Inflation increases with caps and floors – managing LPI-linked cashflows

DB pension schemes typically pay inflation-linked benefits with caps and floors, called limited price indexation (LPI) linked benefits. How should trustees manage these cashflows?

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EXECUTIVE SUMMARY

While inflation increases in pension scheme benefits often reference the retail price index (RPI), typically the increases come with caps and floors, e.g. benefit payments increase in line with RPI with an upper limit of 5% and a lower limit of 0%. These limited price indexation (LPI) linked benefits do not have exactly the same sensitivity to moves in interest rates and inflation as pure RPI-linked benefits. As such, they create a challenge for schemes looking to hedge their liability risk.

Given the scarcity and prohibitive cost of LPI-linked instruments many pension schemes adopt a pragmatic approach buying a mix of fixed and RPI-linked assets so that their combination has the same sensitivity to moves in inflation as the LPI-linked liabilities. We believe that this approach, known as 'delta hedging', is sensible but the risks involved are often hidden and neglected. In this article we detail:

- How using market prices of LPI swaps to determine the delta hedge (i.e. the mix of fixed and RPI-linked assets) is problematic because the LPI swap market implies unrealistic inflation behaviour
- No single correct real-world alternative method exists. We illustrate one approach that we believe is likely to reduce long-term risk relative to using market pricing. However a degree of risk remains in practice – we call this 'LPI risk' and find that it is a significant unappreciated risk in many schemes
- LPI risk becomes more important as schemes de-risk. Understanding LPI risk and other 'small' risks encourages a practical approach when rebalancing and has implications for wider investment strategy

Legal & General
INVESTMENT MANAGEMENT

DB pensions in the UK are often LPI-linked. The idea is to limit the cost of pensions (in the case of caps) but also to ensure that pensions don't fall in nominal terms[1] (in the case of a 0% floor). There are a few different ways that these caps and floors can be applied[2]. In this piece we focus on a year-on-year application of the caps and floors and illustrate our thinking for pensions with a 0% floor and a 5% cap, denoted LPI(0, 5), benefits[3].

LPI benefits present a risk management challenge to pension schemes. The ideal hedging instruments are LPI swaps[4]. But the UK LPI swap market has become increasingly illiquid; most banks have withdrawn from the market or are pricing these contracts at levels not justified by historic inflation. Given the scarcity of LPI-linked instruments, another approach is needed. In this paper we explore one such approach known as delta-hedging.

DELTA HEDGING BASICS

The idea behind delta hedging LPI benefits is to estimate their sensitivity to inflation and then buy inflation-linked assets to match that sensitivity. The mix of assets to hold is regularly reviewed and rebalanced to ensure the hedge continues to work. However the estimation of the inflation sensitivity is easier said than done.

Trustees could assume that LPI benefits are 100% inflation-linked when expected inflation is between the cap and floor, and 100% fixed when outside. This is called a 'binary' approach. However this misses that caps and floors have a value due to the chance they bite.

From a member's perspective a cap has a negative value because there is a chance that it will reduce their pension (in the event of high inflation). And a floor has a positive value because there is a chance it will increase their pension (in the event of deflation). When inflation expectations move, the value of the caps and floors change – the aim is to hedge these changes in value. Therefore, the sensitivity (or delta) of LPI benefits to inflation should never be 0% or 100% - it should be somewhere in between. The question is what exactly it should be.

