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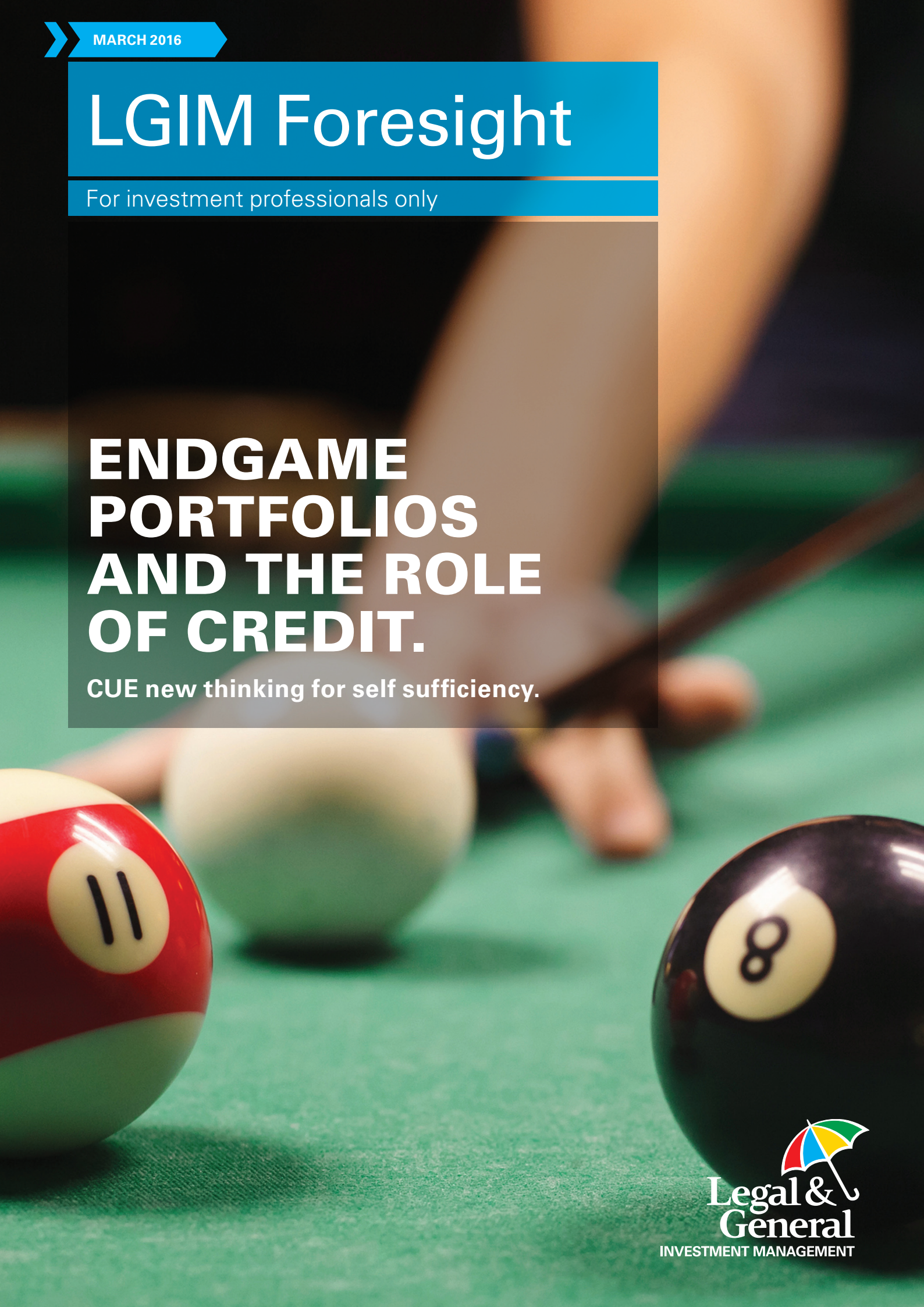

ENDGAME PORTFOLIOS AND THE ROLE OF CREDIT.

CUE new thinking for self sufficiency.

Legal & General
INVESTMENT MANAGEMENT

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Executive summary

Pension schemes are maturing and there is an increasing focus on the endgame. Because most pension schemes are closed not only to new members but also to future accrual, this endgame involves either transferring the assets and liabilities to a third party, usually an insurance company (buy-out), or running them off (self-sufficiency).

The purpose of this paper is to set out a framework for designing endgame investment portfolios for schemes aiming for self-sufficiency. There are three key findings:

Paul Sweeting
Head of Research

First, we find that schemes focused on self-sufficiency need to rethink how to measure success. We believe that **success for a self-sufficient pension scheme is the assets outlasting the liability cashflows.** To quantify the chances of this happening, we introduce a new measure – the chance of ultimate excess or 'CUE'. This is the likelihood that a scheme's assets will outlast its liabilities. The CUE measure can be used to compare various self-sufficient investment portfolios to determine the most CUE-maximising one for a particular scheme. To measure the CUE, we need to focus on the cashflows generated by the assets held and the extent to which they can meet the liabilities, rather than looking just at the market values of those assets.

Second, using the CUE framework we find that corporate bonds are very efficient for endgame portfolios focused on self-sufficiency. All high quality bonds promise stable cashflows, but corporate bonds have an advantage over government bonds for long-term investors. A short-term investor is at risk of loss if credit spreads widen. This can happen even if there is no fundamental change in the creditworthiness of the bond. However, **a long-term investor who is less concerned with short-term volatility ought to be less concerned with spread changes, and thus able to 'pocket' a long-term investor premium.**

Third, we find that for a self-sufficiency strategy the ongoing evaluation of the solvency of a scheme needs to be grounded in the CUE metric and how that changes over time: **continuous monitoring is important.** However, changes in credit spreads on corporate bond holdings which are not attributable to changes in the creditworthiness of the bonds won't change the CUE. This is because the anticipated cashflows from those corporate bonds have not changed and, all else equal, the solvency of the scheme has not changed either. This CUE framework for measuring solvency can be reconciled with the current mark-to-market world by deriving a liability discount rate consistent with the level of funding and the desired probability of success.

