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Trend-following in a low-yield environment

An analysis on return opportunities provided by government bond futures for trend-following CTAs in a low-interest rate environment

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In a world where interest rates have fallen into ultra-low or negative territory, more and more investors are questioning the diversification benefits of a fixed income allocation in a portfolio context. It is highly unlikely for rates to fall much further from current levels, and the expected upside from holding a long bond exposure is more limited than ever before. With bonds having supposedly lost their shine, many investors have been questioning whether trend-following strategies will manage to continue delivering attractive risk-adjusted returns and providing diversification during equity market crisis periods.

In order to express a view on the subject, we argue that a thorough understanding and historical analysis of the key return drivers of bond futures is a necessity. Relying on such analysis, we show that carry, a pure function of the shape of the yield curve, has accounted for more than half of the returns earned from holding a long bond position since 2005. The return contribution coming from carry has been even more predominant during normal and bull markets. Inversely, in times of equity market stress, yield depreciation has been the main driver of strong bond future returns. With global yields at all-time lows and carry having largely contracted towards zero as a consequence of flattening yield curves, we believe it is unlikely that the superior return contribution and natural diversification benefit of bond futures observed during the past 15 years will persist. Such contraction of carry, however, offers new attractive return opportunities for trend-followers, such as the building-up of short positions in bond futures in a rising rate environment. We conclude that a systematic, diversified and risk-adjusted approach to trend-following remains as valuable as ever to adapt to and benefit from any new yield curve scenario or return opportunities in other asset classes that may arise.

Introduction

In this note, we show that an ultra-low or negative interest rate environment is not necessarily detrimental to the return opportunities offered by trend-following CTA programs. We demonstrate that since 2005 the risk-adjusted return of a diversified bond future portfolio across all maturities was higher during the low yield periods compared to the high yield periods. However, past performance is not an indication for future performance, and the question is if the return pattern of the last 15 years can repeat from here on.

To be able to formulate a view on the opportunity set offered by a bond future position today and going forward, a thorough understanding of the return drivers in different yield environments is essential. Breaking down a bond future's return into its components leads us to conclude that the opportunity set offered by such bond future is indeed lower these days than it used to be. We show that this is not only a result of low yields, but is largely related to the contraction of carry. For most of the past 15 years carry has been a factor that highly contributed to the overall attractive returns earned from holding a long bond futures position.

We also demonstrate that despite the current near-zero or negative level of their underlying interest rates, bond futures may still contribute meaningfully towards improving the risk-adjusted return characteristics of a typical trend-following program. By trading futures, a CTA can always allocate the desired level of risk exposure to a bond position, independent of the volatility, the price or yield level of the underlying bond. In a low interest rate environment, this is a huge advantage against the limited opportunity set of a long only, cash bond investor. In fact, the upside potential of an unlevered long only cash bond position is very limited for short duration, low volatility or low yield bonds, whereas a CTA can increase its futures positions easily to achieve the desired risk-return potential.

In addition, the ability to enter into short positions in bond futures will become more important in a low yield environment with low or even negative carry, as the implicit carry costs of entering a short position are significantly reduced.

In a last section, we analyze the diversification characteristics of bond futures during equity market stress periods. We show that the diversification potential is mainly driven by decreasing yields rather than carry returns. As the potential for further decreasing yields seems currently lower than in the past, this could well result in a muted diversification potential of bond futures going forward.

A representative universe of the most liquid global government bond futures

To start our analysis we define a universe of 15 of the most liquid global government bond futures contracts. We group these contracts into three buckets based on their duration/maturity profile:

- The short bucket groups four futures with underlying bonds maturing in up to five years
- The medium bucket is composed of eight futures with an underlying maturity of five to ten years
- The long bucket contains three futures with underlying maturities of longer than ten years

An overview of all contracts by their underlying cheapest-to-deliver bond maturity and duration characteristics is provided in Table 1.

