An Intermarket Approach to Tactical Risk Rotation

Using the Signaling Power of Treasuries to Generate Alpha and Enhance Asset Allocation

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***2014 Wagner Award*, 3rd Place Winner**

Updated Through November 30, 2020

Abstract: Numerous academic studies have shown that asset allocation is the single most important determinant of portfolio returns. We accept this premise but note that an optimal asset allocation strategy must still be determined based on dynamic conditions. Using the principles of intermarket analysis and the relationship between the total return of the 10-year Treasury and the 30-year Treasury, we develop one such strategy. We find that an active strategy that uses the signaling power of these Treasury bonds to position into either the stock market or Treasuries can be used to outperform a buy and hold stock portfolio on an absolute and risk-adjusted basis. We also find that the signaling power of Treasuries can be used to enhance asset allocation decisions and traditional rebalancing. The predictive behavior of Treasuries on equities is a market anomaly that has persisted over time, and has served as an anticipatory gauge of expansionary or contractionary conditions which favor stocks or bonds. Contrary to the Efficient Market Hypothesis, the information provided by relative total return Treasury movement does not appear to be priced in immediately by broad stock market averages, and therefore may be exploitable for active traders and tactical asset allocators.

Introduction

Asset allocation is widely regarded as the single most important determinant of portfolio returns. Its significance has been documented in numerous studies over the last several decades. Brinson, Hood, and Beebower (1986) noted that over 90% of the variability in a portfolio's performance was due to asset allocation policy, while Ibbotson and Kaplan (2000) argued that "on average, policy accounted for a little more than all of total return." Much of the reasoning behind this relates to the idea brought forth by Sharpe (1991) who argued that the average performance across all investors must equate to the market, and as such after fees and expenses active return from security selection is negated. This is one of the primary reasons why passive indexing has been shown to produce superior results relative to active mutual funds in the long-term.[1] This is also a central tenet of the Efficient Market Hypothesis which states that no strategy can consistently outperform a simple buy and hold investment.

However, several studies have called into question the Efficient Market Hypothesis as certain market anomalies have been persistent and exploitable.[2] Momentum is one such anomaly which has been well documented in the stock market.[3] Recent research indicates that persistence of returns at the one-month interval is not only an equity phenomenon, but also applies to bonds.[4] Therefore, if we accept that asset allocation accounts for all of a portfolio's return but reject the idea that active management can't outperform, then the focus should be on choosing an appropriate active strategy to guide portfolio tilts. In this paper, we outline such a strategy.

By tracking the relative performance of intermediate and longer duration Treasuries, we document a powerful way to outperform traditional asset allocation strategies on both an absolute and risk-adjusted return basis. Broadly speaking, when the total return of long duration Treasuries (30-year) outperforms that of intermediate duration Treasuries (10-year), volatility in equities for the following month tends to rise and bond momentum drift continues. When the opposite signal occurs, stocks become the preferred asset class. We refer to this idea as Tactical Risk Rotation due to the timing of stock and bond rotations around information the Treasury market is providing about near-term volatility changes.

The theory behind why this strategy works ultimately relates to investor behavior during periods of anticipated stock market volatility and slowing growth/inflation expectations. Because Treasuries are considered a "risk-free" investment from the standpoint of credit worthiness, and longer-duration Treasuries tend to react most favorably during "risk-off" periods, investors tend to position into longer duration bonds in advance

[1] See Day, Wang, and Xu (2001).
[2] See Philip and Torbey (2002).
[3] See Moskowitz and Grinblatt (1999).
[4] See Luu and Yu (2012).

of periods of higher volatility. As near-term confidence grows and investors begin to expect a more expansionary environment to follow, intermediate term duration Treasuries tend to outperform their more defensive 30-year counterparts. Therefore, the relative behavior between 10-year and 30-year Treasury bonds serves as an anticipatory gauge of conditions that favor either a defensive or more aggressive posture. The key word is "anticipatory," as we show that the relative behavior within the Treasury market alerts us of economic weakness/strength well in advance of more formal declarations of expansions/contractions made by the National Bureau of Economic Research (NBER).

We also extend Tactical Risk Rotation to rebalancing in creating a strategy which adjusts target weights using the same relationship between the 10-year Treasury and 30year Treasury. We show that risk adjusted returns and volatility are considerably better in using this strategy than a traditional rebalancing based on monthly intervals. We find this to be true for aggressive, moderate, and conservative iterations of our strategy. Finally, we propose ways of implementing Tactical Risk Rotation through the use of mutual funds and Exchange Traded Funds for active asset allocators and investment managers.

Observing the behavior of the Treasury market has always been of special importance to the Federal Reserve, economists, and market participants given the leading nature of the yield curve. Much of the prior research has focused on the spread between short duration and long duration bonds. This spread, or the Treasury term structure, has been shown in academic literature to be a leading indicator of oncoming recessions and credit risk.[5] While the yield curve may be indicative of economic behavior, we find that total return intermarket behavior proves to be a stronger indicator of near-term volatility in equities, which in turn provides a roadmap for enhancing asset allocation decisions.

The All-In Strategy

We first test the validity of Tactical Risk Rotation by exploring the most extreme case of asset class rotation: a 100% portfolio shift. Using total return indices provided by CRSP® and Fama/French, our strategy positions a portfolio either fully into Treasuries or fully into equities based on the relative performance of the 10-year Treasury and the 30year Treasury.[6]

The strategy is descriptively named the Tactical Risk Rotation Strategy ("TRRS") as it attempts to rotate into bonds during higher risk periods and into stocks during lower risk periods. We illustrate two versions of the strategy, one that uses the 10-year Treasury as its bond allocation ("TRRS 10") and another that uses the 30-year Treasury ("TRRS 30"). Rotating into bonds in general and intermediate to longer duration Treasury bonds in

[5] See Estrella and Mishkin (1996).

[6] 10-year Treasury and 30-year Treasury Total Return Indices were calculated (or derived) based on data from the University of Chicago on behalf of its Center for Research in Security Prices (CRSP®) ©2014. As a proxy for broad equity market exposure, we used the Fama/French U.S. Stock Market Index, which is a total return index. Source: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

particular during higher risk periods is effective because of their negative correlation with stocks during periods of market stress (see Table 1).

