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AEGON Asset Management

LDI Deep Dive Series
Part 5: Pulling the pieces together

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Gosse Alserda
Investment Strategist

Oliver Warren
Investment Solutions Consultant

Investors with long-term liabilities, like pension funds or life insurers, are normally exposed to interest rate risk because a fall in interest rates will increase the value of their liabilities. By adopting a liability-driven investment (LDI) strategy, much of this interest rate risk can be mitigated. In this LDI Deep Dive Series, we have decomposed interest rate risk into parallel shifts of the interest rate curve, curve risk, and basis risk. This final article pulls all the pieces together and analyzes how to effectively allocate risk budget to different types of interest rate risk.

Parallel interest rate risk

The first and most prominent component of interest rate risk is that of parallel shifts of the interest rate curve. Approximately 90% of the movements in the interest rate term structure can be reflected as parallel shifts. Liability-driven investors can protect against these movements by matching the duration (interest rate sensitivity) of liabilities in the investments. As we have seen in the first article, this reduces risk but may also increase expected returns due to the term premium and convexity. However, when interest rates rise this strategy will lead to lower returns. The optimal interest rate strategy therefore depends on the investor's interest rate view. Without a specific view that interest rates are expected to increase, most liability-driven investors would benefit from a high level of interest rate hedging. Using a dynamic hedging strategy (as discussed in the second article) can increase the expected return by benefiting from mean reversion tendencies, but also increases the potential exposure to interest rate risk.

Curve risk

While the majority of interest rate movements can be decomposed into parallel movements, non-parallel movements also represent a material element and can significantly impact the funding level of an investor as we have showed in third article. This is the case for investors that have a mismatch between the cashflow profile of their interest rate hedging instruments and the profile of their liabilities. For example, an investor with long term liabilities who hedges interest rate risk with shorter term instruments. Having a very close match between the cashflows of the interest rate hedge and those for the liabilities can be expensive, so investors should consider the trade-off between the additional costs and the impact on funding level risk (tracking error).

Basis risk

The interest rate hedge might be less effective because the discount rate of the liabilities might differ from the discount rate of the instruments used for interest rate hedging. This might be, for example, due to different risk profiles and/or a different currency. We discussed this basis risk in the fourth article. While basis risk increases funding level risk, it is often useful to include such instruments if they have efficient risk-return properties and/or add to portfolio diversification. Therefore the risk budget for basis risk is a trade-off between lower risk and higher return, and should be considered from a total portfolio perspective.

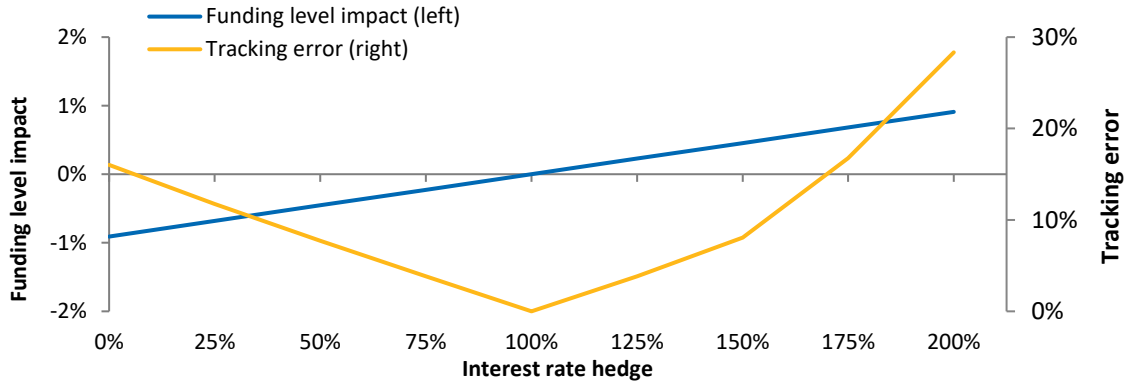
Efficient allocation of interest rate risks

Next, we consider how we can efficiently allocate to these different types of interest rate risks. First, we will look at the risk-return trade-off for each type of risk in isolation. Then, we will consider diversification effects.

