported in our Annual Report and Accounts, our own funding level increased slightly over the year from 115.1 per cent to 116.3 per cent. However, the funding level that we use as a starting point for our modelling is different from this, as it also allows for some contingent liabilities that have not yet materialised. This year this allowance was significantly higher than last year's.

One key output from our modelling is the PPF's 'Probability of Success'. When we carried out the modelling for this update, this had increased from 88 per cent at the end of the 2014/15 financial year to 93 per cent this year. The main drivers of this increase were technical rather than driven by market conditions; in particular the enhancements we made to our models, especially the change in our interest rate forecasting model, were responsible for the bulk of the increase in this probability. Our Board has continued to review both the assumptions and the outputs of our funding strategy, and its view is that both the funding horizon of 2030 and the 10 per cent self-sufficiency margin remain appropriate.

Even though the results presented in this update were generated before the referendum took place, we believe that the stress scenario and sensitivity analysis shows our funding strategy remains robust under a wide set of circumstances. Therefore, we believe our funding strategy remains fit for purpose and we continue to make good progress against it. However, as noted above the outcome of the referendum has brought additional and significant new risks to the risks already present in the current economic climate, and therefore regular monitoring of our positions and progress remains absolutely essential.

Hans den Boer
Chief Risk Officer

July 2016

3: Review of the funding objective

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

The purpose of the PPF

The PPF exists to pay the right people the right amount at the right time. The cornerstone of this objective is that we have sufficient funds to pay members their compensation for the period that it is due. However, the Board faces a number of risks in ensuring that the assets it holds will cover future liabilities. These risks need to be monitored and managed within a holistic governance framework. Central to this framework is our funding objective: to be self-sufficient at our funding horizon.

The PPF's approach to risk management

The PPF operates within a robust risk management framework which we are constantly seeking to improve. The PPF's funding strategy provides the impetus for a cycle of risk identification, evaluation and mitigation. As part of our regular review of the funding strategy, we have considered all risks currently covered by our risk policies and assessed whether or not these risks should be explicitly modelled within the funding strategy. No new risks have been allowed for in this year's review of the funding strategy. Sensitivity and stress testing are also conducted – see sections 7 and 8 for further details.

While insurance companies in the UK are required to identify risks to which they are exposed and consider the capital that should be held against them, the PPF is not required to hold capital. However, we carry out a process to determine our funding margin which can be viewed as analogous to this, 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 have sufficient funds to pay members their compensation. By assessing whether or not we are on track to meet our funding objective, we can test out our ability to meet this goal.

In summary, the funding objective is a central element of the PPF's risk management framework. Having a clearly defined objective allows us to assess how we are performing relative to our overall goal, and whether we need to take action to ensure we remain on track. It also provides a way for the Board to assess the possible impact of expected (or unexpected) changes on the PPF's overall mission. By analysing the impact of a change by reference to our funding objective, we can decide how serious a potential risk is and be guided as to what an appropriate mitigation might be.

The Board has two main levers it can use to address the risk that we have insufficient assets to meet our liabilities. The first of these is to change the levy collected. The second is to alter its investment strategy. The Board also has the power to restrict inflation-linked increases to compensation or to ask government to reduce the level of compensation payments, however these actions would only be considered in exceptional circumstances.

Rationale for the funding objective

The PPF operates in an environment of continual change. Over the next couple of decades, we expect that the number of DB schemes will significantly reduce as schemes buy out their liabilities, or enter the PPF. Moreover the funding level for surviving schemes should improve over time as a result of the scheme funding legislative framework. There will therefore come a point when the levy is no longer an effective tool for managing the PPF's funding position, because the levy we could justify collecting from remaining schemes will be so small compared to the PPF's assets and liabilities. By this point in time we will therefore want to have a lower-risk investment strategy. We will be less able to use levy to address any deficit that might emerge as a result of poor asset performance or a poor claims experience. We call this point in time the funding horizon.

3: Review of the funding objective

When we reach the funding horizon, some risks to the PPF will still remain. As long as there are DB schemes, there is a risk of claims from some of these schemes. Longevity risk will remain as long as the PPF is responsible for paying compensation. There will remain the risk that some failure in the PPF's risk management framework leads to a material financial loss. Also there is the risk that there may not be suitable investment options available with which we can 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 ensure that, even if the future is worse than expected, we can still pay members their compensation? If we can gauge this funding level correctly, and can attain that funding level at our funding horizon, we should be self-sufficient.

What is self-sufficiency?

The assumptions that we use to assess our liabilities and therefore our funding position reflect our best estimate of the future¹. By “best estimate” we mean that it is equally likely that the future is better than we expect, or worse than we expect. Therefore if at our funding horizon our assets were exactly equal to our liabilities we would have only a 50 per cent chance of being able to meet compensation payments in full, which is not high enough. We have therefore added a margin to protect ourselves against the risks to which we would be exposed.

The Board chose the funding horizon 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 is no formal definition of ‘small’ in this context, our modelling has shown that expected claims at the 90th percentile to be less than 2 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.

The target for self-sufficiency is set as a percentage margin over the liabilities, this being held to cover remaining risks after we reach the funding horizon and thus increase the likelihood of meeting compensation payments in full from the 50 per cent best estimate level. When the risk margin was introduced, it was set at 10 per cent and was intended to cover two key risks which would remain after the funding horizon: the risk of unexpected longevity improvements and any future claims (beyond the funding horizon) in excess of PPF levies. The margin was calculated such that at the assumed funding horizon it would be sufficient in 90 per cent of modelled scenarios to cover both uncertainty in longevity, and claims risk in excess of levy. In other words the margin would be sufficient to meet compensation in full in 90 per cent of modelled scenarios.

The Board conducted a review of the self-sufficiency margin for the first time in 2014 to allow for changes in the pensions environment, the latest longevity data, and refinements in the modelling itself. The Board also decided to incorporate a third risk into the margin – operational risk – since this risk will remain as long as the PPF is in existence. By operational risk, we mean the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events, including legal risk (i.e. the definition used under Solvency II). As a result of that review the Board decided that both the funding horizon of 2030 and the 10 per cent self-sufficiency margin remained appropriate.

Further developments over the past year led the Board to conduct a second review of the margin. Alongside refinements to our modelling, the most significant change is to the assumption previously made that, eventually, a market in CPI-linked instruments will develop. Given current industry opinion on the emergence of such a market, for the latest review the Board has chosen to assume that no deep or liquid market in CPI-linked instruments will in fact develop.

This assumption of non-emergence introduces a new risk into the margin. Our inflation-linked liabilities are linked to CPI but we now assume we will be only able to invest in assets that are linked to RPI. There is therefore a risk that these two measures of inflation do not move in tandem so our RPI-linked assets do not exactly track our CPI-linked liabilities.

¹ The best estimate used for CPI increases is the best estimate of the market's view of the actual outcome. This is distinct from the other assumptions which are best estimates of the actual outcome itself.

3: Review of the funding objective

Following this latest review the Board decided that both the funding horizon of 2030 and the 10 per cent self-sufficiency margin still remained appropriate to meet future compensation payments with at least 90 per cent certainty. As a point of reference, had the Board chosen a 99 per cent confidence level, the funding margin would have been required to be around 25 per cent.

We are aware that there are a number of other areas which may lead the Board to review the margin in future. The PPF's Statement of Investment Principles ('SIP') has been updated to allow investment in long-term, illiquid assets with hedging properties ('HAIL' assets) and the PPF has continued to transition to this strategy. In a similar way to holding RPI-linked investments to match CPI-linked liabilities, holding such long-term assets will result in an asset allocation at and beyond the funding horizon that does not perfectly match our liabilities at that time. We should consider including investment risk in our self-sufficiency margin when we have greater clarity on what our asset allocation may look like at the funding horizon.

There are a number of other risks which we exclude from our funding margin. In general, this is because such risks will be minimal by the time we reach our funding horizon. For example, one risk we currently face is transition risk, which is the risk that when we are moving assets from transferring schemes into the PPF there are unnecessary costs or the market moves against us during the transition period. By the time we reach our funding horizon, far fewer asset transitions are expected to take place so this risk becomes minimal. Also, because our investment strategy is expected to be simpler once we reach the funding horizon, many of the risks currently associated with our existing complex investment strategy, such as taking tactical positions, are likely to be substantially reduced.

