Parametric
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VOLATILITY RISK PREMIUM AND FINANCIAL DISTRESS

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The volatility risk premium (VRP), also known as the insurance risk premium (IRP), has become attractive to investors as a potential source to enhance portfolio returns. The VRP is generally indicated as the difference between the implied volatility of options contracts for a given security and the subsequently realized volatility of the underlying asset. The VRP may be viewed as the premium that option sellers receive from option buyers seeking a form of financial insurance. When properly constructed, a strategy of selling options to capture the VRP can generate returns with a low correlation with more traditional assets, such as equities or fixed income, add diversification benefits, and potentially enhance portfolio returns for investors.

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This is the fourth paper in a series that Parametric has published on the VRP. The first paper discusses the sources of the volatility risk premium, explaining that the VRP may come from three distinct sources: behavioral biases, economic factors, and structural constraints faced by investors (Ge 2014). The second paper compares the three most common derivative-based methods to monetize the VRP: option strategies, variance swaps, and VIX Index futures (Ge 2016b). It concludes that investors can seek to harvest the VRP with either a dedicated capital allocation or an overlay strategy and suggests that for many investors using equity index options may be the best approach, closely followed by VIX Index futures. The third paper discusses how investors can incorporate the VRP into a balanced or an equal-weight multi-asset portfolio (Ge 2016a). It concludes that investors whose structure allows, may utilize the overlay approach to incorporate the VRP into their portfolios to take advantage of the implicit leverage embedded in this approach. Incorporation of the VRP as a dedicated allocation is also seen as a potential good choice as it may deliver better returns without introducing significant extra risk.

Many investors are wary of put-selling strategies due to the perceived downside risk, especially during market turmoil. Put options sellers only collect limited premiums but may be forced to pay out large sums during market downturns. With limited upside benefit, and potentially large losses, put-selling strategies are unintuitive to many investors and represent the least attractive investment risk/return profiles. As an added complication the practice of "tail-risk hedging" became popular among institutional investors (Darnell 2010), especially after the Global Financial Crisis. The most popular approach to conducting the tail-risk hedging is purchasing out-of-the-money index options, thereby eliminating a portion of the downside risk to portfolios caused by market downturns. As a result, put index option selling contrasts with the tail-risk hedging techniques and is essential to many VRP strategies. Thus it is usually associated with significant investment losses when financial stresses are present.

However, this common perception reflects a significant misunderstanding. VRP portfolios, if implemented with out-of-the-money options, should by design outperform the market index during a crisis. The focus of this paper is to explain how VRP portfolios work to cushion investors from investment losses during a crisis in both theory and practice. Two model VRP portfolios are used in the paper, a Dedicated VRP Portfolio and an Overlay VRP Portfolio. The paper examines how these two VRP portfolios performed during five financial crises in the past 30 years (Black Monday, 1987; 1990 Recession; LTCM Crisis, 1998; Internet Bust, 2000-2002; and the Global Financial Crisis, 2007-2009). The two VRP portfolios are further examined in three artificially constructed scenarios modelled after three of the most significant market catastrophes during the early 20th century, the Great Depression of 1929 to 1932, the 1938 Recession, and the 1970s Stagflation and OPEC Embargo.

This study explains, both in theory and with empirical data, that the performance of VRP portfolios during such periods depended on two main factors, the beta of the VRP strategy and the speed of the market crash. Generally, the higher the beta level and the faster the market crash, the larger losses the VRP strategy suffered. On the other hand, even with the worst scenarios, the VRP strategies performed significantly better than the underlying S&P 500® Index. The paper concludes that VRP components can be expected to suffer significantly less losses during market distress. When the market crash is slow-paced, the drawdowns in VRP components are significantly milder. The resilient performance potential during financial crises is a significant benefit and motivation for including the volatility risk premium into investors' portfolios via option selling methodologies.

