EXECUTIVE SUMMARY
RETURN OF THE QUANTS: RISK BASED INVESTING

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• Market volatility has increased in recent years. In the six decades after World War II, there were, on average no more than three “tail events” per year. Between 2000 and 2010, the average has risen to an unprecedented nine three-sigma days per year.

• Volatility—and hence exposure to loss—is not stable through time. From 1994 to 2016, the rolling one-year standard deviation for a 60/40 portfolio ranged from a low of less than 5% to a high of 20%. So a 60/40 portfolio is not always appropriate for a relatively risk-averse investor.

• A managed volatility strategy, by trading stock and bond futures, may adjust a 60/40 portfolio’s exposure to stocks all the way down to 20% when markets are highly volatile and all the way up to 75% when markets are stable.

• This strategy is portable and can easily be applied as an overlay for almost any portfolio. Managed volatility has been shown in practice to reduce exposure to loss and smooth the ride for investors, at a very low—or even positive—cost in terms of returns.

• While managed volatility is used mostly to reduce exposure to loss, we can think of covered call writing as the other side of the coin for risk-based investing, in that investors use it mostly to generate excess returns.

• Covered call writing gives exposure to the volatility risk premium—which represents compensation for providing insurance to market participants.

• Research suggests that the volatility risk premium, which is absent from most investors’ portfolios, has had more than double the risk-adjusted returns (Sharpe ratio) of the equity risk premium.

• Managed volatility and covered call writing are negatively correlated. Therefore, combining these risk-based investment tools may improve investment performance over time, especially when added to traditional equity or multi-asset portfolios.

• Despite our industry’s obsession with return forecasting, these two investment strategies focus on risk. They do not require bold predictions on the direction of markets.
Managed volatility and covered call writing are two of the few systematic investment strategies that have been shown to perform well across a variety of empirical studies and in practice. So far, they have been studied mostly as separate strategies. It turns out that when combined, these two strategies create a powerful toolset for portfolio enhancements.

Increased Volatility
Market volatility has increased in recent years. In Figure 1, we show that during the decade of the 1940s, on average, there were four days per year during which stocks moved by three standard deviations or more (“three-sigma days”).2 WWII created a lot of this turbulence. In the following six decades, the average rose no higher than three days per year. But recently, between 2000 and 2010, the average has risen to nine three-sigma days per year—more than any time in our long dataset.

According to the normal distribution, a three-sigma day should occur only 0.6 times per year (on...
average). We often refer to extreme returns as “tail events” because they lie in the tails of the probability distribution. Clearly, the tails have gotten fatter in the markets, and the normal distribution may not be a reliable tool to measure investment risk.

Several plausible explanations can be offered for this increase in market turbulence, although none can be stated with certainty and a combination of several is likely. Some of the usual suspects include

- central bank interventions,
- global market integration,
- high-frequency trading algorithms, and
- increased use of derivatives and structured products.

Whatever the root cause, investors must manage exposure to large and sudden losses. And to do so, they must recognize that volatility—and thereby exposure to loss—is not stable through time. In Figure 2, we show that from 1994 to 2016, the rolling one-year standard deviation for a 60/40 portfolio (60% stocks, 40% bonds) ranged from a low of less than 5% to a high of 20%. This portfolio’s rolling three-year standard deviation over the same period ranged from about 5% to about 15%.

This example shows that a constant (fixed-weight) asset allocation does not deliver a constant risk exposure. To a certain extent, it invalidates most financial planning advice. Is a 60/40 portfolio appropriate for a relatively risk-averse investor? The answer depends on the volatility regime.

### Managed Volatility

The managed volatility strategy adjusts the asset mix over time to stabilize a portfolio’s volatility and reduce its exposure to loss. By trading stock and bond futures, the strategy, for example, may adjust a 60/40 portfolio’s exposure to stocks all the way down to 20% when markets are highly volatile and all the way up to 75% when markets are stable. This strategy is portable and can easily be applied as an overlay to smooth the ride for almost any portfolio.

The concept of managed volatility has been thoroughly backtested. Ten such studies are listed in Table 1 (full citations are given in the References). To compare risk-adjusted alphas across studies, we report “alpha” over volatility-matched, buy-and-hold benchmarks. When the authors did not report these results directly, we have assumed that Sharpe ratios can be scaled to match the volatility of the static benchmark.

The results are encouraging, especially in a low-rate environment in which expected returns are depressed across stocks and bonds. Managed volatility seems to improve performance across a wide range of

- risk forecast methodologies;
- asset classes (stocks, bonds, currencies);
- factors/risk premiums;
- regions; and
- time periods.