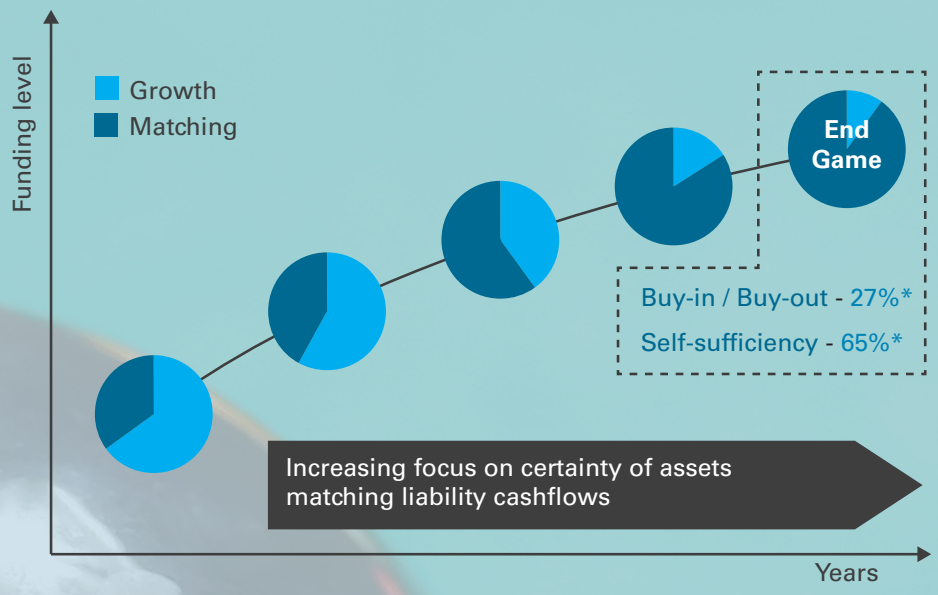
1. Focusing on the endgame

The nature of defined benefit pension provision in the UK has changed significantly. As pension schemes mature, a decreasing number are concerned with providing benefits for current and future workforces; instead, the focus is on having sufficient assets to cover the pensions of former employees. In other words, many pension schemes are facing the endgame.

As Figure 1 shows, over 90% of pension schemes are now focusing on the endgame. Of these, more than half are thinking in terms of self-sufficiency.

Figure 1

Pension schemes are focusing on the endgame



*Source: Aon Hewitt Global Pension Risk Survey 2015

2. Self-sufficiency

Although self-sufficiency might be defined as the ultimate goal for a pension scheme, it might not be clear what this means in terms of the assets required or the investment strategy that might be appropriate.

An allocation to corporate bonds is a good long-term investment for known liabilities.

For many schemes, an adequate level of assets will be determined by setting a funding level – that is, a ratio of assets to liabilities – where the liabilities are valued using gilts plus a small spread. There is no agreed definition of self-sufficiency. In this paper, we take it to mean a scheme having sufficient assets to pay pensions as they fall due with a reasonable degree of confidence, and without relying on further employer contributions[1]. However, this approach represents a more traditional approach to pension scheme valuation than one with the aim of self-sufficiency in mind.

Traditional approaches to valuation are still valid in some instances. For example, if there is a need to place a value on pension scheme liabilities to put into a company's accounts, then discounting to arrive at a present value – in this case using corporate bond yields – is the most obvious approach. Similarly, if the Pension Protection Fund wants to estimate the value of benefits that it might take on, or an insurance company is asked to price a bulk annuity, then calculating the present value of the liabilities is the only sensible method.

However, the use of such an approach for a funding valuation is less appropriate than it would have been in the past. Historically, the primary purpose of a funding valuation was to determine level of contribution required to meet the benefits that were being accrued. This was then adjusted to allow for any excess or – more commonly – shortfall of the assets relative to the accrued liabilities. To allow for this adjustment again requires the present value of the liabilities to be calculated.

We are now in a situation where only **13%** of private sector pension schemes are open to new members. Allowing for another **2%** of schemes that are winding up, this leaves **85%** of schemes that are closed either to new members or to future accrual[2].

1. Employer contributions and the sponsor covenant can be included in the framework we describe, but this is beyond the scope of this paper.

2. Pension Protection Fund (December 2015), Purple Book 2015

The ability of assets to outlast liabilities can be determined without resorting to discounting liabilities.

The fundamental question for such a scheme is: will my assets outlast my liabilities? Consider a scheme with a profile of liabilities as shown in Figure 2. The profile of the assets will be uncertain, as will the period for which they will last. In essence, the question can be answered by

- Projecting the assets forward using randomly simulated investment returns
- Using the projected assets to pay the liability cashflows as they fall due
- Calculating the proportion of scenarios for which the assets outlast the liability cashflows

We call this proportion the CUE, or 'chance of ultimate excess'. In the right-hand panel in Figure 2, it is represented by the proportion of results above the horizontal line, and it is defined as follows:

$$CUE = \frac{\textit{Number of successful outcomes}}{\textit{Total number of simulations}}$$

This metric can be used to answer a number of questions, key ones being:

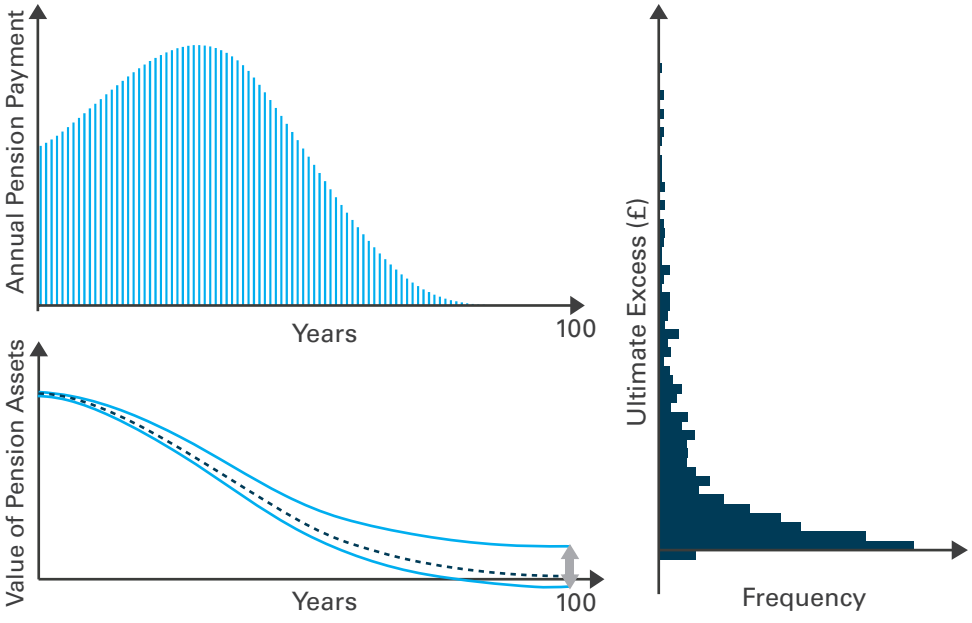
- What is the CUE for a given asset allocation and asset value?
- What is the asset allocation that can maximise the CUE for a given asset value?
- What is the minimum level of assets and asset allocation that can be used to reach a target level of CUE?

