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INTRODUCING LE01: A MEASURE OF LONGEVITY EXPOSURE

WITH INPUT FROM INDUSTRY EXPERTS, WE HAVE DEVELOPED THE CONCEPT OF 'LE01', A MEASURE OF LIABILITY EXPOSURE THAT ENABLES PENSION SCHEMES TO UNDERSTAND THE IMPACT OF A SUSTAINED CHANGE IN FUTURE LONGEVITY IMPROVEMENTS. WE DESCRIBE THE MEASURE, ITS USES AND BENEFITS BELOW.

THE GROWING IMPORTANCE OF LONGEVITY RISK

Over the last decade pension schemes have hedged increasing amounts of their liability-related interest rate and inflation risk, and for many schemes longevity is now their dominant source of liability-related risk. It is therefore increasingly important for schemes to quantify the extent of their longevity risk such that they are able to put it into context, examine the impact of hedging the risk and monitor those hedges through time.

To this end, with input from industry experts, we have developed the concept of 'LE01', a measure of liability exposure that enables pension schemes to understand the impact of a sustained change in future longevity improvements.

DEFINING LE01

Similar in concept to PV01 and IE01 (the industry standard measures of sensitivity to a 0.01% change in interest rates and inflation, respectively), we define LE01 as the increase in liability value that results from a 0.01% rise in all future longevity improvement rates. For example, consider a pension scheme that is using a longevity improvement assumption of 1.50% per annum. In order to calculate the LE01 we project the future liability cash flows using a longevity improvement assumption of 1.51% per annum. The LE01 is the difference in present value between this set of liability cash flows and the original cash flows.

The definition of LE01 reflects a belief that measuring longevity risk through the lens of future improvements is more relevant for most pension schemes than considering the impact of an immediate reduction in current mortality rates, specifically:

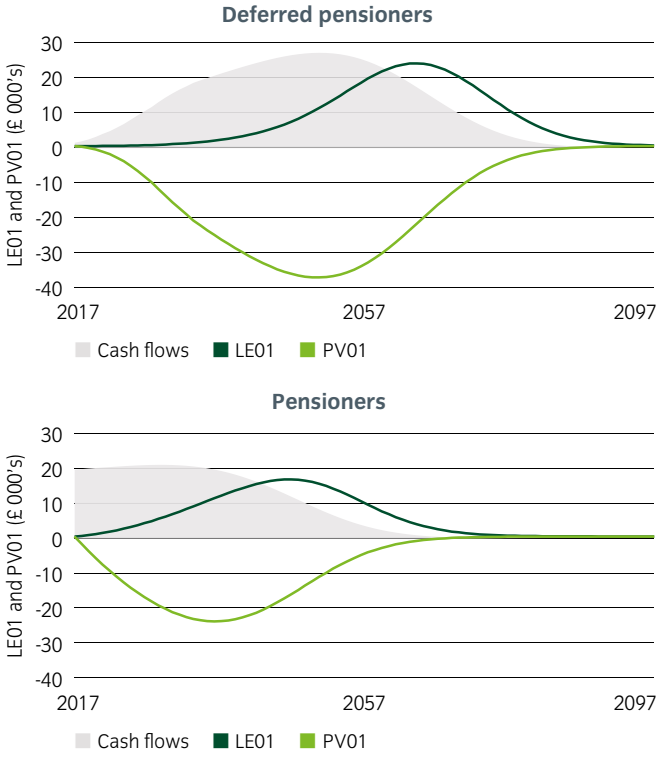
- Current mortality rates can be estimated relatively well, based on either historical scheme experience or a socio-economic model, and are therefore unlikely to unexpectedly vary materially from one year to the next.
- Longevity improvements are far more subjective as they reflect the actuarial profession's current view on the continuation of historic longevity trends and the potential impact of a range of factors, such as advances in medical technology, the availability of healthcare and changes in lifestyle.

The LE01 metric has been designed such that it places more weight on longer-dated liability cash flows, capturing the fact that the level of uncertainty inherent within a longevity projection increases with time.

THE SHAPE OF LE01

In Chart 1 we show the LE01 profile for an example pension scheme with £1bn of liabilities split equally between deferred and pensioner members.[1] For comparison purposes we also show the shape of the underlying cash flows and also the corresponding PV01[2] profiles.

Chart 1: Cash flows from physical assets



[1] Pension scheme has liabilities of £1bn, with the deferred and pensioner members having durations of 29 years and 16 years, respectively. Pre-retirement revaluations are assumed to be in-line with full Retail Prices Index (RPI) and post-retirement increases in line with RPI capped at 5% pa. [2] PV01 is the impact on liability value of a 0.01% pa rise in interest rates, based on the original (rather than the LE01 stressed) cash flows.

Table 1 – Example LE01 and PV01 comparison

	Liability Value	LE01	PV01	Ratio
Deferred pensioners	£500m	£0.75m	£(1.45m)	52%
Pensioners	£500m	£0.50m	£(0.80m)	63%
Total	£1,000m	£1.25m	£(2.25m)	56%

Unlike the liability PV01, the LE01 metric is positive rather than negative, but although slightly smaller its overall magnitude is similar to that of PV01 for both classes of member. The full details are in Table 1 (above).

Chart 1 shows that the profile of LE01 is skewed more towards the longer-dated maturities than is the case for PV01. This reflects the fact that increasing future longevity improvements has proportionately more impact on distant cash flows. The extent of the skew towards the longer-dated maturities is influenced by the nature of pension increases embedded within the liability cash flows. Specifically, the greater the pension increases, the more pronounced the skew.

