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Pricing Pension Insurance: The Proposed Levy Structure for the Pension Protection Fund*

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Abstract

The UK Pension Protection Fund (PPF), established by the 2004 Pensions Act to protect beneficiaries of defined benefit pension schemes when the sponsor becomes insolvent and the scheme is underfunded, is required to finance itself through a levy on participating schemes. In July 2005, the PPF issued a consultative document setting out its proposal for the structure of the levy. In this paper, we provide a critique of the proposal and, in particular, its heavy reliance on securing levy income from the weakest schemes. We propose an alternative structure for the levy that recognises the limits on capacity to pay and also mitigates some other undesirable features of the proposal.

I. Introduction

In the Pensions Act 2004, the UK government created a Pension Protection Fund (PPF), to insure the pensions of UK corporate defined benefit pension schemes. If a sponsoring employer becomes insolvent and the pension scheme is unable to meet its accrued liabilities, the PPF takes over the assets and liabilities of the scheme. It takes responsibility for the payment of pensions to current pensioners and guarantees payment of 90 per cent of the

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accrued pensions of active and deferred members of the scheme up to a cap of £25,000 per year.

The PPF is required to be self-financing. It is funded partly by the assets transferred from schemes for which it has assumed responsibility and partly by an annual levy raised from eligible pension schemes. The legislation prescribes that at least 80 per cent of the levy must be risk-based and that the levy must take account of the funding level of each scheme and the financial strength of the scheme sponsor.

The PPF has recently released a proposal for the structure of the risk-based levy (Pension Protection Fund, 2005). The proposal is based on three principles, one of which is fairness.[1] The intention is that each scheme will pay an amount that reflects the costs it imposes on the PPF, to prevent strong schemes from significantly subsidising weak schemes. The proposed levy rate per pound of insured pension liabilities will vary sharply across schemes. Otherwise identical schemes, with similar assets and liabilities, would be charged a risk-based levy that could vary by a factor of over 100 purely because of the credit standing of the sponsor.

The proposal is based on the implicit assumption that weak employers with underfunded pension schemes can indeed be forced to pay the levy as well as restore scheme funding. If this is not true, much of the levy collected from the weaker schemes will simply deplete the assets of the schemes most at risk, and will serve only to increase the size of future claims when they arise. Since the cost of these claims will then have to be collected from stronger schemes in one way or another, the proposal does not achieve the objective of avoiding cross-subsidies. We argue that it would be better to restrict the rate of levy to a level that reflects how much distressed schemes can reasonably pay. This in turn means recognising that costs are imposed on the PPF not only when schemes actually default, but also when sponsors of underfunded schemes become so weak that they can no longer pay a rate of levy that fully reflects their likely future claims on the PPF.

The current proposal is also subject to at least two other substantial objections. The principle of fairness inevitably leads to volatility in the amount of the levy, because the probability of a weak sponsor defaulting is not only high but also tends to be highly volatile. For instance, as many as a quarter of sponsors with sub-investment-grade credit ratings are likely to experience a substantial deterioration in their financial strength, with the probability of default, and hence the amount of risk-based premium they are

[1]We take fairness to mean that for each scheme, the expected value of future claims should be matched by the expected future levies collected from that scheme on a continuing basis. The current PPF proposal applies this principle only approximately, as can be seen in figure 12 of the proposal. The proposed rate for the weakest schemes (15 per cent) is lower than the 30 per cent historical default rate on Standard & Poor's C-rated sponsors, while the proposed rate for the strongest schemes (0.13 per cent) is higher than the historical default rate on Standard & Poor's AAA-rated issuers (0.01 per cent).

required to pay, increasing by a factor of four. Substantial volatility in the levy is inevitable if cross-subsidies between schemes are to be small, but there are good reasons to spread changes in the rate of levy for individual schemes over several years, rather than to implement them fully every year.

The proposed structure of the levy also puts the PPF into a financially precarious position. In previous work (McCarthy and Neuberger, 2005), we used a continuous time model to examine the properties of the claims process faced by the PPF as a whole. We showed that it was likely to be very volatile. A prolonged downturn in equity markets would increase both scheme deficits and the chance of sponsor defaults. Under such circumstances, the PPF needs to be able to increase its levy income substantially, and needs to be able to spread the burden widely over schemes that can bear the burden. But under the proposals, as much as one-quarter of the PPF's revenue from the levy is to be collected from the weakest 4 per cent of schemes. The strongest 50 per cent of schemes will provide less than 15 per cent of the Fund's income. The PPF's ability to increase levy income when necessary will be greatly inhibited by its intention to do so by a pro-rata increase in the levy for all schemes, since the bulk of any increase will then come from the weaker schemes.

