Intelligent overlay approaches

Low yields, high risk and what to do about it.

Exploration

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Executive Summary

In the past 30 years, fixed-income markets have seen a long-term decline in interest rates which has in turn led to lower discount factors and coupons as well as longer-dated maturities. A side effect of this development has been a rise in interest rate sensitivities and thus in the risk of standard fixed-income benchmarks. In January 2006, a one-percentage-point increase in interest rates led to a loss of roughly 5.1 % in the Bloomberg Barclays US Treasury index. In January 2021, an identical movement would have led to a loss of about 7.1 %.

Europe has experienced the same trend, with both government and corporate bonds affected. Overall, the risk-return ratio has deteriorated significantly over time. In 2007, a standard fixed-income benchmark was able to compensate a rise of about 70 basis points in yields through its own running yield over the course of one year. This measure has dropped ever since. Meanwhile, the break-even rise of yields stood at a mere 12 basis points at the end of June 2021. Investors in standard benchmark mandates are currently facing significantly higher risks, exposing them more to negative total returns than a decade earlier. Two alternative courses of action are, however, not to be recommended:

1. **Significantly reducing fixed-income exposure is, regulatory constraints aside, suboptimal from the diversification perspective.**

2. **Simply shortening the duration of bonds does not really solve the problem either. It not only leads to even lower returns but the lower volatility of shorter duration bonds also significantly reduces the potential for balancing equity exposure.**

Executive Summary

In this working paper, we take an in-depth look at these effects and analyse the effects of a risk overlay on a standard benchmark portfolio. Within this framework, we aim to mitigate the elevated levels of risk incurred by fixed-income portfolios in the current market environment through the implementation of a non-symmetric return strategy.

Many sections of the interest rate curves in Europe are close to or even below zero. We will thus focus on scenarios with stagnating or rising yields. Depending on the scenario, our risk overlay reduces the maximum drawdown by more than a third whilst preserving the average total return of the investment.

Volatility falls by about 20 % using a risk overlay, primarily because the overlay reduces investment levels in periods of rising interest rates. In such phases, the advantages of a non-symmetric pay-off structure are clear, effectively reducing losses and allowing gains to run. Overall, a risk overlay reduces tail risks in a low interest-rate environment as well as significantly increases risk-adjusted performance.

This allows investors with low risk budgets or corresponding regulatory requirements to invest in bonds with improved return prospects whilst maintaining the diversification benefits of the bond positions on the portfolio.

Content

1. Introduction

In the past 30 years fixed-income markets have seen a continual decline in interest rates. German 10-year yields have fallen steadily to -0.85 % from well above 8 % in the period. The trend was similar in the US: yields fell to as low as 0.5 % from about 8 %. In short, fixed-income investors have enjoyed a strong 30-year run. The higher the duration of their portfolios, the higher their returns. Even in periods of rising interest rates and thus price deterioration, the running yield led in most cases to a prompt recovery.

This picture is about to change, however, with yields close to or even, in some cases, below zero. Coupons can no longer compensate for losses due to a rise in yields.

As returns for fixed-income investors decline, investment costs are increasingly gaining center stage. Passive investment schemes have become a feature in most strategic asset allocations. The underlying indices are dominated by interest-rate risks and thus the yield curve as well as by issuers' behavior. Many issuers (both governments and corporates) have made the most of flat and low yield curves and have lengthened their issuer profile. As a result, bond maturities in many indices and the involved risk in standard benchmarks have increased. Issue volumes have risen at the same time for both governments and corporates. For example, the market capitalisation of the Bloomberg Barclays Euro Aggregate index has grown more than threefold over the past 20 years to 13.2 trillion euro from 4.3 trillion euro. In the same period, the risk of the index, measured by its duration, rose by more than 60 %.

Long-maturity bonds could still prove to be profitable in a low-yield environment as they benefit from the "rolling-down-the-yield curve" effect. This means that in an upward sloping yield curve, discount factors will fall as maturity reduces over a bond's lifetime and thus the price of the bond will rise, providing overall conditions remain the same. This kind of strategy is especially attractive in markets with steeper interest rate curves as was observed in Europe and the US at the beginning of 2021 on the back of higher inflation expectations and the first signs of more restrictive policies from central banks.

2. Yield and duration

Less obvious for many investors was the effect of falling yields on duration. Duration is affected two-fold: on the one hand, falling yields lower the discount factors used in the calculation of the duration for bond cash flows while on the other, falling yields enable investors to issue at lower coupons, which reduces the earlier cash-flows to be discounted in the duration calculation.

