Trend Following and Rising Rates

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We examine the performance of a hypothetical trend following strategy over the past 70 years, paying particular attention to periods where short-term policy rates or long-term interest rates rose. We find that the strategy's return characteristics and attractive diversification properties, particularly its tendency to perform well in protracted equity drawdowns, are not diminished during historical rising rate environments, and that the result is consistent across geographies. We also show that the strategy's historical performance has shown little dependence on the level of starting nominal bond yields, as it has the potential to perform well in both high and low interest rate regimes.

We thank Lasse H. Pedersen and Ari Levine for their insights in formulating this analysis.

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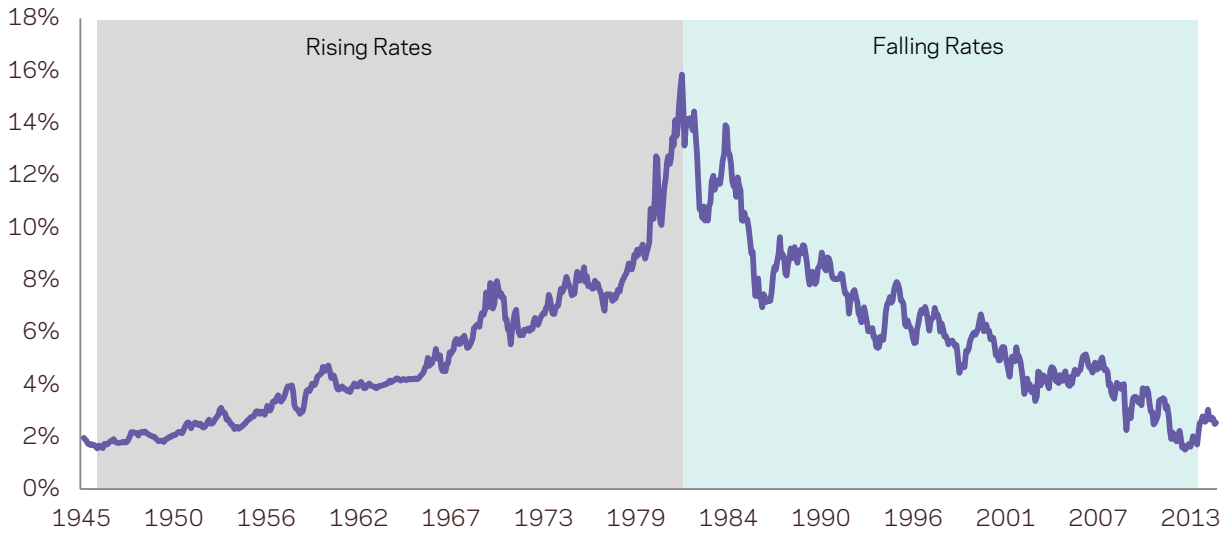
Exhibit 1 — History of U.S. 10 Year Government Bond Yields



Source: AQR. Analysis is for the time period November 1945–April 2013. The above analysis is using the U.S. 10-Year Treasury Yields as a proxy for "yields". Past performance is not a guarantee of future performance.

Introduction

Trend followers, formally known as Commodity Trading Advisors, or CTAs, have benefited from a sustained decline in global interest rates over the past few decades. Over this period, CTAs have generally been positioned long in fixed income markets and generated substantial profits from the persistent positive performance of these markets. Additionally, fixed income markets have tended to do well in large equity drawdowns during this time, helping CTAs generate diversifying returns during equity bear markets. Given the current low yields in global bond markets and the possibility of a rising rate environment going forward, two questions regarding trend-following strategies are often asked. First, can trend followers benefit from the uncertain impacts of rising yields on asset class returns? Second, if trend followers get short fixed income, will the strategy maintain its diversification properties?

We attempt to address these questions by examining the performance of a hypothetical simple trend-following strategy[1] during a historical period of secularly rising rates. History demonstrates that trend followers would not have required declining rates to generate meaningful returns, and the strategy's attractive portfolio diversification properties would not be diminished during rising rate regimes. We value the insights we glean from the historical data as they provide an enhanced understanding of the strategy and its attributes. As we'll soon see, rising interest rates can create exploitable trends in fixed income assets and benefit the strategy. Similarly, the ability of a trend follower to go both long and short helps the strategy maintain its diversification properties with respect to drawdowns in the asset classes it trades, (e.g., equities).

