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AEGON Asset Management

LDI Deep Dive Series
Part 4: LDI instrument selection

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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 will decompose interest rate risk into parallel shifts of the interest rate curve, curve risk, and basis risk. We also propose an efficient distribution of LDI strategies over these risk components.This fourth article looks at the selection of instruments and the impact on basis risk.

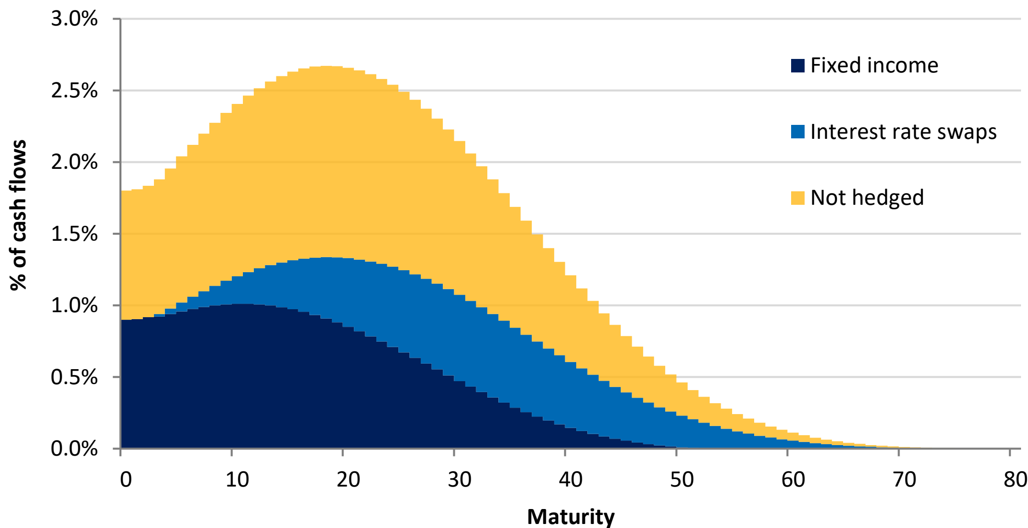
After the overall level of interest rate hedging and an acceptable level of curve risk have been determined, the next step is to select the optimal instruments to implement the hedge. Many assets and derivatives have interest rate exposure and can therefore – in theory – form a part of the LDI strategy. These instruments differ in the extent to which they follow the liability movements, their risk characteristics, leverage, expected returns and cash flow timing. All of these properties are relevant in constructing the LDI strategy. In general it comes down to how much basis risk – the potential difference between the returns on the LDI strategy and on the liabilities – is acceptable, weighed against the advantages of each instrument.

Interplay between fixed income assets and derivatives

LDI strategies can consist of both physical fixed income assets, such as government bonds and credits, as well as derivatives, such as interest rate swaps or futures. When liabilities are discounted using swap rates, interest rate swaps can be seen as the natural instrument for hedging interest rate risk, as they will minimize basis risk. Adding other instruments or assets becomes desirable when the excess return, or other benefits, outweigh the additional basis risk that is introduced.

For pension funds and life insurers, fixed income assets often have shorter maturities than the liabilities to be hedged, meaning that interest rate swaps are necessary to hedge the longer maturities. Figure 1 shows a typical design of the interest rate hedge for a pension fund, where part of the cash flows is unhedged (in yellow, in this case 50%). For the hedged cash flows, the short term maturities are mainly hedged with fixed income assets, while the longer maturities are predominantly hedged with interest rate swaps.

Figure 1: Cash flow profile for a hypothetical pension fund



Source: Aegon Asset Management. Hypothetical pension fund with 50% interest rate hedge. For illustrative purposes only.

Co-movement

Instruments can only be appropriate as part of an LDI strategy if there is a certain degree of co-movement with the liabilities. By co-movement, we mean the degree to which the value of the instrument and the liabilities that it matches move in line with one another. In general it holds that the more certainty that exists about the future cash flows of an instrument the better the co-movement with liabilities with a similar cash flow profile. The required level of co-movement – and, by proxy, the required certainty of future cash flows – depends on the risk tolerance within the LDI strategy.