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

How do we measure progress against our funding objective?

We use two key statistics to monitor progress against our funding objective - 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. The downside risk is a measure of how poorly funded we might become on that journey. It is calculated such that in 10 per cent of modelled scenarios our deficit reaches at least that level at some point before we reach our funding horizon.

To measure these statistics we have developed an internal model that projects the level of PPF assets and PPF liabilities in future years: the Long-Term Risk Model. It generates an extensive range of asset returns, insolvency and longevity scenarios and then projects a range of PPF balance sheet outcomes.

The process of using a large number of modelled scenarios to derive a distribution of outcomes is termed stochastic analysis, 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.

As with any financial model, it is important to exercise an appropriate degree of caution when analysing output. 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 the sensitivity of the output to changes in key assumptions (see section 7).

As well as testing the sensitivity to changes in individual assumptions we carry out more fundamental stresses to the model by changing various assumptions all at once. Three such stress tests are described in section 8.

4: Summary of the year's events

This section summarises the events affecting the risks to the PPF over the year to 31 March 2016.

Markets and their impact on scheme funding

UK economic growth slowed from 2.6 per cent in the first quarter of 2015 to 2.0 per cent in the first quarter of 2016. Furthermore, the growth in the year to the first quarter of 2016 was uneven. Services output rose by 3.0 per cent but construction output fell by 1.8 per cent and manufacturing output fell by 1.3 per cent. Compared with the pre-recession peak, in the first quarter of 2016 services output was up some 12.6 per cent, but construction and manufacturing were down 4.5 per cent and 6.9 per cent respectively.

Against a background of reasonably strong GDP growth and continuing low interest rates, company insolvencies in the whole economy fell by 6.8 per cent in the year to the first quarter of 2016, with the UK company liquidation rate at its lowest level since records began in 1984. However, the number of claims on the PPF rose somewhat in 2015/16 although the level was still well below the levels seen between 2006/07 and 2013/14.

Scheme funding on a S179 basis for PPF eligible schemes improved a little between end-March and end-December 2015. The ratio of total assets to total liabilities rose from 84 per cent² to 85 per cent as the impact of higher gilt yields on liabilities more than offset the impact of lower equity markets on assets. However, scheme funding deteriorated in the first quarter of 2016, to 80 per cent on average, as gilt yields fell sharply and equity markets weakened.

The Purple Book 2015 evidence on de-risking was mixed. The proportion of schemes that were open was unchanged at 13 per cent and has changed little over the last three years. However, the trend in increasing allocation in bonds and decreasing allocation in equities continued.

The PPF's investment strategy

Whilst we published a new Statement of Investment Principles (SIP) in November 2015, our investment strategy has remained unchanged over the past year. It combines a diversified portfolio of assets with a liability driven investment (LDI) programme that ensures we control our portfolio risk and use our risk budget effectively, in order for us to meet our long-term obligations to our members. We invest to reflect our strategic approach to risk and our long-term funding goal.

In line with developing the asset allocation we announced in July 2014 we have continued to build our exposure to hybrid and alternative assets. These provide diversification benefits, as well as an attractive risk-adjusted return to benefit our members and levy payers. Given our long investment horizons, we are also able to benefit from the liquidity premium of investing in less liquid assets.

Our LDI programme continues to deploy a strategy of matching the interest rate and inflation sensitivity of our liabilities.

Investment insourcing

Now that the PPF is equivalent in size to the largest pension funds in the UK, we are developing our asset management capabilities to reflect this. This includes insourcing some aspects of our portfolio and implementing an investment operations function to support the target investment operating model.

Our new risk management systems are now in place to support insourcing and during the year we procured a portfolio management system which gives us the ability to manage assets in-house, together with other key internal processes which continue to be developed to go live later in the year.

2. The figure as at March 2015 in the 2015 Update was stated as 81%. The difference between the figure in that report and that given here is the result of the introduction of a new data set in November 2015. Figures were subsequently recalculated as at March 2015 using this data. In this way the figures stated here are directly comparable as they use the same data set.

4: Summary of the year's events

Claims on the PPF and their impact on PPF 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 2016 we saw a slight increase in the total number of claims compared to previous years. There was one large, high-profile claim coming in at the end of the year. Nevertheless it has been another year with a relatively low number of claims.

In the PPF's Annual Report and Accounts an allowance 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 2016, no insolvency event has taken place, but the Board is nonetheless expecting to receive an insolvency event notice under section 120 of the Pensions Act 2004 from an insolvency practitioner in the future,
- the Board has sufficient data about the scheme to be able to make an estimate of a contingent liability, and
- as at 29 February 2016, 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.

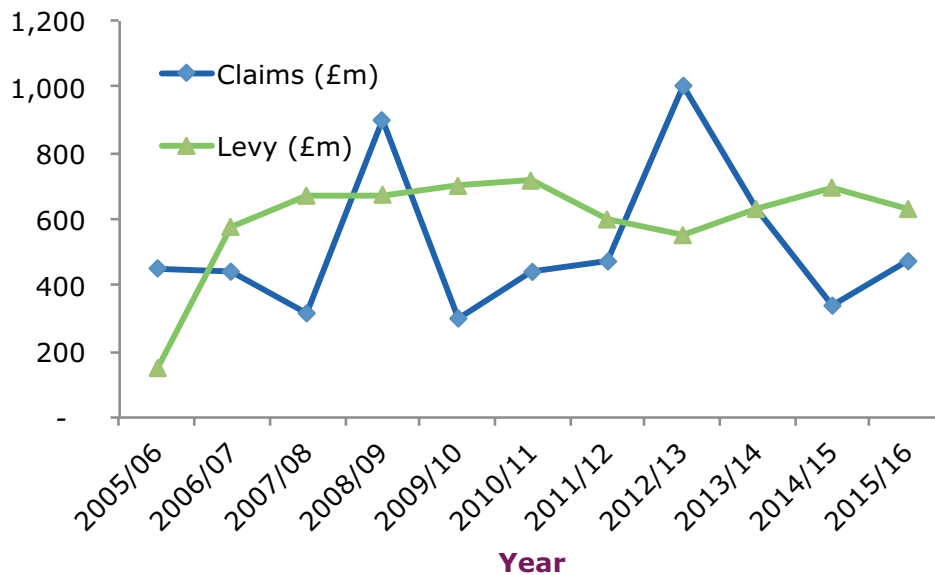
Whereas in the Annual Report and Accounts an allowance as a contingent liability is made, we adopt a slightly different approach in our modelling. Such schemes' liabilities and assets are included in the starting position of the model. As such, an allowance has been made for a potential future claim from the British Steel Pension Scheme (BSPS), as well as some other, smaller schemes, in the near future in our modelling. While we do not know what will be the final outcome of the current well-publicised discussions, we are here to protect the members of all DB pension schemes and based on the information available to us, we believe that we have sufficient reserves should this scheme come to us during the coming year.

Allowance for claims and Type II contingent liabilities is reflected in changes in the PPF's funding level over the year. The funding level, allowing for claims over the year, schemes in assessment and schemes that are denoted as Type II contingent liabilities in the PPF's Annual Report and Accounts, has fallen from 114 per cent as at 31 March 2015 to 108 per cent as at 31 March 2016. For reference, the funding level excluding the Type II contingent liability schemes was 115 per cent at 31 March 2015 and 116 per cent as at 31 March 2016.

4: Summary of the year's events

The following chart shows the history of claims and levies made on the PPF, taking into account recoveries, as well as expected levy collections, as published in the Levy Determination, since the PPF's inception. Neither this chart nor chart 6.3 in section 6 includes the allowance for the Type II contingent liabilities described above as these are not realised claims.

Chart 4.1: History of claims and levy



The number of claims we receive in the coming year will be dependent on economic factors. Scheme deficits have increased in recent years as a result of falling gilt yields, but the low interest rate environment may have helped keep companies afloat. However, if interest rates rise faster than expected, highly indebted companies, particularly smaller ones with restricted access to capital markets, could become insolvent, resulting in more claims on the PPF.