Hedge level

The interest rate hedging level determines the exposure to parallel interest rate risk. We can eliminate parallel interest rate risk by fully (100%) hedging the duration of the liabilities. Figure 1 shows this will – in theory – eliminate the tracking error from this source (parallel shifts) of interest rate risk. Deviations from a full hedge – either positive or negative – will increase funding level risk, as indicated by the tracking error. The impact on the tracking error is significant, with a tracking error of approximately 8% for hedging only 50% more or less than the interest rate risk of the liabilities.

Figure 1: Impact of hedging levels on risk and return



Source: Aegon Asset Management. Annual funding ratio impact and risk for different fixed interest rate hedge levels for an average Dutch pension fund. Average over 2,000 scenarios. Assuming (on average) fixed interest rates.

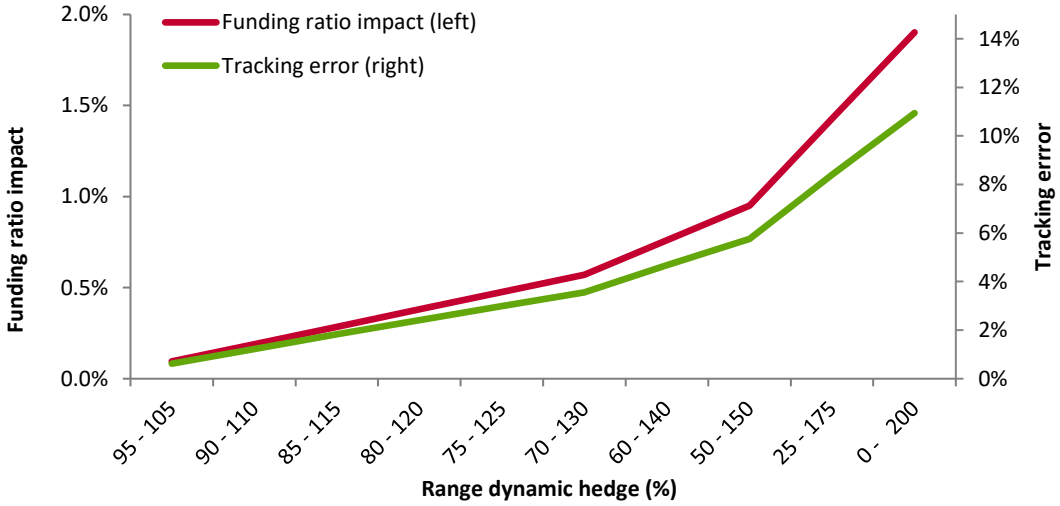
While we can use historical data to estimate the impact of different levels of interest rate hedging on the tracking error, it is more difficult to estimate the impact on expected future returns. Since 2000, we have seen interest rates decline by approximately 6%. As a result of this, interest rate hedging has positively impacted returns. However, lately we've seen interest rates rising again. As we can't rely on history, the expected return impact of the interest hedge therefore depends on the investor's interest rate view. There are many possible interest rate views, some of the more popular are given below:

1. **Back to normal**. Interest rates will return back to their long term mean by, for example, sustained long-term inflation. Higher interest rates will negatively influence the return of the interest rate hedge.
2. **New normal**. Interest rates will remain low, for example due to continued demographic shifts which lead to higher savings levels. If interest rates remain at around their current levels, this will lead to positive returns for interest rate hedging mandates due to carry & roll-down.
3. **Forwards**. Interest rates implied by the forward curve give (with limitations) a prediction from the market for future interest rates. Thereby, the expected carry & roll-down of different maturities is, by definition, equal to the short term rate. Nevertheless, convexity does – to a limited extent – lead to a positive expected return from interest rate hedging.
4. **Equal interest rate**. The current interest rate might be the best estimator for future interest rates. Therefore, interest rates are expected to remain constant. Carry & roll-down in this case will positively impact return. This is the assumption we take in Figure 1.
5. **Mix forwards and equal interest rates**. In reality, the term structure presents both a term premium and expectations. The actual market implied interest rate expectations might be somewhere between the current interest rate and those implied by the forwards rates. Normally, this results in positive expected returns, as a consequence of the term premium and convexity.

Because of these different interest rate views it is difficult to generalize the impact of the hedging levels on expected returns. However, a relatively strong view on expected interest rate increases are needed to rationalize hedging levels that are substantially below 100%, as this will lead to higher tracking errors and will only pay-off when interest rates increase more than the forward rates. One reason to allow for lower hedging levels – next to expecting the interest rate to rise – is as a result of a dynamic hedging strategy.