As with most academic studies, a few caveats apply. First, cynics may argue that only backtests that generate interesting results get published. Second, authors often make unrealistic assumptions about trading, such as assuming that managers can rebalance everything at the closing price of the same day that the signal is generated; moreover, some authors ignore transaction costs altogether. Third, some strategies do not use budget constraints, such that part of the alpha may come from a systematically long exposure to equity, duration, or other risk premiums versus the static benchmark.

**Figure 1. Average Number of Three-Sigma Price Movements in the S&P 500 Index (per year and per decade)**

Sources: FactSet, Standard & Poor’s, and T. Rowe Price. The conceptual idea is from McKinsey.
Figure 2. Rolling One- and Three-Year Volatilities for a 60/40 Portfolio

Note: The balanced strategy is 60% S&P 500 Index and 40% Bloomberg Barclays US Aggregate Index rebalanced monthly.

Sources: Ibbotson Associates, Standard & Poor’s, and Barclays.

Table 1. Selected Studies on Managed Volatility

<table>
<thead>
<tr>
<th>Year</th>
<th>Study</th>
<th>Backtest</th>
<th>Volatility Forecast</th>
<th>Universe</th>
<th>Period</th>
<th>Alpha (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>Fleming, Kirby, and Ostdiek</td>
<td>Daily, MVO</td>
<td>Nonparametric daily</td>
<td>4 asset classes</td>
<td>1983–1997</td>
<td>1.5</td>
</tr>
<tr>
<td>2003</td>
<td>Fleming, Kirby, and Ostdiek</td>
<td>Daily, MVO</td>
<td>Nonparametric, intraday</td>
<td>4 asset classes</td>
<td>1984–2000</td>
<td>2.8</td>
</tr>
<tr>
<td>2012</td>
<td>Hallerbach</td>
<td>Daily</td>
<td>Trailing six-months daily</td>
<td>EURO STOXX 50 vs. cash</td>
<td>2003–2011</td>
<td>2.2</td>
</tr>
<tr>
<td>2013</td>
<td>Kritzman</td>
<td>Daily, TAA</td>
<td>Absorption ratio</td>
<td>8 asset classes</td>
<td>1998–2013</td>
<td>4.9</td>
</tr>
<tr>
<td>2013</td>
<td>Dopfel and Ramkumar</td>
<td>Quarterly</td>
<td>Regime-switching</td>
<td>S&amp;P 500 vs. cash</td>
<td>1950–2011</td>
<td>2.0</td>
</tr>
<tr>
<td>2013</td>
<td>Hocquard, Ng, and Papageorgiou</td>
<td>Daily</td>
<td>GARCH</td>
<td>7 asset classes</td>
<td>1990–2011</td>
<td>2.6</td>
</tr>
<tr>
<td>2014</td>
<td>Perchet, Carvalho, and Moulin</td>
<td>Daily</td>
<td>GARCH</td>
<td>22 factors</td>
<td>1980–2013</td>
<td>3.0</td>
</tr>
<tr>
<td>2016</td>
<td>Moreira and Muir</td>
<td>Monthly</td>
<td>Trailing one-month daily</td>
<td>10 factors, 20 countries</td>
<td>1926–2015</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Notes: We report the average of key results or the key results as reported by the authors. MVO refers to mean–variance optimization; TAA refers to various multi-asset portfolio shifts; all other backtests involve timing exposure to a single market or risk premiums. Countries refers to country equity markets, except for Perchet, Carvalho, and Moulin (2014), which includes value and momentum factors across 10 countries and 10 currencies. Some backtests in Fleming, Kirby, and Ostdiek (2001) and Perchet, Carvalho, and Moulin (2014) involve shorter time series because of the lack of available data. The backtest by Dopfel and Ramkumar (2013) is in-sample. The regime-switching model in Kritzman, Page, and Turkington (2012) combines turbulence, GDP, and inflation regimes. Readers should refer to the original papers for more information on the volatility forecast methodologies. Regarding transaction costs, Fleming, Kirby, and Ostdiek (2001, 2003) assume execution via futures contracts and estimate transaction costs in the 10–20 bps range. Moreira and Muir (2016) report transaction costs in the 56–183 bps range for physicals. All other studies do not report transaction costs.
Nonetheless, although these risk-adjusted alphas should be shaved to account for the usual implementation shortfall between backtests and reality, managed volatility has been shown in practice to reduce exposure to loss and smooth the ride for investors, at a very low—or even positive—cost in terms of returns.

