Risk Parity with Trend-Following

This Version: January 30, 2024

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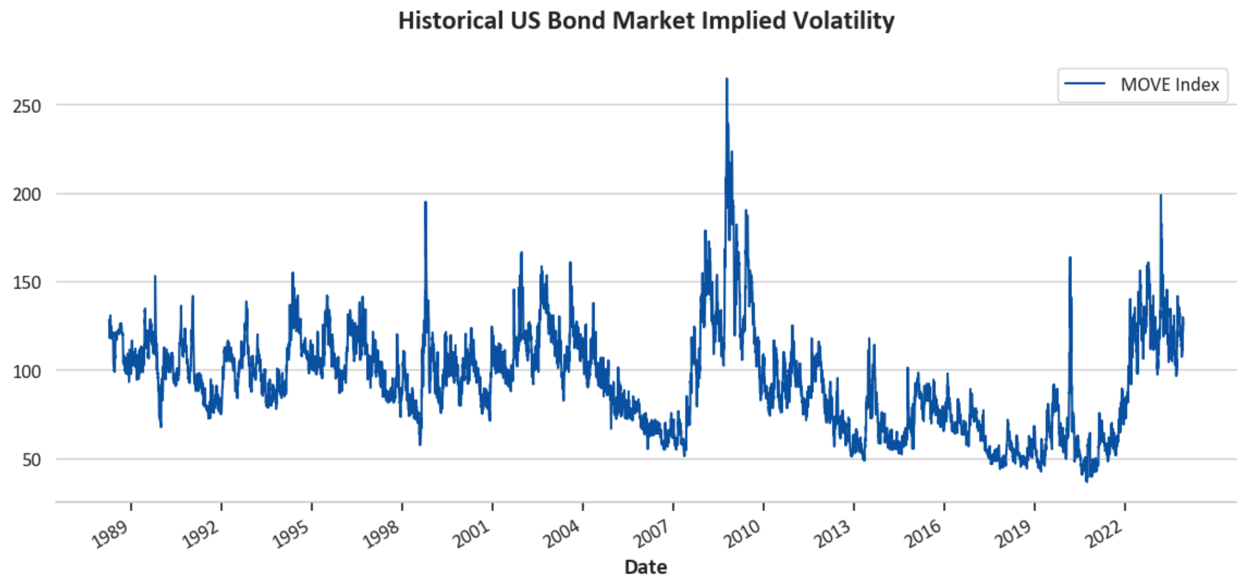
1. Introduction

Risk-parity as a portfolio construction strategy is now well-established. As discussed in some of our previous articles on the topic[2], risk-parity's implementation depends on being able to combine assets using leverage and correlation to create a robust and diversified portfolio. In the thirty-years from the early 1990s to 2020, risk-parity has worked wonderfully, since (1) stock and bond returns were negatively correlated, (2) the cumulative returns on both stocks and bonds were positive and significant, and (3) falling interest rates and ample liquidity allowed for the availability of leverage. As a result, investors were able to get the ultimate free lunch with levered, positive, and diversified returns. In classic risk-parity implementations, stock volatility, which is approximately two to three times bond volatility, is balanced out by leveraging up the bond exposure through derivatives. In the simplest terms, one could think of risk-parity as simply one unit of the stock market combined with three to four units of the bond market. While the exact ratio depends on the volatility and correlation of these assets, the main reason risk-parity has historically "worked" is because by levering up the bond allocation to match the volatility of the equity allocation, the negative correlation of the two assets resulted in lower volatility of the total portfolio. Of course, as any astute observer would have noted, the background for this outcome is a period during which global economies were disinflationary, and this disinflation resulted from credible central banks following responsible monetary policy, along with governments following generally responsible fiscal policy.

The last three years may have marked a major regime shift as inflation rose sharply and interest rates increased from very low levels. This in turn resulted in the correlation between stocks and bonds turning positive. The year 2022 was a historic period in which not only did bonds fail to diversify against stocks, but as anticipated in some of our previous work, bonds fell in value and dragged stocks down with them. As rates rose from very low levels, this event also resulted in expensive leverage. The speed and magnitude of the bond market selloff also resulted in a very sharp rise in the level of bond market volatility (as shown in Exhibit 1), which lead to decreased allocation to bonds when risk parity portfolios rebalance. In sum, the ingredients that are critical to the success of traditional stock-bond based risk-parity failed miserably in 2022, resulting in sharp losses to this and similar strategies.

[2] See "The Risk in Risk Parity", V. Bhansali et. al., The Journal of Investing (2012), "Beyond Risk Parity", V. Bhansali, Journal of Investing (2011), "Active Risk Parity", available on SSRN (2012)



