

QUANTICA'
QUARTERLY
Insights

A half-century of trend-following: How CTAs make money in different yield curve regimes

A long-term empirical analysis
of trend-following returns

#4 – 3 December 2020

Diversified trend-following relies on the premise that persistent trends can be captured in all types of markets and across all asset classes, independent of a specific market environment. This note focuses on analyzing and quantifying the opportunity set of profitable trends in bonds, equities, commodities and FX as a function of the term structure characteristics of US interest rates.

Using a generic trend-following model and relying on a representative investment universe covering close to 50 years of price history across bond, equity, commodity and currency markets, we quantify the opportunity set offered by each asset class under four different interest rate term structure scenarios. We show that while the bond future opportunity set for a trend-follower has been naturally reduced in an environment of rising yields, it was usually compensated by increased opportunities in other asset classes.

We further break down these results by the level of interest rate carry and highlight that a rising rate regime associated with a high level of carry is the most challenging environment from a trend-following perspective. This is partially explained by the fact that it has been more difficult to capture upward trends in bond yields since the 1990s, as these trends have been more whipsawed. In addition, a high carry corresponds to a premium and hence reduced profitability of holding short positions in bond futures, from which trend-followers would usually benefit in a rising rates scenario.

On the other hand, an environment of persistently *declining* yields may offer much stronger and at times exceptional trend opportunities in bonds, which are even more reinforced by a high carry. This was particularly the case in recent years, when bond markets contributed a large part of the positive trend-following returns. While this environment is unlikely to persist for much longer, the unusually low contribution from currencies and commodities could also come to an end. In the four decades between 1970 and 2000, three quarters of trend-following returns originated from asset classes other than fixed income.

The most striking result from our long-term analysis is that trend-following returns were consistently positive and surprisingly similar in all scenarios except the one mentioned above with rising rates and high carry. Our results confirm and highlight the importance of a diversified approach to trend-following across all main liquid asset classes in order to achieve the best possible long-term risk-adjusted returns.

Introduction

In our last Quarterly Insights (Quantica Capital, September 2020)¹, we took a deep dive into understanding the return opportunities provided by government bond futures for trend-following CTAs in a world of zero yields and flat yield curves. We outlined the reasons why we believe the return and diversification opportunities offered by bond futures throughout the last decade are unlikely to repeat in the near future. Additionally, we have identified four future yield curve scenarios depending on the direction of two key variables: (i) the level of yields and (ii) the slope of the yield curve. Each variable is likely to be associated with an expanding or a contracting opportunity set.



Figure 1: Return & diversification opportunities offered by government bond futures as a function of yield level change and yield curve slope.

Source: Quantica Capital Quarterly Insights, September 2020.¹

In this report, we empirically analyze and quantify the risk-return and diversification characteristics of trend-following returns under each of the four term-structure scenarios, using close to 50 years of available futures price history. More specifically, we also put an emphasis on the return attribution across all asset classes to show how the opportunity set provided by the four asset classes – bonds, equities, FX and commodities – have evolved *relative* to each other over time.

For that purpose, we first introduce a representative investment universe, a generic trend-following strategy and realistic trading cost assumptions. We then define regimes of falling and rising rates and regimes of high and low bond carry, to create the four yield curve scenarios illustrated in Figure 1. For the sake of simplicity, we base our analysis solely on the yield and carry of the 10-year US Treasury Note Future, and do not consider any other maturities or issuing countries.

We then discuss the regime-conditional return attribution of our generic trend-following model and show that a reduced opportunity set for bond futures has usually translated into increased return opportunities in all three other asset classes. We conclude that a diversified approach to trend-following is essential to achieve optimal long-term risk-adjusted returns, and that opportunities for diversified trend-followers prevail even in a weakening opportunity set for bond markets.

A representative diversified trend-following investment universe since 1973

To cover a representative sample of all four yield curve scenarios we go back as far as 1973. The 1970's are of particular relevance as this decade had been characterized by extended periods of rising interest rates. In fact, the 10-year US Treasury rate increased from about 6% to 16% between 1970 and 1981. We choose 1973 as a starting point of our analysis, as it is difficult to construct a diversified universe of representative markets before. Neither FX as an asset class, nor e.g. Gold existed as a liquid market before. Following the Bretton Woods agreement of 1944, currencies were pegged to the US Dollar, which in turn was pegged to Gold until 1973. Furthermore, most financial futures started trading during the late 80's and early 90's only.

In order to construct a representative and diversified set of futures returns going back to 1973, we backfill synthetic futures return time series, using equivalent cash instruments and funding rates as far back as such

proxy time series are available. This backfilling approach allows for the creation of a representative universe of 30 instruments across all four asset classes with consistent daily return data since 1973.