Furthermore, if schemes are already paying a levy based on their expected future claims, then adjusting the levy pro rata to pay the costs of past claims is neither equitable nor economically desirable. We argue from the perspective both of the financial sustainability of the PPF itself and of equity between schemes that any additional levy required to meet the PPF's revenue needs should be levied using a basis that is independent of the risk of the scheme sponsor defaulting (i.e. it should be what the consultation document calls 'scheme based', rather than 'risk based'). If the Pensions Act requires the additional levy to be largely risk-based, it would be better to base it purely on the deficit in each scheme than on the sponsor's credit rating.

We develop a model for setting a risk-based levy. It seeks, so far as possible, to ensure that there is no cross-subsidy between schemes. Our model differs from the PPF's current proposal in several key areas. We recognise that there is a limit beyond which weak schemes can only make levy payments by worsening scheme funding. This needs to be allowed for when setting the risk-based levies of schemes that are currently healthy but that may become weak in the future. We believe that by calculating the levy on a longer-term basis than annually will result in a more stable levy for individual schemes, but one that is still risk-based. Finally, we argue strongly against the principle implicit in the current proposal of recouping past deficits mainly from weaker schemes – a practice which we believe will result in the long-term unsustainability of the proposed PPF levy structure.

We start by discussing the risk-rated levy presented for comment by the PPF and examine some of its implications (Section II). We then present our model and use it to derive a risk-based premium basis for the PPF that is consistent with legislation and sustainable in the longer term (Section III). Section IV concludes.

II. The proposed levy structure

Under the PPF proposal, the risk-based levy will be based on the level of scheme funding and on the strength of the sponsor. The level of funding (denoted by F) is measured by scheme assets as a proportion of PPF liabilities, L. The strength of the sponsor is measured by a credit rating agency or similar. There are to be 10 risk bands, and each has associated with it a probability of insolvency within one year. Denote this by p. The levy is

$$\text{Min}\left\{s \times p \times \text{Max}\left[1\%, 105\% - F\right], 3\%\right\} \times L.$$

s is a scaling factor which we discuss below. The logic of the formula is as follows. If a scheme were to fail in the next year, the claim on the PPF would be zero if the scheme were fully funded, and $(100\% - F) \times L$ if it were underfunded. But the PPF only knows the funding level at the beginning of the year, and the funding may have deteriorated, so using $(105\% - F) \times L$ gives a margin of error. Also, a scheme that is fully funded initially still creates some risk, so for such schemes a notional 1 per cent is used.

To reflect the probability of default within the levy period, the potential claim size is multiplied by the probability of a claim. This means that the fair premium is

$$p \times \text{Max}\left[1\%, 105\% - F\right] \times L.$$

The formula used reflects two additional considerations. The first is that a premium set in this way may well raise too much or too little revenue overall, so a scaling factor s is applied to the fair premium to generate the required revenue. The second consideration is that it is not practical to levy an open-ended charge on underfunded schemes with weak sponsors, so the levy is capped at 3 per cent of PPF liabilities.[2]

[2]The precise way in which the cap is intended to operate and its interaction with the scaling factor are not entirely clear from the consultation document. The cap would only apply to the schemes with sponsors in the two worst credit categories.

1. Fairness

The proposal is intended to ensure fairness between schemes. On the assumption that the scaling factor is close to unity, and few schemes are subject to the cap on levy payments, each scheme each year pays a levy that is roughly equal to the expected claim it will make on the PPF that year. Weaker schemes pay more than stronger schemes, and there is no cross-subsidy between the weak and the strong. As well as being approximately fair, it also provides employers with appropriate economic incentives to ensure their schemes are adequately funded.

But there is one implicit assumption in this argument that is critical: that all schemes can actually pay the levy without any adverse effect on their funding status. If sponsors that are likely to become insolvent do not increase their contributions to the pension scheme to make up for the effect of the levy, the logic fails. The levy paid by weaker schemes is then not paid by the sponsor but by the PPF itself. For when the employer does become insolvent, and the assets and liabilities of the scheme fall to the PPF, the assets will be diminished by the amount of the levy paid.

The basic premiss that no scheme should be subsidised by any other fails because the weakest schemes simply cannot pay the full economic cost of the PPF guarantee. In theory, the Pension Regulator and the PPF have substantial legal powers to compel the payment of this levy and to require the sponsor to make contributions. However, their powers to extract value are limited by wider considerations than purely protecting the solvency of the PPF – for instance, maintaining employment at the company – and by insolvency law: ultimately, if the sponsor becomes insolvent, the PPF is likely to recover very little beyond the assets of the scheme. The proposal recognises this and so caps the levy repayment for any scheme at 3 per cent of PPF insured liabilities and caps the default probability used for rating purposes at 15 per cent. Although the true level and appropriate form of the caps are uncertain, we argue below that too much of the PPF's levy income will be paid by weaker schemes and that therefore these caps have been set too high.

