

DB Dynamics

Setting the liability hedge level

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In this edition of DB Dynamics we present our hedging philosophy, explaining the factors we believe should be taken into account when setting the hedge level of a DB pension scheme.

When setting the investment strategy for a Defined Benefit (DB) pension scheme, an important decision is how much of the rates and inflation risk of liabilities should be hedged. There is no single right answer - different participants are likely to have different views and the answer will depend on the specific circumstances of the scheme.

There are two potential aspects to setting the hedge level: strategic and tactical. The boundaries can get blurred, particularly if a scheme is on a de-risking glide path. We focus on the question primarily from a strategic perspective; discussion around whether gilts are good value, and the likely future path of bond yields, will be left for another piece. Before imposing views on the current attractiveness of liability hedging it is important to understand what the best hedge level is assuming that markets are currently fairly priced. In this piece we first explore factors that may help determine a 'neutral' hedging position for a scheme, chosen to minimise short-term risk. The neutral position depends on how risk is assessed. Relevant decisions include a focus on funding level or deficit risk, the choice of liability basis and the specific risk metric adopted. We then highlight influences such as costs and the long-term direction of travel which could cause trustees to deviate from this neutral stance.

Why hedge liabilities?

The aim of liability hedging is to reduce the overall risk of the scheme (i.e. the position of the scheme in the context of its liabilities) that arises from uncertainty in future interest rates and inflation. In this piece we specifically look at interest rate and inflation risk as opposed to demographic risks in the liabilities such as members living for longer than expected.

Alongside equity risk, interest rate and inflation risks are typically the major sources of risk of a DB pension scheme. Risk taken by investing in growth assets is generally (assuming it is well diversified) rewarded in terms of a higher expected rate of return. However, the situation is different for interest rates and inflation where there is usually much lower confidence about the ability to generate excess returns through running risk.

For a DB scheme the two main parties are the sponsor, who pays the necessary contributions into the scheme, and the trustees, whose duty it is take care of the members' interests and ensure pensions are paid when they fall due.

From the perspective of the sponsor, a key risk is that changes in interest rates and inflation lead to volatile or unaffordable contribution requirements. From the perspective of the trustees, the key risk is that of being unable to pay benefits when they fall due. The pensions may not become payable for many years, so the trustees may primarily focus on the long-term. However a scheme can only afford to take a purely long term view if it is confident it will get there in the first place.

The reality is that there is a chance, albeit in some cases a very small one, that the sponsor will default, cutting the life of the scheme short. The main risk to the scheme is that the sponsor suffers insolvency and that this occurs when the scheme is in a poor position. Reduction in the risk of both short-term and long-term outcomes is therefore important, as insolvency of the sponsor is likely to coincide with poor performance of growth assets.

How much to hedge

The consideration of risks and rewards of any investment decision should include assessment of both short-term and long-term outcomes and how these may evolve over time.

When deciding how much of the liabilities to hedge, we assume that schemes are willing to use leverage and Liability Driven Investment (LDI) solutions to hedge interest rate and inflation risks. In the absence of leverage, the amount to hedge becomes a simpler question of the risk-on/risk-off split which will likely be determined by broader journey plan considerations.

In terms of deciding on an appropriate hedge level, the approach we have taken is to build up an answer in stages. We believe that a reasonable starting point is to seek to minimise the short-term risk of the scheme without reducing the scheme's allocation to growth assets. This gives what we call a Strategic Hedge Ratio – a measure which represents the neutral position for the scheme given its objectives and risk constraints. As part of this, we need to define what we mean by short-term risk.

Short-term risk: an appropriate measure

An important question is what metric we should seek to reduce short-term risk on. In particular, it needs to be decided whether a focus on funding level or deficit risk is most appropriate and which liability basis risk should be minimised on. Finally, the precise form of the metric needs choosing.

Funding level or deficit risk

Broadly speaking, assuming no interaction between assets and liabilities, if the scheme was interested in minimising the risk of a fall in funding level then it would hedge up to the value of the assets. If, on the other hand, they are interested in the risk of an increase in the size of the deficit, they should hedge all of their liabilities.

As an example, we consider a 60% funded scheme – £60m in assets and £100m in liabilities – that is exposed to an instantaneous shock in interest rates, leading to an increase in the liabilities to £120m. **Figure 1** shows the impact on the funding level and deficit under three scenarios – no hedge, hedging up to the value of the assets

and hedging up to the value of the liabilities.

