

Enterprise Risk Management
at the U.K. Pension Protected Fund

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**ENTERPRISE RISK MANAGEMENT
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ABSTRACT

The U.K. Pension Protection Fund (PPF) was established in April 2005 to protect the pensions of members of U.K. private sector defined benefit pension schemes that have insufficient assets and whose corporate sponsor fails. The fund takes over the pension scheme assets and assumes responsibility for the payment of compensation to the former members of the scheme. PPF is funded by a levy on the population of eligible schemes. The elements of the enterprise risk management of the fund have been developed by reference to practice within proprietary insurance institutions and other pensions funds; their application to this unique financial vehicle is the subject of this paper. The paper draws on references to relevant risk and actuarial work. It is designed to illustrate the application of principles and techniques to a real world example.

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1 INTRODUCTION

- 1.1 Kemp and Patel (2011) described the many ways they believe it makes sense for pension funds to adopt enterprise risk management (ERM). They observe that organizations outside the pensions arena are increasingly focusing on holistic risk management, recognizing the value that it should bring. They conclude, "Pension funds do have some unique characteristics, but non-exposure to a wide variety of interconnected risks is *not* one of them."
- 1.2 The U.K. Pension Protection Fund (PPF) is a unique institution with an extremely valuable mission. Even in global terms, it differs in some material ways from its international comparators such as the Pension Benefit Guaranty Corp. (PBGC) in the USA, the experience of which guided much of the PPF's construction.
- 1.3 The PPF is itself a product of a holistic approach to risk management, albeit at a governmental level. This paper, however, concerns itself with the interconnected risk environment in which the PPF operates and the principles and practices the fund has established to manage those risks with a clear focus on the many thousands of pension scheme members that will rely on PPF for an income in retirement.
- 1.4 In effect this paper is a detailed case study. It is written by two of the individuals who have worked to create and implement the financial objective, funding framework and enterprise risk management of the fund.
- 1.5 The paper sets the scene in Section 2 with a brief description of the history, role and purpose of the PPF and, in the succeeding sections, aims to provide a thorough description of the main elements of the risk and financial management processes of the fund and in particular to illustrate ways in which the fund has embraced the holistic approach referred to in 1.1.
- 1.6 Section 3 describes the financial risk management process beginning with the PPF board's risk appetite and progressing to the detailed identification and measurement of key financial risks. A key element of the risk measurement tool kit is the PPF internal stochastic model, a high level description of which is given in the appendix.
- 1.7 Section 4 describes the rationale for the PPF's long-term funding objective to be self-sufficient by 2030. This section also provides an overview of the funding framework, which aims to capture the complete set of financial risks to which the fund is exposed and in the context of which long-term strategic decisions are made. It is the

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development of this funding framework, the PPF's comprehensive internal model and the embedding of risk management at many levels within the business that comprise the ingredients of this case study.

2. HISTORY AND BACKGROUND

- 2.1 The PPF was created in 2005 in response to concerns about the fate of members of underfunded defined benefit (DB) pension schemes should the scheme sponsor become insolvent.
- 2.2 Established as a statutory corporation, the PPF is run by a board that is independent of government. Powers conferred on the board give it responsibility for managing the calculation and application of three levies (the Pension Protection Levy, the Administration Levy and the Fraud Compensation Levy) and setting the fund's investment strategy. A primary driver for conferring these powers on the board was to ensure that the activities of the PPF would be independent of and not have to be underwritten by the government and ultimately taxpayers.

Chart 2.1 Key facts about the PPF (as of the end of March 2011)

Key facts as of March 31, 2011
<p>The PPF universe of eligible DB schemes comprised 6,550 pension schemes with 12 million members and aggregate liabilities of £943 billion, measured under the basis set in accordance with Section 179 of the Pensions Act 2004.</p> <p>More than 330 pension schemes with, in total, nearly 90,000 members had transferred to the PPF. An additional 355 schemes with 208,000 members were in a PPF assessment period during which the scheme is assessed for PPF entry.</p> <p>The PPF's balance sheet had grown significantly to the point where, as of March 31, 2011, £7 billion of assets were under direct PPF management, with a further £7 billion of assets managed by schemes in an assessment period.</p>

- 2.3 Broadly speaking, the PPF provides two levels of compensation. For individuals who have reached their scheme's normal pension age or, irrespective of age, are either already in receipt of survivor's pension or a pension on the grounds of ill health, the PPF will generally pay 100 percent of the pension immediately before the insolvency event.

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- 2.4 For the majority of people below their scheme's normal pension age, the PPF will generally pay 90 percent of the pension an individual had accrued (including revaluation) immediately before the insolvency event. An individual's compensation is revalued in line with the increase in inflation as measured by the consumer prices index (CPI) between the assessment date and the commencement of compensation payments, this revaluation being subject to a cap of 5 percent compound per annum in respect of compensation attributable to pensionable service prior to April 6, 2009, and a cap of 2.5 percent compound per annum in respect of compensation attributable to pensionable service on or after April 6, 2009.
- 2.5 Compensation for members in the latter category above is subject to an overall annual cap. As of April 2011, this cap equates to £29,897.42 at age 65 after application of the 90 percent factor, with the cap being adjusted according to the age at which compensation comes into payment.
- 2.6 Once compensation is in payment (for either category of member), the part that derives from pensionable service on or after April 6, 1997, is indexed each year in line with CPI inflation capped at 2.5 percent.
- 2.7 While the PPF has the ability to alter the Pension Protection Levy (subject to certain statutory limits) to meet its liabilities, in extreme circumstances it is also possible to reduce compensation. First, revaluation and indexation can be reduced by the PPF, and, secondly, levels of compensation can be reduced by the Secretary of State on the recommendation of the board of the PPF. To date, the PPF has not articulated the circumstances in which these powers might be exercised and for the purpose of its financial management such scenarios are not explicitly modeled.
- 2.8 To fulfill its broader statutory objectives, the PPF must have sufficient funds to pay compensation to the members it protects. Income currently derives from four sources: the assets of pension schemes that transfer into the fund, recoveries from the insolvent sponsoring employers of those schemes, the annual Pension Protection Levy and returns on invested assets. Table 2.1 shows the development of the PPF balance sheet in the six years 2005-06 to 2010-11.

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Table 2.1 PPF assets, liabilities and claims experience. The funding ratio is based on the assets and liabilities of the fund measured according to the PPF valuation assumptions. The figures include those of schemes in assessment anticipated to transfer to the fund. Claims are measured in terms of the deficits of schemes entering an assessment period in the relevant year as measured in accordance with the actuarial basis set under the terms of Section 179 of the Pensions Act 2004.

	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Assets (£M)	2,086	4,409	5,554	9,330	12,257	14,043
Liabilities (£M)	2,429	5,018	6,071	10,560	11,863	13,366
Funding ratio	86%	88%	91%	88%	103%	105%
Claims in year (£M)	485	442	318	721	285	373

Source: PPF Annual Reports and Accounts.

- 2.9 Although short-term prospects for the PPF may be challenging owing to the current global economic climate, the long-term decline in private sector DB provision and the influence of regulation toward improved funding levels both tend to suggest that the risk to the PPF balance sheet is likely to diminish over time. A number of factors are likely to contribute to this, including regulatory intervention, a move to liability-driven investment and the overall decline in the number of schemes as they transfer their liabilities to the insurance regime, enter the PPF or otherwise become ineligible for PPF protection.
- 2.10 Against this background, the PPF recognizes there will come a point in time when the fund is unable to rely on surviving schemes to amortize any deficit it may have accrued. The PPF's current objective therefore is to be fully funded by 2030 with no further risk to the balance sheet at that point. This is the basis for the financial objective of the fund that is discussed in more detail in Section 4.

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3. FINANCIAL RISKS AND RISK APPETITE

3.1 *General principles and appetite for risk*

3.1.1 Good risk management should allow the PPF to have increased confidence in achieving its objectives, effectively constrain threats to acceptable levels and take informed decisions about exploiting opportunities.

