

Using VIX to Dynamically Hedge Portfolio Risk

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Abstract

Many investors accept "buy and hold" as their long-term investment strategy. However, during periods of heightened risk, staying disciplined can be problematic. Alternatively, market timing appeals to our emotions but is very difficult to employ successfully. Between these two extremes lies tactical asset allocation, where limited variances are allowed to take advantage of market conditions. Dynamic hedging is a form of tactical asset allocation. Instead of relying on future predictions of asset class returns, dynamic hedging strives to reduce portfolio risk when market risk is elevated. This paper presents a dynamic hedging strategy developed to accomplish this goal. It uses VIX's normal trading range to assess market risk. When VIX trades above its normal trading range and the upper Bollinger band, the dynamic hedging strategy is applied. The result is that portfolio risk is lowered when market risk is extreme. The application of this strategy provides better returns, lower volatility, and better downside protection than a strategic "buy and hold" allocation. It also avoids the deployment problems associated with market timing strategies.

JEL Codes: G10, G11, G14, G17

Keywords: VIX, Dynamic Hedging, Tactical Asset Allocation

Introduction

A central doctrine of financial advice is to concentrate on long-term goals, pick an asset-allocation strategy to meet those goals, and stick with it. This approach is defined by strategic asset allocation and calls for setting target allocations, and then periodically rebalancing the portfolio back to those targets as investment returns cause a drift from the original allocation percentages. The strategy is often referred to as "buy and hold," rather than an active-trading approach. Asset allocation changes are made due to changes in the investor's circumstances. Moving in and out of the market based on near-term expectations is seen as counterproductive to reaching long-term goals.

Market timing, on the other hand, is moving in and out of asset classes in an attempt to profit from the future direction of the market. In a truly efficient market, profiting from these trades would not be possible; however, many investors do not accept this hypothesis and believe that inefficiencies in the market persist and can be exploited. Although numerous academics believe it is impossible to time the market, most active traders believe strongly in market timing. What we know for certain is that it is very difficult to be continuously successful at market timing over the long run.

While these two strategies represent extremes in financial theory and appear to be at odds, a combination of the two may be beneficial. During the periods of heightened market risk, earmarking a portion of the portfolio to hedge against this risk may help lower volatility. This more active approach is considered a tactical asset allocation within a strategic asset-allocation framework.

Tactical asset allocation is an active investment strategy that allows for small, short-term shifts in the strategic asset allocation in order to profit from opportunities in the markets. As a result, investors can actively manage their allocations, within a limited range, to adjust to near-term market aberrations. Dynamic hedging is a form of tactical asset allocation, which focuses on reducing portfolio risk during periods of elevated market stress.

This paper develops a practical dynamic hedging strategy that lowers portfolio risk and improves downside protection when market or systematic risk is heightened. To measure the efficacy of the strategy, I examined returns, standard deviations, and Sharpe ratios.

The efficient-market hypothesis would imply that tactical asset allocation cannot increase risk-adjusted returns, since markets are already efficiently priced. Even though I agree with the efficient-market hypothesis, I am in with

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the camp that believes in what is called the “weak-form efficiency,” in which future prices cannot be predicted simply by analyzing prices from the past. This weak form believes that prices are not always at equilibrium.

Since most individual investors invest for the long term, making major shifts in the asset allocation is generally not advisable. Therefore, it is impractical to develop a strategy that requires large bets on the direction of the market. However, volatility drives investors out of the market, generally at the wrong time, keeping them from reaching their long-term goals.

I proceeded to build a tactical strategy that would complement a long-term, well-diversified portfolio and improve downside protection, which should allow investors to stay invested for the long term. To that end, I developed a systematic strategy to exploit the variance in returns of certain asset classes based on market volatility.

Market volatility increases the variance in potential returns and, therefore, increases risk. During the times of heightened volatility, growth assets tend to underperform. My tactical strategy was developed to exploit these trends.

To assess market risk, I used the CBOE Volatility Index or the VIX Index. It is the most widely watched statistic to measure market volatility (risk). The VIX Index is designed to measure near-term volatility as indicated by index option prices in the S&P 500 Index (SPX).