**Managed Volatility Model Portfolio.** Consider a backtest that we have built specifically to represent real-world implementation. For this example, we set a target of 11% volatility for a balanced portfolio of 65% stocks and 35% bonds. We scaled the overlay to avoid any systematically long equity or duration exposure versus the underlying portfolio. We allowed the managed volatility overlay to reduce equity exposure to as low as 20% and increase it as high as 75%.³

We then applied a band of 14% and 10% volatility around the target. As long as volatility remained within the band, no rebalancing was required. When volatility rose above or fell below the bands, the strategy rebalanced the overlay to meet the (expected) volatility target. We used a wider upper band because volatility tends to spike up a lot more than it tends to spike down, so the asymmetrical bands are meant to reduce noise and minimize the intrusiveness of the algorithm.

Within the portfolio, we assumed that 95% of assets were invested directly in a balanced strategy composed of actively managed mandates (i.e., within each of the asset classes, managers engaged in security selection).⁴ The remaining 5% were set aside as the cash collateral for the volatility management overlay, which we assumed to be invested in Treasury bills. When volatility was at target, the futures overlay was set to match the balanced portfolio at 65% stocks and 35% bonds. Equity futures were allocated 70% to the S&P 500 Index and 30% to the MSCI EAFE (Europe, Australasia, and the Far East) Index futures, to reflect the neutral US/non-US equity mix inside the balanced strategy. Lastly, we imposed a minimum daily trade size of 1% and maximum trade size of 10% of the portfolio’s notional.

To forecast volatility, we used a DCC–EGARCH model (dynamic conditional correlation, exponentially weighted generalized autoregressive conditional heteroskedasticity) with fat-tailed distributions. This model replicates fairly closely the implied volatility on traded options and thus how investors in general forecast volatility. DCC relates to time-varying correlations, and the ARCH category of models accounts for the time-series properties of volatility, such as its persistence or tendency to cluster. We re-estimated the model daily using 10 years of data ending the day prior to forecast.⁵ Volatility forecasts were updated daily using the most current parameter estimates. Importantly, we strictly used information known at the time to determine how to trade the overlay.

**In Figure 3,** we show the rolling volatility for the strategy versus a static benchmark.⁶

As expected, over the 18-year period studied, managed volatility has consistently stabilized realized volatility compared with a static benchmark—despite the relatively wide bands used in our algorithm and despite the fact that volatility is measured on a very short window of 60 days (shorter windows tend to show more variability in volatility). The algorithm worked particularly well during the 2008–09 financial crisis.

**In Figure 4,** we show the strategy’s equity exposure during the same 18-year period. The strategy is quite tactical. Although it does not trade more than 10% of the portfolio’s notional value in futures in a given day, some of the shifts in equity allocations are meaningful and occur over relatively short periods of time.

**In Figure 5,** we show the realized annualized return and worst drawdown for three balanced fund strategies:

- “Balanced portfolio with active components” is the static balanced fund that allocates to actively managed building blocks.
- “Balanced portfolio with active components and MVOL” is the same balanced fund with active building blocks, to which we have applied the managed volatility overlay on the entire notional.
- “Balanced portfolio with index components” is the static balanced fund allocated to passive (index) building blocks.

We also show results for US bonds, US stocks (S&P 500), and international stocks (MSCI EAFE).

In this example, active managers added returns over passive benchmarks (after fees) through security selection while slightly increasing exposure to loss. When we applied the managed volatility overlay to this portfolio, we sacrificed a few basis points of returns, but we significantly reduced drawdown exposure.

³Notice that the model allows for adding risk above the 65% strategic allocation when volatility is low. In fact, investors can calibrate managed volatility overlays to any desired risk level, including levels above the underlying portfolio’s static exposure.

⁴Note that we used an actual track record for an actively managed balanced fund. However, this example is for illustrative purposes only.

⁵We used an expanding window, increasing from 3 years to 10 years, until 10 years of data became available.

⁶Here the benchmark (static portfolio) is invested in passive (index) building blocks. The portfolio with actively managed building blocks generated similar results for the purposes of this illustration.
Figure 3. Rolling 60-Day Volatility of Managed Volatility Portfolio vs. Static Benchmark (December 1996–December 2014)

Note: The managed volatility benchmark is composed of 65% equity (45.5% S&P 500 Index and 19.5% MSCI EAFE Index) and 35% fixed income (Bloomberg Barclays US Aggregate Bond Index).
Sources: Standard & Poor’s, MSCI, Barclays, and T. Rowe Price.