▸▸ HOW VRP PORTFOLIOS OUTPERFORM DURING TIMES OF MARKET DISTRESS

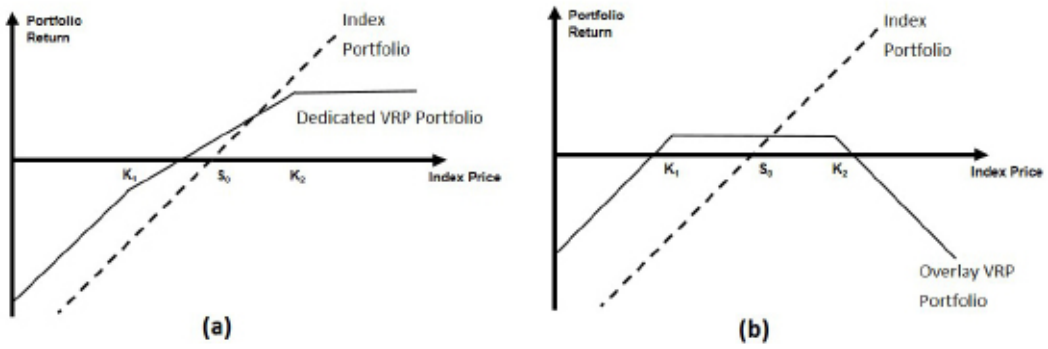
Two VRP-based portfolios, the Dedicated VRP Portfolio and the Overlay VRP Portfolio, are examined here. They are the same two portfolios previously examined in the third paper of the VRP series (Ge 2016b). They are constructed using delta 20% S&P 500 Index options that expire in a month, as follows:

- **The Dedicated VRP Portfolio** - 50% S&P 500 Index exposure, 50% Treasury Bills, and a short strangle consisting of shorting S&P 500 Index puts and calls layered on top of the base assets. Both short positions of put and call options are explicitly and fully collateralized by the underlying S&P 500 Index and Treasury Bills. This construct has a long-term regression beta of 0.54 against the S&P 500 Index.
- **The Overlay VRP Portfolio** - a short strangle based on shorting S&P 500 Index options[1] with equal notional, i.e. 100% S&P 500 Index puts and 100% S&P 500 Index calls, plus 100% Treasury Bills. This construct has a long-term regression beta of 0.08 against the S&P 500 Index.

The two VRP portfolios are constructed in a fashion so that the S&P 500 Total Return (TR) Index, the Dedicated VRP Portfolio, and the Overlay VRP Portfolio form a consistent gradient. Stated another way, the assets of the Dedicated VRP portfolio are exactly half way between the S&P 500 TR Index and the Overlay VRP Portfolio, or stated mathematically:

Dedicated VRP Portfolio = (S&P 500 TR Index + Overlay VRP Portfolio) / 2

Figure 1. Performance Profile of Dedicated and Overlay VRP Portfolios



Note: S_0 refers to the index price when the option contract is initiated; K_1 refers to the strike price of the index put option; K_2 refers to the strike price of the index call option.

Source: Parametric, 5/31/2016. Provided for illustration purposes only; not a recommendation to buy or sell any security or adopt any investment strategy. It is not possible to invest directly in an index.

The VRP portfolios are designed to outperform the market index during a crisis. The cause of this outperformance is illustrated in Figure 1. When the market index price falls, the fall has to reach the strike price before triggering option payouts. Therefore, the put option payouts should always be lower than the loss of the market index, if the payout is made at all. In the Overlay VRP portfolio, the outperformance equals the difference between the put strike price and the market index price at the time of option initiation, plus the option premiums collected from both index calls and puts. In the Dedicated VRP portfolio, the outperformance equals the total of two components: (1) half the difference between the put strike price and the market index price at the time of option initiation, plus (2) the option premiums collected from both index calls and puts. As the Dedicated VRP Portfolio has a beta of around 0.5 and the Overlay VRP Portfolio has a beta close to 0, the former is expected to suffer more losses during financial crises than the latter.

[1] A strangle on the S&P 500 Index consists of an index put option and an index call option at the same expiration date, with different strike prices. The profitability of shorting strangles depends on the strike price and the index price at the expiration date.

Of course, Figure 1 only shows the return profiles of VRP portfolios during the life time of a single option. Over the longer term, the profitability of the VRP strategies depends on the cumulative profits and losses of the options over many cycles. During the life time of each option, the profitability of the VRP constructs will depend on the severity of the market loss and the premiums collected from selling the options. By extension, the overall profitability of the VRP constructs over many option cycles depends on the market volatility trajectory, the path of the underlying index, as well as the performance of the index during the time spans examined. Stated differently, a path-dependency is introduced for the VRP strategies. During crisis times, it can be predicted that if the market index falls at a fast pace, both VRP constructs will suffer significant losses, although still not as much as the market index. On the other hand, if the market falls down only slowly, the VRP portfolios will suffer significantly less losses than the market index.