[1] Our simple trend-following strategy is an equal weighted combination of 1-month, 3-month and 12-month time series momentum strategies for 67 markets across commodities, equity indices, bond markets and currency pairs. Prior to the availability of futures data, we rely on cash index returns financed at local short rates. The positions across the three strategies are aggregated each month, and scaled such that the combined portfolio has an annualized ex-ante volatility target of 10%. The returns are net of estimated transactions costs. See Hurst, Ooi and Pedersen, "A Century of Evidence on Trend-Following Investing" (2014) and the end of this document for important details on this analysis.

Exhibit 2 — Hypothetical Performance of Time Series Momentum: Rising Rates vs. Falling Rates

Time Period	Change in 10-Year Bond Yields (bps)	Net of 2/20 Fee Returns (Annualized)	Realized Volatility (Annualized)	Sharpe Ratio	U.S. Equity Market Correlation	U.S. 10-Year Bond Correlation
By Subperiod						
Rising Rates: 1945-1981	**+1429 bps**	15.4%	10.2%	1.12	-0.02	-0.29
Falling Rates: 1981-2013	**-1414 bps**	11.7%	9.2%	0.79	-0.07	0.18
Full Sample	**+15 bps**	13.7%	9.7%	0.97	-0.04	-0.06
By Decade:						
Nov 1945-Dec 1949	**+25 bps**	9.0%	12.4%	0.66	0.18	0.14
Jan 1950-Dec 1959	**+289 bps**	15.1%	9.0%	1.45	0.23	-0.19
Jan 1960-Dec 1969	**+319 bps**	10.0%	10.9%	0.56	-0.09	-0.37
Jan 1970-Dec 1979	**+245 bps**	21.3%	9.0%	1.70	-0.24	-0.24
Jan 1980-Dec 1989	**-240 bps**	17.8%	9.5%	0.96	0.18	-0.15
Jan 1990-Dec 1999	**-148 bps**	13.2%	8.5%	0.98	0.01	0.20
Jan 2000-Dec 2009	**-260 bps**	9.0%	10.4%	0.61	-0.34	0.27
Jan 2010-Apr 2013	**-215 bps**	6.2%	7.7%	0.80	-0.18	0.16

Source: AQR. The Full sample time period is from November 1945-April 2013. The above analysis is using the U.S. 10-Year Treasury Yields. The Hypothetical Trend-Following Strategy performance is a backtest net of 2/20 fees and estimated transaction costs. Markets considered only where data existed during the time period. Please read performance disclosures at the end of this document for a description of the investment universe and the allocation methodology used to construct the Trend-Following Strategy and for details on the construction of the U.S. Equity series. Hypothetical performance results have inherent limitations, some of which are disclosed at the end of this document. Past performance is not a guarantee of future performance.

Trend Following in a Rising Rate Regime

We start by looking at the long-term history of U.S.[2] 10-year government bond yields from 1945 through 2013 in Exhibit 1.

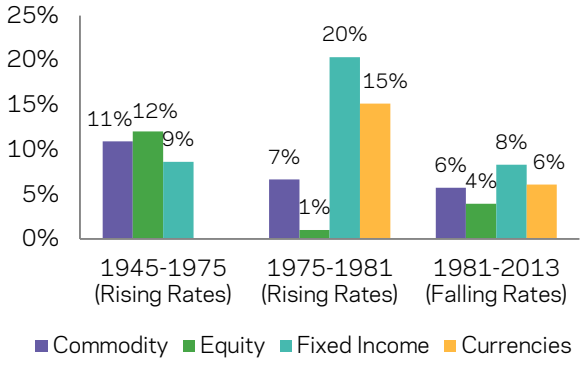
We chose this time period because it represents a full round trip on U.S. 10-year Treasury yields, starting at a secular low of 1.6% in 1945, peaking at 15.8% in 1981 and declining roughly back to our starting point prior to the "taper tantrum" in 2013. In Exhibit 2, we further divide this time period to understand the performance and diversification benefits of the simple trend-following strategy during the periods of rising rates, falling rates and in each decade over the entire period.

The results show that the simulated simple trend-following strategy realized a higher average annualized return and Sharpe ratio over the period of secularly rising rates than during the period of declining rates, which might seem surprising. Importantly, the strategy also maintained attractive portfolio diversification properties as measured by the correlations to broader U.S. equity and bond markets in both periods. The strategy exhibited negative correlation to U.S. bond markets during the period of rising rates, while importantly maintaining a low (slightly negative) correlation to equity markets over the same period.