This highlights an important difference between the CUE approach and traditional methods of asset allocation, in that the CUE can be used to propose an optimal asset allocation. Traditional methods of asset allocation instead give a range of optional portfolios: the efficient frontier.

This is the first key priority: success for a self-sufficient pension scheme is the assets outlasting the liability cashflows. The CUE provides us with a measure that we can use to assess this, by focusing on the cashflows generated by the assets held and the extent to which they can meet the liabilities.

Figure 2

Stylised profile of assets and liabilities



Source: LGIM; for illustration only

3. Assets and liabilities modelled

In this section we find that schemes focused on self-sufficiency need to rethink how to measure success. We believe that success for a self-sufficient pension scheme is the assets outlasting the liability cashflows.

We need to focus on the cashflows generated by the assets held and the extent to which they can meet the liabilities.

To quantify the chances of this happening, we introduce a new measure – the chance of ultimate excess or 'CUE'. This is the likelihood that a scheme's assets will outlast its liabilities and can be used to compare various self-sufficient investment portfolios to determine the most CUE-maximising portfolio for a particular scheme. Whilst this portfolio will be the most efficient in terms of the CUE, the CUE is unlikely to be the only consideration. For example, employer insolvency could trigger wind-up, forcing a much shorter term view to be relevant. To measure the CUE, we need to focus on the cashflows generated by the assets held and the extent to which they can meet the liabilities, rather than looking just at the market values of those assets.

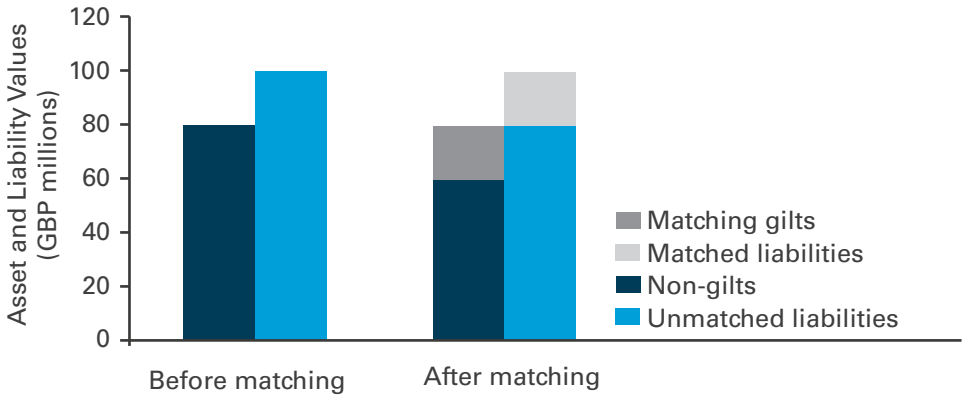
For the liability cashflows, we assume a stable population, with pension accrual ceasing at the date of analysis. Further details are included in the appendix.

For the assets, we consider three types of investment. The first is a matching gilt portfolio. This is a portfolio that we assume matches the liability cashflows so exactly that any allocation can be treated as a deduction from both the assets and the liabilities. This means that an allocation to gilts has an interesting effect on the CUE. If the value of a gilt portfolio is even slightly greater than the value of the liabilities discounted using the gilt yield, then the CUE is, by definition, 100%. However, if the value of assets is less than the value of liabilities discounted using the gilt yield, then any allocation to gilts will reduce the CUE.

This can best be illustrated with an example. Imagine a scheme with GBP 80 million of assets and GBP 100 million of liabilities. Its funding level is therefore 80%. If the scheme invests GBP 20 million in exactly matching gilts, this is equivalent to reducing both assets and liabilities by GBP 20 million. In other words, it is equivalent to having assets of GBP 60 million and liabilities of GBP 80 million – and a funding level of 75%. Even though the size of the deficit is unchanged, the likelihood of the GBP 60 million of assets outlasting the GBP 80 million of liabilities is lower than the likelihood of the GBP 80 million of assets outlasting the GBP 100 million of liabilities, so the CUE is lower – in other words the CUE will fall. This is shown graphically in Figure 3.

Figure 3

Assets and liabilities – the consequences of matching



Source: LGIM; for illustration only

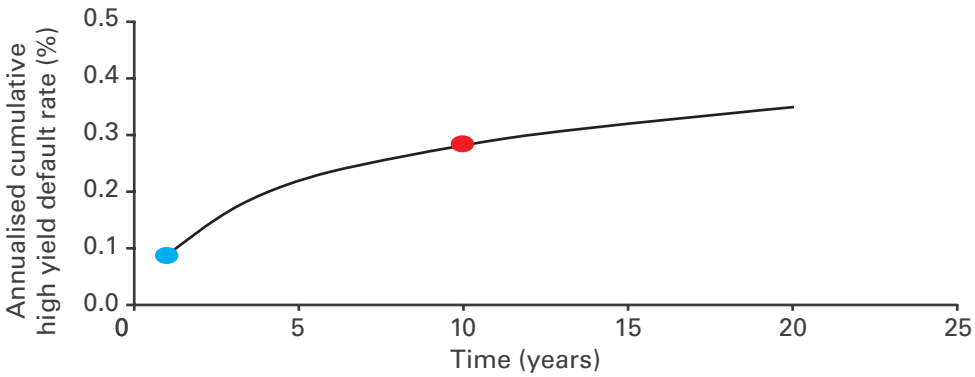
The second asset class we consider is a matching buy-and-hold[2] portfolio of investment grade corporate bonds. In the case of corporate bonds, exact matching is impossible, as the impact of downgrades and defaults cannot be known with complete certainty at the outset. The portfolio chosen is therefore one where the **expected** payments after allowing for the impact of downgrades and defaults will exactly match liability cashflows.

