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Modelling uncertainty: an introduction to the PPF Long Term Risk Model

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Foreword

This is the first information paper to be published by the Board of the Pension Protection Fund, and is aimed at helping inform readers about the PPF long term risk model. The Board sees setting out its approach to assessing long term risks as part and parcel of the openness that it aims to display about the way the levy reflects the risks which schemes are running.

The long term risk model is the key tool that the Board uses to understand and quantify the risks facing the Pension Protection Fund in the future, and thereby to help assess the level of resources that are required to meet future potential liabilities. As such it is an important input to the Board's decision making about the level at which the pension protection levy is set, but it is no magic bullet – the Board still needs to exercise judgement about assumptions that feed into the model, the level of risk that it can accept, and the means by which costs are distributed between eligible schemes.

The Board itself has been involved with developing the model, and has also sought external input – through for example obtaining views from KPMG on the robustness of the model. And whilst it uses some externally generated components, it is a bespoke system because the PPF faces risks that are unique in that it has to assess three uncertainties: insolvency events and levels of scheme funding and the interaction between the two all in the context of a range of economic factors and other changes to the pensions landscape.

There are, of course, limits on how far the Board can proceed in opening the long-term risk model to external scrutiny. Key elements of the model were supplied to us by external contractors, themselves well respected in their fields, and those elements are therefore proprietary information. And the model makes extensive use of material provided by pension schemes, which needs to be kept confidential.

In any case, it is our belief that the industry is probably less interested in seeing a "wiring diagram" of the model, than in understanding how it works in principle, understanding some of the key assumptions that have had to be made for it to function and the sensitivity of the risks that the PPF faces to changes in conditions in the sector. These issues are, therefore, the focus of this paper.

I hope that, when read in combination with existing and forthcoming consultation papers on the risk based levy, this paper will contribute to a better understanding of how risks facing the industry – and the PPF – may evolve over time, and how the PPF will look to manage those risks. I would be interested to hear views from stakeholders on the work we have done and on this paper.

Partha Dasgupta, Chief Executive
Board of the Pension Protection Fund

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Chapter 1

Introduction

Chapter 1 – Introduction

1.1 Introduction

1.1.1 Employees join occupational defined benefit pension schemes expecting that they will receive the pension that they have been promised. This promise is realised if there are sufficient scheme assets to meet pension liabilities as they fall due, or the sponsoring employer is able to make good any shortfall. In the great majority of cases members receive the pension they have been promised.

1.1.2 However, if an employer becomes insolvent there are sometimes insufficient funds in the pension scheme to meet the liabilities in full. In some cases employees have contributed to a pension scheme for their entire working life, only to discover that when the scheme wound up in the immediate run-up to their retirement, they received a much lower pension than they expected. This has led to hardship and to reduced confidence in occupational pension schemes.

1.1.3 The Pension Protection Fund has been established to pay compensation to members of occupational defined benefit pension schemes, following sponsoring employer insolvency, where there are insufficient assets to pay the Pension Protection Fund level of compensation. In order to be able to fund payments to the pensioners it is seeking to protect, the Pension Protection Fund must raise sufficient funds from a combination of the assets transferred from schemes for which the Pension Protection Fund has assumed responsibility, an annual levy raised from eligible pension schemes and investment returns on assets held by the Fund. For a fuller explanation of the role of the PPF, including the conditions under which schemes are eligible for protection by the PPF, and the design of the pension protection levy, see the 2007/08 Pension Protection Levy Consultation Document.

1.1.4 It follows that a central task for the Board of the Pension Protection Fund is to form a judgement on the level of liabilities that the Fund may have to meet in the future, and then to set a levy consistent with financing those liabilities.

1.1.5 In principle, the Board could look simply at the liabilities it already has and those that are likely to transfer to it over the course of the following year.[1] However, this would result in a levy with the potential to vary significantly from year to year, and would be out of keeping with the approach to pension provision adopted by individual pension schemes in the UK which emphasises prudence. Accordingly the Board has sought to develop information about

[1] This, in essence, is the approach taken by one of the PPF's overseas comparators – Germany's PSVaG – reflecting the rather different nature of occupational pension provision in that country and their approach to securing benefits. PSVaG's annual charge reflects the cost of buying annuities for pensioners in schemes newly requiring protection and for those reaching retirement age that year from previous claims. Their experience over the last 30 years has been that costs can vary dramatically – by as much as a factor of 20 between good and bad years – and even this may not capture the full potential variability if there were a particularly bad year.

potential risks over a multi-year period, and to set a levy related to those. The key tool it uses to inform this judgement is the Long Term Risk Model (LTRM).

1.2 Purpose of this paper

1.2.1 This paper is designed to provide readers with an introduction to the thinking that lies behind the model and how it operates. It also aims to provide some insights on trends that may potentially affect the future level of risk faced by the Pension Protection Fund.

1.2.2 Key aims for the Board include providing stability and certainty in relation to the levy, and an understanding of the factors that influence the long term risk model should help to inform readers about the drivers of risk in the sector and their potential impact on future levies.

1.2.3 The paper also recognises that any model, including the PPF's LTRM, is a work in progress. Therefore, the Board would be pleased to receive comments that may help inform development of the model over the coming years. In particular, Chapters 6 & 7 set out a number of issues that the Board is considering and on which it would be grateful for stakeholders' thoughts.

1.3 Links with other Pension Protection Fund publications

1.3.1 As noted above, the long term risk model is a key tool for the Board in setting the overall size of the pension protection levy. The Board therefore sees publishing this paper as contributing to a fuller understanding of the Board's levy setting process, particularly when read in conjunction with the consultation papers that set out:

- how the levy is to be distributed between schemes;
- and what the overall quantum of the levy for a particular year should be.

1.3.2 The first of these issues was covered in respect of the 2007/08 levy year in The Pension Protection Levy Consultation Document (published in September 2006)[2]. A consultation document setting out how it is proposed to distribute the levy for the 2008/09 levy year will be published later in the summer.

1.3.3 The second was covered in the Levy Estimate Consultation Document, published for the 2007/08 levy year in December 2006[3] and the statement on the final levy scaling factor[4]. The consultation document set out developments in the Board's assessment of the risks to the Pension Protection Fund, which together with other factors, underpined the Board's calculation of the levy

[2] Link to The 2007/08 Pension Protection Levy Consultation Document
[3] Link to The 2007/08 Pension Protection Levy Estimate Consultation Document
[4] Link to Pension Protection Levy 2007/08 - Levy Scaling Factor

estimate for the following year, and the statement recorded on the levy scaling factor calculated in accordance with the process set out in the consultation document.

1.3.4 As will be clear from consultation documents on the levy estimate, the degree of risk of future claims is a significant consideration in setting the overall level of income needed to ensure that the Fund can meet its obligations going forwards. So that, whilst the levy charged to an individual scheme is determined by short term insolvency and underfunding risks, these are scaled up or down to reflect aggregate long term risk.

1.3.5 In addition to these consultation documents the Board, together with the Pensions Regulator, published in December 2006 an analysis of the information contained in pension schemes' annual returns, entitled the Pensions Universe Risk Profile (the Purple Book). This includes a detailed description of the data set underlying the study (pages 14-17). The model uses data from the same sources but its different requirements mean that a somewhat larger data set of around 6,400 schemes was used (rather than Purple's 5,800). This represents around 80% of schemes and around 90% of all scheme liabilities. The data set used was the most comprehensive on the DB pensions universe to date, representing a step change in the available information on the DB universe. As information on more schemes becomes available, the model will use it.

1.4 Structure of this Paper

1.4.1 This paper sets out in chapter 2 the nature of the uncertainty that the Pension Protection Fund faces over the future level of liabilities the fund will need to meet. It shows that the Fund faces a particular challenge because of the interaction of uncertainty over the volume of liabilities taken on and over the extent to which these are matched by assets, which gives rise to a very wide range of potential levels of claim. In particular, in poor economic conditions there is a greater likelihood both of employers failing and of scheme assets proving insufficient to meet liabilities (due to lower equity asset prices). The paper will then set out what the Board considers is the best way to approach modelling this - a stochastic approach.

1.4.2 Chapter 3 provides an overview of the development of the model and its functioning. The chapter concludes by setting out how the Board uses the outputs of the model – as an input to its decision on the levy quantum and for other purposes.

1.4.3 The remaining chapters provide further information on the model, focussing on the key issues addressed. Chapter 4 looks specifically at the uncertainties involved in modelling the future course of employer insolvency. It begins by showing how it is expected that credit ratings, used as a proxy for insolvency probability, are expected to change over time. It then considers how this modelled approach needs to be adjusted to take account of the huge variety of economic conditions that may occur over time.

1.4.4 Chapter 5 then proceeds to consider how economic conditions impact upon scheme funding levels. Following an explanation of how the model handles demographic factors and projects assets and liabilities, the chapter will look at some of the other key factors to take into account. These include the impact of contingent assets, deficit reduction contributions, and recovery plans. It concludes by looking at how to take account of the uncertainties around the PPF's own funding position – reflecting that the PPF will have its own assets and liabilities whose value may fluctuate.

1.4.5 Chapter 6 then considers the sensitivity of the risks faced by the PPF to a range of factors. This draws out the significant impact that changes, for example scheme closure rates or other changes, may have on the overall level of risk in the DB sector.

1.4.6 Chapter 7 considers possibilities for the future development and use of the model.

1.4.7 Chapter 8 summarises the data that underlies the model – drawn principally from the Pensions Regulator's scheme return.

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Chapter 2

Long term risk and how the PPF has sought to address it

Chapter 2 – Long term risk and how the PPF has sought to address it

This chapter provides a high level overview of the Pension Protection Fund's long term risk model and its constituent parts.

2.1 Introduction: the challenge facing the Pension Protection Fund

2.1.1 A traditional approach to forecasting future demands on the Pension Protection Fund would be to use information about past experience of employer insolvency and the degree of underfunding in schemes to produce a single point estimate of future claims, with better and worse case estimates alongside the central case. The Board considered that this approach was unlikely to offer a satisfactory degree of assurance about the range of possible future events given the particular risks facing the Pension Protection Fund.

2.1.2 In particular, employer insolvencies are relatively rare events, but can have a very high individual impact. Looking at historical evidence, especially over a limited period, is unlikely to provide a full picture of the potential variability of claims on the PPF. Each year there will be a number of insolvencies affecting smaller and medium sized schemes – that number may rise or fall – perhaps in response to economic conditions. And each year there may be one – several – or no insolvencies affecting larger schemes. In its assessment of the risks facing the PPF, the PURPLE book showed that a large proportion of the total risk exposure currently rested with large schemes with low probabilities of insolvency[5].

2.1.3 And the impact of an employer becoming insolvent upon the PPF will depend not simply on the size of the employer, or of its pension scheme, but on a range of factors. Most obviously, it will depend on how well funded the pension scheme is (which in itself is likely to vary over time depending on factors such as the state of financial markets and changes in mortality) but also on any contingent assets the scheme has, and on the extent to which the scheme's trustees and the PPF are able to recover assets following the employer's insolvency – using rights in section 75 of the Pensions Act 1995.

2.1.4 The inter-relationship between the two factors of insolvency and underfunding, presents the PPF with what is a difficult challenge to model, and one that is unique in a UK context, since the two factors cannot simply be considered separately. For example, there is a significant likelihood that a future period of higher insolvency rates might be linked to a fall in pension scheme funding levels, but no certainty that this would be the case or about the extent of such

[5] The Purple Book, pages 81-83

a linkage, which might depend significantly on the causes of any change in insolvency rates. A generalised economic downturn might cause a rise in insolvencies combined with a fall in pension scheme funding levels, whilst a sector specific shock might trigger a rise in insolvencies whilst having little if any impact on scheme funding.

2.1.5 It is also worth noting that the PPF does not currently have the reserves of capital that typically an insurer might have to protect it from unusually high claims. In principle, this could render the PPF more vulnerable to poor years early in its existence, though against this must be balanced the capacity of the PPF to repair its balance sheet if it did experience difficult conditions – as its liabilities fall due over many years and a deficit could be recovered retrospectively. A deficit might be recovered simply through the passage of time, if claims experience reverted to expected levels. Alternatively the Board could take a range of actions aimed at improving funding – increasing the levy, reducing indexation or (with agreement from Government) redefining compensation levels, or by retaining the existing asset mix of schemes entering the PPF when asset prices/interest rates are depressed rather than quickly de-risking them

2.2 Why a stochastic approach?

2.2.1 With such an uncertain risk, the Board required an analysis that could illustrate the full range of risk the Fund faces and indicate how likely different – particularly adverse - outcomes were. To achieve this it turned to the computer based technology of stochastic modelling, a set of techniques increasingly used in the financial world and elsewhere. A stochastic analysis, also known as a Mote Carlo simulation, uses a random number generator, combined with statistical modelling to simulate the financial impact of numerous different possible economic environments.

2.2.2 This, the Board considers, will provide it with a more solid basis for determining how much allowance needs to be made for potential adverse scenarios when setting the levy. However it needs to be appreciated that no model can entirely eliminate the possibility of unexpected events: either because, in modelling risks, assumptions about underlying relationships are inaccurate or, even if the assumptions are accurate, a highly unlikely outcome occurs.

2.2.3 A comparator for the problem the PPF faces comes from the world of insurance – and in particular those insurance markets that cover catastrophic loss such as that caused by major floods, earthquakes or hurricanes. Hurricane Katrina for example, caused claims at many times the usual level for the US Gulf coast. To assess potential claims for hurricane insurance, weather models can be constructed that will simulate a very large number of hurricane seasons. Rather than seeking to predict how many or how damaging hurricanes may be in a particular year, computer based models will estimate the probability of storms and damage of different severities. The result is a probability distribution which can show both what happens in an

"average" year, and how likely more extreme events are. This is what lies behind claims that a particular storm was a "once in hundred years storm" - rather than the existence of reliable information on severity stretching back hundreds of years.

2.2.4 There are of course differences between insurance and the situation the PPF faces - typically insurers are able to segment risk and share it through re-insurance – and insurance is not generally compulsory (on either party). By comparison the PPF cannot choose which defined benefit pension schemes to cover, and neither can schemes decline to be protected, or to pay for that protection. Another difference is that the liabilities that the PPF will need to meet as a result of a "claim" are rather different, since these will be pensions falling due over many years rather than being a single large claim at a point in time. These differences are taken account of, in part in the way that the PPF has designed its particular model, and in part in the considerations the Board weighs alongside the outputs of the model. (e.g. considering issues such as affordability of the levy). But the board believes that a similar analytical approach will, in principle, work well for the PPF.

2.2.5 Amongst the PPF's overseas comparators, America's Pension Benefit Guaranty Corporation (PBGC)[6] is the body that has perhaps the most similar risks, and has also chosen to use stochastic modelling to assess them. The PBGC's requirements are rather different from the PPF's – in particular premiums are set by Congress so their model is primarily intended to illustrate risk rather than determine funding requirements. Their model differs from the PPF's in taking no account of smaller schemes – and in using an in-house model of insolvency probability – rather than market based information on credit ratings. It also requires information on schemes that is not currently collected on UK DB schemes. But overall the approach is similar.

2.3 What is involved in a stochastic analysis

2.3.1 At the heart of a stochastic analysis of risks to the PPF is the requirement to generate a very large set of different possible states of the world – to take account of the range of economic and insolvency risks that could affect the schemes the PPF protects. For each set of economic and credit risks the potential impact is assessed. Combining these analyses into a distribution of impacts provides a more holistic picture of the expected level of costs and the potential variability in costs than a single estimate could.

[6] The PBGC's website at http://www.pbgc.gov/ carries extensive information on their role and the risks they cover. For an explanation of their modelling approach see http://www.pbgc.gov/docs/1998databook.pdf.

2.3.2 The first step is the creation of a large number of economic scenarios - potential economic futures - over a number of years[7]. This allows consideration of what may happen to the schemes the PPF protects and to the PPF's own investments under a wide range of possible future economic conditions – ranging from continued dynamic economic markets to deep recession and many intermediate situations involving some "good" and some less "good" periods.

2.3.3 Then for each economic scenario the model considers which employers might become insolvent. Of course, the financial health of the employers linked to pension schemes depends not just on the state of the economy, but on factors connected to the individual business – including the quality of management of that business. This clearly cannot be predicted, and so statistical modelling is again employed.

2.3.4 The model then assesses the implications for the PPF of each insolvency (reflecting a range of factors including how well funded the pension scheme is at that point in that particular scenario) and along side that what might be expected to have happened to the PPF's existing assets and liabilities. Combining the results of this analysis for all the different runs for all the economic scenarios creates the probability distribution of claims on the PPF.

2.3.5 Of course, whilst such a model can suggest how likely different outcomes are, it is a matter for the Board to decide what its response to that is – how much of a risk of claims exceeding PPF resources is acceptable for example.

[7] In principle the PPF can produce scenarios over 30 or more years, though in practice it is most useful to model claims and the balance sheet for time horizons of 5-10 years (note: this implies assessing the present value of liabilities over many years more than that, since the balance sheet in 5 years time will be consist of assets and liabilities with cash flows over many years). This is because the inevitable uncertainties in the model come to dominate the outcomes over a very extended time horizon.

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Chapter 3

Overview of the long term risk model

Chapter 3: Overview of the long term risk model

This chapter provides an overview of the development of the model, its functioning, and the type of outputs it can generate. It also indicates how the Board uses the outputs of the model as an input to its decision on the level of resources that need to be raised through the levy and for other purposes

3.1 Introduction: The development of the model

3.1.1 The model has been subject to a continuing process of development over the last two years, and further work is under way to refine it. Inevitably, with a project such as this, development is incremental, and the PPF would be interested to hear the ideas of stakeholders on ways in which the model could be refined.