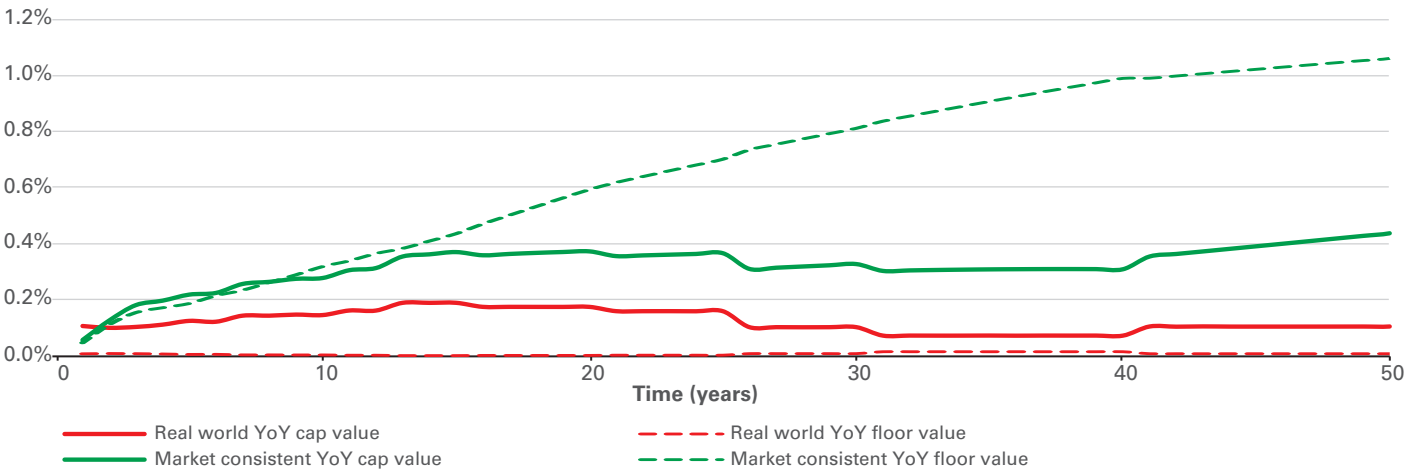
USING LPI SWAPS TO GAUGE INFLATION SENSITIVITY

A common way to estimate deltas is to take an objective "market-consistent" approach. For LPI-linked benefits this involves using LPI and RPI swap rates together with a model[5].

THE PROBLEM

So what's the problem? Well, over time the UK LPI swap market has become highly illiquid, particularly following the financial crisis. All but a very small number of banks have withdrawn from the LPI swap market, leading to some strange looking prices. In particular, the market appears to be pricing in a very high chance of deflation – see Figure 1. This is reflected in the high cost of buying a floor for future years.

Figure 1: The year-on-year (YoY) prices of 5% caps and 0% floors under mark-to-market and real-world[6]