2. Sharing the burden

If the inability of schemes to pay the full cost of the levy were just a feature of a small number of schemes that are bound to fail, it would not be of great concern. But some rather crude calculations suggest that the PPF is relying rather heavily on levy income from financially weak employers.

Data from the PPF's consultation document (Pension Protection Fund, 2005, figure 5), based on a Dun & Bradstreet analysis, show the distribution

of the risk of failure among 1,000 sponsoring employers, including 500 of the largest schemes. If we assume that

- the data are representative of the population insured by the PPF,
- there is no systematic relationship between employer strength and size of pension plan and between employer strength and degree of underfunding, and
- the risk-based levy is proportional to the probability of failure over 1 year,

then we can compute the degree to which the risk-based premium will fall on different classes of employer. This is shown in Table 1.

Thirty per cent of the PPF's risk-related premium income (which in turn accounts for 80 per cent of its total levy income) comes from just 4 per cent of schemes – and these schemes have sponsors whose probability of failure is at least 4 per cent per year.

There is an effective limit to the rate of levy that can be imposed on scheme deficits. If the levy is at the rate of, say, 5 per cent, then any employer is better off borrowing in the market and paying the proceeds into the pension scheme to reduce the deficit, provided only that they can borrow at a rate no higher than 5 per cent above the risk-free rate. If some employers continue to run a deficit despite the levy, this suggests either that

TABLE 1

Distribution of risk-based levy borne by different schemes

Probability of failure (% per year)	*Percentage of schemes*	*Cumulative percentage of schemes*	*Cumulative share of levy*	
(1)	(2)	(3)	(4)	(5)
0.13%	38.0%	100.0%	100.0%	100.0%
0.38%	22.0%	61.9%	94.9%	92.3%
0.63%	11.0%	39.9%	86.0%	83.6%
0.88%	5.0%	28.9%	78.6%	76.3%
1.50%	13.0%	23.8%	73.9%	71.6%
2.50%	4.0%	10.8%	52.8%	50.9%
3.50%	3.0%	6.8%	42.0%	40.3%
4.50%	2.0%	3.8%	30.7%	29.2%
7.50%	1.0%	1.8%	21.0%	19.6%
12.50%	0.4%	0.8%	12.9%	11.7%
17.50%	0.4%	0.4%	7.5%	6.4%

Notes: Based on Pension Protection Fund (2005, figure 5). (1) is the mid-range probability of failure. (2) is from figure 5. (3) is (2) cumulated from the bottom. (4) assumes the levy per scheme is proportional to the probability of failure. (5) recalculates the levy share when the top rate is capped at 15 per cent and the bottom rate has a floor of 0.13 per cent. The strongest schemes, with an average default probability of 0.13 per cent, pay a levy based on an assumed rate of 0.19 per cent.

they have no borrowing capacity or that they can only borrow with a credit spread of above 5 per cent. But an employer who is so stretched financially is unlikely to be able to find additional resources to pay the PPF risk levy. The levy will either reduce scheme assets or hasten insolvency. In neither case are net resources being transferred to the PPF.

It is a matter for debate where precisely the limit on the levy is, but it is hard to believe it is as high as the 15 per cent envisaged in the PPF report. We show in the next section of this paper that a lower limit has substantial ramifications for setting the levy. If the PPF cannot rely on extracting the full economic cost of insuring the weakest schemes, it needs to set the levy on stronger schemes to take account not only of the employer becoming insolvent, but also of the risk that the employer will become so weak financially that the present value of the future levy they will pay will fall below the expected size of their future claim on the PPF. For those schemes that currently cannot pay the full value of their insurance cover, the PPF will need to collect the cost of this insurance from more solvent schemes.

But before looking at alternatives to the PPF's levy proposal, we consider some other concerns that arise with a levy based entirely on the expected size of a claim in the coming year.

3. Levy volatility

Because the PPF levy is dependent on the employer's credit rating at the beginning of the year, the levy on an individual scheme will be very volatile, particularly for the riskier employers. The consultation document (Pension Protection Fund, 2005, figure 7), using figures from Standard & Poor's, shows that a quarter of BB-rated credits are downgraded in a year. A BB rating corresponds to rating bands 3 and 4 in the proposal, which have assumed insolvency probabilities of 1.25 per cent and 1.70 per cent. If they are downgraded to B (band 8), the probability increases to 6.60 per cent, a fourfold increase. Since the risk-based premium is proportional to the probability of default, and this will constitute the great bulk of the levy for riskier sponsors, this would mean that a quarter of riskier schemes might face a quadrupling in their levy year on year, without taking account of variations in the other components of the formula (changes in solvency level or the scaling factor). It is hard to believe that such volatility in the levy would be acceptable.

The volatility derives largely from assessing the risk afresh at the beginning of each year. This may be appropriate in a market where insurance is bought for a year at a time and customers switch freely between insurers each year. But with most conventional insurance contracts, premium rate changes are smoothed over time; in effect, the insurer provides limited informal insurance against a sudden change in the risk of a claim.