Contract (Name)	Min. remaining term to maturity (years)	Max. remaining term to maturity (years)	Duration (as of 31/08/20)	Cheapest-to-deliver yield-to-maturity (as of 31/08/20)	Maturity bucket	Region
2-year US Treasury Note	1.75	2	1.67	0.131	short	US
Euro Schatz	1.75	2.25	1.76	-0.655	short	Germany
5-year US Treasury Note	4.16	5.25	4.06	0.223	short	US
Euro Bobl	4.5	5.5	4.61	-0.649	short	Germany
10-year US Treasury Note	6.5	10	6.21	0.477	medium	US
Euro Bund	8.5	10.5	8.97	-0.469	medium	Germany
Long-Term Euro BTP	8.5	10.5	7.89	0.993	medium	Italy
Euro OAT	8.5	10.5	8.57	-0.220	medium	France
Long Gilt	8.75	13	8.39	0.310	medium	UK
10-year Japan Govt Bond	7	11	7.02	-0.060	medium	Japan
10-year Govt of Canada Bond	8	10.5	7.75	0.552	medium	Canada
10-year Australian Treasury Bond	n/a*	n/a*	8.11	n/a	medium	Australia
US Treasury Bond	15	25	11.91	0.940	long	US
Ultra T-Bond	25	n/a	19.37	1.425	long	US
Euro Buxl	24	35	21.03	0.000	long	Germany

*Cash settlement

Table 1: Overview of the 15 bond futures used throughout this note with their underlying maturities and duration characteristics (instruments of the same color belong to the same region, except for Canada/Australia).

The historical relationship between yield level and risk-adjusted return of bond futures since 2005

The global decline in yields is best captured by looking at the simple average yield level for each maturity bucket, calculated across all of the constituents between 2005 and 2020, as depicted in Figure 1. In order to evaluate the overall yield level's impact on average bond future returns, we construct three hypothetical portfolios, each composed of the instruments of the respective three maturity buckets introduced above.

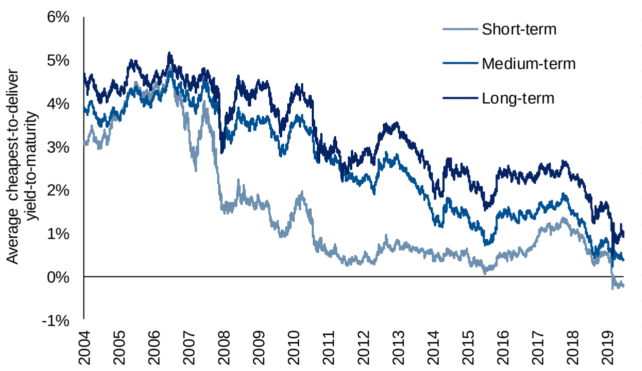

Figure 1: Average yield-to-maturity level by maturity bucket from 2005 to 2020.
(Please refer to Table 1 for the full list of constituents.)

Every portfolio constituent is risk-weighted by an equal annualized target volatility. Volatility exposures of individual instruments are calculated with an exponentially weighted moving average method and a decay factor of 0.94, corresponding to a 22-day lookback period. Within each of the three resulting portfolios, we scale their constituents so as to meet a portfolio volatility target of 6% p.a. The three portfolios' cumulative performance between 2005 and 2020 is displayed in Figure 2.

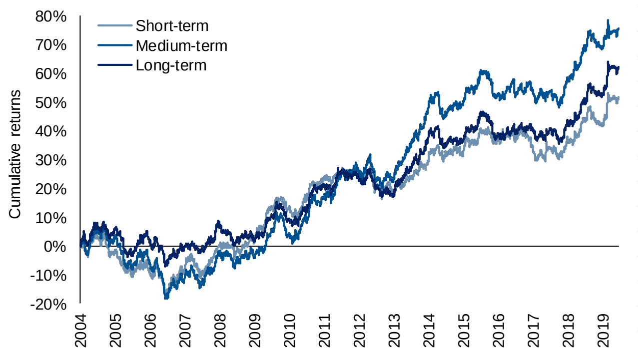

Figure 2: Cumulative returns from 2005 to 2020 for three bond futures portfolios of distinct maturity types (short, medium, long), each targeting an annualized volatility of 6% p.a. with each individual constituent weighted to target an equal amount of risk. Please refer to Table 1 for the full list of constituents for each of the three portfolios.