Figure 4. Equity Exposures for Managed Volatility vs. Static Benchmark (December 1996–December 2014)

Notes: The managed volatility benchmark is composed of 65% equity (45.5% S&P 500 Index and 19.5% MSCI EAFE Index) and 35% fixed income (Bloomberg Barclays US Aggregate Bond Index). Past performance cannot guarantee future results.
Sources: Standard & Poor’s, MSCI, Barclays, and T. Rowe Price.
Why Would Managed Volatility Improve Risk-Adjusted Return? To explain this success, we must understand why volatility is persistent (and therefore predictable). Periods of low and high volatility—so-called risk regimes—tend to persist for a while. This persistence is crucial to the success of the strategy, and it means that simple volatility forecasts can be used to adjust risk exposures.

A fundamental argument could be made that shocks to the business cycle themselves tend to cluster. Bad news often follows bad news. The use of leverage—in financial markets and in the broader economy—may also contribute to volatility clustering. Leverage often takes time to unwind. Other explanations may be related to behavioral aspects of investing that are common to investors across markets, such as “fear contagion,” extrapolation biases, and the financial media’s overall negativity bias.

In terms of managing tail risk specifically, one way to explain how managed volatility works is to represent portfolio returns as being generated by a mixture of distributions, which is consistent with the concept of risk regimes. When we mix high-volatility and low-volatility distributions and randomly draw from either, we get a fat-tailed distribution. By adjusting risk exposures, managed volatility essentially “normalizes” portfolio returns to one single distribution and thereby significantly reduces tail risk.

Importantly, short-term expected (or “forward”) returns do not seem to increase after volatility spikes, which explains why managed volatility often outperforms buy-and-hold in terms of Sharpe ratio (or risk-adjusted performance in general). This phenomenon has been studied in academia (see, for example, Moreira and Muir 2016). Most explanations focus on the time horizon mismatch between managed volatility and value investing. Moreira and Muir (2016) observe that expected returns adjust more slowly than volatility. Therefore, managed volatility strategies may re-risk the portfolio when market turbulence has subsided and still capture the upside from attractive valuations. The performance of managed volatility around the 2008 crisis is a good example. As Moreira and Muir (2016) put it:

Our [managed volatility] portfolios reduce risk taking during these bad times—times when the common advice is to increase or hold risk taking constant. For example, in the aftermath of the sharp price declines in the fall of 2008, it was a widely held view that those that reduced positions in equities were missing a once-in-a-generation buying opportunity.
opportunity. Yet our strategy cashed out almost completely and returned to the market only as the spike in volatility receded… Our simple strategy turned out to work well throughout several crisis episodes, including the Great Depression, the Great Recession, and the 1987 stock market crash. (p. 2)

Another way of thinking about how managed volatility may increase Sharpe ratios in certain market environments is to think of time diversification as being similar to cross-sectional diversification. Suppose we invest in five different stocks with the same Sharpe ratios but very different volatility levels. If we assume the stocks are uncorrelated, we should allocate equal risk (not equal value weights) to get the Sharpe ratio–maximizing portfolio. The same logic applies through time; the realized variance of the portfolio is basically the sum of the point-in-time variances. So, to get the highest Sharpe ratio through time, we should allocate equal risk to each period.

However, managed volatility does not always outperform static portfolios. For example, when spikes in volatility are followed by short-term return gains, managed volatility may miss out on those gains (versus a buy-and-hold portfolio). Also, it is possible for large market drawdowns to occur when volatility is very low. In those situations, managed volatility strategies that overweight stocks in quiet times (to a higher weight than the static portfolio) may underperform.

In sum, the empirical observations in support of managed volatility—volatility persistence and the lack of correlation between volatility spikes and short-term forward returns—hold on average but not in all market environments.

Covered Call Writing (Volatility Risk Premium)

Although managed volatility is used mostly to reduce exposure to loss, we can think of covered call writing as the other side of the coin for risk-based investing, in that investors use it mostly to generate excess returns. The basics of the strategy are simple: The investor sells a call option and simultaneously buys the underlying security or index. Covered call writing gives exposure to the volatility risk premium, one of the best performing of the “alternative betas” that have risen in popularity recently. As mentioned by Israelov and Nielsen (2015), “The volatility risk premium, which is absent from most investors’ portfolios, has had more than double the risk-adjusted returns (Sharpe ratio) of the equity risk premium” (p. 44).

In the same article, the authors decompose the return from covered call writing into three components:

1. The equity risk premium, net of the call delta or “equity sensitivity exposure”
2. The volatility risk premium, which is the difference between implied volatility from option prices and realized volatility
3. A dynamic equity exposure, which is a reversal component that exists if investors do not delta-hedge their equity exposure over time

Covered Call Writing Example. In Table 2, we show a stylized example of the mechanics of covered call writing with delta hedging.