An analogy with conventional medical insurance is appropriate – an insurance company would not increase a person's medical insurance premiums to equal the present value of his future claims just after, say, he was diagnosed with cancer. The argument for smoothing must be still stronger in the case where insurance coverage is compulsory and there is a monopoly provider.

It is not difficult to find a levy formula that respects the principle of fairness as interpreted by the PPF but avoids the extreme volatility of annual determinations. Companies mitigate the volatility of their cost of borrowing by negotiating long-term loans or equivalent financial arrangements. In this way, the rate of interest they pay in any one year reflects their average credit rating over several years rather than their rating at just one point in time.

In exactly the same way, in setting the levy on a particular scheme, the PPF could take account of its average credit standing over some period, such as five years, rather than just use its credit rating at the beginning of the year. This would provide much greater predictability and stability in premiums charged while still ensuring that, over the long run, weaker schemes are not subsidised by stronger schemes.

Smoothing would greatly increase the predictability of the individual levy, but it would do little to mitigate its long-term volatility. So long as the levy is based on the principle of no cross-subsidy, weak schemes will pay far higher premiums than strong schemes. And if the financial status of the sponsor deteriorates, then the levy will ultimately reflect this, once any smoothing arrangements have run their course.

4. Scaling the levy to meet PPF income needs

The risk-based levy is adjusted by a scaling factor, s, to ensure that the total revenue from the risk-based levy equals 80 per cent of the revenue the PPF requires for the year. If the factor is always close to 1, no major issue arises. But it is likely that the PPF will need to set the levy to be much higher or lower than the expected cost of claims arising in the coming year.

As shown in McCarthy and Neuberger (2005), the claims on the PPF are likely to be volatile and sensitive to the credit cycle, with a downturn in equity markets leading to large scheme deficits at the same time as scheme sponsors are under most financial pressure. This volatility has been a feature of the experience of the PPF's US counterpart, the Pension Benefit Guaranty Corporation (PBGC, 2004). By contrast, the PPF's revenue from the levy will be much more stable than the claims process, with the maximum increase year on year being constrained by statute to be no more than 25 per cent.

The PPF is thus likely to build up large deficits or large surpluses, and the income it needs to raise each year will be determined much more by its

own solvency than by the expected level of claims over the next 12 months. The scaling factor applied to the levy to bring its income into line with its needs could well differ from unity by a substantial margin and for long periods of time.

If additional revenue does need to be raised from schemes to meet past losses rather than to meet future claims, it is hard to justify why this additional amount should be raised by increasing the risk-based levy proportionately. The burden of meeting past losses will then fall on the weakest schemes, with no economic justification for this. Conversely, if the full risk-based levy provides more income than the PPF needs, it would be better to reduce the scheme-based levy and ensure that underfunded schemes continue to be charged a premium that properly reflects the costs they are expected to impose on the PPF.

But there is another more powerful reason for rejecting the scaling factor as proposed, and that concerns the viability of the PPF itself. The levy, because it is risk-based, falls most heavily on those least able to pay. If the PPF does need to raise additional revenues to remain solvent – and we have argued elsewhere (McCarthy and Neuberger, 2005) that the pattern of claims is likely to be exceedingly volatile – it will simply not be possible to do so by raising an impost that falls largely on underfunded schemes sponsored by financially distressed employers.

III. An alternative approach to computing PPF levies

The broad principle underlying the PPF's proposed levy structure is that the levy should be set in such a way that, for each scheme, the present value of future levy income should equal the expected claim by the scheme on the PPF. Making a scheme pay each year a sum equal to the product of its deficit and the one-year probability of failure respects that principle. But this principle is impossible to implement. Some sponsors are so weak and their schemes so underfunded that they simply cannot pay a levy that ensures that the present value of expected future claims is matched by the present value of future levy payments they will make.

We therefore argue that the principle needs to be modified: for all schemes that can afford it, the levy should be set to ensure that the present value of levy payments equals the present value of future claims. But we should recognise that some schemes are so distressed that this is not feasible, and in their case the levy should be set to secure as much net income for the PPF as possible. We use a simple model to show the effect of this approach.

1. The model

There are N credit ratings, where rating 1 is the highest possible credit rating and N is insolvency. We assume that rating transitions follow a Markov process. The probability that an employer who starts the year in class i ends the year in class j is p_{ij}. We have

$$(1) \qquad \begin{aligned} &\sum_{j=1}^{N} p_{ij} = 1 \text{ for all } i; \\ &p_{Nj} = 1 \text{ if } j = N, \text{ and 0 otherwise.} \end{aligned}$$

The PPF charges the scheme an annual levy equal to l_i times the deficit of the scheme, where i is the employer's current credit rating. We ignore the scheme-based levy. The deficit of a particular scheme is currently (in year t) D_t. Claims arise only when the sponsor becomes insolvent, and then the PPF incurs a loss equal to the deficit.