Figure 1 illustrates the almost steady decline of global government bond yields since 2007. However, the figure shows some interesting differences between the different maturity buckets: The average short-term yield has hovered around a very low level since the end of 2011. It is probably the best portfolio to look at in order to evaluate the impact low yields may have on return opportunities. As can be seen from Figure 2, the performance of the risk-adjusted short maturity portfolio has been remarkably strong, despite underlying yields being close to zero for the last eight years.

Figure 3 highlights the relationship between the buckets' (short, medium and long) average yield level and the corresponding average portfolio return by representing each portfolio's annualized return as a function of three terciles of yield levels. As an example, the average annualized return of the medium maturity portfolio (composed of eight 5-10-year bond futures) on the 33% of all days since 2005 with the lowest average yield across all eight constituents has been close to 10%, whereas it has been less than 2% annualized during the 33% of all days with the highest average yields.

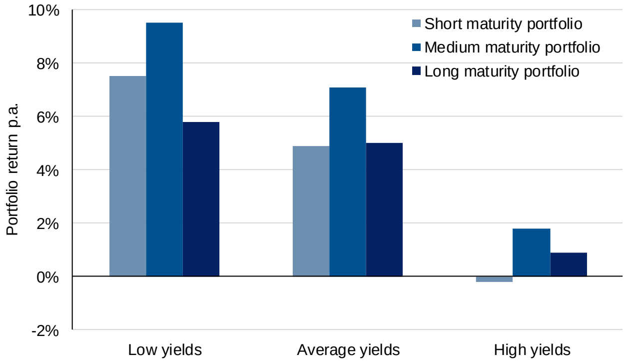

Figure 3: Average annualized return of three hypothetical bond futures portfolios with distinct maturity profiles (short, medium, long), each targeting a constant volatility of 6% p.a. for three terciles of yield levels (defined as the average of a portfolio constituents' yield levels). The first tercile represents the 33% of all days with the lowest average yield, the second one the next 33%, and the third tercile stands for the 33% of all days with the highest yields. Period of reference: 2005 – 2020.

We conclude that the P&L contribution of a constant risk exposure to the most liquid global bond futures has not structurally diminished with declining yield levels over the last 15 years. In fact, the risk-adjusted return of a diversified bond future portfolio was higher in periods with lower average yield levels.

The reason for this somewhat counter-intuitive result is mainly twofold:

- A risk-adjusted approach to investing in bond futures allows to easily increase notional exposures in short duration, low volatility and low yielding bonds.
- There is another important source for bond futures returns which is independent of yield levels: the carry return.

To illustrate the first point, it is important to understand that the exposure of a bond future position in a constant volatility target portfolio is a function of the future's price volatility only: the lower the volatility of such contract, the higher the number of contracts to be bought or sold to maintain a constant risk exposure. As illustrated in Figure 4, the 10-year duration equivalent gross exposure required to achieve the 6% target volatility increased from a low of 60% at the peak of the great financial crisis in 2008 to a high of 220% at the end of 2014. This gross exposure has averaged at around 180% over the past eight years until the recent Covid-19 crisis versus an average of around 120% for the prior six years, i.e. between 2005 and 2011.

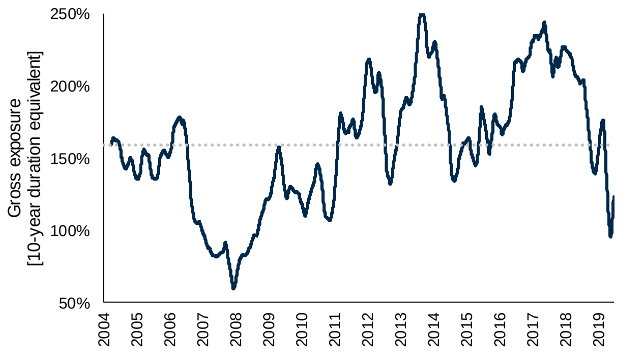

Figure 4: 10-year duration equivalent gross exposure of a portfolio of 15 bond futures targeting a constant volatility of 6% p.a. with each individual constituent weighted to target an equal amount of risk.

The inherent trading on margins allows investors to control the risk exposure and allocate any desired level of risk to a portfolio, even if the underlying instruments trade on short duration, low volatilities, low or even negative yields. Futures trading hence significantly expands the investment opportunity set, which becomes even more important in times of low yields.