4: Summary of the year's events

PPF levy

The Board's strategy for setting the levy is to keep the rules stable throughout the levy triennium (the three year period from 2015/16 to 2017/18) 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 below £1 billion)
- A 25 per cent year-on-year increase in the levy we expect to collect
- A 25 per cent year-on-year decrease in the levy we expect to collect

The second year of the second levy triennium commenced on 1 April 2016. Final levy rules for the coming year remain very largely unchanged as we seek to keep our approach stable. Small changes were made to make it easier to certify mortgage exclusions and asset backed structures.

As scheme funding overall has remained low, when publishing the levy determination we took the opportunity to encourage schemes to continue implementing risk reduction measures to improve security for members and to reduce their levy bills such as putting in place contingent assets and making deficit reduction contributions.

The final rules for 2016/17 also confirmed the levy estimate of £615 million, lower than our estimate of £635 million for 2015/16. The reduction relative to last year's estimate reflects that while scheme funding has deteriorated since we made our 2015/16 estimate, this was expected to be offset by improvements in the new Experian scores that scheme employers and guarantors are receiving as the new system beds in.

Work on the next levy triennium, commencing in 2018/19, is already underway. However, in advance of the next triennium, we will also be carrying out analysis to see whether further changes to the rules are necessary for 2017/18, for example to reflect the introduction of the new Financial Reporting Standard FRS102.

Pension freedoms come into force

Pension changes announced in the 2014 Budget came into force in April 2015. Pensioners can now cash in as much or as little of their defined contribution (DC) pot as they want, removing the need to buy an annuity. From April 2016, people who already have an annuity will be able to sell it on.

These changes may prompt people to transfer their savings from DB schemes to DC pots. This could result in a significant shift in assets and liabilities away from DB schemes. It is too early to see the impact of these changes on the DB universe but we continue to monitor them and their potential impact on for the PPF's risk profile.

As noted in the 2015 Long-Term Funding Strategy Update, another possible implication of pension freedoms relates to the size of the reduction in demand for retirement annuities. As the basis for assessing scheme entry to the PPF is linked to the cost of securing annuities for members, a change in pricing these products could affect the number of claims on the PPF. Again, we will continue to monitor for the potential impact on the PPF.

End of contracting out

Contracting-out ended in April 2016 with the introduction of the new single-tier State Pension. Prior to this, members of DB schemes may have given up part or all of the Additional State Pension and received extra pension from their occupational scheme in exchange for lower National Insurance contributions.

We encouraged schemes to ensure their information on contracted-out members is reconciled with HMRC. Failure to do so could result in increased liability on the scheme. Members who could otherwise have been proven to have left the scheme will become a liability, as could any increased individual entitlements. This would mean an additional liability on the PPF should the scheme ever come to us.

On 24 June 2016 it was announced following a referendum that the United Kingdom has decided to leave the European Union. This is a significant event for the United Kingdom and the full consequences will emerge over time. However, the PPF's long-standing low-risk approach and hedging strategy mean that we are able to cope with the volatile markets we expect to see. No changes have been proposed which would change the role of the PPF or the compensation which we provide and consequently we do not consider this to materially affect our long-term operations.

5: Updated assumptions

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

The main modelling assumptions are described in Annex A1. Some of these have been updated since the previous publication of our Funding Strategy update in July 2015, and are described below.

Modelling of interest rates and inflation

The Economic Scenario Generator (ESG) is a key model in the LTRM, generating the economic variables used in each of the projections of possible alternative futures. A number of different models for each key variable exist. We seek to follow industry best practice in our approach to modelling. The PPF also has an ESG Calibration Framework and we comply with the principles of this framework where possible. In order to ensure that we meet these requirements we have reviewed the models we use for nominal interest rates and inflation and taken the decision to adopt different models for these variables. In broad terms the previous model of interest rates was one that assumed the average risk-adjusted excess return on government bonds (over cash) was the same at all maturities and remained so throughout our projections – a Constant Term Premium model. The model has been upgraded to one where the average risk-adjusted excess return is the same at all maturities but changes throughout the projection to reflect future expectations of interest rates – a Time-Varying Term Premium model. The inflation model has been upgraded to allow a random component in modelled inflation³.

Proportion of benefits retaining salary link

When a scheme closes to future accrual members who were active at closure may have their accrued benefits revalued in line with rules for deferred members or retain a link to their future salary. Much depends on the powers under the specific scheme rules.

Evidence from a number of sources indicates that around 5 to 25 per cent of schemes closing to future accrual retained their salary link. Based on this the assumed proportion of active liabilities retaining a salary link on closure was reduced to 20 per cent.

Limit on deficit reduction contributions

In our modelling we place a cap on deficit reduction contributions (DRCs) to represent a limit a company may reasonably be expected to contribute to a scheme (based on the size of the scheme's liabilities). This cap was previously based on the credit rating of a scheme (the averaged credit rating of sponsoring employers of that scheme). Schemes with a credit rating of Baa or better had a cap on their DRC amount of five per cent of liabilities and all other schemes had a cap of two per cent.

Recent investigations have found there to be no strong link between the creditworthiness of the scheme's sponsor and the level of DRCs received by a scheme. We therefore increased the cap to five per cent for all schemes.

3. Technical details of the differences between the previously used and newly adopted models are beyond the scope of this publication.

5: Updated assumptions

Cost of using over-the-counter derivatives

Legislation relating to central clearing of over-the-counter (OTC) derivatives will increase the PPF's costs of dealing in swaps in the near future, though the PPF does have an exemption from the legislation until 2019.

A review of the anticipated costs concluded that the 'drag' these costs may have on the performance of our asset portfolio would be around 15 basis points, based on the value of our liabilities. To reflect this we have reduced the performance of our asset portfolio by 15 basis points (based on the value of our liabilities). We have also delayed the start point for introducing these costs to 2017 i.e. two years before our exemption expires. This reflects the likelihood that we will transition before the exemption expires. A more accurate date for the PPF to transition its OTC derivatives to a centrally cleared system will become clearer over time.

Length of recovery plans

Information from The Pensions Regulator (TPR) 2015 Annual Funding Statement showed that tranche 8's⁴ recovery periods have remained relatively constant over the period between valuations. If reparation of deficits had progressed as expected recovery plans would, on average, be three years shorter following a subsequent triennial valuation. The trend for recovery plan lengths to not materially shorten is expected to continue for future tranches.

We have therefore increased the number of years we add to recovery plan periods from one year to three years in recognition of the most up-to-date information available.

Use of liability driven investments by schemes

A 2015 survey monitoring trends in LDI strategies employed by DB pension schemes showed an increase in the use of LDI strategies from pension schemes with liabilities in excess of £50 million.

Based on the results of this survey and discussions with industry experts we have updated the assumption for the proportion of the universe's liabilities hedged using unfunded LDI assets from 15 per cent to 20 per cent.

Initial creditworthiness of employers

Within our model, insolvency events are determined using a transition matrix based on credit rating migrations. To model insolvencies employers are required to have a starting credit rating. However, it is not possible to obtain publicly available credit ratings for the majority of employers of schemes in the universe.

The assumed distribution of employers between credit ratings has a material impact on the results of the model (see sensitivity results in section 7). An investigation by the PPF determined a suitable distribution of companies between credit ratings, with sponsors of eligible schemes then ranked by their Experian insolvency probabilities and the derived distribution used to assign credit ratings i.e. the x per cent of employers with the lowest insolvency probabilities assigned to the highest credit rating, the next y per cent to the next highest credit rating and so on.

The exception to this ranking approach is where we have obtained a credit rating issued by a rating agency or a market implied rating for an employer. We obtain such ratings for employers of schemes that present the greatest risk to the PPF (based on size of deficit). Such employers are guaranteed assignment to a specific credit rating based on these ratings, with this assignment carried out before the remaining employers are allocated a rating.

4. Schemes with valuation dates between 22 September 2012 and 22 September 2013.

5: Updated assumptions

Modelling high-risk pension schemes

Due to the risk presented to the PPF by pension schemes with large deficits, special attention is paid to these schemes. A dedicated model is used to assign a credit rating to pension schemes which have one of the 500 largest deficits on a S179 basis.