3.1.2 In line with the general principles of enterprise risk management, the PPF adopts the following cycle in the management of risks:

- i. Board formulation of the strategy and risk appetite
- ii. Risk identification
- iii. Risk assessment
- iv. Risk mitigation/control
- v. Monitoring
- vi. Reporting

3.1.3 The PPF board has identified seven risk areas in its overall management of the PPF, and has determined an appetite for each area, as set out in Table 3.1 below. It will be observed that the risk areas that are primarily financial are the first two, and these are where the remainder of this section will be focused.

Table 3.1 The PPF's seven risk areas

Risk area	Appetite statement adopted by the PPF board
Funding and investment strategy	"We seek to provide security for current and future members, but recognise the potential cost to levy payers of aiming for a resilient balance sheet whilst high levels of external risk persist."
Investment operations	"We have a low appetite for operational risk in respect of our investment portfolio. We have put in place a strong control environment which is supported by accurate and frequent monitoring of asset and liability data."
Strategy/ environmental	"We have limited appetite for changes in the external environment not being identified and managed."

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Legal	"We favour prevention over cure, but not at any cost. We accept that untested legislation and the Board's obligation to set policy in some areas (notably levy) could lead to challenges. Judgemental caution will always be exercised in this area."
Operational	"We support innovation and empowerment and have an appetite to accept risks which would improve throughput and reduce costs where the materialisation of these risks would have a limited impact on the achievement of our stated goals."
Reputational	"We have limited appetite for accepting risks that will damage the PPF's reputation, but will tolerate risk taking where there is a low chance of a significant impact, and appropriate steps or plans are in place to minimise any exposure."
Organizational design/ culture	"We have limited appetite for an inappropriate culture, and will seek innovation and actively desire challenge to ensure that our culture remains fit for purpose."

3.2 Comparators from other sectors

3.2.1 PPF operations might easily be viewed as a combination of:

- A credit insurance business that would underwrite policies insuring the insolvency risk of the sponsors of DB pension schemes, and
- An annuity business that would take on the assets and liabilities of the claimant schemes.

3.2.2 With regard to the first aspect above, the PPF's major credit risk exposures are similar to the covenant risk of a typical private sector pension scheme. The aggregate credit exposure may be quantified as:

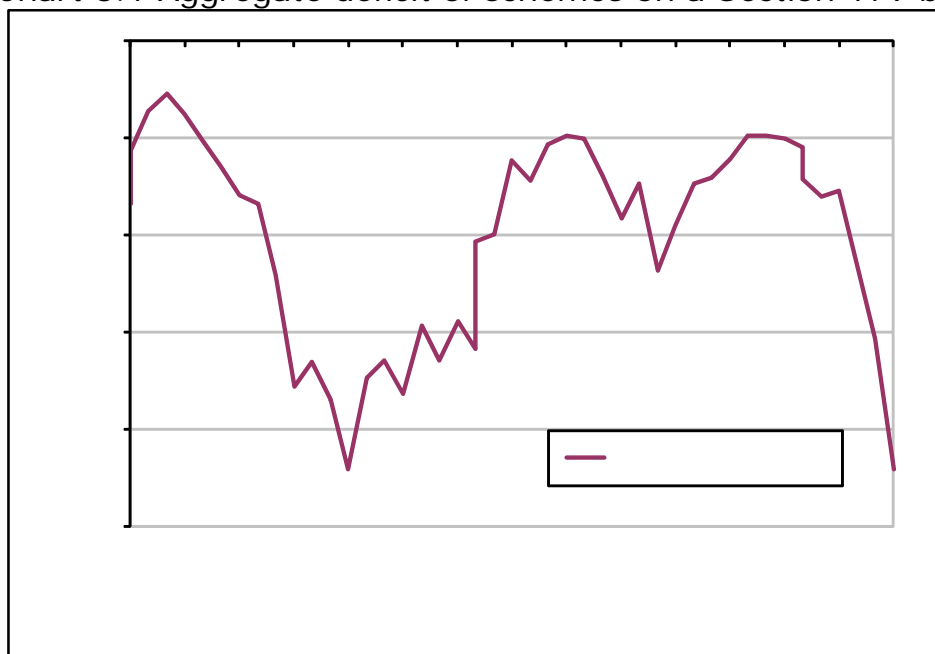
(Probability of default x Loss given default)

The summation is performed over the whole universe of eligible DB schemes. The "loss given default" is defined as the scheme deficit (if

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any) on a Section 179 basis, net of recovery from the insolvent sponsor(s). This measure is highly variable over time, as pension scheme funding levels fluctuate according to the value of both their liabilities and assets (which may not be positively correlated). The PPF 7800 index as shown in Chart 3.1 tracks the movement of aggregate Section 179 deficits (ignoring potential recoveries) over recent years.

Chart 3.1 Aggregate deficit of schemes on a Section 179 basis



- 3.2.3 Unlike a commercial insurer and some of its international counterparts, the PPF must accept the credit risk of sponsor default. Furthermore, the PPF has no control over the distribution of the risk across business sectors. The portfolio of credit risks is heavily tilted toward the manufacturing and service sectors, with underweight exposure to technology and other modern industries. Credit risk has both idiosyncratic and systematic or cyclical features (for example, insolvency rates typically rise immediately following a slump in GDP growth).
- 3.2.4 As mentioned in paragraph 3.2.1, the second component of the PPF's operations is analogous to an annuity business. Here, the PPF is exposed to similar risks to those faced by commercial annuity providers and which are described by Telford et al. (2010). These broadly comprise asset-liability mismatch (ALM) risk (risk that assets underperform liabilities because of mismatches between assets and liabilities), longevity risks, and operational risks such as those

associated with a large investment portfolio or with the maintenance of accurate annuitant data.

3.2.5 However, before the assets and liabilities of a scheme are taken on and managed directly by the PPF, the scheme undergoes a period of assessment to determine whether it had sufficient assets at the assessment date to buy out benefits above PPF compensation levels on the commercial annuity market. This assessment period can typically last between one and three years, during which time the estimated Section 179 deficit of the scheme (net of any anticipated recoveries) is carried as a provision on the PPF balance sheet. However, as the scheme trustees retain ultimate responsibility for the investment strategy during the assessment period, there is a risk that the deficit at the point of transfer could be higher than if the scheme had been subject to the PPF's own strategy for controlled assets. This "pipeline risk" is peculiar to the PPF.

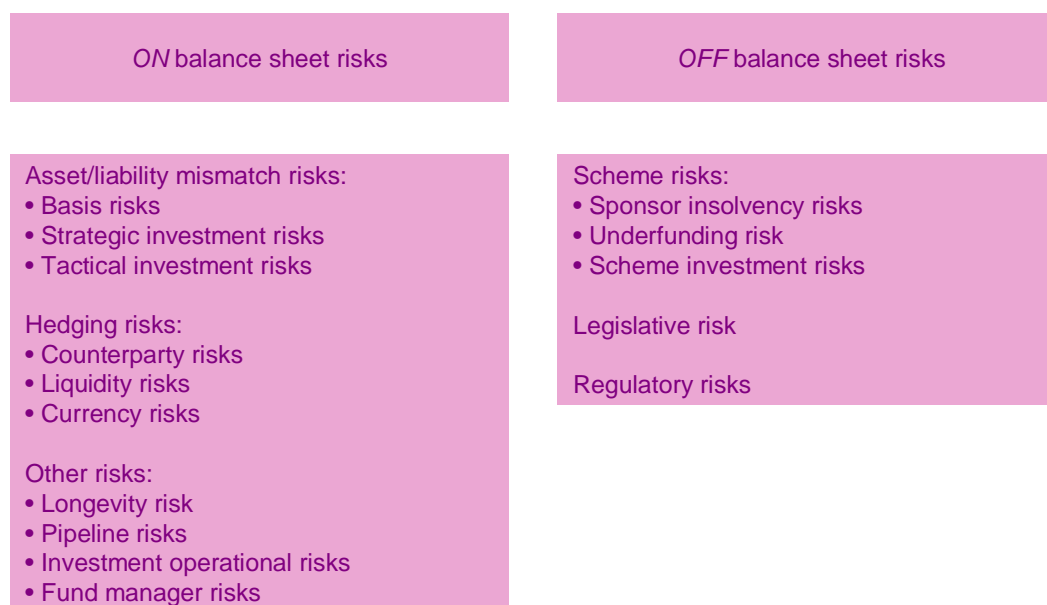
3.2.6 The PPF's status as a public corporation, accountable to Parliament and not subject to prudential or consumer protection legislation, means there are other notable differences in its exposure to regulatory risk compared to that of commercial providers. For example, whereas commercial providers are constrained by prudential and consumer protection legislation, but own their pricing policy, compensations paid by the PPF are dictated by the Pensions Act. The change of pension indexation from retail prices index (RPI) to CPI is a good example of materialization of the regulatory risk that applies to the PPF.¹

3.2 *The PPF financial risk map*

Figure 6.1 PPF financial risk map

¹ See the case study in A.3 of the appendix.