Also for trend-following CTAs such advantages of trading bond futures are crucial. Bond futures provide an easy way of implementing short positions that can benefit from decreasing bond prices and increasing yields.

Decomposing bond futures returns into price and carry returns

To assess the second important factor driving bond futures returns besides a bond's yield, we provide a more granular assessment of an investment into bond futures. We decompose bond futures returns into (i) return due to yield changes and (ii) carry return.

A bond futures contract calls for the delivery of any bond that matures within a range of years from the contract's date of delivery. This means, for example, that the 10-year US Treasury bond future settles to the delivery of US Treasury notes with a remaining term to maturity of at least 6.5 years, but not more than 10 years.

In practice, the bond future will tend to track or correlate most closely with the "cheapest-to-deliver" (CTD) bond from the basket of eligible securities for delivery. A key driver of a bond future return will be the income gain generated from its underlying CTD-bond's current annual yield y^T_t with time-to-maturity T. Additionally, since the future contract is entered on margin, its expected return has to match the expected return of the underlying funded security minus the funding rate r^f_t (such as the generic on-the-run 3-month government bond for a typical front-month contract expiring in three months).

Consequently, a bond future's return $r_{\Delta T}$ over a given holding period ΔT in years may be approximated by:

- the underlying bond's annual yield spread to the risk-free rate (or difference between yield income and financing costs) times the holding period or yield carry; and
- capital gains/losses due to yield changes, measured as minus the underlying CTD bond's duration ***Dur*** times its change in yield over the holding period;

or:

Bond future return	≈	Yield carry	+	Return due to yield changes

Or, mathematically,

$$r_{\Delta T} \approx (y^T_t - r^f_t) * \Delta T \quad - \quad Dur * (\Delta Y / \Delta T)$$

The above decomposition may be further broken down by isolating the impact of the yield curve structure on the yield of a bond with shortening time-to-expiry over the holding period. Assuming the entire yield curve stays constant over the holding period enables to extract the so-called roll-down carry, which measures, as its name suggests, the capital gains/losses generated solely from the bond rolling down the yield curve. As the yield curve is typically upward sloping, the roll-down carry translates into a capital gain through the implied fall in yield as the bond ages towards maturity.

In short, the total carry return of a bond future can be represented as the sum of the bond's periodic income earned over financing costs plus the additional price gain (or loss in the unusual case of an inverted term structure) earned from the term structure premium.

The portion of a bond future's return that is explained by yield changes can therefore be further decomposed as follows:

Return due to yield changes	=	Roll-down carry	+	Return due to change in yield of a constant maturity bond

The complementary factor in the above equation would represent the returns generated from changes in bond yields, assuming the bond's maturity stays constant during the holding period.

The return of a bond future may hence be decomposed into three different factors:

- Yield carry
- Roll-down carry
- Return due to the yield changes of a constant maturity bond

Unlike the last factor, the first two components (yield carry and roll-down carry) are deterministic. On any given date they can be estimated directly from the bond markets' structural characteristics and their term structure, and may actually be realized if the bond yields' term structure was to stay constant.

Estimating yield carry and roll-down carry for the 10-year US Treasury future

We provide an example of the estimation process of carry on the basis of the 10-year US Treasury future using information of the US Treasury yield curve on 31 August 2020 (see Figure 5).

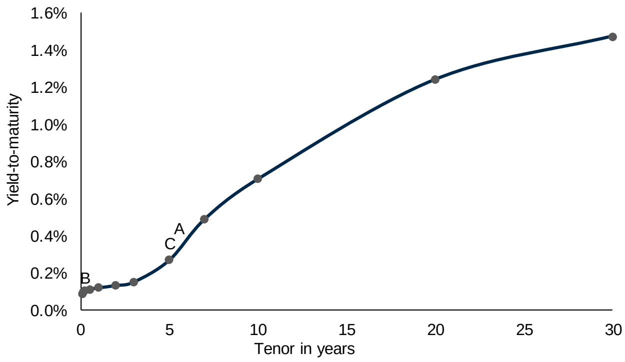

Figure 5: US Treasury yield curve on 31 August 2020. Source: Bloomberg.

On 31 August 2020, the underlying CTD-bond to the 10-year Treasury bond has a duration of 6.2 years, and yields 0.47% (A), compared to the on-the-run 3-month T-Bill yield of approximately 0.1% (B). The expected yield carry earned from holding a 10-year US bond future stands therefore currently at around 0.37% p.a.