Using this internal model a high rate of credit rating reversal has been observed. A rating reversal occurs when a credit rating assigned to a scheme by the model reverts back soon after the change has been made. This is an undesirable feature in the model and is not observed in the real world. To overcome this the model has been redesigned. The objective was to build a model that was able to discriminate between insolvent and non-insolvent schemes while generating fewer false signals through a low reversal rate.

The revised model puts greater emphasis on public credit ratings and on an industry specific scoring model from the rating agencies than the previous model did.

Modelling of the PPF's corporate bond holding

Modelling of the PPF's corporate bond holding has been updated to better reflect the creditworthiness and the duration of the actual investments held. This has involved changing the asset modelled from a single, Aa-rated bond of 15 years duration to a diversified portfolio of A rated bonds with a 7 year duration. It should be noted that this is a change only to our modelling of the bonds. This does not reflect any change to the PPF's investment strategy.

Schemes targeting a funding level above technical provisions and schemes buying out their liabilities

Surveys by various parties in the pensions industry suggest that 11 per cent to 25 per cent of sponsors are considering buy-in or buy-out. The level of funding necessary to achieve a buy-in or buy-out is generally well above the level required to be fully funded on a technical provisions (TP) basis. We have amended the Long-Term Risk Model (LTRM) so that a scheme with a strong sponsor continues to receive extra contributions after the scheme is fully funded on its TP basis, until the scheme is fully funded on a buyout basis. Once a scheme reaches this point, we now assume that it buys out and it is removed from the universe at that point.

Expenses

To keep the assumption used for expenses consistent with those used in the valuation of the PPF for the Annual Report and Accounts we have increased the loading for expenses incurred by the PPF from the 2.8 per cent of liabilities used in the 2015 valuation to 3.0 per cent of liabilities used in the 2016 valuation.

Mortality

We have updated our mortality base table to be in line with the assumptions used in the valuation. We have also updated our longevity projections to remove one year of stochastic longevity projection from the start of the period as our starting point for the calculations has moved on one year.

5: Updated assumptions

Long term difference between RPI and CPI (valuation of liabilities)

Parts of PPF compensation are indexed by reference to the Consumer Prices Index (CPI). At present there is almost no market in CPI swaps or indeed any other instruments from which CPI prices can reasonably be inferred. Such limited current market pricing information as is available from insurance companies would suggest an assumption of CPI increases being 0.5 per cent a year less than RPI increases. The PPF valuation basis has been updated to reflect this and, for consistency, we have assumed the same in our modelling (compared with a CPI assumption 0.4 per cent a year less than RPI used in 2015). It should be noted that, where relevant, in the valuation of our assets we use a best estimate for the difference between RPI and CPI, where we assume CPI to be 1.1 per cent a year below RPI.

Valuation of the PPF's swap spread reserve

The discount rate used to value the PPF's liability cashflows is based, each year, on the higher of the swap rate (less 15 basis points) and gilt yield at that time. The choice of asset used to hedge the cashflows will in turn depend on the measure used for the discount rate. It has not always been possible to completely hedge cashflows discounted using the gilt yield (as opposed to the swap rate) through gilts alone and swaps have had to be held instead. This created a mismatch, exposing the PPF to movements in the difference between swap and gilts yields - the swap spread. An adjustment has previously been made to our starting balance sheet to allow for this mismatching of assets and liabilities.

Changes to the markets and the instruments available has increased the speed with which the PPF is able to close down this swap spread exposure. As such we believe it is no longer appropriate to make an adjustment to the balance sheet for the swap spread and we have ceased to do so.

Impact

As discussed in section 6, the net impact of these changes on our funding outputs is positive.

6: Modelling output - base case

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

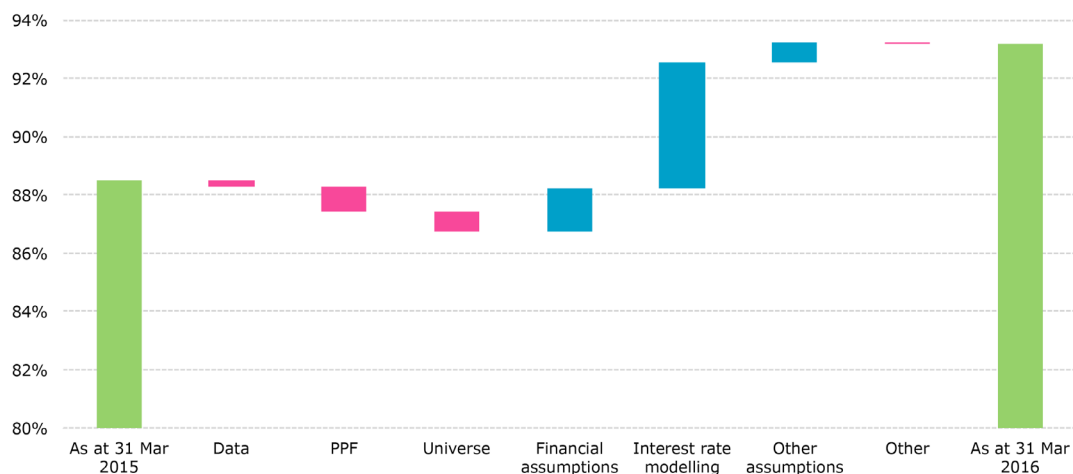
In our base case, the probability of achieving self-sufficiency by the funding horizon has increased from 88 per cent at 31 March 2015 to 93 per cent at 31 March 2016. The downside risk statistic is correspondingly lower, at £2 billion, compared with £5 billion a year earlier.

The 5 per cent increase in the probability of success is mostly attributable to the changes we have made to the model we use for calibrating nominal interest rates and inflation in the ESG. These changes, introduced to better meet industry best practice and comply with our Calibration Framework principles, increased the probability of success by a little over 4 per cent. Whilst this represents a large change to the probability of success we view the changes made to the modelling of nominal interest rates and inflation as an improvement as it provides a more realistic path of future interest rates than the previous model. This in turn allows us to better model the liabilities of the PPF, those of future claims and those used in calculation of levy collections. It should also be noted that the introduction of the new calibration models at a time when interest rates have for some time been at historic lows means that we will not recognise the same sort of improvement in the probability of success in response to rising interest rates as we would have under the old calibration models.

Changes to the financial conditions over the year and the impact of the remaining assumption changes outlined in section 5 also acted to increase the probability of success. Changes to the data held on schemes in the universe, a deterioration in the starting funding level of the PPF (driven largely by the large claim toward the end of the year and the recognition of the Type II contingent liabilities, as outlined in section 4), and a slight deterioration in the funding levels of these schemes partially offset the positive factors.

The following chart reconciles the probability of success at 31 March 2016 with the position one year earlier. The blue bars denote improvement and the red bars denote deterioration over the year.

Chart 6.1 Change in probability of success over year



6: Modelling output - base case

The following table explains what the bars represent.

Bar	Explanation
2015	This is the probability of success at 31 March 2015, which was 88 per cent.
Data	This allows for the change in data over the year, including schemes' valuations, recovery plans and employer credit ratings.
PPF	This allows for the changes in the PPF's funding level over the year. The funding level, allowing for schemes that are denoted as Type II contingent liabilities in the PPF's Annual Report and Accounts, has fallen from 114 per cent as at 31 March 2015 to 108 per cent as at 31 March 2016. For reference, the funding level excluding the Type II contingent liability schemes was 115 per cent at 31 March 2015 and 116 per cent as at 31 March 2016.
Universe	This is the effect of scheme funding changing over the year. The funding level of the universe has decreased from 84 per cent as at 31 March 2015 to 80 per cent as at 31 March 2016 (see footnote 2 in section 4 for further detail.)
Financial assumptions	This is the net effect of the various changes to financial assumption discussed in section 5 and changes in financial markets, both of which acted to improve the probability of success.
Interest rate modelling	The impact from changing the calibration models for nominal interest rates and inflation was material and has been separated from the other assumption changes to highlight this. The introduction of these models is in line with industry best practice and reduces the number of subjective assumptions required in modelling these financial variables. See section 5 for further detail.
Other assumptions	This includes improvements to the modelling.
Other	All other factors not accounted for above.
2016	This is the probability of success at 31 March 2016, which is 93 per cent.

