Transferring the risk

JOHN HAWKINS AND **TIM KEOGH** EXPLAIN HOW DE-RISKING IN PENSION SCHEMES CAN TRANSFER VALUE BETWEEN STAKEHOLDERS.

Executive summary

- The members of well-funded pension schemes adopting a liability-driven investment strategy benefit from any increase in certainty in receiving their pensions, but does the sponsor also benefit? And what about the Pension Protection Fund, both now and when it changes its levy calculation rules? Financial models exist for answering these questions, but they are not widely known. This is the first of two articles that introduce and explain two such models.

There is now overwhelming evidence that many pension scheme stakeholders find the concept of de-risking not only attractive, but sufficiently so to encourage large-scale implementation. This can be seen through the use of both very simple techniques, such as higher bond allocations and increased use of defined contribution features, and very sophisticated techniques, such as the use of swap overlays and equity derivatives.

The total nominal value of interest and inflation rate swaps executed by UK schemes is now in the high tens of billions of pounds at least, equity derivative utilisation is increasing and there have been high-profile examples of large scale de-risking in the traditional and alternative buy-out markets (for example, Rank Group and Thomson Regional Newspapers). Sponsors and trustees will have different reasons in each case, but there is now a realisation that few sponsors are in a position to manage these risks either as well as they can manage normal commercial risks, or as well as specialists can. In other words, they have no competitive advantage in managing pension scheme risk. So far, so good, but do such de-risking actions benefit all stakeholders?

To answer this question, we need to do at least three things:

- identify the range of possible de-risking actions;
- identify the major stakeholder classes, not just in the pension scheme, but also in its sponsor; and
- build a model that can estimate value transfers between stakeholders as a result of de-risking.

This article will address these issues, describe two different model approaches and offer conclusions based on very simple models. Some of the tools used will be familiar to many treasurers, who will be well placed to understand the construction of such models and the potential importance of their application, once developed.

THE COMFORT ZONE

De-risking actions This is a relatively well-trodden area, where treasurers will generally have a high level of comfort. A reasonably comprehensive list would include:

- additional funding (such as extra capital through the use of actual or contingent assets);
- other means of reducing sponsor credit risk;
- reducing interest rate and/or inflation risk;
- reducing the market risk related to equities and other return-seeking assets;
- reducing foreign exchange risks;
- reducing demographic (such as longevity) and other (such as fiscal) risks through the purchase of annuities, for example;
- reducing agency costs and/or non value-adding investment management techniques; and
- reducing the risk of trapped surpluses being used for discretionary member benefits.

Stakeholder classes Again, many of the stakeholder classes will already figure in the day-to-day considerations of treasurers: shareholders and holders of various tranches of corporate debt, including banks and trade creditors. Employees (whether or not pension scheme members) form another obvious category, as do pension scheme members of various categories (actives, deferred and pensioners), customers and advisers to the scheme and the company. Perhaps slightly less obvious stakeholders are the government (through taxation) and the Pension Protection Fund (PPF). Whether or not most, or all, of these stakeholder classes should be included in a specific analysis will depend on the details of the situation, but in many instances some, such as customers, can be safely ignored, others, such as various unsecured debt providers, grouped together.

DEVELOPING MODELS Numerical models, particularly stochastic models, are now a familiar component of the pension risk management toolkit. Two decades ago, asset liability models (ALMs) simply estimated the risks of potential physical investment classes. Today's models, the most advanced of which take into account longevity and sponsor credit risk as well as the more familiar investment and liability risks, can be used to analyse the contributions of individual risks.

Convenient devices such as value at risk (VaR) can then be used to explain the results in simple terms and to show how risk can be modified by using sophisticated solutions such as swaps and other types of derivatives. Modern models can therefore give a good answer to the question of how risk changes if a particular action is taken. What they cannot answer is the follow-on question of how the action changes the relative wealth of stakeholders.

The interaction between pensions and corporate finance has been a fertile area for academic research since the early 1970s when tools for examining valuation and value transfer in the context of pensions began to be developed. In 1976, Sharpe[1] proposed a model that viewed pension costs as a series of contingent claims, which constitutes the first of the two types of model considered in this article. This model was developed in the US by Lee Willinger[2, 3] and Zvi Bodie[4]. However, the methodology was not generally aired in the UK until Ben Alexander's paper *Gentlemen Prefer Bonds* was published in 2002[5], which analysed the Boots transaction (a high-profile early example of a transformational risk reduction strategy using derivatives). This article will look at an example of how a simple contingent claims model of this type can be applied in practice.