The duration illustrates the average capital lockup and is determined by four variables (Coleman, 2011): market value of the bond ***PV***, current interest rate ***r***, cashflows ***CF*** (coupons and final payment) and maturity ***T***. Given these parameters, the Macaulay duration can be computed as the discounted sum of cash flows from the bond:

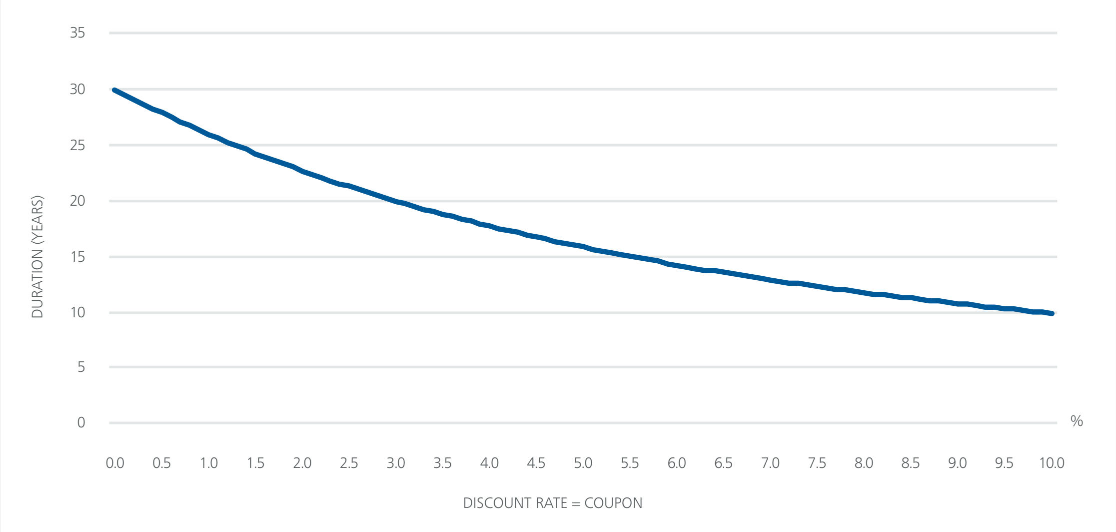
$$\text{MacDuration} = \sum_{t=1}^{T} \frac{t * CF_t}{(1+r)^t} * \frac{1}{PV}$$

The following example highlights the effects of lower discount rates on duration. In 2008, a German government bond with a 10-year maturity was issued at a yield-to-maturity (YTM) of 4.5 % and a coupon of 5 %. As a result, Macaulay duration was around 8.15 years. By 2013, yields had tumbled to roughly 2 % and the duration of our hypothetic bond rose to 8.35 years. With an adapted market coupon of 2.5 %, this bond would already have a duration of about 9 years. The approximated effect of changes in interest rates on a bond's price can be found in the sensitivity measure modified duration, which is derived from the Macaulay duration. In our example, the modified duration would be at 8.82, meaning the price of the bond would fall by roughly 8.82 % if the level of interest rates in the market increased by one percentage point.

Duration history in a nut-shell.

By 2020, government bond coupons were close to zero, with corporate bonds not far behind. Duration is therefore increasingly approaching maturity, while the Macaulay duration and modified duration are almost equal. In the following figure, we show the relationship between yield and duration for a 30-year bond. Coupons and discount factors match each other for the sake of simplicity.

Figure 1: Illustration showing duration in relation to coupon and yield for a 30-year bond. For the sake of simplicity, we set the coupon equal to the yield. At an interest rate of 0 %, duration equals maturity.



Source: Own calculations, Universal-Investment-Luxembourg S.A., branch Frankfurt am Main

The duration risk in the Bloomberg Barclays Euro Aggregate Treasury was up by more than 40 % at 8.81 on January 1st 2021, compared with 6.12 on January 1st 2006. In the same period, the maturity of the average bond in the index rose by just 22 % to 10.47 years from 8.59 years. A similar trend was seen in the US, with duration rising by more than 35 % from 2006. In January 2006, an increase of one percentage point in yields resulted in a 5.1 %-loss for the Bloomberg Barclays US Treasury index. The same yield increase would have caused an index loss of 7.1% in January 2021. These are some examples of the fundamental changes in international fixed-income markets since the beginning of the 21st century. We will study these changes in more detail in the following chapter.

3. A brief history of risk and return in fixed-income markets

In order to highlight the historic changes that have taken place, we will examine the returns of several global fixed-income indices. In addition to current yields, roll-down returns are key in assessing historic expected total returns.