Source: Bloomberg, LongTail Alpha

Exhibit 1: US Bond Market Implied Volatility

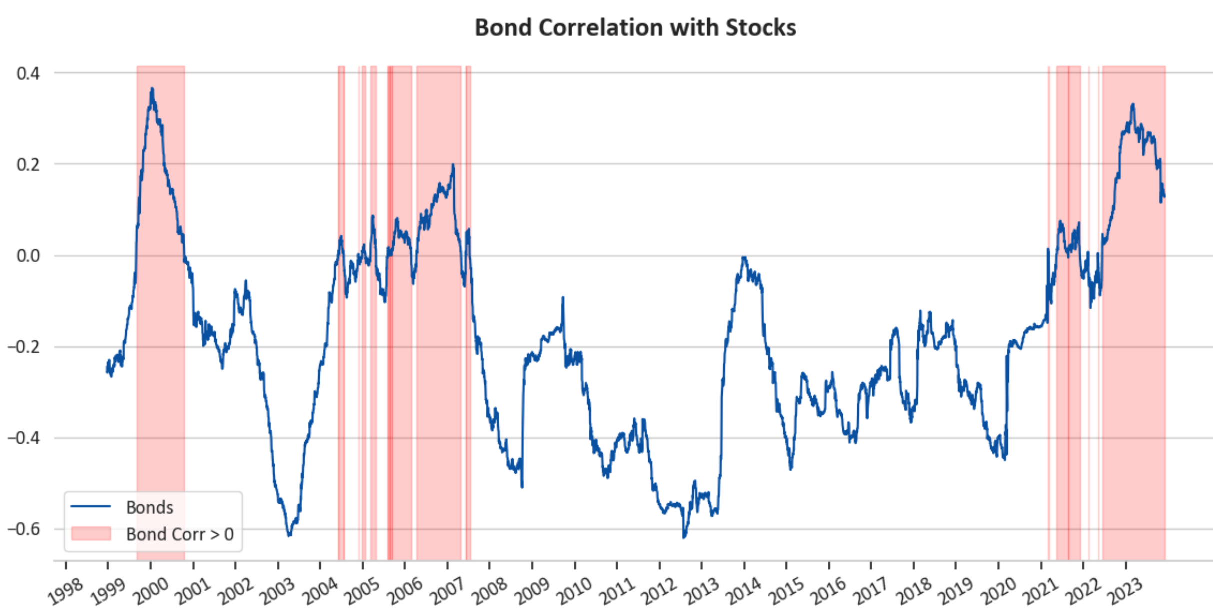
During this short period, another well-known systematic strategy, trend-following, performed quite well even as correlations between stocks and bonds broke down. Trend-following benefited from both the selloff in stocks and in bonds during this period, just as central bank credibility and underlying correlation assumptions were being challenged by the markets and mean-reversion based strategies, including volatility selling strategies, suffered. The power of trend-following as a diversifying strategy emanates from the fact that it can adapt relatively quickly to changing volatility and correlation dynamics in the markets, since the parameterization of almost any trend-following algorithm is driven largely by the performance and volatility of the individual assets in the portfolio. To the degree that the correlations and volatilities of the assets come into play within trend-following, the main role of these parameters is to set the overall risk and allocation of risk amongst the assets. Thus, rather than holding the bond market even when macro conditions undergo a regime shift, trend-following can reverse its exposure if the price and volatility of the bond market indicates that it is optimal to do so. Of course, the flip side of this ability to adapt is that it is inherently backward looking, and if the trends reverse, as they frequently do, trend-following can experience significant losses. Indeed this ever-present reversal risk is the Achilles heel of trend following as a strategy.

Since trend-following is implemented as a dynamic strategy rather than just holding bonds as a passive diversifier, we asked the question whether trend-following, if systematically included in a risk-parity portfolio, would result in better outcomes during 2022, as well as over the longer historical period in which risk-parity has had its success. The idea is very simple – if trend-following's dynamic, adaptive nature can balance out a passive holding of the bond market in a risk-parity portfolio, then one can enhance the performance of a risk-parity portfolio by including trend-following in a risk-parity portfolio. Note that in doing so, we are promoting trend-following to the same level as one of the other fundamental assets within a risk-parity portfolio. With trend-following now a well established and easily accessible strategy, it is not a big stretch to imagine that one can think of this strategy as an asset warranting inclusion in a systematic portfolio. In this paper, we demonstrate that it is indeed the case that trend-following inside of risk-parity can improve the performance of risk-parity, and this "Risk Parity 2.0" is an improvement over traditional risk-parity by most metrics. In addition, we show that by adding some very simple active management rules to trend-following, a trend-following allocation may be made an even more attractive complement to risk-parity and may result in even better and more robust results.

2. Risk Parity Portfolio Construction

The crucial component in the formulation of risk parity portfolios is the interplay of correlation between stocks and bonds (and other assets, if they are included), and their individual volatilities. These factors determine the proportional allocation and sizing of these assets within the portfolio, playing a fundamental role in achieving the desired "parity" risk balance.

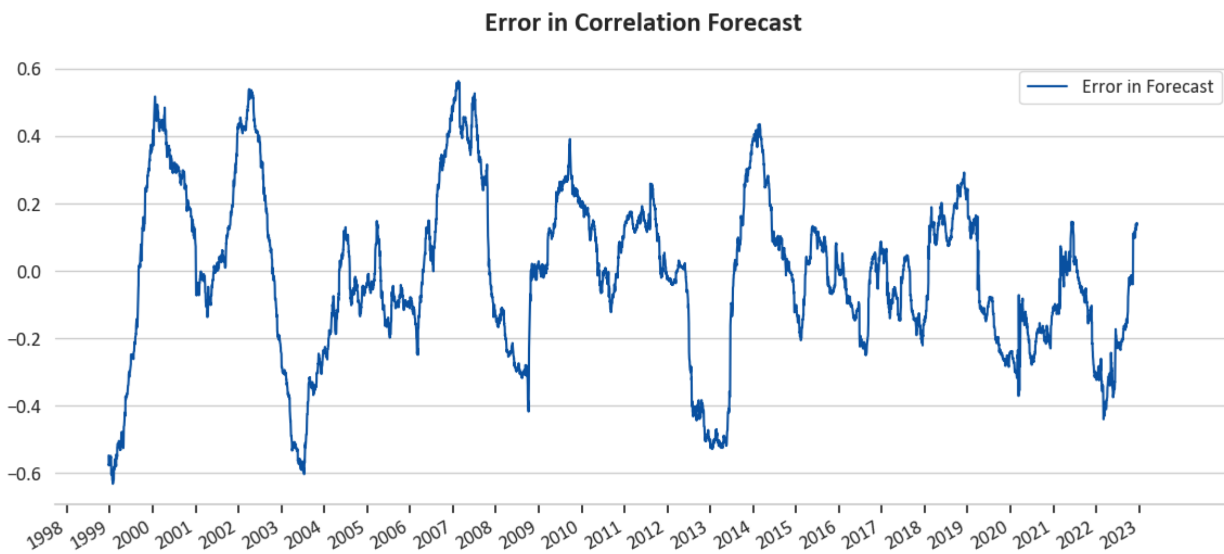
The methodology used in constructing risk parity portfolios is highly responsive to asset correlations. Increased positive correlation between the two asset classes leads to a rise in overall portfolio volatility, prompting the algorithm to reduce their respective weights to maintain the targeted volatility level. Conversely, when this correlation weakens or turns significantly negative, the algorithm adjusts by increasing the weights of both components, ensuring the portfolio aligns with the desired risk parameters. 2022 saw a massive breakdown in the traditionally negative correlation between stocks and bonds. This directional shift to positive correlation is not terribly uncommon, nor is the magnitude of the shift, as evidenced by the Tech Bubble as well as the Great Financial Crisis. Exhibit 2 highlights periods since 2000 when stock/bond correlation has turned positive.