The second type of model is based on a significant development of this approach. Most treasurers will be familiar with financial models that attempt to forecast the future value of a business. In their simplest form, dealing with a single time period and deterministic scenarios, they can be almost trivial. But they can become extremely complex computationally when developed into multiple time period stochastic models. They become even more complex when an attempt is made to model the business and its pension scheme on a fully integrated basis (that is, including contingent claims) and to understand how the relative value-shares of different stakeholders (shareholders, debt holders, scheme members, and so on) in the business's assets vary in relation to one another. The work of Gim Seow in 1995[6] was an important first step in this direction.

There is also a technical issue in connection with such models that we need to consider. In building a theoretical model of a business and its pension scheme, the easiest starting point is to generate a set of cashflows using risk-neutral probabilities and then discount them at the risk-free rate. As we actually live in a risk-averse world rather than a risk-neutral world, the analytical approach needs to be modified if real-world cashflows are used. One way in which this can now be done is to use deflators and to calibrate these models to the way debt and equity securities are known to behave in the real world. The only real downside to this approach is that it is effectively limited to those businesses that have marketable debt and equity securities.

The genesis of what we will term stochastic deflator models in the UK within a pensions context lies in a paper written by Andrew Smith in 1996[7] and further developed by Jarvis and others in 2001[8] and Chapman and others later in the same year[9]. Since these papers were presented, the pensions world has moved on significantly, not least with the replacement of the minimum funding requirement by the statutory funding objective and the introduction of the Pension Protection Fund.

Given some of these changes, the conclusions of the models developed only five years or so ago are certainly incomplete and might even be misleading. That is the bad news. The good news is that building and running the models is today much easier than it was then and they can be readily focused on a specific company/scheme combination.

It is reasonable to ask if both types of model (simple contingent claim and stochastic deflator) should lead to the same conclusion in a given situation. The answer will be yes, as long as the latter is calibrated in a market-consistent way. However, the cost of model development and achieving perfect calibration may not always be justified. In practice, simple contingent claims models are more likely to be used for understanding the direction of changes, rather than in trying to quantify a precise (but possibly spurious) value for the change that is theoretically possible with stochastic deflator models.

CONTINGENT CLAIMS MODELS Models of this type are ultimately based on the Merton debt pricing model. Although in due course they may be replaced in general use by stochastic deflator models, they are relatively intuitive and provide a good introduction to the concept of wealth transfer between stakeholders. The basic concept underlying such models as applied to pension schemes is that, over time, value exists in any surplus that is generated, and the business is able to default on its obligations. This is a case of uncertainty and time value, so it looks like a situation in which options may provide insight.

For the convenience of anybody who wishes to read the original papers, this article will employ a similar terminology to that used by both Bodie and Alexander. For analytical ease it will be assumed that the pension scheme runs for a fixed period, at the end of which benefits are settled to the extent possible from the scheme's assets and/or a debt payment from the employer. Clearly, the real world is more complex, but this does help to establish the principles.

The first thing to do is to construct the two segments of the balance sheet for an economic entity that includes a pension scheme. They are as follows (together with the expanded corporate balance sheet):

Standalone Corporate Balance Sheet

Assets		**Shareholders' equity, etc**	
Operating assets, etc	A	Conventional debt	D
Corporate share of call option on surplus	$(1-\varphi)C$	Business guarantee of accumulated benefits obligation (ABO)	$(1-\lambda)P$
Shareholders' net worth	E		

Pension Fund Balance Sheet

Assets		**Scheme liabilities, etc**	
Scheme investments	I	Accumulated benefits obligation	ABO
Business guarantee of ABO	$(1-\lambda)P$	Call option on surplus	C
Scheme share of call option on surplus	φC	Scheme members' net worth	S

Expanded Corporate Balance Sheet

Assets		**Shareholders' equity, etc**	
Operating assets, etc	A	Conventional debt	D
Scheme investments	I	Accumulated benefit obligation	ABO
		Scheme members' net worth	S
		Shareholders' net worth	E

There are two options in the corporate and pension scheme balance sheets that need to be explained.

The put option (value P) exists as a result of the business being required to make up any deficit in the scheme. In effect, it is equivalent to a put option on the scheme's investments (I), with an exercise price equal to the value of the liabilities (ABO) at some point in the future. However, the company can clearly avoid making up the deficit if it is bankrupt at the time. If its probability of default is λ, then the cost to the employer and the value to the scheme of this guarantee is $(1-\lambda)P$. λ can be estimated using proprietary models, bond spreads, credit default swap prices, and so on

The call option (value C) exists as a result of potential surplus arising within the scheme – for example, through equity investment outperformance. In practice any surplus is likely to be shared between the scheme members and the shareholders, and this can be taken into account by assigning a proportion (φ) to the scheme and a proportion $(1 - \varphi)$ to the company. In most cases, φ will not be well defined, given the legal ambiguity that surrounds surplus refund, but a well-structured funding agreement can define it more precisely and exploring a range of values can give an indication of its significance.