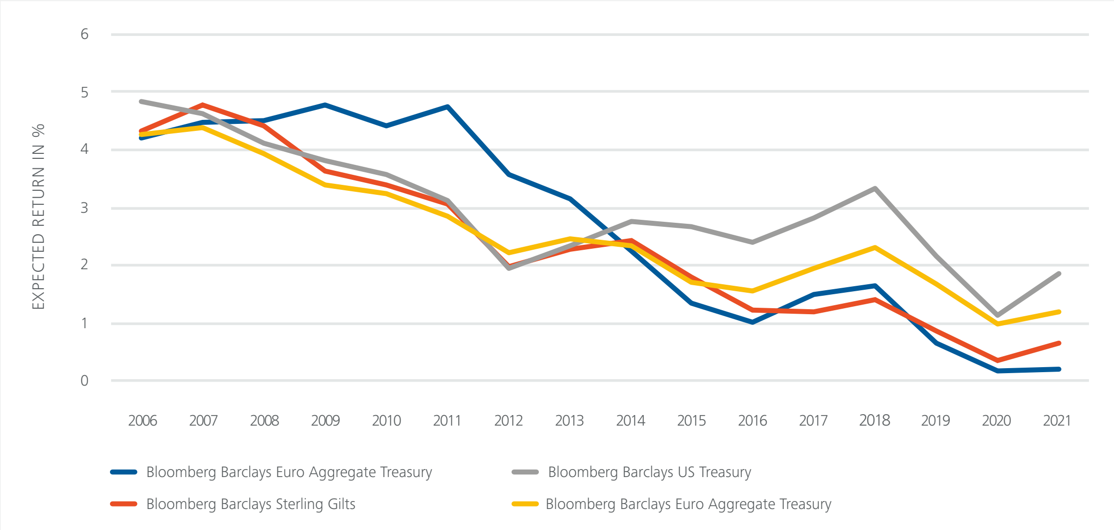
We use a simple proxy for expected returns, which comprises the average annual yield and the roll-down component. Our expected return therefore reflects what an investor would earn over a one-year period if the yield curve remained unchanged. Roll-down returns are approximated as the difference between the yield of 10-year government bonds and a 3-month money market yield r_{3m}, multiplied by the modified duration of the relevant benchmark. We arrive at the expected return r_E by adding the index yield-to-worst (YTW).

$$r_{RD} = \frac{r_{10y} - r_{3m}}{9.75} * \text{Mod.Duration}$$

$$r_E = YTW_i + r_{RD}$$

Using this gauge for the expected return for one year we can highlight the developments in government bond markets over the past decades.

Figure 2: Annual expected return of various fixed-income indices over the course of the past 16 years. The expected return comprises the average yield-to-worst of the previous year and the steepness of the yield curve. Expected returns are shown for the year in which the estimate for the following year is calculated.

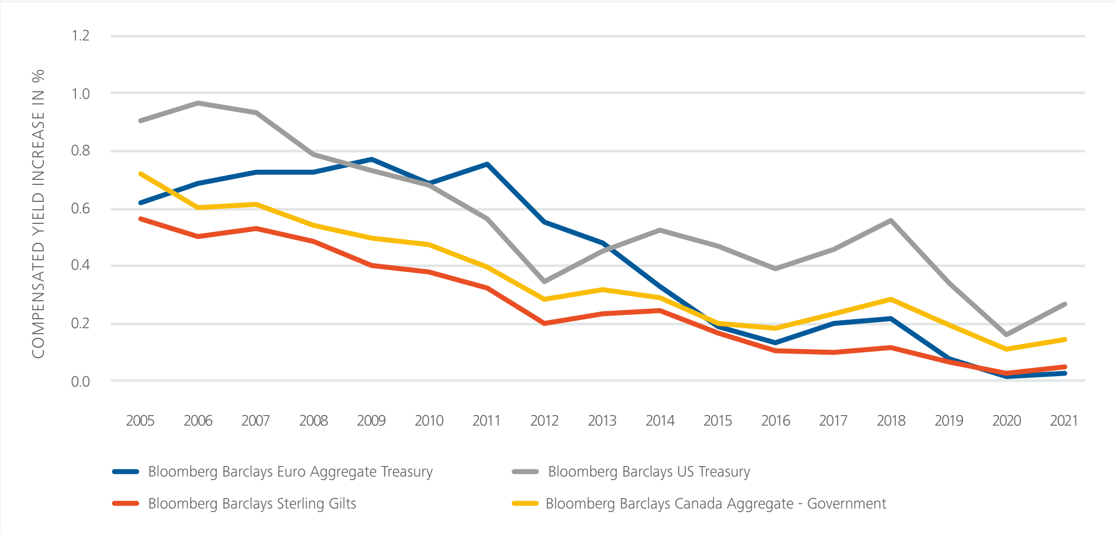


Source: Bloomberg data, own calculations, Universal-Investment-Luxembourg S.A., branch Frankfurt am Main

Figure 2 shows a continual sharp downward trend in yield expectations. In 2020, the Euro Aggregate Treasury Index hit an absolute low at a rate of 0.15 %. Despite their low yields, European government bonds recorded a strong performance of roughly 5 % in 2020. Half of that performance is attributable to a 0.3 %-fall in interest rates, while the other half is due to a reduction in government spreads. Negative yields in core European countries were significantly overcompensated at the index level. In the first few months of 2021, it became clear that this development would not continue indefinitely. On June 30th 2021, the index recorded a year-to-date performance of almost -3 %. A similar trend was seen in most investment-grade government and even in corporate bond indices.