3.1.2 The model's design both reflects the information that the PPF receives on pension schemes and associated employers, and the limitations of that information – limitations which reflect the intention of the Board not to place excessive burdens on schemes. As a result of those limitations, the model has needed to make assumptions about a range of factors. Key assumptions that have been made, and the thinking that lies behind them are explored in chapters 4 to 6. The Board's view is that the assumptions used are reasonable at a macro level and that it would be disproportionate to seek more detailed information to allow for more precise analysis at the moment.

3.1.3 The model also reflects the Board's desire to develop a sophisticated tool - on which it can rely when making judgements that have real impacts on schemes' levies – without introducing unnecessary complexity. This balance is a common feature of any modelling exercise – since any model is a simplification of reality. For this reason, the model uses a range of techniques that aim to reduce the complexity of the processing task, where the benefit in terms of simplicity clearly outweighs the cost in reduced accuracy. A prime example of this is the modelling of only the 479 largest schemes directly, with a grouped approach for smaller schemes – which represent around a quarter of liabilities – this reduces some of the processing tasks of the model by a factor of 10 or more whilst only reducing accuracy by around two or three per cent.

3.1.4 It is worth noting that the model is not currently used to allocate the proportion of the overall levy that each scheme pays, but rather to decide the overall sum that needs to be raised. Indeed, as the model only individually models the long term risk of just over one in twenty schemes (though representing three quarters of liabilities) it cannot be used for such a purpose. The allocation of the levy between schemes is dealt with, for 2007/08 in the 2007/08 Pension Protection Levy Consultation Document published in September 2006 and for 2008/09 in a consultation document being published shortly. This considers

ways in which there may be greater alignment between long term risk and the distribution of the levy.

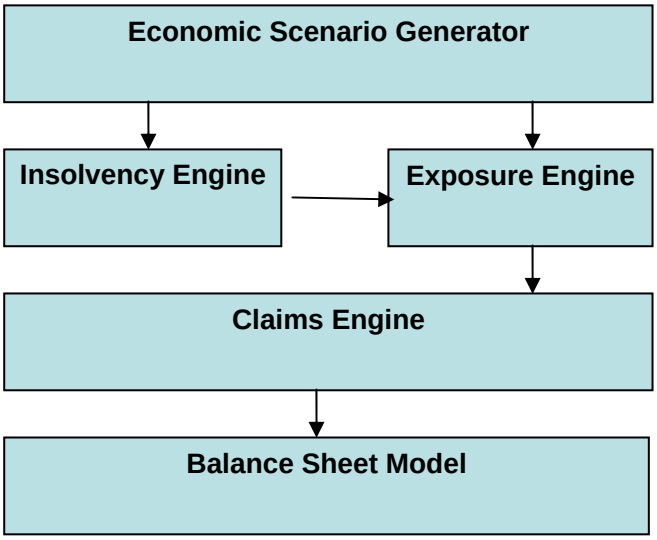
3.2 The design of the model

3.2.1 The long term risk model developed by the Pension Protection Fund forecasts its future claims and projects the future assets and liabilities of the Fund. By projecting its balance sheet, the Board is able to consider the inter-relationships of investment and levy strategies on the future funding ratio of the Fund.

3.2.2 Whilst, as explained in chapter 2 the PPF's risks are unique, and the data needed to populate the model is only available as a result of data collection by PPF and TPR, the techniques needed for modelling are more standard. As a result, it has been possible to develop the PPF's model partly through work by the PPF's own modellers and partly by buying in programming or expertise from external providers.

3.2.3 Figure 1 shows how the model components are combined to generate a statistical distribution of future claims and of future assets and liabilities.

Figure 1: Components of the long-term risk model



In summary, the economic scenario generator produces the economic scenarios on which the model depends, the Insolvency Engine then determines the probability of companies becoming insolvent, the Exposure Engine assesses the deficits in the event of insolvency, the Claims Engine then calculates the claim based on the pattern of insolvency and underfunding and the balance sheet model brings this together with the PPFs assets and liabilities to assess the extent of the PPF's surplus / deficit. The remainder of

the chapter explains the functioning of the model, taking the role of each component in turn.

Economic scenarios

3.2.4 At the heart of a stochastic analysis is the requirement to generate a large set of economic scenarios over a number of years. To do this the PPF has turned to Barrie and Hibbert, whose Economic Scenario Generator (ESG) is widely used by financial institutions carrying out stochastic analyses[8].

3.2.5 The ESG is an asset price based model –and is used by the PPF to project forward the returns on key asset classes and other variables, required for the other stages of the analysis (such as long term nominal and real bond yields) rather than modelling economic growth and inflation directly[9]. It produces a large number of stochastic scenarios of economic and financial variables (real and nominal interest rates, and equity returns) and insolvency risk factors[10].

3.2.6 The ESG creates these different possible scenarios from using past experience about how individual economic variables (such as share prices and interest rates) have varied[11].. Each variable will have its own pattern of returns that will need modelling: in the same way that if one tosses a coin a hundred times, it could come down heads every time, or tails every time, but one might more commonly see results with broadly equal numbers of heads and tails, the variables in the model will vary over a range – but typically more often towards the centre of that range.[12] Bringing the different variables together creates a scenario – with many of the outcomes toward the middle but spreading out to some more "extreme" scenarios. Whilst only one of these possible futures will actually occur, and it is impossible to know which, the model has the effect of generating a distribution with probabilities of different outcomes based on past experience.

3.2.7 Barrie and Hibbert's design of the economic scenario generator allows it to be used with their own calibration of parameters or using an alternative best estimate approach, or a combination of the two. This allows users to take their own view on future looking distributions, or to calibrate the model for a purpose not covered by a standard B&H calibration. Last year the PPF adjusted a number of parameters in order to achieve a result more in line with recent economic experience - as set out in the December 2006 levy estimate consultation document.

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[8] For more information on Barrie and Hibbert see http://www.barrhibb.com

[9] Inflation rates are, however, derived in the model: from the difference between real and nominal bond yields.

[10] The PPF has chosen to use a thousand economic scenarios

[11] The historical period used in producing best-estimate calibrations varies between asset classes, due to differences in the availability of data and B&H views on whether data remain relevant today – very old data may or may not be relevant to today's markets. B&H combines the use of historical data with expert opinion, either using internal experts or, where appropriate, external consultants and/or academics.

[12] Annex A provides information on the B&H standard calibration for each output – showing for a ten year period the mean of the distribution and 5th and 95th percentile results.

3.2.8 On further analysis, the PPF has concluded that for 2007 model runs it will be possible to use the Barrie and Hibbert calibration, though perhaps with some, more limited, modifications[13]. A list of key outputs generated by the ESG, and information about their distributions is included at Annex A

Modelling employer solvency

3.2.9 The next stage of the analysis is to assess the impact of different economic conditions on employer solvency. The Insolvency Engine does this by bringing together information on the employers of the schemes the PPF protects and the output of the economic scenario generator.

3.2.10 The Insolvency Engine assesses, for each scenario, what the impact on employer solvency is – using evidence on how credit ratings change over time due to economic and other factors - to predict changes in employer solvency. Of course, employer insolvency will depend not just on factors external to the business – but on the quality of management of the business. This cannot be predicted, so the model again uses a random process, repeated many times, to produce a distribution of company failures for each economic scenario[14].This is a resource intensive process, involving the carrying out of 500 simulations for each scenario.

3.2.11 Each simulation involves using factors appropriate to that particular economic scenario to modify the chance that businesses with different credit ratings see that credit rating rise or fall and then uses a randomisation process to decide if, for that particular simulation of that scenario the credit rating of each of the businesses does change (up or down)[15]. This will result in a number of companies' ratings improving and a number of companies having worsening credit ratings, some of whose position will have deteriorated to the point that they default on their debts and most of which then become insolvent[16]. Some employers may go bust in many of the simulations for a given economic scenario, others less often or never in that scenario.

3.2.12 Because this process and assessing the impact of insolvencies are major tasks, whilst for the largest 479 schemes (which represent over three quarters of scheme liabilities) this assessment is done individually, for smaller schemes there is a pooled approach. This reflects the greater risk to the PPF's solvency from large schemes. Chapter 4 sets out in more detail how the process works – including explaining the approach for the smaller schemes

[13] The PPF will consider modifying one or more parameters. For example, it may be worthwhile reducing the number of scenarios with negative real interest rates, to accord better with experience over the last ten to twenty years. This could be achieved through reducing the modelled volatility of real interest rates. Unadjusted distributions are shown at annex A. Reducing volatility would leave the mean unchanged but reduce dispersion.

[14] The process, though random, is weighted so that the poorer the economic scenario and the poorer the credit rating of the company the greater its chance of insolvency.

[15] Producing 500 simulations of credit events for each of the 1,000 economic scenarios means that, in total 500,000 different simulations are run.

[16] Not all businesses that default on debts become insolvent, and chapter 4 explains how the LTRM takes account of the difference between credit risk and insolvency

that are not modelled individually – and how multi-employer schemes are dealt with.

Measuring the impact of insolvencies

3.2.13 Having determined that particular employers fail in a given simulation, it is necessary to estimate the impact of the failure on the PPF. The first stage of that is to understand how underfunded the pension scheme was at the time of failure, in that particular economic scenario[17]. The Exposure Engine has been developed, in conjunction with Hewitt, to carry out this task - rolling forward assets and liabilities of those pension schemes whose employers fail, subject to the economic conditions simulated by the ESG[18]. The model estimates the likely level of deficits for each such scheme using the financial assumptions and asset market returns generated by the ESG for each year that is being projected.

3.2.14 The exposure engine projects forward the demographic profile of the pension scheme and, at each future period over the projected time horizon, values that profile in accordance with the Pension Protection Fund valuation basis and compares it with a projection of the scheme assets that is consistent with the appropriate economic scenario. By projecting the benefits through time rather than the liabilities, a more accurate representation of the split between different types of pension is produced and the increasing maturity of closed schemes is more accurately reflected.

3.2.15 The Claim Engine combines the outputs of the insolvency and exposure engines. It translates insolvency events into claims on the Pension Protection Fund taking into account contingent assets held by pension schemes and recoveries of section 75 debts from the scheme's sponsoring employer. It then combines this information with the rolled forward assets and liabilities to derive claim values measured by the deficit valued on the Board's financial accounting basis of schemes that make a claim on the Pension Protection Fund. The end result of this process is the distribution of future claims over the period chosen in the simulation.

3.2.16 The Balance Sheet Management Model combines information taken from the claim engine with the economic scenarios to produce the distribution of Pension Protection Fund assets and liabilities. It uses similar techniques to the exposure engine to roll forward the liabilities of the Pension Protection Fund and the assets taking into account the investment strategy. This component enables the Board to examine the impact of a levy policy and/or of an investment strategy on the Pension Protection Fund's actuarial funding level.

[17] The same employer could fail in two different scenarios with significantly different impacts, if in one case the pension scheme is better funded at the time, for example because the assets it holds are higher in value as share prices are high when the business fails

[18] It is a key feature of the LTRM that it only calculates the funding position of schemes where the employer has failed, and not where the employer remains solvent. This dramatically reduces the scale of the task.

The Results

3.2.17 The output of the model is a probability distribution of the level of claims over the period chosen, involving all 500,000 scenarios (500 credit risk scenarios for each of 1,000 economic scenarios). Figure 2 shows the base case run of the model from November 2006, projecting claims over a five year period and table 1 sets out the annualised claim.[19]. This formed part of the material for last year's consideration of the level at which the levy should be set, which in turn was a key input to determining the levy scaling factor which feeds into the calculation of individual scheme levies.

Figure 2 - Base case run November 2006 for 5 year period

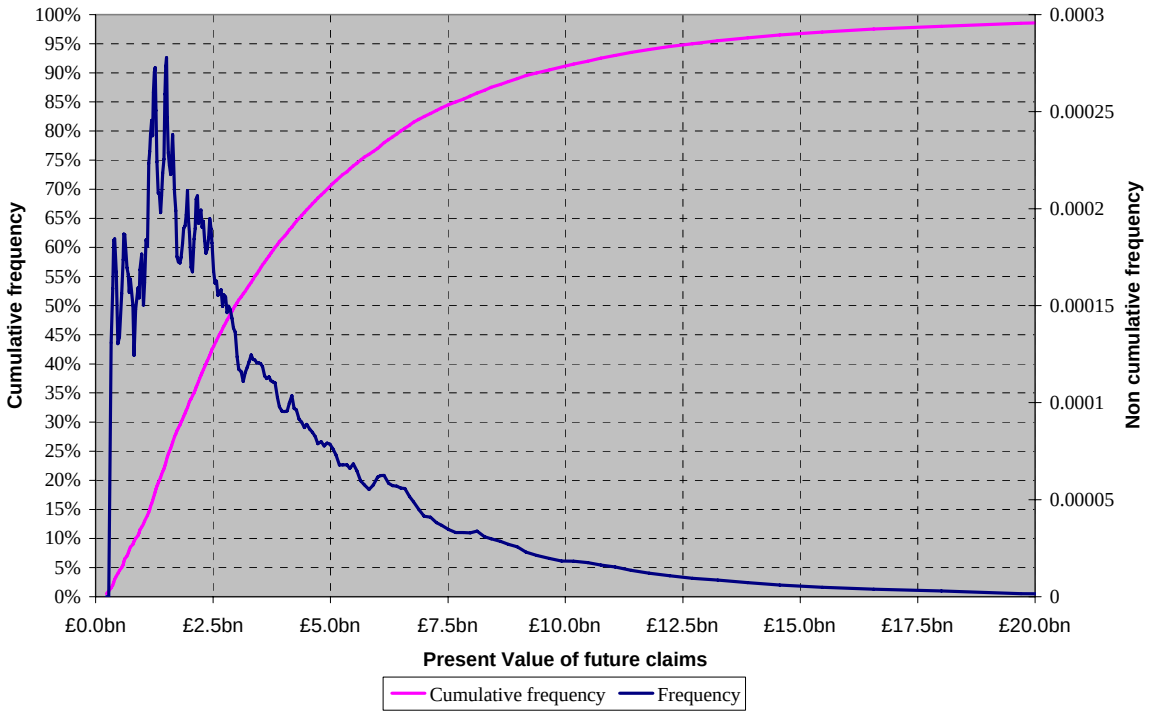


Table 1 Claims on the PPF (s 179 basis) – 1st year

	Median	Mean	75th percentile	90th percentile	95th percentile	99th percentile
Claim (annualised)[20]	£0.68bl	£1.0bl	£1.3bl	£2.2bl	£3bl	£5.3bl

[19] 5 years is considered by the Board of the PPF an appropriate period to model, being long enough to allow significant change in the landscape without moving beyond the range of accurate modelling (data on credit rating migration is available for a maximum of 6 years for example). The Board of the PPF also looks at similar information on a ten year basis.

[20] The annualised claim shown is for year 1 and is not simply 1/5th of the 5 year figure, as an adjustment has been made to take account of the declining populations in later years of the model run as insolvencies take effect. This prevents solvent schemes in year 5 facing higher charges simply because the pool of schemes across which the claim is spread has declined and means that the year 1 figures shown have an element of front-end loading. The effect is most marked in the tail, thus the 95th percentile claim can be seen on the graph to be just over 12.5bn, but the year 1 annualised equivalent is 3 bn not 2.5bn.

3.2.18 Figure 2 and table 1 demonstrate that the distribution of claims is significantly skewed – with a significant impact on the average claim (the mean figure) from claims at the higher end of the distribution. This can be seen in table 1 from the fact the average claim (i.e. the mean) is midway between the 75th percentile claim and the median claim. This is an expected result, since a large claim can be many times the average level of claim.

3.2.19 The impact on the PPF of differing levels of claims is shown at table 2. This is generated by the model by translating the claims cost on a section 179 (s179) basis into a cost on a basis that more accurately reflects the impact on the PPF. In particular, the s179 basis assumes that liabilities are secured by buying them out commercially. In fact the PPF will pay pensions as they fall due, and will invest assets until they are required to meet liabilities. Thus the model takes account of levy receipts, investment returns – where it is assumed that the PPF's investments are in line with our statement of investment policy (SIP) and returns in line with the appropriate ESG asset return - and a discount rate on liabilities based on swap rates (reflecting the expected actual cost of deferred liabilities). The key modelling assumption here is that the levy continues at the current level over the period.

Table 2: PPF surplus or deficit after 5 years

	Median	Mean	75th percentile	90th percentile	95th percentile	99th percentile
PPF surplus /(deficit if negative)[21]	£1.95bl	£1.1bl	£0.15bl	-£2.6bl	-£5.05bl	-£11.7bl

3.2.20 It is noteworthy that outcomes (in terms of the cost to the PPF of claims) that are quite similar can be produced by significantly different combinations of economic scenario and credit risk experience. This can readily be seen by comparing pairs of scenarios drawn from very similar points on the distribution, as illustrated in the examples shown in Table 3 below. These represent 8 of the half a million different possible futures that make up the curve – and are drawn from the 50th percentile (the median case), the 70th percentile (which is closer to the mean claim on the PPF), the 90th and the 99th percentile.