Digging deeper, we examine the performance of a hypothetical trend-following strategy in each asset class separately during the rising and falling rate periods to compare return characteristics. The standalone asset class portfolios each target a 10% annualized volatility and are net of estimated transactions costs and gross of fees. We split the rising rate period into pre- and post-1975,

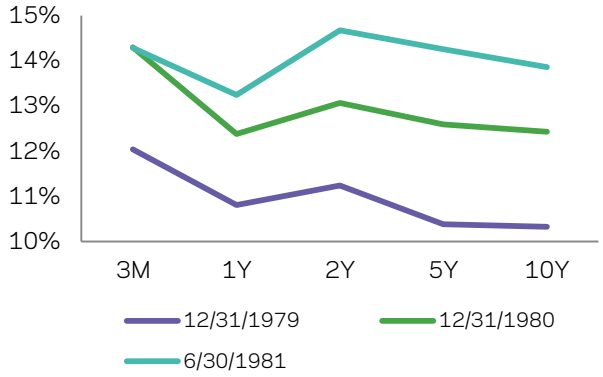
[2] The Appendix analyzes the interest rate regimes of other countries, such as Australia, Canada, Germany, Japan and the U.K., as well.

Exhibit 3 — Hypothetical Trend Following Average Annualized Excess Returns by Asset Class



Source: AQR. Data above is from November 1945 through April 2013. Hypothetical annual gross of fees, excess of cash performance for each of the four primary asset classes in the Hypothetical Trend-Following Strategy. Hypothetical performance results have inherent limitations, some of which are disclosed at the end of this document. Past performance is not a guarantee of future performance.

Exhibit 4 — U.S. Government Yield Curves 1979 to 1981



Source: AQR. The above analysis is using the U.S. 10-Year Treasury Yields as a proxy for "yields." Past performance is not a guarantee of future performance.

as this is when we begin to have comprehensive currency market returns.

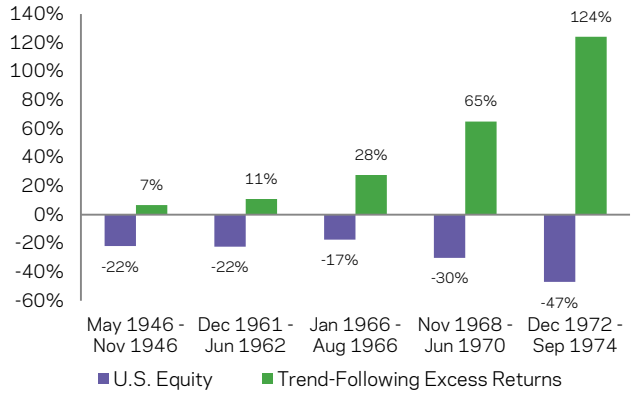
During the rising rate period, fixed income trend following performed positively, as seen in Exhibit 3. The strong positive performance in the 1975 to 1981 period is particularly noteworthy as yields rose over 800 basis points in a six-year period. Most of this rise came between 1979 and 1981, when Paul Volcker served as Chairman of the Federal Reserve and aggressively hiked interest rates to lower the rate of inflation. Over the rising-rate period, trend following was positioned short fixed income approximately 50% of the time, and was short almost entirely from 1979 to 1981. We also note, as seen in Exhibit 4, that during the 1979 to 1981 period, the U.S. yield curve was inverted for a meaningful amount of time. Hence, shorting bond futures during this period may have generated positive carry and roll yield relative to other periods when carry and roll yield could have been a headwind to shorting.

In the falling-rate period, we see trend following in fixed income outperforming other asset classes. During this period, the hypothetical simple trend-following strategy was generally long fixed income approximately 72% of the time, capturing the broad secular decline in global interest rates. The general conclusion we glean from this data is that trend following in fixed income has the ability to generate strong outcomes in both rising- and falling-rate periods.

Diversification Properties in Rising Rate Environments

What about the diversification benefits of trend following during a rising rate period? We specifically look at how the hypothetical simple trend following strategy performed during the five largest equity market drawdowns over the 1945 to 1981 period to determine whether trend following had the ability to protect equity sensitive portfolios. As Exhibit 5 shows, the strategy performed well during these equity market drawdowns, and would have likely protected investors' capital.