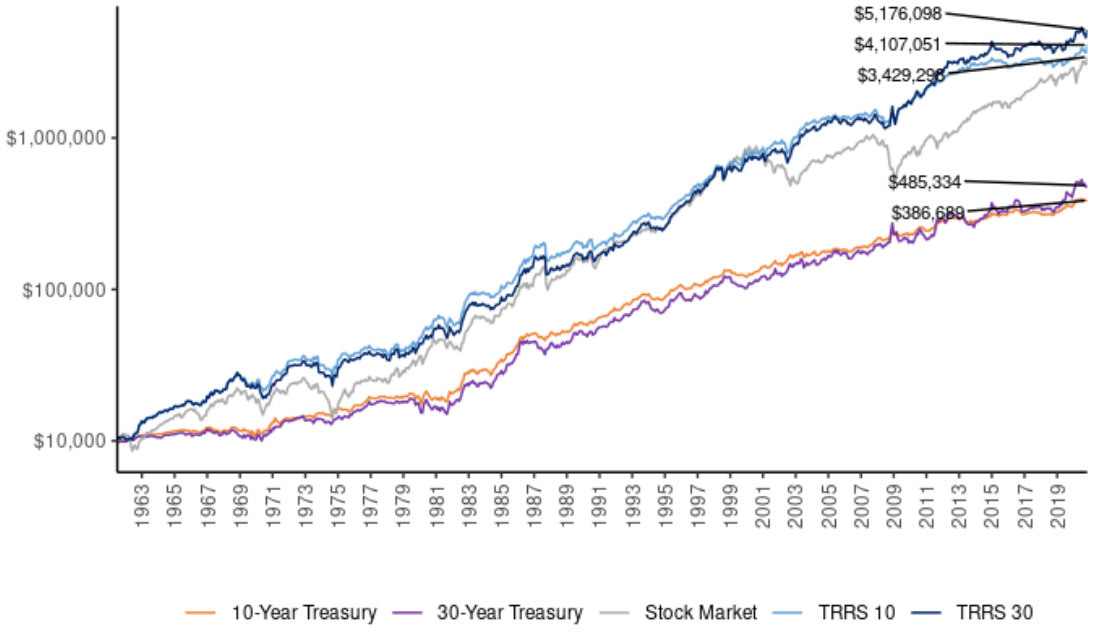
Table 1: Bond Correlations to the US Stock Market 1977 – 2020			
Stock Market Performance	**Barclays Aggregate**	**10-Year Treasury**	**30-Year Treasury**
Positive	0.12	0.13	0.06
Negative	0.03	-0.17	-0.16
Overall	0.08	0.03	-0.03

The strategy focuses on the monthly time frame and employs the following trading rule:

> *When the 10-year Treasury total return is greater than the 30-year Treasury total return in the prior month, position into stocks for the following month. When the 10-year Treasury total return is less than the 30-year Treasury total return in the prior month, position into either the 10-year Treasury or 30-year Treasury for the following month.*

Using available data from July 1961 through November 2020[7], both the TRRS 10 and the TRRS 30 outperform a buy-and-hold portfolio of the stock market, the 10-year Treasury, and the 30-year Treasury (see Chart 1).[8] The cumulative outperformance over the stock market is 20% for the TRRS 10 and 51% for the TRRS 30.

Chart 1: Growth of $10,000: July 1961 - November 2020



[7] In the original version of this paper, the evaluated period started in April 1977 only. Thanks to new data provided by CRSP now going back till June 1961, we were able to go back further. As shown, the treasury signal proved reliable also "out-of-sample."
[8] Assuming no slippage and commission.

The true value of the Tactical Risk Rotation Strategy, though, is not simply outperformance, but the manner in which that outperformance was achieved.

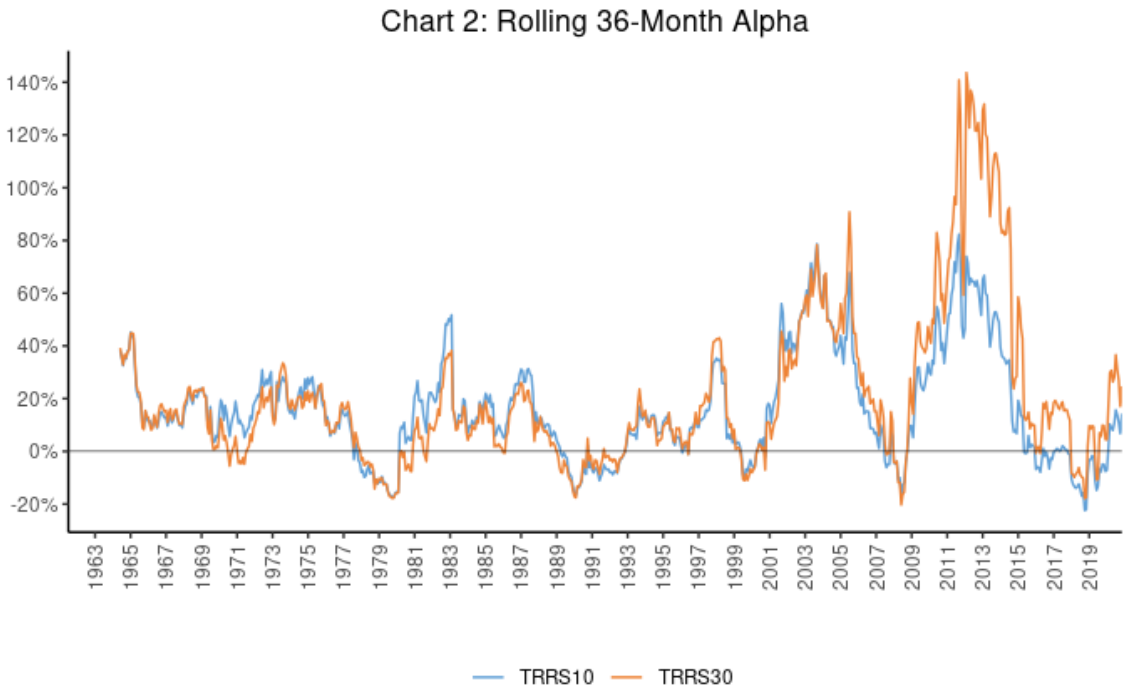
The TRRS was able to realize this outperformance while spending only 51% of the time in stocks. By limiting the time spent in equities to less than half of all months, the TRRS displayed significantly lower volatility and higher risk-adjusted returns than a buy-and-hold portfolio of the stock market. This is illustrated below in Table 2. Both the TRRS 10 and TRRS 30 achieved higher annualized returns with lower annualized volatility than the stock market, resulting in a higher Sharpe Ratio and higher Sortino Ratio than the stock market.[9] The annualized alpha created by the TRRS 10 and the TRRS 30 was significant at 4.9% and 5.8% per year.