An alternative view on the developments is the potential yield increase that can be compensated by the yield of an index itself. A simplified example helps to illustrate this concept: imagine a hypothetical bond with a modified duration of 5 which yields 5 % per year. The running yield can thus compensate for a 1 % yield increase, which causes roughly a 5%-decrease in the bond price. Two effects coincide in this measure: on the one hand, yield-to-worst has decreased in recent years, while on the other, duration has risen strongly in the indices. Both effects reduce the amount of yield rises that can be compensated for through the expected returns.

Figure 3: History of maximum yield rises that can be compensated for by expected yields to arrive at a zero return for various fixed-income indices. Calculations are based on the data of the shown years for the following year.



Source: Bloomberg data, own calculations Universal-Investment-Luxembourg S.A., branch Frankfurt am Main

Figure 3 shows the history of the maximum interest rate rises that can be compensated for through the indices' expected total return. Back in 2007, prior to the financial crisis, fixed-income indices were still able to digest a rise in interest rates of about 70 basis points before their total return hit zero.

That amount fell to a mere 12 basis points at the end of June 2021. This development explains why the recent increases in interest rates were directly visible in the indices' total returns and why they diminished the returns of many portfolios.

In addition to the returns, a lot of investors are focusing on the risk-return ratio. In the fixed income sector, this measure has often played an important role in investments. We will therefore examine this aspect in more detail in the next section.

We calculate the measure of risk for an index through the product of the average volatility of its yield-to-worst and the index duration.

$$\text{Indexrisiko}_t = \sigma_{t,YTW} * \text{Duration}_t$$

Estimates of σ_t are derived as daily-expanding window volatility of yield-to-worst changes since the beginning of 2005. As for the risk-return ratio, we calculate the quotient of expected total returns (as calculated above) and our derived index risk. In **Table 1**, we show the resulting index risk and return ratio for selected years.

This risk-return ratio was still well above one in 2006 but has deteriorated sharply over time. The ratio for European government bonds moved even closer to zero by 2021. Risk, on the other hand, has risen: Canadian government bond risk is up by more than 34 % and British government bonds' risk has doubled.

Overall, fixed-income markets have lost a great deal of their appeal, while investors are now exposed to greater risk than in the past.

Table 1: Duration-implied volatility (index risk) and risk-return ratios are shown for various fixed-income indices and time periods. Average duration of each year is used in the calculation. Volatility is based on an expanding window estimate of daily yield-to-worst changes since the beginning of 2005. Expected returns are the sum of average annual index yield-to-worst and estimated rolldown returns for the respective years.

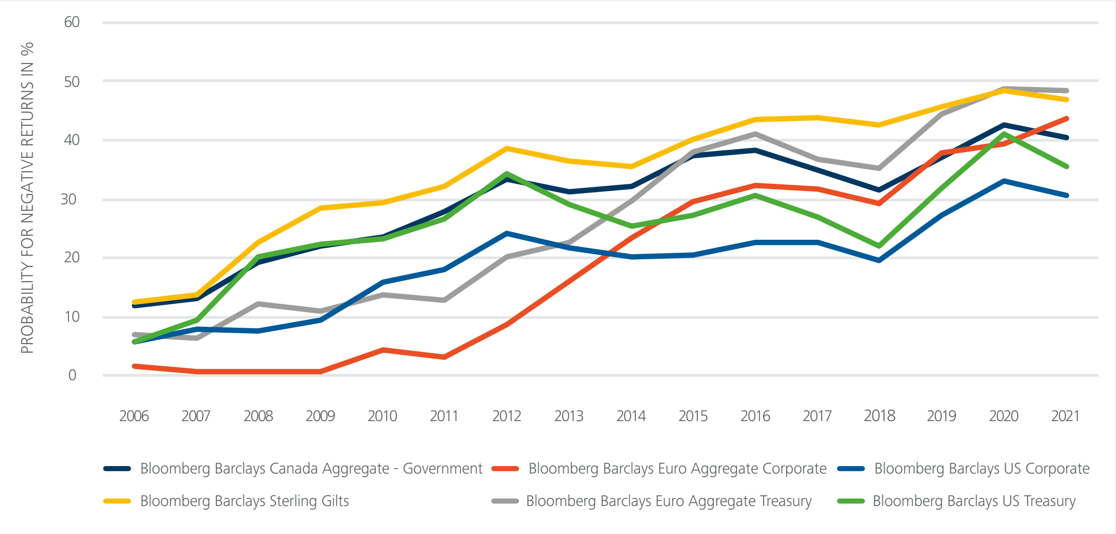
INDEX	2006		2011		2016		2021	
	INDEX RISK	RETURN / RISK	INDEX RISK	RETURN / RISK	INDEX RISK	RETURN / RISK	INDEX RISK	RETURN / RISK
Bloomberg Barclays US Treasury	3.05 %	1.58	4.97 %	0.63	4.70 %	0.51	4.91 %	0.38
Bloomberg Barclays US Corporate	3.67 %	1.56	6.19 %	0.92	5.80 %	0.74	6.51 %	0.51
Bloomberg Barclays Euro Aggregate Treasury	2.83 %	1.48	4.18 %	1.13	4.49 %	0.23	4.81 %	0.05
Bloomberg Barclays Euro Aggregate Corporate	2.16 %	2.07	2.78 %	1.82	3.11 %	0.45	2.94 %	0.16
Bloomberg Barclays Canada Aggregate - Government	3.61 %	1.18	4.90 %	0.58	5.23 %	0.30	4.86 %	0.25
Bloomberg Barclays Sterling Gilts	3.78 %	1.14	6.57 %	0.46	7.57 %	0.16	8.04 %	0.08