Co-movement is often measured by looking at the 'beta' and the 'tracking error' of the instrument with the liabilities as a whole, or with a sub-set of the liabilities:

- **Beta**: Slope coefficient of a linear regression with the return of the relevant instrument and liabilities
- **Tracking error**: Standard deviation of the return on the instrument minus the return on the liabilities

For both measures it is usual to compare to a set of liabilities with the same duration as the assets. This then gives a like-for-like comparison. The assumption is then that the swap portfolio can be adjusted to accommodate the inclusion (or exclusion) of the instrument under consideration and ensure that the desired overall level of interest rate hedging is maintained and that restrictions on curve risk are met.

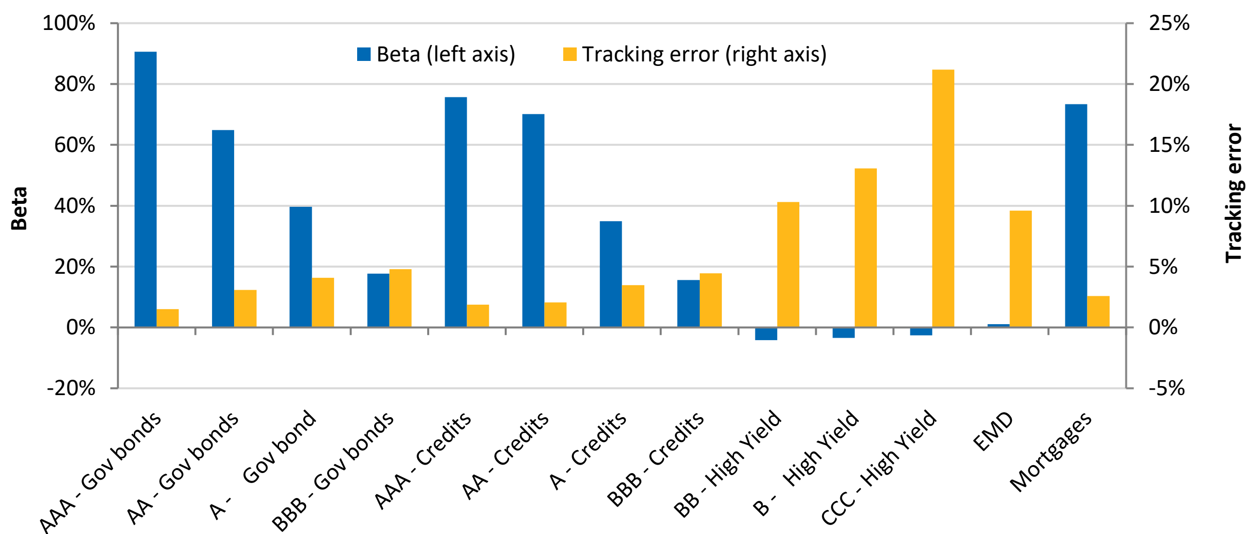
An instrument with a beta close to 1 has a strong co-movement and therefore delivers a good interest rate hedge in the long run, although short term variations might be large. The tracking error measures these variations, and an instrument with a large tracking error might – in the short run – behave quite differently to the liabilities. Ideally an instrument that is included in the LDI strategy has a beta of 1 (or higher) and a tracking error close to 0. Factors that influence the beta and the tracking error are, amongst others:

- Exposure to **credit risk** – indicated by the credit rating – which makes future cash flows less certain and therefore reduces the co-movement with the liabilities (where valued with swap rates).
- Instruments with lower **liquidity** – such as mortgages or private market instruments – may be valued less frequently and will not necessarily have market pricing. Changes in their value may therefore be lagged or smoothed, thereby increasing the tracking error.

- Instruments denominated in a **foreign currency** will normally have a lower co-movement as the value of future cash flows in euros becomes more uncertain due to fluctuations in the exchange rates.
- **Options**, such as on callable bonds or early repayment options on mortgages, will make the timing of future cash flows less certain and therefore reduce the co-movement with the liabilities those instruments are matching. In some cases, liabilities themselves may have in-built options (such as early retirement or commutation).

Figure 2 shows the beta and tracking error of a number of different fixed income asset classes and rating levels. As the figure clearly shows, the beta decreases with lower credit ratings while the tracking error increases with lower credit ratings. This represents the negative effect from exposure to credit risk on the co-movement with the swap rate (representing the liabilities). In general we can conclude that investment grade fixed income (ratings AAA through to BBB) have a reasonable co-movement with swap rates, and can therefore be included in the interest rate hedge. The co-movement of Dutch mortgages with liabilities is also quite high – with a beta of 73% and a tracking error of 2.6%. However this is only after adding a one month lag to the returns of the investment in mortgages (without the lag, the beta reduces to 16%). This lag represents the delay in pricing connected to the lower liquidity of mortgages.