Thinking about the impact of downgrading.

Whilst the impact of defaults is clear, it might be less clear why downgrades negatively impact investment grade corporate bond returns. One way of thinking about the impact of a downgrade is that any movement from investment grade to high yield can trigger a forced sale. Such a sale capitalises any loss. Another way of thinking about the impact of a downgrade is that it results in a higher subsequent probability of default. This can be appreciated by looking at the annualised cumulative default rate for increasing periods, shown in Figure 4. This shows that the longer a bond is held, the higher the chance per year that it will default. This is because over time, and without rebalancing, an increasing proportion of a credit portfolio would consist of high yield bonds. These bonds have a higher risk of default than investment grade bonds. Because of this, the risk of default for the portfolio as a whole increases over time. As an example, consider the blue point highlighted in Figure 4. This shows that if a portfolio of investment grade bonds were held for a single year, the expected default rate based on historical data would be less than 0.1%. However, if it were held for ten years, with those bonds downgraded to high yield staying in the portfolio, the lower average credit quality would have a noticeable impact on expected default rates. In fact, they would treble to nearly 0.3% per annum, as shown by the red dot.

Figure 4

Annualised default rates, 1970-2014



Source: Moody's Investor Services (2015), Annual Default Study: Corporate Default and Recovery Rates, 1920-2014; LGIM calculations

The final asset that we consider is a diversified fund, consisting mainly of equities and corporate bonds. Broadly speaking, one would expect two things to happen if more investment risk were taken. The first would be that you would expect, on average, for the assets to last longer; and the second would be that there would be less certainty over the time for which the assets would last. However, investment risk encompasses more than just market volatility. This is most obvious in relation to corporate bonds , where volatility is only one of the risks which can be rewarded. This is what we look at in the next section.

2. Whilst we use 'buy and hold' portfolios in our analysis, the portfolios used in practice would be 'buy and maintain' – in other words, they would change in relation to a range of investment factors.

4. Corporate bonds and long-term investors

In finance, risk is generally thought of as being equivalent to uncertainty over the future price of an investment. As such, it might be measured by volatility, value at risk (VaR) or some other measure.

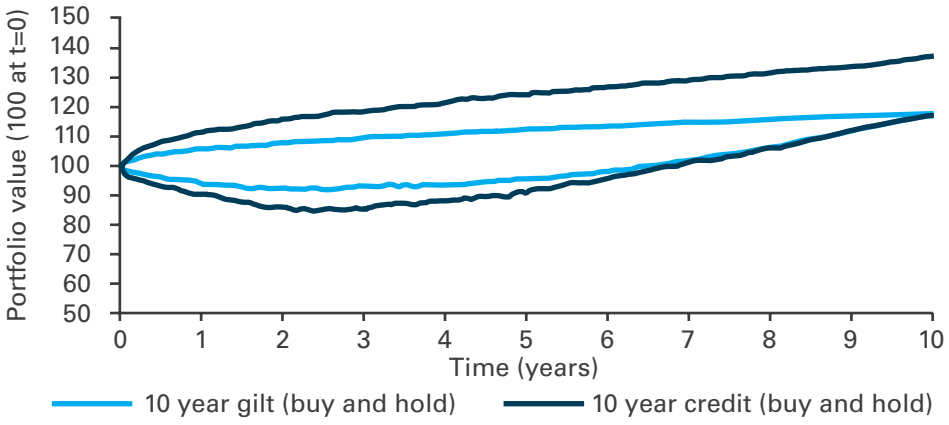
Short-term volatility does not necessarily lead to risk for an investor who can take a long-term view.

However, uncertainty over one time horizon does not necessarily lead to risk over another. Consider the price evolution of a ten-year gilt principal STRIP (Separate Trading of Registered Interest and Principal) securities, which is essentially a zero-coupon bond, as shown in Figure 5. In our example, a zero coupon government bond bought now for GBP 100 would give a guaranteed payment in ten years' time of around GBP 115. Over time, one would expect the price of this bond to change, as gilt yields changed, affecting the price for which the guaranteed payment at the end of the ten-year period could be secured. But at the end of the ten-year period, an investor knows exactly how much will be received. Therefore short-term volatility does not necessarily lead to risk for an investor who can take a long-term view.

Figure 5 also indicates that greater returns are available from corporate bonds. True, there is uncertainty over the final redemption payment that does not exist with the gilt, arising from uncertainty over the impact of downgrades and defaults. It is also important to note that this analysis is based on historical patterns of downgrade and default and is based on long-term averages rather than today's specific market conditions. Bearing this in mind, it appears from our simulations that the corporate bond would have outperformed the gilt 95% of the time. This is also consistent with our analysis of historical ratings transitions and spread levels.

Figure 5

Simulated values (5th and 95th percentiles) of two zero coupon bonds



Source: LGIM

The availability of such a premium seems to contradict what we know about the relationship between risk and return. This is because market volatility is not the only risk there is.