Source: Bloomberg, LongTail Alpha. We use the E-Mini Futures contract (Bloomberg ticker ES1 Index) vs. the Bloomberg Aggregate Index (Bloomberg ticker LBUSTRUU Index) to compute rolling 1-year daily correlations.

Exhibit 2: Stock and Bond Correlation

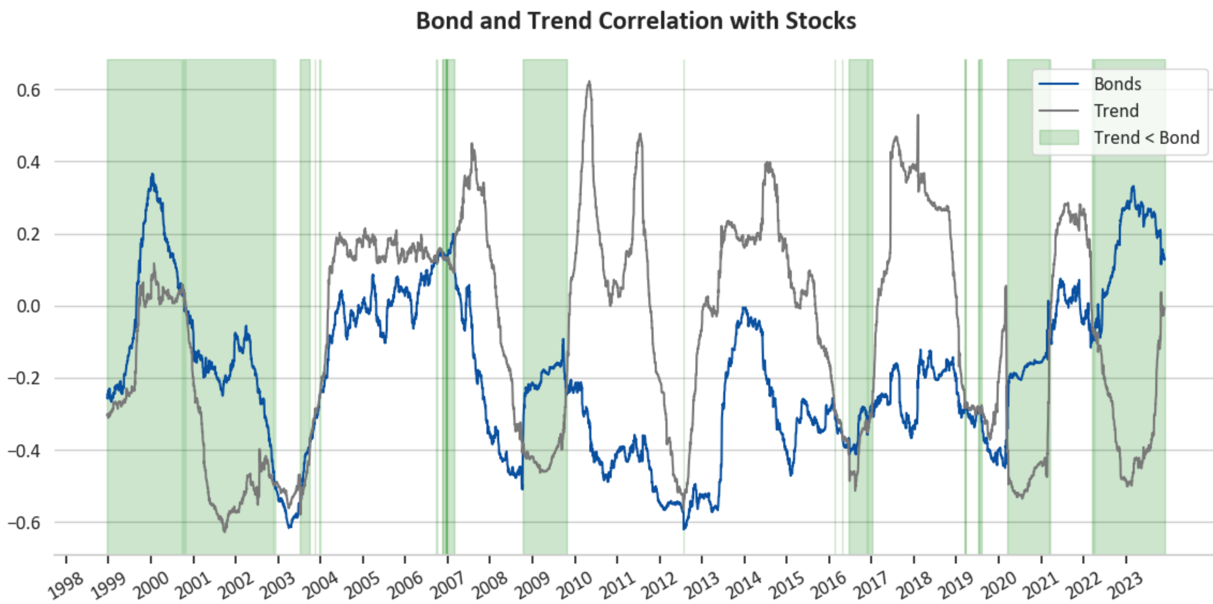
Risk parity portfolios are particularly vulnerable when their active weighting algorithms fail to predict shifts in asset correlations. This vulnerability is exacerbated when the algorithm has increased positions in assets that were previously negatively correlated, only to be blindsided by an abrupt reversal in their correlation. A key challenge lies in the fact that asset correlations are not static. Risk parity strategies often hinge on the premise that future correlations mirror historical correlations, a presumption that can be tenuous at best. For instance, reliance on trailing one-year correlations to forecast future correlations, as illustrated in Exhibit 3, can lead to significant errors in the correlation estimates that underpin risk-parity portfolio construction.



Source: Bloomberg, LongTail Alpha. Forward 1-year correlation minus trailing 1-year correlation

Exhibit 3: Error in Correlation Forecast

The efficacy of risk parity strategies from the 2000s through the 2020s largely depended on bonds effectively diversifying the stock component within the portfolio. Concurrently, trend-following has demonstrated a robust track record in diversifying against both stocks and bonds during this period. It is not uncommon for the correlation between stocks and trend-following to be more negative than the correlation between stocks and bonds. This is illustrated in Exhibit 4, where the green highlights indicate periods when the correlation of trend-following is below that of bonds. While trend-following has historically offered positive diversification benefits – often manifesting when stocks decline, and market trends become more pronounced – it carries the risk that these trends may not persist as they have in the past.



