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LDI Deep Dive Series
Part 2: Dynamic interest rate hedging

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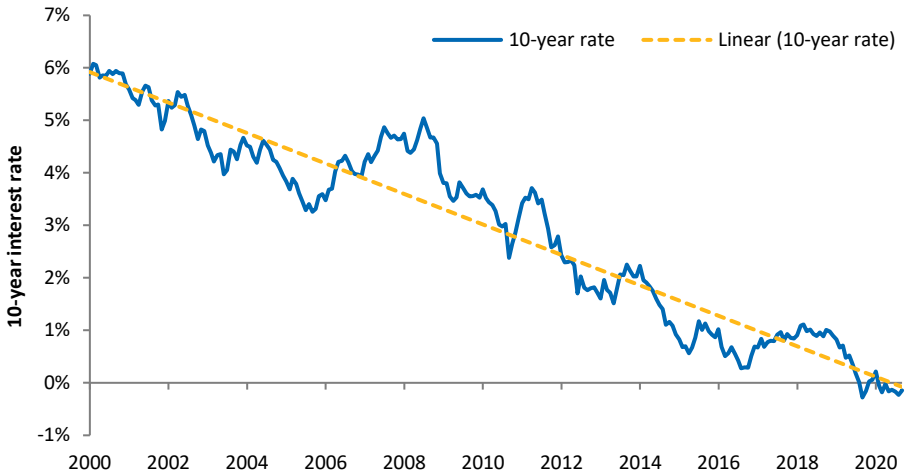
Investors with future liabilities are normally exposed to interest rate risk. A fall in interest rates will increase the value placed on future liabilities. By adopting a liability-driven investment (LDI) strategy, much of this interest rate risk can be mitigated. In this LDI Deep Dive Series, we will investigate the most important considerations for developing successful LDI strategies. This second article covers dynamic interest rate hedging.

Even though the past 20 years have seen a significant downward trend in interest rates, the trend was not one-way. As Figure 1 shows there have been some significant and repeated rises in rates against the background downward trend or, put another way, we have found that interest rates often oscillate around a longer-term trend.

Figure 1: Historic oscillation in interest rates



Source: Bloomberg, Aegon Asset Management.

If interest rate oscillates, investors can benefit by applying a dynamic interest rate hedging strategy. With a dynamic hedge, the hedge level is lower for interest rate increases than for similar decreases. We illustrate the workings of a dynamic interest rate hedge using the example given in Figure 2 and Table 1. Due to the asymmetric design, the (average) hedge is higher when interest rates are falling than when they are rising. This results in a net profit when from the interest rate oscillations.