For the sake of clarity, the investment universe is held constant over two consecutive time periods:

- 30 instruments from 1973 to 1992
- 64 instruments from 1993 to 2020

A detailed overview of all universe constituents and the historical split between exchange-traded futures prices and backfilled prices can be found in Figure 9 at the end of this note.

Introducing a generic trend-following strategy

In our April 2020 Quarterly Insights (Quantica Capital, April 2020)² we have introduced a fully systematic generic trend-following strategy, and we use the same strategy for this empirical analysis. To recall, the strategy captures trends with exponentially weighted averages of risk-adjusted past returns in conjunction with a bottom-up portfolio construction using a continuous, increasing and bounded risk-allocation function. A further implementation layer aims at minimizing the number of transactions and hence trading costs. The strategy is targeting an annualized volatility of 12%.

For benchmarking purposes, we also compare trend-following returns with a generic risk parity approach applied on the same underlying investment universe. This type of a long-only strategy weighs every universe constituent and each of the four asset classes by an equal annualized volatility target. Individual portfolio constituents are scaled to meet a portfolio volatility target of 12% p.a.

Introducing realistic trading costs

All returns in this note are reported as excess returns, not taking into account any risk-free interest earned on top of the futures return. In addition, strategy returns are reported net of trading costs, including conservative estimates of market impact and commissions. To account for the fact that such trading costs were much higher in the past, we double them for the period from 1993 to 2004, and multiply them by six for the years between 1973 and 1992. We hereby follow the approach of Hurst et al. (2017)³. An overview of the trading cost assumptions over time can be found in Table 1.

Period / Asset Class	Equities	Fixed Income	Currencies	Commodities
1973-1992	34	6	18	58
1993-2004	11	2	6	19
2005-now	6	1	3	10

Table 1: One-way transaction costs in bps of notional traded.

Source: Hurst, B., Ooi, Y., Pedersen, L., *A century of evidence on trend-following investing. Journal of Portfolio Management* 44, 15-29, 2017.³

Trend-following characteristics in rising and falling rates regimes

We define periods of declining or increasing yield levels by calculating non-overlapping quarterly yield changes of the generic “on-the-run” 10-year US Treasury Note. A negative yield change identifies a period of declining yields while a positive change classifies a period of rising rates.

Figure 2 provides an illustration of these two regimes over time, including the historical yield of the 10-year US Treasury Note (UST). Based on our regime classification metric, rising rate periods have also occurred quite regularly in recent years, with the last longer period dating back to 2018.

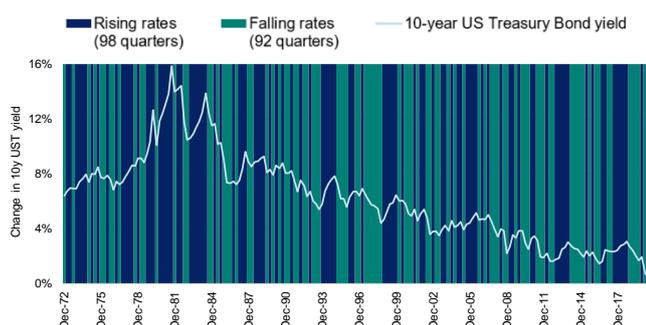


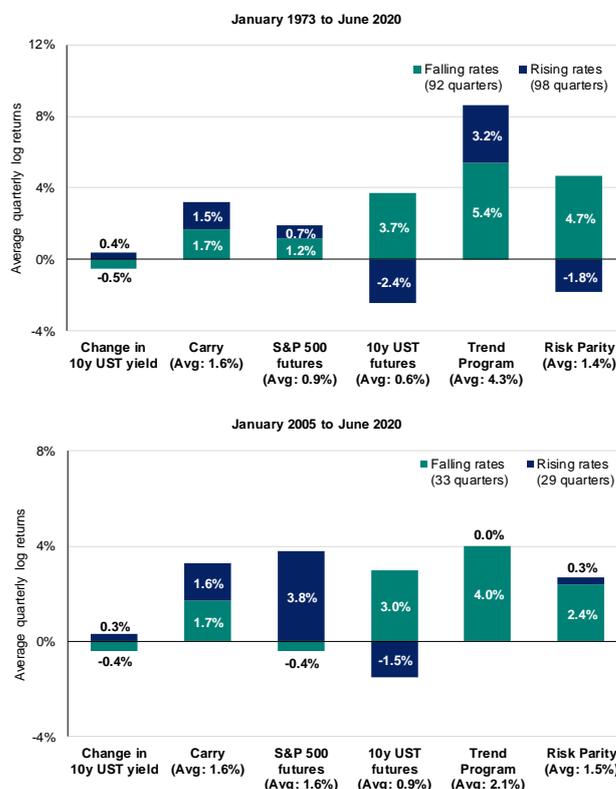
Figure 2: 10-year US Treasury Note yield and corresponding regimes of rising and declining rates.