[21] PPF surplus/deficit calculated on an "internal" basis reflecting the reduced cost to the PPF of paying pensions directly rather than buying out commercially represented through discounting future liabilities at swap rates

Table 3: Example scenarios from the Long-term risk model

Scenarios close to 50th percentile		
scenario	(1)	(2)
Economic background	In this scenario share prices rise on average 14% pa over 5 years and bond yields (30 year gilts) average a little below 4%. There is a relatively high risk of insolvency – 2 ½ times the average for the model[22]	In this scenario, share prices weaken slightly (on average 2 % pa - though this is made up of 2 years of rising, 2 years of falling and 1 year of essentially flat prices) and bond yields rise gently from around 3.5% to 4%. There is however a lower general risk of insolvency – half the average
Experience of pension schemes	The number of failures of smaller schemes was high, but in spite of the raised risk of insolvency, all 479 larger employers survived the 5 years. Strong asset growth meant schemes experiencing insolvency were on average 90% funded	Small scheme failures run at a fifth of the rate in example A, but 2 of the larger pension schemes' employers become insolvent. Weaker asset prices mean that the schemes experiencing employer insolvency average 81% funded
Comment: The much higher rate of insolvencies overall in scenario 1 is counterbalanced by the "good luck"[23] experienced by large schemes and by schemes being better funded. As a result the two examples result in almost identical overall claims on the PPF.		

Scenarios close to 70th percentile (close to mean outcome)		
scenario	(3)	(4)
Economic background	In this scenario share prices rise on average 5% pa over 5 years and bond yields average 3.6% over the period. Insolvency rates are 1½ times the average	In this scenario, share prices perform a little less well than C (on average up just below 5%) but bond rates average 4.8%. Insolvency rates are just over 1½ times the average
Experience of pension schemes	The number of failures amongst larger schemes was higher than in A above – 4 larger employers failed. Weaker asset prices mean that the schemes experiencing employer insolvency average 81% funded	In this case 7 larger schemes' employers went insolvent. Higher bond rates mean that scheme funding is better – at 87%
Comment: The overall rate of insolvencies was lower in both these cases than in scenario 1 above but that was counterbalanced by the failure of some larger employers – a result more in line with what would have been expected given general rates of insolvency. Scenario 3 sees schemes better funded, compensating for less insolvencies than in scenario 4.		

[22] The average probability of insolvency in the model varies by credit rating. For a company initially rated at Baa the distribution of insolvency probabilities and its mean are shown in the Annex

[23] "Good luck" in that it is produced in the model by randomly drawing results that mean at risk companies survive. This may be thought of as simulating a situation in which those companies most at risk had management able effectively to deal with adverse economic conditions.

Scenarios close to 90th percentile		
scenario	(5)	(6)
Economic background	In this scenario share prices rise on average 5% pa over 5 years and bond yields soften from 3.7% to 3.0 % over the period, increasing bond prices. Insolvency risks are 2½ times the average (very similar to that in scenario1 above)	In this scenario, share prices rise on average 3.4 % pa – though (as with B above) made up of 2 years of rising, 2 years of falling and 1 year of flat prices. Bond yields fall very slightly over the period, to 3.5%. Insolvency risks are just over 1½ times the average.
Experience of pension schemes	The number of failures related to smaller schemes was high, and 21 of the 479 larger employers failed over 5 years (a strong contrast with scenario 1 above), including 4 with assets over £1billion. Moderate share price and bond price increases mean schemes experiencing insolvency averaged 91% funded	Small scheme failures run at a lower rate than in scenario 5, as do larger scheme results (15 insolvencies). Weaker asset prices mean that the schemes experiencing employer insolvency average 81% funded
Comment: Scenario 5 closely resembles scenario 1 in terms how well funded schemes are – and the general insolvency risk. It shows how much impact unfortunate results from the modelling of credit events can have on the outcome for the PPF. In Scenario 6 the lower insolvency experience than in scenario 5 is balanced by poorer scheme funding		

Scenarios close to 99th percentile		
scenario	(7)	(8)
Economic background	In this scenario share prices fall on average 6.7% pa over 5 years and bond yields average 4.5%. There is a dramatically higher risk of insolvency - 8½ times the average for the model.	In this scenario share prices fall on average 4.2% pa over 5 years and bond yields fall from 4.3% to 3.5%. There is again a dramatically high risk of insolvency – 8 times the average.
Experience of pension schemes	Smaller scheme insolvencies are very high, but in spite of the raised risk of insolvency, only 6 larger employers failed. Very weak asset prices meant that schemes experiencing insolvency were on average 59% funded	Small scheme failures are again very high (but not so high as example 7), but 39 larger employers fail. Weaker asset prices mean schemes average 73% funded (i.e. better than scenario 7)
Comment: These are two very bad scenarios for the PPF – only 1% of scenarios are worse than this. Scenario 7 is bad because a number of big failures are coupled with collapses in asset prices that lead to very large deficits. It could have been worse…had the number of insolvencies approached that in 8, the claim would have been even larger.		

3.2.21 Another feature which is noteworthy, particularly by comparison with short-term risk, is that a significant proportion of the risk shown by the model – especially for more adverse scenarios – is related to large, currently stable businesses. So, large well funded schemes paying the levy now are not simply supporting weaker schemes – but are insuring against the risk that their business proves to be one which is unfortunate enough to experience deteriorating conditions over time and fails in a number of years time. The PPF is essentially providing cover for "catastrophe risk" – which has a low probability but high impact.

3.3 The use the Board makes of the LTRM to inform its decisions

3.3.1 The policy framework in which the level of the Levy is decided was set out in the 2007/08 Levy Estimate Consultation document. To assist with that decision the Board receives, and takes account of, a range of information. In setting the 2007/08 levy this included the probability distribution shown, summary information on the claims distribution of the kind shown in tables 1 and 2, and equivalents over a ten year time horizon. In addition, sensitivities in relation to a number of factors were produced.

3.3.2 By running the model for different periods, and by altering the base assumptions, it is possible to provide further information and test out the impact of different developments in the pensions landscape. Sensitivity work of this kind is an important addition to the Board's information base for considering the level at which to set the levy. For consideration of the 2007/08 levy, the Board looked at a run of the model of 10 years and a range of sensitivities. The impact of some of these is set out in more detail in chapter 6.

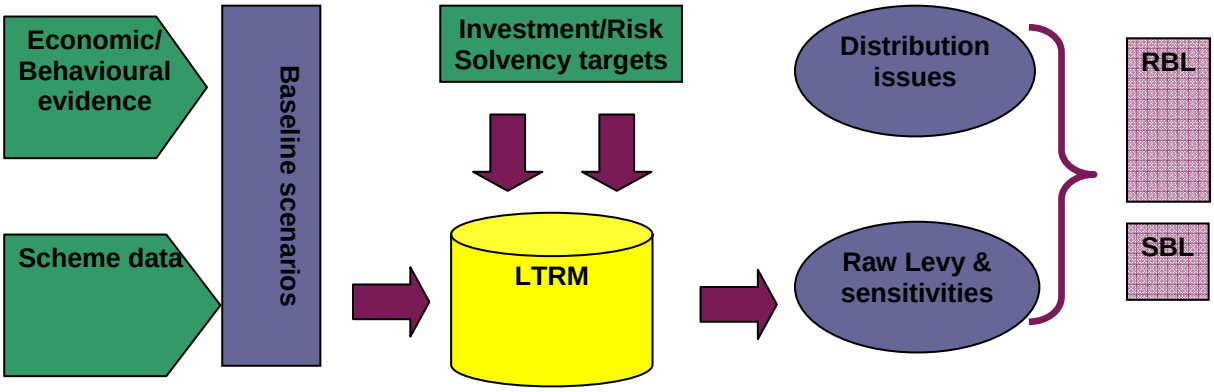
3.3.3 Alongside the outputs of the model, the Board has had to balance a range of factors in setting the levy estimate[24]. These include reflecting the interests of:

- beneficiaries in being able to have confidence that the PPF will remain well placed to meet liabilities;
- levy payers in ensuring that the levy remains affordable – now and in the future.

[24] These are set out in more detail in the levy estimate consultation.

3.3.4 The Board also takes account of a range of factors from current economic conditions to its view of trends in the pensions sector. These wider factors, and issues around the distribution of the levy can be represented diagrammatically:

Figure 3: Representation of the factors influencing the LTRM and the levy



3.3.5 Setting the levy at too low a level could expose the PPF to the risk that a period of high claims could leave its assets below the level of long term liabilities, potentially requiring the Board to raise the levy at a time when economic conditions were poor. Setting it too high might lead to the building up of unnecessarily large reserves - with an impact on the costs of maintaining DB schemes.

3.3.6 In addition to helping the Board make an informed decision on the sum that the levy will need to raise, the model is used as a financial risk management tool. The LTRM produces a statistical distribution of the PPF net financial position and can be used to assess the impact of investment and risk mitigating strategies on this distribution. Therefore the model enables the Board to choose investment and risk transfer strategies that improve the PPF's future financial position on a risk-adjusted basis.

Pension
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Chapter 4

How does the PPF take account of the impact of economic conditions on insolvency rates?

Chapter 4 – How does the PPF take account of the impact of economic conditions on insolvency rates?

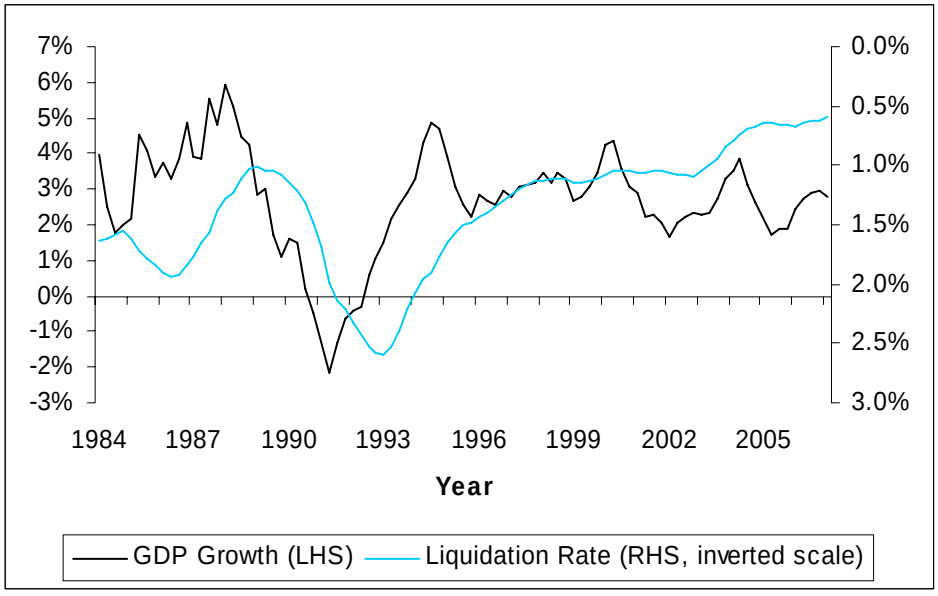
This chapter outlines the approach the PPF has taken to considering the problem of modelling insolvency over time.

4.1 Introduction

4.1.1 Claims on the Pension Protection Fund result from company insolvencies which vary over time with economic circumstances. The rate of corporate insolvencies in Great Britain of 0.6%[25] was at its lowest level for 25 years in Q1 2007, according to figures produced by the Insolvency Service (based on a much bigger group of companies than the sponsors of eligible DB schemes). This compares with an average over the past 10 years of 1.0% and a record high of 2.6% in Q4 1992. The low level of insolvencies is not entirely surprising given that the economy has experienced such a long period of sustained growth while company finances are in good shape. GDP growth seems to be a good lead indicator of insolvencies although the lead seems to vary. (For further discussion see The Purple Book pages 55-59.)

4.1.2 Furthermore, the relationship between financial markets and insolvencies is not straightforward. For example, the level of insolvencies rose between 1981 and 1986 at a time when stock markets were advancing.

Figure 4: GDP Growth and liquidation rate



[25] Insolvency Service figures for 12 months ended 31 March 2007

4.1.3 To model future insolvency rates, the PPF uses credit ratings as a proxy measure – for reasons set out below. A credit rating is an assessment of the likelihood that an entity defaults on its debt, rather than that it becomes insolvent; so if default is used as a proxy for insolvency then an adjustment is needed for the likelihood that a business that defaults on debt survives. Analysis carried out for the PPF by Moody's KMV placed this probability at around 20%.

4.1.4 In addition to understanding the relationship between default and insolvency there are four further main effects that need to be captured. Firstly, over time it is to be expected that credit risk will change for purely idiosyncratic reasons connected to the performance of the individual company. Secondly there is an expected effect that may be termed "credit migration" – the tendency for a fixed group of businesses' credit quality to converge toward the mean for that group. Thirdly the influence of economic environment on the likelihood of sponsoring employers to become insolvent and finally the correlation within and between industry sectors i.e. the effect of industry concentration on the likelihood of many employers defaulting at the same time.

4.1.5 In addition to these standard features of an exposure to credit risk, the PPF is faced with the challenge of modelling claims made by multi-employer pension schemes.

4.2 Modelling credit rating migration

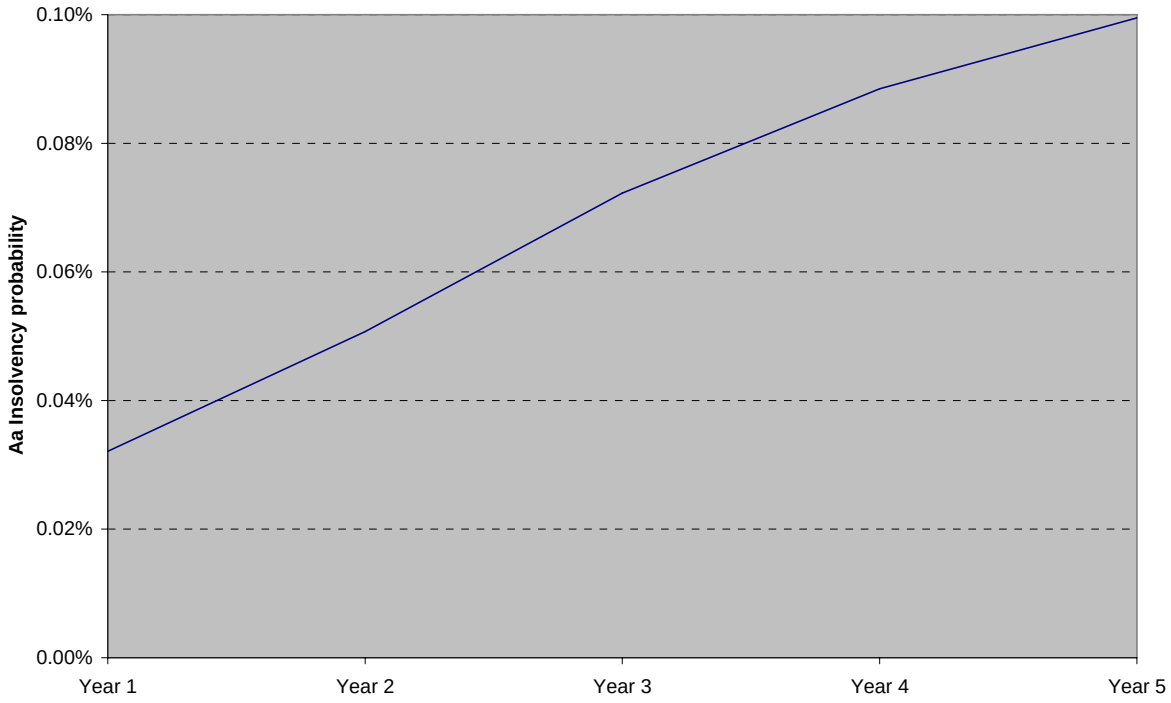
4.2.1 There are two approaches to measuring the likelihood of a business becoming insolvent that are available commercially: one can either use information on insolvency probability from a credit referencing agency, such as Dun & Bradstreet (who the PPF uses for providing insolvency factors for the risk based levy), or use a credit rating.

4.2.2 Whilst for the purposes of calculating a levy for each of the nearly 8,000 eligible defined benefit schemes the wide coverage of credit referencers is a key advantage, for modelling purposes the key issue is to obtain data over a long time series – to provide a clear understanding of how insolvency risks move over time and with economic trends.

4.2.3 The availability of time series data is particularly important because there is evidence that for a given set of companies there is likely to be reduction in the spread of credit quality over time. Credit quality of strong companies tends to deteriorate whereas credit quality of those weak companies that survive improves, shown below in figures 5 & 6. Using a single insolvency probability would fail to capture this term structure of insolvency risk. Accordingly, for modelling purposes credit ratings are used[26].