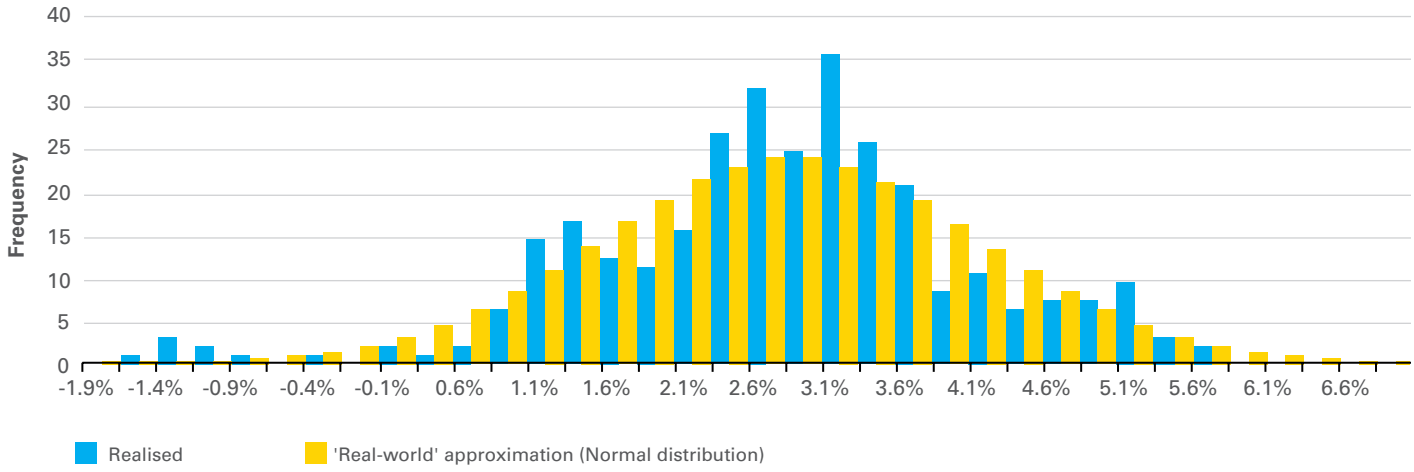


Source: LGIM calculations as at 31 December 2017

1. Due to money illusion, a behavioural effect, people hate nominal cuts in income even if the general price of goods has fallen by the same amount
2. For example, some deferred pensions are increased at the lower of some cap rate compounded over the whole period and the actual increase in the RPI
3. Year-on-year caps and floors typically apply once a pension is in payment and are, all else equal, more likely to bite than other types of caps and floors
4. LPI swaps exchange a fixed amount for a limited-price index (LPI) return over the life of the swap
5. One market-consistent approach to delta hedging involves fitting a mathematical distribution - the Stochastic Alpha Beta Rho (SABR) model is the industry standard - to quotes from banks
6. The real world model used is explained later

Compared with Figure 2, which shows realised RPI increases[7] since October 1992 (when inflation targeting began in the UK), the distribution of RPI implied by market-pricing is very different from history. History shows a relatively symmetric distribution other than a small blip of deflation during the financial crisis – arguably an exceptional event. We shouldn't let the past be the sole driver of what we expect from the future, but it's hard to believe that LPI swap pricing is fair, particularly for the floor[8].

Figure 2: Historic RPI data readings since October 1992



Source: LGIM calculations

This matters because trustees should assume a realistic distribution for future inflation in designing their delta hedge. Given market pricing is hard to believe, what should trustees do?

A REAL-WORLD APPROACH

One solution is to move away from market-pricing and adopt a 'real world' model for inflation behaviour. As a relatively simple approach, the Black-Scholes model is regularly used by pension actuaries to value LPI-linked benefits. Under this approach inflation rates have a (practically[9]) symmetric distribution, more consistent with history. Using a Black-Scholes methodology is simple to understand and implement, but requires an estimate of inflation volatility. From our analysis we believe a sensible choice is 1.5% per annum, under current market conditions. However we note that the task of choosing an LPI model in general is a challenging one, with many considerations – both technical and practical – involved[10]. Exploring the exact choice of model is not the key aim of this paper.