A dynamic hedging strategy might increase expected returns by benefiting from (assumed) mean reversion in the interest rate. By implementing a higher hedging level for interest rate decreases than for increases, the net impact is positive. However, to benefit from this, the hedging level has to be dynamic and therefore has to deviate from 100% most of the time. In other words, to benefit from a dynamic hedging strategy, one has to incur a tracking error. The larger the deviation allowed, the larger the impact on expected returns but also on the tracking error. Looking at Figure 2 we see that, in this example, the ratio of risk (tracking error) to return (funding ratio) is approximately 6-to-1. While this number is strongly dependent on the assumptions, amongst which the investor's interest rate view, it is in this case comparable to the ratio of risk to return for equities over January 2000 to June 2021. Therefore, combining a dynamic interest rate hedge with other risk exposures might improve the efficiency of the portfolio due to diversification effects.

Figure 2: Impact of dynamic hedging strategies on risk and return



Source: Aegon Asset Management. Annual funding ratio impact and risk for different ranges of dynamic interest rate hedging strategies for an average Dutch pension fund. Average over 2,000 scenarios. Assuming (on average) fixed interest rates.

Maturity selection

After the appropriate level of the interest rate hedge has been determined, the next step is to determine how to allocate the interest rate hedge over different maturities. Perfectly matching the maturities of the liabilities will eliminate exposure to curve risks, but might be expensive due to high transaction costs. In addition, it may be beneficial to actively take position on specific maturities to benefit from market opportunities. Reasons for this includes an investor's specific interest rate view (for example, steepening of the term structure), optimizing roll-down return or benefiting from convexity.

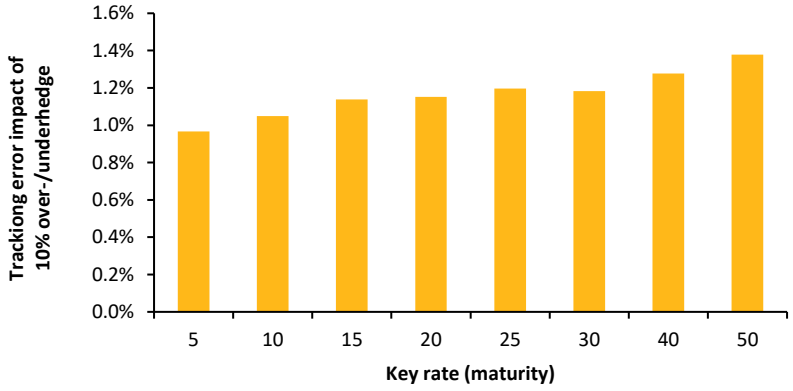
When analyzing the impact of curve risks we normally focus on a set of key rates, such as the eight presented in Figure 3. These key rates explain the vast majority of curve movements and simplify the analysis significantly. As the figure shows, the impact of curve mismatches can be significant: over 1% tracking error for a 10% mismatch in any key rate.

The impact on expected returns is again strongly dependent on the investor's interest rate view. When an investor expects interest rates to remain constant, maturities between 5 and 10 years will normally produce the highest return from carry & roll-down. On the other hand, when large volatility in the interest rate is expected, longer maturities benefit from convexity. When the interest rate is expected to change in line with the forwards, maturity selection becomes less relevant, while longer maturities might still benefit from higher convexity.

Two important reasons to allocate risk budget to maturity selection are: 1) operational efficiency and 2) avoiding market inefficiencies. First, by allowing for larger mismatches in maturities we can reduce frequent transactions, thereby reducing higher transaction costs. In addition, it provides more freedom to select efficient fixed income assets, who normally have relatively short maturities. Strict maturity bandwidths may increase costs, because it will often require using payer swaps to correct the hedge for shorter maturities, which in turn requires additional receiver swaps for longer maturities. Secondly, the markets for different maturities might not all be equally efficient. This is especially true for longer maturities, which might have a mismatch in market supply and demand. Demand from (mainly) pension funds is often not matched with the supply side of the market, causing interest rates at the long end being relatively low. Allowing a lower hedge on the long end thereby may increase expected returns.

Unfortunately, it is difficult to generalize the impact on expected returns and costs of allowing for maturity mismatches. This impact will depend, among others, on the liability structure, the investor's interest rate view and risk appetite, and the instruments used for the interest rate. In addition, the impact of maturity mismatches on regulatory capital may also deviate with the relevant regulations.