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- 3.3.1 The financial risks of the PPF are split between on-balance-sheet risks (the risks related to the current balance sheet) and off-balance-sheet risks, i.e., the risks associated with future claims made on the PPF. The current balance sheet can also be broken down into a controlled balance sheet, i.e., the accumulated levies and the assets and liabilities relating to schemes that have already transferred, and the assets and liabilities of schemes in assessment that have made a claim on the PPF but not yet transferred.
- 3.3.2 The risks affecting the controlled balance sheet of the PPF are by and large related to its investment operations. The PPF board has a low appetite for these risks and they are strictly monitored. The main risk attached to the controlled balance sheet is that the assets underperform the liabilities over the funding horizon (see Section 4). The risk of assets underperforming the liabilities is often referred to as ALM risk, which can be broken down as illustrated in the following paragraphs.
- 3.3.3 First, it is not possible to perfectly replicate the liability cash flows with financial instruments. The liability benchmark is a replicating portfolio of reasonably risk-free assets (cash, conventional gilts, interest rate swaps, index-linked gilts and inflation swaps) that most closely (but not perfectly) match the liability. The residual mismatch between the liability benchmark and the liabilities is the *basis risk*. The sources of this basis risk currently include the absence of assets with maturity terms in excess of 50 years and the absence of assets indexed to CPI rather than RPI.

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- 3.3.4 The extent to which the adopted investment strategy departs from the liability benchmark leads to further risks. The PPF investment strategy seeks to outperform the fund's liability benchmark. The mismatch between the liability benchmark and the strategic asset allocation results in *strategic investment risk*. Moreover, deviations from the strategic asset allocation are permitted within tolerance limits agreed upon with the PPF Investment Committee. This deviation is termed *tactical investment risk*.
- 3.3.5 Inflation and interest rate risks would ordinarily be considered to also form part of ALM risk. However, one of the investment beliefs of the PPF is that these two risks are unrewarded and they are therefore hedged as much as possible using a derivative overlay. Although this hedging strategy largely removes interest rate and inflation risks, the associated extensive use of derivatives introduces *counterparty risk* and *liquidity risk* that may materialize as a result of collateral requirements. Finally, because of its international investments, the PPF has a degree of exposure to *currency risk*.
- 3.3.6 The controlled balance sheet is also subject to *longevity risk*, i.e., the risk that pensioners live longer than expected, thus rendering the level of funding insufficient to cover the cost of the liability. Longevity risk is currently tolerated by the PPF as it is well-diversified by the off-balance sheet risks. However, this risk will become much more significant as the PPF matures and thus the fund's financial objective includes a margin to cover this risk.
- 3.3.7 With the exception of longevity risk (which is monitored but not currently controlled), all risks affecting the controlled balance sheet of the PPF are monitored and controlled. It is not possible to exercise the same level of control over the risks relating to schemes in assessment, although trustees of these schemes are encouraged to reduce their level of investment risk. The residual risk is monitored by the PPF and mitigated under its program of interest rate and inflation hedging where this is appropriate.² Another pipeline risk is the potential inaccuracy of the data of schemes in assessment. The assessment process seeks to clarify these inaccuracies but, in the interim, PPF asset allocation and hedging must be based on provisional data.

² For more information about the PPF policy with regard to schemes in assessment, refer to http://www.pensionprotectionfund.org.uk/DocumentLibrary/Documents/SIP_November_2010.pdf.

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- 3.3.8 The main risk that affects the long-term prospects of the PPF is that the value of the accumulated claims outgrows the value of the accumulated levies. Scenarios where this might occur correspond to economic circumstances leading to an increase in the number of claims, in combination with deterioration in scheme funding and large unexpected claims made on the PPF. This implies that there are three economic risk factors that drive the off-balance-sheet risk: *sponsor insolvency risk*, *scheme underfunding risk* and *scheme investment risk*.
- 3.3.9 In addition to these economic risks, claims frequency and size are also affected by risks related to the general state and regulation of the pension industry, over which the PPF has no specific direct control. In particular, the future claims experience of the PPF will be determined in part by the effectiveness of the U.K. pensions regulator's funding regime. It will also depend on the policy of the government toward the PPF and the legislative environment including any influence from Europe.

3.4 *Interactions between risks*

- 3.4.1 Risks interact at several levels. First, the diversification between the two notional business units (sponsor credit risk insurance and annuity business) is far from perfect. When return-seeking assets perform badly, scheme funding deteriorates and leads to an increase in the impact of potential claims. Assets of the PPF also tend to underperform in these circumstances, despite the care taken to minimize the correlation between the assets of the PPF and those of U.K. DB pension funds.
- 3.4.2 Secondly, in scenarios of underperforming assets, credit risk itself tends to increase. This assertion is supported by economic theory (Merton's model of default risk) and historical evidence. This *wrong-way risk* is captured by the PPF's internal model (see appendix), which assumes a negative correlation of 0.5 between equity market returns and the credit risk factors of the 15 industry sectors modeled.
- 3.4.3 Thirdly, although there is no reason for longevity risk to be correlated with market risks, it does interact with other risks associated with the two business components. When unexpected longevity improvements occur, the liability of DB pension schemes increases. This in turn increases exposure to sponsors' credit risk and can increase the credit risk itself and also increases the value of the PPF's liabilities. Moreover, unexpected improvements in longevity serve to lengthen the duration

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of liabilities, with a consequent increase in exposure to falling interest rates and rising inflation.

3.5 *Measuring risk*

3.5.1 The main tool used by the PPF to measure risk is the fund's internal risk model, which is described in the appendix.

3.5.2 The internal model outputs are used to measure risk over the long term and at an aggregate level. Additionally, the PPF also measures ALM risks over the short term at a much more granular level. In this case, the risk metrics used are downside risk measures such as value at risk (VaR) or tail value at risk (TVaR), or symmetric risk measures such as tracking error and volatility. Exposures to interest rate and inflation risks are measured by sensitivities – PV01 is the sensitivity of the present value of the portfolio to a one basis point move in interest rates and IE01 is the sensitivity of the portfolio to a one basis point move in inflation expectation.

3.5.3 Exposure to counterparty risk is also measured on a short-term basis. As derivative contracts are collateralized, in the event of a default of a counterparty, the loss would be the difference between the value of the collateral and the cost of reinstating the contracts. The PPF measures this exposure by the VaR of this difference of the expected time to reinstate the position. The bigger the notional size of the contracts, the longer it takes to reinstate the positions.

3.5.4 Liquidity risk, which in the case of the PPF manifests itself by collateral requirements arising from derivative positions, is measured by the short-term VaR of the sum of the value of the derivative contracts and the value of the collateral.