Table 2: Performance and Risk Statistics (1961 - 2020)

Metric	Stock Market	TRRS 10	TRRS 30
Annualized Return	10.1%	10.5%	10.9%
Annualized Volatility	15.4%	12.3%	14.0%
Sharpe Ratio	0.35	0.46	0.44
Sortino Ratio	0.31	0.41	0.39
Max Drawdown	-50.4%	-28.9%	-32.3%
Beta	1	0.54	0.52
Annualized Alpha	0.0%	4.9%	5.8%

Importantly, this alpha generation is consistent over time, with the TRRS 10 producing positive alpha in 79% of rolling 36-month periods and the TRRS 30 producing positive alpha in 80% of rolling 36-month periods (see Chart 2).

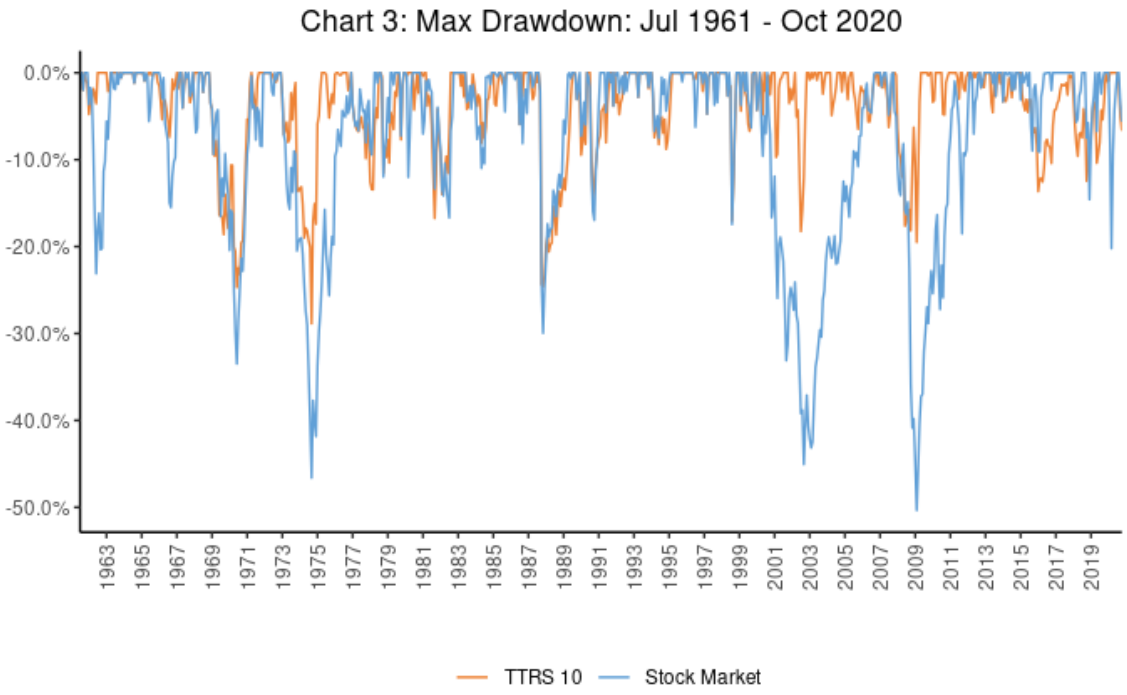
[9] The TRRS 30 is the more volatile version of the strategy as the 30-year Treasury bond tends to exhibit higher volatility than the 10-year Treasury note over time. Both the Sharpe Ratio and Sortino Ratio are popular statistical measures which help in determining the efficiency of risk taken for return generated.



The primary factor behind this alpha creation was the tactical avoidance of risk. We test the robustness of this concept in a number of ways.

First, Chart 3 displays the rolling maximum drawdown of the TRRS 10 versus that of the stock market.[10] The TRRS 10 has a significantly lower maximum drawdown during most periods, particularly during periods of market stress. Over the full time period studied, the maximum drawdown for the TRRS 10 was slightly more than half of the stock market's maximum drawdown (-28.9% vs. -50.4%).

[10] The TRRS 30 displays a similar drawdown pattern and maximum drawdown to the TRRS 10.



Second, the risk avoidance power of the TRRS can be illustrated in viewing its performance during up and down periods for the stock market. Table 3 illustrates that over the full time period, the TRRS 10 and TRRS 30 achieved Up Capture of 64.9% and 65.3% respectively, while limiting Down Capture to 40.8% and 37.6%.

Table 3: Risk/Return Statistics

	Average Monthly Performance		Up/Down Capture	
	Up Stock Market	**Down Stock Market**	**Up Capture**	**Down Capture**
TRRS 10	2.3%	-1.4%	64.9%	40.8%
TRRS 30	2.3%	-1.3%	65.3%	37.6%
Stock Market	3.6%	-3.5%	100.0%	100.0%

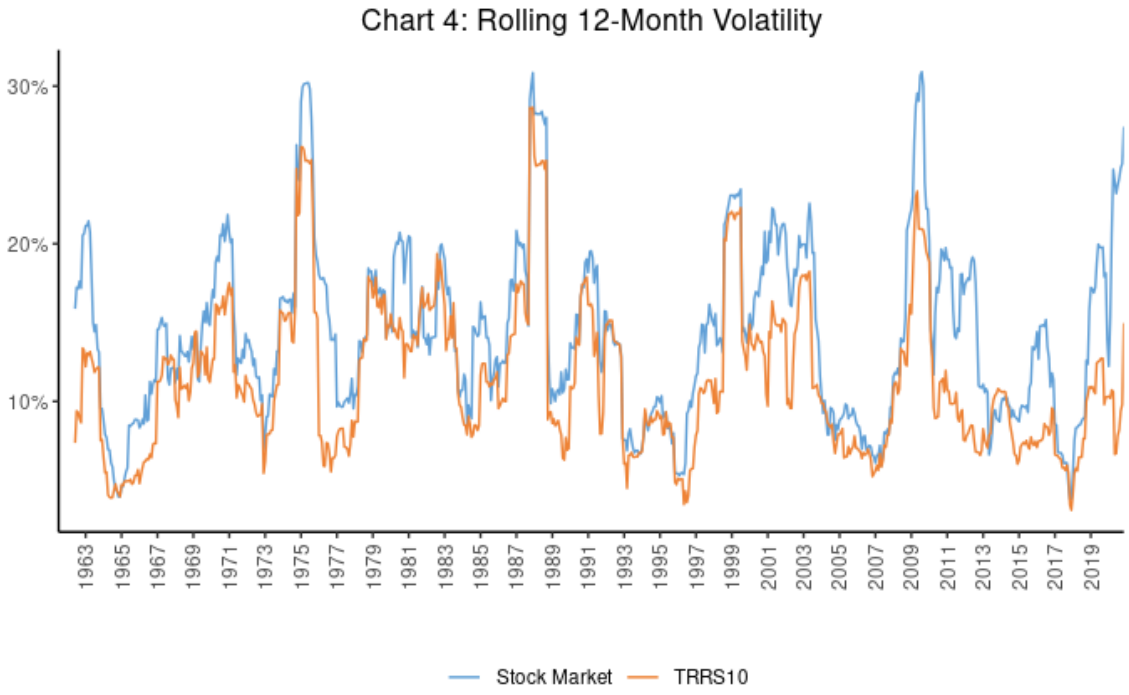
A third way of testing the concept of risk avoidance is in calculating the percentage of time the TRRS was in bonds during down months and higher volatility periods for the stock market. We found that the TRRS was in bonds 53.1% of the time during down months, which is higher than the average time spent in bonds of 50.7%. Again, while this may not seem significant, by simply avoiding some of the worst months for stocks, one can achieve superior risk-adjusted returns. In the 10% of months with the largest negative market return (n=72, return below -4.5%), TRRS was positioned defensively in bonds 54.2% of time. In the 5% worst months (n =36, return below -7.1%), TTRS was in bonds 58.3%. On the opposite side, TRRS was in stocks in also 58.3% of the time in the 5% best market returning months (return above 7.6%).