The VIX index is an index of 30-day implied volatility as indicated by the prices of SPX option contracts. Implied volatility rises when the relative prices of options increase. In contrast, volatility falls when the relative prices of options decline. The daily change in the VIX index is an indication of how aggressively SPX option contracts are being purchased or sold.

Historically, the VIX has routinely traded in a range between 20 and 30. A price below 20 generally implies complacency in the market and shows that investors have become bullish, while a reading greater than 30 indicates a high level of investor apprehension. I regarded the higher reading as an aberration for a turning point in the market.

To further refine the strategy, and limit trading to a more reasonable level, I superimposed the VIX with the Bollinger bands. The Bollinger bands consist of a center line, the simple moving average of the VIX (in this case) and two price channels (bands) above and below it. The

Bollinger bands are plotted two standard deviations above and below the moving average. Because standard deviation is a measure of volatility, the Bollinger bands adjust to the market conditions. When the markets become more volatile, the bands widen. During the less volatile periods, the bands contract. The theory behind the Bollinger bands is that the closer the prices move to the upper band, the more overbought the market, and the closer the prices move to the lower band, the more oversold the market. As a result, I employed the overlay strategy only when the VIX was above 30 and above its upper Bollinger band. Thereafter, I conducted a test of the strategy without the Bollinger bands to see if a less restrictive strategy would add value.

To maximize the efficacy of the strategy and stay prudently invested at all times, I looked at a number of traditional and alternative assets/strategies to see which assets had the largest discrepancy in returns when the VIX traded outside of its normal range – above 30 and below 20. To ensure diversity, I invested the portfolio in these traditional and alternative asset classes/strategies in allocations that are generally considered balanced growth (60% growth and 40% fixed income) and maintained proper diversification throughout the study, regardless of the level of VIX.

Using the data from January 1, 2002 (data for the S&P Global Infrastructure Index and SG Trend Index are not available before this date) through June 30, 2016, I found that the tactical asset-allocation strategy reduced volatility, improved returns, and increased the Sharpe ratio from the static buy-and-hold strategy. Removing the Bollinger bands from the strategy reduced volatility even further, and reduced returns so that the Sharpe ratio was slightly lower. Although the tactical asset-allocation strategy (with the use of the Bollinger bands) was triggered less than 8% of the time, it lowered portfolio volatility for the entire study period on average 8.1% and improved returns for the entire study period on average 4.6%. In addition, during the financial collapse of 2008, the only year in the study with a substantial downdraft, this tactical strategy reduced the drawdown of the well-diversified balanced growth portfolio by over 19%.

The rest of the paper is organized as follows: in Section I, I review prior research on asset class returns given different levels of VIX. I also develop and explain the strategy. Section II provides the data description and Section III documents the main results. Section IV offers conclusions.

Literature Review and Strategy Development

Literature Review

Market timing and the potential profits, which can be reaped, has been an allure for investors since the dawn of investing. In “Market Timing: Better Than a Buy-and-Hold Strategy,” Shilling (1992) illustrates the benefits of market timing and the improved returns by being out of stocks in bear markets. Bauer and Dahlquist (2001) point out that an initial investment of \$10,000 optimally timed in and out of the U.S. large capitalization stocks and T-Bills from 1990–99 would have returned an annualized rate of 26.6%; however, they go on to conclude that in order to profit from market timing an investor would have to have predictive accuracy of 66%.

Articles dating back to Sharpe’s 1975, “Likely Gains from Market Timing,” discuss the problems with market timing. Other research including Chua (1987), Droms (1989), and Kester (1990) further analyze the difficulties, especially when you consider transaction costs. Furthermore, Jeffrey (1984) discusses the sheer folly of market timing especially for institutional investors with fiduciary responsibilities.

For most investors, a buy-and-hold strategy has become the norm, yet many still yearn for a strategy that takes advantage of short-term market anomalies and hopes that investment firms can provide this information. And many investment firms appeal to this desire by over-weighting or under-weighting assets based on near-term expectations. However, Goyal and Welch (2007) looked at out-of-sample performance of 15 different predictors commonly used to forecast market movement (e.g., earnings-price ratio, book-to-market ratio, long-term yield, term spread, etc.) and found that none of these variable had any conclusive predictive power.