Figure 2: Beta and tracking error for different types of fixed income assets



Source: Aegon Asset Management, Bloomberg. Monthly data from January 2000 – June 2021 with the exception of EMD (January 2005 – June 2021) and Dutch Mortgages (November 2013 – June 2021 with a one-month lag). Details of the specific indices used are available in the Appendix.

High Yield fixed income (BB-rated and below) and Emerging Market Debt (EMD), on the other hand, do not show a clear link with the swap rate movements, with betas close to zero and relatively high tracking errors. Therefore, in normal circumstances, these assets are not considered part of an interest rate hedging strategy. However, in the remainder of the article we continue to include them for comparison purposes.

Excess return

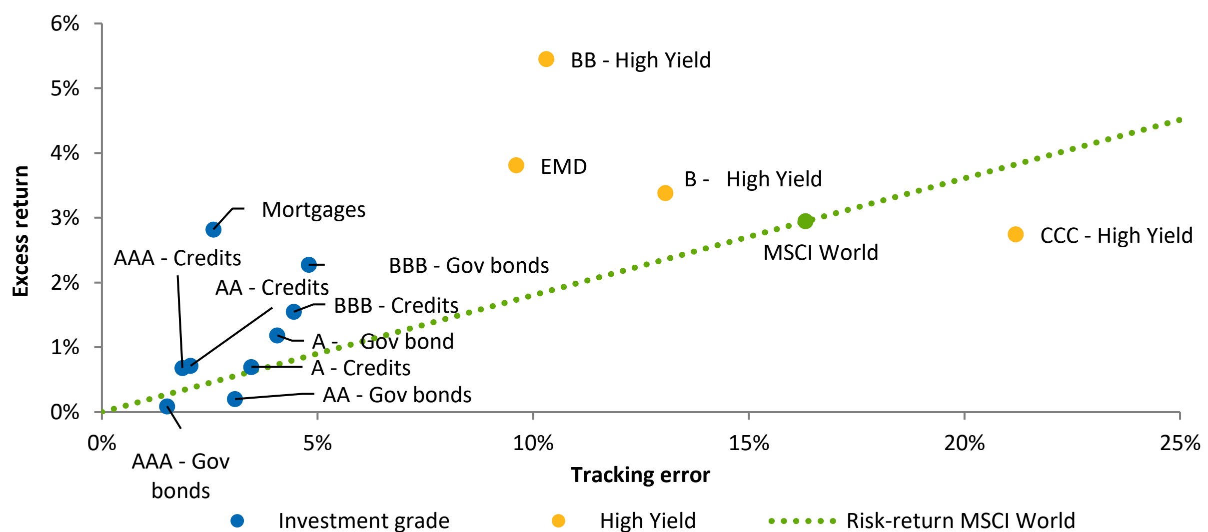
In addtion to the co-movement with the liabilities, the potential excess return is of interest when selecting instruments for the LDI strategy. When investigating excess return it is important to correct for duration, so that we are seeing the excess return that the instrument might offer relative to the liabilities it is hedging. So to calculate the excess return we should subtract the expected return from an interest rate swap offering the equivalent interest rate hedge, in addition to subtracting the short term interest (cash) rate. In our analysis we assume that investment

grade bonds and mortgages will contribute 100% (of duration) to the interest rate hedge, while high yield bonds and other risky assets – that we only include for comparison – do not contribute (0%) to the interest rate hedge.[1]

Figure 3 presents the historical excess return of the various fixed income assets. The excess return is plotted against the tracking error to show relationship between risk and return. For the investment grade bonds and Dutch Mortgages, excess returns are with respect to swap returns of the same duration. For the other categories, excess returns are with respect to cash. In general we see that – to be expected - more risky assets – have a higher excess return and tracking error. The exception is an investment in Dutch Mortgages, which has a relatively high excess return as compensation for the lower liquidity and higher complexity.