This is also confirmed in calculating the percentage of time the TRRS was in bonds during the highest levels of the VIX index (since January 1990).[11] We found that during months in which top decile levels of the VIX were observed (levels greater than 28.2), the TRRS was positioned in bonds 65.8% of the time, significantly higher than the average time spent in bonds.

Risk Avoidance and Mitigating Behavioral Biases

Before moving on, it is important to understand why risk avoidance and superior risk-adjusted returns are so critical, beyond the obvious benefits. As investors are inherently emotional beings, they are more likely to abandon a strategy with a higher drawdown and higher volatility at precisely the worst time. Regardless of their stated risk tolerance, when faced with a 50% drawdown in their stock portfolio, many investors will panic and begin to sell. This behavior was very clear in 2002 and 2009 at the tail end of bear markets that saw over 50% declines in equities. While no strategy can completely eliminate risk, the TRRS manages risk to a more acceptable level for most investors.

We see this first in observing the rolling annualized volatility of the TRRS 10 relative to the stock market (see Chart 4).[12] The TRRS 10 shows lower volatility in 88% of rolling 12-month periods.



[11] The VIX index is a popular measure of implied volatility of S&P 500 options, and is often referred to as the "fear gauge" of the stock market.

[12] The TRRS 30 shows a similar (albeit less so as the 30-year is the more volatile instrument) improved volatility profile relative to the stock market.

We also see clear evidence of risk management in comparing calendar year returns, which investors tend to place a high level of importance on. The worst calendar years for the TRRS 10 and the TRRS 30 were 14.9% and 18.1% respectively, versus -36.6% for the stock market (see Table 4). The average investor is much more likely to stick with a strategy in which its worst year is half of what we have seen in the stock market. Therefore, the TRRS is, in effect, providing additional utility in that it is less likely to elicit a negative behavioral response from an investor.

Table 4: Calendar Year Returns

Year	Stock Market	TRRS 10	TRRS 30
1961	11.5%	5.3%	5.8%
1962	-10.2%	22.1%	21.4%
1963	21.0%	15.8%	15.4%
1964	16.0%	9.9%	10.0%
1965	14.5%	10.9%	11.9%
1966	-8.8%	-0.3%	-0.4%
1967	28.7%	17.3%	16.3%
1968	14.0%	28.8%	28.7%
1969	-10.9%	-14.9%	-18.1%
1970	0.2%	9.5%	1.0%
1971	15.9%	28.4%	33.9%
1972	17.0%	11.5%	12.1%
1973	-19.5%	-13.7%	-16.6%
1974	-27.8%	-4.3%	-6.0%
1975	37.9%	20.7%	28.3%
1976	27.0%	16.9%	14.7%
1977	-3.2%	-7.4%	-6.5%
1978	8.0%	-0.5%	-0.3%
1979	23.4%	15.5%	13.9%
1980	33.4%	40.0%	33.8%
1981	-3.6%	-1.5%	-2.8%
1982	21.3%	39.9%	38.3%
1983	22.5%	8.7%	7.2%
1984	3.7%	2.6%	2.7%
1985	32.6%	27.7%	28.5%
1986	16.3%	32.3%	32.6%
1987	1.5%	-5.1%	-7.9%
1988	18.1%	12.7%	11.2%
1989	28.8%	15.0%	18.5%
1990	-6.1%	-3.5%	-0.7%
1991	34.9%	19.8%	19.5%
1992	9.7%	13.5%	12.5%
1993	11.1%	16.0%	19.5%
1994	-0.1%	-5.0%	-7.6%
1995	36.7%	32.4%	42.1%
1996	21.2%	21.5%	21.7%
1997	31.1%	20.6%	26.9%
1998	24.2%	16.3%	14.2%
1999	25.6%	22.0%	16.7%

2000	-11.9%	3.2%	4.0%
2001	-11.2%	11.8%	7.2%
2002	-21.2%	8.7%	11.3%
2003	31.7%	24.4%	24.9%
2004	11.9%	9.0%	11.2%
2005	6.0%	1.6%	5.6%
2006	15.4%	1.3%	-0.4%
2007	5.8%	8.4%	6.7%
2008	-36.6%	-6.0%	14.3%
2009	28.3%	21.7%	8.9%
2010	17.5%	18.6%	18.6%
2011	0.5%	14.3%	32.1%
2012	16.2%	12.6%	12.6%
2013	35.1%	17.3%	10.7%
2014	11.7%	2.5%	13.3%
2015	0.1%	-4.0%	-6.7%
2016	13.5%	4.4%	10.7%
2017	22.5%	4.2%	8.3%
2018	-5.1%	-8.2%	-9.8%
2019	30.5%	8.8%	10.7%
2020 -Nov	18.6%	22.8%	19.3%
Min	-36.6%	-14.9%	-18.1%
Max	37.9%	40.0%	42.1%

All-In Strategy vs. NBER Recession/Expansion Announcements

Expansionary periods tend to be characterized by lower overall volatility in financial markets, while contractionary periods tend to exhibit higher price fluctuations. A key component of the TRRS is its ability to identify more volatile periods for equities in advance of their occurrence. In using the relative performance between the 10-year Treasury and 30-year Treasury as our risk trigger, we are letting intermarket relationships define the economic cycle and are not simply relying on the standard definition of expansion or contraction as determined by the National Bureau of Economic Research (NBER).[13] This is important because by the time the NBER officially recognizes a period of contraction, the economy is well into a recession. Similarly, by the time the NBER recognizes the end of a recession and beginning of a recovery, the economy is well into the next expansion.