Source: Bloomberg data, own calculations Universal-Investment-Luxembourg S.A., branch Frankfurt am Main

4. Implications for investment decisions

Based on the estimated return expectations and calculated index risk figures, we can calculate the probability of negative returns assuming a normal distribution as the probability distribution for changes in yields. **Figure 4** shows these probabilities over time.

Figure 4: Ex-ante probabilities for negative returns over a one-year period for various fixed-income indices. Calculations are based on a normal distribution assumption. Expected total returns and approximated index risk are defined as above.



Source: Bloomberg data, own calculations Universal-Investment-Luxembourg S.A., branch Frankfurt am Main

Probabilities for negative returns of fixed-income indices were very low historically for a long time, with figures below 20 %. These probabilities have risen since 2009 and have reached the 50 % threshold for some indices. For corporate bonds, the credit spread is helping to prevent negative returns. Nevertheless, in March 2020, it became all too clear to investors that these credit spreads were not to be taken for granted as they can increase sharply in certain market environments.

Many investors are considering tweaking their strategic asset allocation towards equities and alternative investments (Neubauer, 2018). Investors less bound by regulatory constraints used this approach in particular to attain their investment goals. Generally, such investors are - and have to be - more willing to take risks in case but it definitely requires a higher risk-bearing capacity. Not all investors can afford the potential losses of large equity positions.

Fixed-income investments will therefore continue to play a key role in most asset allocations (Constantinides & Malliaris, 1995).

Another way investors can mitigate the issues described above is to reduce the risk of benchmark indices by limiting the maturity profiles. This means excluding longer-dated maturities from benchmark calculations. There are, however, some disadvantages to this approach: shorter-term bonds have even lower returns and thus a higher probability of negative returns. Their lower duration also limits the diversification effect within the strategic asset allocation, especially with equity risks. Correlations of fixed-income and equity risks have been proven to vary (Collie, 2017; Hamlin, 2021), but studies have also shown that bonds and equities perform independently of each other on longer-term horizons or even have the potential to hedge each other (Johnson et al., 2013; Rankin & Idil, 2014).

Sacrificing fixed-income investments all together or reducing the duration too sharply may therefore not be a viable alternative for most investors.

A risk overlay strategy may prove helpful in capturing the diversification benefits of fixed-income investments and at the same time may limit the downside. With the help of a risk overlay, the return of broad fixed-income indices can be maintained overall while the tail risks that have grown in recent years may still be avoided.

In the following chapter, we will highlight various aspects and the potential of risk overlays for fixed-income portfolios in different market environments.

5. Case study: fixed-income risk overlay

Having discussed recent developments in the most important fixed-income markets, we now examine the application of a risk overlay strategy on a bond portfolio to mitigate the threat of rising risk due to low yields. To that end, we study two historical time periods, whose returns we partially adjust to fit the yield and risk environment of 2021. We approximate the portfolio of a potential investor using the Bloomberg Barclays Euro Aggregate Treasury Total Return Index (BB Euro Treasury), which reached a yield-to-worst close to zero in 2021 after a long-term overall decline in interest rates in the Eurozone.[1]

By using a broad portfolio of European investment-grade government bonds, we isolate the interest-rate component from other potential sources of risk. However, our results are directly applicable to the interest-rate component of the entire fixed-income asset class.

As seen in **Figure 4**, the probability of negative returns in a bond portfolio has increased considerably due to low expected returns and increased duration. To measure these risks, we analyse the performance of such a portfolio based on two historical time periods:

Period 1 is characterised by an overall stagnation in interest rates, with comparably small upward and downward movements. A good example for this scenario is the period between January 1st 2018 and June 30th 2021. With its low average yield and high duration, the period is close to the investment environment of 2021.