Figure 2: Example of a dynamic hedge strategy

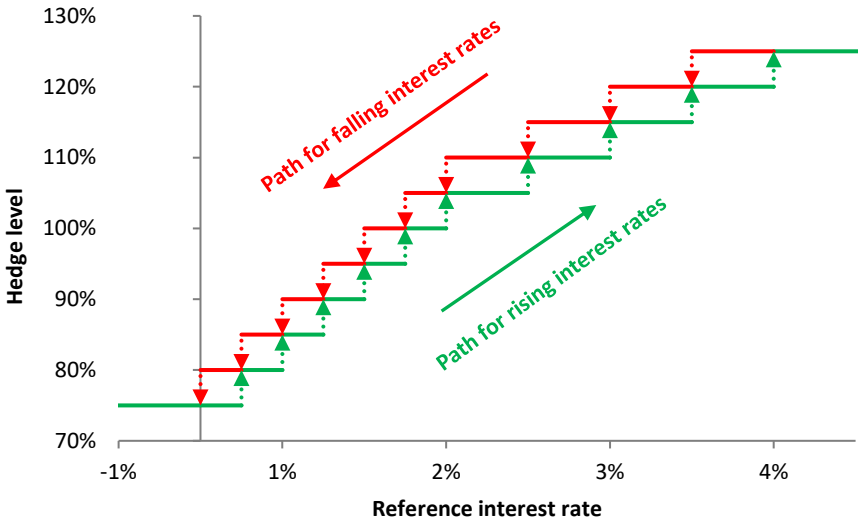


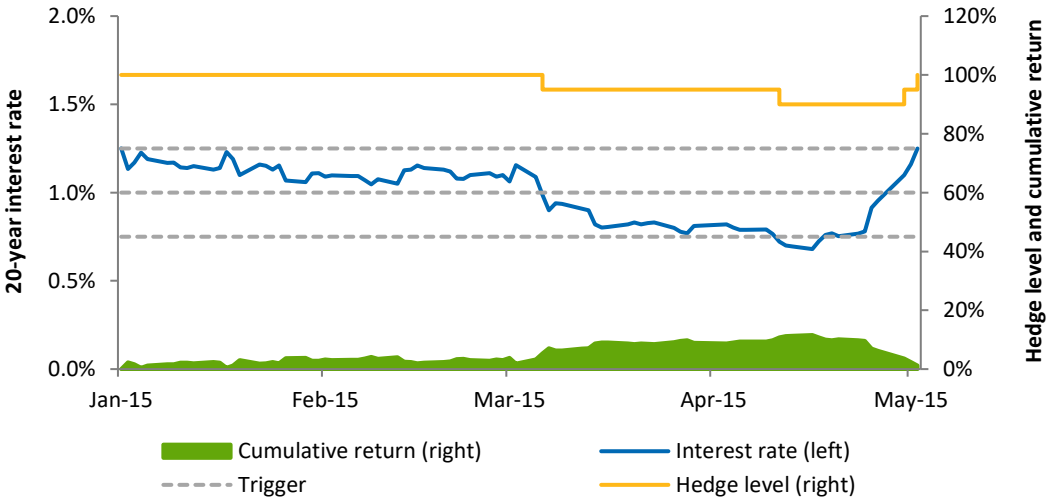
Table 1: Example of a dynamic hedge strategy

Trigger	Hedge level
0.00%	75%
0.25%	80%
0.50%	85%
0.75%	90%
1.00%	95%
1.25%	100%
1.50%	105%
2.00%	110%
2.50%	115%
3.00%	120%
3.50%	125%

Source: Aegon Asset Management.

To illustrate the workings of a dynamic interest rate hedge we use the period of January 2015 to May 2015 as an example. During that period, the 20-year interest rate decreased from 1.25% to 0.68% before increasing to 1.25% again. We start the dynamic hedge by assuming that the investor would like to have a 100% interest rate hedge at the start. According to the strategy outlined in Table 1, the decrease in interest rate reduced the hedge level twice, from 100% to 95% and then 90% at the two triggers of 1.00% and 0.75% respectively. After that, the hedge level increased back to 95% and 100% at the triggers of 1.00% and 1.25% when the interest rate increased. Even though the interest rate ended at the same level as it started – so the liabilities did not change in value[1] – the dynamic hedge strategy added value by having a higher average hedge level during the decrease in interest rate (97.5%) than during the increase (92.5%). This would have led to a net increase in the funding ratio of approximately 0.6% over this period.

Figure 3: Example working of a dynamic hedge strategy



Source: Bloomberg, Aegon Asset Management.

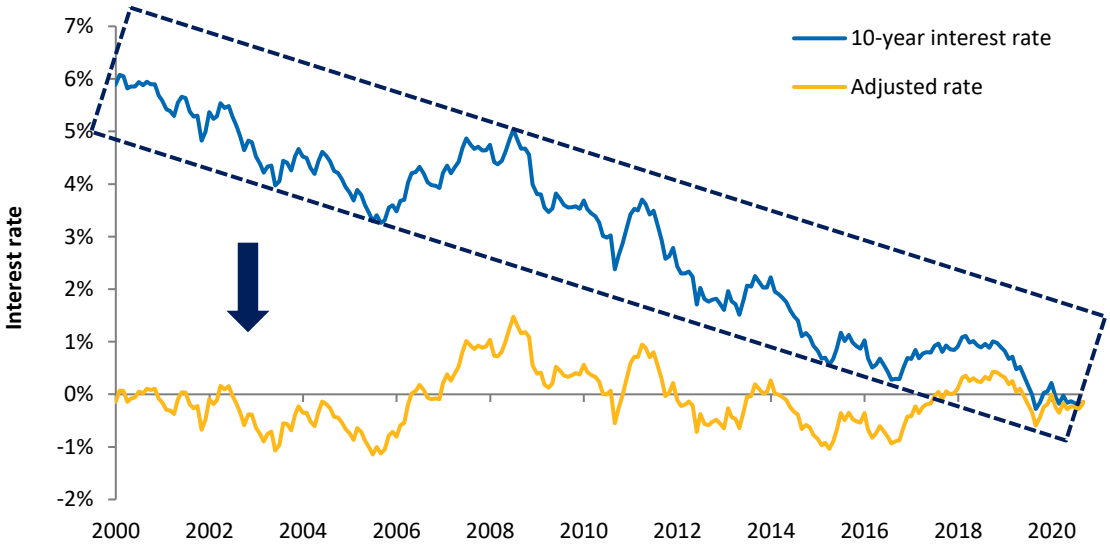
[1] Disregarding the limited impact of roll-down during this period and assuming rates at other maturities behaved similarly.