In this example, we assume the investor wants to maintain a 75% equity delta exposure while markets rally over a one-week period. In this case, the delta-hedged strategy would unfold as follows:

- Initially, the investor holds a 100% long equity position, with a –50% delta at-the-money call. (The delta is negative to represent the short position in the call.)
- The investor simultaneously takes a 25% long position in equity futures, such that the net equity delta exposure for the portfolio is 75% (100% long equities – 50% short call + 25% long equity futures).
- One week later, the market is rallying. The investor’s long equity position remains 100%, but the call’s delta is now –70%. In general, the more in the money the option, the higher the delta (and

<table>
<thead>
<tr>
<th>Time: 0</th>
<th>Delta Exposure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long equity</td>
<td>100</td>
</tr>
<tr>
<td>Short at-the-money call</td>
<td>–50</td>
</tr>
<tr>
<td>Long equity futures</td>
<td>25</td>
</tr>
<tr>
<td>Portfolio’s delta exposure</td>
<td>75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time: One Week Later/Scenario: Market Rally</th>
<th>Delta Exposure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long equity</td>
<td>100</td>
</tr>
<tr>
<td>Short at-the-money call</td>
<td>–70</td>
</tr>
<tr>
<td>Long equity futures</td>
<td>25</td>
</tr>
<tr>
<td>Portfolio’s delta exposure</td>
<td>55</td>
</tr>
</tbody>
</table>

To maintain a portfolio delta to take the portfolio’s exposure from 55% to 75%.

Note: This table shows a hypothetical example. Source: T. Rowe Price.
ipso facto, the more negative the delta on the short position).

- The long equity futures remains 25%. Therefore, the portfolio’s delta exposure is down to 55% (100% long equity – 70% short call + 25% long equity futures).

- To maintain a portfolio delta of 75%, the investor buys 20% in equity futures.

This example shows how delta hedging works. The investor estimates the equity sensitivity of the call at any point in time (or according to some predetermined frequency) and adjusts the portfolio to its targeted net equity exposure using futures. Doing so isolates the volatility risk premium and negates the dynamic equity exposure/reversal timing component of covered call writing. As Israelov and Nielsen (2015) show, this component tends to detract from the performance of covered call writing—hence delta hedging tends to add value.

In Table 3, we show results from several empirical studies on the performance of covered call writing. The strategy has been shown to generate alpha across markets and time periods and for several variations of the underlying methodology. Fallon, Park, and Yu (2015) backtested volatility risk premium strategies across 11 equity markets, 10 commodities, 9 currencies, and 4 government bond markets. They found that “the volatility risk premium is sizable and significant, both statistically and economically” (p. 53).

Nonetheless, the same caveats apply as for the managed volatility studies—namely, that only backtests with good results tend to get published and that authors often ignore implementation shortfall between backtests and realized performance. Nonetheless, in practice, covered call writing has been shown to deliver good risk-adjusted performance, although perhaps not as high as 6%-7% alpha across all market regimes.

### Why Would Covered Call Writing Continue to Deliver Excess Returns?

As for managed volatility, we must ask why we should expect the strategy to continue to perform well going forward. In other words, what are the theoretical foundations behind the volatility risk premium?

First, hedging is in great demand. For example, insurance companies need to hedge explicit liabilities they have written. More generally, investors in many countries are increasingly seeking drawdown protection. Thus, by selling options, investors should earn a risk premium. The magnitude of this premium is determined by the supply-and-demand imbalance for insurance. (Some observers may say that covered call writing does not sell protection. But if the puts are overpriced because of the demand for protection, calls should be overpriced as well, through put–call parity. Indeed, dealers can replicate the put with the call and a short forward position. As long as no arbitrage occurs, demand for protection will also drive up the call price.)

The history of implied volatility for US stocks is consistent with the fact that investors crave protection, as shown in Figure 6. From January 1996 to March 2016, implied volatility was almost always significantly above realized volatility, as shown in Figure 6. Fallon, Park, and Yu (2015) report similar

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8For clarity, we implicitly refer to “delta-hedged covered call writing,” but once we are delta hedging, we do not technically have a “covered call” position anymore.