On the flip side, when the underlying S&P 500 Index experiences strong upswings, the VRP strategies are expected to underperform the index moderately. This conclusion can be implied easily from the right sides of Figures 1 (a) and 1 (b). The option premiums collected from selling the options should mitigate the magnitude of the underperformance.

In summary, based on the option payout curves and logic, the following predictions can be made regarding the two VRP portfolios examined in this paper:

(1) The VRP portfolios are expected to outperform the market index during crisis times. The Overlay VRP portfolio should outperform the Dedicated VRP portfolio as the latter possesses a higher beta and will suffer more from market losses.

(2) The overall profitability of the VRP portfolios depends on the speed of the market crashes. The faster the market crashes, the higher the predicted losses suffered by the VRP portfolios.

In the following sections, empirical performance data of the VRP portfolios are examined.

▸▸ DATA AND METHODOLOGY

This study analyzes the monthly returns of the VRP portfolios, the Dedicated VRP Construct and the Overlay VRP Construct, in detail. All options have delta levels of 20%, expire in 30 days, and are assumed to trade at the end of each calendar month. The back-test of the two VRP portfolios date from Jan 1986 to Jun 2015. The annual net-of-fees monthly performance of the two VRP constructs and the S&P 500 Index are compared in Figure 2. Part (a) displays performance statistics and part (b) displays the growth of wealth.

Figure 2. Simulated Performance Comparison of Two VRP Constructs vs. the S&P 500 Index (Jan 1986 – Jun 2015)

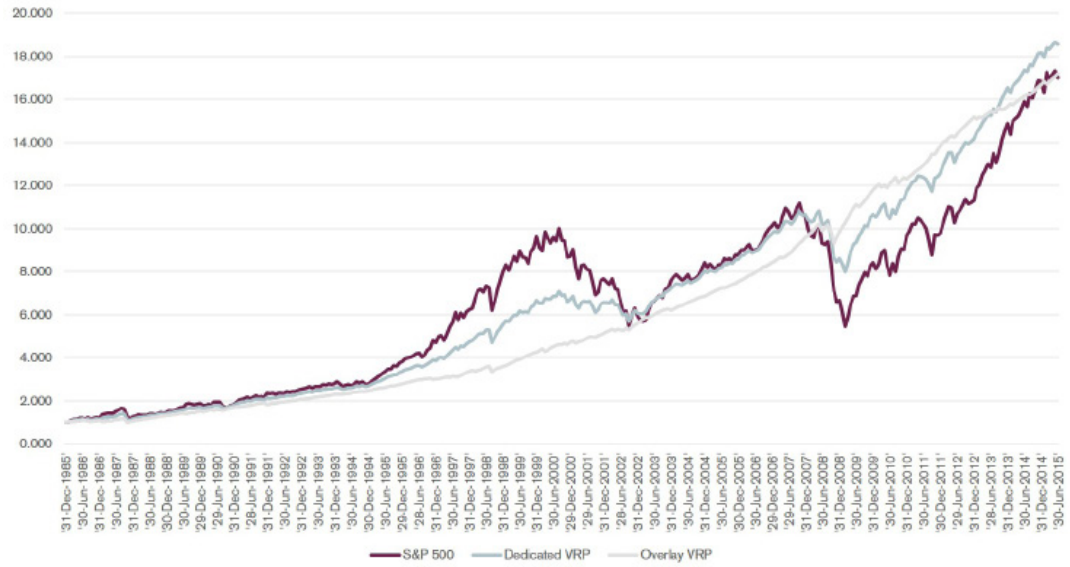
	Net Return	Risk	SR	Skewness	Beta	Max DD (monthly)
S&P 500 Index	10.08%	15.20%	0.44	-0.81	1.00	-50.99%
Dedicated VRP	10.44%	8.57%	0.82	-2.38	0.54	-25.98%
Overlay VRP	10.16%	5.18%	1.30	-4.99	0.08	-15.19%

Note: Return – Annualized Returns Net of Fees and Transaction Costs[2]; Risk – Standard Deviations; SR – Sharpe Ratios; Max DD – Maximum Drawdowns

Source: Parametric, Option Metrics, 5/31/2016. Simulated performance is hypothetical and is for illustrative purposes only; it does not represent actual returns of any investor, and may not be relied upon for investment decisions. Actual investor returns will vary. All investments are subject to the risk of loss. Past performance, actual or hypothetical, is not indicative of future results. It is not possible to invest in an index. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Please refer to the Disclosure section for further information.