Arithmetically, the scheme members' net worth (S) is the difference between the scheme's total assets (investments plus business guarantee plus share of call option) and its liabilities (ABO plus call option). It is the difference in value between the promises made to scheme members and the resources potentially available to them. In the absence of the two options it would simply be the scheme's surplus or deficit. S will exceed the simple surplus if there is a large potential surplus and/or low potential to default (in other words, a strong covenant), but it can be lower if the reverse is the case.

Now let us consider the corporate and pension fund balance sheets more closely and how the relative values of shareholders and scheme members can be influenced. The key insight is that there is a relationship between the values attributable to shareholders and scheme members driven by the values of P and C and that these are in part driven by investment strategy.

By re-arranging the balance sheet equalities, shareholders' net worth (E) and scheme members' net worth (S) can be expressed as:

Shareholder perspective	**Scheme member perspective**
$E = A - D + (C - P) - \varphi C + \lambda P$	$S = I - ABO - (C - P) + \varphi C - \lambda P$

Since the strike prices of the put and call options are the same, the standard Black Scholes option put-call parity relationship can be used: $C - P = I - ABO^{*}.e^{-rt}$ (where I is the spot price, ABO* is the strike price, being the future value of the ABO, r is the risk-free rate and t the term of the option). We can also make the assumption that liabilities increase continually at the risk-free rate, so that $ABO^{*} = ABO.e^{rt}$ (in other words, $C - P = I - ABO$). Then:

$E = (A - D) + (I - ABO) - \varphi C + \lambda P$ **[Eq. 1a]**	$S = + \varphi C - \lambda P$ **[Eq. 1b]**

From the shareholder perspective **[1a]**, it is no surprise that the value of E depends directly on the values of A, I, D and ABO. However, I and ABO also indirectly affect the value of E through the price of the put and call options, P and C. From the scheme member perspective **[1b]**, only the φC and λP terms are involved, with opposite signs.

For a scheme with perfectly matched assets and liabilities (with zero-volatility options) *and* with the ABO exceeding investments, the value of the call option would be zero and the value of the put option would simply be its intrinsic value, in other words, ABO – I. Starting from **[1a]** and **[1b]**, this leads to the following simplified forms, which are independent of φ:

$E_{\sigma=0} = A - D + (I - ABO).(1 - \lambda)$ **[2a]**	$S_{\sigma=0} = (I - ABO).\lambda$ **[2b]**

For businesses that are effectively risk-free (in other words, $\lambda = 0$), there is a further simplification:

$E_{\lambda=0} = A - D + I - ABO$ **[3a]**	$S_{\lambda=0} = 0$ **[3b]**

Since treasurers will often be interested in the way the values of shareholder and members change, there is one special case: when a business borrows to fund its scheme. Adapting the already derived equalities **[1a]** and **[1b]** above, concentrating on the changes in values (designated by Δ) and making use of the fact that $\Delta C - \Delta P = \Delta I = \Delta D$:

Shareholder perspective	**Scheme member perspective**
$\Delta E = - \varphi.\Delta C + \lambda.\Delta P$ **[4a]**	$\Delta S = + \varphi.\Delta C - \lambda.\Delta P$ **[4b]**

[4a] shows that the transfer of value from shareholders to members is independent of the amount of the incremental debt (which is equivalent to the incremental scheme funding). It is, however, a function of the changes in value of the call and put options. An increase in funding will normally increase the value of the call option and decrease the value of the put option, so the overall impact will also be negative. The effect on member worth would be equal and opposite.

However, the tax impact on shareholders and members is not symmetrical; if the business is tax-paying, a tax shield will normally be available, so it is perfectly possible for both members and shareholders to benefit. The PPF levy impact will also need to be considered and is also likely to benefit the business.

Let's now return to the special case touched on earlier: that of a scheme where assets perfectly match liabilities and the volatility is therefore 0%. Assuming the scheme starts and finishes with a deficit, the value of the call will be zero and the value of the put in each case will simply be the intrinsic value. Since the change in intrinsic value will be the change in the level of investments, ΔI, and it is known that ΔI = ΔD, the equity value transfer will be:

$$\Delta E = -\lambda.\Delta D$$

As can be seen, this is again independent of φ. For businesses with a very small default probability, the value of ΔE will also clearly be very small. In other words, for businesses with a strong credit rating, there will be minimal value transfer from shareholders to scheme members by borrowing in the market and investing in the pension scheme if a liability matching investment strategy is adopted. And, of course, there could well be a benefit if the tax asymmetries are taken into account.