Are we happy with a 93 per cent chance of success?

It should first be noted that the figure of 93 per cent is calculated on the assumption that no adjustment is made either 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 the PPF does not respond to changing circumstances.

The Board also has the power to restrict inflation-linked increases to compensation or to ask government to reduce the level of compensation payments. However, these actions would only be considered in exceptional circumstances.

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 converge towards 100 per cent by the funding horizon. However, to achieve such a level of comfort today we would need to charge a levy running into billions of pounds a year. This would not be in the best interest of levy payers, or indeed be possible under the limits set by legislation.

The Board regularly monitors the probability of success and the downside risk in quarterly updates of the modelling. 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 and a red rating indicates that it should almost certainly be planning to pull one of its strategic levers. The probability of success has been in the green zone throughout the past year.

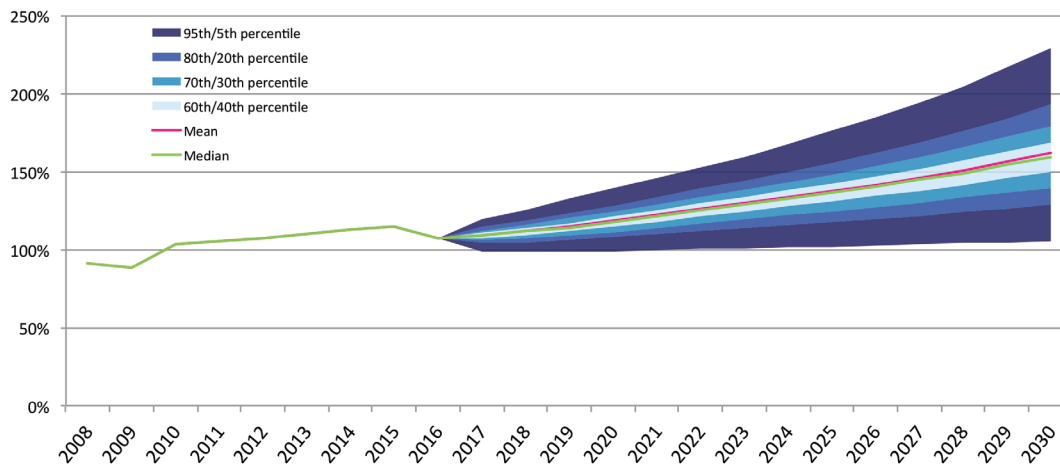
6: Modelling output - base case

Projections of our funding level

At 31 March 2016 our funding level stood at 116 per cent ignoring the Type II contingent liability schemes discussed in section 4. Being 116 per cent funded does not mean that we have achieved our funding objective of being self-sufficient, as self-sufficiency is measured at the funding horizon and there is a material chance that our funding level could decline before that time.

The following fan chart shows the history of our funding level as well as a projection beyond 2016. The starting point of the projection (31 March 2016) does include Type II contingent liability schemes, which has resulted in a decrease in funding level at this time (see explanation in table accompanying chart 6.1). As mentioned above, the assumption in our projections is that the PPF does not respond to changing circumstances and 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 to indexation or level of compensation. This is because the model is used to inform current strategy rather than predict future strategy.

Chart 6.2 History and projection of PPF's funding level

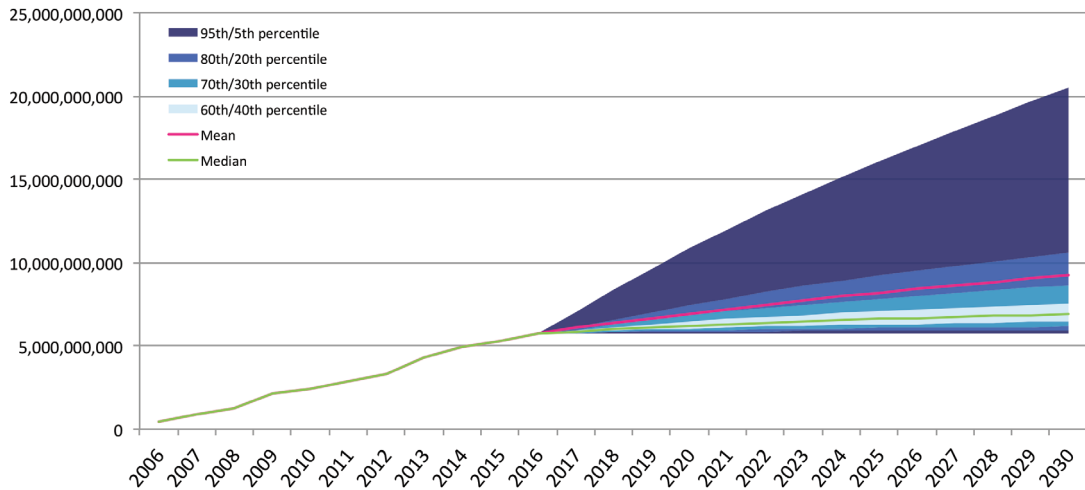


6: Modelling output - base case

Projections of claims

One of the main factors that could lead to a decline in funding is the level of claims being made on the PPF in future years, which is largely outside of our control. The following fan chart, taken from our base case, shows the cumulative deficit of schemes that make a claim on the PPF, measured at the point at which they enter the PPF. The chart includes claims already accumulated to 31 March 2016, but does not include allowance for schemes included in the Annual Report and Accounts as Type II contingent liabilities as these are not realised claims.

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



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 future claims experience of the PPF. It is therefore important to assess alternatives to these base case assumptions and test the robustness of the PPF's funding to adverse economic outcomes. To assess this, we have carried out various stress tests in which we adjust the assumptions from our base case to reflect different possible views of the future. We describe three such stress tests in section 8.

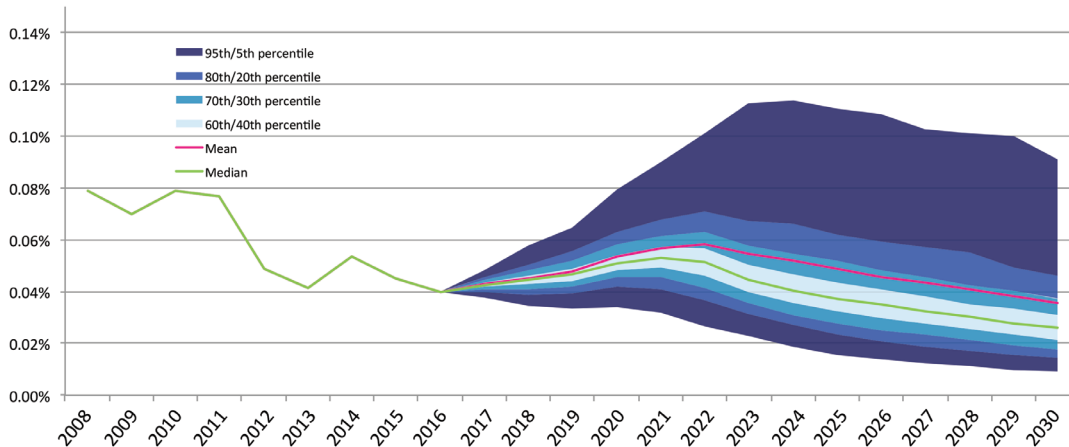
6: Modelling output - base case

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 and the strength of sponsoring employers. We would therefore expect that as schemes repair their funding deficits 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 2016, and how it is projected to change in future years.

Chart 6.4: History and projection of levy as proportion of scheme liabilities⁵



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

- in the long term, schemes repairing their deficits 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 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 the rise period.