In our analysis we look at returns before costs because costs can be highly situation dependent. In general transaction costs – which tend to be the most relevant – will not significantly alter the results as these are rather small for interest rate derivatives compared to the gains from the dynamic hedging strategy. Assuming prudent transaction costs of 0.5 of the transacted PV01 (ie. the change in present value of a 0.01% change in interest rate), and interest rate triggers that are 0.25% apart of each other (as illustrated in Table 1), the transaction costs will be ca. 4% of the total profit. Operational costs might increase if the number of the number of transactions rise significantly. We will look at this topic when we analyze the number of interest rate triggers in a dynamic hedge strategy.

Historical analysis

As we have seen, a dynamic interest rate hedge can add considerable value over the short term if interest rates exhibit oscillatory behavior. We will now turn to the question how much value it can add over the long run. We will start with an analysis based on historical interest rates. However, as the recent history is characterized by a strong downward trend we will need to adjust for that.[2] Such a downward trend is not in line with having a neutral interest rate view, in addition, it is unlikely that this trend will continue for the next two decades (implying an interest rate of -6% by 2040). Therefore we set the starting interest rate equal to the current interest rate, thereby removing any trend in the interest rate. This is illustrated in the next figure.

Figure 4: Oscillation in interest rates after adjusting downward trend



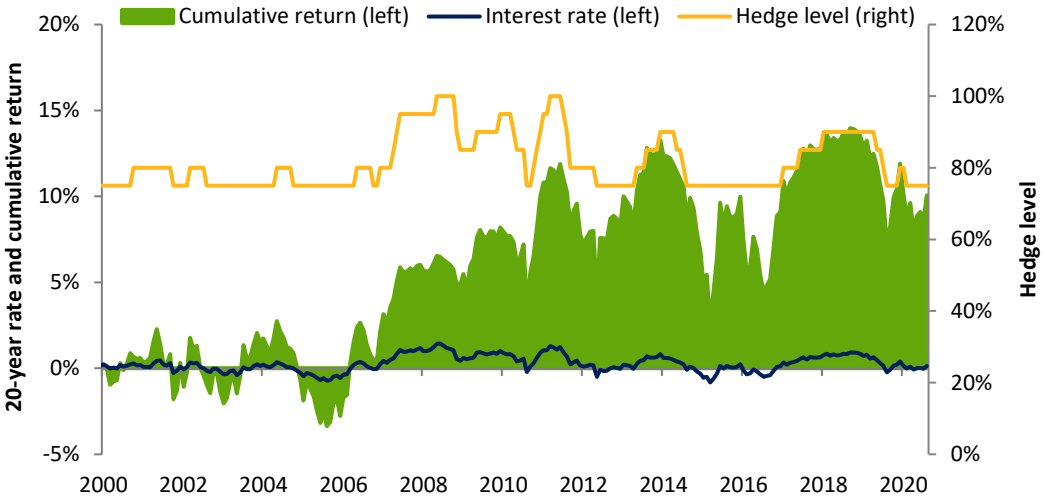
Source: Bloomberg, Aegon Asset Management.