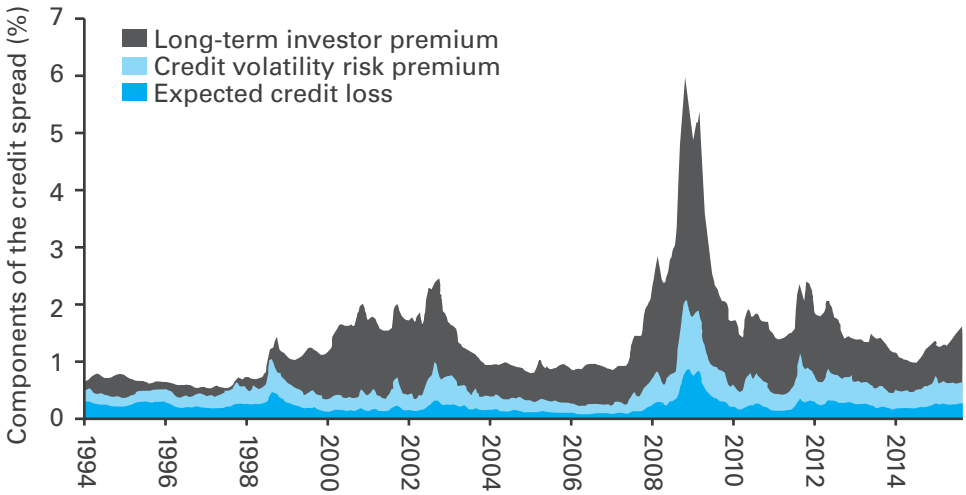
For corporate bonds, there are a number of separate risk premia, which can be thought of as components of the credit spread – that is, the difference between the yield on a corporate bond and the yield on an equivalent government bond.

The most obvious is the premium is that received as compensation for expected defaults and downgrades. In other words, it is the part of the spread that one might expect to lose because some bonds will default or will need to be sold at a loss following a downgrade to high yield.

As we have already noted, these defaults and downgrades are uncertain. As such, any investor will require a risk premium to provide compensation for this uncertainty – otherwise, there would be no incentive to move away from gilts and to invest in corporate bonds.

Figure 6

Estimated decomposition of the investment grade credit spread

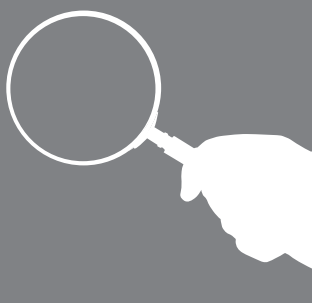


Source: Bloomberg, LGIM

Excess spread can be thought of as a long-term investor premium.

But when we analyse the spread on investment grade corporate bonds we find that there is still a reward above and beyond these two components, as shown in Figure 6. This is compensation for a number of factors such as reduced liquidity – in that corporate bonds are more difficult and more costly to trade than gilts – and for price volatility arising from changes in the spread. Whilst both of these factors will be a concern for a short-term investor, neither should be important for anyone with a longer time horizon. For example, a defined benefit pension plan is unlikely to need to trade a portfolio of corporate bonds that are held to pay long-term liabilities. Nor should it be overly concerned with spread movements that affect the price of bonds but not the cashflows they produce. As such, this excess spread can be thought of as a long-term investor premium.

*So, to **summarise**, corporate bonds have an advantage over government bonds for long-term investors. As such, one would expect corporate bonds to be highly efficient for endgame portfolios focused on self-sufficiency. We investigate whether this is the case in the next section.*



5. Self-sufficient investment strategies

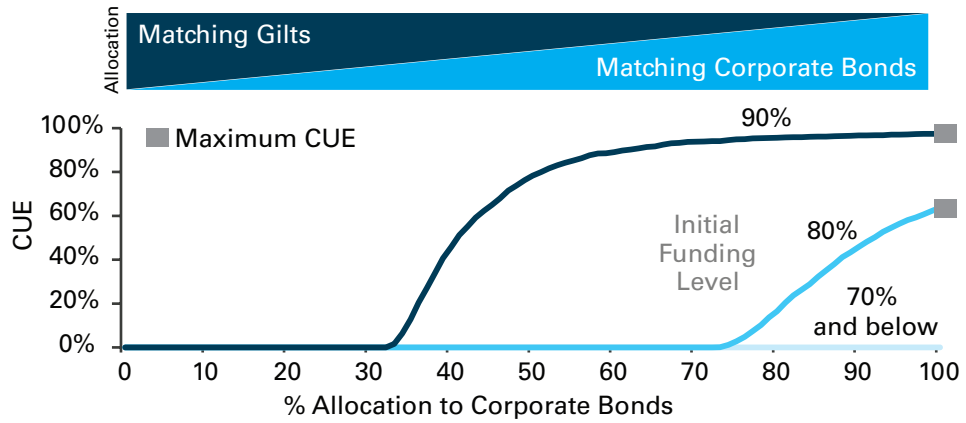
We measure all liabilities using gilt yields for consistency.

For a given set of liability cashflows, the CUE depends on two key factors: the initial level of assets relative to these liabilities, and the way in which these assets are invested. In order to have an objective starting value of assets, we measure everything relative to the present value of liabilities discounted using the gilt yield. This is a useful starting point as under the assumptions outlined in Section 3, any scheme that has assets equal to its liabilities on this basis can simply buy a portfolio of exactly matching gilts and know that those assets will meet the liabilities.

We also established that for any scheme with less than this value of assets, no gilts would be held if maximising the CUE were the only objective. (This assumes that no gilts would be needed for collateral, and that corporate bonds of sufficient duration would exist.) The reason for this is shown graphically in Figure 7. For a funding level of 90% or 80%, the CUE is maximised with an allocation of 100% to corporate bonds; with a funding level below this, no combination of gilts and corporate bonds offers any prospect of the assets outlasting the liabilities. As such, the choice in our model is between a diversified growth fund and a portfolio of buy-and-hold corporate bonds. The impact of the asset allocation on the CUE is shown in Figure 8.

Figure 7

CUE-maximising asset allocations



Source: LGIM

There are a number of interesting features in this chart. First, it seems that reasonably well-funded schemes – say, those with a funding level of over 85% on a gilts basis – can have a high CUE. In other words, the chance of them meeting their liability cashflows is over 90%.

A second point of interest – and the second key finding of the paper – is that the asset allocation in these portfolios leans strongly towards corporate bonds. In other words, the long-term investor premium allows pension schemes to be underfunded on a gilts basis, but still to have a good chance of meeting their liabilities. However the allocation is not exclusive to corporate bonds. Even for these very well-funded schemes, there is a small allocation to diversified growth assets as shown in figure 8. This is because these assets diversify the uncertainty around the losses from defaults and downgrades that will be experienced in the corporate bond portfolio.