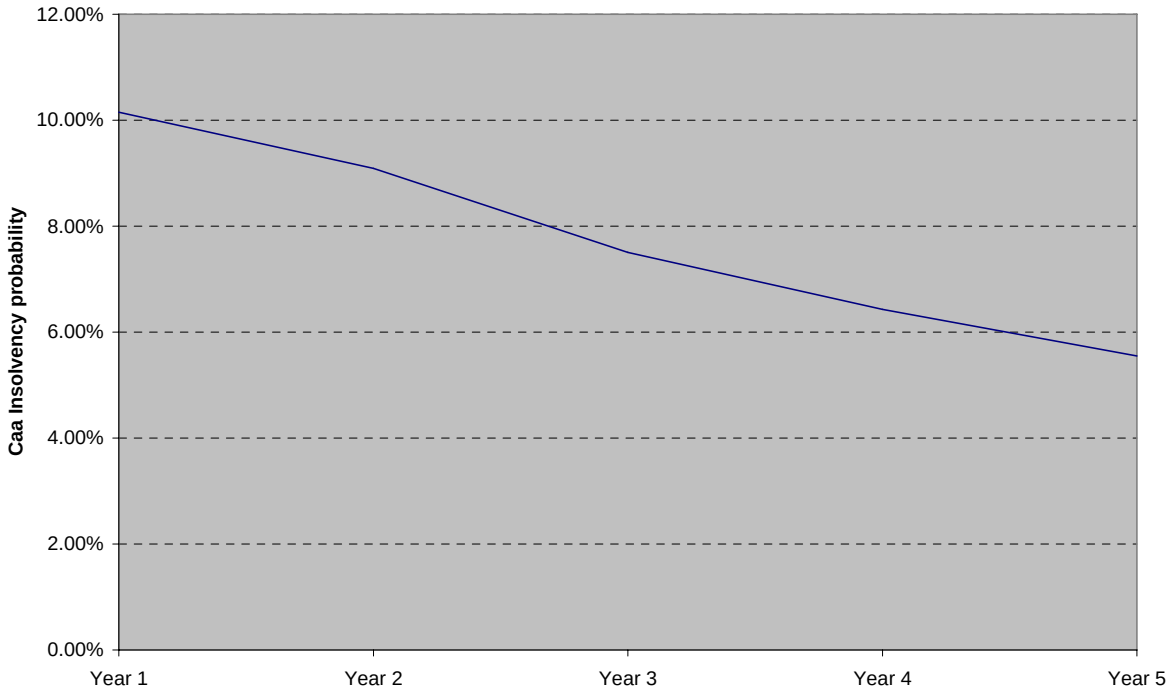
[26] Only a minority of employers are rated companies – generally these are issuers of traded debt. Where available we use credit ratings as we need extensive historic information on which to base projections. But for non rated companies, D&B failure scores are mapped to a credit rating.

Figure 5: Insolvency rates over time for Aa rated companies[27]



Moody's KMV data

Figure 6: Insolvency rates over time for Caa rated companies[28]



Moody's KMV data

[27] Companies with a Moody's credit rating of Aa
[28] Companies with a Moody's credit rating of Caa

4.2.4 A credit rating is a qualitative assessment of the creditworthiness of a company performed by a rating agency, the principal ones being Standard & Poor's, Moody's Investor Services and Fitch IBCA. A credit rating does not provide directly an insolvency probability. But from historical data, it is possible to estimate how credit quality changes over time. This credit migration is expressed by rating transition matrices. A rating transition matrix is a table where each cell gives the probability for a company to migrate from one credit rating to another or from one credit rating to default, over a given period of time. Table 4 is an example of a rating transition matrix. The cell at the intersection of row Baa and column Ba shows that there is a 4.66% probability for an employer to be downgraded from a credit rating of Baa to a rating of Ba over the period.

Table 4: Average 1 - Year(s) Rating Migrations Rates, 1970-2003

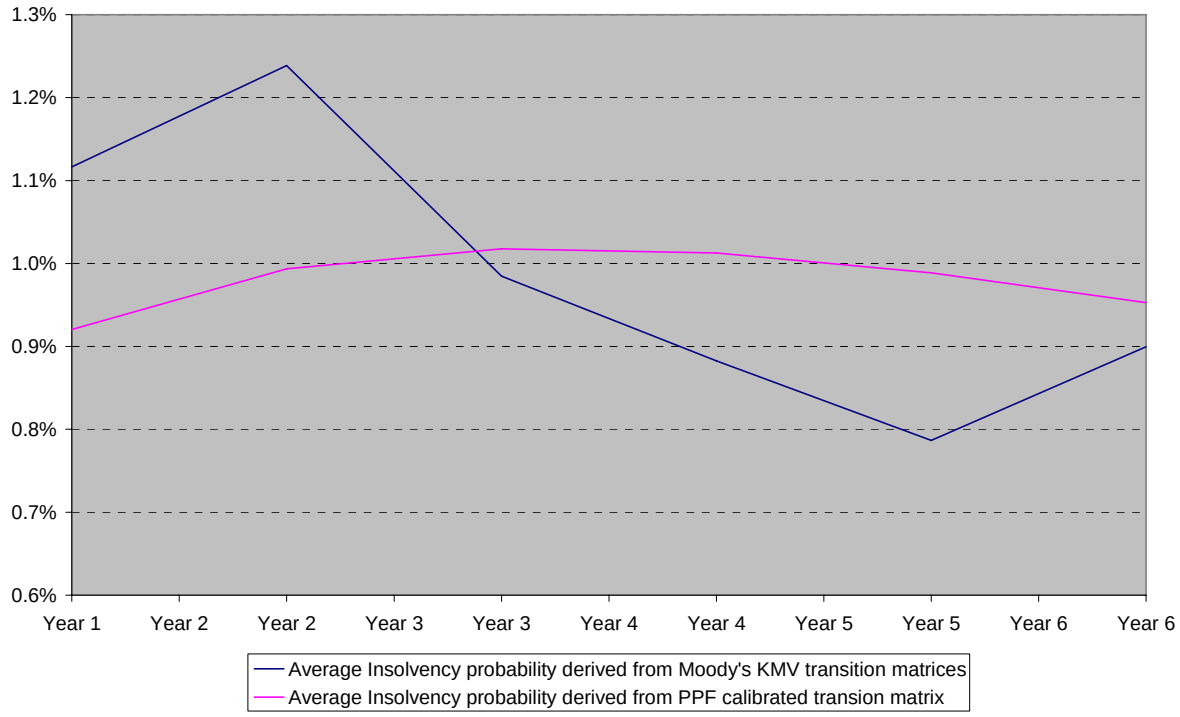
		Rating To								
		Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	Non rated
Rating from	Aaa	89.76%	6.87%	0.71%	0.00%	0.02%	0.00%	0.00%	0.00%	2.63%
	Aa	1.14%	88.34%	7.42%	0.25%	0.07%	0.01%	0.00%	0.02%	2.76%
	A	0.05%	2.31%	88.95%	4.91%	0.48%	0.13%	0.01%	0.02%	3.15%
	Baa	0.05%	0.23%	4.97%	84.49%	4.66%	0.76%	0.15%	0.17%	4.51%
	Ba	0.01%	0.05%	0.46%	5.06%	79.03%	6.54%	0.51%	1.18%	7.17%
	B	0.01%	0.03%	0.12%	0.40%	6.08%	77.58%	2.83%	6.19%	6.77%
	Caa-C	0.00%	0.00%	0.00%	0.53%	1.60%	3.85%	62.63%	23.49%	7.88%

Moody's KMV data

4.2.5 For the PPF, Moody's KMV developed six rating transition matrices over one to six years, using credit data on 20,000 companies between 1990 and 2005. A single one-year transition matrix was then calibrated on these six matrices to best fit the rates of insolvency produced by them, and to allow for the survival of a proportion of those businesses that default on debt[29]. This calibrated matrix is used to model credit migration. Figure 7 shows the term structure of insolvency rates derived from the matrices estimated by Moody's KMV compared to those derived from the calibrated one-year transition matrix for Baa rated companies.

[29] KMV Moody's carried out analysis of historical data for the PPF which suggests that 80% of business that default on debt then proceed to insolvency.

Figure 7: Term Structures of Moody's KMV transition matrices and PPF matrix



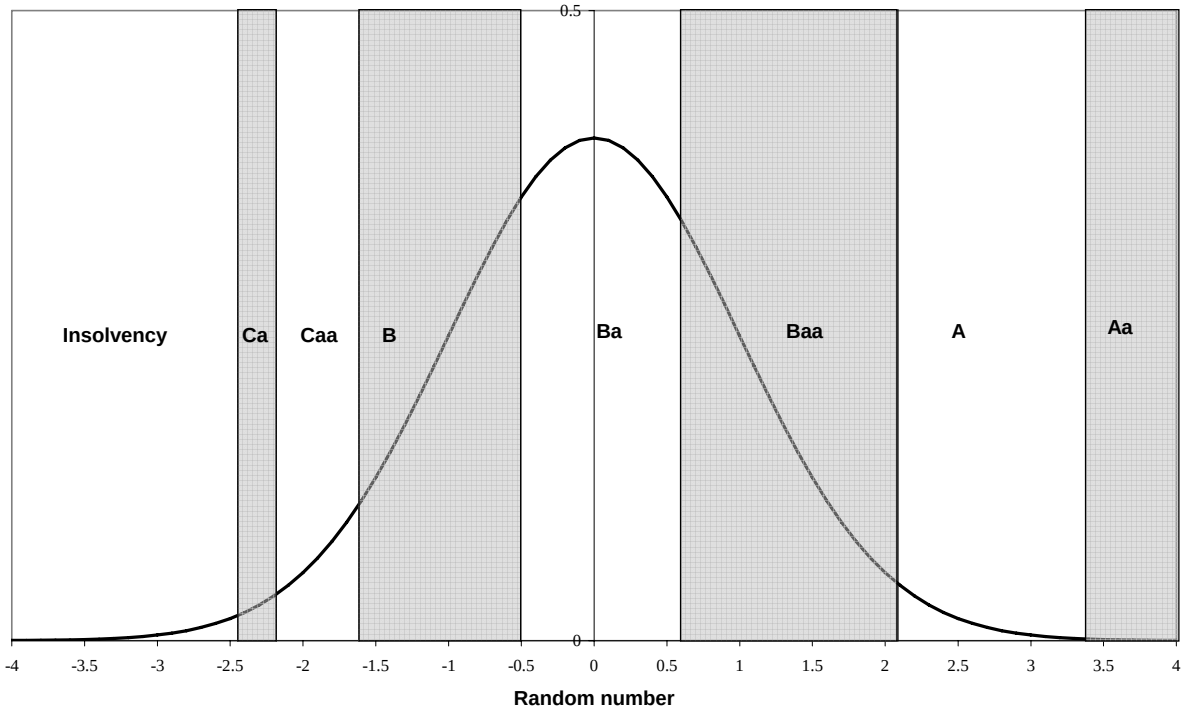
4.3 How Rating Migration for a Particular Employer is Simulated

4.3.1 For pension schemes treated individually in the model, rating migration is simulated at the employer level. 1,000 economic conditions are produced by the Economic Scenarios Generator in the form of credit risk factors and 500 credit risk scenarios reflecting the particular circumstances of a company are generated by the Insolvency Engine. At each time step and for each sponsor, a random number is generated for each of the 500 credit risk scenarios to decide if, for that particular simulation of that scenario their credit rating does change (up or down). This will result in a number of companies' ratings improving and a number of companies having worsening credit ratings, some of which will have deteriorated to the point that they are in default.

4.3.2 Random numbers for each credit risk scenario are drawn from a normal distribution. Figure 8 shows how, depending on the range in which the random number falls, the rating of a Ba rated company changes in one year[30]. A company with a better credit rating would "draw" from a similar looking curve but which centred on its initial credit rating.

[30] This procedure is known as the Jarrow, Turnbull model.

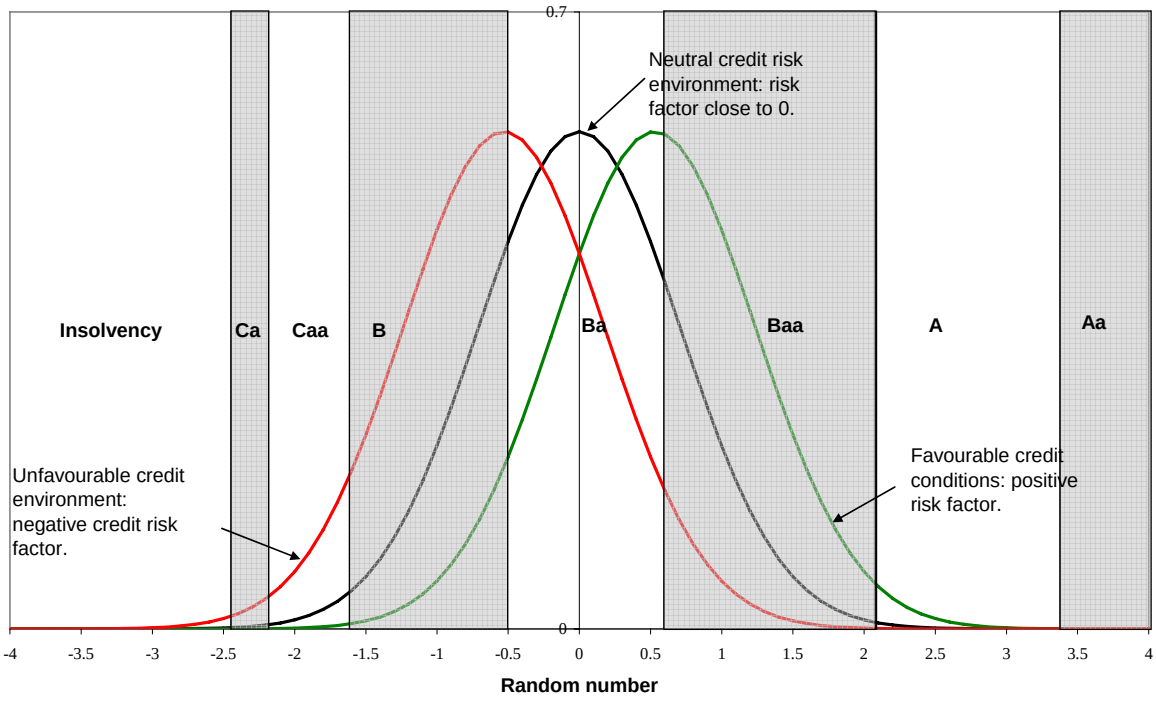
Figure 8: distribution of credit risk factors



4.3.3 Credit risk factors are random numbers drawn from a standard normal distribution that is generated in each economic scenario for each industry sector. Credit risk factors are correlated between one another and with UK equity and property returns. They capture the effect of industry concentrations and correlations between schemes' funding deficits and insolvency risk via correlation with asset returns. The correlations the PPF uses have been estimated for us by Moody's KMV, based on historical data for the fifteen economic sectors. Correlations between the sectors and equity returns vary but are close to 50%, and correlations between the sectors are in the region of 60-80%.

4.3.4 To reflect the impact of economic conditions, the random numbers for each of the credit scenarios are then made conditional on credit risk factors. This is the equivalent of loading a dice – it increases or decreases the likelihood of particular outcomes – without determining when a particular outcome occurs. Figure 9 shows how this is done – by shifting the curve so that there are more (or less) random numbers that result in a downgrading.

Figure 9: Flexing credit risk factors to reflect economic conditions



4.3.5 For a given economic scenario, once distributions have been produced for businesses with each credit rating in each economic category (construction, consumer products etc) for each year of the scenario, the insolvency engine randomly generates a set of random numbers – one for each business in each year. This determines in that simulation whether the businesses credit rating has changed in each year. The process is repeated 500 times to decide whether there is a change in credit rating or indeed an insolvency event in each of the 500 simulations.

4.3.6 The following example illustrates this process in operation.

Box A: An example of Credit Migration – Bad luck Plc

Bad Luck Plc is an employer, with an initial Ba credit rating, operating in the Consumer Products sector. The scenario starts at year 1 in a rather benign environment materialised by a credit risk factor relative to the Consumer Products sector close to 0 and hence a probability of downgrade of 25% like in the calibrated transition matrix. But because of poor management decisions the company has been downgraded to B category. This event has been generated by a low random number produced by the insolvency engine (-1.23). Furthermore, economic conditions deteriorate in year 2 (credit risk factor of -1.35), thus the probability for the company to be downgraded further to Caa or worse has increased from 24% in year 1 to 70% in year 2. The management team of Bad Luck plc did not perform particularly well in year 2 (random number of -0.3) thus the company is further downgraded to Caa. In year 3, economic conditions do not improve significantly and there is a 16% probability for a Caa rated company to become insolvent. Bad Luck Plc's story ends with an insolvency event in year 4 after the default of its biggest customer Poor Credit ltd (random number of -1.15).

The key point to appreciate is that, in other credit risk simulations for the same economic scenario the random numbers generated to simulate luck / management quality may well see the same business survive.

4.3.7 For each economic scenario, the Insolvency Engine generates simulations individually for each employer sponsoring one of the largest 479 pension schemes. The impact of idiosyncratic risk is significant for schemes classified in the large schemes' category (schemes with assets of more than £350m) but less significant for schemes of smaller size – where the number of schemes is much larger and their individual impact far lower. For this reason, the smaller schemes are pooled in groups, according to the industry in which their sponsors operate, according to their status (whether they are open, closed to new entrants or closed to new accruals) and according to their funding level (only schemes with similar funding levels are pooled in the same group).

4.4 How insolvency is modelled for pooled employers

4.4.1 There are about 6,000 pooled schemes in 150 groups and they represent about a quarter of the total assets and liabilities of the UK Defined Benefit pension schemes' universe. For these schemes, idiosyncratic risk is not modelled. The average insolvency probability prevailing in the economic scenario for the relevant industry sector is applied to the group instead. The advantage of this method is that it reduces the number of schemes to model from 6,000 to 150 and the number of simulations to perform 1,000 instead of 500,000. This approximation results in an improvement of the run time by a factor of 14 for the Insolvency Engine and by a factor of 10 for the exposure engine with an acceptable loss of accuracy[31].

4.5 Modelling multi-employer schemes

4.5.1 One of the challenges faced when modelling insolvency risk for pension schemes is that many pension schemes have more than one sponsoring employer. For multi-employer pension schemes of the "last man standing category", in theory all employers need to become insolvent before a qualifying insolvency event occurs. In practice, if the biggest employer or several employers employing a majority of the pension scheme's members become insolvent, the surviving employers follow rapidly the employers that have already been bankrupted. The PPF attempts to factor in this domino effect at the same time as the fact that there is more than one employer.