We observe this fact in Table 5, which shows that the average lag time between the turning point in the economy and NBER official announcement was 12 months. The most recent example was the 2020 recession, which started in February 2020. NBER did not officially recognize this end date until June 2020, 5 months later. By that point, the stock market had already advanced over 43% from its low in March 2020.

[13] Founded in 1920, the NBER is a research organization widely recognized as the definitive source for determining Business Cycle Expansion and Contraction dates in the U.S. www.nber.org.

Table 5: Turning Point vs. Announcement Date			
Peak or Trough	**Turning Point Date**	**Announcement Date with Link**	**Lag (Months)**
Peak	2/1/2020	6/8/2020	5
Trough	6/1/2009	9/20/2010	16
Peak	12/1/2007	12/1/2008	12
Trough	11/1/2001	7/17/2003	21
Peak	3/1/2001	11/26/2001	9
Trough	3/1/1991	12/22/1992	22
Peak	7/1/1990	4/25/1991	10
Trough	11/1/1982	7/8/1983	9
Peak	7/1/1981	1/6/1982	7
Trough	7/1/1980	7/8/1981	13
Peak	1/1/1980	6/3/1980	6
	Average Lag (months)		**12**

Therefore, as bonds and stocks are known to be leading indicators of the economy and bonds tend to lead stocks over multiple cycles, a preferable strategy from an investment and trading standpoint is using market prices themselves to define economic cycles. This becomes immediately clear in observing the performance of the TRRS 10 versus a strategy that rotates into bonds (10-year Treasury) or the stock market based on NBER announcement dates (see Table 6). In every risk and return metric, the TRRS 10 is superior and the NBER Strategy also underperforms a simple buy and hold stock portfolio. This leads us to conclude that investors would be better served ignoring such announcements as by the time the announcement occurs, the stock market has long ago priced in the turning point in the economy.

Table 6: TTRS10 vs. NBER Announcement Strategy (1977 - 2020)			
	Stock Market	**TRRS10**	**NBER Strategy**
Cumulative Return	5918.9%	7731.1%	3302.3%
Annualized Return	11.8%	12.6%	10.1%
Annualized Volatility	15.7%	12.9%	14.3%
Sharpe Ratio	0.41	0.56	0.33
Sortino Ratio	0.35	0.46	0.32
Max Drawdown	-50.4%	-24.6%	-43.8%
Beta	1	0.57	0.76
Annualized Alpha	0.0%	5.8%	1.3%

Tactical Risk Rotation and Asset Allocation

In practice, there are a number of reasons why an all-in rotation strategy may be an unfeasible one for most, particularly money managers with discretionary authority over client accounts. First, a strategy that can rotate either completely into bonds or completely into stocks on a monthly basis may be too difficult to explain to clients, who are likely to question the merits of such an uncommon approach. Additionally, due to a lack of sophistication, clients may seek to abandon the strategy during inevitable short-term periods of underperformance. While this is true of any strategy, the underperformance in

the all-in strategy will be glaring when it occurs as the strategy will be 100% in the underperforming asset class.[14] Second, the volatility of the all-in strategy, while lower than the stock market, may still be too high for clients with a moderate or conservative risk tolerance. Finally, most advisors would not use the 10-year or 30-year Treasury as a proxy for fixed income exposure, preferring instead to use a more broad representation of the bond market. We address these concerns in developing an asset allocation strategy that is more suitable for the average investment advisor.

In addressing the first concern, our asset allocation strategy is making incremental shifts to a mix of stocks and bonds and is not switching from 100% stocks to 100% bonds in every rotation. As to the second concern, we have developed three distinct asset allocation strategies based on an investor's risk tolerance: 1) Aggressive, 2) Moderate, and 3) Conservative. In addressing the third concern, we used the Barclays Aggregate Bond Index as the fixed income portion of the portfolio, representing a more diversified exposure to the bond market.

Aggressive Asset Allocation Model

We first developed a rebalancing rule for the Aggressive category. The default allocation is an 80% weighting to the stock market and a 20% weighting to the Barclays Aggregate Bond Index. In months where the 10-year Treasury outperformed the 30-year Treasury (expansionary signal), the portfolio is rebalanced to this 80/20 mix of stocks and bonds. In months where the 30-year Treasury outperformed the 10-year Treasury (contractionary signal), the portfolio is rebalanced to a lower equity allocation and higher bond allocation. We tested a range of weights in 5% increments from the standard 80/20 allocation. The most defensive rebalancing moved the portfolio to a 50/50 split between equities and bonds.

The results are shown in Table 7. We first note that in confirmation of prior research on the subject, a simple monthly rebalancing lowers overall volatility and improves risk-adjusted returns. [15] This can be seen in comparing the "Monthly Rebalance" column with the "No Rebalance" column.

Table 7: Aggressive Asset Allocation

Default Risk Rebalance	No Rebalance	80/20	75/25	70/30	65/35	60/40	55/45	50/50
Annualized Return	11.0%	10.5%	10.4%	10.4%	10.3%	10.3%	10.2%	10.2%
Annualized Volatility	14.2%	12.5%	12.1%	11.8%	11.4%	11.1%	10.8%	10.6%
Sharpe Ratio	0.51	0.54	0.56	0.57	0.58	0.59	0.6	0.62
Sortino Ratio	0.36	0.39	0.4	0.41	0.42	0.43	0.44	0.44

[14] It is worth emphasizing that the real power of the Tactical Risk Rotation Strategy is in minimizing downside risk, rather than maximizing upside return over time. In 2013, the strategy had its worst year of relative underperformance against the broader stock market as Treasuries suffered from a historic shift and yield spike. While investors during that year may have exhibited home bias and questioned the strategy's validity, the longer-term results are undeniably strong precisely because of risk minimization.

[15] Arnott and Lovell (1993).

Max Drawdown	-46.5%	-41.8%	-40.3%	-38.8%	-37.3%	-35.8%	-34.2%	-32.6%
Beta	0.92	0.81	0.78	0.76	0.73	0.71	0.68	0.66
Annualized Alpha	0.7%	1.3%	1.5%	1.7%	1.9%	2.1%	2.3%	2.5%
Avg Exposure to Stocks	90%	80%	77%	75%	72%	70%	67%	64%
Avg Exposure to Bonds	10%	20%	23%	25%	28%	30%	33%	36%

Next, we can see that volatility and risk adjusted returns are further improved with Tactical Risk Rebalancing. Each 5% move from the standard 80/20 weighting shows an incremental improvement in the Sharpe Ratio, Sortino Ratio, and Annualized Alpha. Similar to the all-in strategy, this is largely a function of risk rotation accomplished by moving out of equities in advance of higher periods of volatility for the stock market.