If the US Treasury yield curve remains unchanged in the coming year, the yield of today's 10-year maturity Treasury will fall from its current level of 0.47% to the 0.37% yield of a 5.2-year bond (C) simply because, as the bond ages, it "rolls down" the yield curve, here by 10bps (A-C). This means that in an unchanged yield curve scenario, the 10-year Treasury with a duration of 6.2 years, augments its 0.37% yield carry by a 0.62%

roll-down carry (Dur 6.2 x 10bps / 1 ≈ 0.62%). Mechanically, the annual carry earned from holding a 10-year Treasury bond future is therefore around 0.99% (0.37% + 0.62%).

As the yield curve is currently steepest at around maturities of six to seven years, the roll-down carry on the 10-year US Treasury future is currently higher than its yield carry.

More generally, relying on the above estimation methodology, Figure 6 provides an estimation of the yield carry and roll-down carry returns from owning a long position in the 10-year US Treasury bond future between 2005 and today, using the 3-month T-Bill yield as a proxy for the funding rate. For this contract, the roll-down carry has been of similar magnitude to the yield carry.

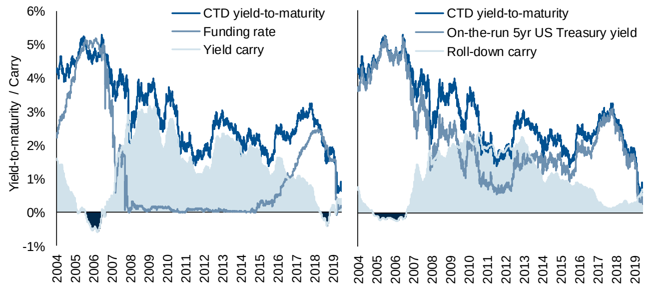

Figure 6: Historical yield carry and roll-down carry for the 10-year US Treasury bond future.
Left: the spread between the CTD yield-to-maturity and the 3-month T-Bill yield.
Right: the spread between CTD yield-to-maturity and the "on-the-run" 5-year US Treasury yield multiplied by the duration of the CTD bond divided by (CTD time-to-maturity – 5).

To conclude, both the yield carry and the roll down carry are both a function of yield differentials only (i.e. the slope or steepness of the yield curve), and not of the yield levels itself.

The yield carry is a function of the global curve steepness, i.e. the bond's yield spread to the risk-free rate. The roll-down carry is a function of the local curve steepness around the duration of the CTD bond. For a perfectly linear term structure these two components are equal, and in a perfectly horizontal yield curve both carry components are equal to zero.

The importance of adjusting for the volatility of the underlying

In an ultra-low interest environment yield differentials and hence carry components will naturally be smaller. However, by trading bond futures instead of cash bonds, the important quantity is not carry, but risk-adjusted carry. One can easily trade more futures contracts to exploit even a low carry, low volatility environment. The actually relevant metric in the context of a trend-following allocation to bond futures will hence be "carry divided by the future's volatility". The yield level independent opportunities for a futures investor are hence represented by such risk-adjusted carries.

Figure 7 displays the historical time-series of risk-adjusted yield carry and roll-down carry for the 10-year US Treasury future since 2005.

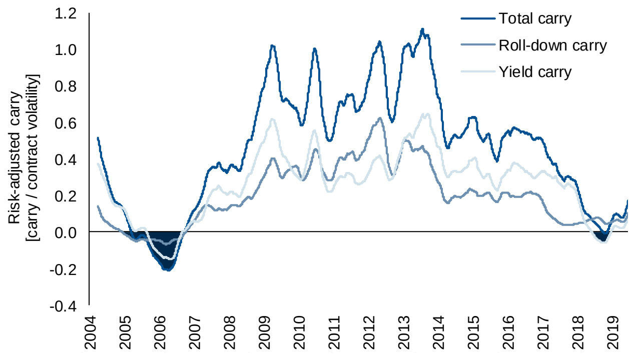

Figure 7: Historical total risk-adjusted carry broken down into risk-adjusted yield carry and roll-down carry for the 10-year US Treasury bond future.