### Table 3. Selected Studies on Covered Call Writing

<table>
<thead>
<tr>
<th>Year</th>
<th>Study</th>
<th>Analysis</th>
<th>Period</th>
<th>Alpha (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Feldman and Roy</td>
<td>BXM</td>
<td>2003–2004</td>
<td>5.2%</td>
</tr>
<tr>
<td>2006</td>
<td>Hill et al.</td>
<td>Dynamic strategies</td>
<td>1990–2005</td>
<td>7.0%</td>
</tr>
<tr>
<td>2007</td>
<td>Kapadia and Szado</td>
<td>10 backtests</td>
<td>1996–2006</td>
<td>3.5%</td>
</tr>
<tr>
<td>2008</td>
<td>Ilya Figelman</td>
<td>BXM</td>
<td>1988–2005</td>
<td>5.8%</td>
</tr>
<tr>
<td>2015</td>
<td>Israelov and Nielsen</td>
<td>Delta-hedged BXM</td>
<td>1996–2014</td>
<td>1.7%</td>
</tr>
<tr>
<td>2015</td>
<td>Fallon, Park, and Yu</td>
<td>34 asset classes</td>
<td>1995–2014</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

Notes: The BXM index refers to the CBOE S&P 500 BuyWrite Index. It is a benchmark index designed to track the performance of a hypothetical buy-write (covered call writing) strategy on the S&P 500. Fallon, Park, and Yu’s (2015) analysis includes 11 equity markets, 10 commodities, 9 currencies, and 4 government bond markets. Start dates vary from January 1995 to February 2001 based on data availability, and alpha is averaged across all backtests.
tail risks in the volatility risk premium for 33 out of 34 of the asset classes they studied.

Both explanations—the demand for hedging and the compensation for tail risk—are, in fact, connected. Providers of insurance should expect negatively skewed returns, by definition. The bottom line is that if long-term investors can accept negative skewness in their returns, they should get compensation through the volatility risk premium.

Combining Managed Volatility and Covered Call Writing

Investors can use managed volatility to reduce the tail risk exposure in covered call writing. In general, investors should think of risk-based investing as a set of tools, rather than standalone strategies. Low or even negative correlations between risk-based investing strategies can add a lot of value to a portfolio, even when the individual strategies’ Sharpe ratios are relatively low.

In Table 4, we show the correlation of monthly returns above cash from January 1996 to December 2015 for (1) the S&P 500, (2) covered call writing, and (3) managed volatility (overlay only, without the equity exposure). In this case, the covered call writing strategy sells at-the-money calls and maintains an equity delta of 0. The managed volatility strategy captures the excess return above the S&P 500 by increasing and decreasing exposure to stocks based on market volatility. The strategy

<table>
<thead>
<tr>
<th>Monthly Returns above Cash</th>
<th>Covered Calls</th>
<th>Managed Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managed volatility</td>
<td>—0.20</td>
<td>—0.51</td>
</tr>
<tr>
<td>S&amp;P 500</td>
<td>0.36</td>
<td></td>
</tr>
</tbody>
</table>

Notes: All returns are excess of cash, which is defined as the total return of three-month US Treasury bills. The data exclude the impact of fees and trading costs.

- buys stocks’ futures when short-term trailing volatility is lower than long-term volatility and
- sells stocks’ futures when the short-term volatility is higher than long-term volatility.

We calculated short-term realized volatility on a 60-day rolling window. For long-term volatility, we used an expanding window of out-of-sample data going back to January 1940.

The correlation between the S&P 500 and covered call writing was 36%—a very low number for a risk premium (hence the term “alternative” beta). However, this correlation may increase in times of market stress.

Figure 6. Implied Market Volatility Compared with Realized Market Volatility (January 1990–March 2016)

Notes: The VIX represents investors’ expectations of the S&P 500 Index’s volatility over the next 30-day period. Data are as of March 2016.
Sources: S&P 500, Bloomberg, and T. Rowe Price.
volatility and covered call writing was –20%. This result suggests that when investors incur a loss on covered call writing, they are likely to have already de-risked their portfolio with their managed volatility overlay, thus reducing the impact of the loss.

In Table 5, we further illustrate the power of diversification between covered call writing and managed volatility. We report returns, volatilities, downside risk, and relative performance statistics for the standalone and combined strategies. From January 1996 to December 2015, the risk–return ratio of the S&P 500 was 0.41. When combined with the covered call writing strategy (with gross exposure capped at 125%), the S&P 500’s risk–return ratio increased from 0.41 to 0.49 while downside risk was only marginally reduced.

But when we added managed volatility, the risk–return ratio jumped from 0.49 to 0.69 (even though the standalone managed volatility strategy had a relatively low risk–return ratio of 0.17) and downside risk was reduced substantially.

The important takeaway is that managed volatility and covered call writing are negatively correlated. Therefore, combining these risk-based investment tools may improve investment performance over time, especially when added to traditional equity or multi-asset portfolios.