The most extreme rebalancing, to a 50/50 split during contractionary periods, achieved the highest risk-adjusted returns and outperformed a monthly rebalancing strategy while maintaining only a 65% average exposure to stocks.

Moderate Asset Allocation Model

The second strategy was developed for a moderate risk investor, with the default weighting of 60% stocks and 40% bonds. Using the same methodology as the Aggressive rebalancing, we see similar results in Table 8. There was an improvement in risk-adjusted returns with each incremental shift. The most extreme form of this strategy, a rebalancing to 30% stocks and 70% bonds during contractionary periods, was the optimal portfolio from a risk-adjusted return standpoint.

Table 8: Moderate Asset Allocation

Default Risk Rebalance	No Rebalance	60/40	55/45	50/50	45/55	40/60	35/65	30/70
Annualized Return	10.8%	9.8%	9.7%	9.7%	9.6%	9.5%	9.5%	9.4%
Annualized Volatility	12.5%	9.6%	9.3%	8.9%	8.6%	8.4%	8.1%	7.9%
Sharpe Ratio	0.57	0.64	0.65	0.67	0.69	0.7	0.72	0.73
Sortino Ratio	0.4	0.48	0.49	0.51	0.53	0.54	0.56	0.57
Max Drawdown	-41.0%	-32.0%	-30.4%	-28.7%	-26.9%	-25.1%	-23.3%	-21.5%
Beta	0.81	0.61	0.59	0.56	0.54	0.52	0.49	0.47
Annualized Alpha	1.6%	2.7%	2.9%	3.1%	3.3%	3.5%	3.7%	3.9%
Avg Exposure to Stocks	78%	60%	57%	55%	52%	50%	47%	44%
Avg Exposure to Bonds	22%	40%	43%	45%	48%	50%	53%	56%

Conservative Asset Allocation Model

The last strategy was developed for a conservative investor, with the default weighting of 30% stocks and 70% bonds. Again, using the same methodology outlined above, we see an improvement in risk-adjusted returns and lower drawdowns (see Table 9). The most extreme form of the strategy, which moved stock exposure down to 0% during contractionary periods, was again the strongest in terms of risk-adjusted returns. This portfolio achieved an annualized return of 0.5% less than standard rebalancing while cutting average exposure to equities in half (30% to 14%).

Table 9: Conservative Asset Allocation								
Default Risk Rebalance	**No Rebalance**	**30/70**	**25/75**	**20/80**	**15/85**	**10/90**	**5/95**	**0/100**
Annualized Return	10.1%	8.5%	8.4%	8.4%	8.3%	8.2%	8.1%	8.0%
Annualized Volatility	9.0%	5.8%	5.5%	5.3%	5.1%	5.0%	4.9%	4.9%
Sharpe Ratio	0.72	0.85	0.88	0.9	0.92	0.92	0.91	0.9
Sortino Ratio	0.54	0.79	0.83	0.87	0.9	0.92	0.92	0.92
Max Drawdown	-27.3%	-14.8%	-13.0%	-11.3%	-9.5%	-8.3%	-7.4%	-6.6%
Beta	0.56	0.32	0.3	0.27	0.25	0.22	0.2	0.18
Annualized Alpha	3.5%	4.7%	4.9%	5.1%	5.3%	5.5%	5.7%	5.9%
Avg Exposure to Stocks	52%	30%	27%	25%	22%	20%	17%	14%
Avg Exposure to Bonds	48%	70%	73%	75%	78%	80%	83%	86%

Credit Rotation Strategy

We have seen that by applying a risk on/off strategy based on the prior month's relative return of the 10-Year vs. the 30-Year Treasury Index, alpha generating performances can be achieved. The signal especially shines in avoiding market corrections, by being positioned defensively ahead of time. We have shown this in the Market-Treasury Rotation Strategies (see Section All-In Strategy), and also in the Tactical Risk Rotation and Asset Allocation approaches, where we test rotating to a reduced-risk asset allocation. All strategies so far were rebalanced monthly using a signal from the prior month's treasury returns.

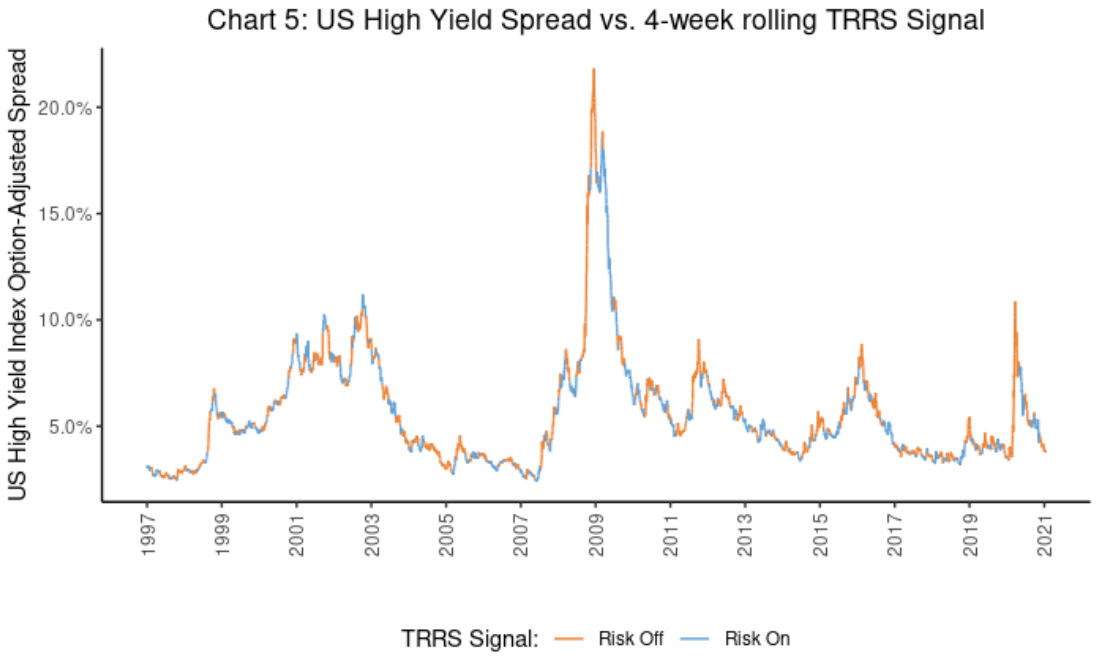
A modified version of the strategies we have seen can be applied to bonds only. For a fixed income portfolio manager, a rotation between higher risk/higher yielding bonds (High Yield or "Junk" bonds) and Treasuries can be an attractive way to improve performance.