The expected net revenue that the PPF will receive from the scheme over the current year is

$$(2) \qquad \left(l_i - p_{iN}\right) D_t.$$

For convenience, we assume that the levy is paid with certainty at the beginning of the year and that there is no discounting within the year.

We define V_t as the present value to the PPF of the scheme; it is equal to the present value of the future stream of levy payments less the present value of any claims. The value can be defined recursively by the following equations:

$$(3) \qquad \begin{aligned} &V_t = -D_t \text{ if } i = N; \\ &V_t = \left(l_i - p_{iN}\right) D_t + E_t\left[\delta . V_{t+1}\right] \text{ otherwise.} \end{aligned}$$

δ is the annual discount factor and E_t is the expectation operator at time t.

Since credit ratings follow a Markov process, and assuming the deficit is a random walk and uncorrelated with any future rating change, and making the additional assumption that the discount factor is independent of the scheme, the value of a scheme can be expressed as a function of the size of the scheme's deficit and of the employer's credit rating:

$$V_t = v_i D_t, \tag{4}$$

where the vector $\{v_i\}$ satisfies the following recursive equations:

$$\begin{aligned} v_i &= \left(l_i - p_{iN}\right) + \delta \sum_{j=1}^{N-1} \left[p_{ij} v_j \right] \text{ if } i < N; \\ v_N &= 0. \end{aligned} \tag{5}$$

Equation (5) can be read as defining the valuation vector given a levy vector. Alternatively, it can be used the other way round, to define a levy vector to produce a desired valuation vector.

2. A fair premium

The PPF's proposed levy in effect requires that each scheme pays its own way, so $v_i = 0$ for all rating classes i apart from $i = N$. It can readily be seen that this can only be achieved by setting $l_i = p_{iN}$. But we have argued that there is a limit to the effective levy that can be charged. Call it $\overline{l}$; then weaker employers – those with a credit rating of some level m or worse – pay the capped levy and have negative value to the PPF, while stronger employers have their levy set to ensure that they have zero value to the PPF. Formally, we require that the levy be set to ensure that

$$\begin{aligned} &v_i = 0 \text{ if } i < m; \\ &l_i = \overline{l} \text{ and } v_i < 0 \text{ if } i \geq m. \end{aligned} \tag{6}$$

The lower the levy cap, the higher the risk-based levy paid by uncapped schemes. If the scheme sponsored by a strong employer is to have zero value, the premium paid must cover not only the risk of insolvency in the year, but also the risk of the employer's credit rating deteriorating to the extent that the scheme has negative value to the PPF. The lower the cap, the lower the critical credit rating m at which the cap comes into force, and the greater the probability that the strong employer will become a capped employer with negative value to the PPF next year. Also, the lower the cap, the greater the loss of value if the employer's credit rating does fall below the critical level.

With the cap, the recursive equations then become

$$l_i = \begin{cases} p_{iN} - \delta \sum_{j=1}^{N-1} \left[p_{ij} v_j \right] \text{ if } i < m; \\ \overline{l} \text{ if } m \le i < N; \end{cases}$$

(7)

$$v_i = \begin{cases} 0 \text{ if } i < m; \\ \overline{l} - p_{iN} + \delta \sum_{j=1}^{N-1} \left[p_{ij} v_j \right] \text{ if } m \le i < N; \\ 0 \text{ if } i = N. \end{cases}$$

It is straightforward to solve this set of equations for the levy vector l, the valuation vector v and the critical rating level m for any given transition matrix and values of $\overline{l}$ and δ.

With this methodology, some schemes have a negative value and none has a strictly positive value. With a mixed population of schemes, the present value of the PPF's aggregate income from the risk-based levy is lower than the present value of future claims. If the PPF simply charged the risk-based levy computed in this way, it would in the long run be insolvent. We assume any deficit is made up by income from the scheme-based levy that accounts for up to 20 per cent of the PPF's income. It would be straightforward to modify the methodology to set the levy so that uncapped schemes had a strictly positive value, so as to bring the average scheme to zero value.

By estimating the distribution of schemes in each credit rating class, we can readily estimate the net present value of levy less claims and compute the additional levy per pound of deficits that would need to be charged across all schemes to bring the PPF to solvency.

3. The scheme-based levy

The natural place to collect the additional levy – as well as the premium required to make up for past deviations between PPF assumptions and its actual claims experience – is the scheme-based levy. The risk-based levy could be based entirely on expected future claims, while the scheme-based component could be adjusted to get the desired total levy revenue. In some cases, this might be difficult, given the legal requirement that at least 80 per cent of the levy be risk-based.