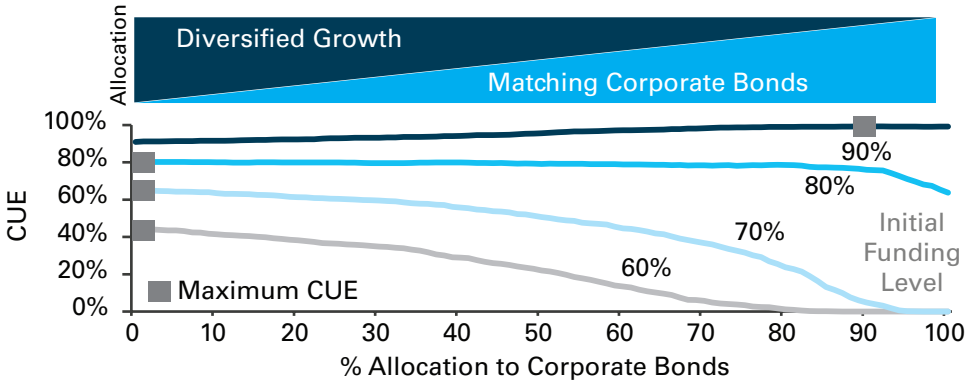
The CUE-maximising allocation is not exclusive to corporate bonds.

If the funding level falls much below 85%, Figure 8 shows that the maximum achievable CUE also starts to fall rapidly. This highlights the third interesting point – that as it falls, the optimal allocation appears to be one that is exclusive to diversified growth assets.

This happens because below a critical level of funding, it becomes impossible for a corporate bond portfolio to meet the liability cashflows, even with no losses from defaults or downgrades. In contrast, there is no limit to the potential upside from a portfolio of diversified assets, so this becomes the only reasonable allocation if your sole aim is to maximise the CUE.

Figure 8

The relationship between asset allocation, funding level and CUE



Source: LGIM

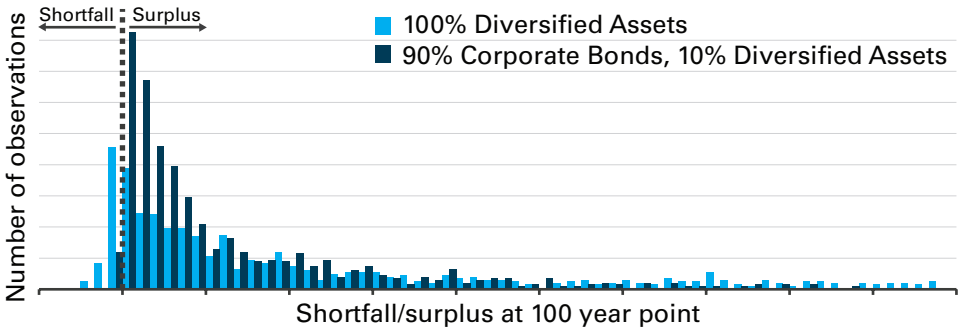
This is not to say that poorly funded schemes should aim for self-sufficiency by investing solely in diversified assets. Once the funding level falls below the point at which corporate bonds seem attractive, the CUE also declines more quickly. Pension schemes in this situation should instead focus on a glide path that will enable them to reach self-sufficiency in a reasonable time horizon.

The probability of a very large shortfall is significantly higher if corporate bonds are not used.

It is also worth considering the range of outcomes by asset allocation. For example, at a 90% level of funding, the CUE for an allocation of 100% to diversified assets does not appear to be appreciably worse than a 90%/10% split between corporate bonds and diversified assets – although it is worth noting that the proportion of 'failures' has increased by a factor of four. More importantly, though, the probability of a very large shortfall is significantly higher if diversified assets are the only investment. This is shown in Figure 9, where the left tail is far more pronounced. Because the CUE looks only at the probability of success, analysis such as that shown in figure 9 is needed to help assess the potential magnitude of any shortfall.

Figure 9

CUE-maximising asset allocations



Source: LGIM

It is worth noting that the cashflows of a 'real' pension scheme will be less certain than we have assumed here. For example, longevity uncertainty, combined with benefit caps and floors can make exact matching more difficult. In these circumstances, a higher allocation to diversified assets could be appropriate, particularly if those assets also produce a stable income.

6. Ongoing monitoring

A larger spread would reduce the value of assets held, but might imply a higher long-term investor premium.

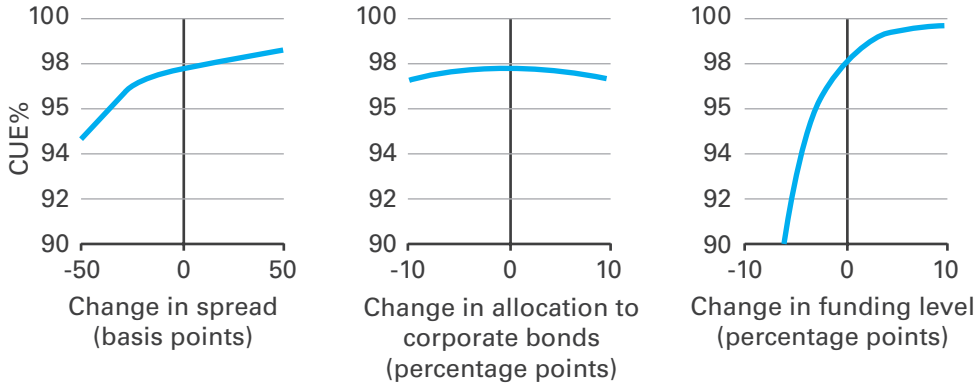
Once an asset allocation has been set, it is necessary to monitor the CUE on a regular basis. In practice, a change in (for example) the spread would have a range of impacts on a pension scheme's CUE. A widening spread could mean a higher expected level of defaults and downgrades for any investor holding the bond. But for a new investor, it could mean a higher long-term investor premium. A larger spread would also reduce the value of assets held and, more importantly, would reduce the funding level relative to liabilities values on a gilts basis. Furthermore, it would change the asset allocation of the scheme if the value of all other investments stayed the same. This shows that there are three items that are important to consider:

As indicated above, none of these three items is likely to change in isolation. However, it is helpful to consider the impact of a change in each of these items independently for the purpose of building a monitoring tool.