As can be seen, for a 60% funded scheme, a 60% liability hedge protects the funding level against an isolated shock in the liabilities due to rates and inflation, whereas a 100% liability hedge protects the deficit.

Figure 2 illustrates how deficit and funding level risk typically vary with the liability hedge ratio.

The sponsor is likely to be most concerned with the deficit in the scheme rather than the funding level, since this represents the amount that it owes the scheme. For example, it is probably of secondary importance to the sponsor whether a £40m deficit is a consequence of assets of £60m and liabilities of £100m (a 60% funding level), or assets of £10m and liabilities of £50m (a 20% funding level).

From the perspective of trustees and members, however, the answer is less clear and depends how they view a potential reduction in pensions. Members or trustees who are told they will suffer a 30% (for example) haircut in pensions will obviously be displeased. Exactly how unhappy they are, however, will depend on how they view the reduction. They may think about it in two ways:

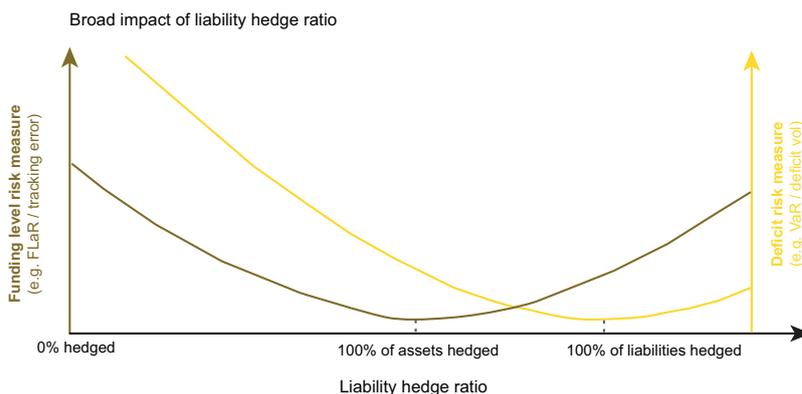
1. The member may disregard whether they are in a high or low yield environment. A current pensioner may be able to proceed with retirement plan A if their pension is £1,000 per month, or have a less enjoyable retirement plan B if their pension is only £700 per month. This may be independent of how high interest rates are. The monetary value of the shortfall (i.e. the difference in present values) is not relevant to the pensioner if they have no money to make up the shortfall – they simply have a good retirement (plan A) or a bad retirement (plan B), regardless of yields. In this case it could be appropriate to look at funding level risk mitigation because this is a broad proxy for the proportion of their promised pension that members would actually receive in the event of a wind-up of the scheme.
2. The member may recognise that such a haircut is less detrimental in monetary terms in a high yield environment than in a low yield environment. This is particularly the case for non-pensioners who may seek alternative provision – for example via a DC vehicle – to

Figure 1. Impact of a liability shock assuming different hedging levels

	Before shock	After shock		
		No hedge	60% liability hedge	100% liability hedge
Assets (£m)	60	60	60 + 60% x 20 = 72	60 + 20 = 80
Liabilities (£m)	100	120	120	120
Funding Level	60%	50%	60%	67%
Deficit (£m)	40	60	48	40

Source: LGIM

Figure 2. Funding level and deficit risk



Source: LGIM

Figure 3. The funding level hedging versus deficit hedging debate

Reasons to hedge the deficit	Reasons to hedge the funding level
<ul style="list-style-type: none"> • The sponsor is more likely to be concerned by the monetary amount they owe the scheme • Funding is a contribution problem: Trustees care about the risk that the sponsor won't be able to pay the deficit off. The sponsor's ability to do so depends on the monetary amount that they owe • The member may recognise that a haircut to benefits is less detrimental in monetary terms in a high yield environment than in a low yield environment • A negative view on the attractiveness of hedging is a separate decision as to whether, strategically, you should hedge the funding level or the deficit 	<ul style="list-style-type: none"> • Trustees may be more concerned with protecting a proportion of members' pensions • Funding is an investment problem: If further contributions from the sponsor are unlikely, trustees may care more that the investment returns from the scheme won't be able to close the deficit. In this case it may be better to preserve the funding level (e.g. 20% funding level gap is closed by 2% pa outperformance over 10 years) • Members may disregard whether they are in a high or low yield environment in their perception of the value of their pension • Results in lower hedging levels than hedging the deficit, which may be more attractive given a popular view amongst trustees and sponsors that bonds are overpriced • If a scheme is starting from a low level of hedging, there is potential regret risk resulting from a large increase in the hedge • If assets and liabilities have the same return, this preserves the funding level. From a monitoring perspective, this is beneficial in terms of being able to compare asset and liability returns relative to one another