To put the risk-return relationship of the various LDI investments in perspective we have added the risk and return relationship of the MSCI World Index over cash over the same period. While this result is quite sensitive to the starting period[2] it does show that over this period most fixed income investments had a higher Sharpe Ratio than the equity benchmark. This indicates that – depending on the return ambition and leverage restraint – adding these investments would have improved the risk-return profile of the portfolio, i.e., increasing expected returns with the same risk level, or lowering the risk level with the same expected return.

Figure 3: Tracking error and excess return



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 Mortages one month lagged and over November 2013 – June 2021. Details of the specific indices used are available in the appendix.

Diversification

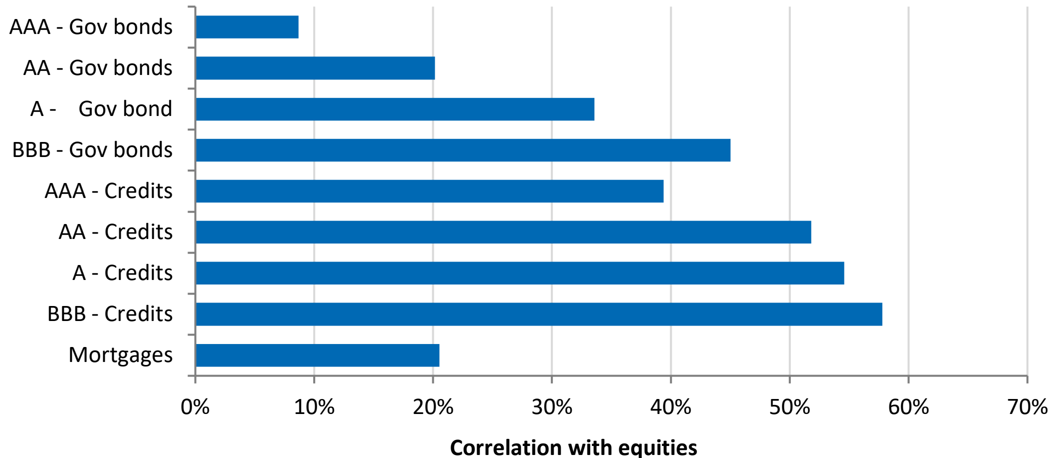
The results above do not, however, take diversification effects into account. When we look at the total portfolio the correlation (co-movement) between asset classes is also of interest. Figure 4 shows the correlation of excess returns of LDI investments with the excess returns of equities (over cash), which is normally the most imporant contributor to expected return in a portfolio. The LDI investments show low to medium correlations with equities. Combining

[1] In theory we could let all assets contribute to the interest rate hedge in line with their beta, as this would give the most exact interest rate hedge (lowest tracking error). However, the betas are not constant over time and continually adjusting the interest rate hedge in line with changing betas is cumbersome and very dependent on the chosen historic period of analysis. In addition, it would overestimate the accuracy of the interest rate hedge in our 'in-sample' analysis as the correct betas would not, in practice, be available beforehand.

[2] The time period shown starts just before the dot-com crash. Starting in 2003 would increase the Sharpe Ratio from 18.0% to 46.1%.

these investments with equities therefore offers diversification benefits to the portfolio. This is particulary true for highly rated governent bonds and Dutch mortgages, which show the lowest correlations with equities.