This desire to move into the market when times are good, and move out before times are bad, generally leads investors to base their decisions on emotions. As Shiv, Loewenstein, Bechara, Damasio, and Damasio (2005) illustrated, emotions lead to investor mistakes. J.P. Morgan Asset Management (2017) highlights this problem regularly when it publishes its study showing the average investor underperforming all asset classes over the preceding 20 years – even inflation.

Therefore, developing an effective tactical asset-allocation strategy could have two main benefits: 1) improving risk-adjusted returns and 2) reducing excessive trading due to emotions. Philips, Rogers, and Capaldi (1996) discuss the nature and benefits of tactical asset allocation.

Brenner and Galai (1989) first developed the idea of a volatility index. Whaley (1993) discussed the efficacy of using VIX for hedging market risk in portfolios and Cippolini and Manzini (2007) documented the utility of VIX as a signal for stock direction. Research by both Engle (1982) and Bollerslev (1986) illustrated the clustering behavior of volatility and its resulting predictability. Additional research by Munenzon (2010) exhibited the very different return and risk characteristics associated with traditional asset classes given different VIX states. Munenzon (2010) further demonstrated that correlations among alternative investment strategies vary, producing outsized benefits in times of heightened market risk. In addition, the assets and strategies that are desired in these periods are the assets investors should minimize to enhance returns when markets are good.

Cloutier, Djatej, and Keifer (2017) developed a tactical asset-allocation strategy using VIX as an indicator of market risk. In their research, they reduced portfolio risk when market risk was high, and added portfolio risk when market risk was low. Subsequent research conducted for this paper showed that the dynamic hedging strategy developed here, which provides downside protection only, reduced trading by almost 60% and, yet, generated statistically similar results. Simply reducing the drawdown, reduced volatility, which, as Bouchev, Nemtchinov, Paulsen, and Stein (2012) illustrated, hinders long-term growth.

Strategy Development

Before creating a tactical asset-allocation strategy to exploit the varying risk and return characteristics of traditional assets and alternative strategies given at the different levels in VIX, I developed a few rules, which I thought were essential if this approach were to be replicated:

- The process had to be transparent (clearly defined).
- The portfolio would have to be well diversified.
- There would have to be a clear economic rationale supporting the data.

4. There would have to be a long-term evidence of positive returns under different market environments.

In addition, my goal of maintaining broad diversification meant large shifts in assets could not be tolerated; therefore, only limited rebalances in a few asset classes/strategies would be allowed.

Whaley (2009) illustrated that historically, the VIX tends to trade between 20 and 30. As a result, I looked at how returns in assets vary when the VIX trades below and above this normal range. I used a number of asset classes/strategies used by investors to broadly diversify portfolios. The list includes traditional asset classes, as well as, a number of alternative real return and absolute return strategies. The data used were as follows: mortgaged backed securities – GNMA 15 year Index; short-term bonds – Barclays US Government/Credit 1 – 5 Year Index; Treasury Inflation Protected Securities – Barclays US Treasury US TIPS Index; commodities – Bloomberg Commodity Index; high-yield bonds – Citi HY Market Index; real estate – FTSE NAREIT All Equity REIT Index; emerging market bonds – JPM EMBI Global Diversified Index; market neutral strategies – Morningstar Market Neutral Index;

long/short equities – Morningstar MSCI Long Bias N America Index; international developed large cap stocks – MSCI EAFE Index; international developed small cap stocks – MSCI EAFE Small Cap Index; emerging market equities – MSCI EM Index; US large cap stocks – Russell 1000, US small cap stocks – Russell 2000, US mid-cap stocks – Russell Mid Cap Index; infrastructure – S&P Global Infrastructure, managed futures – SG CTA Trend Sub-Index; and global macro strategies – Credit Suisse Global Macro Replication Index.