make up the shortfall in pension following the loss of some of their defined benefits. In this case a focus on reducing deficit volatility makes more sense.

Figure 3 lists some of the reasons in favour of hedging the deficit or funding level. In some cases, leverage constraints mean that the choice of metric makes no difference to the strategic hedge ratio attainable. Where it does have an impact, different approaches may be better for different schemes. In the remainder of this piece we consider deficit risk, but acknowledge that a focus on funding level risk may be more appropriate in many cases.

The liability basis

It is also important to consider the liability basis being targeted when seeking to reduce deficit risk. For example, a typical scheme hedging 100% of liabilities on a typical Technical Provisions (TP) basis may only be hedging around two-thirds of the liabilities on a gilts basis.

There are advantages and disadvantages to hedging on a basis that allows for a significant risk premium in its discount rate. Hedging on a TP basis may be beneficial in terms of more stable contribution requests from the sponsor. However,

it should be remembered that the TP basis will probably be inappropriate in the event of insolvency. Arguably a key benefit of hedging is to protect against the situation that the scheme is in poor health and the sponsor becomes insolvent.

As such we believe that, in the majority of cases, it makes sense to focus on risk on a strong (i.e. very prudent) basis such as gilts, buy-out basis or at least self-sufficiency. However, different schemes will have different objectives and may wish to reduce short-term risk on other bases, including TP and accounting bases. In extreme circumstances, for example, the value of the liabilities on an accounting basis can have an impact on the strength of the sponsor covenant.

The specific metric

There are various measures of short-term deficit risk, for example its volatility or value-at-risk. Value-at-risk has a number of advantages including that it distinguishes between upside and downside risk and captures any fat tails in the distribution. The 1 in 20 worst deficit relative to expected over one year, for example, may be a suitable metric.

The strategic hedge ratio

In line with the above discussion,

the heat-map in **figure 4** shows the optimal strategic hedge ratio for an illustrative scheme, calculated by minimising the 1 in 20 deficit relative to expected over a one year time horizon. The example scheme was chosen to be fairly typical¹. **Figure 4** assumes there are no leverage constraints.

In practice, there are constraints on the leverage of the matching funds. The revised heat map in **figure 5** shows ideal hedge ratios allowing for leverage constraints (holding sufficient collateral to support capital calls in the event of a significant yield shock).

At low funding levels and/or high growth allocations the leverage constraints are hit. At higher funding levels and lower growth allocations you typically get c.90% hedging. Obviously the exact answer depends on many factors (for example, higher duration schemes will, all else being equal, prefer higher hedging ratios because unhedged liabilities are more volatile for schemes with longer duration liabilities). However the above pattern is typical.

It is worth noting that even without leverage constraints the hedge ratios are lower than 100%. The standard view is that liability risk is unrewarded so should be hedged

¹Liability duration 20 years. Assets invested in a diversified growth portfolio, corporate bonds and LDI.

Figure 4. Strategic hedge ratios with no leverage constraints

Proportion growth \ Funding Level	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
10%	100%	100%	100%	99%	99%	99%	99%	98%	98%	98%	98%
20%	100%	100%	99%	99%	98%	98%	97%	97%	97%	96%	96%
30%	100%	99%	99%	98%	97%	97%	96%	96%	95%	94%	94%
40%	100%	99%	98%	97%	97%	96%	95%	94%	95%	92%	91%
50%	100%	99%	98%	97%	96%	95%	94%	92%	91%	90%	89%
60%	100%	99%	97%	96%	95%	94%	92%	91%	90%	88%	87%
70%	100%	98%	97%	95%	94%	92%	91%	89%	88%	86%	85%
80%	100%	98%	97%	95%	94%	91%	90%	88%	86%	84%	83%
90%	100%	98%	96%	94%	92%	90%	88%	86%	84%	83%	81%
100%	100%	98%	96%	94%	91%	89%	87%	85%	83%	81%	78%