Spikes in the High Yield credit spread [16] appear suddenly and have (as per definition) an immediate negative valuation impact on higher-risk bonds and a positive impact on Treasuries. The daily return correlation between High Yields and 10-Year Treasury is -0.06 and -0.12 for negative days in the High Yield Index. A weekly rebalancing period is preferred to capture the short-term relative performance difference. We use a rolling 4-week computation, i.e. the following rule is set:

> *When the rolling 4-week 10-year Treasury total return is greater than the rolling 4-week 30-year Treasury total return in the prior week, position into High Yield ("Junk") bonds for the following week. When the (rolling 4-week) 10-year Treasury total return is less than the (rolling 4-week) 30-year Treasury total return in the prior week, position into the 10-year.*

[16] The "ICE BofA US High Yield Index Option-Adjusted Spread," which measures the yield spread between a basket of High Yield Bonds and the spot Treasury curve, is used in this paper.

A leading 30-year Treasury Index is an anticipatory indicator of an approaching rise in credit spreads. Chart 5 shows that as spikes build, the rolling 4-week TRRS signal is mostly risk-off.

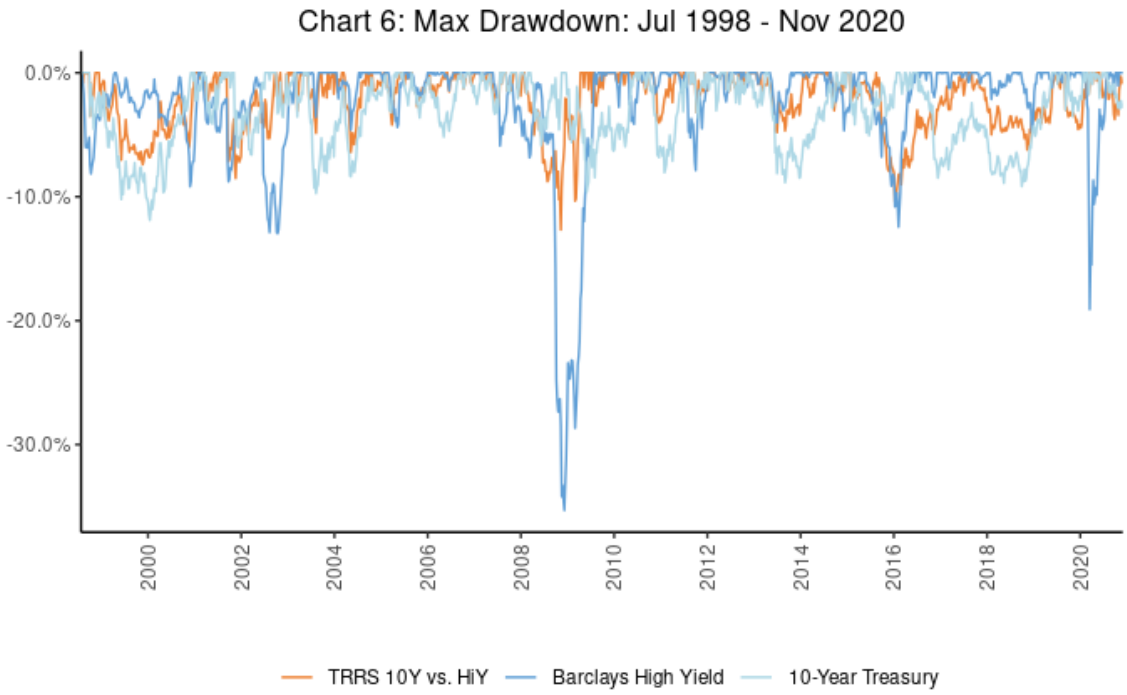


In the 20% of weeks with the largest credit spread increases (n=250 since 1997), the signal was risk-off 62% of the time, in the 10% of weeks, 66%, and in the top 1% of weeks (n=13), the signal indicated risk-off each time.

Table 10 shows that the Credit Rotation Strategy (CRS) achieved a significantly higher risk-adjusted return (Sharpe ratio of 0.82) than both the 10-Year Treasury (0.49) and the Barclays High Yield index (0.62). The strategy's maximum drawdown (-12.7%) is comparable with that of the 10-Year Treasury (-11.9%), all while exceeding the performance of the High Yield index. Besides that, the strategy is able to recover considerably quicker from drawdowns than both of its rotating components (see Chart 6).

Table 10: Performance and Risk Statistics (1998 - 2020)

	10-Year Treasury	Barclays High Yield	CRS 10Y vs. HiY
Cumulative Return	212.6%	317.9%	372.8%
Annualized Return	5.2%	6.6%	7.2%
Annualized Volatility	6.9%	7.7%	6.5%
Sharpe Ratio	0.49	0.62	0.82
Sortino Ratio	0.16	0.16	0.24
Max Drawdown	-11.9%	-35.3%	-12.7%
Beta	-0.11	0.22	-0.01
Annualized Alpha	6.5%	4.7%	7.4%



Modern-Day Implementation

We recognize that many investors do not have access to CRSP® total return data for 10-year and 30-year Treasuries. With the advent of an increasing subset of Exchange-Traded Funds and no-load mutual funds, an investor could replicate the TRRS and Asset Allocation Models above.

First, in replicating the signal, the instruments that currently resemble the 10-year Treasury and 30-year Treasury most closely are the iShares 7-10 Year Treasury Bond ETF (IEF) and the iShares 20+ Year Treasury Bond ETF (TLT). From the inception of these ETFs in July 2002, the signal produced from their total returns was similar in 93.2% of months to the signal generated from the CRSP® data. The Vanguard fund's signal had an accuracy of 83.6%. We therefore prefer to extract the signal from the ETFs.

The signal can also be calculated based on total returns derived from yield data [see Swinkels (2019)]. This approach produced an overlapping signal in 90% of months since 1977, and 96.2% since 2002.

Next, in replicating the available instruments, investors could choose from a variety of products.

In the all-in strategy, substitutes for the Fama-French Stock Index include the Vanguard Total Market ETF (VTI), the Vanguard Total Stock Market Index Fund (VTSMX), and any other total U.S. stock market product. Substitutes for the 10-year

Treasury note include the iShares 7-10 Year Treasury Bond ETF (IEF), the Vanguard Intermediate Bond Fund (VBIIX), and any other Treasury bond product with an average maturity of close to 10 years. Substitutes for the 30-year Treasury bond include the iShares 20+ Year Treasury Bond ETF (TLT), the Vanguard Long-Term Bond Index Fund (VBLTX), and any other product with an average maturity of close to 30 years.