The relationship between each of these and the CUE is shown in Figure 10, with a starting funding level of 90% on a gilts basis and an allocation of 90% to corporate bonds. In each case it is assumed that nothing else changes. This means that, for example, an increase in the credit spread results in an increased CUE, because it assumes that the funding level remains unchanged: in other words, a fixed proportion of the (increased) yield is received. In practice, unless the diversified fund performed well, the funding level would worsen and the net result would be a slight fall in the CUE (since a higher credit spread implies greater losses from defaults and downgrades as well as a larger long-term investor premium).

Figure 10

CUE sensitivity to individual factors



Source: LGIM

This information can be effectively combined into charts that allow the CUE to be tracked as frequently as is required. Figure 11 shows the relationship between the CUE and the funding level for three different allocations to corporate bonds, centred on the current allocation of 90%.

But say markets and spreads moved, resulting in the allocation to credit falling to 85%. This could be down to an increase in spreads, but it could also be a result of strong performance from the diversified assets. Whatever the case, our focus should now be on the left-most panel in Figure 11.

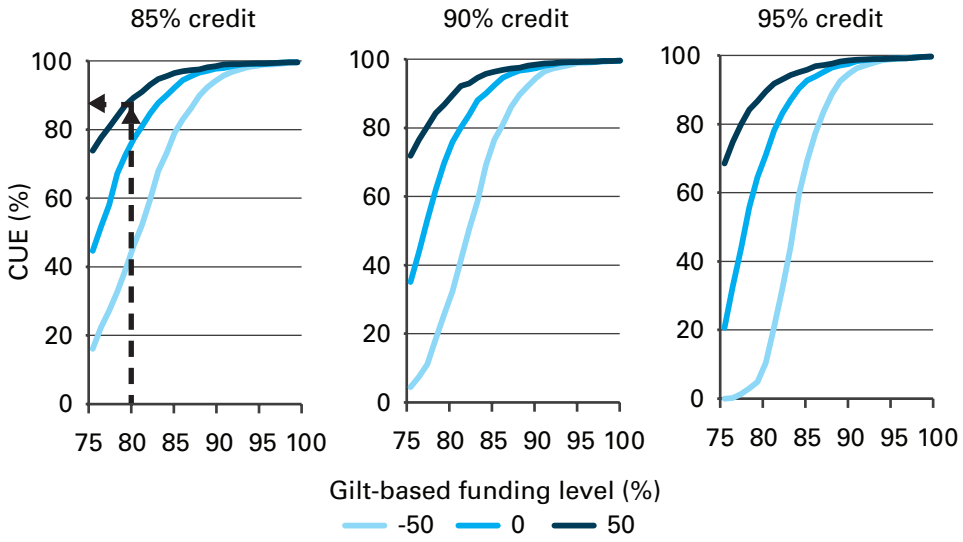
An increase in spread indicates an increase in the CUE, all other things being equal.

If the change was due in part to a widening in spreads – say by 50 basis points – this would indicate that we should focus on the uppermost line on this chart. This seems positive, as an increase in spread indicates an increase in the CUE. However, this assumes no change in the funding level – and it is likely that the funding level will have fallen.

And if the funding level had fallen to 80% for example, we could surmise that the CUE would now be around 83%, by reading up from the horizontal axis, as far as the dark blue line, and then across to the vertical axis. This is indicated on the chart.

Figure 11

CUE tracking tools (with the legend indicating the basis point change in spread)



Source: LGIM

7. Reconciliation to mark-to-market discount methodology

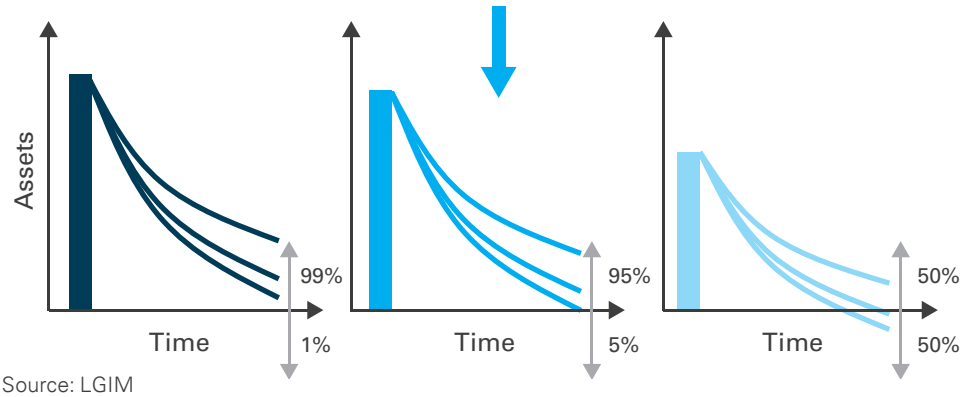
Pension schemes still need a present value of their liabilities for statutory funding purposes.

A key feature of the CUE approach is that it does not rely on a discounted value of liabilities, or even a discount rate. In fact, the only reason any discounting was done in the earlier discussion was to give an objective measure of the funding level. However, there are circumstances under which a discount rate and a value of liabilities will be necessary. The key area will be for funding valuations in the UK, for which legislation requires a discounted value of liabilities. However, this does not mean that the CUE approach cannot be used. Indeed, the CUE approach can be used to infer both a value of liabilities and a discount rate.

The way in which this can be done is as follows. First, decide on the CUE that is regarded as adequate, say 95%. Next, determine the value of assets that would be required to achieve this CUE given the current asset allocation. For example, this might be the value of assets shown in the middle panel of Figure 12, which would give a CUE of 95%. This can be regarded as the value of the liabilities, since if this level of assets were held the scheme would be considered "adequately funded".