Carry returns for a diversified portfolio of bond futures

In Figure 2 we have shown the overall P&L of a constant risk allocation to a diversified bond future portfolio. In this section, we show the corresponding estimated aggregate total carry (yield carry + roll-down carry) across our universe of 15 bond futures between 2005 and 2020. Figure 8 provides a historical attribution of the total carry metric by maturity bucket. The chart highlights that at the time of this publication short maturity bonds have a negative total carry, whereas the medium and long bucket still offer an average carry of between 1-2% p.a. This is not an unprecedented situation as already back in 2007, for a short period of time, the total carry of all three maturity buckets was negative.

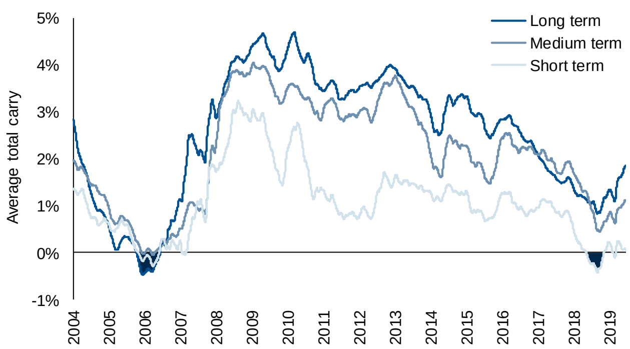

Figure 8. Average total carry, yield carry and roll-down carry by maturity buckets.
(Please refer to Table 1 for the full list of constituents.)

Moving to our previous portfolio targeting a constant volatility of 6%, the total carry for this portfolio is defined as the exposure-weighted sum of its constituent's carry components.

Figure 9 provides the attribution by yield carry and roll-down carry at aggregate portfolio level for the target risk portfolio. It shows that a 6% p.a. constant volatility allocation to the 15 bond futures has earned on average a total carry of 3.9% p.a. between 2005 and 2020, decomposed into 2.0% p.a. yield carry and a roll-down carry of 1.9% p.a. This means that two-thirds of the total portfolio return, which was 5.6% for that same period, was attributable to carry.

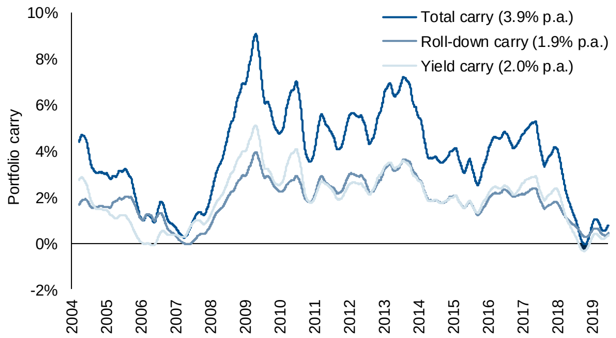

Figure 9: Total aggregate carry, yield carry and roll-down carry for a portfolio of 15 bond futures targeting a constant volatility of 6% p.a. with each bond future equal risk weighted.

Yield or price appreciation returns vs carry returns

Subtracting the estimates of yield and roll-down carry returns for each individual instrument (their aggregate portfolio values are shown in Figure 9) from their total return allows to extract and isolate the portion of the return that purely relates to the instruments' yield or price change. Figure 10 shows the cumulative return attribution by the three distinct return drivers – price change due to the yield level change, yield carry and roll-down carry – for the hypothetical bond future portfolio targeting a constant volatility of 6% p.a. since 2005. The portfolio delivered an annualized return of 5.6% with a volatility of 6%, resulting in a Sharpe-ratio of 0.90. However, only 1.6% p.a. is attributed to decreasing yields, whereas 3.9% p.a. can be attributed to carry.

A breakdown of the realized Sharpe ratio contribution for each driver of return shows the same result. More than two thirds of the realized total Sharpe ratio (0.64 of 0.90) originates from the two carry components, which makes them superior to the Sharpe ratio contribution from yield level change (i.e. 0.26).