This means that third party and pension scheme debt are largely interchangeable, although it is worth remembering that value transfers to or from debt holders are not being considered here.

SHAREHOLDER PERSPECTIVES In the context of actions that can be taken by the business specifically in relation to the pension scheme, the question then becomes how to minimise the value of the accumulated benefit obligation (ABO) and call option element (φC) and maximise the value of the put option element (λP). In practice there will be various constraints not yet considered, such as funding subsidies through tax treatment and the cost of the PPF levy, but it is still possible to draw some conclusions. In each case the equality where this can be seen most easily is **[1a]**.

Management actions that can be taken to reduce (or at least minimise the increase in) ABO will be beneficial (through incentivised transfers, discretionary benefit restrictions, and so on). Of course, this conclusion does not depend on a contingent claims approach. To the extent that it is possible to do so, the scheme members' share of any surplus should be minimised (thereby minimising φ).

A deterioration in business creditworthiness (in other words, an increase in λ) represents a transfer of value from the scheme to the business. This can be important when a change in creditworthiness is on the cards. All other things being equal, an improvement will strengthen the negotiating position of the scheme (and vice versa).

Higher investment risk will increase deficit/surplus volatility and therefore the cost of the call and put options, so that E will depend on their relative values and those of φ and λ. Generally, φ will be greater than λ (that is, the extent to which surplus leaks to members exceeds the probability of corporate default), so a hedged investment strategy will be superior. However, for companies with a high probability of default, the reverse strategy may have merit.

Since the values of both C and P are time-dependent, the length of time for which the scheme is kept open will affect shareholder value, in a manner again dependent on φ and λ.

Although corporation tax is not included here, it will be apparent that increasing both D and I by ΔD (that is, borrowing ΔD to invest the same amount ΔI in scheme assets) will have a beneficial effect (assuming a business pays tax) since interest paid on ΔD is tax-deductible and interest on ΔI (if invested in bonds) is not taxable. The potential saving can easily be estimated outside the model.

EXTERNAL GUARANTORS Let us now briefly consider the impact of an external guarantor, such as the PPF. Leaving aside the fact that different liability definitions may be involved, and ignoring any requirement for the insurer to hold capital, the theoretical premium charged would be λP (that is, the proportion of the deficit guarantee not available internally as a result of the business's credit risk). Strictly speaking this analysis only holds if the premium for the whole of the period is paid in advance, but let us not introduce further complications here. The pension scheme now has an additional asset (λP) and the company an additional liability (also λP). The values of E and S are now given by (equivalent to **[1a]** and **[1b]**):

$$E = A - D + I - ABO - \varphi C \quad \textbf{[5a]} \qquad S = \varphi C \quad \textbf{[5b]}$$

The employer now has a one-sided incentive to minimise surplus potential because of leakage.

In practice the premium charged by the PPF will differ from λP, so that it is unlikely the business's value will be independent of the value of the put option. More importantly, the liabilities guaranteed by, say, the PPF may be lower than the ABO, in which case deteriorating creditworthiness will still transfer value to the business. The annual collection of PPF premiums accentuates this impact.

The equalities **[5a]** and **[5b]** provide a curious insight into recent behaviour by German pension sponsors, whose scheme members benefit from the PSV, the equivalent of a PPF guarantee. Most DAX 30 constituents have now set up contractual trust arrangements (CTAs) into which purely voluntary contributions have been paid. CTAs provide no tax benefits or relief from insurance premiums and can be set up in such a way that members have no claim on any surplus generated, so that φ = 0. The equalities as represented by **[5a]** and **[5b]** are therefore:

$$E = A - D + I - ABO \quad \textbf{[6a]} \qquad S = 0 \quad \textbf{[6b]}$$

Setting up and funding a CTA not only provides no economic benefits to shareholders or scheme members, but could in fact do the opposite after taking into account setup and ongoing expenses and unavoidable PSV premiums.

The situation for unsecured lenders can be even worse. If new debt is being raised to inject into the CTA, it effectively immediately becomes collateral for the benefit of scheme members and the PSV.

For those who are interested, a detailed consideration of CTAs is contained in Hawkins and Klauke 2008[10].

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Footnotes

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