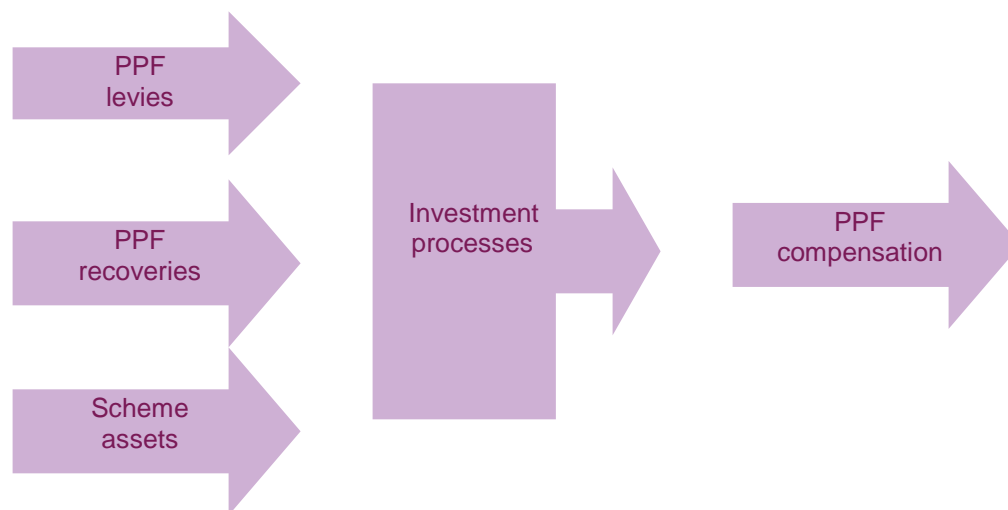
4. FINANCIAL OBJECTIVE AND FUNDING FRAMEWORK

4.1 *The PPF's financial operating model*

4.1.1 Most financial firms have clear objectives around which business strategies are built and performance tracked. Choice of the objective and the framework around it define and influence the firm's business strategies.

4.1.2 The PPF's financial operating model is illustrated in Figure 4.1 This shows the flows of money into the fund and the outputs from the investment processes, being the compensation payable to former members of pension schemes that have transferred into the PPF.

Figure 4.1 The PPF financial operating model



4.2 *PPF financial objective is self-sufficiency*

4.2.1 It is inevitable that the PPF will continue to experience failure of scheme sponsors and consequently future claims. It is, however, likely that the impact of claims on the fund will decline over time because:

- The long-term expectation is that pension scheme funding will improve on account of the efforts of trustees, sponsors and the pensions regulator.
- Schemes are expected to participate increasingly in risk mitigation strategies such as funding triggers, and interest rate and longevity hedging.

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- Current activity points to growth in pensions buy-out and buy-in activity that reduces risk to the fund.
- The trend toward closure of schemes to new entrants and new accrual is expected to continue, as is the increasing preference for defined contribution schemes as the solution to employer-sponsored pension provision.

4.2.2 There are, of course, scenarios where these expectations are not met and which must be included in any financial analysis of the PPF. Nevertheless, the expected decline, over a long period, in the scale of claims on the fund is likely to lead to a point when the off-balance-sheet risks (namely the risks associated with future claims on the fund described in Section 3) are much less significant than the on-balance-sheet risks.

4.2.3 Any funding shortfall experienced by the PPF at that time would become a significant burden on the remaining levy payers. Furthermore, as the level of risk in the eligible defined benefit universe shrinks over time, it would be desirable for the Pension Protection Levy to reduce in proportion. It would be unsatisfactory if, several years hence, a large levy needed to be raised to deal with a substantial PPF shortfall at a time when the base of levy-paying schemes had shrunk considerably and almost all of them were well funded.

4.2.4 The PPF therefore believes there needs to be a funding horizon by which time the PPF should be self-sufficient.

4.3 *What is meant by self-sufficiency?*

4.3.1 The use of the term self-sufficiency is becoming increasingly common in pensions work. It is important, however, that the term is carefully defined to avoid misunderstanding. In the context of its financial objective, the PPF has defined self-sufficiency to mean:

- Being fully funded on a reasonably risk-free measure of liabilities
- Having removed exposure to interest rate and inflation risk as far as possible
- Having removed exposure to financial market risk as far as possible

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- Having acquired protection against residual risks such as longevity and residual insolvency risk

Self-sufficiency therefore implies that the PPF will no longer need to raise levies to maintain its funding position.

4.4 *The funding horizon*

4.4.1 The PPF has considered how it should quantify the expected decline in the risk of insolvency and at what point to draw the line in terms of setting a funding target. The deliberations of the PPF board in 2010 concluded that 20 years was an appropriate timescale to aim for (i.e., the year 2030), although it accepted there was an element of subjectivity in this choice.

4.4.2 The PPF board chose the 20-year horizon after considering the following factors:

- The maturing profile of its liabilities
- The expected decline in its exposure to the effects of sponsor insolvencies
- The decreasing size of the eligible universe of levy payers

In broad terms, the board considered that the risk to the PPF was likely to be much diminished by 2030.

4.4.3 Owing to the closure of many schemes to new entrants and accruals and especially those schemes most likely to be candidates for PPF entry in future, the duration of PPF liabilities is expected to shorten over the same timescale. Chart 4.1 below shows the maturing profile of PPF liabilities.³ It is projected that by 2030:

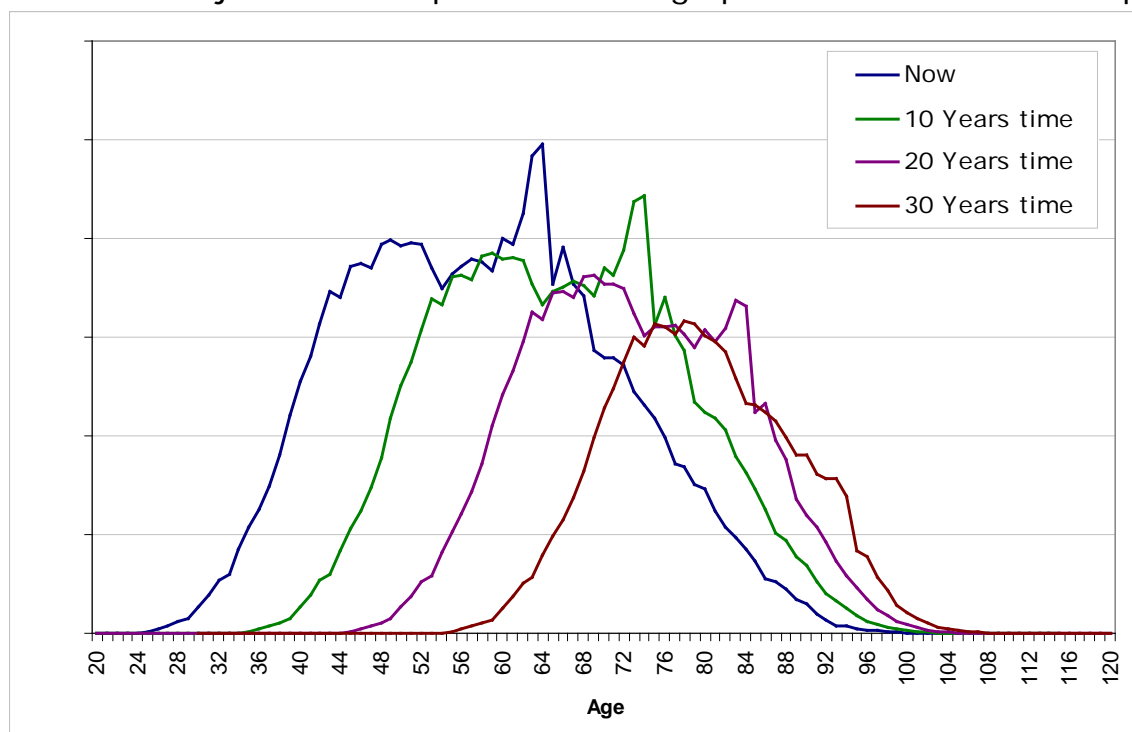
- The average age of DB scheme members will have increased from 56 to 71 (pensioner average age rising from 68 to 76, nonpensioner average age moving from 47 to 59).
- About 70 percent of scheme members will be pensioners, up from about 40 percent today.