The key statistical characteristics corresponding to each regime are given in Figures 3a and 3b. This and all subsequent tables and charts provide the statistics for the full long-term period from 1973 to 2020, and additionally for the more recent period of 2005 to 2020.

Between 1973 and 2020 – a period including a total of 190 quarters – the 10-year US bond yield has increased in 52% of all quarters (rise by an average of +40bps) and declined in the remaining 48% (decline by an average of -50bps).

It is to be noted that before 2005 the S&P 500 Index future performed better in quarters of falling yields, returning an average 1.2%, compared to 0.7% in quarters of rising yields. That pattern has been inverted for the last 15 years, with the equity benchmark gaining

on average 3.8% in rising rates quarters versus losing on average -0.4% in falling rates quarters. This points to a significant regime change in the correlation structure and diversification characteristics between equities and bonds, possibly triggered by central bank monetary policy measures implemented since 2007 in response to the great financial crisis.



Figures 3a and 3b: Key statistical characteristics of falling and rising rate regimes. Regimes and statistics are calculated and reported on a quarterly basis and for two time periods: 1973-2020 and 2005-2020. A quarter belongs to the falling (rising) rate regime if the generic 10-year UST yield finishes the quarter below (above) its previous quarter level.

Results for the risk parity approach were more consistent through both periods under consideration: Returns have been significantly higher in periods with falling rates, even more pronounced over the long-term 50 years period. This might lead to the conclusion that the long-only risk parity approach is strongly dependent on falling rates, as the long-term realized return spread between the two scenarios has been highly significant over the past 50 years.

We demonstrate in the next section that this is not the case for trend-following returns: The directional, dynamic and adaptive nature of the trend-following investment process allows opportunistic short positions in all markets in response to falling market prices.

Trend-following returns are driven by efficiently capturing complementary trends in asset classes other than bonds

Since 1973, a generic trend-following strategy has delivered gains in both rate environments, i.e. 5.4% on average in quarters with falling yields and 3.2% on average in quarters with rising yields. In more recent years, however, the return generated in quarters of rising rates has been subdued.

To further elaborate on this, we show in Tables 2a and 2b the average notional asset class exposures of the generic trend-following strategy in each of the two regimes.

Jan 73 - Jun 20	Average exposures			
	Equities	Fixed Income	Currencies	Commodities
Falling rates	26.1%	121.1%	31.8%	-5.1%
Rising rates	32.7%	1.4%	-1.8%	2.1%
Total	29.5%	59.4%	14.5%	-1.4%

Jan 05 - Jun 20	Average exposures			
	Equities	Fixed Income	Currencies	Commodities
Falling rates	30.0%	192.2%	1.1%	-3.0%
Rising rates	64.0%	35.8%	11.3%	-0.9%
Total	45.9%	119.1%	5.9%	-2.0%

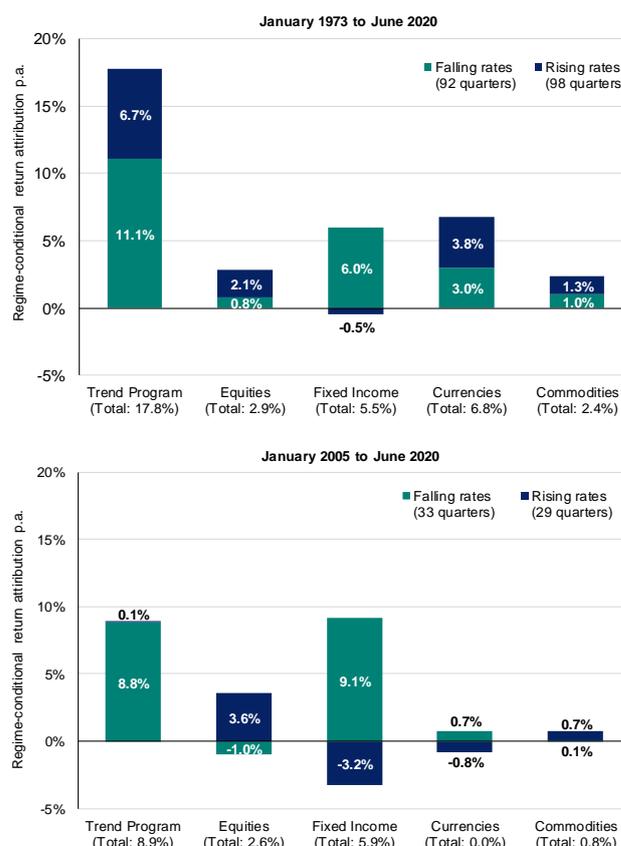
Tables 2a and 2b: Average notional exposures of a generic trend-following strategy in falling and rising rate regimes. Fixed income exposures are stated as 10-year duration equivalents.