Figure 12

The relationship between starting assets and CUE (shown as percentages)

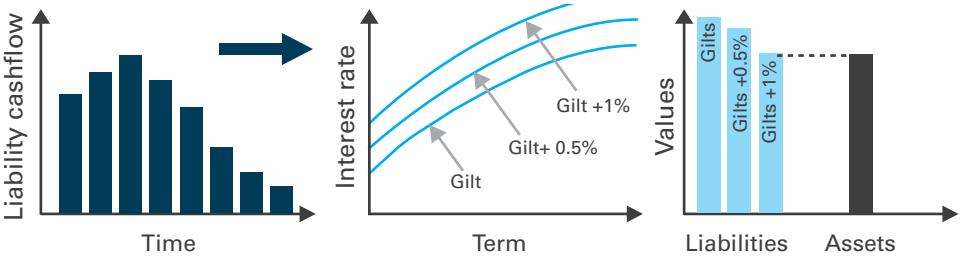


Source: LGIM

Next, this value of liabilities must be used to determine the discount rate implied by the analysis, as shown in Figure 13. This is done by taking the cashflows and working out what discount rate – perhaps expressed as a spread over the gilt curve – would result in the discounted value of cashflows being equal to the value of liabilities given above. In this way, the implied discount rate can be determined. The discount rate that does this is the discount rate implied by the CUE approach for this level of confidence – in this case, 95%.

Figure 13

The relationship between discount rate and liability value



Source: LGIM

The resulting discount rate takes into account not just the expected outperformance of corporate bonds and any other assets held; it also allows for uncertainty in this outperfomance. For a pension scheme invested mainly in credit, the discount rate that emerges will be similar to the corporate bond yield less an allowance for the part of the spread needed for expected defaults. This itself is close to the discount rate used in accounting standards. As such, for a pension scheme invested mainly in corporate bonds, levels of funding under the CUE approach will be similar to accounting funding levels.

8. Conclusion

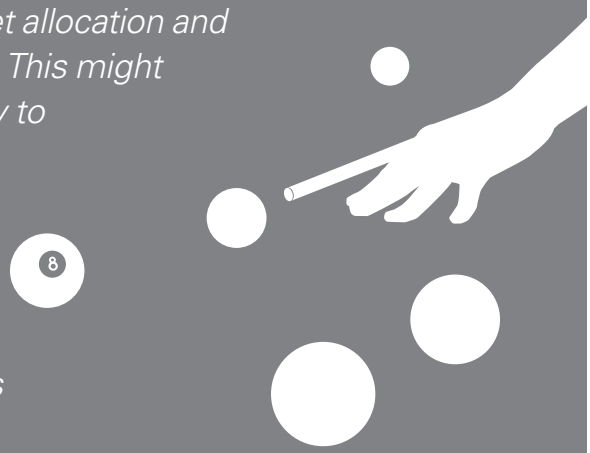
It's worth reconsidering how pension schemes measure funding.

The objectives of defined benefit pension schemes have changed in recent years. In particular, they are increasingly focused on being able to pay their accrued benefits rather than allowing new members to join and earn pensions. But not all pension schemes are on a path to buy-out – many view self-sufficiency as a realistic endgame.

As such, it is worth reconsidering the way in which pension schemes measure funding. If the aim of a self-sufficient pension scheme is to have enough money to pay benefits when they fall due, then the measure of success should reflect this. The CUE does exactly that.

The CUE can also be used to help design an appropriate asset allocation – and, for a mature pension scheme, such an allocation is likely to be dominated by corporate bonds if the CUE is the primary metric being used. The nature of self-sufficiency allows pension schemes to capture the long-term investor premium.

But it is not possible to just set and forget a strategy. It is important to review the adequacy of the assets relative to their goal. This can be done by mapping out the impact on the CUE for various possible changes in spread, asset allocation and gilt-based funding level. This might also offer an opportunity to tactically move into and out of corporate bonds and even, ultimately, to buy-out by responding to potential future changes in credit spreads.



Appendix: liability cashflows

In constructing our liability cashflows, we use data from the Office for National Statistics. The number of people at each age is determined by assuming a stable population consisting of men only aged 25 and above. The underlying population is for United Kingdom males 2012-based principal projection, projected to 2015. For the purpose of determining the proportion of lives at each age, mortality is assumed to be in line with the same projection table from that point on. Individuals are assumed to start accruing benefits at age 25 and to retire at age 65, with benefits being accrued continuously over this period. However, it is assumed that benefit accrual ceases when the analysis is carried out. In other words, anyone aged 65 or older will have earned 40 years of pension. Anyone younger than this will have earned a progressively smaller amount, with a 26 year-old earning only a single year of their pension.

Benefits are assumed to increase in line with the Retail Price Index (RPI), both before and after retirement. However, we also assumed that future increases are fully hedged using inflation swaps. In other words, there is no inflation risk in these cashflows. In practice, this would mean that a certain proportion of the assets would need to be invested in gilts as collateral for the swaps; in our analysis we ignore this requirement.

It is also assumed that there is no demographic uncertainty. This is another simplification, as the mortality projections used are only estimates; however, the issue of longevity uncertainty and investment strategy is a significant topic in itself.

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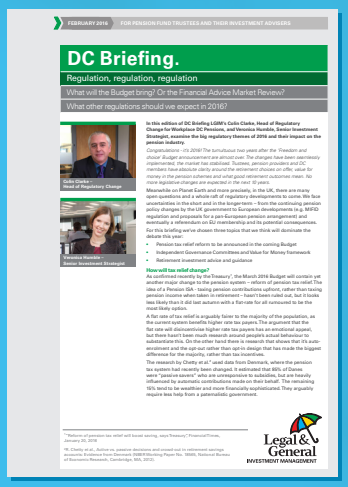
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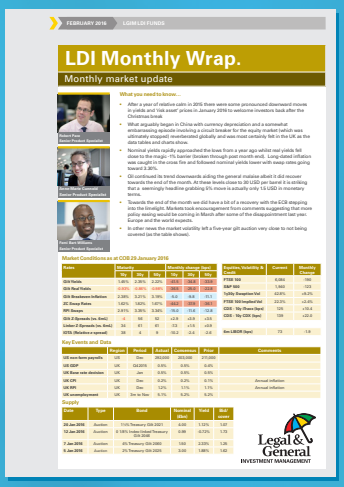
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