³ The spike at about age 65 is also reflected in population statistics and is partly explained by the post-war baby boom.

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4.4.4 As a result, the duration of the fund's liabilities is expected to reduce from 21 years to 12 years. This facilitates the matching of compensation payments using conventional investment techniques, as a smaller proportion of liabilities is projected to fall outside the term of long-dated gilts.

Chart 4.1 Projected development of the age profile of PPF membership



4.4.5 Claims and scheme membership projections therefore point to a much improved risk environment for the PPF balance sheet in 2030. If the fund arrives at this date in a sound funding position, with assets that match its liabilities as far as possible and with arrangements in place to protect it from residual risks, there should only be a low risk of the fund failing to meet its financial obligations. A 20-year period from 2010 has therefore been set as the horizon over which the board will seek to achieve a resilient balance sheet.

4.5 *Protecting against residual longevity and unexpected claims risk*

4.5.1 Risk to the PPF balance sheet will not be entirely eliminated by 2030. The fund aims to remove market, interest rate and inflation risk using

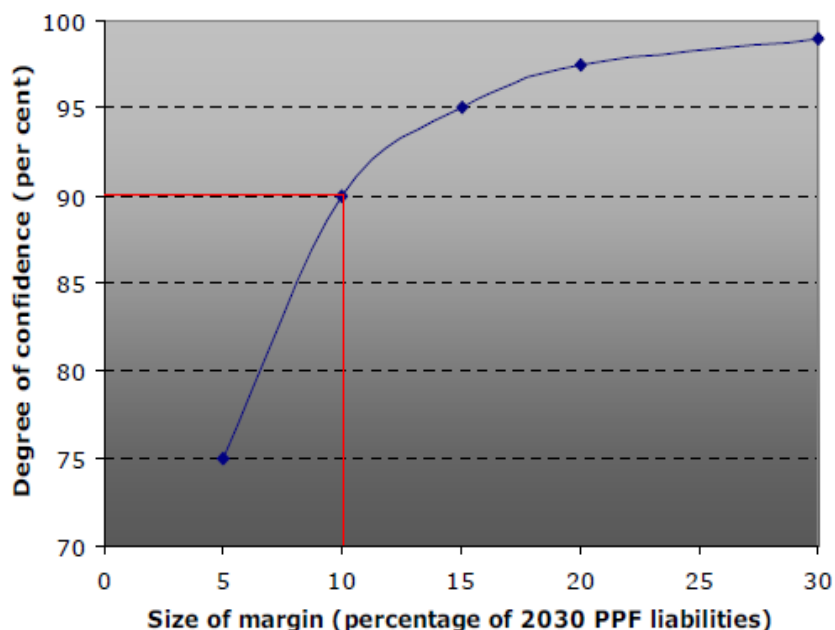
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appropriate investment techniques. Nevertheless, the risk of unexpectedly high claims and member longevity is likely to persist. The fund will also need to deal with operational hazards, such as the risk of counterparty insolvency.

4.5.2 The PPF considers it prudent to target a funding margin above best-estimate liabilities to protect against these residual risks. At the same time, it recognizes it must balance the interests of different generations of levy payers and members in determining the size of this margin.

4.5.3 To identify a suitable margin, the board considered stochastic modeling of longevity and claims using the PPF's internal model. The first step was to produce an expected PPF and scheme profile for 2030 using model output, credit transition matrices and current mortality tables. A range of scenarios was then generated for insolvencies over five years and longevity over the outstanding lifetime of the fund. This was applied to the expected PPF and scheme profile for 2030, providing a set of outcomes for claims and PPF funding. From these outcomes, it was possible to examine the protection against combined longevity and claims risk provided by various sizes of reserve. The estimated relationship between the size of margin and the extent of protection is illustrated below in Chart 4.2.

Chart 4.2 Funding margins for combined longevity and claims risk



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4.5.4 The PPF is targeting a funding margin equivalent to 10 percent of liabilities to protect, with 90 percent confidence, against unexpected claims over five years and longevity over the outstanding lifetime of the fund. This target will not be static over time, however; it will be re-evaluated against changing economic and demographic circumstances. Revision may also occur as a result of the development of more sophisticated modeling techniques.

4.6 *The risk-return trade off for the PPF*

4.6.1 The number, size and shortfall in respect of those schemes that enter the PPF are beyond the PPF's control, but the investment strategy and the size of the levy quantum that the PPF seeks to raise are clearly within its control. The PPF's funding framework is a useful tool with which a range of decisions, including those related to levy and investment strategies, can be evaluated. Such a framework also represents a rational basis for communicating with key stakeholders. Because the funding framework embraces a comprehensive range of financial risks, it has also proved invaluable in testing policy options such as the financial impact of regulatory decisions and of legislative changes such as the switch from RPI to CPI as the basis for escalation of PPF compensation.

4.6.2 Development of the PPF funding framework has leaned heavily on the language and principles that have been applied to both pension funds and insurance undertakings. For example, Urwin et al. (2001) refer to the financial mission of a pension fund including *key financial goals*, *secondary financial goals* and the *risk measure*. And in the insurance context, Shaw et al. (2010) note the main components of economic capital to be *risk measure*, *probability threshold* and *time horizon*.

4.6.3 The probability threshold was established in 2010 when the board of the PPF expressed comfort with a probability of reaching the financial objective over 20 years of 80 percent. In reaching this position, which was also subject to informal stakeholder consultation and subsequent exposure through the publication of the funding strategy, the board had to accept that, under a principle that the possibility of any adjustment to compensation levels or indexation would not be formally incorporated into its financial planning, success cannot be guaranteed.

4.6.3 Two risk measures have been selected: first, a downside risk measure (sometimes referred to as drawdown) being the maximum deficit

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reached by the fund under the 90th percentile adverse scenario and, second, the volatility of the funding level assuming no further claims on the fund. The former measure reflects the near worst-case scenario where the fund may inherit potentially irrecoverable deficits on a large scale as a result of adverse claims experience and is used to inform board levy and investment decisions. The latter reflects short-term uncertainty in the PPF's own funding level, is used to express the board's appetite for investment and funding risk, and is used to inform more detailed day-to-day investment decisions.

4.6.4 The sensitivity of the downside risk and probability of success measures to controllable factors such as investment strategy and levy collections, and to key assumptions such as current scheme and the PPF funding levels, is shown in Table 4.1.

Table 4.1 Sensitivity of downside risk and probability of success

Scenario	Probability of success (%)	Downside risk (£B)
Base case as of March 31, 2011	87	7
Levy reduced by £100 million	85	8
1 percentage point reduction in asset returns	78	13
Initial PPF funding reduced by 10 percentage points	83	9
Initial scheme funding increased by 15%	89	4
Length of recovery plans doubled	85	8
Reduced funding owing to a 10% reduction in scheme technical provisions	83	9

4.6.5 As noted in 4.6.1, the practical risk-return trade offs available to the PPF center on the investment and levy strategies of the fund. In addition to the quantitative outputs such as those from the PPF risk model within the funding framework, the board will also consider qualitative issues such as the balance between protection and affordability of the PPF levy.

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4.6.6 Analysis of investment strategies will involve the trading off of success and downside risk measures subject to the overall investment and funding risk budget set by the board.

4.7 *Applications of the funding framework*

4.7.1 The funding framework is particularly useful to assess strategic decisions likely to apply over the funding horizon. Furthermore, by including both the on-balance-sheet assets and liabilities of schemes that have already entered the PPF or that are in their assessment period, and the off-balance-sheet risks from future claims, any analysis can be better informed of:

- The effects of risk combinations such as weak funding and high insolvency rates that might be understated in less comprehensive modeling.
- The diversifying effects of risks that are not fully correlated. The funding framework can, for example, help capture the substantial credit risk exposure to sponsors of U.K. defined benefit pension schemes uncorrelated with, for example, longevity risks.
- The particular diversifying impact that occurs when the PPF adopts an investment strategy that differs in performance characteristics from the universe of pension schemes covered by the fund.