Figure 5 shows the development of the hedge level and the funding ratio return of the dynamic hedge strategy given in Figure 2 and Table 1. Using the adjusted historical interest rate movements we see frequent oscillations, in which the dynamic interest rate hedge adds value to the funding ratio. Over this 20-year horizon we find that the dynamic interest rate hedge adds approximately 10 percentage points to the funding ratio, or about 0.5% per year. This funding ratio return is compared to a fixed interest rate hedge of 100% which, given the assumption of a perfect hedge, results in no impact on the funding ratio. On average the dynamic hedge results in a tracking error (standard deviation of the funding level) of 3.3%. Because the interest rate starts at the lower end (75%) of the dynamic hedge strategy the average hedge is 81.5%, so below 100%. If we were to adjust the hedge so that the average hedge was

[2] The dynamic interest rate hedge would have added approximately 0.1% per year if we do not adjust (detrend) the historical interest rate development. The difference follows from the strong downward trend in combination with a below 100% interest rate hedge.

100% (add 18.5% to each step) the dynamic hedge would add 0.6% (= 0.1%) to the funding level per year with a tracking error of 1.4% (-1.9%). Of course we do not know the path of the interest rate beforehand, but it does show the importance of keeping the average hedge close to 100% from a nominal tracking error perspective (as discussed in the first article of this series).

Figure 5: Historical funding ratio return (adjusted interest rate)

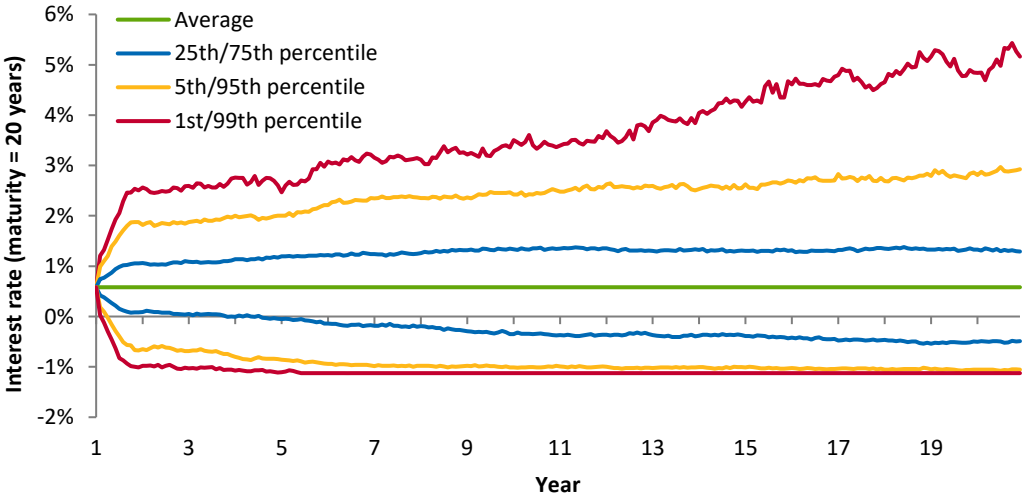


Source: Bloomberg, Aegon Asset Management.

Scenario analysis

We will now analyze the added value of a dynamic hedging strategy by performing a scenario analysis. We use 2,000 simulations over a time period of 20 years. We assume that the interest rate on average remains constant, which implies that in each year the average term structure is equal to the term structure at the start, although there is of course a wide diversity in interest rate paths. This is illustrated in Figure 6. Furthermore, we assume that the cash flows of the assets used for the interest rate hedge match those of the liabilities (for an average Dutch pension scheme) perfectly.