Interestingly, the average trend-following net exposure in fixed income futures in a rising rates environment has increased to +36% lately, compared to a long-term average of only +1.4%. This is likely the consequence of less persistent upward trends in rates in recent years, which prevented building up meaningful short positions in bond futures and adversely affected the profitability of the fixed income book in a trend-following portfolio in those periods.

All these observations imply that trend-following gains in a rising rate regime are primarily driven by efficiently capturing complementary trends across and within other asset classes, rather than by efficiently capturing upward trends in bond future prices.

Figures 4a and 4b corroborate this hypothesis by breaking down the regime-conditional trend-following returns by asset classes between 1973 to 2020 and 2005 to 2020. In periods of falling rates since 1973, bonds have been the biggest contributor to overall trend-following returns with an annual return contribution of 6.0% compared to 0.8%, 1.0% and 3.0% for equities, commodities and FX respectively.

Inversely, in periods of rising rates since 1973, the fixed income book has had a small negative contribution of on average -0.5%. However, this has been largely compensated by attractive returns from each of the three other asset classes (annualized return contributions of 2.1% for equities, 1.3% for commodities and 3.8% for currencies). When looking at the years since 2005, the same pattern is still observable, with an increased negative contribution from fixed income – likely due to more whipsawed upward trends in yields – and a positive contribution from equities (3.6% p.a.) and commodities (0.7% p.a.), but a negative contribution of -0.8% from currencies.



Figures 4a and 4b: Annualized regime-conditional return attribution of a generic trend-following strategy with target annualized volatility of 12% by two distinct rate regimes and four asset classes for two time periods: 1973-2020 and 2005-2020.

To summarize, it seems more difficult to capitalize on profitable upward trends in interest rates than on downward trends. By just looking at the numbers for the most recent period from 2005 to 2020, one might be tempted to conclude that trend-following returns depend heavily on a falling rates scenario. However, this is not confirmed in a longer-term context, where all asset classes, with the exception of bonds, have delivered significantly positive returns in a rising rates scenario.

Indeed, the upside in a rising rate environment does not originate from shorting bonds, but from capturing profitable trends in other asset classes.

The trend-following returns for equities, FX and commodities were positive and even higher in periods of rising rates than in those of falling rates. This holds true in both periods under consideration on an aggregated basis.

In the subsequent section, we further refine our findings by introducing interest rate carry as an additional dimension to our analysis.

Classification of different yield curve regimes

The second relevant variable to consider when evaluating return opportunities offered by bond futures is the level of carry to be earned from holding a long position in bond futures. We discussed the importance of interest rate carry for bond futures returns in much detail in our previous publication.

For this note, we measure bond carry by the difference between the generic “on-the-run” 10-year US Treasury yield and the 3-month US T-Bill rate. Again, for the sake of simplicity, we use the carry of the 10-year US Treasury Note as the only explanatory variable for our study and ignore any other maturities and regions. Regimes of high and low bond carry are defined based on the variable being above or below its historical median over the full period from 1973 to 2020, respectively. Unlike the yield variable, the carry variable is hence categorized based on an ‘in-sample’ methodology.

As a result of the definition of the four different regimes, the sample frequency accounts for about 25% for each of the four different regimes, and this holds true for both the longer period (1973-2020) and the more recent period 2005-2020.

Figure 5 provides a visual overview of the historical occurrences of each of the four regimes. Our classification depicts the regime change from low carry to high carry in 2008, which came to an end in 2015 and has remained in a low carry period over the last five years.