Source: LGIM

Figure 5. Strategic hedge ratios with leverage constraints

Proportion growth \ Funding Level	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
0%	0%	33%	67%	100%	100%	100%	100%	100%	100%	100%	100%
10%	0%	30%	60%	90%	99%	99%	99%	98%	98%	98%	98%
20%	0%	27%	53%	80%	98%	98%	97%	97%	97%	96%	96%
30%	0%	23%	47%	70%	98%	97%	96%	96%	95%	94%	94%
40%	0%	20%	40%	60%	80%	96%	95%	94%	95%	92%	91%
50%	0%	17%	33%	50%	67%	83%	94%	92%	91%	90%	89%
60%	0%	13%	27%	40%	53%	67%	80%	91%	90%	88%	87%
70%	0%	10%	20%	30%	40%	50%	60%	70%	80%	86%	85%
80%	0%	7%	13%	20%	27%	33%	40%	47%	53%	60%	67%
90%	0%	3%	7%	10%	13%	17%	20%	23%	27%	30%	33%
100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Source: LGIM

as much as possible. Whilst this is broadly right in most circumstances, a more refined approach takes account of the interaction between the assets and the liabilities. Leaving some liability risk unhedged can actually be beneficial in terms of reducing deficit risk, as it can diversify some of the asset risk. This is somewhat related to the question of what assets are actually counted as a hedging assets. For example, high yield bonds don't normally count towards the headline hedge ratio. However, by allowing for the interaction of these with the liabilities (as above), the amount of hedging via assets that do count (such as gilts and swaps) may be reduced.

Deviating from the strategic hedge ratio

There are a number of considerations that may result in a departure from the strategic hedge ratio. These other factors include:

- (i) The longer term implications of hedging
- (ii) The costs of hedging
- (iii) The long-term direction of travel
- (iv) Tail risk considerations
- (v) Active views on interest rates or inflation

(i) The longer term implications of hedging

In some cases an investment decision can be beneficial in terms of both short and long-term outcomes. In other cases there is a trade-off involved.

Opportunity cost

In the absence of leverage, the choice of how much to hedge comes down to a question of the split between return-seeking assets such as equities and matching assets such as bonds. This involves a balancing act between short-term risk and long-term risk. Whilst the scheme can reduce the short-term risk in the scheme by holding a low allocation to growth assets, this may make the scheme unaffordable to the sponsor over the long term.

As we mentioned earlier, the risk-on/ risk-off split is a complex decision that goes beyond the scope of this piece. In calculating the strategic hedge ratio we have, as per the heat-map above, done so for a range of different growth allocations. Although we chose the hedge level to minimise short-term risk for a given expected rate of return in this example, a scheme could equally look to maximise expected rate of return for a given level of short-term risk tolerance.

Leverage

One solution to the high opportunity cost of investing only in bonds, is via leveraged hedging of the scheme's liabilities. This can be achieved using swaps. A swap exchanges LIBOR floating payments for cashflows that match the benefits payable. If the scheme has no view on market levels and it doesn't cost anything to hedge, leverage allows the scheme to reduce short-term risk whilst maintaining the same expected rate of return over the long term. Whilst there can be a complicated effect on the long-term distribution of outcomes from swaps hedging, there is usually no harm, and often a benefit over the long term, in choosing the hedge level so as to minimise short-term risk.

Hedging using swaps

Hedging using swaps is effective at reducing short-term risk. A further advantage of inflation hedging is that, in addition to protecting the scheme's position against movements in break-even inflation, it also hedges against actual experienced inflation. This can lead to a reduction in risk over the long run.

The benefits of interest rate hedging in the long run are less clear. **Figure 6** shows that, for a liability payment of £100 due in 20 years, there is a

funnel-of-doubt of the value of the liability obligation on a swaps basis.

Figure 7 shows the liability net of swaps, effectively transforming the liability into a LIBOR obligation. A LIBOR obligation is low risk in the short term but, due to uncertainty about where short-term interest rates will move in the future, is more risky in the long term.