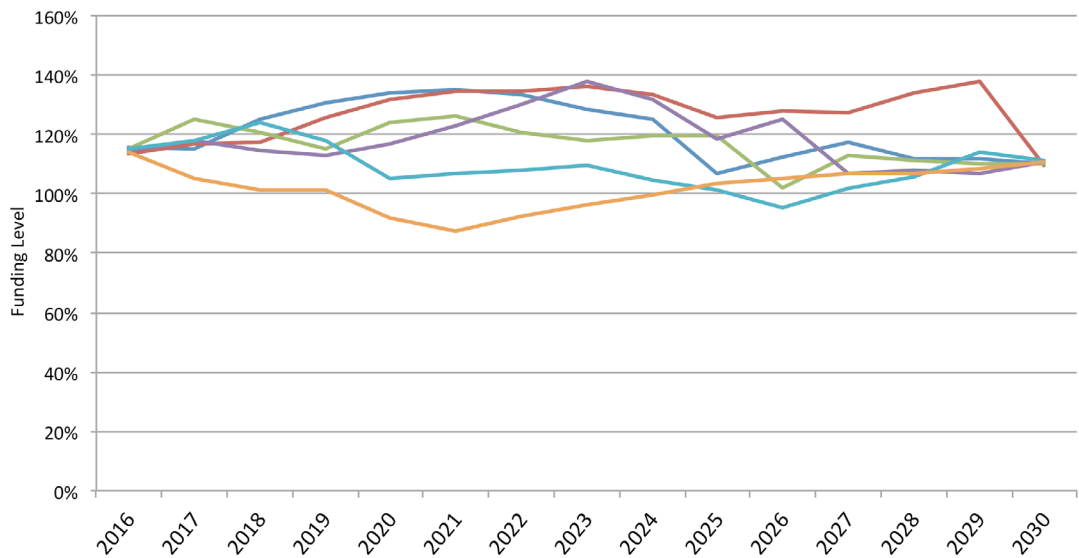
5. The historic levy as a proportion of scheme liabilities has been revised down this year as they are now based on the 7800 index as reported at the time rather than the reassessed past liabilities which were estimated in the Purple Book based on scheme data at the date of Purple publication.

6: Modelling output - base case

Pathways to achieving success

It is important to note that a strong funding position in the medium term is no guarantee that the funding objective will be met in the long term. Conversely, it is possible to recover from a poor funding position in the medium term, if conditions are favourable in the years immediately preceding the funding horizon. Indeed, our modelling illustrates that the path to the funding objective often contains highs and lows, rather than being a smooth trajectory. 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.

Chart 6.5: Example pathways to achieving our funding target



7: 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. These sensitivities are broadly unchanged from their 31 March 2015 levels as described in the July 2015 Funding Strategy document.

We have introduced a new sensitivity this year that shows how our probability of success might be impacted if a market in CPI-linked investments were to develop to allow us to buy assets that better match our liabilities.

We have also changed three of the sensitivities conducted last year. As part of our review of the sensitivities we conduct, we made the decision to revert back to exploring changes to funding levels. This allows schemes that are ordinarily over-funded to be pushed into an under-funded state by the sensitivity. Under the deficit-based approach adopted last year, over-funded schemes would simply have had their surplus halved and thus remained over-funded. We have therefore changed the sensitivity back to uniformly decrease funding levels by 10 per cent.

We have changed the sensitivity of a reduction in the gap between RPI and CPI from a reduction from 1.1 per cent to 0.4 per cent to one showing a reduction from 1.1 per cent to 0.5 per cent. This reflects the change to the assumptions used in the LTRM as detailed in section 5. The 1.1 per cent represents the best estimate of the difference between RPI and CPI whereas the 0.5 per cent (previously 0.4 per cent) is the market expectation of the difference between RPI and CPI.

We have also changed the sensitivity to explore increasing insolvency probabilities of employers. Rather than apply an arbitrary, uniform increase of 20 per cent to the insolvency probabilities for all credit ratings we have instead assumed that every employer has a credit rating one 'notch' lower. For example, a sponsor with a credit rating of A+ would be downgraded to A. Employers with the lowest credit rating are, however, assumed to retain this rating rather than undergo an immediate default. We feel that adopting this sensitivity provides a more satisfactory representation of the risks to which the PPF is exposed.

As described in section 6 there are two main strategic levers – our investment policy and our levy – that we could pull should any of these sensitivities become our base case. For example, in the scenario where we reduced expectation of asset returns by one per cent a year, with a six per cent reduction in our probability of success, one option available to the Board would be to adopt a more risky investment strategy to make up the lost (expected) returns. This would come at the cost of a higher downside risk.

As noted in section 6, the Board monitors the probability of success through 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 and a red rating indicates that it should almost certainly be planning to pull one of its strategic levers. In none of the sensitivity examples explored would the rating have fallen from the current green rating to an amber one.

The sensitivities described above only look at one risk factor in isolation. However, it is also important

7: Sensitivity of base case

Table 71: results of sensitivity tests

Assumption	Probability of meeting funding objective	Downside risk
Base case	93%	£2 bn
Initial PPF funding reduced by 10 percentage points	-5%	£+4 bn
Size of the PPF increases by 20% (assets and liabilities)	no change	no change
Reduction in asset returns of 1.0% pa (excluding cash and government bonds)	-6%	£+2 bn
Scheme funding levels reduce by 10%	-2%	£+2 bn
Recovery plans 5 years longer	-1%	£+1 bn
Scheme Technical Provisions reduced by 10% (relative to S179 basis)	-3%	£+1 bn
Sponsor credit rating falls by one rating notch	-2%	£+2 bn
PPF levies lower by 10%	-1%	no change
Schemes do not close to new accruals	-1%	no change
Longevity sensitivity (probability of death in any single year (qx) reduced by 20%)	-3%	£+3 bn
A market in CPI instruments emerges (after five years)	no change	no change
Assumed difference between best estimate RPI and CPI widens (1.1% to 1.5%)	+2%	no change
Assumed difference between best estimate RPI and CPI narrows (1.1% to 0.5%)	-3%	£+1 bn

In the table above 'no change' means that any change observed rounds to 0 per cent to the nearest per cent.

to consider the impact of multiple concurrent risks; the overall impact can be greater than the simple sum of the individual impacts. Also, certain risks may be correlated, for example a reduction in asset returns is likely to lead to a decrease in scheme funding levels. This may well occur as a result of a difficult economic environment, which could also lead to a higher rate of sponsor insolvencies. In order to assess the potential impact of probable combinations of different risks, we also perform scenario or stress testing, as described in section 8.

8: Scenario testing

This section considers how our results differ under three scenarios⁶.

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 at the same time. Such stress testing can also reveal how resilient the PPF is to different economic shocks.

For the July 2015 Funding Strategy document we adopted a system of scenario tests that help explore the possible outcomes should further evidence challenge our view as to the appropriate base case assumptions.

For this year's Funding Strategy we have adopted the same system, but somewhat different stress scenarios from last year. The scenarios we have chosen are intended to reflect potential events which, based on the current economic and political conditions, are plausible.

Modelling methodology

We describe below the three stresses we have looked at, one pessimistic scenario (labelled "Stagflation"), one optimistic scenario (labelled "Stronger near-term growth"), and one scenario consistent with that published by the Prudential Regulatory Authority (PRA) in 2015 as part of guidance for insurers under Solvency II (labelled "PRA anchor").

To model these scenarios, we apply a stress for a period and assess the impact on the PPF and the pensions universe. The stress period uses a single set of deterministic economic variables for each of the one million simulations run by the model. Once the stress period has elapsed, we then model the evolution of the PPF and pensions universe in the same way as our normal stochastic approach. We tailor the starting point of the post-stress projections to reflect the economic conditions produced at the end of the stressed period for each of the three stressed scenarios.

In line with the approach adopted last year we have used a modified version of the base case against which the stressed scenarios are compared. The modified base case uses median values of economic variables to give a deterministic five year period, representing a best estimate projection for that period, followed by a stochastic period to the funding horizon and thus comparable in length to those in the stressed scenarios. This is to ensure that the period over which volatility of variables is experienced is the same in the stressed scenarios as in the base case to which they are compared.

The Stagflation and PRA anchor scenarios are also further modified to add depth to the scenario. We 'overlay' the economic stresses of these scenarios with changes to our assumptions on companies' ability and willingness to contribute into their schemes. Due to the pressure on businesses in these scenarios we assume that companies will take five years longer to clear their deficits. For the Stronger near-term growth scenario we assume the repayment period remains unchanged.