4.7.2 *Example 1: Hedging liability risks*

4.7.2.1 The Finance, Investment & Risk Management Board Working Party (2007) describe liability-driven investment (LDI) as “about reducing investment risk by measuring the success or otherwise of the investment strategy by reference to the funding position. It is not whether the return on the assets beat a performance target or a peer group or a benchmark but whether it keeps pace with the changing value of the liabilities.”

4.7.2.2 The PPF has adopted an LDI strategy using derivative instruments that aim to neutralize the effect of changes in interest rate and inflation expectations on the value of its liabilities.

4.7.2.3 The trade offs in this strategy include (i) the potential return drag from assets used to provide collateral to support the derivatives program, (ii) the frictional costs of the hedging program and (iii) the

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counterparty and operational risks associated with a derivative program.

- 4.7.2.4 Any under-hedged strategy would generally lead to greater dispersion of funding outcomes and larger downside risks, thereby reducing the probability of success. It would also add to short-term volatility of the funding level. The funding framework provides a means to examine, at a high level, different hedging strategies.

4.7.3 *Example 2: Assessing longevity risk exchange*

- 4.7.3.1 Longevity risk transfers of varying kinds have become more common in recent years. Blake, Cairns and Down (2006) describe a wide range of longevity products. However, the total size of pensions-related longevity risk transactions remains fairly low compared to, for example, the aggregate liabilities of U.K. pension schemes. Supply and demand are driven, inter alia, by price and by the appetite for longevity risks of those involved in the transfer.

- 4.7.3.2 For the PPF, the view of longevity risk changes as the fund matures. In the current phase of evolution, the major risks the PPF faces are the credit risk of pension scheme sponsors and the funding risks of their pension schemes. While the PPF is still relatively immature, these risks both dwarf and diversify the longevity risk assumed by the fund.

- 4.7.3.3 At the end of the funding horizon, it is assumed these risks are comparatively small and the residual longevity risk will be both large and undiversified as it is not envisaged the PPF will continue to take investment risk at that stage. During this phase, it is assumed the PPF is de-risked apart from longevity risk, for which a reserve is maintained.

- 4.7.3.4 Under these circumstances, it is possible to judge the financial effects of risk transfer by comparing the price of the risk transfer with the margin that might be released. However, at earlier points in the funding horizon, a more complex analysis is necessary to capture the diversifying effects of the credit and funding risks. Such an analysis is enabled by the funding framework.

4.7.3.5 Table 4.2 compares the base case with a scenario in which 25 percent of the fund’s liabilities are systematically re-insured with buy-in annuities. In this scenario, the assets of the fund are reduced by the price of the risk transfer. This price is assumed for simplicity to be 7 percent of the liabilities, being that part of the funding margin described in 3.5 that is attributable to longevity risk, although in practice the price will vary according to conditions prevailing at the time. The investment risk budget saved through fully matching 25 percent of liabilities is re-applied to the remainder of the portfolio and the PPF’s balance sheet is reduced on both sides by the value of the annuities to reflect the reinsurance arrangement. The effect is a decrease in the probability of success and an increase to the downside risk. Table 4.2 in effect shows there is little value in the PPF insuring some of its longevity risk systematically throughout its funding period at the rate it has chosen to margin for in 20 years time.

Table 4.2 Effect of a premature longevity risk transfer

Scenario	Probability of success (%)	Downside risk (£B)
Base case as of March 31, 2011	87	7
25% systematic buy-in of longevity risk	86	9

4.7.4 *Example 3: Tail risk assessments*

4.7.4.1 The PPF’s funding framework is a basis for articulating the extreme events, or combination of events, that may cause most damage to the fund. Typically these will comprise a combination of weak economic conditions and systemic failure of U.K. defined benefit pension scheme sponsors or the failure of one or more very large schemes.

4.7.4.2 At these extremes, the quantitative usefulness of the PPF internal model can be limited. More specific modeling could be undertaken; Frankland et al. (2009) describe approaches to modeling extreme market events for equity and interest rate risks. To date, the PPF has used scenario testing to develop plausible, if unlikely, scenarios based on insights gained from interrogation of model outputs and on wider experience and consideration. Three examples of such scenarios relevant to the PPF are shown in Table 4.3.

Table 4.3 Examples of adverse stress scenarios

Scenario	Description
1. Policy rates rise to dampen inflation	<p>Central banks and policymakers overestimate the level of spare capacity in the economy and loose monetary policy results in an increase to headline inflation.</p> <p>There is a policy reaction to this inflation that causes an increase in interest rates and stunts economic growth over a number of years.</p>
2. Eurozone crisis	<p>There is an orderly default among the peripheral Eurozone countries (such as Ireland, Greece and Portugal) causing falls in growth and equity markets.</p> <p>Following this, market confidence recovers to give a strong bounce back in economic growth.</p>
3. Sharp rise in bond yields	<p>Markets have concerns that the level of debt hanging over major economies (United Kingdom, United States and Japan) is unsustainable leading to higher bond prices.</p> <p>Growth and equities both fall.</p>

4.7.4.3 To examine the impacts of these stresses in the context of the funding framework, the risk model parameters can be adjusted to more closely replicate the stressed conditions, the resultant outputs providing more insight into the specific effects of the scenario. The effect of these “tilts” to the success and risk measures is shown in Table 4.4. These figures include the changed impact in each scenario of projected insolvency events that occur in the baseline. No further insolvencies are assumed, despite the stressed economic conditions.

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Table 4.4 Effect of stress scenarios

Scenario	Probability of success (%)	Downside risk (£B)
Base case as of March 31, 2011	87	7
1. Policy rates rise to dampen inflation	65	37
2. Eurozone crisis	80	14
3. Sharp rise in bond yields	72	26

4.7.4.4 More detailed analysis of the scenarios may then lead to the development and testing of risk mitigation strategies.

5. CONCLUSION

- 5.1 This paper has been written as a real case study on the application of enterprise risk management principles to the financial management of the Pension Protection fund.
- 5.2 There are, however, some conclusions we would like to draw from our experiences:
- 5.2.1 Despite the risks and uncertainties inherent in the operating environment, a clear framework for decisionmaking with agreed financial objectives provides an effective and objective basis for making those decisions. In the absence of a firm direction within its founding legislation, the board of the PPF has developed a framework and objectives that are visibly transparent to its stakeholders and which form the basis for quantitative risk assessments of strategic and policy decisions.
- 5.2.2 The capture of, and integration into, the financial model of the comprehensive range of risks to the strategic objectives improve understanding and decisionmaking. In the case of the PPF, it has built a model that incorporates three phases of an eligible scheme's potential journey into the PPF, including both on- and off-balance-sheet risks. This has led to closer integration of funding strategy, levy and investment decisions.
- 5.2.3 Good governance combines top-down supervision and direction linked firmly to the business strategy with bottom-up analysis and information. It also involves clear delegation of decisionmaking and accountability.
- 5.2.4 The PPF's model is built firmly on these principles but, as the fund grows, it is still a work in progress. For example, the paper has observed that investment operational risks are not specifically built into the PPF funding margin.
- 5.2.5 The current global financial crisis has challenged financial institutions and while it has promoted risk up the agenda in many boardrooms, a truly integrated ERM system would embed risk management, interrogation and analysis at various levels within an organization. We have illustrated in this paper how stress and scenario testing is undertaken at the PPF and presented as part of board-level decisionmaking.