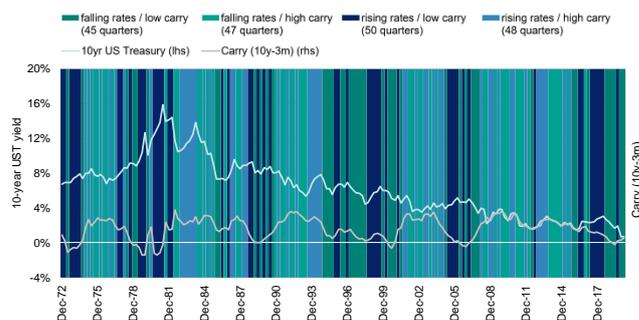
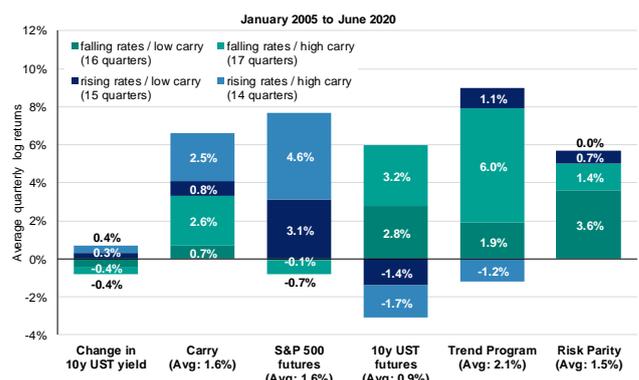
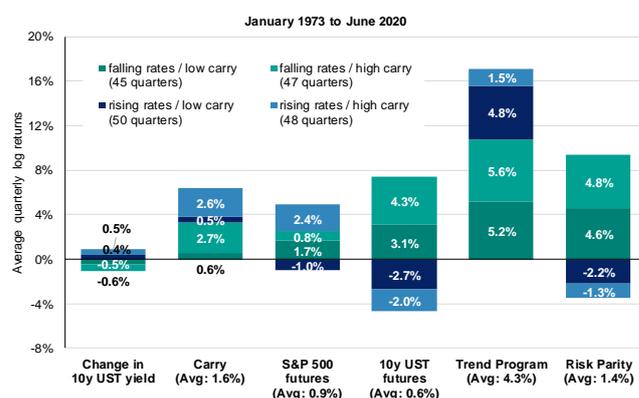


Figure 5: 10-year US Treasury Note yield and bond carry returns with corresponding four interest rate regimes from 1973 to 2020.

Each regime is composed of at least 45 quarterly observations since 1973, a meaningful sample size to evaluate the long-term risk/return characteristics under each regime. For the last 15 years, there are at least 14 quarterly observations in each regime, which – if on the lower end – still give a glimpse into the more recent return dynamics. Please refer to Figures 6a and 6b below for a comprehensive analysis.



Figures 6a and 6b: Key statistical characteristics of four interest rate regimes, classified as a function of quarterly yield changes and the level of carry. Regimes and statistics are calculated and reported on a quarterly basis and for two time periods: 1973-2020 and 2005-2020.

For equity markets, an environment of rising yields and low carry (i.e. flat yield curve) used to be the worst environment in the decades before 2005. The S&P 500 future posted an impressive average quarterly loss of -2.8% between 1973 and 2004 (not reported in Figure

6). Interestingly, this environment has become most profitable for equities over the last 15 years, as the S&P 500 future has recorded an average 3.1% return in such quarters since 2005. An environment of rising yields but with steep yield curves (i.e. high carry) has consistently offered the most attractive return opportunities for equities throughout time, with the S&P 500 future returning 2.4% on average in such quarters since 1973 and even 4.6% since 2005.

For the generic risk parity strategy, the above-mentioned change in correlation structure between equity and bond markets explains why the last 15 years provided an almost perfect scenario for such strategy, while the long-term view shows a different picture. The generic risk parity strategy posted an average quarterly loss of -2.2% in a rising rate with low carry environment over the long-term. It should hence not be considered a reliable diversifier against adverse scenarios for bonds.

Long-term trend-following returns have been positive in all four term structure regimes

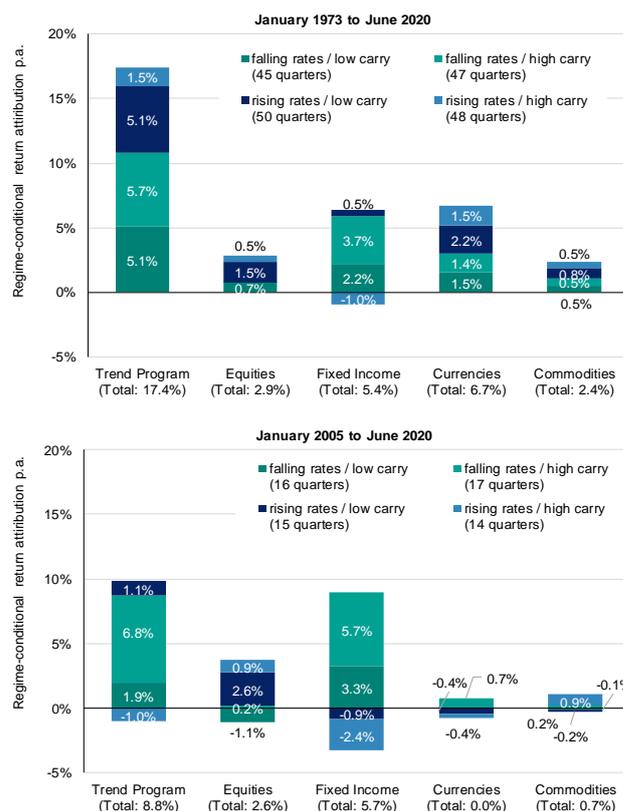
The first and most remarkable result of our long-term empirical trend-following study going back almost 50 years is the following: Analyzing the last 190 non-overlapping quarters shows that our generic trend-following strategy produced positive average returns in all four term structure regimes. Trend-following strategies have hence provided highly beneficial smart diversification against different interest rates scenarios.