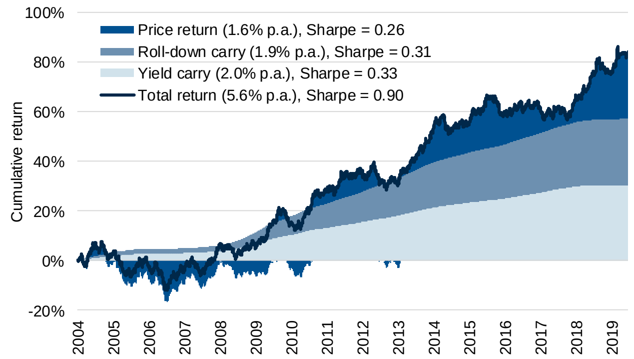

Figure 10. Performance attribution by source of return of a bond future portfolio with constant volatility of 6% p.a. between 2005 and 2020.

Bond futures diversification characteristics in different equity market regimes

An important aspect of bond futures in a portfolio context is the diversification potential in equity market stress periods. In order to gain a deeper understanding of the drivers of bond future returns in different equity market environments, we perform a regime conditional return analysis and follow the definition and approach as in Trend-Following CTAs vs Alternative Risk Premia[1]. In short, three different equity market regimes are defined based on non-overlapping quarterly returns of an equity market benchmark (we use in this analysis the MSCI World Equity Index as such benchmark): a Bear market regime, a Normal market regime and a Bull market regime[2]. Figure 11 shows the resulting regime conditional return attribution for the period 2005-2020 YTD.

On an aggregate level, the figure illustrates the beneficial smart diversification characteristics of bond futures: Bond futures delivered on average positive returns in all three different equity market regimes. Even more so, the highest return contribution has been realized in equity Bear market regimes. This shows that a risk-based bond futures portfolio served as an extremely important building block to diversify equity market risk of a balanced portfolio.

[1] For details on specifications of regimes relative to any benchmark we refer to Artur Sepp and Louis Dezeraud (2019), "Trend-Following CTAs vs Alternative Risk Premia: Crisis beta vs risk premia alpha", The Hedge Fund Journal
[2] In particular, we term market regimes
1. as Bear regimes when returns on the benchmark are below the 16%-quantile;
2. as Bull regimes when returns are above the 84%-quantile;
3. as Normal regimes when returns are in-between the 16%- and 84%-quantiles.

Furthermore, our empirical analysis shows the regime-conditional performance attribution of the price and carry components of the constant risk exposure bond future portfolio. The results highlight an interesting feature of bond futures: Their risk-adjusted performance in equity bear regimes can be almost exclusively attributed to their price appreciation. On the other hand, the majority of bond futures returns during Normal and Bull market regimes can be attributed to carry. As such, the potential for further declining yields seems an important requirement for the diversification potential of bond futures during equity market stress periods, whereas an increasing term structure is the important factor for positive returns during normal and equity bull markets.

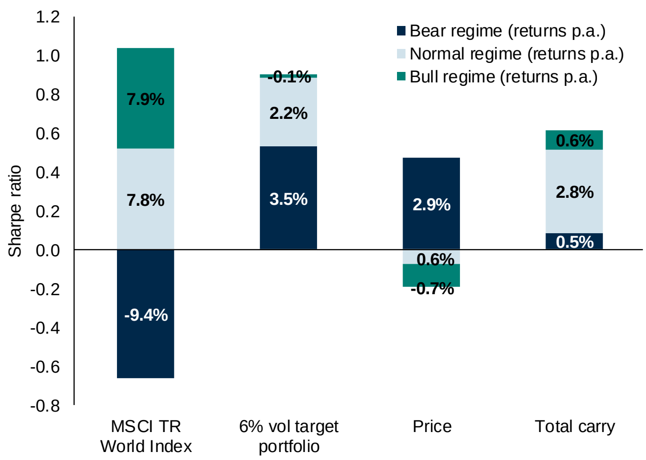

Figure 11. Smart Diversification provided by a bond future portfolio targeting a constant volatility exposure of 6% p.a. Performance attribution broken down by pure price appreciation and carry, conditional on quarterly MSCI TR World Index returns and Bull, Normal and Bear regimes between 1 January 2005 to 30 June 2020. Sharpe ratios are based on excess returns, except for the MSCI TR.