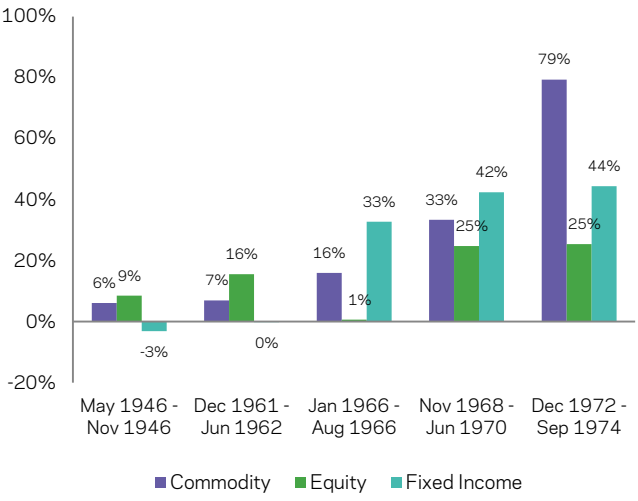
Exhibit 5 — Rising Rates and Equity Drawdowns: Hypothetical Trend Following Total Excess Returns During Equity Market Drawdowns



Source: AQR. Analysis is for the time period November 1945–September 1981. The Hypothetical Trend-Following Strategy performance is a backtest net of 2/20 fees and estimated transaction costs. Please read performance disclosures at the end of this document for a description of the investment universe and the allocation methodology used to construct the Trend-Following Strategy and U.S. Equity series. Markets considered only where data existed during the time period. Hypothetical performance results have inherent limitations, some of which are disclosed at the end of this document. Index performance does not include fees and expenses. Past performance is not a guarantee of future performance.

Exhibit 6 analyzes each drawdown to better understand how trend following in different asset classes performed. Importantly, equity trend following saw positive returns in each, indicating that the diversification properties of trend following has the ability to come from short positions in equity markets, and not only from long positions in fixed income. In fact, during these historical equity market drawdowns, the average excess return of the U.S. 10 year government bond was also negative (approximately -3.2%), with trend following in fixed income generally benefiting as well.

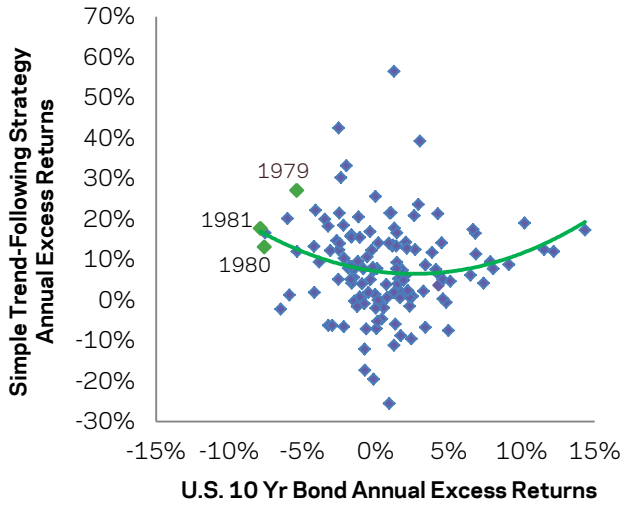
Exhibit 6 — Rising Rates and Equity Drawdowns: Asset Class Hypothetical Trend Following Excess Returns



Source: AQR. Analysis is for the time period November 1945 –September 1981. Hypothetical annual gross excess of cash performance for each of the four primary asset classes in the hypothetical Trend-Following Strategy. Markets considered only where data existed during the time period. Hypothetical performance results have inherent limitations, some of which are disclosed at the end of this document. Past performance is not a guarantee of future performance.

One key reason for the preceding results is related to the way trend-following strategies are designed. Historically, the majority of large bull and bear markets have tended to occur gradually, over a period of months or years, rather than overnight. As a result, the performance of trend following strategies has tended to be stronger during large market moves, regardless of whether markets have risen or fallen. This tendency can be seen in the classic "smile" graph, which is usually shown relative to equity market returns, as equity risk often dominates investors' portfolios. The "smile" is actually also relevant across other asset classes. In Exhibit 7, we show the annual returns of the hypothetical trend-following strategy relative to the annual excess returns of the U.S. 10 Year government bond, and highlight the 1979 to 1981 years (in green).