If the assets held were only cash this would obviously be a good match for the LIBOR obligation. If, more realistically, the assets held are return-seeking ones such as equities then the long-term impact of hedging depends on whether equities are better at matching the original liability target (which may be fixed or inflation-linked) or a LIBOR target. In general, growth assets are equally capable of meeting either target so leveraged hedging may enable a reduction in short-term risk without compromising longer term outcomes.

Notwithstanding the inflation hedging that inflation swaps provide, the long-term benefits of hedging using swaps are generally weaker than the shorter term benefits of hedging, particularly if costs or a belief in yield reversion are taken into consideration. If the sponsor covenant is particularly strong, then the scheme may be comfortable with a long-term perspective and this may justify a lower level of hedging.

Term premium

Entering a swap or leveraging exposure to gilts may impact the expected return if the investor believes there is a term premium on bonds.

The basic theory of the term structure of interest rates is the expectations hypothesis. This states that the expected return of holding a long bond until maturity is equal to the expected return of rolling over a series of shorter bonds with a total maturity equal to that of the long bond. The yield of the long bond is the (geometric) average of the expected short-term rates.

Whilst the expectations hypothesis provides an intuitively pleasing interpretation of the yield curve, it ignores the fact that those investors who do not hold their bonds to maturity are exposed to interest rate risk and could require compensation for this risk. Any compensation for

this risk is called a term premium. Technically, the term premium also includes any other sources of deviation from the expectations hypothesis.

Empirical estimation of the term premium on bonds is notoriously difficult. However, a range of recent analyses indicate that there has been a structural decline in the term premium over the past few decades, suggesting that the expected returns on bonds are now close to or even below the expected returns on cash. This may be related to increased demand for long-dated bonds from pension schemes and insurance companies (who are primarily concerned with matching liability cashflows, so do not demand a term premium) and, more recently, the effects of quantitative easing.

Given the above, a reasonable starting point may be to assume that there is no term premium, and consider any deviation from this as an active view (discussed later) on the relative attractiveness of cash, short and long-dated bonds, rather than a strategic decision.

(ii) Costs

Strongly related to long-term implications is the issue of costs. Hedging costs typically include an

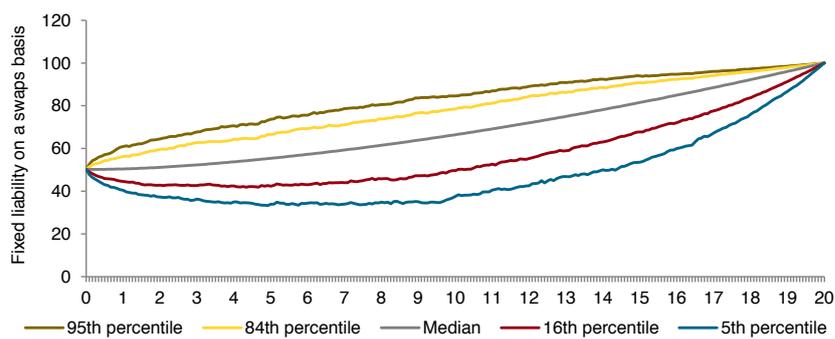
initial transaction or set-up cost and then a series of ongoing running costs. As you would expect, taking account of transaction costs and ongoing hedge costs shifts the balance in favour of lower hedge ratios. The longer the prospective time horizon the more important ongoing costs are likely to be but the annualised impact of initial costs will be more diluted.

(iii) Direction of travel

Somewhat related to the issue of costs is a consideration of the endgame objective. This becomes more important as the scheme matures, particularly through closure to new entrants and possibly future accrual.

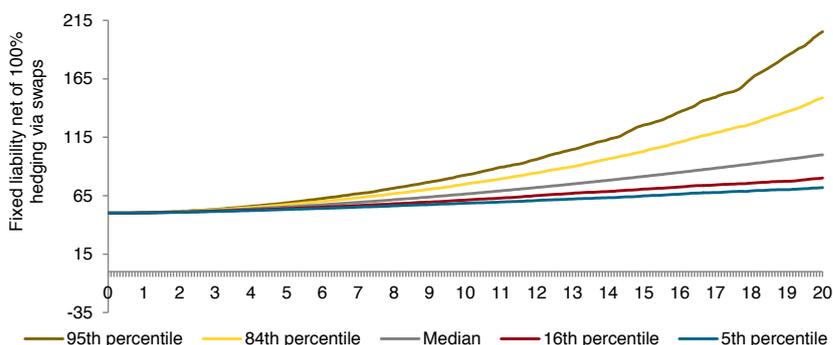
The endgame objective, whether self-sufficiency or buy-out, will likely involve being fully hedged. A move towards a higher hedge ratio is therefore likely to be preferred to a move to a lower hedge ratio, to help avoid round-trip costs. Having said this, it is worth noting that the method of hedging is likely to differ depending on how mature or well funded the scheme is. With a high funding level, less leverage may be needed so there will be more use of physical assets such as gilts and corporate bonds rather than swaps.