What to expect for the future

We have worked out the key factors driving bond future returns and highlighted the many advantages that bond futures offer compared to cash bond investments. As we write this note, yields across maturities are at all-time lows and at near-zero or negative levels across developed markets. Because of flattening yield curves, the total carry earned from a diversified basket of liquid bond futures has converged towards zero. This naturally translates into a currently reduced opportunity set offered by bond futures. The question is, what lies ahead of us and what are the most likely scenarios going forward?

Depending on the future direction of yields and the slope of the yield curve, one can identify four distinct scenarios. Each is translating into an expanding or contracting opportunity set as depicted in Figure 12.

On one side, if yields were to continue to move lower and assuming there is an implicit floor to further declines in yields, the potential upside from holding a long position is more limited than in the past. Furthermore, on the negative side, the diversification potential against equity market stress seems muted. In such a scenario, only a steepening of yield curves from current levels would provide non-negligible additional upside in a zero yield environment through yield carry and roll-down carry.

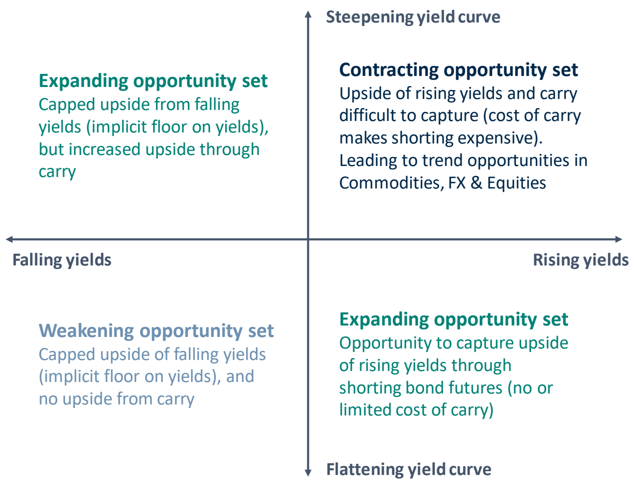

Figure 12: The opportunity set of bond futures under four yield curve and yield level scenarios.

On the other hand, if yields were to rise from current levels, investors would be facing two distinct scenarios with radically different outcomes. If yield curves remain flat, the carry from holding a bond future position remains null, which makes a short position a cheap and very attractive position to hold in a rising yield environment. However, if rising yields were to be accompanied by steepening yield curves, a short position would have to overcome carry costs to be profitable. Consequently, under such scenario, the opportunity set originating from a portfolio of bond futures would be muted and one should expect meaningful opportunities to arise from this yield environment in other asset classes such as commodities, FX or equities.

Conclusion

Bond futures were an important portfolio constituent of any trend-following CTA over the last 15 years, providing significant return contribution and important diversification benefits during equity market stress periods. We have shown in this analysis that the two main drivers of the strong bond futures returns were price appreciation, and, even more important, carry returns. While price appreciation was caused by the almost steady decline of yields since the beginning of the financial crisis in 2007, carry returns were a result of the positive slope of the yield term structure. A decomposition of bond futures returns over the past 15 years shows that more than half of the risk-adjusted returns of bond futures can be attributed to carry, which is a pure function of the shape of the yield curve and as such independent of the yield levels.

A regime-conditional return attribution analysis illustrates that the main driver for strong bond futures returns during equity market stress periods has been price appreciation rather than carry returns. The main return drivers during normal and bull market periods, however, have been carry returns. As global yield levels are at all-time lows and further downside potential is limited, this poses a natural question mark on the future diversification potential of bond futures in equity market stress periods.

On the other hand, the contraction of carry indicates improved return opportunities from entering short positions in bond futures, as the implied cost of carry for short positions are much more attractive. Should yields eventually start to increase from today’s low levels, and the cost of carry remain low, this could lead to an important return contribution from bond futures for trend-following CTAs.

To conclude, we are convinced that a systematic, diversified and risk-adjusted approach to trend-following is extremely well suited to cope with the changed environment of a low yield and low carry regime, and allows to quickly adapt to and benefit from any of the different scenarios that may unfold in the future.

Bond futures will continue to be an important portfolio constituent of any trend-following CTA portfolio, even though the superior return contribution and diversification benefit realized over the past 15 years is unlikely to persist for the next decade.

This further reconfirms the importance of a diversified approach to trend-following as the return potential from other asset classes such as equities, commodities and FX will again become more important in the future.

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