I developed the tactical asset-allocation strategy to profit from the different return characteristics. Table 1 highlights the average daily return of the different asset classes/strategies when the VIX trades outside of its normal trading range. In addition, I also exploited the variance in correlation that some asset classes/strategies exhibit when VIX trades above 30 and below 20. For example, managed futures exhibit positive correlation to the non-fixed income asset classes/strategies when VIX is below 20, but negative correlation when VIX is above 30. Similarly, GNMA's show negative correlation to VIX when VIX is above 30, but slightly positive correlation when VIX is below 20.

Table 1: Asset Class Returns when VIX is Trading Outside of Normal Range

<i>Asset Classes/Strategies</i>	<i>Daily returns when VIX is above 30</i>	<i>Daily returns when VIX is below 20</i>	<i>Difference</i>
Barclays GNMA 15 Year	0.0269	0.0115	-0.0154
Barclays Government/Credit 1-5 Year	0.0135	0.0114	-0.0021
Barclays US Treasury US TIPS	0.0389	0.0484	0.0095
Bloomberg Commodity	-0.1071	-0.0157	0.0914
Citi HY Market TR	-0.0670	0.0243	0.0913
FTSE NAREIT All Equity REITs	-0.0814	0.0276	0.1090
JPM EMBI Global Diversified	0.0230	0.0177	-0.0053
Morningstar Market Neutral	-0.0141	0.0074	0.0214
Morningstar MSCI Long Bias N America	-0.1325	0.0384	0.1709
MSCI EAFE	-0.0808	0.0025	0.0833
MSCI EAFE Small Cap	-0.1012	0.0188	0.1199
MSCI EM	-0.0387	0.0334	0.0721
SG CTA Trend	0.0193	0.0187	-0.0007
Russell 1000	0.0034	0.0049	0.0015
Russell 2000	-0.0628	-0.0023	0.0605
Russell Mid Cap	-0.0187	0.0119	0.0305
S&P Global Infrastructure	-0.0550	0.0447	0.0997
Credit Suisse Global Macro	-0.0292	0.0134	0.0426

For simplicity, I began with a model that is commonly called moderate or strategic growth; however, the strategy could be adjusted to meet differing risk tolerances. To ensure broad diversification, I included stocks, bonds, cash, and alternatives. The real return asset classes I used in our asset mix include commodities, real estate, and infrastructure. The absolute return strategies consist of market neutral, managed futures, hedged equity, and global macro strategies. Of the alternatives, I only considered global macro as part of our fixed income allocation. For my starting point, I used a diversified blend, which broadly translates into 60% growth – 40% fixed income allocation, for the neutral position. The tactical asset-allocation strategy basically underweights the more volatile asset classes during high volatility periods with a corresponding increase in risk-hedging assets. However, I remained committed to the 60/40 split, even when the tactical asset allocation was implemented, for investors who are governed by an investment policy statement. For many investors, an investment policy statement provides a target allocation between growth and fixed income assets, thereby restricting the ability to trade in and out of stocks and moving the money into bonds or cash. This

investment policy statement provides guidance and help in order to maintain discipline during stressful times.

In addition, to ensure proper diversification, changes in allocations were limited to a small number of asset classes/strategies. Since most of the volatility comes from the growth side, most of the changes appear here. The most volatile assets tended to be the assets/strategies that exhibited the highest negative sensitivity in returns based on heightened VIX levels. These were commodities, REITs, international small-cap stocks, global infrastructure, and long/short equities. Managed futures, however, exhibited the best hedging characteristics. Of the fixed income assets/strategies, high yield, as you would expect, showed the highest negative sensitivity in returns based on heightened levels of VIX. Conversely, GNMA's showed the best hedging benefits against risk when VIX was elevated.

Table 2 displays the portfolio's allocation when VIX is below 30 (the neutral allocation), the portfolio's allocation while the tactical asset allocation is on (VIX above 30), and the changes that were made.