4.5.2 In order to achieve that, when the multi-employer scheme is classified in the large scheme category, insolvency events are generated for each sponsor. To account for the domino effect, we have assumed that, as soon as sponsoring employers representing 60% or more of the pension scheme's liability become

[31] We estimate that this procedure results in a +/-10% error on the value of claims made by small schemes i.e. about £20m for the mean value of claims.

insolvent, a claim is made on the PPF. The number of members or, if that is unavailable, the number of employees is taken as a proxy for proportion of liabilities. For schemes classified in the small scheme category, a joint probability for employers representing more than 60% of the scheme is calculated before pooling the scheme.

Pension
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Chapter 5

How does the PPF take account of the impact of economic conditions and other factors on scheme funding?

Chapter 5: How does the PPF take account of the impact of economic conditions and other factors on scheme funding?

This chapter consider how economic conditions impact upon scheme funding levels. Following an explanation of how the model handles demographic factors and projects assets and liabilities, the chapter will look at some of the other key factors to take into account.

5.1 Introduction

5.1.1 After claims made on the PPF are simulated following the process described in chapter 4, the severity of claims needs to be assessed. This is achieved by rolling forward assets and liabilities of schemes making a claim to the point at which a claim occurs[32].

5.1.2 Rolling forward assets by applying asset returns of the relevant economic scenario is a relatively straightforward operation – involving increasing or decreasing the value of scheme assets to reflect contributions from the employer and changes in the price of the relevant assets[33].

5.1.3 Rolling forward pension schemes' liabilities is a far more complex process that will be described in the next sections. This calculation is performed by the Exposure Engine that has been developed by Hewitt Bacon & Woodrow.

5.1.4 The Exposure Engine calculates, for each of the 500,000 combinations of economic scenarios and credit scenarios, the assets and liabilities of pension schemes making a claim in the PPF. The calculations are then adjusted (in the Claim Engine) to account for the effect of contingent assets on claims.

5.1.5 The output from the Claim Engine is used by the balance sheet module that projects the PPF balance-sheet in each scenario. This module adds together the assets and liabilities transferred to the PPF and rolls them forward according to the relevant economic scenario[34]. The processes involved in the three modules, Exposure Engine, Claim Engine and Balance-Sheet Model are described in this chapter as well as the assumptions made to account for

[32] For efficiency reasons, this calculation is performed only for schemes that make a claim on the PPF.
[33] For example, if a pension scheme initially has £100m of assets invested 100% in equities and normal contributions of 10m paid at the end of the year and shares rise 20% in year 1 and fall 10% in year 2, then the assets will rise in value to £130m at the end of year 1 and then fall back to £117m at the end of year 2. Details of the approach the PPF uses to roll forward assets is set out in guidance published on our website
[34] A roll forward of PPF assets is necessary as the model will see some failures in each year of the run. Once an employer has become insolvent the assets will transfer to the PPF, whose investment strategy may differ from that of the scheme – so that the assets will change in value by a different amount than they would have done had the scheme failed later.

actions taken by pension schemes trustees such as contributions made or schemes' investment strategies.

5.2 Factors influencing the nature of a pension scheme's liability

5.2.1 To project the value of any pension scheme's liability, the following characteristics need to be projected over time:

- Its membership data by age (number of active members by age, number of deferred members by age, number of pensioners by age and number of spouses by age);
- The distribution of pension entitlement by age and category (active, deferred, pensioners, spouses);
- The distribution of salary by age for active members.

5.2.2 These characteristics are influenced by several factors: the passage of time, retirement age, people joining and leaving, mortality, new accruals and salary increases.

5.2.3 The passage of time modifies a pension scheme's liabilities in many ways. First of all, members age, and begin drawing pensions. Secondly, with the passage of time new salaries are paid and new pension entitlements are accrued.

5.2.4 New joiners will increase the number of active members and create new pension entitlements. Withdrawals due to employees changing jobs result in withdrawal from the pension scheme and change from active to deferred member's status.

5.2.5 Finally, mortality affects the distributions by age and reduces numbers of members and pension entitlements.

5.2.6 To model pension schemes' liabilities precisely, one would need to know the age distribution of each pension scheme. However, for efficiency reasons, the Exposure Engine does not use scheme specific distributions by age but the distribution by age of a standard scheme.

5.2.7 In actual fact, it is not necessary to project every pension scheme's demographics. This is because the characteristics of any pension scheme can be expressed by combining a small number of elementary pension schemes – in varying proportions. Thus the Exposure Engine only projects characteristics of the elementary pension schemes – and then the impact on a particular scheme is simulated through adding together varying proportions of the different elementary schemes.

5.2.8 An elementary pension scheme is a theoretical scheme with a standard age distribution[35] and £1 of pension entitlement at the beginning of the projection. There are nine elementary schemes which model an active member, a deferred member and a pensioner for each of: open schemes, schemes closed to new entrants, and schemes closed to new accruals.

5.2.9 Once the elementary schemes are projected, they are valued both on the S179 basis and on the PPF ongoing basis[36]. Finally in each scenario and each time step, pension schemes making a claim on the PPF are valued by combining appropriate proportions of the elementary pension schemes for each scheme.

5.3 How the PPF takes account of scheme actions to mitigate risk

Contingent assets

5.3.1 The PPF has encouraged trustees to take action to mitigate the risk they present for the organisation. One of these actions is the use of contingent assets. Contingent assets recognised by the PPF are instruments designed to increase the value of a pension scheme's assets in case of insolvency of a sponsor. There are three types of contingent asset eligible for a Risk Based Levy reduction, and the impact of these is modelled in the LTRM.

5.3.2 The first type, Type A contingent assets, take the form of group company guaranties. A company, generally the parent of the pension scheme's sponsor guaranties some or all of the liability. The second type, Type B, consists of security over specified assets. Finally, Type C contingent assets are letters of credit or bank guarantees provided by a financial institution on part or all of the pension scheme's deficit.

5.3.3 The effects of contingent assets on the value of claims are modelled explicitly in the Claim Engine.

5.3.4 For a type A contingent asset, in each scenario where a claim is generated by the insolvency engine and where there is a deficit on the S179 basis, the claim engine tests whether the guarantor is still solvent. If it is, the guarantee is activated, reducing the claim.

5.3.5 For a type B or C contingent asset, in each scenario where a claim is generated by the insolvency engine and where there is a deficit on the S179 basis, the claim engine adds the value of the assets or guarantee to the pension scheme's assets.

[35] The age distribution of each elementary scheme is different at the start of the model period and will evolve differently – with for example the average age of members of schemes closed to new members increasing more quickly than that of open schemes

[36] As set out in chapter 3

5.3.6 Contingent assets in place at the time of projection are assumed to stay in place over the projection horizon, which reflects the Board's expectation that contingent assets be essentially evergreen if they are to benefit from recognition in the risk based levy.

5.3.7 The modelling of contingent assets does not take account of their full complexity – taking account of neither the possibility of additional contingent assets being created over the period modelled – nor of the planned reduction of a contingent asset once a deficit reduction payment has been made. These two effects may be expected in part to counterbalance each other, and are unlikely to have a significant overall effect, they are most likely to lead to a slight overstatement of the risks to the PPF.

Recovery plans

5.3.8 Reform of the pension scheme funding regime that is being put into place through The Pension Regulator's actions and policies could have a significant impact on future claims on the PPF. Therefore, recovery plans are modelled in the LTRM. The LTRM attempts to reflect the fact that recovery plans depend on both the funding position of pension schemes and the strength of sponsor covenants. For more information on the scheme funding regime see Chapter 6, para 6.2.10-6.2.13.

5.3.9 Depending on their initial funding levels and strength of sponsor covenants, funding targets (technical provisions expressed as a percentage of S179) and recovery periods (the period over which the deficit is to be tackled) are assigned to all schemes.

5.3.10 To reflect the fact that recovery plans are reassessed every three years, in the model deficit reduction contributions are re-calculated – though for practical reasons it is only possible to do this on a rolling one year basis – rather than model a three year review. Schemes that have reached their target before the end of their recovery plan stop their deficit reduction contributions but in any case, total contributions are at least equal to new accrual, which means that it is assumed that there is no contribution holiday.

5.3.11 Results of model runs are sensitive to values of funding targets and recovery periods. Therefore, the Board examine results of alternative scenarios assuming different values for these parameters.

5.4 Other mitigating actions

Renegotiations of pension schemes

5.4.1 Employers sometimes renegotiate the pension scheme to reduce the burden, or make use of non-pensionable remuneration as part of the overall package (for example increasing the use of bonuses). It is impossible to model future renegotiations, however we can test the effect of such actions by reducing the value of the liability, and the effects of such a change are set out in one of the sensitivities in chapter 6.

Investment strategies aimed at reducing risk

5.4.2 Some pension schemes have taken actions to reduce the investment risk they face (in particular the duration and inflation exposure mismatch between assets and liabilities) by implementing a Liability Driven Investment strategy. We recognise that such actions tend to reduce the volatility of pension schemes' funding level and have developed the functionality to model the effect of LDI strategies. But information about scheme investment strategies is usually only accessible in terms of broad asset allocation and this data says nothing about pension funds' use of derivative instruments. Therefore the PPF can only perform sensitivity model runs to ascertain the impact of wider use of LDI strategies. In the longer term, the PPF will obtain information about the prevalence of LDI strategies in order to permit modelling of this and its aggregate impact on risk.

5.5 Modelling the PPF balance sheet

5.5.1 As well as for projecting the distribution of future claims on the PPF, the LTRM is used to assess the PPF's funding position. In order to achieve that, the Exposure Engine can project the PPF assets and liabilities applying the same method as outlined above for pension schemes[37]. However, this method is prohibitively resource intensive. This is because, as schemes are transferred to the PPF, active members become deferred members at different points throughout the period being modelled. The use of the elementary pension schemes therefore becomes impractical – as it relies upon the status of a member remaining the same - and a detailed valuation process needs to be applied in each of the 500,000 scenarios because profile of assets and liabilities entering the PPF will change with the specific risk scenarios as well as for the economic scenarios.

5.5.2 For efficiency purposes a short-cut has been taken. This has been possible because the PPF follows a Liability Driven Investment strategy. Thanks to this investment strategy, assets' sensitivity to interest rates and inflation rates matches liability sensitivity to interest and inflation rates. This feature

[37] sections 5.1 and 5.2 above

effectively converts the pension liability into a debt indexed to short term interest rates. Therefore to roll forward liability one only needs to apply a money market index to the value of the liability.

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Chapter 6

How key trends may affect the PPF's risk

Chapter 6: How key trends may affect the PPF's risk

This chapter considers the sensitivity of the risks faced by the PPF to a range of factors, and considers the key trends influencing those factors. This aims to illustrate the significant impact that key trends may have on the overall level of risk in the DB sector

6.1 Introduction

6.1.1 There are a number of key trends which impact the defined benefits pension universe which, depending on their evolution over time, could have a significant impact on the risks that face pension funds individually and the PPF's aggregate risk. This chapter considers these trends, and seeks to provide a guide to their potential impact through describing the base case assumptions made last year and the impact of alternative assumptions.

6.1.2 In recent years, many DB schemes have closed to new members as companies have become more concerned about scheme funding. The falls in equity markets and bond yields between 2000 and 2003 resulted in ballooning pension fund deficits. Deficits were aggravated further by rising longevity assumptions. The deficit of schemes in deficit on a s179 basis is estimated to have peaked at around £160bn in early 2003. Although this deficit had fallen £30bn by June 2007, around 60% of schemes were still in deficit. This experience has made companies increasingly aware of the risks contained in the pension schemes they sponsor.

6.1.3 Pension schemes have also been changing their asset allocation in response to growing scheme maturity, concerns about big deficits, and new thinking about the optimal investment for pension funds. Such thinking points to asset diversification, a focus on liabilities as a benchmark, and the use of derivatives to improve returns and reduce risk in an efficient way.

6.1.4 This year the Pensions Regulator will receive technical provisions (liabilities on a prudent basis) and recovery plans for around 2,500 schemes with a funding shortfall under the new scheme-specific funding regime. This regime was laid down in Part 3 of the Pensions Act 2004 which came into force in December 2005. These plans could have a significant impact on company pension contributions and deficits. The Pension Protection Fund's risk based levy also provides incentives to reduce scheme deficits and make use of deficit reduction contributions and contingent assets.

6.1.5 As well as various behavioural assumptions, the Pension Protection Fund also has to make assumptions on longevity.

6.1.6 The remainder of this chapter:

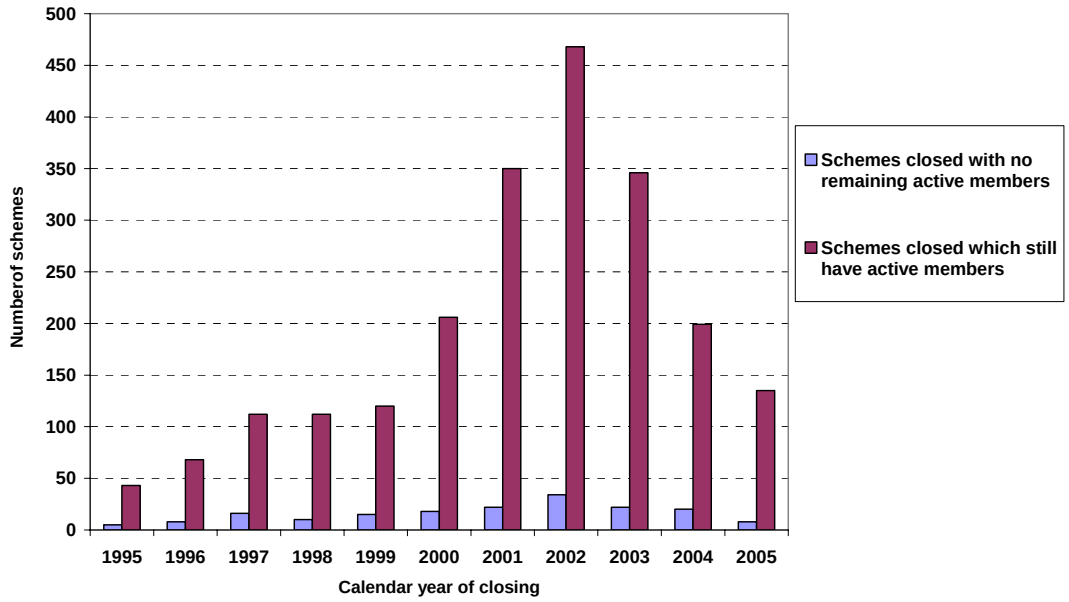
- describes the behavioural and regulatory changes in recent years in more detail;
- sets out the behavioural assumptions made in the 2006 model runs;
- assesses the impact of making alternative behavioural assumptions;
- sets out sensitivities of model results to changes in longevity assumptions;

6.2 Key influences considered

Pension scheme closures

6.2.1 An important feature of recent years has been the closure of pension schemes. There are two types of scheme closure, the first is where the scheme closes to new members and the second where the scheme also closes to future accrual. When the scheme closes to new members the existing members are still able to accrue benefits. When the scheme is closed to future accrual then new members cannot join and active members will no longer accrue pension benefits from their future service. (For more information see the Purple Book pages 18-25)

Figure 10: scheme closures



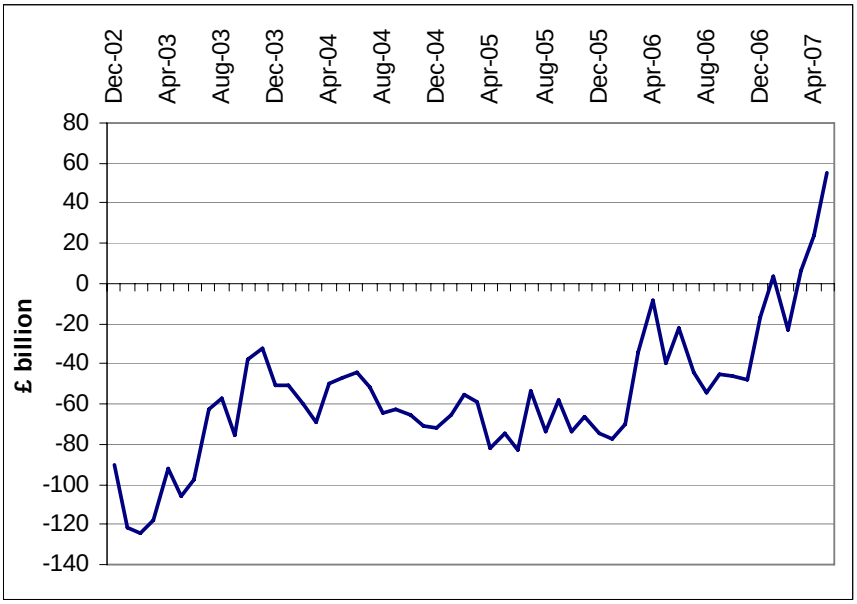
6.2.2 Defined benefit schemes began to close in the mid-1990s but the rate of closure increased dramatically soon after the turn of the century. The three main reasons that schemes gave for closure were the size of the deficit, wanting to contain the risk/liability, and the long term pension cost[38]. Companies also became more concerned with the introduction of the new FRS17 accounting standard in 2002 which increased disclosure requirements in relation to company pension schemes.

[38] Source: NAPF Annual Survey 2005

6.2.3 There were a number of factors that contributed to worsening scheme funding in the early years of the new century. During the 1990s real bond yields had fallen, which caused scheme liabilities to increase, but this was offset by strong equity markets and some schemes even took contribution holidays.

6.2.4 However, equity markets, which made up around 60% of scheme assets, fell by almost 50% between 2000 and 2003. Furthermore, real bond yields continued to decline causing the scheme liabilities to rise whilst equities were falling pushing up the aggregate funding deficit (figure 11). As scheme funding levels were so low, companies needed to increase contributions to improve scheme funding. The number of schemes that closed in between 2000 and 2004 increased massively and by 2006 less than half of schemes were still open to new members[39], although only around one in ten were closed to future accrual (figure 12).