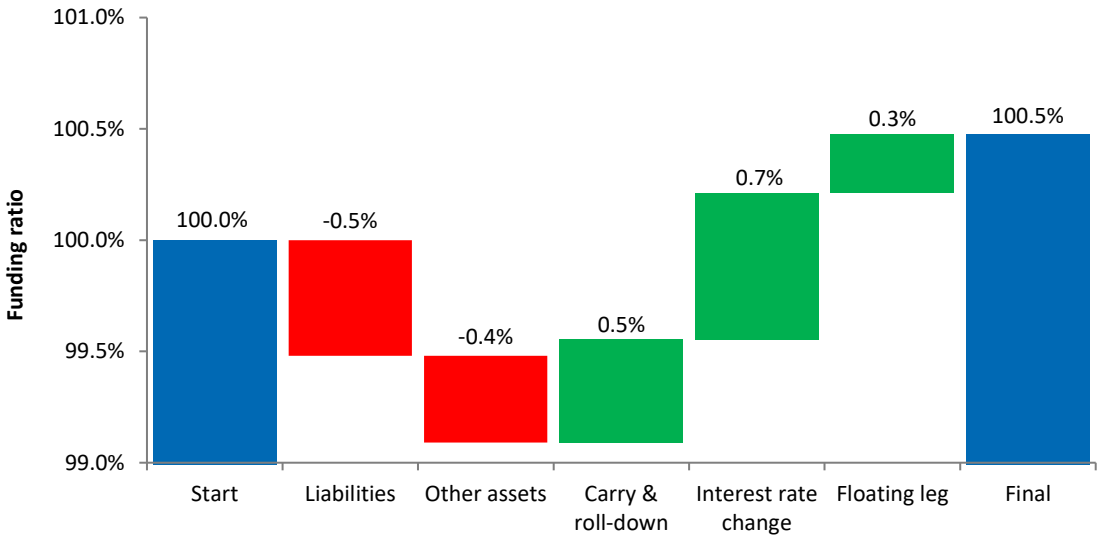
Figure 6: Interest rate scenarios



Source: Aegon Asset Management.

Figure 7 shows the average annual funding ratio impact of a dynamic hedge strategy with hedging levels between 75% and 125%. Given our assumption that the interest rate does not change on average, the impact of interest rate changes (+0.7% on average) represents the impact of the dynamic interest rate hedge.[3] Because the average hedge level is below 100% – due to the low interest rate at the start – the benefit of carry & roll-down is also lower, but the net impact is still positive (+0.5% improvement in funding ratio per year). The impact on tracking error is 3.0%, giving an information ratio of 15.9%.[4]

Figure 7: Average annual funding ratio impact of a dynamic hedging strategy (75%-125%)



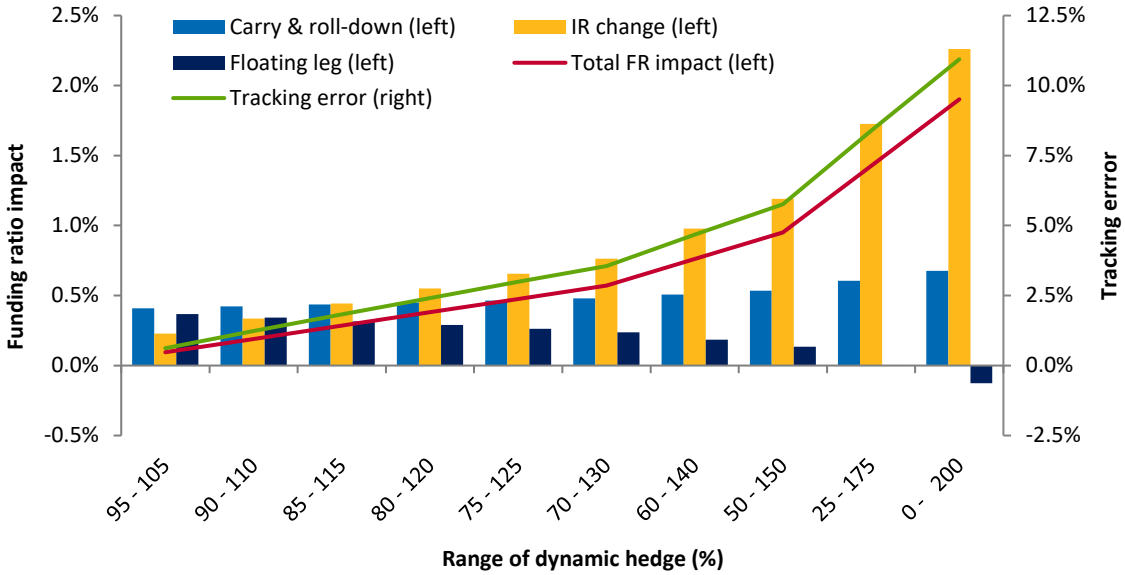
Source: Aegon Asset Management.