Source: Bloomberg, LongTail Alpha. Trend is represented by CSLAB 15% Vol Index. Trailing 1-year correlation

Exhibit 4: Stock, Trend and Bond Correlation

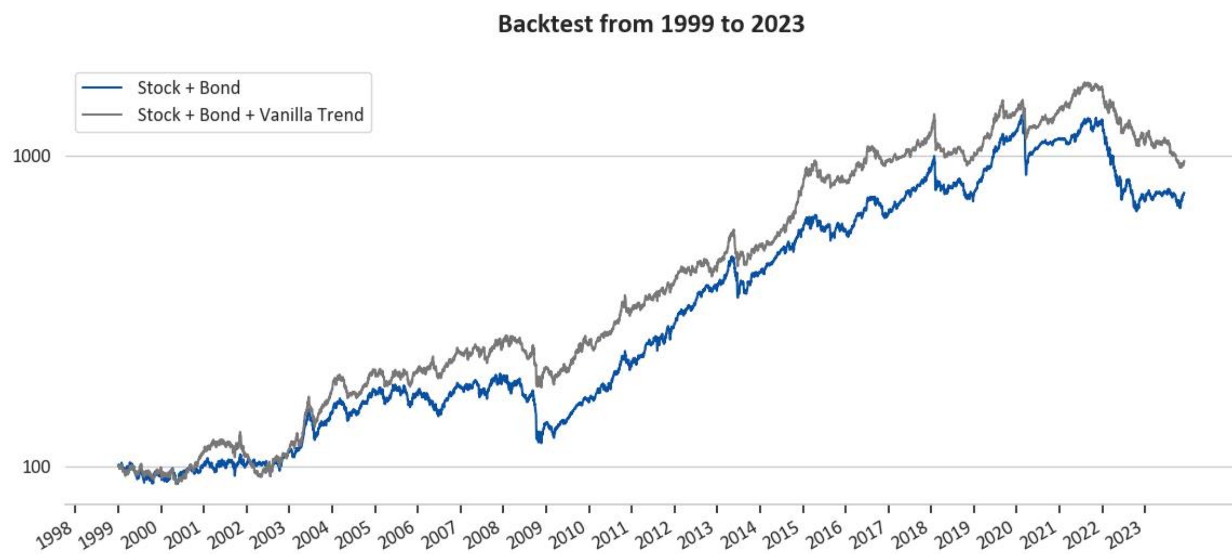
Informed by these results, we return to the main question: what if one adds to a risk parity program a strategy such as trend-following which can naturally adapt to an environment of changing correlations? In the following sections, we summarize the results of comprehensive backtests on different formulations of risk parity strategies using various combinations of stocks, bonds, and trend-following. For more details on our backtesting methodology, please refer to the Appendix. For any strategy involving leverage, we have accounted for the associated costs, including leverage financing costs and margin assumptions.

3. Adding Trend-Following to Risk Parity

We first demonstrate the benefits of adding even a simple trend-following strategy to a stock and bond risk parity portfolio. Since there is no universally accepted benchmark for trend-following, here we assume that the Credit Suisse 15% volatility trend-following index (CSLABT15 Index on Bloomberg) is a reasonable representation of a trend-following index (which we refer to as "Vanilla Trend"). While the effect on portfolio return of adding trend is minimal, albeit positive, one receives additional diversification as shown by an increase in Sharpe and Sortino, as well as reduced negative skew and reduced kurtosis (a.k.a "Fat Tails").

	Stocks + Bonds	Stocks + Bonds + Vanilla Trend
CAGR	8.46%	9.49%
CAGR @ 15% vol	7.80%	8.80%
Sharpe	0.56	0.63
Sortino	0.89	1.14
Skew	-0.90	-0.19
Kurtosis	2.20	0.61

Statistics are monthly. 01/01/1999 – 11/30/2023



Source: Bloomberg, LongTail Alpha. Vertical axis is in log scale

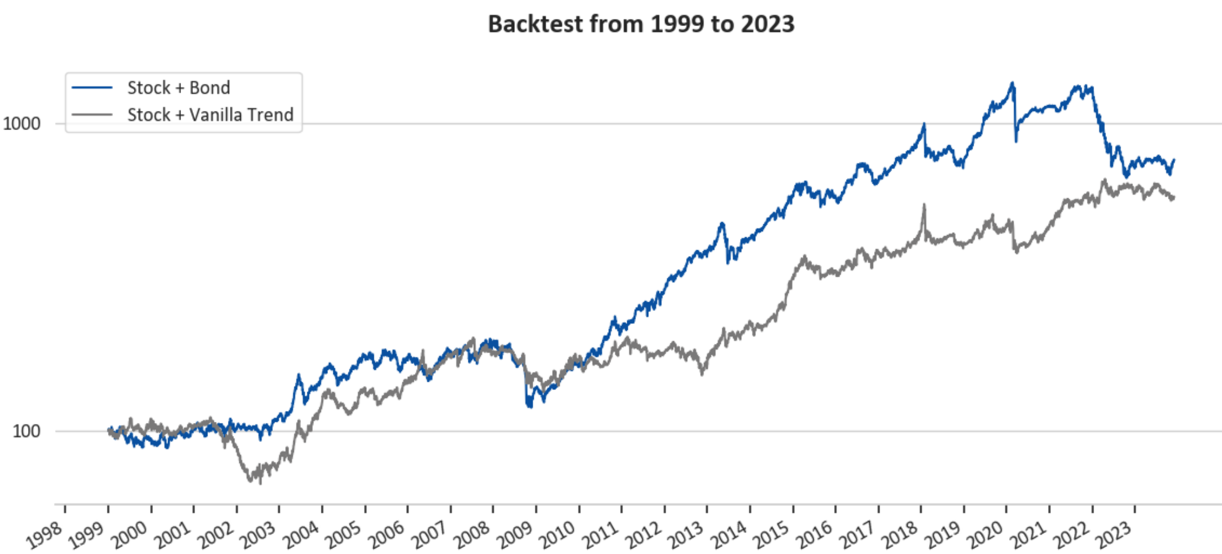
Exhibit 5: Adding Simple Trend to Risk Parity

4. Replacing Bonds with Trend-Following

What if we replaced the bond component entirely with trend-following? Unsurprisingly, long duration exposure was a significant contributor to portfolio returns over the last two and a half decades. Therefore, excluding this asset class entirely is hard to justify. However, it's important to highlight the significant drawdown experienced by traditional stock and bond risk parity portfolios in 2022, which can be attributed to the simultaneous drawdown in both of its only two holdings: stocks and bonds. Trend-following, by construction, has positive duration when duration has been performing well, and minimal or negative duration when it has not been performing well. Assuming that trends persist, trend-following can adapt, i.e. provide exposure to the best of both worlds. Over the full sample history, replacing bonds completely with trend-following would have resulted in roughly 1.18% lower annualized return at a volatility of 15%, which was primarily driven by the outstanding outperformance of the bond markets in the post GFC era from 2010 to 2020. A large part of the returns to bonds in this period came from a fall in volatility and an increase in returns from the "carry" in bond portfolios.