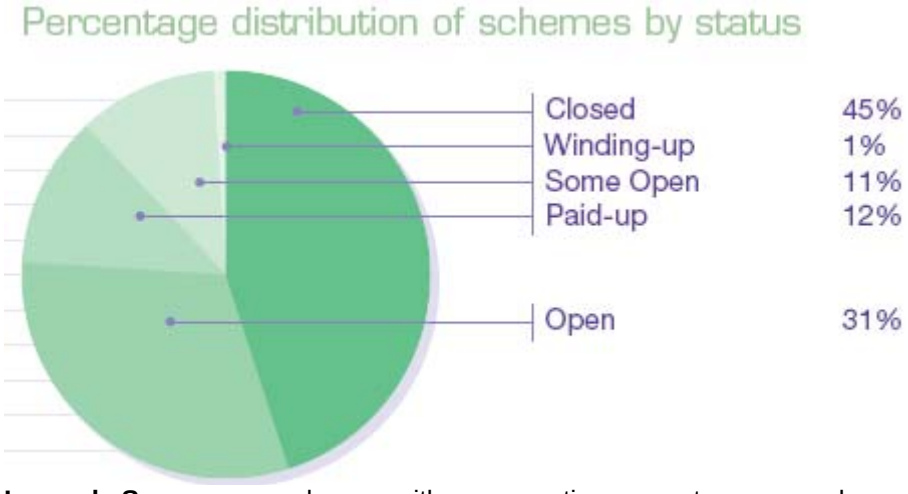
Figure 11: Aggregate funding balance (total assets-total liabilities) on a s179 basis of 7,800 DB schemes



PPF 7800 index

[39] The precise proportion depends upon the basis being considered, as closures have disproportionately been of smaller schemes. schemes in the Purple sample, 31 % of schemes remained open representing 43% of memberships (Purple Page 18)

Figure 12:



Legend: **Some open**: schemes with some sections open to new members, which may be a mix of DC sections open and DB sections open; **Paid up**: schemes open to new accrual but not new members.
Source: Purple

6.2.5 The final factor that has caused deteriorating scheme funding, and potentially encouraged scheme closure, has been the reflection of improving longevity in actuarial longevity assumptions. People were living longer and these improvements became particularly evident in the late 1990s.

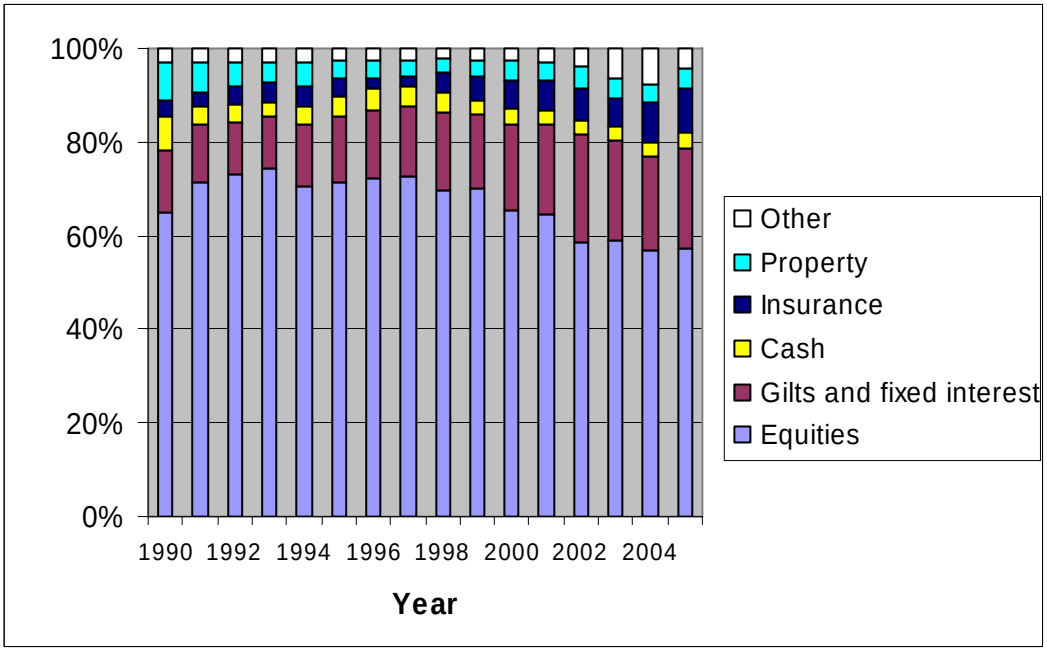
Asset Allocation

6.2.6 Since the late 1990s there has been a noticeable shift in pension scheme asset allocation away from equities and into the less volatile bonds (Figure 14). The proportion that schemes hold in 'other' assets (property, hedge funds, private equity and cash) has also increased. Schemes have been making large net inflows into bonds while tending to disinvest from equities. (see the Purple Book, pages 66-71)

6.2.7 Within the equity portfolios of pension schemes, there has been a marked shift towards overseas equities since the mid-1990s so that there is almost a 50/50 split between UK and overseas. There has also been diversification within bonds with schemes increasingly choosing to invest in overseas and corporate bonds.

6.2.8 Schemes seem to be increasingly using liability driven investment (LDI) strategies to match their investments and their liabilities more closely. They do this to try to eliminate mismatches between the future flows of cash from investments and the liabilities for which they are required. The approach may involve schemes using inflation and interest swaps, long dated bonds and other derivatives.

Figure 13: Asset split for pension schemes



Scheme funding regime

6.2.9 This year, TPR will receive returns from around 2500 pension schemes which include the key features of scheme funding, in particular the level of technical provisions and recovery plans for those with a shortfall. Technical provisions refer to the level of a scheme's liabilities using prudent assumptions on, for example, the discount rate. By the end of 2009 all DB schemes should have completed scheme funding valuations and those with a shortfall should have agreed a recovery plan[40].

6.2.10 Given the large number of schemes still with a shortfall, TPR use a filter mechanism based on triggers to identify schemes whose funding plans seem more likely to be based on imprudent or inappropriate assumptions. The triggers relate separately to technical provisions (TPs) and recovery plans (RPs). All schemes that trigger will be subject to some form of further assessment process to help TPR decide whether intervention would be appropriate.

6.2.11 So that TPR can make an initial assessment of the adequacy of technical provisions they will compare these with a range between two liability values: s179 and FRS17. The circumstances where a recovery plan trigger include:

(i) the recovery plan being longer than ten years;

(ii) the recovery plan appearing to be significantly back-end loaded with sponsoring companies making larger contributions towards the end of the recovery period;

[40] For more information on the scheme funding regime see "The regulator's statement: How the Pensions Regulator will regulate funding of defined benefits", May 2006

(iii) assumptions underlying the recovery plan, especially investment assumptions, appearing inappropriate.

6.2.12 The level of technical provisions (TPs) and the recovery plans (RPs) will be revisited every three years as part of the tri-annual scheme valuation. Both may be adjusted in the light of movements in financial markets and sponsor company fortunes. For example, changes in financial markets may lead to significant improvements in the shortfall between the value of assets and the level of TPs. The pension trustees and sponsoring company may then agree to keep company contributions the same and reduce the length of the original recovery plan. Taking another example, an employer sponsoring a particular scheme may see a downturn in its fortunes which would push up the level of technical provisions and its shortfall. However, the company may argue that it can no longer afford the contributions originally agreed so that the recovery plan is lengthened.

6.3 The impact of changing the model assumptions

6.3.1 This section sets out the key assumptions used in 2006. It also looks at how the changes in key assumptions affect the Pension Protection Fund's balance sheet at the mean, 75th percentile and 95th percentile of the claims distribution assuming levy payments of £675 million (the current level). The sensitivities are looked at over five and ten year time horizons and take as their starting point the 2006 baseline runs. In the baseline, the average level of claims on a 5 year time horizon and on the PPF ongoing basis was £0.4bn while the level of claims at the 75th percentile was £0.6bn and £1.6bn at the 95th. Taking the mean of the claims distribution, the PPF would see a surplus of £1.1bn after 5 years while at the 75th percentile there would be a surplus of £0.2bn and at the 95th percentile a deficit of £5.0bn.

6.3.2 The model is still relatively new and there are limitations in the way that it can model behavioural assumptions. It is difficult, for example, to introduce a gradual change such as a steady progression in asset allocation from equities to bonds over a 5 or 10 year period. It is also difficult to make different assumptions for different schemes for example to have some schemes closing at different times. As a result, the assumptions may need to be somewhat stylised. Furthermore, some of the interactions in the real world may be difficult to capture with the model in its current form, for example, the relationship between strength of employer covenant and technical provisions and deficit reduction contributions.

Assumption 1: Scheme closure

6.3.3 In the 2006 runs, it was assumed that there would be no further scheme closures to new members or new accruals. Furthermore, the level of scheme benefits was assumed to be broadly unchanged in real terms. As we will see in the next section, changing these assumptions can have significant effects on the model results while the survey evidence suggests that scheme closures are likely to continue.

6.3.4 As a stylised alternative, the case where all schemes are closed to new members in five years and closed to new accruals in seven years was considered (the construction of the model making either a gradual pattern of closure, or closure of some schemes impractical to model). The assumption that schemes will close has the affect of reducing the size of the claims as the schemes will not continue to accrue benefits. The impact on the 10 year results is to increase the Pension Protection Fund's mean surplus by £0.9bn from £3bn to £3.9bn and to reduce the deficit at the 95th percentile by £4.3bn (the change in assumptions didn't affect the 5 year results).

6.3.5 In practice scheme closure would be likely to be gradual, and see a proportion of schemes remain open at the end of 5 years. So a best estimate of the surplus/deficit will lie between the two modelled figures.

Assumption 2: Scheme benefits

6.3.6 There was assumed to be no scaling back in scheme benefits in the 2006 runs with benefits broadly increasing with average earnings growth.

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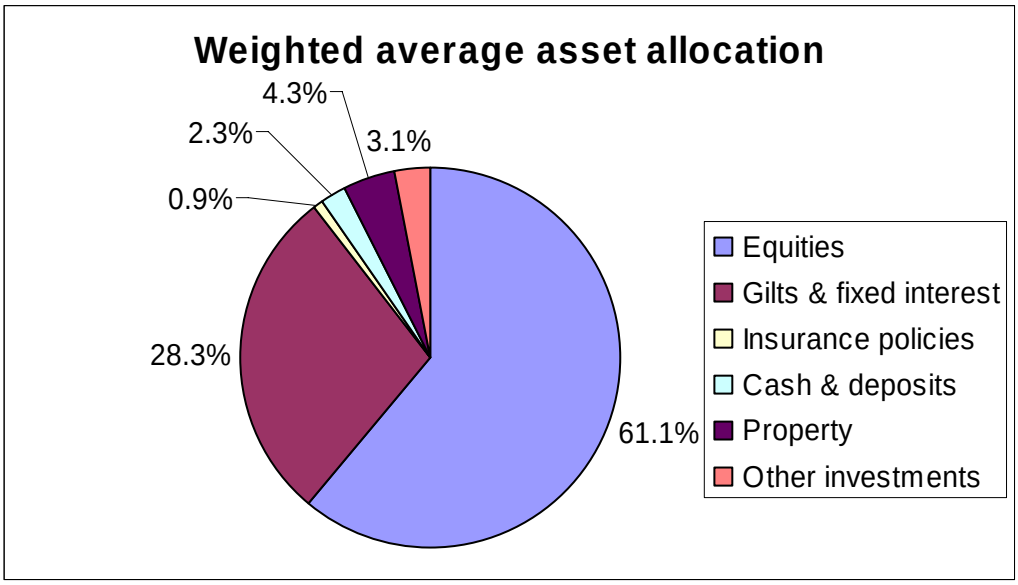
6.3.7 As an alternative, it was assumed that benefits increase by ½ a percentage point less a year than wages, simulating the effect of employers switching remuneration to non-pensionable pay or other actions to reduce pension costs. In the 5 year simulation this increases the PPF's mean surplus from £1.1bn to £1.4bn while the deficit at the 95th percentile is reduced from £5bn to £4.3bn.

Assumption 3: Asset allocation

6.3.8 The data on asset allocation used in the model comes from the Scheme Returns sent to the Pensions Regulator. In the scheme return, six classes are identified: equities, gilts and fixed interest, insurance policies, cash and deposits, property, and other. The 2005/6 scheme returns showed that pension funds had 61% of their assets in equities and 28% in gilts (see the Purple Book 2006 page 60).

Figure 14: Weighted average asset allocation



6.3.9 In the 2006 model runs it was assumed that:

- Schemes invest in five asset classes – equities; gilts and fixed interest; cash and deposits; property and other. These correspond to the available asset allocation data collected by TPR in the scheme return
- Equities and fixed interest are assumed to be UK only
- Asset allocation is fixed for the model forecast horizon[41]
- There is no hedging of assets or liabilities
- There is no additional use of contingent assets

6.3.10 Two sensitivities to alternative assumptions were explored:

- In the first, the equity holdings of all schemes were split 50:50 between UK and overseas holdings rather then being all UK holdings. (The economic scenario generator produces separate rates of return on UK and overseas equities reflecting such factors as different cyclical and structural developments in other advanced economies, and the inclusion of emerging markets in the "overseas" category.)
- In the second, the bond share in total assets is set at 60% for all schemes from 2007 and the equity share at 40%.

6.3.11 When equities were split 50:50 the size of the surplus in the better outcomes was higher and the deficit at the 95th percentile was lower than in the base case (taking the mean of the claims distribution the surplus after 5 years improves from £1.1bn to £1.3bn). By diversifying equity portfolios, schemes can benefit from lower risk when UK equities begin to slide. If schemes changed to 60% bonds then the effect on the balance sheet would be very similar to having a 50:50 equity split.

[41] The asset allocation at the start of each year in the model run is set to the asset allocation supplied in the scheme return

6.3.12 However, when the two assumptions for asset allocation are taken together the balance sheet improves by a little less than by adding the benefits of the two individual changes together. This is because the benefit from equity diversification is diluted by the lower equity share.

Assumption 4: Scheme funding

6.3.13 In the 2006 model runs, attempts were made to reflect some of the key features of the scheme funding regime and the impact that they may have in stimulating deficit reduction contributions. For example, the level of technical provisions as a percentage of S179 liabilities was assumed to be higher for weaker employers. The recovery period varied according to employer strength and funding; the shortest recovery period of 10 years was for schemes with a strong sponsoring employer and a funding ratio greater than 75%. The deficit contribution was effectively recalculated each year as scheme assets and liabilities changed. (It should be noted that in the absence of the new scheme specific funding regime the model runs would still have assumed some deficit repair.)

6.3.14 The specific assumptions used in 2006 are shown below. It is worth noting that these were chosen as initial assumptions, prudent from a PPF perspective,[42] and made in the absence of any data in this area. These assumptions will be reviewed in the light of emerging evidence from the Pensions Regulator on technical provisions and recovery periods so that the assumptions for 2007 and later years could well point to higher contributions from the sponsoring company, reflecting higher technical provisions and shorter recovery plans.

- The target technical provisions for schemes with a strong sponsor (those with a credit rating better than or equal to BB) were 95% of S179 liabilities
- The target technical provisions for schemes with a weak sponsor (those with a credit rating below BB) were 100% of S179 liabilities.

Strength of the employer	Current funding ratio[43]	Technical provisions[44]	Recovery period (years)
Strong sponsor	>=75%	95%	10
Strong sponsor	<75%	95%	15
Weak sponsor	<85%	100%	30
Weak sponsor	>=85%	100%	15

- Recovery periods depended on the strength of the employer and current funding ratio.

[42] i.e. they are prudent in that they tend to understate the impact of improvements to funding. This should not be confused with a prudent approach for the individual scheme

[43] Based on estimated section 179 liabilities using data submitted in the scheme return

- In calculating the deficit reduction contribution for each scheme for each year, the model takes any shortfall between the technical provisions and the value of assets and divides it by the length of the recovery period.
- New accruals are automatically funded with contribution even if the fund is in surplus (i.e. no contribution holiday).

6.3.15 In the alternative scenario chosen to illustrate the possible impact of different levels of deficit reductions, technical provisions are assumed to be higher than in the baseline while deficit reduction is accelerated by assuming that pension schemes amortise their scheme funding deficit twice as quickly as in the baseline scenario. The increase in the PPF's mean surplus after 5 years from the accelerated recovery plan is £0.6bn (from £1.1bn to £1.7bn) while the increase for more aggressive targets is £0.2bn.

Strength of the employer	Current funding ratio	Technical provisions	Recovery period (years)
Strong sponsor	>=75%	100%	5
Strong sponsor	<75%	100%	7.5
Weak sponsor	<85%	120%	15
Weak sponsor	>=85%	120%	7.5

Assumption 5: Longevity

6.3.16 The mortality assumption on which the model is currently based is the PA92 tables with medium cohort improvement rates. A feature of this assumption is that a 65-year-old male is currently assumed to have a life expectancy of 22 years. This assumption is currently under review; and it is expected that it will be replaced in the model by more conservative mortality assumptions (i.e. by assumptions that lead to increased life expectancies).

6.3.17 As an alternative, a 10% reduction in mortality rates was considered. This causes an increase in the average life expectancy of slightly less than 1 year at age 65. The impact on the balance sheet from this change is a £1.0 bn decrease at the 95th percentile over ten years.

6.3.18 A summary of the impacts on the PPF's surplus or deficit at the end of 5 years of each of the alternative assumptions modelled is included below at table 5.