We have repeated this analysis for a number of different dynamic hedging ranges. For each dynamic strategy, we applied the triggers of Table 1 and used linear interpolation for the hedging levels between the ranges (equal steps). So the range 75% to 125% corresponds to hedging steps of 5% (= [125% - 75%] / 10).

First, we look at different 'widths' of the dynamic hedge – the difference between the lowest and highest hedge level – while keeping the range centered around 100%. Figure 8 presents the results of widths between 10% and 200%. The funding ratio impact of the liabilities (-0.5%) and those of other assets (-0.4%) has been excluded as these are not dependent on the hedge level. The results show that a wider dynamic interest rate hedge results in a higher average total funding ratio impact (red line; axis on the left). The majority of the funding ratio impact is, of course, driven by the impact of the interest rate change (yellow bars) and carry and roll-down (light blue bars). With a wider dynamic interest rate hedge, the steps in the hedge levels become larger and as a result the positive impact from each oscillation increases as well. However, as the hedge level can also deviate further from the neutral level of 100%, the funding ratio risk – measured as tracking error – will also increase (green line; axis on the right). The impact on the average funding ratio return and tracking error are relatively similar and approximately linear, giving relatively small differences in the information ratio for these alternatives. The optimal width is therefore above all dependent on risk preferences and/or the risk budget of the investor.

[3] And the impact of convexity of about 0.1%
[4] For the information ratio we compare the impact on funding ratio and tracking error of a dynamic hedge strategy to a static 100% perfectly hedge portfolio (having a 0% funding ratio return and a 0% tracking error).

Figure 8: Funding ratio impact of different widths in dynamic hedge strategies

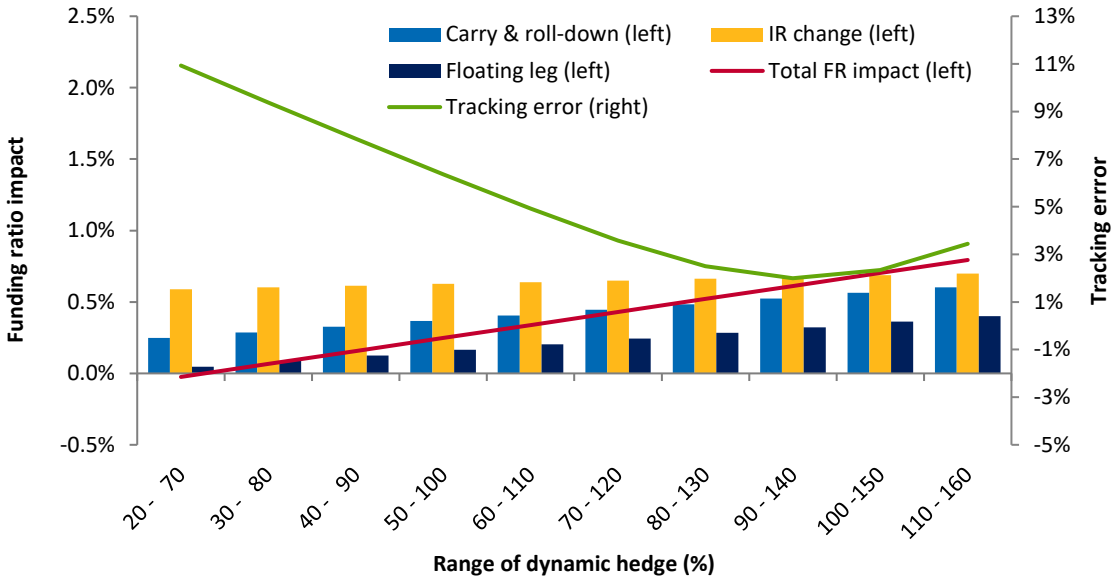


Source: Aegon Asset Management.