There are some other solutions that would be better than what the PPF is proposing, including adding a margin to the default probability. This would be equivalent to charging an additional premium per pound of deficits, at a rate that is the same across all schemes. This would spread the cost of

meeting past deficits and expected future deficits more evenly, and make it easier for the PPF to raise additional revenues. The PPF would charge

$$\text{Min}\left\{\left(s+l_i\right)\times\text{Max}\left[1\%,105\%-F\right],3\%\right\}\times L$$

rather than

$$\text{Min}\left\{s\times p\times\text{Max}\left[1\%,105\%-F\right],3\%\right\}\times L.$$

4. A quantification of the proposal

The PPF's proposal can be regarded as a special case of our model when the levy rate is unbounded. We now seek to quantify the effect on the levy of imposing a plausible ceiling on the rate. The main inputs needed are the transition probabilities. Since they are used in a valuation context, it would be correct to input risk-adjusted numbers. As we showed in our earlier work (McCarthy and Neuberger, 2005), with changes in both credit ratings and scheme deficits having a substantial systematic component, there are large differences between objective and risk-adjusted probabilities, and these have a large impact on the required level of the levy. The risk-adjusted transition matrix can be estimated from the objective transition matrix by making use of market data on credit spreads on rated bonds, and on recovery rates (Lando, 2004), but this assumes that the risk-adjusted expected return on all bonds is the same. Our concern here is less with the overall level of the levy than with the way it is assessed on individual schemes. So rather than estimating the risk-adjusted matrix, we go along with the consultation document in basing our figures on historic default and transition rates, and leave the question of the appropriate risk adjustments to future work.

While we would like to provide estimates for the 10 ratings classes described in the PPF proposal, there are no available data for computing the transition matrix, so we base ourselves on Standard & Poor's seven broad letter ratings. We estimate the transition matrix using Standard & Poor's database, for all countries and all industries over the period 1981 to 2003.

More specifically, we take the five-year transition matrix, recalculate it to exclude companies that were not credit-rated at the end of the period, and compute the corresponding single-year transition matrix. Companies may become non-rated because they have repaid all their debt, or because they have been merged or taken over, or because they cease to cooperate with the rating agency. Between 19 and 38 per cent of companies become non-rated after five years, depending on rating class; the methodology assumes that the non-rated company or its successor is of similar credit quality to the original rated company.

TABLE 2

Ratings transition matrix (p_{ij})

	To:							
	AAA	*AA*	*A*	*BBB*	*BB*	*B*	*CCC/C*	*Default*
AAA	92.04%	7.46%	0.27%	0.19%	0.01%	0.03%	0.00%	0.01%
AA	0.64%	90.35%	8.44%	0.39%	0.03%	0.10%	0.00%	0.04%
A	0.02%	2.26%	91.44%	5.46%	0.50%	0.29%	0.00%	0.02%
BBB	0.06%	0.16%	4.53%	89.66%	4.21%	0.71%	0.34%	0.33%
BB	0.00%	0.12%	0.10%	7.37%	81.19%	7.24%	1.05%	2.92%
B	0.02%	0.01%	0.28%	0.02%	7.66%	77.87%	3.83%	10.31%
CCC/C	0.10%	0.00%	0.00%	1.35%	0.00%	12.75%	55.45%	30.35%

Sources: Standard & Poor's Risk Solutions, June 2005; authors' calculations.

The use of five-year transition data annualised rather than annual transition data is intended to mitigate the problem of rating momentum – if a company has been downgraded, it is slightly more likely to suffer a further downgrade. This is not consistent with our model, which assumes that rating transitions are Markov. We quantify the impact of using quinquennial data below.

The transition matrix we use is given in Table 2.

To compute the overall effect on the PPF, we also need to know the distribution of schemes by rating class (more accurately, the distribution of deficits by rating class). Drawing on the consultation document (Pension Protection Fund, 2005, figure 6), we use the distribution shown in Table 3.

The annual discount factor assumed is 0.98, with values of $\bar{l}$ of 5 per cent, 10 per cent and 15 per cent. The resultant figures for the levy are given in Table 4.

The figures in the last pair of columns correspond to the pure uncapped philosophy where each scheme pays a levy on its deficit equal to the probability of the employer becoming insolvent in the year. On the quite

TABLE 3

Distribution of schemes by rating class

AAA	2%
AA	15%
A	30%
BBB	29%
BB	17%
B	6%
CCC/C	1%
Total	100%

Source: Based on Pension Protection Fund (2005, figure 6).