In the rebalancing strategies, the substitutes for the stock portfolio are the Vanguard Total Market ETF (VTI), the Vanguard Total Stock Market Index Fund (VTSMX), and any other total U.S. stock market product. Substitutes for the Barclays Aggregate Bond Index include the iShares Barclays Aggregate Bond ETF (AGG), the Vanguard Total Bond Market ETF (BND), the Vanguard Total Bond Market Index Fund (VBMFX), and any other total U.S. bond market product.

In the bond rotation strategy, the High Yield index can be substituted by the iShares iBoxx $ High Yield Corporate Bond ETF (HYG), or the Vanguard High-Yield Corporate Fund (VWEHX). As a substitute for the 10-year Treasury again the iShares 7-10 Year Treasury Bond ETF (IEF), or the Vanguard Intermediate Bond Fund (VBIIX) can be used.

While our above analysis did not incorporate fees, commission, slippage, or taxes, we would also note the following:

1) All of the products listed above are passive funds at the lowest end of the fee spectrum currently available to investors.

2) The products listed are also at the highest end of the liquidity spectrum where slippage is not a concern.

3) Both the TRRS and the Rebalancing Strategy are not extremely active, with the TRRS shifting the portfolio roughly once every two months and the Rebalancing Strategy moving the portfolio monthly. The Credit Rotation Strategy rebalances weekly between the High Yield and the Treasury index replicating products.

4) With this level of frequency, commission levels would be de minimis and not likely to alter returns. Additionally, an account housed within Vanguard could buy/sell both Vanguard mutual funds and Vanguard ETFs without incurring a commission. In this case, the transaction fee would be $0.

5) There are tax implications in the TRRS and Rebalancing Strategy which could reduce overall returns. If executed in a non-taxable account (IRA, 401k, etc.), this would not be an issue. In a taxable account, one would generate additional short-term capital gains which is sub-optimal from a tax perspective, though the risk reduction benefits over time may outweigh this.

6) Overall, a non-taxable account housed at one of the major brokerage firms that offers no-fee trades for their products would be the best way to approximate the strategy at minimal cost.

Conclusion

We find that the signaling power of Treasury bonds is a market anomaly that has persisted over time, especially so since the first version of this paper was published in 2013. The relationship between the total return of the 10-year Treasury and the 30-year Treasury in particular contains important information about future volatility in markets. Contrary to the Efficient Market Hypothesis, this information does not appear to be priced in immediately by broad stock market averages, and therefore may be exploitable on a monthly or weekly frequency. In the weekly view, the relationship could anticipate several upcoming credit spread widenings.

The implications from both a strategy and signaling standpoint are meaningful. We find that by using a Tactical Risk Rotation Strategy based on the relationship between intermediate and long duration Treasuries, one could have outperformed a buy and hold strategy over time with lower risk. This finding is contrary to the widely accepted notions of risk and return dictated by the Capital Asset Pricing Model (CAPM) and Security Market Line (SML).

Outperformance is achieved by timing exposure to risk using a monthly relative performance signal of the 10-year Treasury to the 30-year Treasury. The strategy rotates into equities when the investing environment favors risk taking and into bonds when the investing environment favors capital preservation. Importantly, because the Tactical Risk Rotation Strategy spends more than half of its time in bonds, it also benefits from lower volatility and higher compounding of interest.

The key to the strategy's outperformance, though, was in the tactical avoidance of risk. Specifically, when the 30-year Treasury is outperforming the 10-year Treasury, it often serves as a warning sign of increased volatility in the equity market during a "risk-off" environment. This is seen in low down capture ratios.

The strategy has similar timing and risk avoidance characteristics as other leading indicators, especially the Utilities-Market signal presented in the 2014 Dow Award winning paper "An Intermarket Approach to Beta Rotation: The Strategy, Signal, and Power of Utilities" (2014 and updated 2020). The risk avoidance behavior is also seen in the Lumber-Gold signal presented in the 2015 NAAIM Founders Award winning paper "Lumber: Worth Its Weight in Gold" (2015 and updated 2020).

We also find that a Tactical Risk Rebalancing Strategy based on the same risk signal produces higher risk-adjusted returns with lower average exposure to equities than a simple monthly rebalancing. This was true for aggressive, moderate, and conservative allocations.

The critical component was once again the avoidance of risk by holding a higher percentage of bonds during periods of higher stock market volatility.

Similarly, the weekly bond rotation strategy delivers higher risk-adjusted returns when rotating between Treasury and high yielding "junk" bonds. This is especially interesting for tactical positioning in fixed income asset management.

The avoidance of risk is especially important for investment advisors and other fiduciaries, who recognize that the business of portfolio management is as much about managing client behavior as it is about managing money. Real-time access to accounts and a constant flow of information from the financial media about short-term market movements often results in emotionally-driven responses from clients. Needless to say, these responses tend to be suboptimal and are the primary cause of the gap seen between investor returns and average mutual fund returns.[17] This behavior is most evident during periods of heightened volatility and market stress, when investors may force their advisors to reduce risk and sell out of positions due to loss aversion. Meanwhile, home bias in strong up years for stocks can result in excessive risk taking and the termination of a manager who underperforms.[18] Both situations are highly counterproductive as they are entirely reactionary and completely disregard the investor's risk profile. While advisors who have discretionary authority over an account can attempt to counteract this adverse behavior, obeying a client's wishes (even if it is against his or her best interest) can be the difference between keeping those assets, and losing them. Tactical Risk Rotation offers a potential solution to this problem.

Further Research

Although beyond the scope of this paper, there are a number of broader implications that our findings may have on the investing and trading landscape.

As it relates to trading and the timing of volatility, further research could study the benefit of: (1) implementing option overlay strategies around the risk signal[19], (2) hedging around the risk signal, (3) timing of gross exposure or leverage around the risk signal, and (4) developing a risk signal within even shorter time frames (using daily data).

As it relates to asset allocation, further research could study: (1) implementing Tactical Risk Rotation on portfolios with additional asset classes, and (2) applying an

[17] See Frazzini and Lamont (2008).

[18] Both loss aversion and home bias are terms advanced in the field of behavioral finance and economics. Loss aversion relates to the idea that people feel the pain of portfolio losses more acutely than the joy of the same portfolio gain. Home bias causes people to want to overweight domestic equities in favor of global diversification, which in turn causes clients to benchmark their portfolios to popular domestic indices regardless of portfolio construction.

[19] The "risk signal" is when the 30-year Treasury is outperforming the 10-year Treasury.

overweight or underweight to specific sectors within the equity allocation (ex: cyclical or defensive).

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