	Stocks + Bonds	Stocks + Vanilla Trend
CAGR	8.46%	7.27%
CAGR @ 15% vol	7.80%	6.62%
Sharpe	0.56	0.54
Sortino	0.89	1.03
Skew	-0.90	0.07
Kurtosis	2.20	1.15

Statistics are monthly. 01/01/1999 – 11/30/2023



Source: Bloomberg, LongTail Alpha

Exhibit 6: Replacing Bonds with Vanilla Trend

5. Replacing Bonds with a Carry-Optimized Trend Program

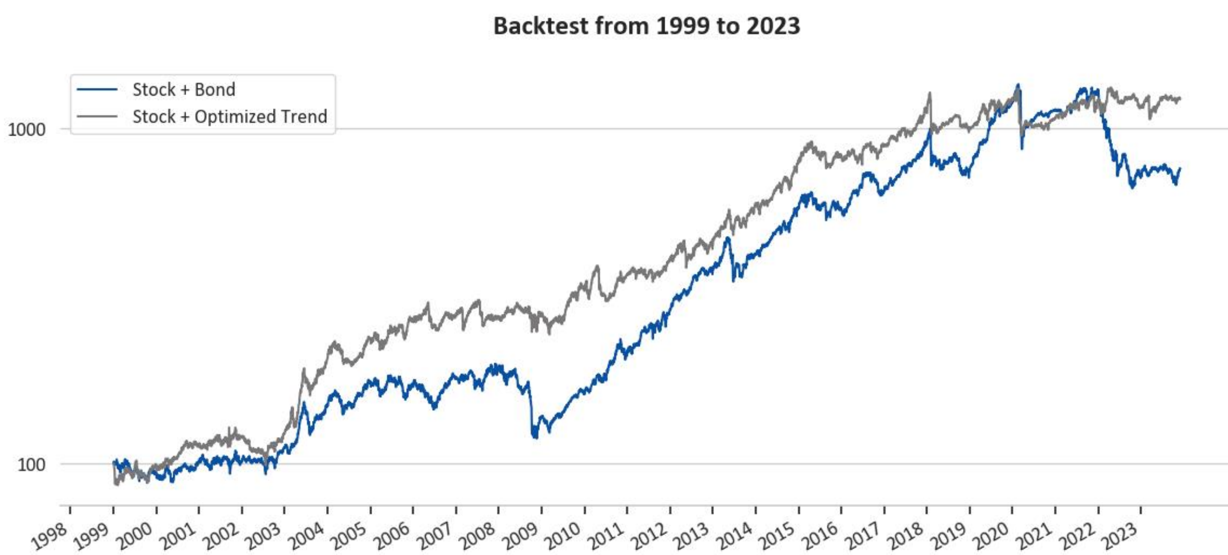
Bond investors know the benefits of including "carry" in their portfolio construction. Research has shown that carry is indeed an important driver of returns across all asset classes[3]. As we saw in the last section, replacing bonds with trend resulted in lower performance due to the loss of carry from the bond component. In this section we ask if there is a way to get the benefits of carry inside of a trend-following program. Thus, instead of a simple trend-following strategy, what if we utilize a "carry-optimized" trend program? The strategy below differs from a vanilla trend program in that it has one additional requirement before it can go long or short a security: the carry must be in the same direction as the trend. In other words, it only goes long securities with positive trend and positive carry; and vice versa for going short. We find that the carry-optimized trend program spends significantly less time short bonds during this sample history, hence it generally has more positive duration, possibly making it a more attractive substitute for a long duration bond allocation compared with simple trend following. As discussed in one

[3] See, for instance "Carry", R.S.J. Koijen et. al., "Journal of Financial Economics" (2018), Vol. 127.

of our previous papers[4], incorporating carry considerations in a trend-following algorithm is generally additive to performance. Since carry can be thought of as a “cost” of participating in a trend, if the negative carry is too large, then over time this can result in subpar trend-following performance.

	Stocks + Bonds	Stocks + Optimized Trend
CAGR	8.46%	10.58%
CAGR @ 15% vol	7.80%	9.73%
Sharpe	0.56	0.79
Sortino	0.89	1.43
Skew	-0.90	-0.27
Kurtosis	2.20	2.28

Statistics are monthly. 01/01/1999 – 11/30/2023



Source: Bloomberg, LongTail Alpha

<u>Exhibit 7: Replacing Bonds with Optimized Trend</u>

In exhibit 7, we observe better performance using a carry-optimized trend program compared with a vanilla trend strategy. The enablement of a carry “filter” ensures that one only enters positions when you are “paid” to do so: long with positive carry, short with negative carry. We observe that this feature notably increases CAGR and other risk-return statistics as well over the long run.