Exhibit 7 — Hypothetical Trend Following Excess Returns (1880 to 2014)



Source: AQR. The Hypothetical Trend-Following Strategy performance is a backtest, net of 2/20 fees, estimated transaction costs and cash. Please read performance disclosures at the end of this document for a description of the investment universe and the allocation methodology used to construct the Trend-Following Strategy. Markets considered only where data existed during the time period. Hypothetical data has inherent limitations, some of which are disclosed at the end of this document. Past performance is not a guarantee of future performance. The green line represents the statistical best-fit line for the scatterplot shown. Labeled points represent years with extreme positive or negative performance.

When the Fed Hikes Rates

The Federal Reserve's aggressive policy actions in 1979 through 1981 provide one clear example of how trend following may be able to benefit in an environment where yields rise dramatically. We also take a look at other historical rising policy rate scenarios to understand how trend following performed during those episodes. Exhibit 8 shows the next 10 largest U.S. policy rate increases[3], and the performance of the hypothetical simple trend-following strategy in the initial month of the rate increase and during the six months before and after the initial rate increase.

The study indicates that trend-following tended to produce positive excess returns before and after the initial policy rate increases in this sample. We do see weaker performance in the six months leading to the commencement of rate hikes, and modestly negative excess returns in the month of the initial rate increase. To the extent existing trends reversed around initial rate

Exhibit 8 — Hypothetical Trend Following Excess Returns During U.S. Policy Rate Increases

Policy Rate Changes				Initial Month of Rate Increase	6m Prior to and Including Initial Rate Increase	6m After Initial Rate Increase
Start	End	Months	Change	Excess Return	Excess Return	Excess Return
March 1972	August 1973	17	600bps	0.4%	8.1%	2.8%
December 1976	December 1978	24	525bps	-1.5%	8.8%	7.3%
June 2004	June 2006	24	425bps	-1.6%	-4.4%	5.5%
March 1974	July 1974	4	400bps	-0.3%	3.4%	17.1%
October 1968	August 1969	10	338bps	-1.9%	2.7%	12.8%
July 1958	October 1959	15	325bps	0.8%	-3.3%	4.3%
March 1988	March 1989	12	325bps	3.6%	7.7%	19.6%
February 1994	February 1995	12	300bps	-5.6%	-0.9%	3.2%
January 1982	April 1982	3	300bps	-0.6%	-1.9%	5.8%
October 1919	June 1920	8	250bps	-1.2%	4.7%	19.8%
Average		**13**	**379bps**	**-0.8%**	**2.5%**	**9.8%**

Source: AQR. The Hypothetical Trend-Following Strategy performance is a backtest, net of 2/20 fees and estimated transaction costs. Please read performance disclosures at the end of this document for a description of the investment universe and the allocation methodology used to construct the Trend-Following Strategy. Markets considered only where data existed during the time period. Hypothetical data has inherent limitations, some of which are disclosed at the end of this document. Past performance is not a guarantee of future performance.

[3]We include discount rates from the Federal Reserve Bank of New York from November 1914 to June 1954 when we use the effective federal funds rate.

Exhibit 9 — Starting Bond Yields and Hypothetical Long-Term Trend Following Excess Returns

	Starting 10Yr Govt Bond Yield		Subsequent 10 Year Annualized Excess Return of 10 Yr Bond	Subsequent 10 Year Trend Following Annualized Excess Returns		
Decile	Low	High	Average	Average	Worst	Best
1	1.6%	2.4%	0.1%	11.1%	7.5%	13.4%
2	2.4%	3.0%	0.1%	7.8%	1.0%	13.6%
3	3.0%	3.2%	-0.6%	4.9%	0.0%	11.6%
4	3.2%	3.4%	0.1%	4.5%	-1.0%	10.0%
5	3.4%	3.6%	0.2%	4.3%	-1.2%	9.9%
6	3.6%	3.9%	0.6%	7.1%	2.3%	9.9%
7	3.9%	4.7%	0.6%	9.1%	4.4%	15.2%
8	4.8%	6.3%	1.3%	10.2%	5.1%	17.6%
9	6.4%	8.0%	0.8%	11.0%	6.0%	17.2%
10	8.0%	15.8%	2.2%	8.3%	6.2%	12.0%

Source: AQR. The Hypothetical Trend-Following Strategy performance is a backtest, net of 2/20 fees and estimated transaction costs. Please read performance disclosures at the end of this document for a description of the investment universe and the allocation methodology used to construct the Trend-Following Strategy. Markets considered only where data existed during the time period. Hypothetical data has inherent limitations, some of which are disclosed in at the end of this document. We use U.S. 10 Year Government Bond returns. Past performance is not a guarantee of future performance.

increases, we might expect losses for the strategy as markets digested the change in course.