Stagflation

The Stagflation scenario is based on the assumption that an unanticipated wage-price spiral develops in the U.S. and U.K. as they hit full employment and as the Organization of Petroleum Exporting Countries (OPEC) agrees to cut output pushing oil prices up sharply to around \$100 a barrel. Pressures on core consumer price inflation increase as the higher oil prices and wages push up production costs, prompting a number of central banks to tighten monetary policy. The Federal Reserve starts raising interest rates faster as inflation expectations deteriorate. The sudden monetary tightening sends the U.S. economy into recession. Similar happens in the U.K. Inflation moves above the Bank of England's 2 per cent target leading to a swift tightening of monetary policy there, also causing recession. Eventually inflation comes back to target in the U.S. and the U.K., allowing interest rates to be cut and resulting in strong growth in 2018 and 2019.

This scenario has been designed so that there is around a 10 per cent probability the economy will perform worse than this scenario.

6. Due to the timescales involved in producing results, the scenarios reported in this section were selected in December 2015. As a result of the uncertainty following the United Kingdom's decision to leave the European Union we will undertake further scenario testing as appropriate.

8: Scenario testing

PRA anchor

The Prudential Regulation Authority (“PRA”) requires insurers to conduct stress tests. In order to guide them in the calibration of these stress tests, it produces a scenario called the anchor scenario. Stress tests conducted by insurers should be similar in severity to this anchor scenario.

We have again decided to use the PRA anchor scenario as part of our stress testing. While there are differences between the stress testing the PPF conducts and that required of insurers (for example the PPF considers the impact of stress tests on its long-term funding position whereas insurers look at a shorter-term view), we believe this provides a useful benchmark for creating a stress which is very economically disruptive, but still plausible.

The 2015 PRA anchor scenario is based on disappointing global growth intensifying disinflation pressures in Europe which reignites sovereign debt concerns. Investors seek a safe haven in U.K. government debt, driving down yields, with sterling appreciating sharply. Trade and financial linkages combined with a global re-pricing of risk lead to a sharp fall in U.K. house prices and stock prices and have widespread negative impacts via the effect on confidence, leading the U.K. back into a deep recession.

Strong near-term growth

The U.K. economy receives a boost from stronger than expected demand after Chinese officials take aggressive steps to support the economy, restoring confidence and investor sentiment. In addition, easing of uncertainty over the Federal Reserve’s normalisation cycle reduces risk aversion in capital markets. Improved confidence lifts consumption and business investment spending with solid gains in U.K. stock prices further boosting business. Strong income and lower unemployment lead to improved credit quality and fewer bankruptcies. A steady decline in unemployment does, however, place some upward pressure on wages and domestic prices and the rate of CPI is higher than under the baseline.

This scenario has been designed so that there is around a 10 per cent probability the economy will perform better than this scenario.

Funding metrics

The following table gives the probability of success and downside risk under these three scenarios.

Table 8.1: result of stresses compared with base case

Assumption	Probability of meeting funding objective	Downside risk
Modified base case	93%	£2 bn
Stagflation	-1%	£+3 bn
PRA anchor	-4%	£+9 bn
Stronger near-term growth	no change	no change

8: Scenario testing

In the Stagflation scenario, the probability of success falls by one per cent. The relatively muted impact is due to modelling of a fairly quick and robust recovery removing any serious long-term impacts. In reality the impact could be worse than this – there could be further falls in funding at the beginning of the assessment period before we direct the insolvent schemes' investment strategies, and also realistically we would not be able to hedge all the liabilities at once but would need to phase this over time, exposing us to additional risks.

In the PRA anchor scenario, an extended, low interest rate environment leads to increasing liabilities of schemes in the universe. At the same time weakened asset returns reduce the level of assets the schemes hold. The combined impact is to give markedly poorer funding levels. The scenario also models higher insolvency rates. The combined impact is for both the number and size of claims to increase in the PRA anchor scenario. The resultant reduction in probability of success of four per cent could have been even worse were the starting point not one already exhibiting historically low interest rates leaving little room for further falls.

The optimistic, Stronger near-term growth scenario has a marginally higher probability of success than our (modified) base case (this has been rounded down to no impact in table 8.1 above). As the Board has a balance to strike between the interests of levy payers and security for members the purpose of investigating such scenarios is to test the circumstances in which the PPF runs upside risk, for example the risk of building up excessive surplus. If such a situation were to occur the Board may need to consider whether any action was required to reduce this upside risk, for example moving to a risk-free investment strategy sooner than currently anticipated. In the particular scenario modelled here there was very little change from our base case and so it would be unlikely for the Board to consider it necessary to move from its current strategy.

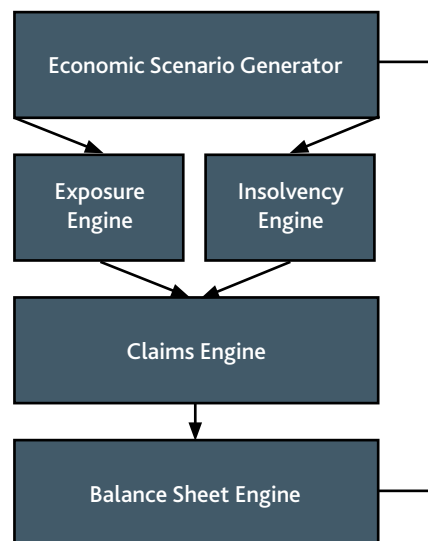
While we have discussed three stress tests in this document, it should not be inferred that we believe these scenarios are particularly likely to occur. Nor have we based any strategic decisions on these outputs. They serve as a comfort check on the robustness of our funding strategy.

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 or S+ as appropriate. Each engine covers a different feature of the calculations and are linked together in mimicry of 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 up from its constituent parts.



Economic Scenario Generator

The projection process begins in the Economic Scenario Generator with the production of two thousand economic scenarios. Each scenario is a set of projected paths for asset prices, interest rates, bond yields and inflation rates. These are obtained from an Economic Scenario Generator (ESG) provided by an external provider, Barrie & Hibbert, and adapted for use by the PPF.

Insolvency Engine

Insolvencies are modelled in the Insolvency Engine by assigning a credit rating to each company (as detailed in section 5) and using transition probabilities to model credit ratings changing over time. We have five hundred scenarios for credit risk, with the transition rates varying in each. Each such scenario is mapped to each of the economic scenarios providing one 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' PPF liabilities move in response to changes in nominal and real interest rates. We model benefits paid out to pensioners, and an allowance is made for accruals of new benefits (where appropriate) and contributions both from employees and the sponsor.

A1: Further detail on modelling

Claims Engine

The output of the Insolvency Engine and Exposure Engine feed through into the Claims Engine which produces the distribution of claims on the Fund and projected levy from eligible schemes. A scheme is deemed to make a claim on the Fund where an insolvency event occurs and the scheme's liabilities, assessed on a S179 basis, are less than its assets. The size of the claim is then determined using the PPF's internal funding basis to calculate the value of the transferring liabilities.

Balance Sheet Engine

The aggregate deficits then feed through into the Balance Sheet engine which projects the returns on the PPF's investments and investment hedge, and models levy collections, PPF expenses and the payment of PPF compensation. The result is a distribution of PPF balance sheet outcomes over a chosen projection period that takes account of all primary funding risks.

It is this last engine from which our key risk metrics – the probability of success and the downside risk – are derived. The former is the proportion of the one million scenarios that lead to a PPF funding level of 110 per cent (i.e. 100 per cent funded with an additional margin for uncertainties after the funding horizon, currently equal to 10 per cent of liabilities) or more at the funding horizon, currently 2030. The downside risk is the greatest deficit which is experienced at any time point within the period to the funding horizon measured at the 10th percentile of all scenarios.

2. PPF Characteristics

Our funding horizon of 2030 rests on, among other factors, assumptions about the rate of scheme closure and the strength of recovery plans. Other things being equal, the slower the rate of scheme closure or the lower the deficit contributions, the later our funding horizon should be.