[44] Expressed as a percentage of section 179 liabilities

Table 5: PPF's 5 year balance sheet (i.e. at end 2012) under different circumstances

5 Years	Mean deficit/(surplus)	75th percentile deficit/(surplus)	95th percentile deficit/(surplus)
2006 baseline	(£1.1bn)	(£0.2bn)	£5.0bn
Change in benefits	(£1.4bn)	(£0.5bn)	£4.3bn
60% bonds	(£1.3bn)	(£0.2bn)	£4.5bn
Equity split (50% UK, 50% overseas)	(£1.3bn)	(£0.3bn)	£4.3bn
60% bonds 50/50 UK/ overseas equity split	(£1.4bn)	(£0.4bn)	£3.7bn
Accelerated recovery plan	(£1.7bn)	(£0.8bn)	£3.8bn
More aggressive targets	(£1.3bn)	(£0.4bn)	£4.5bn
Improved Longevity	(£0.9bn)	£0.1bn	£5,6bn

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Chapter 7

Possible future development and use of the LTRM

Chapter 7: Possible future development and use of the LTRM

This chapter considers future potential development of the LTRM, including the possibility of third party use of the model to explore academic inquiry

7.1 Consideration of the model's assumptions

7.1.1 Pension fund and sponsoring company behaviour respond to changes in the economic, financial market, intellectual and regulatory environment and the sensitivity analyses demonstrated that changes in behaviour can have a material impact on the future balance sheet of the Pension Protection Fund. This section explores some of the key questions the Board is considering in relation to the assumptions to be used in future model runs. The Board would welcome views on the issues raised.

Scheme closure and scheme benefits

7.1.2 It was noted earlier that the pace of scheme closure has slackened, and in the 2006 LTRM runs it was assumed that there were no further scheme closures and no reduction in scheme benefits. Improving scheme funding so far in 2007, with more schemes moving into surplus, could lead to fewer closures.

7.1.3 However, developments in the early 2000s may have led to a sea-change in sponsoring employers' awareness of the risks associated with DB schemes while surveys point to further scheme closures in the future. The Association of Accounting Actuaries "ACA Pension trends" survey published in July and conducted in early 2007 found that that 81% of DB schemes were closed to new members, up from 68% in 2005. The 2005 NAPF survey, based on a different sample, suggested the percentage of schemes closed to new members would rise to 84% by 2010 up from 60% in 2005. Out of those closed to new members in 2010, 16% would also be closed to new accrual, up from 3% in 2005.

7.1.4 What is the most appropriate assumption for trends in scheme closure to: (i) new members and (ii) new accrual? It should be remembered that at present it is only possible in the model to assume no further scheme closures for the forecast period or to assume that all schemes are closed to new members from a particular date, or to assume closure to new members from a particular date and complete closure to new accrual usually from a later date. So, practically, the issue for the Board is as much one of how much weight to put on each of the necessarily stylised assumptions, as it is an issue of modelling.

7.1.5 There have also been numerous moves by companies in recent years to reduce the cost of DB schemes by reducing scheme benefits e.g. by raising retirement ages or basing the pension on career average salary rather than final salary. It is less clear whether this trend will continue or has run its

course. In last year's sensitivity analysis this was captured by assuming that the real pensionable pay increase was reduced by ½% a year over the forecast horizon which would be broadly equivalent to the effect of three quarters of scheme's extending normal pension age by 5 years. In practice one might expect to see a proportion of schemes adopting a combination of one or more of changes to career average salary, extending pension age or increased use of non-pensionable pay.

Asset allocation

7.1.6 Future model runs are expected to build in a 50:50 UK/overseas equity split. But the Board is also considering the potential impact of the growth of the LDI approach to fund management with its focus on switching to bonds that more closely match duration of liabilities and use of inflation and interest rate swaps. In principle, LDI could be reflected by an adjustment to overall claims, or modelled at the level of individual schemes or a combination of both. It should again be remembered that it is difficult at present to build in a gradual process (hence the alternative assumption was cast as a 60/40 bond/equity split from the outset) and so again a stylised assumption will be needed. The Board is currently considering how it might most cost-effectively develop it's understanding in this area, without imposing undue burdens on schemes.

Scheme funding

7.1.7 It is proposed to update the assumptions made in the 2006 runs in the light of the information on technical provisions and recovery plans coming from the first 2,500 schemes. Data on the recovery plans will be published by the Pensions Regulator in September.

Longevity

7.1.8 It was noted in the previous chapter that the model takes estimates of pension fund liabilities using a common longevity assumption – the medium cohort from the PA92 longevity tables – but that this is under review with an expectation that there may be a move to a more conservative assumption.

7.2 Possible future developments of the model

7.2.1 The key assumptions discussed in Chapter 6 will be kept under review. But there may be other changes affecting the Pension Protection Fund's risks. Examples of developments which could have a significant impact are greater buy-out activity, possibly associated with new entrants to the market, or more widespread use of hedging techniques, such as interest rate and inflation swaps.

7.2.2 One aspect of the new scheme funding regime that is not captured by the LTRM is the possible impact of changes in the strength of employer covenant on recovery plans. It is possible to adjust employer contributions in response to changes in bond yields affecting technical provisions, or asset prices (for

the schemes of companies that become insolvent), but it is not possible to change the level of technical provisions or recovery plan length according to the changes in the employer covenant as captured by credit ratings. Under the scheme funding regime if a company's credit rating falls dramatically, then at the tri-annual review its technical provisions could rise but its recovery programme may be lengthened so that its annual contributions are reduced or the opposite may happen. Capturing such effects would require development work.

7.2.3 Presently the long-term risk model is based on a specified mortality assumption. Future mortality is uncertain and so it is important to be able to demonstrate the sensitivity of results to varying the mortality assumption. At present this can only be done by rerunning the model with a modified mortality assumption. It is theoretically possible to adopt a stochastic, rather than a deterministic, mortality assumption. The results would show a greater volatility, but this could be a better representation of the uncertain future. Of course, introducing an additional stochastic analysis would complicate the model, and it would be difficult to decide what the appropriate variability about the expected future mortality should be.

7.3 Making additional use of the LTRM

7.3.1 The long term risk model has been developed by the Board of the PPF to fulfil a specific requirement to model the PPF's risk – principally to contribute to the setting of the levy quantum. However, the Board has already found additional uses for the model – as noted in chapter 2 – to assist in assessing risk transfer and in evaluating the Board's investment strategy.

7.3.2 The Pension Protection Fund is exploring with the Pensions Regulator the possibility of using the LTRM to explore the impact of the new scheme funding regime on scheme funding in general. At present, the LTRM may be used to explore the impact of the scheme funding regime on the probability distribution of claims on the Pension Protection Fund. Given this focus the funding calculations only need to be carried out in those cases when a sponsoring employer becomes insolvent. Enabling the model to calculate funding for all schemes for all the scenarios modelled would require model development and considerably more computing capacity.

7.3.3 The Board would be interested to receive ideas about further analysis that might be carried out. Proposals could be simply a suggestion to model a particular variable in a different way – since the PPF recognises that its model is a work in progress and would welcome the ideas of external parties. Alternatively, the Board would be interested in hearing expressions of interest in working with the PPF on a research project to develop an aspect of the model.

7.3.4 The proprietary nature of parts of the model – and data protection issues around scheme specific information - mean that the PPF is not in a position to offer unfettered access to the model to any third party. Any project would

need to be of a research rather than commercial nature. However the Board believes that this need not prevent the use of the model and underlying data to produce interesting and informative research which could be published academically.

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Chapter 8

Data

Chapter 8: Data

This chapter summarises the data gathering and management that underlies the model. A fuller discussion of the information sources that the PPF uses for its analysis is included in the Purple Book

8.1 Data sources for the model

8.1.1 The information used in the model came from three primary sources:

- Scheme returns provided to the Pensions Regulator;
- Voluntary form reporting
- Information from credit rating and referencing agencies.

Scheme returns provided to the Pensions Regulator

8.1.2 The scheme returns include valuation information on scheme assets and liabilities, asset allocation, the employers, scheme type and status, membership details, the trustees and their advisers. There were 6360 schemes with sufficient data to be used in the LTRM in October 2006 in the run up to the levy quantum decision. This sample made up 59% of what was thought to be the universe in terms of schemes at the time and contained nearly 90% of pension liabilities as most of the large schemes were included. Of the largest schemes, those with over 5,000 members, more than 90% were included, compared with only 35% of schemes with less than 100 members (table 6).

Table 6: schemes in the sample

Size of scheme (number of members)	Less than 100	100- 999	1,000-4,999	5,000-9,999	More than 10,000	Total
Number of schemes in sample	2,065	3,052	823	187	233	6,360
2007 estimate of the universe	2840	3570	920	210	260	7800
Schemes in sample as a percentage of the universe	73%	85%	91%	89%	90%	82%

Voluntary Form Reporting

8.1.3 Electronic forms were available on the Pension Protection Fund's website for pension schemes to provide data regarding sectionalised schemes, contingent assets, participating employers, scheme structure, estimates of pension fund deficits on a S179 basis, deficit reduction contributions, and block transfers.

Insolvency failure scores supplied by Dun & Bradstreet (D&B)

8.1.4 The Dun & Bradstreet failure scores (running from 1 to 100), which cover all the companies in the business universe, are designed to predict the likelihood that a company will cease operations without paying all creditors over the next 12 months. A mapping from failure scores to insolvency probabilities is then used in the Pension Protection Fund's risk based levy calculations.

8.1.5 The failure score is created using a statistical modelling technique that looks at the D&B databases to determine which data characteristics are common to failing companies and successful companies, and then uses this knowledge to build a scoring system. For multi-employer schemes, the Pension Protection Fund needs to adapt the D&B probabilities to make its own calculations of insolvency risk. A weighted average calculation of insolvency is calculated for the multi employer schemes.

Moodys credit ratings

8.1.6 In the 2006 model runs, D&B insolvency scores were mapped on to Moodys credit ratings. The mapping was based on historical data from Moodys with the default rate of each credit rating being matched to the equivalent D&B insolvency score. Within the model a transition matrix provided by Moodys is used to change sponsoring employers' credit ratings over time. For the future, where they are available, the PPF will use credit ratings and default probabilities, rather than map D & B scores to credit ratings. Where credit ratings are not available a mapping from D & B scores will continue to be needed.[45]

Funding

8.1.7 The scheme returns required that an MFR or s179 valuation is given. Using these valuations the PPF converted them to a consistent date as well as converting those on MFRs to the s179 methodology. The PPF uses the s179 valuation methodology, which is a common basis for all schemes, to see how well funded a pension scheme is. This valuation helps the PPF to determine its risk and where that risk comes from as well as providing a way to apportion the risk based levy. s179 is a specific basis that relates to the levels of

[45] The use of credit rating data here contrasts with the use of D&B data for calculating the levy. This reflects the differing requirements of the two tasks. For the levy it is important to use a consistent approach to ensure fairness between schemes. In calculating aggregate risk the issue of consistency of approach is less relevant, and as a credit rating is required for transition matrices it makes sense to obtain this directly where possible and derive it where not.

compensation that the PPF will give when an underfunded scheme has a qualifying insolvency event.

8.2 Data quality

8.2.1 A key task for the PPF has been to ensure that the data received from schemes is accurate – to ensure that the information used for individual billing and for modelling aggregate risk is of good quality. The PPF and TPR in developing electronic forms such as the scheme return and the voluntary forms have made steps to include checks to improve data quality automatically (e.g. ensuring that breakdowns of assets must sum to 100%) – particularly in more recent versions of scheme returns. However this still left a significant task to check and validate information received.

8.2.2 For data submitted in 2005/06 this involved individually reviewing the data collected on around three quarters of schemes – and actually contacting several thousand schemes to check one or more pieces of information. One result of this exercise has been a recognition that there are fewer defined benefit schemes than had previously been thought: resulting in a downward revision to the estimate of the universe of eligible DB schemes, from 10,800 to around 7,800 since the publication of the Purple book. This has had a very limited impact on the global level of DB liabilities, as the overwhelming proportion of the adjustment has been in terms of small and very small schemes.

8.2.3 In addition to data cleansing, there has also been an exercise to test the validity of voluntary forms collected, for example, reviewing the documentation supporting forms notifying the PPF of a contingent asset, to ensure that it meets the PPF's criteria for inclusion as a scheme asset. This provides re-assurance that the reduction in aggregate risk allowed for in the model, in respect of contingent assets, is reasonable.

8.2.4 A similar exercise is currently underway for information received in 2006/07, and whilst it is anticipated that there will be some improvement in data quality – as schemes become more familiar with the requirements of the regulatory framework and ongoing improvements to automatic checks – this is still anticipated to require reviewing the responses of a quarter of schemes.

8.3 The use of pooling

8.3.1 In order to make the running of the LTRM manageable, the largest single employer schemes, according to liabilities, are identified separately. The remainder of 'small' schemes are grouped together if they share the same employer and have the same scheme status (the three statuses are open, closed to new members and closed to future accrual). If any of the groups have total liabilities greater than the smallest large scheme identified, they are counted as one of those 'big' schemes.

8.3.2 The rest of the schemes are pooled together by the three scheme statuses and 15 industry sectors. Finally, cluster analysis is used on each of the groups so that the groups have schemes with the same status, industry and similar funding level. Groups are also created for the missing universe. There are two groups for each credit rating, one for schemes in surplus and the other for schemes in deficit. The known schemes are split by membership size and credit rating and the missing universe is created from this by keeping the proportions the same. There has been no attempt to work out the industry sector or scheme status of the missing universe as this could double the number of groups used.

Chapter 9

Arrangements for comments

Chapter 9 – Arrangements for comments

9.1 Responses

9.1.1 The Board of the Pension Protection Fund welcomes your views on the issues contained in this information paper and in particular thoughts on the areas that have been flagged for further development in chapter 7.

9.2 Arrangements for comments

9.2.1 Please send all comments to:

Martin Clarke
Director of Financial Risk
Pension Protection Fund
Knollys House
17 Addiscombe Road
Croydon
CR0 6SR

Tel: 020 8633 4900
Email: ltrm@ppf.gsi.gov.uk

9.2.3 When responding please state whether you are responding as an individual or representing the views of an organisation. If responding on behalf of a larger organisation please make it clear who the organisation represents, and where applicable, how the views of members were assembled. If responding on behalf of a pension scheme please include the scheme's Pension Schemes Registry number (PSR).

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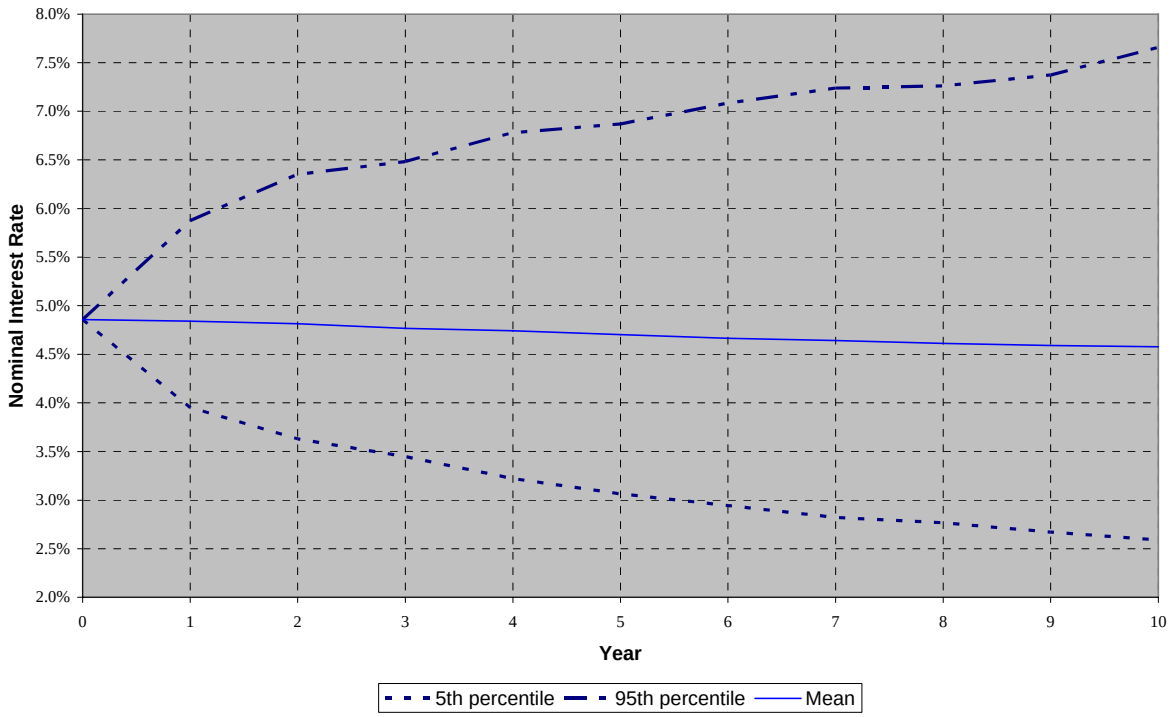
Annex

Key outputs of the economic scenario generator

Annex A: Key outputs of the economic scenario generator

Barrie and Hibbert's Economic Scenario Generator (ESG) is an asset model which produces distributions for key assets over a number of years. The following charts and tables summarise the output from the ESG software. The charts show the mean, 5th percentile, and 95th percentile over 5 years for nominal gilt rates (for 30 years), real gilt rates (for 30 years and short rates), and inflation rates and the return on equities. All these are based on data from Barrie and Hibbert for end June 2007, this is the data (subject to any changes such as that being considered to reduce the volatility of real gilt rates) that will be used for the model runs on which next year's levy quantum is decided by the Board[46]. In contrast, the insolvency risk chart is derived using both the ESG and the Insolvency Engine, and as the latter has not yet been run with 30th June data, is based on interim runs using economic information to December 2006.