### Table 5. Simulated Performance of Standalone and Combined Risk-Based Investing Strategies (January 1996–December 2015)

<table>
<thead>
<tr>
<th>Rolling Annual Returns above Cash (1996–2015)</th>
<th>Components (no gross exposure cap)</th>
<th>Portfolio (capped gross exposure at 125%)</th>
<th>Reference Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Covered Call Writing</td>
<td>Managed Volatility</td>
<td>S&amp;P + Covered Calls</td>
</tr>
<tr>
<td>Absolute performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return</td>
<td>2.2%</td>
<td>1.3%</td>
<td>7.5%</td>
</tr>
<tr>
<td>Volatility</td>
<td>2.1%</td>
<td>7.8%</td>
<td>15.4%</td>
</tr>
<tr>
<td>Risk–return</td>
<td>1.06</td>
<td>0.17</td>
<td>0.49</td>
</tr>
<tr>
<td>Downside</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worst drawdown</td>
<td>5.9%</td>
<td>24.7%</td>
<td>44.7%</td>
</tr>
<tr>
<td>5th percentile</td>
<td>–1.0%</td>
<td>–9.8%</td>
<td>–21.2%</td>
</tr>
<tr>
<td>Worst</td>
<td>–3.4%</td>
<td>–17.5%</td>
<td>–37.7%</td>
</tr>
<tr>
<td>Relative performance vs. S&amp;P 500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alpha</td>
<td>1.7%</td>
<td>3.2%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Beta</td>
<td>0.06</td>
<td>–0.26</td>
<td>0.85</td>
</tr>
<tr>
<td>IR</td>
<td>0.99</td>
<td>0.52</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Notes: All returns are excess of cash, which is defined as the total return of three-month US Treasury bills. The data exclude the impact of fees and trading costs. For the capped portfolio analysis, if gross exposure exceeds 125%, the derivatives are scaled back proportionally within each portfolio so the portfolio’s gross exposure stays at 125%. The “S&P 500 + Covered Calls” component is calculated as (0.80 × Return of the S&P 500) + (0.75 × Return of the option component). The “S&P 500 + Covered Calls + Managed Volatility” component is calculated as (0.80 × Return of the S&P 500) + (0.75 × Return of the covered call component) + Return of the managed volatility overlay.


### Conclusions

Volatility has been shown to be persistent, and in the short run, it has not been predictive of returns. Accordingly, managed volatility is one of the few systematic investment strategies that historically outperform buy-and-hold benchmarks across a wide range of markets and data samples.

Covered call writing is another systematic strategy that has been shown to generate consistently attractive risk-adjusted performance across a large number of empirical studies and in practice. The strategy gives investors access to the volatility risk premium, which represents compensation for providing insurance to market participants and thereby assuming the associated tail risk.

Importantly, combining managed volatility and covered call writing can be extremely effective because these two strategies are negatively correlated and can easily be added to conventional portfolios. And despite our industry’s obsession with return forecasting, these two investment strategies focus on risk. They do not require bold predictions on the direction of markets.
REFERENCES


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Question and Answer Session
Sébastien Page, CFA

Question: How is managed volatility different from risk parity?

Page: Risk parity seeks to equalize risk contributions from individual portfolio components. Usually, it is done at the asset class level and assumes that Sharpe ratios are all the same across asset classes and that all correlations are identical. Low-volatility asset classes, such as bonds, are typically levered up to increase their risk contribution to the portfolio. On the surface, therefore, it is quite different. It is a way to allocate the portfolio, and it doesn’t address risk disparity through time—the fact that periods of high volatility with high exposure to loss alternate with periods of lower volatility.

However, some risk parity strategies maintain a target volatility for the entire portfolio. In a sense, this means that there can be an implied managed volatility component to risk parity investing.

Still, to believe in risk parity investing, you have to believe that Sharpe ratios are the same in all markets and under all market conditions, which is not always the case, in my opinion.

Question: Why not just focus on downside volatility?

Page: Downside volatility can be calculated in many different ways. For example, you can use semi-standard deviation by calculating deviations below the mean, or you can use conditional value at risk and try to manage risk at that level. And option prices, for example, compensate for the tail of the distribution.

To focus on downside risk makes sense (is there such a thing as upside risk?), but in general, it is more difficult to forecast the directionality of volatility than volatility itself. Hence, doing so in backtests may not change the forecast that much.

Question: The volatility risk premium has negatively skewed returns; could you expand on the implications?