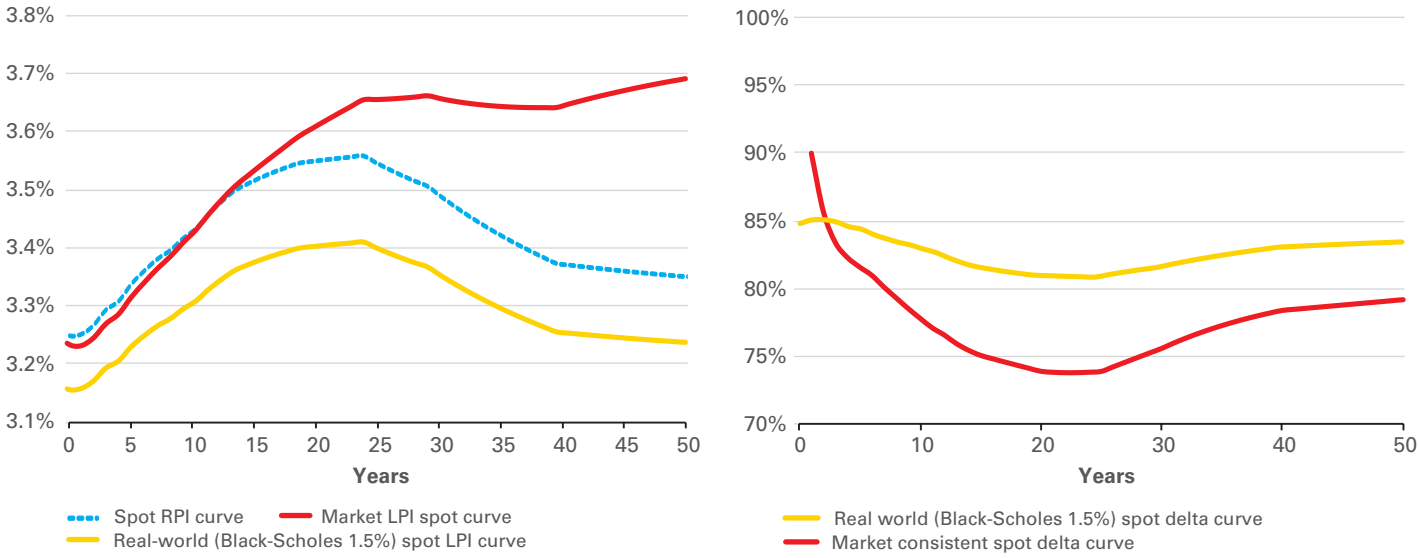
THE IMPACT OF MOVING TO THE REAL WORLD

Figure 3 shows how the LPI curve[11] for a floor of 0% and a cap of 5% differs between a market-consistent approach and the Black-Scholes 1.5% model. The LPI curve is above the RPI curve under the market-consistent approach due to the high cost of the floor. But under a real-world approach the LPI curve is lower, leading to lower estimate of the value of the LPI liabilities.

Due to the lower chance of the cap and floor biting under the real-world approach, the sensitivity of LPI benefits to inflation (delta) increases. For schemes that are interested in funding level hedging (most schemes are), rather than deficit hedging, only the impact on the deltas actually matters for structuring the hedging portfolio[12].

7. Over rolling yearly periods
8. Note that if inflation gets close to zero and many pension funds are delta hedging, they would sell RPI-linked assets as part of their hedging strategy. However, although this could pull expected inflation curves down, it shouldn't impact the underlying economy on which changes in RPI ultimately depend. As such we don't think this is a good reason to think that deflation risk is under-estimated
9. One plus the inflation rate over the year is lognormally distributed
10. The authors recently became members of an LPI Risk working party of the IFoA (with Alexandra as chair) aimed at undertaking a comprehensive review of all the existing alternative methodologies used to calculate the IE01 of LPI-linked benefits
11. LPI using RPI with a yearly cap of 5% and a yearly floor of 0%
12. This is because funding level hedging involves hedging up to the value of the assets, so the reduction in liabilities isn't of consequence to the hedge

Figure 3: Impact on LPI (0, 5) curves and deltas from moving to a real-world model



Source: LGIM calculations as at 31 December 2017

The delta increases by around 10% switching from a market consistent to real-world methodology at 20 years as can be seen on the right-hand side of Figure 3, meaning schemes would hold 10% more in RPI-linked assets and less in fixed assets.