Figure 6. Liability on a swaps basis over 20 years for a £100 payment due in 20 years



Source: LGIM

Figure 7. Liability net of 100% hedging via swaps for a £100 payment due in 20 years



Source: LGIM

(iv) Tail risks

Under most market conditions, at least historically, there is a moderately positive correlation between the return on gilts and the return on growth assets such as equities. This means that in most cases, assets and liabilities will tend to move in line with each other. In the absence of leverage constraints we have seen that this leads to a strategic hedge ratio lower than 100%. However, in times of stress, there tends to be a negative correlation between gilts and equities, which can lead to a double-whammy of both falling assets and increasing liabilities. This may not be fully captured in stochastic analysis. To the extent that a consideration of such scenarios should be over-weighted, there is an argument to hedge more of the scheme's liabilities than implied by the Strategic Hedge Ratio. In general, it is helpful to test any potential investment strategy against a range of potential stress scenarios.

(v) Active views

We will explore the implementation of active views in glidepath design in a forthcoming edition of DB Dynamics, including different philosophical approaches to tilting asset classes to reflect views on their relative attractiveness. For now, it is worth identifying a few specific points relevant to the hedge level that illustrate some of the complexities involved:

- As we discussed earlier, a view on whether a term premium exists may be considered an active view and is relevant to the decision of what the hedge level should be. Depending on confidence that this premium may exist, this may encourage a higher degree of hedging than indicated by the strategic hedge ratio.

- If a scheme chooses to under-hedge then the scheme is accepting a degree of risk. This risk is worthwhile if, but only if, the scheme expects to be rewarded for the risk. In order to justify under-hedging, the investor should not only believe short-term interest rates will rise, but that they will rise faster than implied by the market consensus as indicated by the forward yield curve. Furthermore, it is not sufficient simply to expect to be rewarded for the risk but the expected reward needs to be at least as good as the expected reward associated with the same level of risk-taking elsewhere in the portfolio.
- If there is concern about whether market rates represent fair value, then they may be concerned about implementing a major hedging program over a short period of time. Phasing of a liability hedging program is one response – it reduces the risk that the decisions look poor in timing terms. Phasing does, however, leave schemes exposed to a higher level of risk during the phasing period.
- A desire to increase inflation hedging, because of a positive view on inflation, could have the impact of transforming real liabilities to fixed liabilities. Since, for similar duration, fixed liabilities are typically higher volatility than real liabilities, the scheme should beware of any additional risk.

In general, it is important to assess the risk-return benefits of a tilt into any one asset class in the context of the overall scheme. Well-designed models can help explore some of these trade-offs.

Other considerations

There are a couple of implementation points that, whilst beyond the scope of this piece, deserve a brief mention:

- There may be a choice of hedging instrument – for example a swap-based fund or leveraged gilts. A popular strategy is to choose whichever is higher yielding at that tenor point. However, it is worth asking why there is a higher yield available. Whilst default risk is unlikely to be a major consideration, the use of both leveraged gilts and swaps may help diversify this type of risk.
- We have implicitly assumed that the Strategic Hedge Ratio will involve an equal amount of interest rate and inflation hedging. In most circumstances this is a broadly right in terms of minimising short-term risk but there may be specific circumstances where a material difference is justifiable. The analysis we have presented in this piece can be extended to look at different interest rate and inflation hedges.

Conclusion

A seemingly simple question – how much of the liabilities should be hedged – can be a surprisingly thorny issue. As with any investment decision, these include short and long-term objectives, costs and the impact on both risk and return. In this edition of DB Dynamics we have explored some of the issues and considerations involved in detail and set out one potential framework for determining an appropriate hedge level.

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