Figure 4: Correlation of excess returns with equities

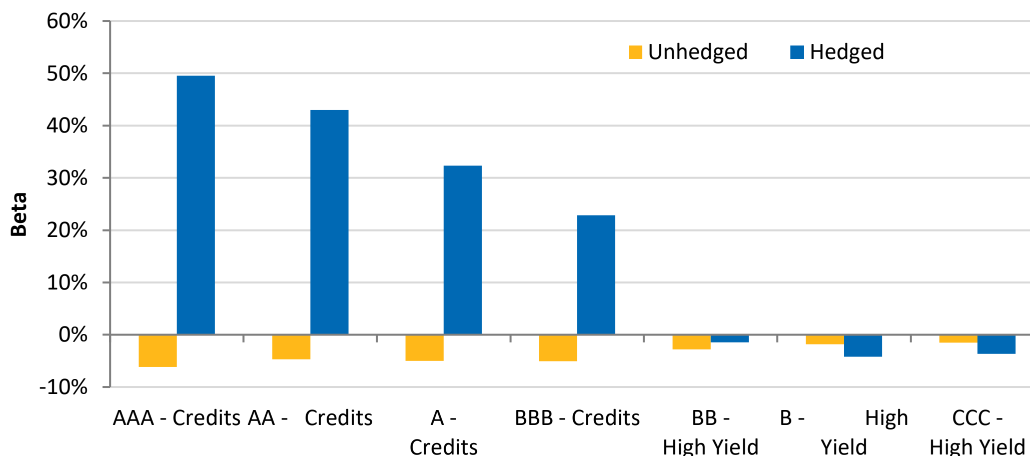


Source: Aegon Asset Management, Bloomberg. Equities represented by MSCI World. Excess return controlled for addition to the interest rate hedge. Monthly data from January 2000 – June 2021 with the exception of Dutch Mortages (November 2013 – June 2021 with a one-month lag). Details of the specific indices used are available in the appendix.

Foreign currency hedging

Many investors invest in fixed income instruments denominated in foreign currencies. This raises the question of whether these can be included within an LDI strategy with euro liabilities. Figure 5 shows the co-movement (beta) of US dollar-denominated corporate bonds with and without currency hedging (using 1-month FX forwards). The co-movement of the hedged bonds is slightly lower – but similar – to euro-denominated bonds. Without currency hedging, the co-movement is close to zero, indicating that hedging currency risk is essential for assets to be included within the interest rate hedge. More sophisticated currency hedging, for example using cross-currency swaps which remove the sensitivity to US dollar term rates, is also possible but will normally be more complex and expensive to manage.

Figure 5: Co-movement of US dollar-denomintated bonds with euro swap rates



Source: Aegon Asset Management, Bloomberg. US bonds with and without currency hedging. Currency hedging based upon 1-month forwards. Monthly data from January 2000 – June 2021. Details of the specific indices used are available in the appendix.

As long as currency risk is hedged, fixed income instruments denominated in developed market currencies are all candidates for inclusion in LDI strategies – US dollar and other European currencies, in particular, as their economies are closely linked.

Conclusion

The selection of appropriate assets and instruments is an important step in the design of an LDI strategy. Investment grade bonds, such as credits and mortgages, move in a similar manner to liabilities valued using swap rates and can therefore be used to hedge the interest rate risk. Although their inclusion presents basis risk, this is compensated by, in most cases, a relatively favorable expected excess return. In addition, these assets, and in particular highly rated government bonds, tend to offer diversification benefits. Remaining interest rate sensitivity (after correcting for the interest rate hedge offered by the fixed income assets) can be hedged using interest rate swaps. This is particularly true for very long term liability cash flows, where there are few physical bonds available.

Appendix: List of indices used

Table 1: List of indices used

Asset class	Index
AAA-rated Government bonds	ICE BofA AAA Euro Government Index
AA-rated Government bonds	ICE BofA AA Euro Government Index
A-rated Government bond	ICE BofA A Euro Foreign Issuers Sovereign, Agency & Supranational index
BBB-rated Government bonds	ICE BofA BBB Euro Foreign Issuers Sovereign, Agency & Supranational index
AAA-rated Credits	ICE BofA AAA Euro Corporate Index
AA-rated Credits	ICE BofA AA Euro Corporate Index
A-rated Credits	ICE BofA A Euro Corporate Index
BBB-rated Credits	ICE BofA BBB Euro Corporate Index
BB-rated High Yield	ICE BofA BB Euro High Yield Index
B-rated High Yield	ICE BofA B Euro High Yield Index
CCC-rated High Yield	ICE BofA CCC Euro High Yield Index
Emerging market debt (EMD)	ICE BofA Emerging Markets Diversified Corporate Index
Dutch mortgages	AeAM Dutch Mortgage Fund
Equities	MSCI World Total Return Index Net Dividends (in Euro)
AAA–rated US Credits	ICE BofA AAA US Corporate Index (in Euro)
AA-rated US Credits	ICE BofA AA US Corporate Index (in Euro)
A-rated US Credits	ICE BofA A US Corporate Index (in Euro)
BBB-rated US Credits	ICE BofA BBB US Corporate Index (in Euro)
BB-rated US High Yield	ICE BofA BB US High Yield Index (in Euro)
B-rated US High Yield	ICE BofA B US High Yield Index (in Euro)
CCC-rated US High Yield	ICE BofA CC US High Yield Index (in Euro)

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