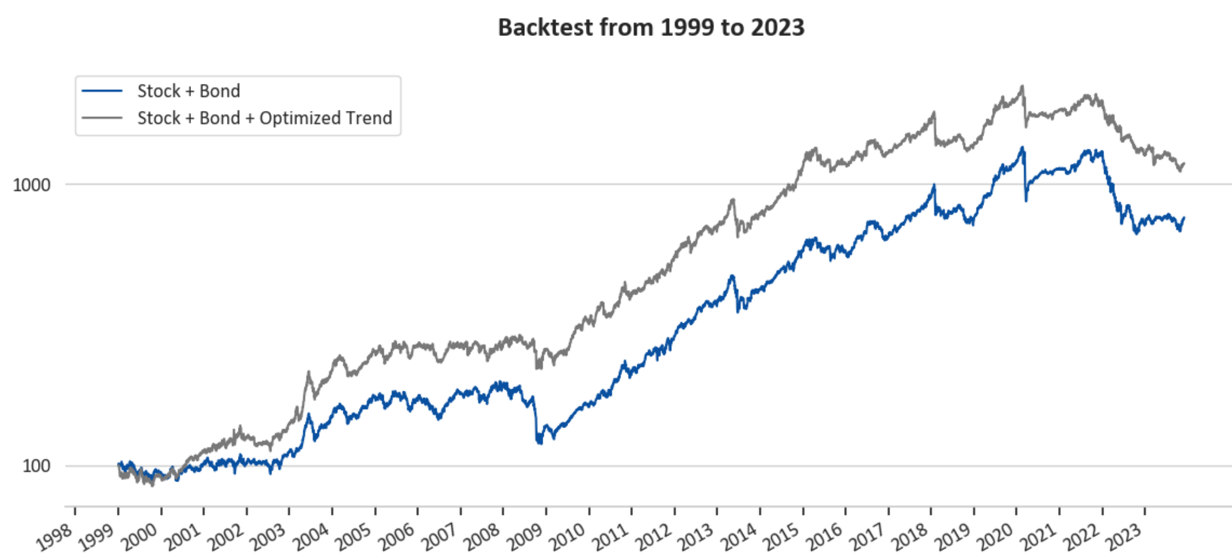
[4] See “Carry and Trend In Lots of Places”, V. Bhansali et. al. , Journal of Portfolio Management (2015), Vol 41.

6. Stocks, Bonds, plus a Carry-Optimized Trend Program

In the prior sections we observed that long duration exposure has been a key contributor to portfolio returns over the last few decades. We also observe that in a risk-parity portfolio with trend instead of bonds, a carry filter-enabled trend strategy is a superior strategy than the vanilla trend strategy. Combining these observations, we backtest a three-asset risk parity portfolio with stocks, bonds, and a carry-optimized trend strategy. Average strategy weights are summarized in the Appendix and show that this portfolio would have approximately 64% in stocks, 251% in bonds, and 54% in trend-following. Thus, such a portfolio would require levered exposure to the bond market, which is readily available using derivatives such as futures and total return swaps.

	Stocks + Bonds	Stocks + Bonds + Optimized Trend
CAGR	8.46%	10.41%
CAGR @ 15% vol	7.80%	9.74%
Sharpe	0.56	0.71
Sortino	0.89	1.26
Skew	-0.90	-0.30
Kurtosis	2.20	1.13

Statistics are monthly. 01/01/1999 – 11/30/2023



Source: Bloomberg, LongTail Alpha. Both portfolios target 15% volatility.

Exhibit 8: Adding Optimized Trend to Risk Parity

This trio solution appears to be the best of all worlds. We observe that the bulk of outperformance attributed to incorporating trend-following occurred predominantly before 2010. In the decade from 2010 to 2019, the performance of the stock + bond + trend strategy closely mirrored that of the vanilla stock + bond risk parity portfolio. This similarity in performance largely stems from trend-following's underwhelming results during the 2010s, a period characterized by muted market trends, uniformly low and declining volatilities across asset classes, dis-inflation, low yields and globally coordinated central bank policy efforts, all of which favored traditional fixed income exposure over dynamic trend-following strategies. During this period, having a carry-optimized trend-following strategy was an important differentiator relative to the vanilla trend strategy since the returns to carry were significant and positive. Despite these periods of underperformance, ex-ante prediction of the efficacy of trend-following as an asset class is extremely hard, but maintaining some level of exposure to trend-following is advisable since a complete removal could leave one to miss out on significant gains, such as those witnessed in 2022.

7. Risk Parity: Stocks, Bonds, Commodities, and Trend

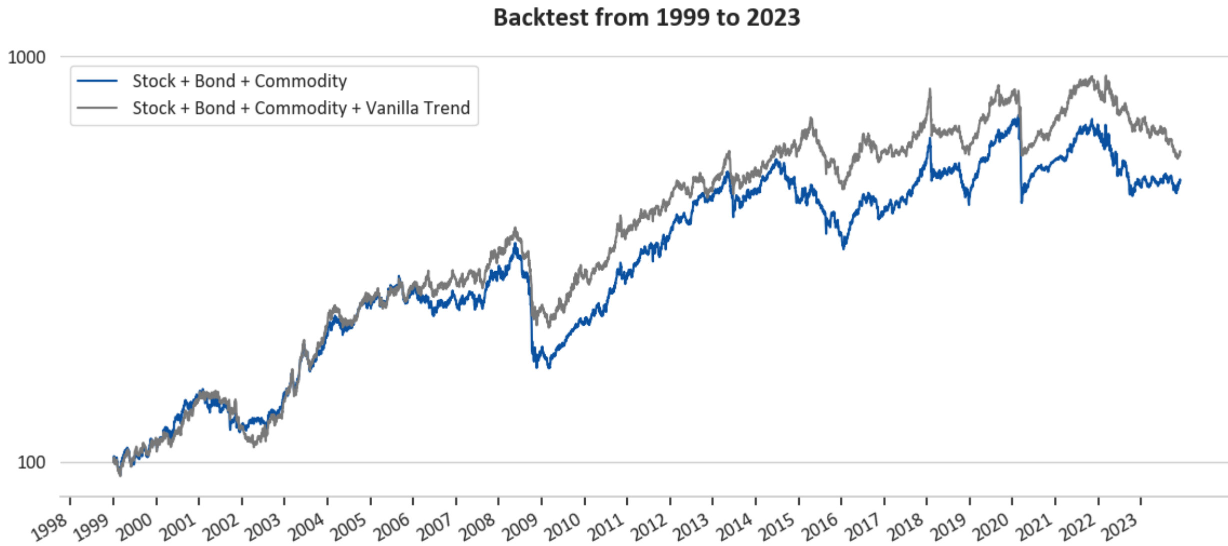
In the sections above we address the benefits of incorporating a trend following strategy into a stock and bond risk parity portfolio. We discuss scenarios when trend is simply added to a risk parity program, as well as scenarios when trend is substituted for bonds. However, many risk parity portfolios may incorporate commodities (and other "alternative" assert classes) in addition to stocks and bonds. As such, we briefly discuss results when the benchmark risk parity portfolio contains stocks, bonds, and commodities.