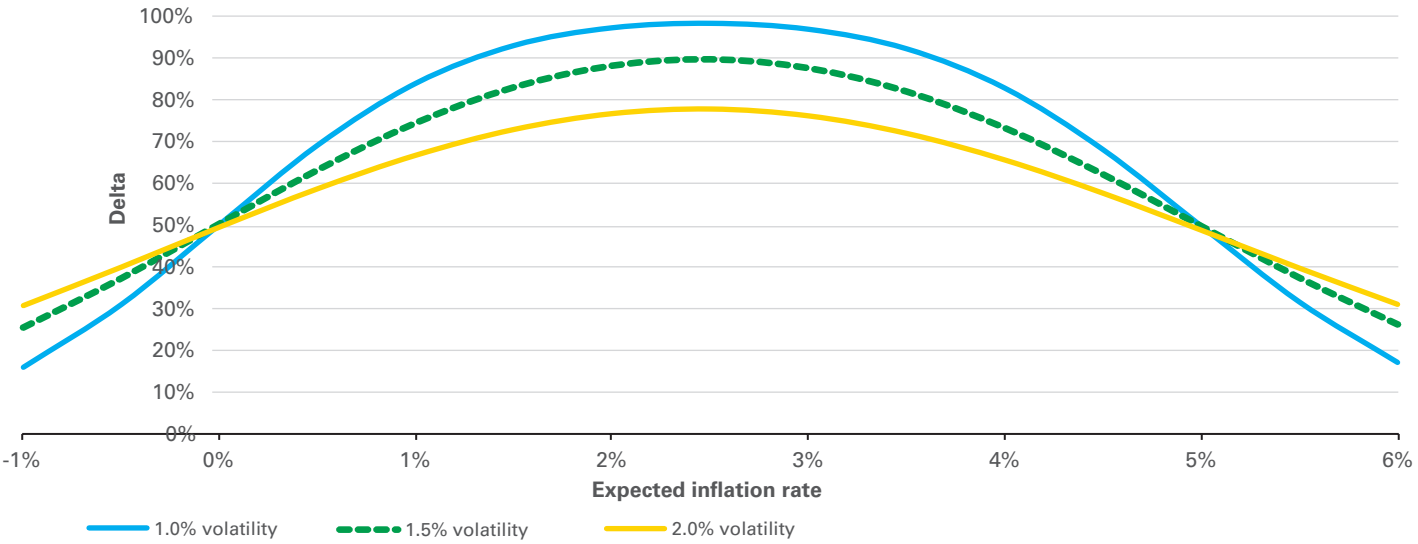
MODEL UNCERTAINTY

Under current market conditions a Black-Scholes model with a 1.5% volatility assumption is one sensible choice of real-world model. However, we stress that there is no "right" answer. In the same way that people often disagree on an equity risk premium assumption, for example, they are also likely to disagree on the volatility of future inflation[13].

This model uncertainty sounds like an academic technicality but it matters. If the wrong model (or parameterisation of that model) is used then the hedge that gets implemented will be wrong. To illustrate this, Figure 4 shows how the delta of a LPI cashflow[14] due in 20 years[15] varies substantially with the volatility assumption under the Black-Scholes model.

For the remainder of this paper we assume the Black-Scholes model is suitable but recognise uncertainty in the volatility assumption to use. We call the resulting risk, together with other risks that remain in practice even if you correctly forecast volatility, 'LPI risk.'

Figure 4: Black-Scholes LPI (0, 5) deltas



Source: LGIM calculations as at 31 December 2017

13. Although we would add that volatilities are generally easier to forecast than risk premia.
14. This means a RPI-linked cashflow with a yearly floor of 0% and a yearly cap of 5%. It is the most common type of LPI benefit.
15. A typical duration for a pension scheme

A HIDDEN BUT SIGNIFICANT RISK

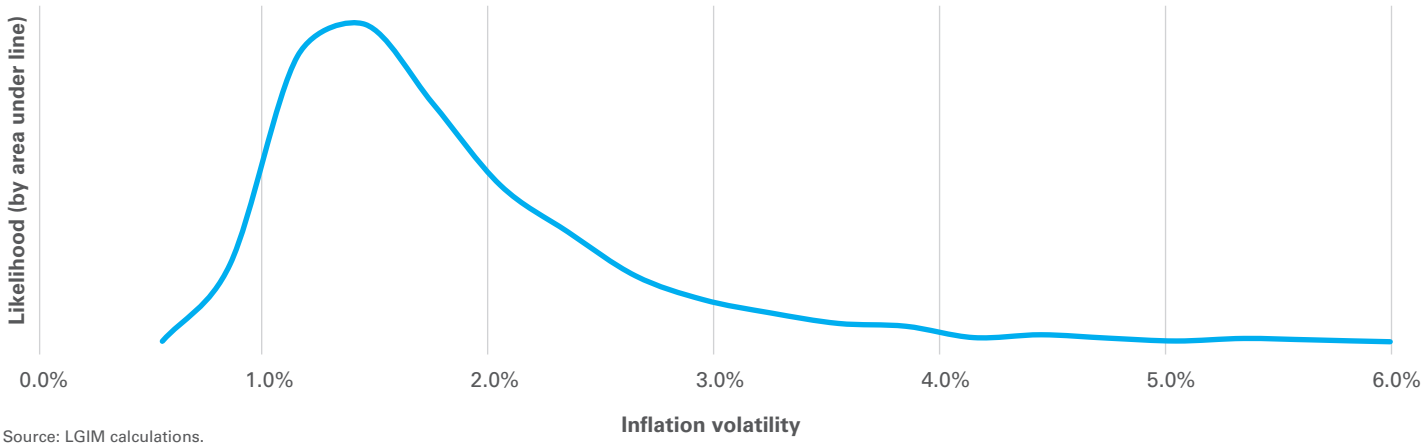
Some readers may find all this discussion of LPI risk strange – they've heard of LPI benefits, but LPI risk? That's never shown up in any asset liability modelling – why hasn't anyone mentioned anything about this before? One reason it has been neglected is that over the short-term, LPI risk is usually hidden. This is because the LPI curves used to value the liabilities are usually consistent with the asset portfolio held to delta-hedge the liabilities. In the short-term, fluctuations in the funding position, driven by moves in the LPI curve, dwarf actual inflation experience.