Initial PPF liabilities are calculated according to the PPF valuation basis. For a description of this basis, see the PPF Annual Report and Accounts 2015/16 published in July 2016. As described in section 5 of this appendix, we include on our starting balance sheet (for long-term funding purposes) those schemes which we consider virtually certain to enter an assessment period in the near future.

As described in section 5 of the main document, we now make the assumption that a market in CPI-linked investments will not develop in the foreseeable future. Our best estimate is that the rate of CPI will settle at around 1.1 percentage points a year lower than the rate of RPI.

The PPF investment allocation is modelled as set out in the Statement of Investment Principles. We make no adjustment for any de-risking that might be expected in practice. As a result of our new SIP including an allocation in long-term, illiquid assets with hedging properties ('HAIL' assets), we can no longer assume that when we reach our funding horizon we will have a completely matched investment strategy with no expectation that we will outperform our liability benchmark. As detailed in section 3 inclusion of this investment decision in our funding margin is something that is likely to be developed in the future.

Schemes' PPF levy payments are modelled taking into account the main features of the second New Levy Framework. For this purpose we assume that the failure score used to calculate a scheme's levy rate will evolve in a manner consistent with the evolution of the sponsor's credit rating as described in section 5 of this appendix.

A1: Further detail on modelling

3. Economics and investment returns

The Economic Scenario Generator 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 Barrie & Hibbert) 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 indeed Barrie & Hibbert are keen to stress that the standard calibration of their tool is not the most appropriate for all purposes.

The following table shows the adjustments the Board makes.

Assumption	Adjustment
Scenarios of Consumer Prices Indexation	<p>We take our scenarios of RPI inflation from the standard Moody's calibration. However, we construct our own scenarios for CPI inflation, based on the projections of property returns, interest rates and RPI.</p> <p>We construct scenarios for the real yield on CPI-linked investments by making adjustments to the RPI-linked real yield taken from the standard Barrie & Hibbert calibration.</p> <p>The adjustment is based on the current and assumed long-term gap between RPI and CPI.</p>
Alternative assets	<p>We derive our own projections for hedge funds, commodities, private equity, unlisted infrastructure and for assets that fall under the 'HAIL' category. 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).</p>

The interest rate projections are calibrated to bond yields observed in the market at the start of the projection. We use standard stochastic models for interest rates – the extended 2-Factor Black-Karasinski model for nominal interest rates, and the 2-Factor Vasicek model for real interest rates.

Both of these models assume mean reversion. In other words, while there is a random movement in interest rates over time and across the 2,000 scenarios, the assumption is that there is a tendency for the rates to move in the direction of a long-term average value. This is to be contrasted with our asset modelling, where we do not assume that markets revert to a long-term average.

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. Every year the CPI model is updated to reflect recent developments in the key drivers of the inflation wedge. This year our annual review of the CPI model resulted in our making some structural changes to its specification. Most notably, we found that historic levels of RPI were significant predictors of the RPI-CPI wedge (something that had been precluded from the previous specification of the model). As a result of this change, the new model performs better under diagnostic testing and also gives rise to CPI forecasts that more closely track RPI. In order to better reflect the PPF's view that the long-term RPI-CPI wedge is 1.1 per cent, we continue to calibrate the CPI model in such a way that ensures that for each model run the average forecast inflation wedge hits this target.

The volume of insolvencies is assumed to exhibit a degree of correlation with equity market conditions. When equity markets deteriorate, sponsor insolvency rates generally move upward, and vice versa. So scheme deficits will tend to rise at the same time as the rate of insolvency. Increasing the correlation between equity returns and credit risk substantially increases the risk of very large claims.

A1: Further detail on modelling

4. Scheme and sponsor characteristics

For the purposes of modelling, initial funding is taken for each scheme as its average between 1 April 2015 and 31 March 2016. We use a smoothed funding level to reduce the volatility of the funding metrics as reported each quarter. Since this might mask the true risk following a sharp rise or drop in funding, we also check that the figure does not deviate too far from an unsmoothed measure.

Schemes' contributions are determined by their recovery plans which target full funding on a statutory funding basis over a period of (currently) around nine years on average. We take this information from The Pensions Regulator based upon the most recently submitted funding plans. On average the statutory funding basis results in higher liabilities than the scheme's PPF liabilities – currently around five per cent higher – largely because PPF compensation is provided at a lower level than full scheme benefits.

We assume that schemes' current funding plans will weaken at the next valuation, as has been the trend in recent years, but will then remain in place over the longer term, with any new emerging deficit being re-spread. This means that in a scenario without any significant adverse experience, deficits are entirely removed before our funding horizon, with half of schemes completing their recovery plans within a decade.

Recent years have shown an increasing trend in schemes looking to secure their liabilities with an insurer. We have amended our modelling to reflect this through two changes. The first amendment is that schemes are assumed to buy out if their funding level (measured on a S179 basis) reaches 140 per cent. Such schemes are removed from the universe.

The second is that sponsors with a strong covenant are assumed to continue making contributions to their schemes even when their technical provisions are fully funded. The assumption here is that such sponsors will actively seek to fund towards buying out the scheme's liabilities. It is the schemes with the highest starting credit rating (rating Aa in our model) that are deemed to have sponsors with covenants of sufficient strength to actively target buying out the liabilities, and this represents around 12 per cent of our universe.

Schemes are assumed to reduce the risk associated with their investment strategies over time. The proportion of scheme assets assumed to be invested in long-maturity bonds gradually rises from an initial level of about 50 per cent to around 80 per cent in the long term.

As at the effective date of the most recent Purple Book, 31 March 2015, only 13 per cent of schemes were open to new members, down from 43 per cent in 2006. Our base case assumption is that schemes close to new accruals of benefit over the next decade which, for simplicity of modelling, we treat as sudden closure in five years' time. This is not a particularly significant simplification in our view as demonstrated in section 7.

The rate of active member withdrawal is set at a constant five per cent a year. This is a simplification of reality in which members closer to retirement typically withdraw from service at a lower rate. We assume (for schemes currently open to new accrual) that there is a constant age profile over time. We also assume that on closure 20 per cent of liabilities in respect of active members at the time of closure retain a link to salary.

We assume that no new DB schemes are set up that are eligible for PPF protection.

A1: Further detail on modelling

5. Sponsor solvency

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. We model credit ratings as changing over time, the probabilities of transition being provided by Moody's and reviewed within the PPF.

In line with our accounting practices an allowance (contingent liability) has been made in the PPF's Annual Report and Accounts for potential claims in the near future from a number of schemes. To ensure consistency with the Annual Report and Accounts we have also made an allowance for these Type II contingent liabilities as at 31 March 2016 for the assessment of the long-term funding strategy position. Whereas the Annual Report and Accounts includes a contingent liability allowance, for the purposes of our modelling we model this by the inclusion of the schemes' liabilities and assets in our starting position. The inclusion of this allowance does not, however, mean that the PPF believes a claim from these schemes is a certainty.

In addition, for schemes that we do consider to be virtually certain to enter the PPF in the very near future but have not yet experienced an insolvency event we bring them onto the PPF balance sheet with immediate effect, even where allowance may not have been made for these schemes in the Annual Report and Accounts, which is more of a snapshot. For the modelling carried out as at 31 March 2016, the results of which are presented in this document, we have allowed for the insolvency of a few schemes for whom insolvency has now occurred post 31 March 2016 as well as some other schemes where there is yet to be an insolvency event at the time of writing.

6. Assurance and future development

Our internal model is subject to continual refinement and audit. KPMG carried out a review of the model in 2015 based upon the information that we provided to them. The conclusion was that the model is fit for purpose although there were various developments and improvements recommended. We have subsequently implemented these or plan to do so over the coming year.

There is a committee within the PPF that 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 in order to continually refine the model's capabilities and ensure it remains up-to-date for changes both within the PPF and in the wider pensions universe. As detailed in section 5 of the main report, over the past year, a change has been made to the methodology employed to model nominal interest rates and inflation within the ESG. This is the only change to the model that represent a major departure from previous practice and has had a material impact on the results, as detailed in section 6 of the main report.