USES OF LE01

We believe that analysis of LE01 allows a pension scheme to develop a more detailed understanding of its longevity exposure. This should facilitate a more informed discussion of the risk, its possible impact on the scheme and the efficacy of potential hedging solutions.

The benefits of measuring and monitoring the LE01 metric include the following:

- Enables longevity risk to be more easily put into the context of other scheme risks
- Makes it possible to understand the contribution to overall longevity risk arising from a specific group of members
- Serves as a benchmark for discussing the impact of new longevity improvement assumptions
- Helps schemes to better understand the potential impact of unexpected future changes in longevity improvement assumptions
- Allows schemes to more easily determine the amount of assets to be held or the investment returns to be targeted as a buffer against the potential impact of longevity risk

For a scheme considering a longevity hedge, the LE01 metric can be used as a way of putting the cost of the hedge into perspective. For example, the present value of the longevity hedging fee might equate to 35 units of LE01, whereas the longevity risk that it is removing could be equivalent to 50 units at the total scheme level.

In the case of a pension scheme that has already implemented a longevity hedge, the LE01 metric can be used in a number of ways:

- Monitor the progress of the longevity hedge ratio over time; as the lives underlying the longevity hedge age, their contribution to overall scheme longevity risk will fall and therefore the longevity hedge ratio will fall
- By monitoring the extent of the unhedged pensioner LE01, the scheme is able to understand when it might be time to implement an additional longevity hedge
- The LE01 can be used to determine the extent of the asset buffer that must be set aside to meet potential collateral calls associated with the longevity hedge

PUTTING LE01 INTO CONTEXT

To make LE01 a useful metric, it is important to put it into context relative to other longevity risk measures. Below we consider two ways in which this can be done.

1. **Current longevity improvement assumptions**

   In the case of our example pension scheme, removing all future longevity improvement assumptions reduces the liability value from £1bn to £795m. Given the scheme's LE01 of £1.25m, this reduction in value of £205m means that the current longevity improvement assumptions are equivalent to roughly 160 units of LE01.

2. **Longevity stress tests**

   Under Solvency II insurance rules, the standard 99.5th percentile (1-in-200) longevity stress test equates to an immediate 20% reduction in current mortality rates.

   Applying this longevity stress to our example pension scheme leads to a 10% increase in the liabilities. The LE01 metric equated to 0.13% of the liability value, meaning that the Solvency II 99.5th percentile longevity stress is equivalent to roughly 80 units of LE01.

   Given that pension schemes typically consider a 95th percentile stress test (1-in-20) rather than a 99.5th percentile, we can scale down the factor of 80. For example, if we assume that the longevity stress has a normal distribution, an equivalent 95th percentile stress test would equate to 50 units of LE01.

CALCULATION DETAILS

Calculation of LE01

Unlike the conceptually similar measure of PV01, LE01 cannot be accurately assessed using a top-down approach based on aggregate scheme cash flows. Instead, an accurate assessment of LE01 relies on a bottom-up member by member cash flow projection. The overall process is as follows:

- Generate aggregate scheme cash flows using best estimate assumptions for all demographic assumptions
- Re-run the member-by-member cash flow model, but with annual longevity improvement assumptions beyond the valuation date increased by 0.01%
- Deduct the original cash flows from this new set of cash flows
- The LE01 is then calculated as the discounted value of these net cash flows

Estimation of LE01

In cases where a member by member cash flow model is not available, it is possible to calculate a crude estimate of LE01 from aggregate scheme cash flows. One such methodology is outlined below. Alternative approaches that better reflect the specifics of a given pension scheme may allow a more accurate estimate be determined.

For a given tranche of in-payment pensions, the LE01 can be estimated from an existing cash flow projection as follows:

- Starting from the deflated annual cash flows, CF_t (t=1,…,100), derive an estimate of the overall underlying mortality rate in each future year:

$$q_t = 1 - \left(\frac{CF_{t+1}}{CF_t}\right)$$

- Adjust each of these mortality rates downwards to reflect the impact of a 0.01% per annum increase in longevity improvements:

$$q_t^{new} = q_t \times 1.0001^{-t}$$

- Construct a series of deflated scheme cash flows based on these improved mortality rates:

$$CF_1^{new} = CF_1$$
$$CF_t^{new} = CF_{t-1}^{new} \times (1 - q_{t-1}^{new}) \text{ for } t \geq 2$$

- Inflating these cash flows and the original cash flows to allow for future pension increases allows us to estimate the LE01

A similar approach can be applied in respect of non-pensioner members, but in this case the cash flows must be split by year of retirement.

The estimation errors associated with this approximate approach reflect the fact that it does not accurately capture the effect of factors such as contingent spouses' pensions and lump sum commutations.

SUMMARY

As pension schemes continue to hedge more of their liability-related interest rate and inflation exposure, longevity is becoming an increasingly important risk for many schemes. By introducing the concept of LE01, based on input from industry experts, we hope to provide schemes with a metric that enables them to develop a better understanding of their longevity risk. As an example, LE01 can be used to:

- Put longevity risk into context against other scheme risks
- Determine the amount of assets to be held as a buffer against longevity risk
- Assess the cost-benefit of a longevity hedging solution
- Monitor the hedge ratio provided by an existing longevity hedge

FIND OUT MORE

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