Table 2: Change Asset Class Exposure When VIX is Above 30

<i>Model Portfolio's Asset Classes/Strategies</i>	<i>Weight</i>	<i>Weight</i>	<i>Allocation</i>
	<i>(%)</i>	<i>(%)</i>	<i>Change</i>
	<i>Neutral</i>	<i>VIX Above 30</i>	
BBgBarc GNMA 15 Yr	3.00	7.20	+4.20
BBgBarc US Govt/Credit 1-5 Yr	19.00	19.00	
BBgBarc US Treasury US TIPS	4.30	4.30	
Bloomberg Commodity	3.00	0.00	-3.00
Citi HY Market	4.20	0.00	-4.20
Credit Suisse Global Macro	3.00	3.00	
FTSE NAREIT All Equity REITs	3.00	3.00	
JPM EMBI Global Diversified	6.50	6.50	
Morningstar Market Neutral	6.00	6.00	
Morningstar MSCI Long Bias N America	3.90	0.00	-3.90
MSCI EAFE	3.00	3.00	
MSCI EAFE Small Cap	4.20	0.00	-4.20
MSCI EM	3.90	3.90	
Russell 1000	21.60	21.60	
Russell Mid Cap	5.40	5.40	
S&P Global Infrastructure	3.00	0.00	-3.00
SG CTRA Trend	3.00	17.10	+14.10

I back tested this tactical strategy from January 1, 2002 – June 30, 2016. This time frame encompasses market downturns, as well as strong upturns. Minor asset class returns varied significantly, as usual, with no class exhibiting superior returns throughout the study.

Data

For the traditional and real return assets, well-known indices were used as benchmarks. For the alternative strategies, determining the best benchmark is an industry-wide challenge. For managed futures, we used the SG CTA Trend Sub Index (formerly Newedge CTA Trend Sub-Index). The SG CTA Trend Sub-Index is a subset of the SG CTA Index, and follows traders of trend following methodologies. The SG CTA Index is equal weighted, calculates the daily rate of return for a pool of CTAs selected from the larger managers that are open to new investment. For global macro, I used the Credit Suisse Global Macro Replication Index. The Credit Suisse Global Macro Replication Index captures the risk/return characteristics of the Credit Suisse/Tremont Global Macro Hedge Fund Index. The Credit Suisse/Tremont Hedge Fund Index is broadly diversified, encompassing 490 funds (September 2008) across ten style-based sectors, and representative of the entire hedge fund industry. Index construction is fully transparent, with unbiased, rules-based selection criteria

and published constituents.¹ For market neutral, I used the Morningstar Neutral Benchmark and for long/short equity I used the Morningstar MSCI Long Bias North America Benchmark. The Morningstar Benchmarks consists of peer groups based on the Morningstar Institutional Categories and specialized investment groupings based on fund attributes. Benchmarks contain constituents from Open End, Closed End, Variable Annuities Underlying, and Exchange Traded Fund universes.²

The portfolio held the neutral allocations when VIX ended the day trading below 30. Trades were placed adjusting the tactical weightings to our defensive tactical asset allocation the day after VIX ended the day over 30 and above its upper Bollinger band. The portfolio was rebalanced on an annual basis.

Daily pricing was obtained for the asset classes/strategies via Morningstar Direct software for the period of study from January 1, 2002 – June 30, 2016. The portfolio returns were also calculated using Morningstar Direct.

Empirical Results

Table 3 highlights the results of the change in average return of the portfolio on the days in which the tactical asset-allocation strategy is employed. The daily return of the portfolio, when employed, is positive, while the daily return when not employed is negative.

Table 3: Improvement in Daily Returns when Tactical Asset Allocation is Deployed

Portfolio Return	2002-07-11 to 2002-08-16	2002-10-08 to 2002-11-04	2003-01-27 to 2003-03-03	2007-11-13 to 2007-11-14	2008-01-23 to 2008-01-24	2008-03-17 to 2008-03-19	2008-09-16 to 2009-05-20	2009-11-02 to 2009-11-03	2010-05-07 to 2010-05-11	2010-05-21 to 2010-06-04	2011-08-05 to 2011-10-17	2015-08-25 to 2015-08-28	Average Daily Return
With TAA	1.065	3.791	1.059	0.956	0.851	-0.644	-6.870	0.249	0.985	0.418	-1.518	1.424	0.006
Without TAA	-0.353	4.168	0.199	0.980	1.321	-0.389	-9.657	0.138	1.008	-0.177	-2.041	1.891	-0.010
Days on	26	19	24	1	1	2	169	1	4	10	51	3	

Table 3 also shows how few times, the tactical asset-allocation strategy was actually deployed. During the 14½ years of the study, the strategy was launched only 12 times for a total of 281 days – less than 8% of the time for the study period. Despite this, the strategy did improve the overall portfolio's performance. Total return improved,

the standard deviation was lowered, and, as a result, the Sharpe ratio increased. Table 4 compares the total return, standard deviation, and Sharpe ratio of the portfolio for the entire study period, with the tactical asset-allocation strategy and without the tactical asset allocation.