More specifically, three out of the four regimes appear to offer almost equally attractive expected trend-following return opportunities. Only one regime has displayed weaker risk-adjusted return characteristics, which is when rates are rising in combination with a high carry (i.e. a steep term structure). In such regime, the average return of 1.5% per quarter has been significantly lower than in each of the three other regimes. Since 2005, the return in such scenario has even turned negative (posting an average -1.2% per quarter), confirming that a combination of rising rates and a steep yield curve appears to be the least attractive rate environment for a trend-follower. However, the long-term view demonstrates that trend-following can still offer a positive expected return in this most adverse scenario from a yield curve perspective.

Finally, the combination of falling rates and high carries has been a beneficial environment for bond futures for a good part of the last 15 years. This explains why this regime has accounted for a majority (6% per quarter on

average) of trend-following returns since 2005. This is the main difference to the longer-term observations, where return contributions from the four regimes are more evenly distributed than over the shorter 15 years period.

In order to refine our understanding of the diversification benefits offered by each asset class under each regime, we further break down the regime-conditional trend-following returns by individual asset class as shown in Figures 7a and 7b.



Figures 7a and 7b: Annualized regime-conditional return attribution of a generic trend-following strategy with target annualized volatility of 12% by four distinct rate regimes and different asset classes for two time periods: 1973-2020 and 2005-2020.

Fixed income return contribution to trend-following in different yield curve regimes

The opportunities offered by bond futures in a trend-following context are highly sensitive to the type of prevailing interest rate regime and in line with our initial conjectures as summarized in Figure 1 – and this hierarchy of opportunities has not changed over time. Indeed, rising rates with high carries are the worst for trend-following in bonds alone, resulting in a negative return contribution of -1% in such periods since 1973, and -2.4% more recently since 2005. The economic cost or risk premium of shorting bonds to capture uptrends in rates is directly linked to the level of carry. In fact, the carry earned from a long bond position

needs to be paid on the short side. In a high carry environment, the upside of a short position is often not enough to compensate the high carry costs associated with a short position. As demonstrated in our analysis, capturing the upside from a rising yield trend appears to be profitable only in a low carry environment. This finding is strongly confirmed by our empirical results: While trend-following on bonds alone delivered a positive average return contribution of 0.5% since 1973, the average attribution in periods with rising rates and high carry for the same period was -1.0%.

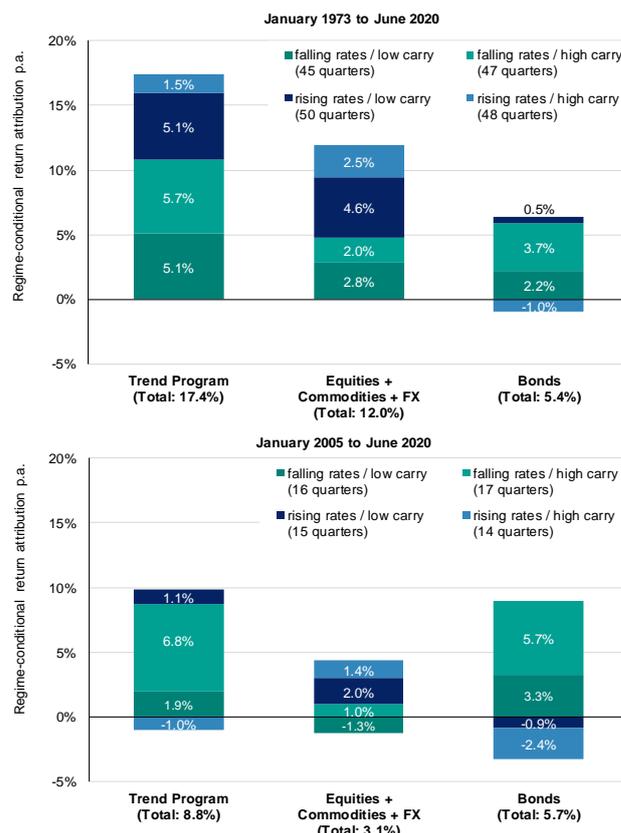
A falling interest rate regime associated with a high carry has always provided the greatest opportunity for a fixed income risk allocation in a trend-following portfolio, and this observation has been exacerbated in the post-GFC years until 2016. Trading the trend of falling yields allowed to benefit from both the price appreciation due to falling yields and earning the high yield and roll-down carries.