However, weaker average performance leading up to and negative average performance in the initial month of the rate increase appear short-lived. There tended to be a period of stronger positive excess returns in the months that followed, when policy rates continued to rise. A possible reason for this is that the new course in policy rates became part of market participants' expectations, meaning fewer reversals around subsequent rate increases. Initial increases could also have been possible catalysts for new trends, causing an initial under-reaction that subsequently led to trending behavior.[4]

Starting Point Nominal Bond Yields

Given our long-term data, we can also extend our analysis to understand how trend following might perform at different historical starting points for bond yields, particularly given today's low levels. We know low starting yields may portend relatively anemic returns for fixed income going forward, but what do they mean for the performance of trend following? Exhibit 9 shows the long-term excess returns of trend following associated with initial bond yields from 1880 to 2014, as well as the long-term excess returns of passively holding a U.S. 10 year bond.

Across the range of starting point yields for bonds, trend following subsequently generated positive long-term excess returns on average. The strategy tended to have better long-term performance near the extremes, and weaker performance metrics in the middle-range of this sample. The data demonstrates it is possible for trend following to generate strong long-term excess returns starting with the low bond yields we have today. We caveat this with the understanding that the level of yields alone doesn't drive this outcome, but rather the path

[4] Hurst, Ooi, Pederson, "Understanding Managed Futures" (2010)

fixed income and other asset classes took from the time of these starting points.

Conclusion

To conclude, the preceding analysis provides a foundation on which we can consider how rising yields could impact the performance of a trend following strategy. Our data indicates that while trend followers may have generated a significant portion of their returns from bullish trends in fixed income markets during the past few decades, that doesn't mean expected returns or diversification properties will necessarily worsen when rates begin to rise. History provides us with one particular path for interest rates, and that path shows the possibility for very strong trend-following excess returns in a period of rising interest rates over multiple decades and asset classes.

Looking ahead, we make two concluding points with respect to returns when interest rates begin to rise. First, as much of our analysis examines excess returns, we note that total returns can benefit from increases in short-term interest rates. Trend-following strategies hold a large percentage of cash given their use of derivatives to build positions. Should short-term interest rates rise, investors should be able to achieve better returns from this component of total return relative to recent history. Second, while we cannot forecast the future path of interest rates, a trend-following strategy is designed to benefit when markets experience gradual and persistent changes in either direction. Hence, the strategy's ability to go both long and short in fixed income and other asset classes will potentially deliver an attractive and diversifying return stream regardless of the direction of interest rates.

Appendix

We acknowledge that our analysis is U.S. centric, so below, we show a summary of trend-following returns for Australia, Canada, Germany, Japan and the U.K. during their respective rising-rate and falling-rate periods using their 10-year (or longer maturity if unavailable) bond yields. The trend-following strategy is the same regardless of which country we're analyzing, with differences mainly being the start and end dates for the rising and falling rate periods, as well as the cash rates used to calculate total net-of-fee returns. One important point is that we see peak yields happening at different times in North America, Europe and Japan, underscoring the importance of asset diversification when constructing a trend-following portfolio, even within an asset class. Despite some differences, the conclusion of the main analysis, that trend following strategies can achieve attractive returns and diversification properties in both rising and falling rate regimes, remains intact.

Exhibit 10 — Hypothetical Performance of Time Series Momentum: Rising Rates vs. Falling Rates Across Countries