¹ Credit Suisse/Tremont Hedge Fund Index; http://www.hedgeindex.com/hedgeindex/documents/Broad_Index_Factsheet.pdf

² Morningstar Manager Benchmarks. October 2010

Table 4: Improvement in Return and Risk for the Entire Study Period

	<i>Return</i>	<i>Standard Deviation</i>	<i>Sharpe Ratio</i>
With TAA	7.61	7.43	0.85
Without TAA	7.27	8.09	0.75

Table 5 shows the annual returns with and without the tactical strategy. Noticeable is the benefit the tactical allocation had in reducing the downdraft during the collapse of 2008. The strategy reduced the decline in the broadly diversified portfolio over 19%. This year suffered the only significant selloff in equities during the study. The reduction in loss during this period highlights the efficacy of the strategy.

Table 5: Improvement in Annual Returns

<i>Portfolio Return</i>	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Jan-Jun 2016
With TAA	-0.73	25.66	12.77	8.63	13.29	8.45	-16.59	20.28	13.42	0.52	11.07	12.04	6.25	-1.89	3.96
Without TAA	-0.65	24.03	12.77	8.63	13.29	8.10	-20.51	23.56	12.40	0.04	11.07	12.04	6.25	-1.39	3.96

Finally, I looked at how the use of the Bollinger bands affected performance. Table 6 compares the return, standard deviation, and Sharpe ratio of the tactical asset-allocation strategy with and without the Bollinger bands. As you can see, removing the Bollinger bands from the strategy lowered the standard deviation but also lowered returns. The result was a slightly reduced Sharpe ratio. In addition, the number of instances the strategy would have been deployed without the use of Bollinger bands increased nearly three times, thereby reducing the strategy's practicality. Therefore, employing the Bollinger bands enhanced the benefits.

Table 6: Change in Performance when Bollinger Bands were not used

	<i>Return</i>	<i>Standard Deviation</i>	<i>Sharpe Ratio</i>
With Bollinger bands	7.61	7.43	0.85
Without Bollinger bands	7.51	7.35	0.84

Conclusions

This paper develops a feasible dynamic hedging strategy that provides downside protection and produces higher returns and lower risk by utilizing variations in market risk as indicated by VIX. The preceding data show that the dynamic hedging strategy I developed by rebalancing a limited numbers of assets based on VIX trading above

its normal range and the Bollinger bands reduced risk, improved returns, and provided better risk-adjusted returns compared to a buy-and-hold strategy, even for well-diversified portfolios. By trimming the most volatile assets during the riskier periods and placing those dollars in a portfolio hedge, I reduced instability and provided better performance – higher returns, lower standard deviation, and better risk-adjusted returns.

For my tests, I used indices to represent commonly used asset classes and strategies to build a diversified portfolio. Daily pricing for the asset classes/strategies was obtained via Morningstar Direct software for the period of study from January 1, 2002 – June 30, 2016. While adhering to the rules stated in Section II. B., the dynamic hedging strategy generated fascinating statistics. My results show that an effective strategy based on signals given by the level of VIX can be built.

As the research documents, when setting portfolio strategy, a dynamic hedging strategy can add value. Asset classes and strategies act differently under different market environments, especially during the periods of market stress and VIX can be used as a proxy for risk. A dynamic hedging strategy, which maintains proper diversification and involves the rebalancing of a limited number of assets when risk is high as measured by VIX, can provide better long-term returns with lower risk than the static buy-and-hold strategy and unlike market timing, does not involve correctly predicting future asset prices.

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