For **Period 2**, we take a time frame with rising interest rates, which we observed historically between July 1st 2005 and June 30th 2008, with an increase in the index yield-to-worst of the BB Euro Treasury of 2.4 %. However, average duration was lower, and the initial yield was considerably higher at that time compared with 2021. To achieve comparable performance figures to the initial situation in 2021, we thus adjust the historic daily return time series by subtracting the initial yield-to-worst and scaling returns to a higher duration level:

$$r_t = \frac{S_t}{S_{t-1}} - 1$$

$$y_0 = YTW_{2005\text{-}07\text{-}01}$$

$$\Delta Dur = Dur_{2021} - Dur_{2005\text{-}07\text{-}01}$$

$$r_t^* = \frac{Dur_t + \Delta Dur}{Dur_t} \left(r_t - y_0 \, \Delta t \right)$$

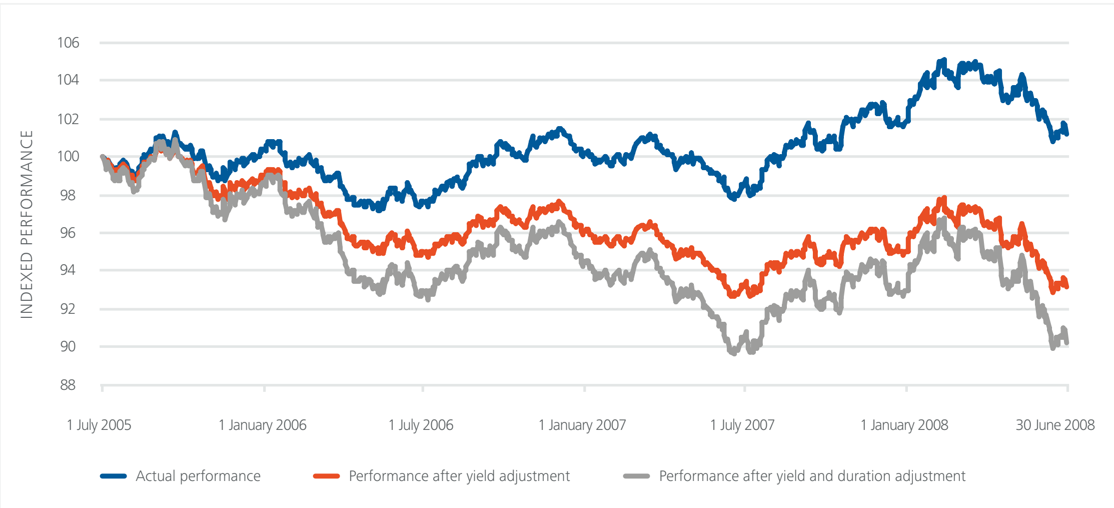
$$S_t^* = \left(1 + r_t^*\right) S_{t-1}^*$$

[1] On June 30th 2021, the average yearly yield-to-worst of the Bloomberg Barclays Euro Aggregate Treasury Total Return Index was -0.03 %.

Here, S_t represents the index level of the BB Euro Treasury at time t, y_0 is its index yield-to-worst and $Dur_{2005\text{-}07\text{-}01}$ its average option-adjusted duration at the beginning of the period. Via the adjusted return r_t^*, we compute an adjusted index trajectory S_t^*, which is driven by the interest rate movements between July 1st 2005 and June 30th 2008 and at the same time corresponds to the observed investment environment of 2021. More precisely, we set the initial yield-to-worst of this adjusted index to 0 and its initial option-adjusted duration to Dur_{2021}=8.7.[2] However, this adjustment merely determines the initial values of the index yield-to-worst and duration, all movements in these features are tracked in the historic time period. The yield-to-worst thus rises during the considered time frame to 2.11 % from an initial 0 %, which results in notable carry earnings towards the end of the period. At the same time, the duration drops slightly to 8.5 from 8.7.

The effect of our adjustment on the index development over time is shown in **Figure 5**. The weaker performance of the adjusted index compared with the original version is evident. Here, higher duration leads to stronger price declines in bonds due to rising interest rates. At the same time, these losses cannot be compensated by carry as they might have been in the past because the initial yield-to-worst is 0.

Figure 5: Index development of the Bloomberg Barclays Euro Aggregate Treasury Total Return Index between July 1st 2005 and June 30th 2008. To translate the historic index performance into the investment environment of 2021, we first set the initial yield-to-worst to 0, thus reducing the carry earned over the period. Second, we scale returns to set the initial option-adjusted duration of the index to 8.7, which corresponds to its 2021 level.



Source: Bloomberg data, own calculations of Universal-Investment-Luxembourg S.A., branch Frankfurt am Main

[2] This conforms to the duration of the Bloomberg Barclays Euro Aggregate Treasury Total Return Index on June 30th 2021.