Whilst this is a reasonable thing to do, it also gives a (false) illusion of precision. Over the long-term, holding a different asset portfolio as a result of a different assessment of the inflation sensitivity of the liabilities has a significant impact on the cashflows. There is a significant risk from using a different delta, but how big might it be?

SIZING LPI RISK

To quantify LPI risk we built a model that combines the risk of getting the volatility assumption wrong (see Figure 5), the knock-on impact on the hedging strategy (shown in Figure 4) and finally the potential impact of this – essentially the risk of being over- or under-exposed to inflation.

Figure 5: Estimated uncertainty of inflation volatility assumption



Source: LGIM calculations.

This uncertainty is based on the fact that we only have a limited amount of appropriate data[16] and the fact that the past is never perfectly relevant to predicting the future[17].

Our calculation gives an estimated funding level volatility from LPI risk of around 1.3% for a scheme where 100% of liabilities are LPI(0, 5). Other model risks and practical issues add an additional layer of risk[18]. Overall we estimate that LPI(0, 5) risk could be in the region of 1.5%-2.0% p.a. under current market conditions. This is inevitably (despite the maths) a highly subjective estimate but it is interesting to get a feel for its possible size.

What does a risk of this size actually mean? Well for context, our estimate for the funding level volatility that arises from longevity uncertainty – admittedly a very different type of risk – is typically also around 2.0% p.a.

So a scheme that has 100% of benefits linked to year-on-year LPI(0, 5) could be exposed to LPI risk of a similar magnitude to longevity risk. Of course, few or no schemes have all their benefits exposed to year-on-year LPI. In addition, LPI risk will be dwarfed by investment risk for a scheme heavily invested in equities and other growth assets. Where it does become important is for schemes further along their de-risking journey.

WHEN SHOULD A DELTA-HEDGE BE REBALANCED?

Monitoring and rebalancing a delta hedge based on a very tight tolerance between assets and liabilities may not make sense given the degree of uncertainty as to what the right fixed/real split should be. As such recognising model uncertainty can promote a degree of pragmatism and should be factored into any rebalancing strategy in our view.

16. c.25 years of realised inflation since inflation targeting but considerably less data (depending on tenor) on realised inflation relative to that expected from inflation forward curves
17. We've assumed, purely for illustration, that inflation volatility has a two-thirds chance of lying between 1.0% and 2.0%. In practice, estimating inflation volatility, and gauging the uncertainty in that estimate, is as much an art as it is a science, like many aspects of risk management.
18. Even if inflation rate volatility can be perfectly forecast this doesn't mean there is no risk

IMPACT ON OVERALL INVESTMENT STRATEGY

There are a large number of 'small' risks that traditional ALM ignores and as a result these may go neglected. These include LPI risk, CPI risk (due to a lack of available CPI-linked assets, with RPI instruments often used instead), longevity risk and other demographic risks.

Appreciation of these risks can impact a scheme's investment strategy. For example:

- Risk-adjusted returns from taking investment risk can be higher in the presence of these risks. These small additional risks diversify investment risk, which can make it more attractive (the same return pick-up for only a marginal increase in overall risk)
- Short-term risk budgets may have been breached (by taking these additional small risks into account)
- The probability of meeting objectives may be lower than thought
- Insurance strategies could be useful

In general we recommend taking a long-term holistic approach that models all scheme risks, including covenant risk.

WHAT NEXT FROM LGIM?

We would be delighted to meet with you in person to discuss our findings in more detail, and show how they could be relevant for your scheme. To set up a meeting or request more information please contact your Client Director.