Finally, the regime of falling yield and low carry is comparable to the falling yield and high carry regime, except that the return earned from carry (and in particular the roll-down carry) is significantly reduced. This corresponds to 2019, a year in which most of the return contribution from bonds was achieved through declining levels of yields, and not carry.

Long-term asset class diversification benefits

As outlined previously, periods of rising rates tend to coincide with profitable trend patterns in the three other asset classes. Their positive return contribution and combined diversification benefit lead to positive overall trend-following returns in all four different yield curve regimes under consideration. This highlights the importance of running a diversified approach to trend-following.

Figures 8a and 8b provide the same type of return attribution as Figures 7, but they combine equities, commodities and FX contributions into one single group. They highlight the fact that the four asset classes appear to complement each other and reduce the dependency of trend-following on macro-economic cycles and regimes. Indeed, if fixed income has been accounting for two-thirds of generic trend-following returns since 2005, the long-term view shows a much more balanced result with the three other asset classes generating approximately three quarters of total trend-following returns.



Figures 8a and 8b: Annualized regime-conditional return attribution of a generic trend-following strategy with target annualized volatility of 12% by four distinct rate regimes and different asset classes for two time periods: 1973-2020 and 2005-2020.

More specifically, the yield curve scenarios that have been most challenging for bond futures (and trend-following in bond futures) have been the most rewarding periods for the other asset classes in aggregate. While the average trend-following attribution in fixed income in a rising rate and high carry environment has delivered a negative -1.0% contribution over the last 50 years, the attribution of all other asset classes was +2.5% and has more than compensated the losses. Even more striking, in periods with rising rates and low carry, when fixed income delivered a small +0.5% since 1973 (and a loss of -0.9% since 2005), the other asset classes performed exceptionally well and posted a +4.6% contribution (+2.0% since 2005).

We conclude that when the opportunity set in bond futures has been contracting (expanding) or has been below (above) its historical average, the opportunities offered by each of the three other assets classes have been expanding (contracting) and have been above (below) their historical average. This highlights again the importance of asset class diversification in a trend-following context, if one assumes that timing asset classes in a trend-following context is most challenging.

Conclusion

Systematic trend-following is based on the assumption that persistent trends are recurring events in all types of financial market environments and across all asset classes. It is assumed that such trends can be efficiently captured in a systematic manner to generate attractive long-term returns independent of the profitability of traditional asset classes such as stocks and bonds.

If history provides any guidance, it is notoriously difficult to time and identify trends. Typically, the most profitable trend-following positions are initially confronted with a high degree of investor skepticism, as they are usually built up against the prevailing market sentiment. Because it is so difficult to predict the occurrence of the next major trend, a systematic and diversified approach to trend-following across multiple asset classes and instruments maximizes the likelihood of successfully capturing trends whenever they occur. Trends rarely occur simultaneously in different asset classes over an extended period of time, and a declining trend opportunity in one group of markets typically leads to new trend opportunities in other asset classes.

We argue that this is no different in today's extremely challenging environment for fixed income markets. Since the great financial crisis, falling interest rates coupled with high carry (and lower carry in recent years) have provided trend-followers with one of the most prolific periods for bond futures in history, albeit against general market sentiment for many years now. Therefore, it should come as no surprise that the consistently high exposure to bond futures on the long side has been the main performance driver for diversified trend-followers over the past 15 years. On the other hand, the contributions of equities, currencies and commodities to trend-following returns have been below their historical long-term averages over the same period. However, as yields have finally reached an implicit floor and carries have reached historical lows, it is unlikely that this exceptional period will last much longer.

We dedicated this note to putting the current difficult environment for fixed income securities into a historical perspective for trend-following strategies. Using data from almost 50 years and the resulting back-test returns of a generic medium- to long-term trend-following strategy, we have reported trend-following returns and yield attributions conditioned on four different scenarios for the level and shape of the yield curve.

We have shown that when bond futures are in a low-opportunity regime from a trend-following perspective, the trend opportunities offered by each of the three other major asset classes were at least equal to or higher than their historical average.

In fact, historical trend-following returns were positive on average in all four different yield curve scenarios, and only the rising rates / high carry regime has led to below average trend-following returns in the long run. We have shown that when the trend-following opportunities in bond futures contracted (expanded), the opportunities offered by each of the three other asset classes expanded (contracted).

If the current medium-term outlook for the yield curve environment suggests an increase in interest rates within a still low carry environment, our long-term results indicate that the opportunities for trend-following remain ample and healthy. In fact, our empirical results in such a scenario suggest that the expectation of below-average performance contribution from bond futures is more than offset by above-average contributions from equities, currencies and commodities.