We simulate a simple risk overlay strategy to address the increased loss potential in bond portfolios. At the beginning of each year, we equip the portfolio with a risk budget of 110 % times the Value-at-Risk (VaR). The difference between the portfolio value and the risk budget constitutes a lower bound that the strategy aims to protect as the minimal portfolio value. Negative performance reduces the risk budget, while positive performance increases it, so that the lower bound stays constant. If the risk budget surpasses 200 % times the VaR, the excess budget is used to increase the lower bound, effectively keeping the budget constant. If, on the other hand, the risk budget falls below the VaR, the investment ratio in the portfolio is reduced to the ratio of risk budget and VaR. To that end, short positions in government bond futures are taken in order to synthetically reduce the investment ratio without actually selling the underlying assets. For ease of computation, we assume an ideal hedge quality, which is almost feasible in the context of the portfolio of Euro government bonds under review. Finally, if the investment ratio drops below 25 % for three months, we assume an automatic re-budgeting with 110 % times the VaR to simplify matters, and close all hedging positions.

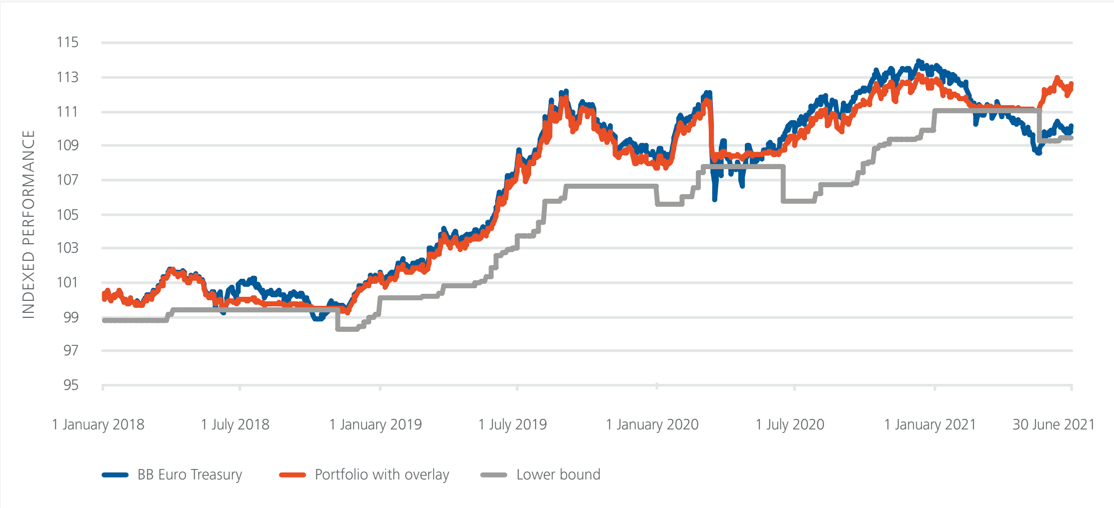
Table 2 contains a summary of the index performance during the two periods under review. During Period 1, the index gained an annual 2.72 % on average, with an annualised volatility of 3.92 %. This positive performance is mainly due to the decrease in the index yield-to-worst to 0.08 % from 0.55 %. Nevertheless, there were rising interest rate phases in Period 1, too, with intermediate losses of up to 5.66 %.

Table 2: Annualised statistics of the Bloomberg Barclays Euro Aggregate Treasury Total Return Index with and without risk overlay. We consider the period between January 1st 2018 and June 30th 2021 as representative of an overall stagnating interest rate level with comparably small increases and decreases. The period between July 1st 2005 and June 30th 2008 is our sample for a rising interest-rate regime. Here, we adjusted the return time series so that the initial yield-to-worst and duration of the period match the investment environment in 2021.

	Period 1 1 January 2018 – 30 June 2021		Period 2 1July 2005 – 30 June 2008 (adjusted)	
	INDEX	INDEX WITH OVERLAY	INDEX	INDEX WITH OVERLAY
Average return	2.72 %	3.35 %	-3.26 %	-1.54 %
Volatility	3.92 %	3.03 %	4.47 %	3.77 %
Return / Risk	0.69	1.11	-0.69	-0.41
Max. drawdown	-5.66 %	-3.71 %	-11.15 %	-6.18 %
Max. increase *YTW*	0.75 %	0.75 %	2.15 %	2.15 %

Source: Bloomberg data, own calculations of Universal-Investment-Luxembourg S.A., branch Frankfurt am Main