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- 5.2.6 Regular updating of risk models, open discussion of model outputs, risk positions, and opportunities to improve risk and investment management are also encouraged within the fund's executive teams. As these insights arise and as actions are taken, it is important the risk systems keep pace with developments in a true spirit of integration and iteration.
- 5.2.7 Comprehensive modeling of all risk factors, though highly desirable, should not become an end in itself. In this paper, we have highlighted the limitations of models and the necessity to be clear and open about these. Decisions are generally taken by governing bodies that are one or two steps away from model construction, and good communication and understanding are vital in making appropriately well-informed judgments.
- 5.3 In this paper, we have taken the opportunity to set out how the PPF approaches, in its unique setting, tasks that are more commonly undertaken in the insurance and pensions sectors of the financial services industry. We have chosen not to debate the rationale for a fund such as the PPF but we are keen for feedback from fellow professionals on how our financial management principles and practices have been developed and applied.

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APPENDIX. THE PPF'S INTERNAL MODEL

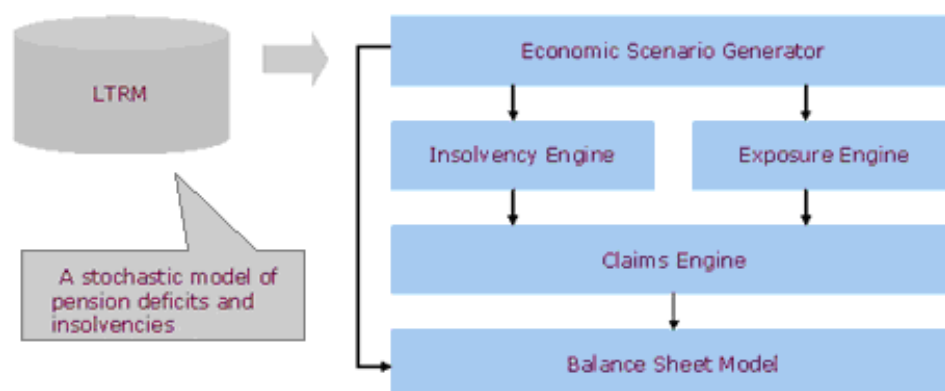
A.1 The PPF's long-term risk model

- A.1.1 Internal models are more commonly associated with risk capital assessments within insurance entities. Although the PPF is not a capitalized entity like an insurance company, an internal model can nevertheless help to assess the full extent and range of risk that the PPF faces. Such assessments are vital to a number of core PPF decisions, most notably those on the total Pension Protection Levy and on the design of an appropriate investment strategy.
- A.1.2 The PPF has developed a model capable of capturing, quantifying and expressing the potential impact of all primary risks to the PPF balance sheet: the so-called long-term risk model (LTRM). The LTRM is a stochastic claims and balance sheet model that generates an extensive range of asset return, insolvency and longevity scenarios over a chosen time horizon and, on this basis, projects a distribution of possible PPF balance sheet outcomes.
- A.1.3 The projection process begins with the generation of 1,000 economic scenarios. Each economic scenario is a set of projected paths for relevant asset prices (including bond yields, equity prices and risk-free rates). These are obtained from a third party-supplied economic scenario generator (ESG).
- A.1.4 The largest of the PPF-eligible pension schemes are modeled individually, with the remaining schemes pooled into groups according to demographic and risk similarities.
- A.1.5 To capture insolvency risk, the PPF models pension scheme sponsors transitioning each year between eight different credit ratings ranging from AA to D, where D constitutes a default. The probability of transitioning to a given credit rating will depend on the sponsor's current rating, its industry sector, the current state of the economy and the company's own idiosyncratic risk. This latter element reflects the fact that companies face their own unique risks that are uncorrelated with their industry and the wider economy. The PPF uses 500 different scenarios of idiosyncratic risk.
- A.1.6 Each of the 500 risk scenarios is mapped to each of the 1,000 economic scenarios (providing 500,000 scenarios in all), with the insolvency dynamics adjusted to reflect the degree of stress at play in

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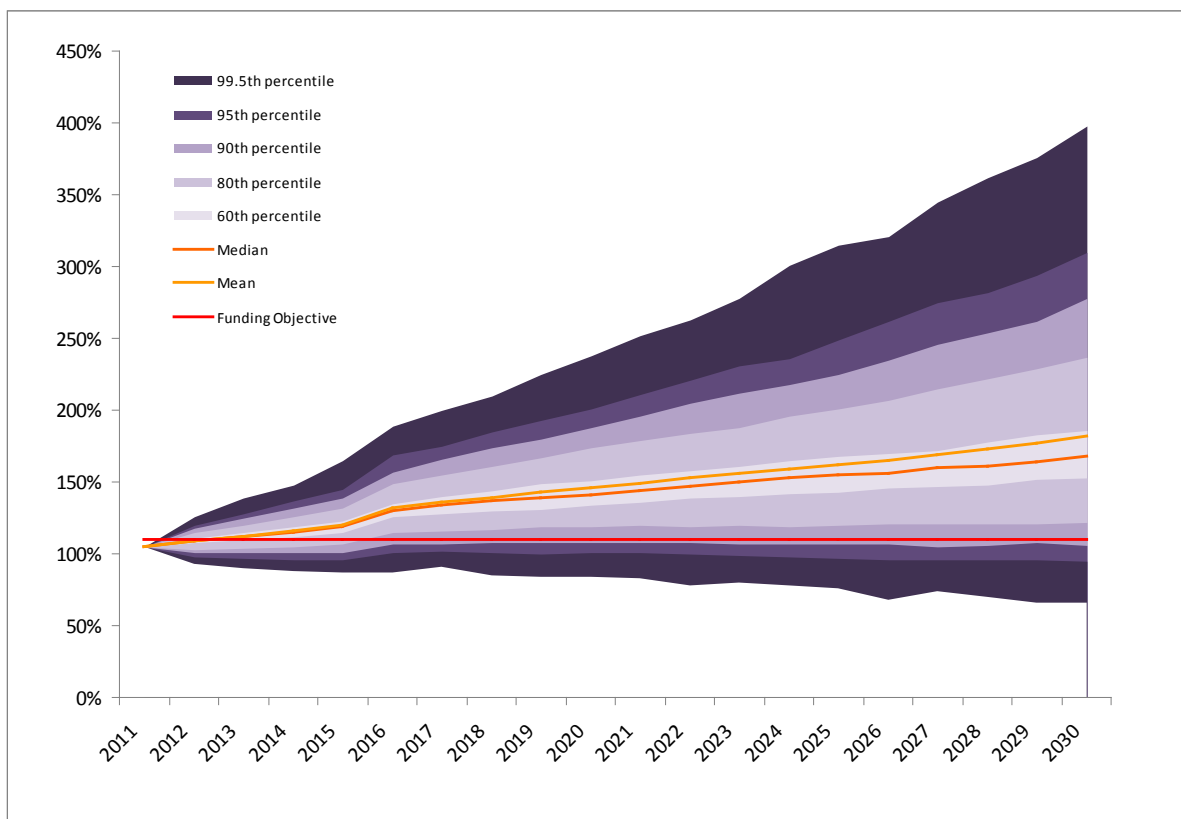
the economy. Funding paths therefore combine with insolvency dynamics to determine the profile and size of claims on the fund.

Figure A.1 The PPF internal model. A third-party economic scenario generator feeds two sub-modules that create consistent insolvency and exposure experiences respectively, combining to form distributions of PPF claims experience and balance sheet.



A.1.7 PPF assets and liabilities are rolled forward under each scenario, taking account of investment returns and movements in the discount rate. It is assumed that the PPF balance sheet is unaffected by changes to interest and inflation rates owing to the fund's policy of hedging out these risks. The funding of schemes in the PPF-eligible universe is rolled forward in a similar manner. These deficits are transferred onto the PPF balance sheet at the point at which they occur. Levy collections are also modeled explicitly, taking into account the main features of the PPF's new levy framework, for example, the way funding risk varies under different economic scenarios. The result is a distribution of PPF balance sheet outcomes over a chosen horizon that takes account of all primary funding risks. Chart 7.1 shows the distribution of balance sheet outcomes from the fund's March 31, 2011, base case.