Page: This question comes up often around managed volatility. The goal is to lower exposure to the market on the way down and then get back in when volatility goes back down but when valuations are still attractive. Moreira and Muir (2016) have done an interesting test related to this question. They argue that time horizon matters. They show, across more than 20 different markets and risk premiums, that the correlation between this month’s volatility, calculated very simply on daily data, and next month’s volatility is about 60%, thus indicating persistence in the volatility.

Then they examined the correlation between volatility this month and returns next month. They found a 0% correlation. If it were negative, it would work even better, but the 0% correlation is good enough to substantially improve risk-adjusted returns by simply timing volatility.

The intuition is that value-focused investors try to buy low and sell high, but they typically do so with a longer time horizon, often waiting for market turbulence to subside before they buy low. It’s worth noting that valuation signals don’t work very well below a 1-year horizon, and they tend to work best when the horizon is relatively long, say 5 to 10 years.

The difference in time horizon between a managed volatility process with a one-month horizon and a longer-cycle valuation process often allows managed volatility investors to get back into risk assets at attractive valuations. The intuition is that value-based investors typically wait for market turbulence to subside before they “buy low.”

Moreira and Muir’s study (2016) is particularly interesting because they tested several market crises, including the crash of 1987, and the strategy with a one-month volatility forecast outperformed buy-and-hold over all crisis periods.

Question: Do liquidity issues arise when implementing managed volatility and covered call writing strategies for very big funds?

Page: You can run managed volatility with very liquid contracts, such as S&P 500 and Treasury futures. If the portfolio is not invested in such plain-vanilla asset classes, there might be a trade-off between basis risk (how well the futures overlay represents the underlying portfolio) and liquidity, but this trade-off can be managed with a risk factor model and a tracking error minimization model.

Nonetheless, it’s irrefutable that liquidity risk can create significant gaps in markets, and some investors—for example, insurance companies—buy...
S&P put options in combination with managed volatility to explicitly hedge this gap risk.

Regarding covered call writing, index options on the S&P 500 are liquid. However, for other options markets, investors must assess the trade-off between illiquidity and the risk premium earned.

Question: What are the costs of implementing these strategies?

Page: The trading costs for a managed volatility overlay are remarkably low because of deep liquidity of futures markets, perhaps 10–18 bps. If the overlay is not implemented in house, a management fee of 10–20 bps will be accrued. Accessing the volatility risk premium through options is probably on the order of 40–60 bps for transaction costs plus a management fee. Note that these are just estimates, and costs always depend on the size of the mandate and a variety of other factors.

Question: Can you use managed volatility to inform currency hedging decisions?

Page: With currency hedging, investors must manage the trade-off between carry, which is driven by the interest rate differential, and the risk that currencies contribute to the portfolio. Importantly, the investor’s base currency matters.

When investors in a country with low interest rates hedge their currency exposures, they typically benefit from risk reduction, but it comes at the cost of negative carry. Japan, for example, has very low interest rates, which means currency hedging is a “negative carry trade.” So it is very hard to convince Japanese investors to hedge, even though from a risk perspective, it may be the right decision.

In Australia, in contrast, currency hedging offers positive carry because local interest rates are relatively high. Hence, Australian investors love to hedge their foreign currency exposures back to the home currency. But the Australian dollar tends to be a risk-on currency.

Ultimately, investors can use managed volatility to optimize this trade-off dynamically. As volatility goes up, they can adjust their hedge ratios to reduce exposure to carry (thereby reducing their “risk-on” exposures). To do so, they must recalculate the risk–return trade-offs on an ongoing basis and re-examine the correlations between currencies and the underlying portfolio’s assets (as well as with their liabilities when applicable).

Question: Is it better to do option writing when the Volatility Index (VIX) is high or low?

Page: It is generally better to sell options when implied volatility is overpriced relative to expected realized volatility. For example, when investors are nervous over a high-volatility event or a market drawdown, options may be overpriced. So, the determinant is not necessarily high or low volatility but rather the effect investor behavior is having on option prices relative to the real economic volatility in the underlying investment. To get the timing right is not easy, of course, but active management may add value over a simple approach that keeps a constant exposure to the volatility risk premium.

Question: With so much money chasing managed volatility, do you think the alpha is likely to become more elusive?

Page: It’s true that managed volatility is harder to implement when everyone’s rushing for the door at the same time. And the risk of overcrowding—and in general, gap risk—is always there, but as mentioned, managed volatility still works well when we slow down the algorithm.

Also, over time, profit opportunities from “overreaction” should entice value or opportunistic investors to take the other side of managed volatility trades. I think of it as an equilibrium. As managed volatility starts causing “overreaction,” the premium early value buyers during spikes in volatility will become more and more attractive, enticing those investors to provide liquidity.
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