TABLE 4

Resultant levy rates and values

	$\bar{l}$ = 5%		$\bar{l}$ = 10%		$\bar{l}$ = 15%		No cap	
	Levy rate	*Value*	*Levy rate*	*Value*	*Levy rate*	*Value*	*Levy rate*	*Value*
AAA	0.02%	0%	0.01%	0%	0.01%	0%	0.01%	0%
AA	0.08%	0%	0.05%	0%	0.04%	0%	0.04%	0%
A	0.14%	0%	0.05%	0%	0.02%	0%	0.02%	0%
BBB	1.00%	0%	0.55%	0%	0.45%	0%	0.33%	0%
BB	5.00%	–5%	4.02%	0%	3.27%	0%	2.92%	0%
B	5.00%	–34%	10.00%	–9%	11.57%	0%	10.31%	0%
CCC/C	5.00%	–65%	10.00%	–47%	15.00%	–34%	30.35%	0%
Mean value		–3.56%		–0.99%		–0.34%		0.00%

Note: Annual discount factor is assumed to be 0.98.

implausible assumption that the levy is paid by all schemes without increasing the deficit, every scheme has zero value.

Imposing a 15 per cent cap on the rate paid (as is proposed by the PPF) means that the weakest schemes now represent a significant net cost to the PPF. Because there is a chance that B-rated employers become C-rated, their levy rate is raised. The increases are quite substantial. Since only 1 per cent of schemes are estimated to be C-rated, the net position of the PPF (risk-rated premium less claims) is equal to –0.34 per cent of the value of the aggregate deficit. With an annual discount factor of 0.98, this could be neutralised by an additional annual premium of 0.34% × (1–0.98) = 0.0068 per cent on all deficits.

Table 4 shows that as the cap is reduced, so the risk-based premium rises substantially for uncapped schemes. With a cap of 5 per cent, only A-rated and the top B-rated (i.e. only investment-grade) employers' schemes are uncapped. They account for about three-quarters of all schemes. Their premiums are greatly increased as compared with the PPF proposals. It should be stressed that the reason that their premiums are increased is not to subsidise the cap on the weaker employers, but rather to recognise that their own credit ratings may well deteriorate and they would then be unable to pay the uncapped premium.

The choice of discount rate, δ, does have some bearing on the rates, as is shown by the sensitivity analysis in Table 5 in the case where $\bar{l}$ is 5 per cent.

The more heavily the future is discounted, the lower the levy. Although the mean value is also lower in magnitude, the additional premium required to keep the PPF solvent is higher. In the case of a discount factor of 0.95, the

TABLE 5

Sensitivity analysis with $\bar{l} = 5\%$

	$\delta = 0.95$		$\delta = 0.98$		$\delta = 1$	
	Levy rate	*Value*	*Levy rate*	*Value*	*Levy rate*	*Value*
AAA	0.02%	0%	0.02%	0%	0.02%	0%
AA	0.07%	0%	0.08%	0%	0.09%	0%
A	0.12%	0%	0.14%	0%	0.17%	0%
BBB	0.83%	0%	1.00%	0%	1.15%	0%
BB	5.00%	–2%	5.00%	–5%	5.00%	–7%
B	5.00%	–30%	5.00%	–34%	5.00%	–38%
CCC/C	5.00%	–61%	5.00%	–65%	5.00%	–68%
Mean value		–2.81%		–3.56%		–4.25%

TABLE 6

Levy rates: using annualised quinquennial matrix vs. using annual transition matrix

	$\bar{l} = 5\%$		No cap	
	Levy rate using annualised quinquennial matrix	*Levy rate using annual matrix*	*Levy rate using annualised quinquennial matrix*	*Levy rate using annual matrix*
AAA	0.02%	0.00%	0.01%	0.00%
AA	0.08%	0.05%	0.04%	0.01%
A	0.14%	0.10%	0.02%	0.04%
BBB	1.00%	0.62%	0.33%	0.31%
BB	5.00%	3.82%	2.92%	1.33%
B	5.00%	5.00%	10.31%	6.45%
CCC/C	5.00%	5.00%	30.35%	33.13%

Note: Annual discount factor is assumed to be 0.98.

mean value of –2.81 per cent translates into an annual premium of 0.14 per cent. The corresponding premiums for discount factors of 0.98 and 1 are 0.07 per cent and 0.

The impact of rating momentum on the levy is noticeable. Table 6 shows the effect of using the annual transition matrix rather than the annualised quinquennial matrix.

5. Extensions of the model

The model set out above is not complex and relies on similar data to those required under the PPF's proposal. But it does depend on a number of simplifying assumptions. It is worth noting these in order to see the direction

of any bias they induce. In many cases, it would not be difficult to extend the model to take account of them, but this would make the model more complex and also require the estimation of more parameters. From the perspective of a statutory body imposing a compulsory levy at rates that vary sharply across eligible schemes, simplicity of modelling and robustness of parameter estimation are both important virtues.

By assuming that deficits follow a random-walk process, and ignoring cases where the employer becomes insolvent but the scheme itself is in surplus, we have a premium that is directly proportional to the scheme deficit. It would be possible to model some more complex process for the deficit and compute a fair levy accordingly. The area where this is likely to make most difference is for schemes that are close to solvency, where a more elaborate model would recognise that a scheme with no deficit would still create a potential claim on the PPF if its funding deteriorated. The methodology adopted by the PPF (augmenting the measured deficit by five percentage points, with a floor of 1 per cent) looks to be a sensible pragmatic solution, though the precise numbers would need to be justified.