Chart A.1 Distribution of balance sheet outcomes from the PPF’s March 31, 2011, base case



A.1.8 The value of liabilities at any particular time step is expressed in terms consistent with the contemporaneous market parameters (such as interest rates and inflation assumptions) that underlie the market value of the assets.

A.1.9 The PPF uses a stochastic mortality model that allows for rates of mortality improvement to vary in different scenarios. The table currently used is generated by the Cairns-Blake-Dowd mortality model with the cohort and curvature effects.⁴

A.2 Modeling assumptions and limitations

A.2.1 In projecting forward the PPF balance sheet, the LTRM models the behavior of asset returns and scheme sponsor insolvencies. Modeling techniques are insufficient, however, to capture many of the additional dynamics affecting pension scheme risk, especially those relating to

⁴ Cairns et al., 2007.

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“scheme behavior.” In these cases, subjective assumptions are used, a selection of which is provided below.

- Scheme contributions are determined in accordance with current recovery plans, as reported to the pensions regulator.
- Schemes reduce the risk of their investments over time (migrating on average to 85 percent allocation to long-dated bonds).
- No new schemes become eligible for PPF protection.

A.2.2 Where assumptions such as the above are material to the risk assessments or decisions being made, it is important that their choice is appropriately governed and that the effect of these choices is explored. In the case of the PPF, key model assumptions are set at board level and their impact assessed through the use of sensitivities.

A.2.3 The PPF model is not subject to uniformly applied assumptions regarding the risk premiums for investment in equity or other return-seeking asset classes. Instead, as noted in A.1, asset returns are generated stochastically by the ESG. Observed data and current market information inform long-term averages around which stochastic projections fluctuate. In the projections carried out at an effective date of March 21, 2011, the risk-free investment return, in this case the short-term return on cash, stabilizes at a long-term average of around 5 to 5.5 percent per annum, with an average risk premium for equity investment of 3.5 to 4 percent per annum.

A.2.4 Sponsor insolvency probabilities are assumed to exhibit a degree of correlation with equity market conditions, as described further in 3.4.

A.2.5 Within the modeling of interest rates, there is an implicit assumption of mean reversion that could disguise the exposure to extreme and historically unprecedented market scenarios. Since these seemingly unlikely scenarios may represent significant financial risks to the fund, their effect should be explored through further analysis. Stress testing of the key risk metrics is carried out using assumptions devised from economic analysis of potential future scenarios of the world economy. These stress tests are used to study the resilience of the fund to various shocks, identify exposures and assist with the planning of mitigations. Some of this work is described in 4.7.4.

A.2.6 As with any financial or economic model, it is important to exercise appropriate caution when analyzing LTRM output. Economic models

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are not infallible; there is no guarantee that future outcomes will conform to dynamics observed in present and past data. To minimize the risk of misleading output, care must be taken to review and update the model on a regular basis and to reconcile its results to previous output and known outcomes. Equally, the decisionmakers within the organization need to be familiar with the limitations of models and to be empowered to interrogate and challenge assumptions and outputs.

A.2.7 In accordance with best practice such as Technical Actuarial Standard on Modelling⁵ and the requirements of the Solvency II Directive⁶ for insurance companies, the PPF maintains model documentation of sufficient detail for a technically competent person with no previous knowledge of the model to understand the matters involved and assess the judgments made.

A.2.8 Known limitations of the model and ideas for improvement yet to be implemented are also maintained in documented form. Examples of such known limitations include:

- (i) Asset projections assume the fund maintains its investment strategy throughout the funding horizon set out in 3.4. It does not capture the dynamic response to changing circumstances that might in reality apply.
- (ii) The model assumes a sponsor's ability to fund scheme recovery plans is a function of its credit rating at the start of the projection. The model does not currently explicitly model the increase to probability of insolvency that results from higher deficit recovery pension contributions (and vice versa).

A.3 *Case study: Measuring the impact of the switch to CPI*

A.3.1 Legislation effective from April 2011 changed the basis of indexation of PPF compensation (before and after retirement) from the retail prices index (RPI) to the consumer prices index (CPI). A similar change was made to the legislation governing occupational defined benefit pension schemes.

⁵ The Technical Actuarial Standard on Modelling (TAS M) adopted by the United Kingdom's Board for Actuarial Standards

⁶ The PPF is voluntarily committed to comply with these standards in so far as the board considers them to be relevant and readily applicable to the fund's operations.

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A.3.2 The switch to CPI posed a number of challenges to align the parameters of the PPF internal model accordingly, necessitating several changes. The main issues were:

- The ESG did not generate projections of CPI so assumptions about the difference between RPI and CPI would need to be made.
- Although the liabilities of the PPF would be referenced to CPI, the actuarial bases of valuations used to determine whether a scheme should be granted entry to the PPF (Section 143 basis) and for levy purposes (Section 179 basis) are both market-consistent. The PPF published valuation also uses mark-to-market assumptions. These bases, in the absence of a market in CPI-linked instruments, would continue to be linked to RPI.
- The absence of a deep and liquid market in CPI-linked investment also meant the PPF would continue to use RPI-linked instruments to hedge liabilities, thus creating an additional source of mismatching risk.
- The extent to which eligible pension schemes would amend benefits to reference CPI would have to be an additional behavioral assumption in the model.

A.3.3 The option of adopting a deterministic assumption about the relationship between RPI and CPI was considered but rejected as this would disguise the mismatching risk. An econometric model that produces scenarios of CPI for use in modeling was accordingly developed in-house. The aim was to establish a statistically and theoretically robust relationship between RPI, CPI and other relevant variables projected by the ESG (particularly property prices and interest rates). The approach adopted was to fit a linear model of the RPI-CPI gap as a function of RPI, monthly percentage changes in the house price index and the 12-month London Inter-Bank Offer Rate (LIBOR). In the PPF base case as of March 2011, the annual increase in CPI is on average 1.1 percentage points lower than for RPI.

A.3.4 It is possible that the issuance of CPI-linked inflation bonds might serve to stimulate development of a wider market in CPI-linked investments during the PPF funding horizon but, at this stage, the prospects remain uncertain. In November 2011, the U.K. Debt Management Office issued its response to the consultation on the issuance of CPI-linked government bonds, confirming that no such instruments would be issued in the near term (before April 2013), with

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the issue kept under review for the medium term. The new PPF base case assumes that a market in CPI-linked investments develops over the next decade. For simplicity, this is modeled in the new base case as an instantaneous emergence in five years, settling such that the market-implied gap between annual CPI and RPI is on average 20 basis points lower than the actual gap based on the difference between the published index figures. This differential reflects the anticipated higher inflation risk premium attaching to CPI-linked investments compared with RPI.

A.3.5 The effect of these assumptions upon the PPF's funding strategy update of March 31, 2011, is shown in Table A.1, which compares the performance measures of the base case with the equivalent based solely on RPI. Note that the reduction in probability of success if no market emerges in CPI-linked investments is equivalent to a reduction in PPF levy of £100 million per annum.

Table A.1 Alternative approaches to modeling the effect of the switch to CPI

Scenario	Probability of success (%)	Downside risk (£ M)
Base case as of March 31, 2011, in which a market in CPI investments emerges	87	7
No market in CPI investments emerges and RPI is used throughout	81	15
No market in CPI investments emerges; the PPF funding objective is set with a best estimate of the difference between RPI and CPI	85	14

A.3.6 The second scenario in the above table allows for the PPF entry basis, levy basis and its funding objective to continue to be set by reference to RPI as if the switch to CPI had not occurred. The third scenario differs from this in that the funding objective is set by reference to a hypothetical market in CPI-linked instruments. In this sense, it is a best estimate rather than a market-consistent assessment of the position in 2030.

A.4 *Summary*

A.4.1 The PPF internal model is continually evolving as new market challenges emerge and as the insights it reveals in the quantification of risks lead to further investigations and analysis. The case study on CPI/RPI described in A.3 is one recent area where new thinking has recently been required.

A.4.2 More detail on the PPF long-term risk model is available in an information note published on the PPF website.⁷

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