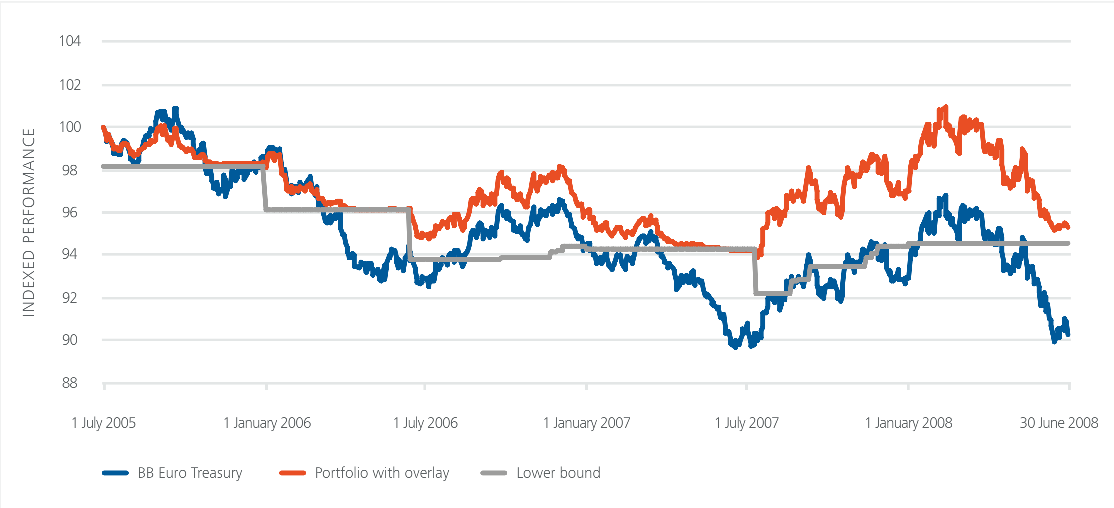
Figure 6: Performance of the Bloomberg Barclays Euro Aggregate Treasury Total Return Index with and without risk overlay from January 1st 2018, to June 30th 2021. Our test assumes an ideal hedge quality. The grey line depicts the lower bound, below which the portfolio value should not fall. As soon as the portfolio value approaches the lower bound, a hedge is built up gradually in order to protect the portfolio from further losses. The hedge is reduced again after three months either because of a strong performance in the underlying portfolio or if the hedge is close to a full hedge.



Source: Bloomberg data, own calculations of Universal-Investment-Luxembourg S.A., branch Frankfurt am Main

The performance of the portfolios with and without risk overlay during our first sample, as depicted in **Figure 6**, shows that risk overlay is an effective instrument for mitigating larger losses: the maximum drawdown of the protected portfolio declines by 1.95 % to -3.71 %. Despite this reduced risk, the portfolio with risk overlay still tracks the performance of its unprotected counterpart quite well and even surpasses it towards the end of the period. The return/risk ratio of the protected portfolio is thus strongly improved.

Fugure 7: Performance of the yield- and duration-adjusted Bloomberg Barclays Euro Aggregate Treasury Total Return Index with and without risk overlay from July 1st 2005 to June 30th 2008. Our test assumes an ideal hedge quality. The grey line depicts the lower bound, below which the portfolio value should not fall. As soon as the portfolio value approaches the lower bound, a hedge is built up gradually in order to protect the portfolio from further losses. The hedge is reduced again after three months either because of a good performance of the underlying portfolio or if the hedge is close to a full hedge.



Source: Bloomberg data, own calculations of Universal-Investment-Luxembourg S.A., branch Frankfurt am Main

The performance of the portfolios with and without overlay during our sample period with rising interest rates is shown in **Figure** 7. Without risk overlay, the roughly 2 % increase in the yield in the period leads to losses of up to 11 % in the bond portfolio. The overlay strategy can prove its strength here by effectively reducing drawdown periods. Despite an unfortunately-timed release of risk budget in January 2006, the losses during the second quarter of 2006 and the second quarter of 2007 can be sharply reduced. In our test, the maximum drawdown of the protected portfolio is cut by 45 % to -6.18 %, which results in a considerably stronger performance during the period under review.

Here, too, risk overlay leads to a significant improvement in the risk/return ratio of the investment.

6. Summary

The continued low interest rate market regime caused considerable adjustments to expected returns and risks of fixed-income investments. Technically, lower discount rates lead to an increase in a bond's sensitivity to yield changes, also known as duration, and at the same time reduce the expected return of a bond investment.

We demonstrated that these theoretical considerations are backed by long-term developments in global fixed-income markets. Average yields of benchmark bond indices fell to below 1 % in 2020 from about 4.5 % in 2005. At the same time, the duration-implied volatility of these indices rose to about 5 % from around 3 %.

Faced with this new investment environment, our analysis based on historical index performances shows that, in particular, phases of stagnating or rising interest rates can come hand in hand with sizable drawdowns in the value of bond portfolios. Such drawdowns can be sharply reduced, however, with a risk overlay strategy for the portfolios. In addition to a significant decrease in volatility, the risk overlay also improved the overall performance of the portfolios in our tests. In total, adding an overlay to a benchmark bond investment leads to a marked improvement in risk-return profiles resembling that of bond investments in and around 2010.

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Overlay management

Whether for cross-segment overlay management of portfolios on our own or an external platform, whether for overlay management in outsourcing or as an administrative KVG: Universal Investment has extensive expertise in the implementation of overlay management concepts - individual, modular and tested.

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