If 50 years of history provide any guidance for the future, then a systematic, diversified and risk-adjusted approach to trend-following will continue to benefit from sustained trends and will offer attractive risk-adjusted returns regardless of a particular yield curve scenario.

Appendix

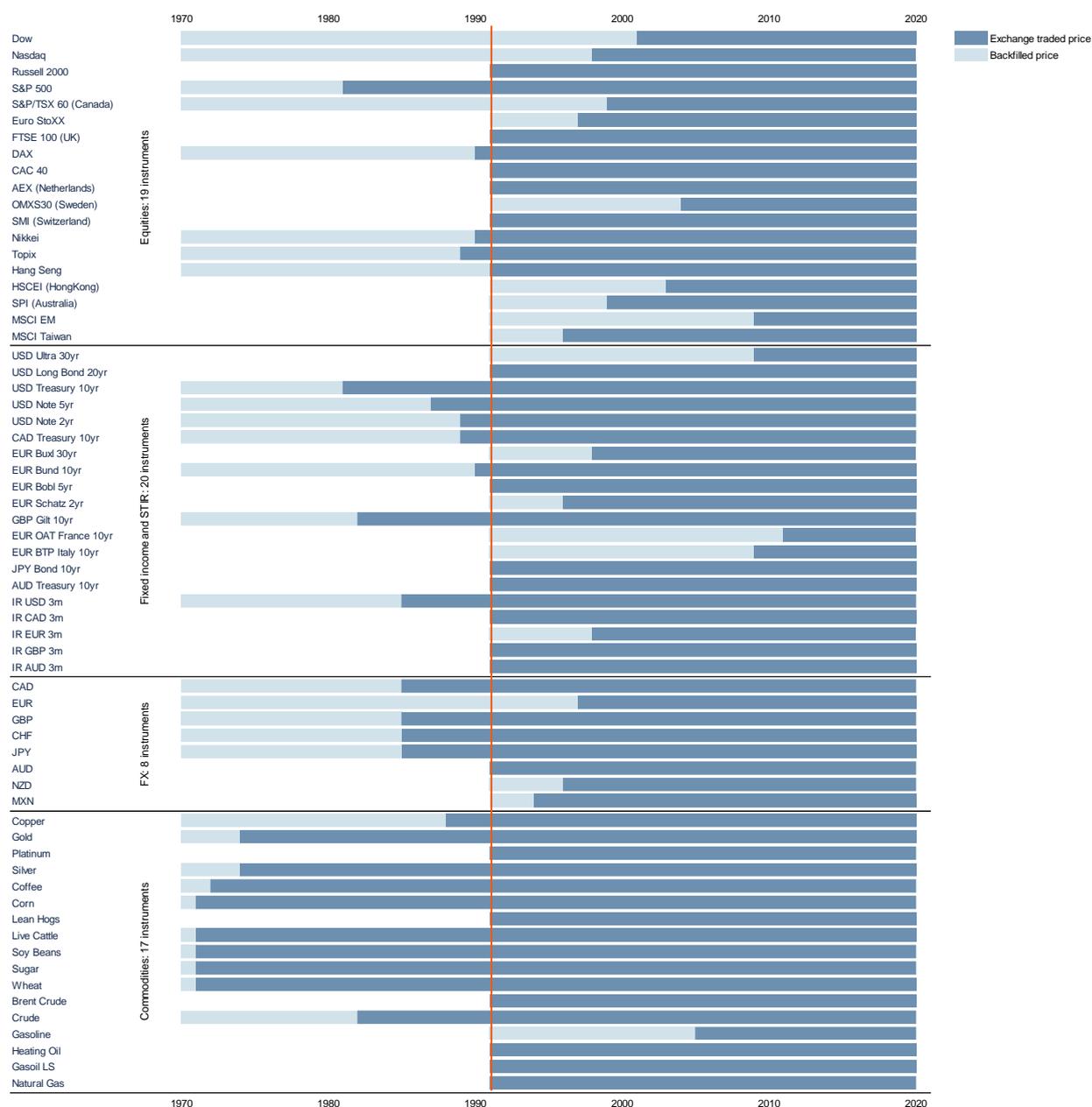


Figure 9. Investment universe by market, time period and data source. The investment universe is held constant over two consecutive time periods (30 instruments from 1973 to 1992, 64 instruments from 1993 to 2020). The dark blue color highlights periods for which an exchange-traded future price was available. The light blue color indicates periods for which an exchange-traded price was not available and has been backfilled by Quantica using equivalent cash instruments and funding rates as far back as such proxy time series are available for the backfilled period.

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- ² Quantica Capital, "Crisis liquidity", *Quantica Quarterly Insights*, April 2020
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To the benefit of our investors and all our stakeholders.

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