Chart 1: 30 years Gilt yield scenarios (nominal)



[46] Information on the calibration used to produce last year's claim distribution and PPF balance sheet (reproduced in chapter 3) is included in the Levy estimate consultation document of December 2006.

Chart 2: 30 years Inflation Linked Gilt yield scenarios

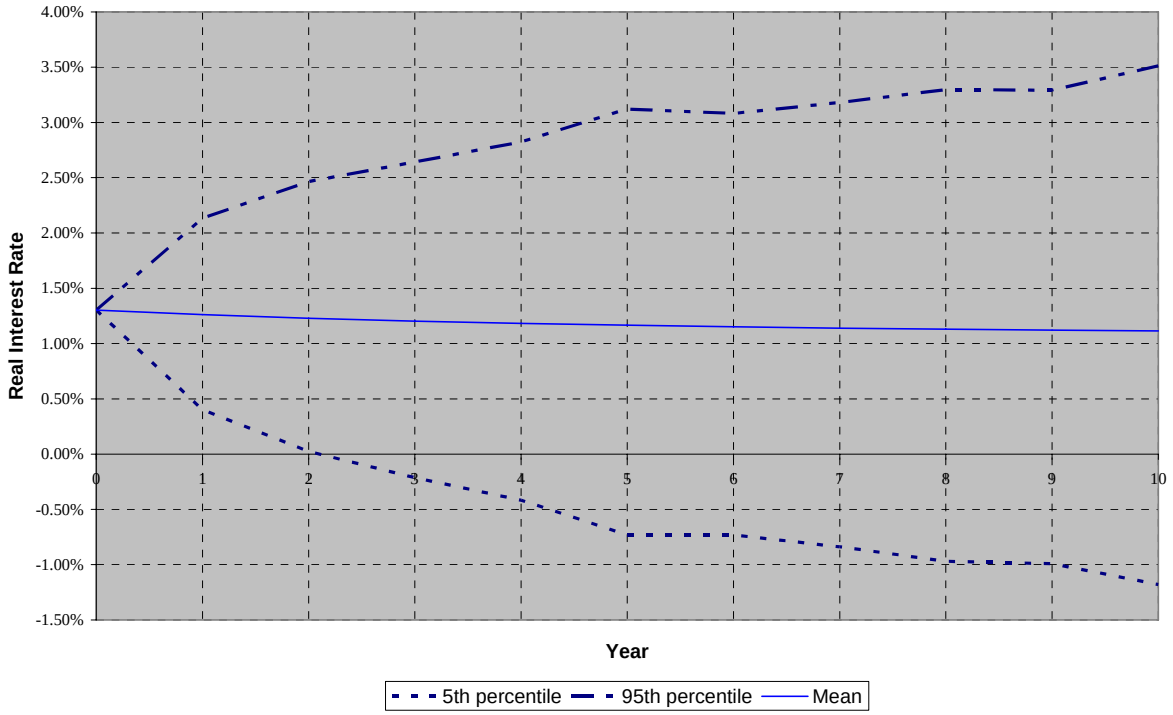


Chart 3: Inflation rate scenarios

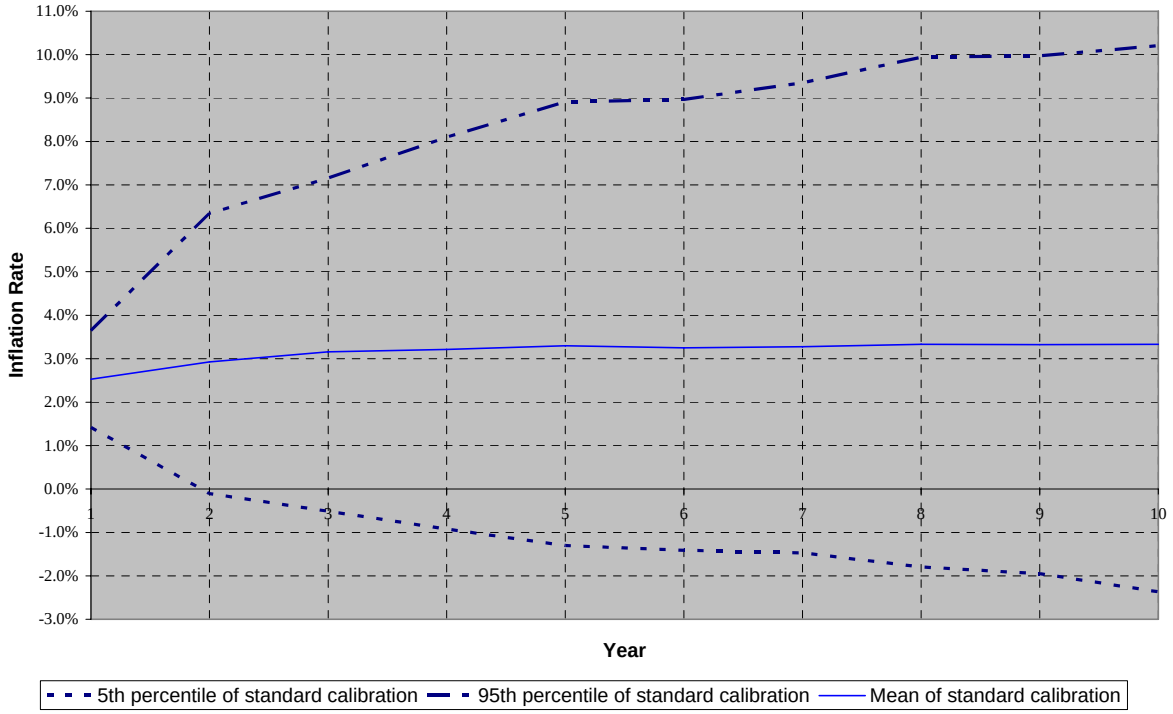
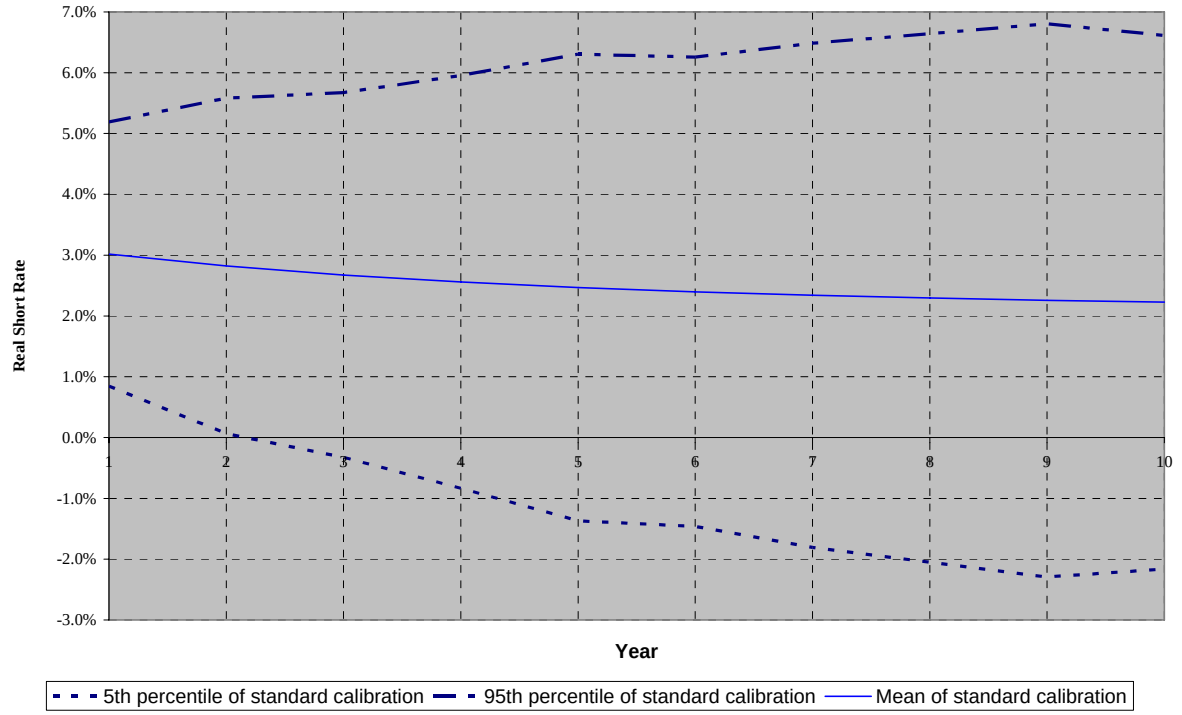


Chart 4: Real short rate scenarios



The following charts summarise the 5 years total equity return and the insolvency risk (baa) produced by the Economic Scenario Generator.

Mean total equity returns[47] average 9.46% pa, with a standard deviation of 0.2215.

Insolvency risks are measured over the five years of a model run. The mean risk of a company initially rated Baa becoming insolvent in those 5 years is 1.69%.

[47] Total equity returns include both dividend and asset price returns and are measured against a zero base (i.e. they include the cash return and the equity risk premium)

Chart 5: Distribution of the 5 years total equity return

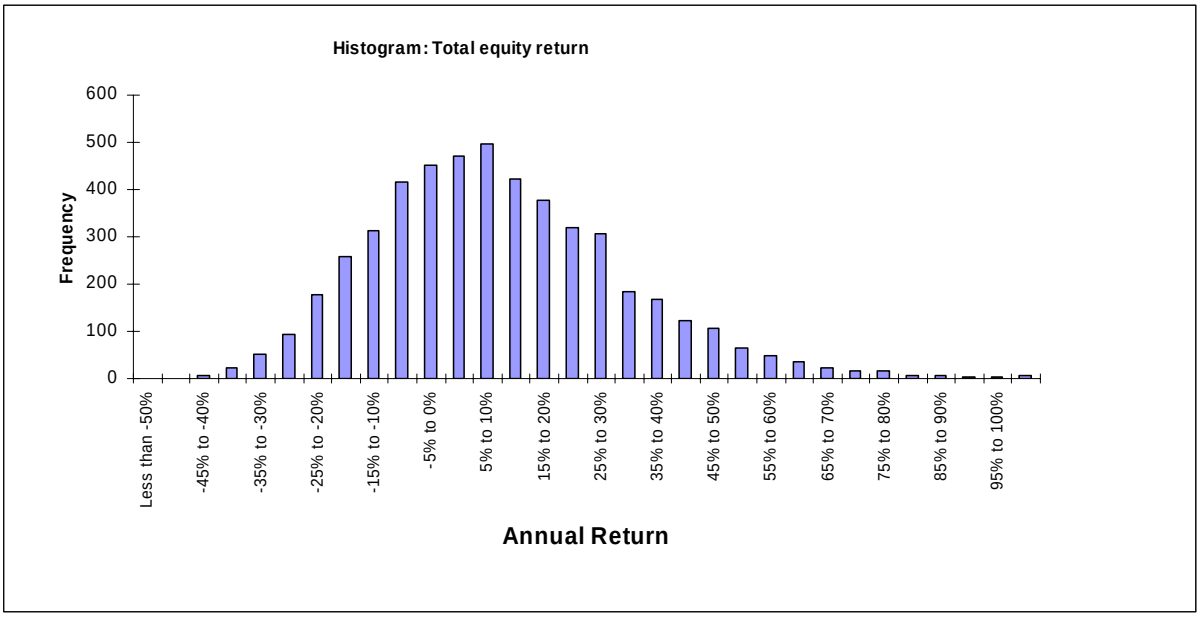
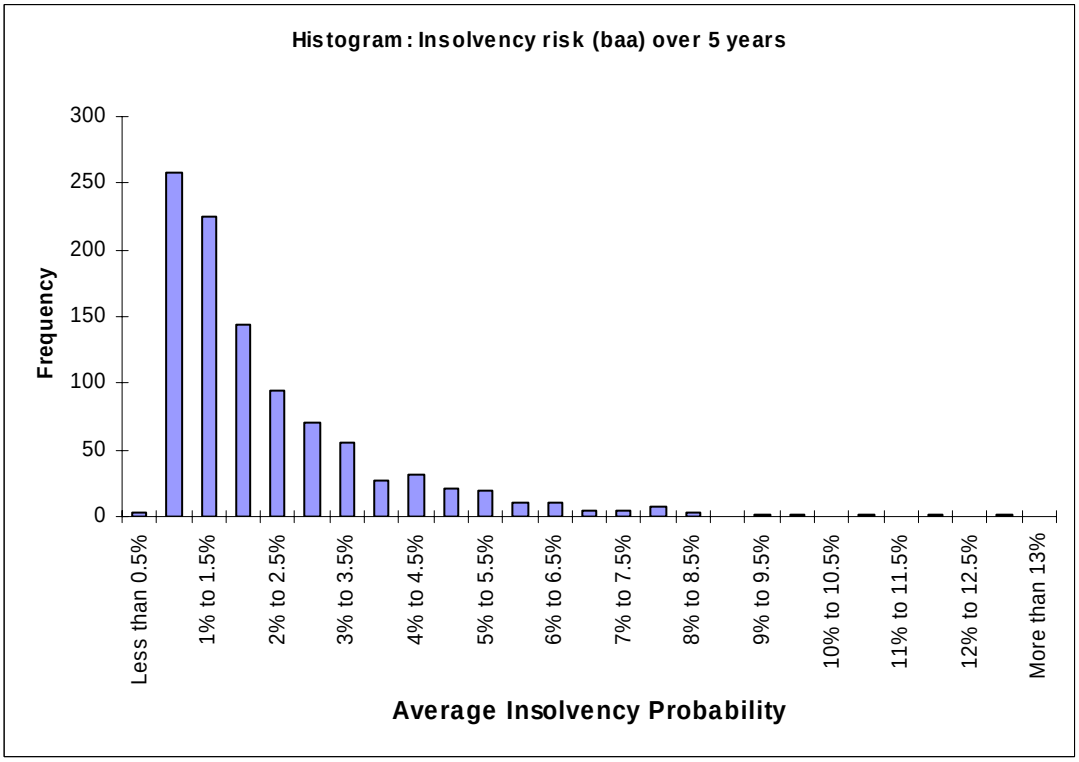


Chart 6: Distribution of the 5 year Insolvency risk (for initially baa)



Glossary

Active member	A person who is in pensionable service under an occupational pension scheme.
Assessment period	If a qualifying insolvency event occurs in relation to an employer of an eligible scheme, this will trigger the beginning of an assessment period. During this period the PPF will assess whether or not it must assume responsibility for the scheme.
Associated	A pension scheme which has more than one sponsoring employer and where the sponsoring employers are linked to the same parent company or have a financial dependency on each other.
Closed scheme	A pension scheme which does not admit new members. Contributions may stop being paid and benefits in relation to future service may stop accruing.
Deferred member	A member of an occupational pension scheme who is no longer accruing benefits in respect to current service but is not yet a pensioner.
Deficit	The difference between the value of a pension scheme's assets and the value of its liabilities, where the assets are lower in value
Defined Benefit pension scheme	This is where the rules of the scheme decide how much pension the member will get. There are different ways of working out the size of the pension, but the member will know which system the scheme uses. The most common type of defined benefit pension scheme is a final salary scheme. A defined benefit pension scheme may include the defined benefit part of a hybrid scheme, for example a scheme that pays a combination of defined benefit and money purchase benefits.
Eligible schemes	A Scheme as set out in s126 of the Pensions Act 2004. Eligible schemes will be liable to pay the Pension Protection Fund levy and the scheme members may be entitled to compensation should a qualifying insolvency event occur in relation to the sponsoring employer.
Multi-employer schemes	Occupational pension scheme which has more than one sponsoring employer.
Non-sectionalised scheme	A multi-employer scheme which is not divided into sections.
Occupational pension scheme	A pension scheme organised by an employer or on behalf of a group of employers to provide pension benefits in respect of one or more employees on leaving service or on death or in retirement.
Open scheme	A pension scheme which admits new active members.
Pensioner member	A member of an occupational pension scheme who is currently receiving a pension, including those dependants currently receiving pension following the death of a member.

Pension protection levy	Money paid to the Pension Protection Fund by eligible schemes to pay towards the cost of compensation. See initial levy and risk based levy.
Risk based levy	Money paid to the PPF by eligible schemes, dependent on the level of underfunding, the insolvency risk posed by the employers, and other risk factors.
s179 valuation	An actuarial valuation undertaken by all eligible scheme to determine the underfunding risk for setting the risk based levy.
Sectionalised scheme	A multi-employer scheme which is divided into two or more sections where: (a) any contributions payable to the scheme by an employer in relation to the scheme or by a member are allocated to that employer's or that member's section; and (b) a specified proportion of the assets of the scheme is attributable to each section of the scheme and cannot be used for the purposes of any other section.
Sponsoring employer	An employer who has agreed to provide benefits to employees under a pension scheme.
Surplus	The excess of the value of the assets over the value of the liabilities in a defined benefit pension scheme on a particular basis.
The Pensions Regulator	The regulatory body for occupational pension schemes in the UK.
Underfunding	This is when the value of a pension scheme’s assets is less than the value of its liabilities.

Abbreviations

AEI	Average earnings index
DB	Defined benefit
D&B	Dun and Bradstreet
FRS 17	Financial Reporting Standard No. 17
FoI	Freedom of Information
GAD	Government Actuary's Department
LTRM	Long term risk model
MFR	Minimum funding requirement
NAPF	National Association of Pension Funds
ONS	Office for National Statistics
S&P	Standard & Poor's
TPR	The Pensions Regulator

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