Figure 3: Impact of key rate exposures on tracking error



Source: Aegon Asset Management, Bloomberg. Using daily interest rate movements from January 2000 until March 2021. Average impact of 10% over- and underhedge of key rate while under-/overweighting the other key rates pro rata.

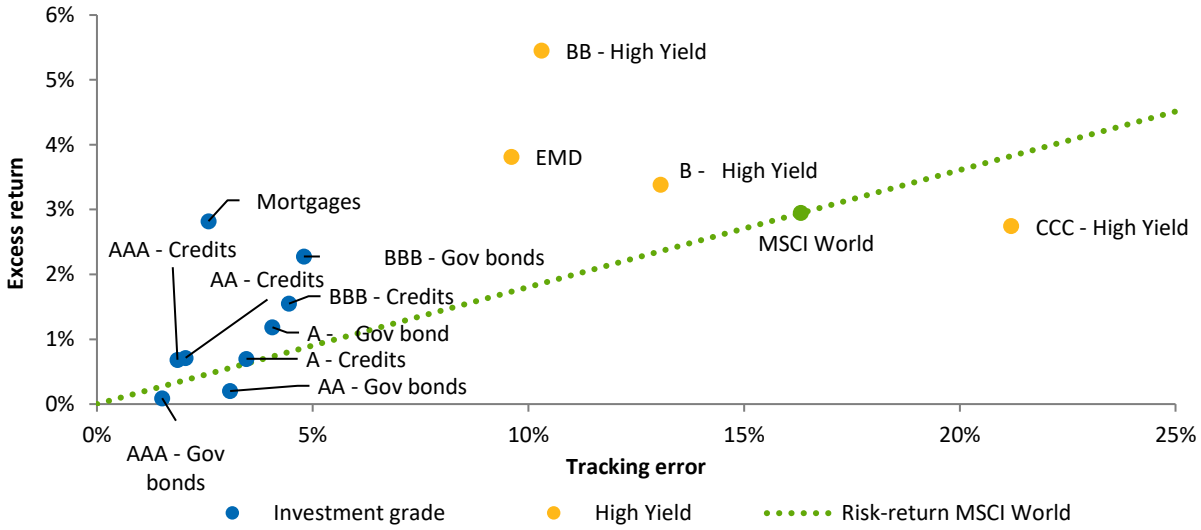
Instrument selection

The selection of instruments for the interest rate hedge is an interesting opportunity to improve the efficiency of the total portfolio. Liability-driven investors have a natural exposure to interest rates and therefore have an advantage over other investors when selecting interest rate sensitive investments. Instead of adding interest rate risk, these investments normally reduce interest rate risk for liability-driven investors. This may result in higher risk-adjusted returns, after accounting for interest rate sensitivity.

In the fourth articles of this series we discussed that investment grade assets – denominated in the same currency, or hedged to the currency of the liabilities – normally closely follow the valuation of liabilities, and are therefore suitable for inclusion in the interest rate hedge. This is not the case for most high yield investments, which show little interest rate sensitivity and therefore normally are not included in LDI strategies.

Fixed income assets will normally replace interest rate swaps within the interest rate hedge. While this causes some mismatch with the liabilities (when these are discounted with swap rates), it can also contribute to expected returns and therefore replace part of the return portfolio. This is interesting when the risk-adjusted return – after removing the interest rate sensitivity – is higher than that of the return portfolio and/or when these assets lead to diversification benefits. Figure 3 shows the excess return and tracking error of various investments after accounting for interest rate effects (for investment grade bonds only). As the figure shows, both credits and mortgages had a relatively efficient risk – return ratio over this period, substantially surpassing that of equities in the same period. In addition, these assets delivered diversification benefits when combined with other assets, such as equities. Instrument selection can therefore substantially improve the overall risk – return relationship of the total portfolio. This supports the idea to allocate substantial risk budget to instrument selection in order to establish an efficient portfolio.

Figure 3: Tracking error and excess return of various instruments



Source: Aegon Asset Management & Bloomberg. Excess return and tracking error controlled for addition to the interest rate hedge (100% investment grade, 0% high yield and equities). Monthly data from January 2000 – June 2021. EMD January 2005 – June 2021 and Dutch Mortgages one month lagged and over November 2013 – June 2021. Details of the specific indices used are available in the appendix.