A second variable of a dynamic hedge strategy is the average hedge level or 'midpoint' of the width in a dynamic hedge strategy. Using a constant width of 50% we analyze different midpoints in Figure 9. Without a specific interest rate view, we find – similar to the analysis with the fixed hedging levels in the first article of this series – that a higher hedge level yields a higher expected funding ratio return (red line), mainly due to carry & roll-down (light blue bars). Because the widths of the dynamic hedge strategies are the same for these options, the impact of oscillations benefits is exactly the same, represented by the relatively constant impact of interest rate changes (yellow bars). Also similar to our results in the first article of this series, we find that the funding ratio risk – tracking error – is the lowest for average hedge levels closest to 100% (green line). Given that the interest rate at the start in our analysis is at the lower side of the interest rate triggers that we have defined, the dynamic hedge that has the average hedge that is closest to 100%, and therefore the lowest tracking error, is 90% - 140%. This again confirms our earlier finding that, without an interest rate view and without taking inflation into account, having an average interest rate hedge close to 100% turns out to be optimal.

If we expected interest rates to rise, or wanted to take more of a real return perspective, a lower average hedge level might be preferred. However, a dynamic hedge strategy might still be beneficial, as it is dependent only on the width of hedging levels and not on the (average) hedging level.

Figure 9: Impact of different midpoints in dynamic hedge strategies



Source: Aegon Asset Management.

Interest rate triggers

In addition to the level and width of the dynamic interest rate hedge, the number of interest rate triggers and the level of these triggers should also be considered. The larger the number of interest rate triggers, the more often can be benefited from interest rate oscillations, but the benefit from each oscillation will be lower. As direct transaction costs are often related to the total interest rate sensitivity being traded this will not increase overall transaction costs and will therefore not impact the profitability of the strategy because the interest rate sensitivity traded per trigger will be lower. However, the overall costs of managing the interest rate hedge according to these triggers might increase because it will require more activity from the portfolio manager.

In Table 2 below we show the impact of increasing or decreasing the number of interest rate triggers. As can be seen the impact before costs of increasing or decreasing the number of triggers is very limited. The funding ratio impact before costs increases slightly with more triggers, but this will probably be offset by additional operational costs due to the larger number of changes in the interest rate hedge. Therefore, we can conclude that the number of triggers should depend on the level of operational activities (changes in the interest rate hedge) that is acceptable for the investor.

Table 2: Impact of number of interest rate triggers (range 0.0% - 3.5%)

Number of triggers	Avg. funding ratio impact	Tracking error impact	Triggers hit per year
6	0.45%	3.0%	0.8
9	0.46%	3.0%	1.7
11 (as in Table 1)	0.48%	3.0%	2.3
16	0.49%	3.0%	3.4
21	0.50%	3.0%	4.3

Source: Aegon Asset Management.

The range of the interest hedge triggers should represent the expected range of interest rate levels so that we optimally benefit from interest rate deviations.[5] Given that we expect that there is a lower limit for the interest rate – even though that lower limit might be below 0% – we have chosen for a level of 0% to 3.5%. However, this range should depend on the interest rate view of the investor. In our example, we have chosen to increase the difference in interest rate levels between the triggers for the higher end of the dynamic hedge strategy as there is some evidence that interest rate volatility is higher for higher levels of interest rate (heteroscedasticity). However, there are reasons investors might take a different view when constructing a trigger strategy.

Conclusions

This article analyzes dynamic interest rate hedging strategies. We find that such strategies can add expected returns, but at the expense of higher funding ratio risk. Although the information ratio we find in our main example (15.9%) is below the Sharpe ratio[6] of for example an investment in equities (MSCI World Index: 35% for the period 2001 to 2020), we believe that a dynamic hedge strategy can still add value within a portfolio if we include diversification with other assets and other interest rate factors (such as curve and basis risk). However, the level to which a dynamic hedge strategy can add value – and the optimal width and midpoint for the hedge levels, and the number of interest rate triggers – depends strongly on the characteristics of the investor and their investment beliefs with respect to interest rate risk.

In the third article of this LDI Deep Dive Series, we will further discuss interest rate hedging by analyzing curve risks.

[5] At interest rate levels below or above the interest rate triggers there is no benefit from interest rate oscillations.
[6] The Sharpe ratio of equities is comparable to the information ratio of the dynamic hedge strategy because we assume the allocation in equities is funded from cash. So, we look at the impact on the funding ratio and the tracking error of either adding equity risk or adding interest rate risk by applying a dynamic strategy as compared to a static 100% hedged portfolio with no equity risk.

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