We also assume in the model that sponsor rating transitions are uncorrelated with changes in the scheme's deficit. In practice, one would expect a fall in equity values to be associated with both a decline in ratings and an increase in deficits. Furthermore, standard finance theory suggests that a lower discount factor should be used for such situations, and a higher discount factor should be used for more benign circumstances where rising equity markets tend to cause both a strengthening of the sponsor's condition and a reduction in scheme deficits.

Taking account of these correlations would, in general, tend to raise the risk-based levy higher than in the simple model. In absolute terms, the effect is likely to be largest for the weakest schemes. Technically, these effects would not be hard to incorporate in the model. The structure of the model would still be Markov, but there would be many more parameters to estimate.

Parameter estimation would not be easy. Given the poor historic disclosure of pension scheme deficits, there might well be problems in reliably estimating the relation between credit rating changes and pension scheme deficits.

For practical reasons, we do not risk-adjust the credit rating transition probabilities and we follow the PPF in using the historically observed transition matrix. Unfortunately, there is no reason to expect that the past will be a reliable guide to the future. Further, the sample of data on which historical transition probabilities are based is fairly small, particularly for lower credit ratings and for annual changes of more than one rating band. Risk-adjusted default probabilities could be estimated using data from the

bond market if one made assumptions about the structure of risk premiums. These would reflect market expectations of the likelihood of future changes in credit ratings, but may be too sophisticated for the purposes of setting the PPF levy.

Making levy rates consistent with the rates at which sponsor companies borrow money from the markets would at least help to ensure that sponsors do not 'borrow' from their pension schemes (by making lower contributions) simply because it is cheaper than borrowing from the market.

However, while all these correlations are likely to be rather important in valuing future claims on the PPF and in assessing its overall revenue requirements, the degree of sophistication is probably inappropriate for setting the rate of the risk-based levy that is to be applied to individual schemes.

IV. Conclusions

The proposed risk-based levy is simple in concept: under it, each scheme would pay a levy each year equal to the expected claim it will make on the Pension Protection Fund. We have argued that this is infeasible. It depends on underfunded schemes with financially distressed sponsors being able to pay the levy. They will not be able to do so; at best, they will pay the levy out of funds that would otherwise go to reduce the deficit, and much of the cost of the levy will end up being borne by the PPF itself in the form of higher claims.

Once it is recognised that the weakest schemes are not going to be able to bear the full economic cost of insuring themselves, the concept of fairness between schemes has to be modified. The levy for stronger schemes needs to take account not only of the risk of the sponsor becoming insolvent but also of the risk of the sponsor becoming so weakened that the scheme becomes a net liability on the PPF. We have shown how to implement this in practice and seen how this affects the levy across all ratings levels.

The levy as proposed would be volatile and unpredictable, particularly for schemes with weak sponsors where the probability of insolvency is itself very volatile. In part, this could be addressed by putting a cap on the rate of levy per pound of deficit (the PPF proposal only envisages a cap on the rate of levy per pound of *PPF liabilities*). But it could readily be further mitigated by basing the levy on the average credit rating of the sponsor over a period of years rather than resting it entirely on the rating at the beginning of the year.

The proposal that the individual levy be adjusted by a uniform factor to bring the PPF's revenue into line with its needs is unfair and unsustainable in the longer run. It is likely that the PPF will build up substantial surpluses

or deficits. The existence of surpluses in the PPF is a poor reason for undercharging weaker schemes for the costs they are expected to impose in future on the PPF. Conversely, there is no reason why the burden of past deficits should be borne disproportionately by the weakest schemes, nor are they likely to be able to bear the burden.

From an economic perspective, it is desirable that any adjustment necessary to ensure that the levy income meets the PPF's financial requirements is done through a less distortionary mechanism, such as raising or reducing the scheme-based component of the levy. If that is precluded by the legal requirement that at least 80 per cent of the levy be risk-based, it would be preferable to make a uniform adjustment to the levy rate per unit of deficit than to charge more to those schemes with a weaker sponsor.

References

Lando, D. (2004), *Credit Risk Modeling: Theory and Applications*, Princeton, NJ: Princeton University Press.

McCarthy, D. G. and Neuberger, A. (2005), 'The Pension Protection Fund', *Fiscal Studies*, vol. 26, pp. 139–67.

Pension Benefit Guaranty Corporation (2004), *2004 Annual Report*, Washington, DC (http://www.pbgc.gov/docs/2004_annual_report.pdf).

Pension Protection Fund (2005), *The Pension Protection Fund Levy Consultation Document July 2005*, Croydon (http://www.pensionprotectionfund.org.uk/rbl_consultation.pdf).