Time Period	Change in Bond Yields (bps)	Net of 2/20 Fee Returns (Annualized)	Realized Volatility (Annualized)	Sharpe Ratio	Global Stock Correlation	Global Bond Correlation
Australia						
By Subperiod						
Rising Rates: 1941-1982	**+1351 bps**	15.7%	9.9%	1.19	0.05	-0.24
Falling Rates: 1982-2012	**-1337 bps**	15.2%	9.4%	0.78	-0.03	0.23
Full Sample	**+14 bps**	15.4%	9.7%	1.02	0.01	-0.03
Canada						
By Subperiod						
Rising Rates: 1947-1981	**+1511 bps**	15.4%	10.2%	1.05	-0.01	-0.32
Falling Rates: 1981-2011	**-1517 bps**	13.4%	9.3%	0.80	-0.01	0.19
Full Sample	**-6 bps**	14.4%	9.8%	0.94	-0.01	-0.05
Germany						
By Subperiod						
Rising Rates: 1948-1974	**+648 bps**	14.0%	10.0%	1.05	0.04	-0.31
Falling Rates: 1974-2003	**-688 bps**	14.9%	8.9%	1.08	0.01	-0.02
Full Sample	**-40 bps**	14.4%	9.4%	1.06	0.02	-0.10
Japan						
By Subperiod						
Rising Rates: 1948-1961	**+1113 bps**	18.0%	9.5%	1.10	0.22	-0.16
Falling Rates: 1961-1995	**-1119 bps**	15.2%	9.4%	1.07	0.01	-0.20
Full Sample	**-6 bps**	16.0%	9.5%	1.08	0.06	-0.19
United Kingdom						
By Subperiod						
Rising Rates: 1946-1974	**+1490 bps**	14.4%	10.4%	0.98	0.01	-0.27
Falling Rates: 1974-2012	**-1465 bps**	15.9%	9.3%	0.91	-0.03	0.05
Full Sample	**+25 bps**	15.2%	9.8%	0.93	-0.01	-0.04

Source: AQR. The Hypothetical Trend-Following Strategy performance is a backtest, net of 2/20 fees and estimated transaction costs. Please read performance disclosures at the end of this document for a description of the investment universe and the allocation methodology used to construct the Trend-Following Strategy. Markets considered only where data existed during the time period. Hypothetical data has inherent limitations, some of which are disclosed at the end of this document. Past performance is not a guarantee of future performance. The table shows correlations to global stocks and bonds. We created global market proxies based on equal weighted historical asset returns for equity indices and bond markets in our dataset, and assumed monthly rebalancing.

Trend-Following Strategy

The Trend-Following Strategy used in this paper is from AQR's recently re-released paper "A Century of Evidence on Trend-Following Investing" (2014). That strategy was constructed with an equal-weighted combination of 1-month, 3-month, and 12-month Trend-Following strategies for 67 markets across 4 major asset classes –29 commodities, 11 equity indices, 15 bond markets, and 12 currency pairs – from January 1880 to December 2014. Since not all markets have return data going back to 1880, we construct the strategies using the largest number of assets for which return data exist at each point in time. We use futures returns when they are available. Prior to the availability of futures data, we rely on cash index returns financed at local short rates for each country.

In order to calculate net-of-fee returns for the Trend-Following Strategy, we subtracted a 2% annual management fee and a 20% performance fee from the gross-of-fee returns to the strategy. The performance fee is calculated and accrued on a monthly basis, but is subject to an annual high-water mark. In other words, a performance fee is subtracted from the gross returns in a given year only if the returns in the fund are large enough that the fund's NAV exceeds its high water mark from the previous year plus the returns of Treasury Bills. The transactions costs used in the strategy are based on AQR's current estimates of average transaction costs for each of the four asset classes, including market impact and commissions. The transaction costs are assumed to be twice as high from 1993 to 2002 and six times as high from 1880-1992, based on Jones (2002). The transaction costs used are as follows:

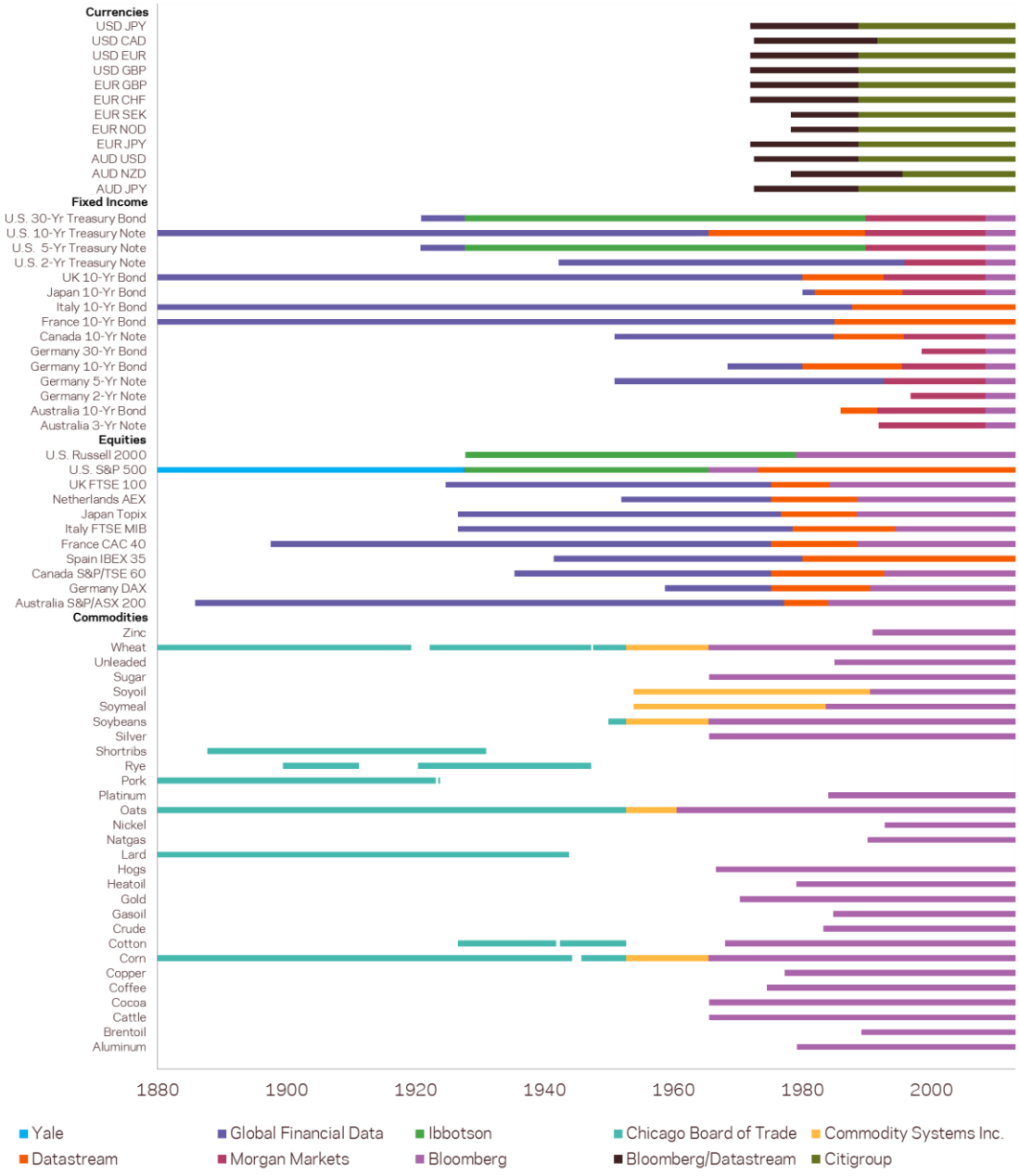
Asset Class	Time Period	One-Way Transaction Costs (as a % of notional traded)
Equities	1880-1992	0.34%
	1993-2002	0.11%
	2003-2013	0.06%
Bonds	1880-1992	0.06%
	1993-2002	0.02%
	2003-2013	0.01%
Commodities	1880-1992	0.58%
	1993-2002	0.19%
	2003-2013	0.10%
Currencies	1880-1992	0.18%
	1993-2002	0.06%
	2003-2013	0.03%

The current estimate of assets under management in the BarclayHedge Systematic Traders index is $280 billion. We looked at the average monthly holdings in each asset class (calculated by summing up the absolute values of holdings in each market within an asset class) for our time series momentum strategy since 2000, run at a NAV of $280 billion, and compared them to the size of the underlying cash or derivative markets. For equities, we use the total global equity market capitalization estimate from the October 2014 World Federation of Exchanges (WFE) monthly statistics tables. For bonds, we add up the total government debt for the 15 developed countries with the largest debt using Bloomberg data. For currencies, we use the total notional outstanding amount of foreign exchange derivatives, excluding options, which are U.S. dollar denominated in the first half of 2014 from the Bank for International Settlements (BIS) November 2014 report. For commodities, we use the total notional of outstanding OTC commodities derivatives, excluding options, in the first half of 2014 from the BIS November 2014 report and add the aggregate exchange futures open interest for 31 of the most liquid commodities.

	Average Position size in $280B Time Series Momentum Portfolio (bn)	Total Market Size (bn)	Percentage of Total Market
Commodities	134	2,300	5.8%
Equities	99	63,000	0.2%
Bonds	758	33,000	2.3%
Currencies	226	62,000	0.4%

Markets and Data Sources

The following chart shows the length and source of data for each individual market used in "A Century of Evidence on Trend-Following Investing" (2014):



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