a. Stocks, Bonds, Commodities, plus a Vanilla Trend Program

We note that commodities did not perform well during our sample period between January 1999 and the end of November 2023. While a stock and bond risk parity program generated a 8.46% CAGR, adding commodities into the risk parity mix took CAGR down to 6.61%. This is not surprising considering that the commodity index we utilize, the S&P GSCI Total Return Index, has only a 0.53% CAGR over this period. That being said, the benefits to adding a trend following strategy still hold. Adding a simple trend program to this stock, bond, and commodity risk parity portfolio leads to greatly improved performance, not only in return, but also in risk-adjusted metrics like Sharpe and Sortino. We also see significant reductions in negative skew and kurtosis ("fat tails").

	Stocks + Bonds + Commodities	Stocks + Bonds + Commodities + Vanilla Trend
CAGR	6.61%	7.30%
CAGR @ 15% vol	6.17%	6.87%
Sharpe	0.45	0.50
Sortino	0.68	0.84
Skew	-1.23	-0.52
Kurtosis	4.41	1.35

Statistics are monthly. 01/01/1999 – 11/30/2023



Source: Bloomberg, LongTail Alpha. Both portfolios target 15% volatility.

Exhibit 9: Adding Vanilla Trend to 3-asset Risk Parity

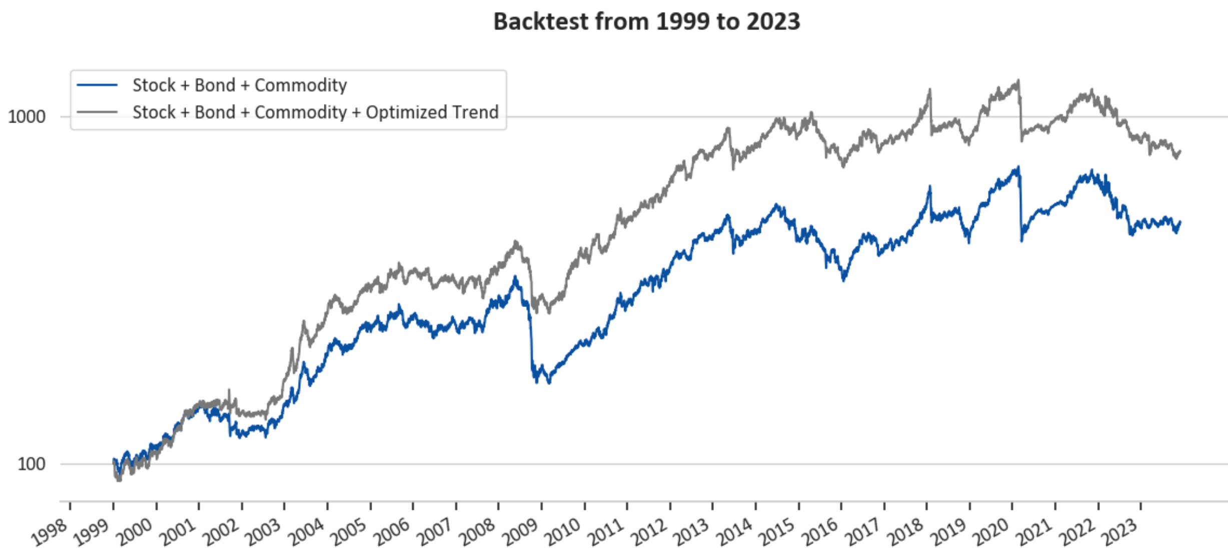
b. Stocks, Bonds, Commodities, plus a Carry-Optimized Trend Program

Adding a carry filter to a trend following strategy tends to make it more diversifying to commodities. Since January 1999, commodities in general were in contango far more frequently than they were in backwardation, indeed about three times as much, meaning that for this majority of the time, a carry-filter trend would only be able to go short commodities[5]. We find during our sample period that the CSLAB Index had a slightly positive correlation with the Bloomberg Commodity Index, while the carry-filter trend program had a slightly negative correlation. As such, we find that adding a carry-filter enabled trend program to a stock, bond and commodity risk parity portfolio yields even greater performance benefits, at the cost of a slight walk-back in the gains in skew and kurtosis.

[5] AQR Capital Management, "Commodities for the Long Run: Index Level Data, Monthly" (August 31, 2023). Available at: https://www.aqr.com/Insights/Datasets/Commodities-for-the-Long-Run-Index-Level-Data-Monthly

	Stocks + Bonds + Commodities	Stocks + Bonds + Commodities + Optimized Trend
CAGR	6.61%	8.64%
CAGR @ 15% vol	6.17%	8.15%
Sharpe	0.45	0.59
Sortino	0.68	0.98
Skew	-1.23	-0.56
Kurtosis	4.41	1.90

Statistics are monthly. 01/01/1999 – 11/30/2023



Source: Bloomberg, LongTail Alpha. Both portfolios target 15% volatility.