Interest rate risk budget

As we have shown in this series of articles, a well-designed LDI strategy can substantially improve the risk-return profile of the total portfolio. The benefits include having exposure to the highest rewarded risk sources as well as optimally benefiting from diversification effects. Unfortunately, we cannot conclude what the most optimal LDI strategy in general is because that highly depends on each individual investor's characteristics such as the liability structure, investment beliefs, regulatory constraints and interest rate view. Therefore, designing an optimal LDI strategy depends on bespoke advice, based around the following three general elements:

1. Tracking error and funding level impact

The first element for designing an LDI strategy is the impact on the funding level and tracking error. The impact on risk and return can differ between investors due to the maturity profile of liabilities, differences in investments beliefs and/or operational design (influencing, for example, costs levels).

2. Diversification benefits

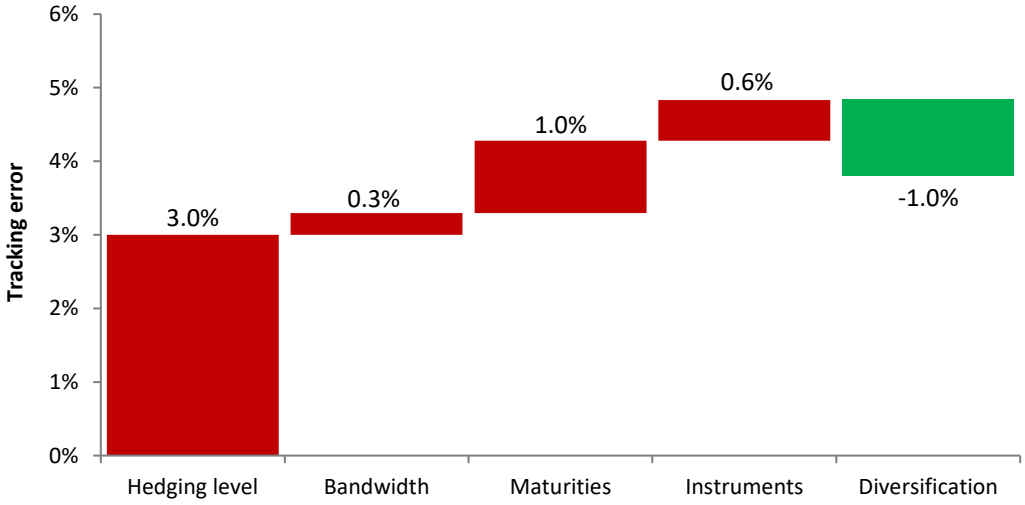
Even though some risk factors might not be interesting on a standalone basis, diversification benefits can make exposure to them worthwhile on a total portfolio level by mitigating other risks. Diversification is potentially the largest added value of a well-designed LDI strategy.

3. Iterations

Diversification benefits of adding exposure to a risk factor depend on the current exposure of the portfolio. Changing the portfolio – for example, as a result of changing the LDI strategy – also changes the diversification properties of the risk factors. Therefore, it is important to regard the process of designing an LDI strategy as an iterative process; repeatedly checking risk-return addition of different risk factors to the most recent (draft) total portfolio until the portfolio cannot be further improved.

This process results in an LDI strategy that essentially distributes the available risk budget over the risk factors that we have described in this series. This can be summarized as we do for a hypothetical pension fund in Figure 4. This figure directly shows what the biggest contributors to risk are within the LDI strategy. It also demonstrates how distribution within the LDI strategy reduces risk. Similar figures can also be made for the total risk exposure of the portfolio (with interest rate risk being one of the elements) and the separate interest rate risks (such as introduced by the instrument selection).

Figure 4: Example risk budget of an LDI strategy



Source: Aegon Asset Management. For illustrative purposes only.

Conclusion

In this final article of our LDI Deep Dive Series, we have looked at all of the components of interest rate risk together: parallel shifts of the interest rate curve, curve risk, and basis risk. Each of these risk factors contributes to the tracking error but might also impact the expected return. Carefully trading-off risk and return, while taking diversification effects into account are the ingredients for an effective LDI strategy. Due to the interaction with the liability structure, investments beliefs and other investor specific elements, an LDI strategy should, in most circumstances, be tailor-made. Translating the LDI strategy to a risk budget helps making clear what the most important sources of risk are and from where expected return should be expected.

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