Exhibit 9: Adding Optimized Trend to 3-asset Risk Parity

Conclusion

Risk-parity strategies excelled from the early 1990s through 2020, benefiting from a negative correlation between stocks and bonds, substantial positive returns from both asset classes, and an environment of falling interest rates coupled with ample liquidity that facilitated leverage. However, as 2022 demonstrated, risk-parity is notably vulnerable to shifts in correlations, and in such periods systematic strategies such as trend-following tend to do very well. Our analysis reveals that augmenting a risk-parity portfolio comprised of stocks and bonds with a simple trend-following program has historically improved risk-adjusted returns. We contend that completely excluding bonds from the portfolio is not advisable due to their proven role in diversifying stock risk. Further, in today's environment, yields are attractively positive. But inclusion of trend-following in traditional risk-parity construction can modulate the risks from duration exposure. Consequently, we advocate for a trio approach in an evolved risk parity strategy – integrating bonds, equities, and trend-following. Trend-following can add significant return and diversification to a portfolio and improve the overall risk-adjusted and absolute performance of traditional risk-parity. A trend strategy, by virtue of its dynamic approach, can serve to amplify returns of these asset classes when they are performing well, and attenuate exposures when they are performing poorly. In addition, due to the inherent leverage in trend-following programs which use derivatives, the volatility of such programs can be tuned to match the risk and reward profile desired in a standalone, traditional risk-parity portfolio. Finally, a trend-following strategy that incorporates simple, systematic active management levers, such as a carry filter, can lead to an even further enhanced implementation of “Risk Parity 2.0”. Including commodities and other asset classes within the risk-parity portfolio does not change the conclusion that trend-following is highly complementary to risk-parity when including these additional asset classes.

Appendix

Backtests start on January 1st of 1999 and end November 30th of 2023.

Instruments:

1. **Stocks** are represented by S&P 500 E-minis (ES1 Index).
2. **Bonds** are represented by the Bloomberg US Aggregate Total Return Unhedged Index (LBUSTRUU Index).
3. We use the Credit Suisse Managed Futures 15% Vol Index as our proxy for "**Vanilla Trend-following**".
4. For "**Carry-Optimized Trend following**" we backtest a simple strategy which combines both a 200-day moving average and a carry signal for 78 liquid futures contracts across equities, interest rates, currencies and commodities. We assume that trades incur 5bps of transactions costs [6,7] each direction.
5. Commodities are represented by the S&P GSCI Total Return index.

Volatility:

1. All portfolios use a Risk Parity algorithm which equates the volatility contribution across assets. It uses a 52-week lookback window for covariance and volatility calculation. All portfolios target 15% volatility, with the backtested, realized portfolio volatilities as follows:
    a. Stock + Bond: 16.5%
    b. Stock + Vanilla Trend: 16.8%
    c. Stock + Optimized Trend: 16.4%
    d. Stock + Bond + Vanilla Trend: 16.3%
    e. Stock + Bond + Optimized Trend: 16.2%
    f. Stock + Bond + Commodities: 16.3%
    g. Stock + Bond + Commodities + Vanilla Trend: 16.1%
    h. Stock + Bond + Commodities + Optimized Trend: 16.0%

Margin Assumptions:

1. Vanilla Trend and Optimized Trend are simulated as if they were on Total Return Swaps. We assume a 10% margin requirement, and a financing assumption detailed below.
2. There is no simulation of variation margin. We just assume a static percentage of notional is posted as margin at any moment.
3. We estimate ES1 and TY1 as requiring 6% and 3% margin throughout their entire history.

The margin simulation will not have any effect on the relative results/ranking of the strategies since all cash (idle cash + cash posted for derivatives margin) earn the same LIBOR - 50bps. In reality, any variation margin posted will likely experience a lower return than the cash-equivalents, like treasury bills, that one is able to post to meet initial margin. Variation margin is frequently required to be in cash. We hope to account for this by being conservative in our cash return assumption, using a rate of return of 50bps below 3-Month LIBOR.

[6] Jones, Charles M., A Century of Stock Market Liquidity and Trading Costs (May 23, 2002). Available at SSRN: https://ssrn.com/abstract=313681 or http://dx.doi.org/10.2139/ssrn.313681

[7] Hurst, Brian and Ooi, Yao Hua and Pedersen, Lasse Heje, A Century of Evidence on Trend-Following Investing (June 27, 2017). Available at SSRN: https://ssrn.com/abstract=2993026 or http://dx.doi.org/10.2139/ssrn.2993026

Financing Assumptions:

1. The Bloomberg US Aggregate is financed at LIBOR + 50 bps
2. Credit Suisse Managed Futures as well as Optimized Trend are financed at LIBOR + 100 bps.

Mean Instrument Weights for backtests:

	Stock	Bond	Commodities	Vanilla Trend	Optimized Trend
Stock + Bond	78%	333%			
Stock + Vanilla Trend	75%			78%	
Stock + Optimized Trend	73%				71%
Stock + Bond + Vanilla Trend	67%	268%		63%	
Stock + Bond + Optimized Trend	64%	251%			54%
Stock + Bond + Commodities	59%	282%	41%		
Stock + Bond + Commodities + Vanilla Trend	53%	240%	34%	53%	
Stock + Bond + Commodities + Optimized Trend	51%	225%	35%		46%

Weights shown as a percentage of total capital. Sum can be greater than 100% since portfolios are leveraged, and exposures are implemented via futures and total return swaps. Note that underlying instrument daily volatilities are 19.9%, 4.2%, 23.2%, 15.4%, and 15.6% for Stock, Bond, Commodities, Vanilla Trend and Optimized Trend, respectively.

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