[2] Option trading transaction costs are assumed to be 15% of the premiums collected; management fees for all three series is assumed to be 35 bps annually.

(a) Simulated Performance Statistics of the Three Series (Net of Fees).



Source: Parametric, OptionMetrics, 5/31/2016. Simulated performance is hypothetical and is for illustrative purposes only; it does not represent actual returns of any investor, and may not be relied upon for investment decisions. Actual investor returns will vary. Performance is presented net of fees (35 bps); option trading costs are assumed to be 15% of premiums collected. All investments are subject to the risk of loss. Past performance, actual or hypothetical, is not indicative of future results. It is not possible to invest in an index. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Please refer to the Disclosure section for further information.

(b) Growth of Wealth Indexes of the Three Series.

The monthly performance of the two constructs and the S&P 500 Index are examined during five periods of significant historical financial distress over the last 30 years, as listed below.

1. **Black Monday (October 1987)**: this episode of financial crisis actually started in September of 1987, but the most notorious decline occurred on Monday, October 19, when the S&P 500 Index lost 22% during that day. The market stabilized quickly after Black Monday but it took another 18 months for the market to fully recover to pre-crisis levels.
2. **Recession of 1990 (Summer 1990)**: this was one of the mildest economic recessions in U.S. economic history. The official recession lasted 8 months, from July 1990 to March 1991. The stock market, however, only suffered minor losses and recovered losses in 6 months' time.
3. **LTCM Crisis (August 1998)**: the demise of the Long Term Capital Management hedge fund in the summer of 1998 forced the New York Fed to orchestrate a rescue and the U.S. equity market suffered significant short-term losses. However, due the strength of the overall economy, the damage was limited and the stock market recovered in 4 months' time.
4. **Internet Bust (April 2000 – March 2003)**: the bursting of the Internet Bubble caused significant headwinds to the economy. Partly due to the Fed's aggressive rate-cutting measures, the actual economic recession was mild. The stock market suffered a slow-motion deflation rather than an outright collapse and it took 25 months for the market to reach the trough. The stock market did not recover to pre-crisis levels until 2007.

5. **Global Financial Crisis (July 2007 – June 2009)**: the Global Financial Crisis consists of several phases. Initially, the market experienced a slow deflation. However, the market collapsed violently after the bankruptcy of Lehman Brothers. With the help of forceful monetary and fiscal rescue measures, the market recovered relatively quickly and the S&P Index reached its pre-crisis levels in early 2013.

The performance of the S&P 500 TR Index and the two VRP constructs (a total of three series) during the five financial crises are analyzed. The drawdowns, speed of losses, and relative scale of loss to the S&P Index in the five crises are compared and analyzed in Figure 3. Figure 4 shows the drawdown charts of the three series during the five financial crises. The descent speed is computed as the largest cumulative monthly drawdowns divided by the number of consecutive negative monthly returns.

Figure 3. Comparison of Simulated Performance Statistics in the Five Crises (Net of Fees)

		Crisis Scenarios				
Strategy	**Statistics**	**Black Monday**	**1990 Recession**	**LTCM Crisis**	**Internet Bust**	**Global Financial Crisis**
S&P Total	Max Drawdown	-29.50%	-14.60%	-15.40%	-44.70%	-51%
	Descent Speed	-9.83%	-2.92%	-7.70%	-1.79%	-3.19%
Dedicated	Max Drawdown	-20.30%	-7.70%	-10.70%	-19.30%	-26%
VRP Portfolio	MDD as S&P DD%	69%	53%	69%	43%	51%
Overlay	Max Drawdown	-15.20%	-3.70%	-6.90%	-2.60%	-9.00%
VRP Portfolio	MDD as S&P DD%	52%	25%	45%	6%	18%

Note: Descent speed is computed as the largest cumulative monthly drawdowns divided by the number of consecutive negative monthly returns; DD – drawdowns; MDD – Maximum Drawdowns. Starting in 1996, option performance is based on the data provided by OptionMetrics. Prior to 1996 option performance is calculated using volatility data provided by the Chicago Board Options Exchange (CBOE).

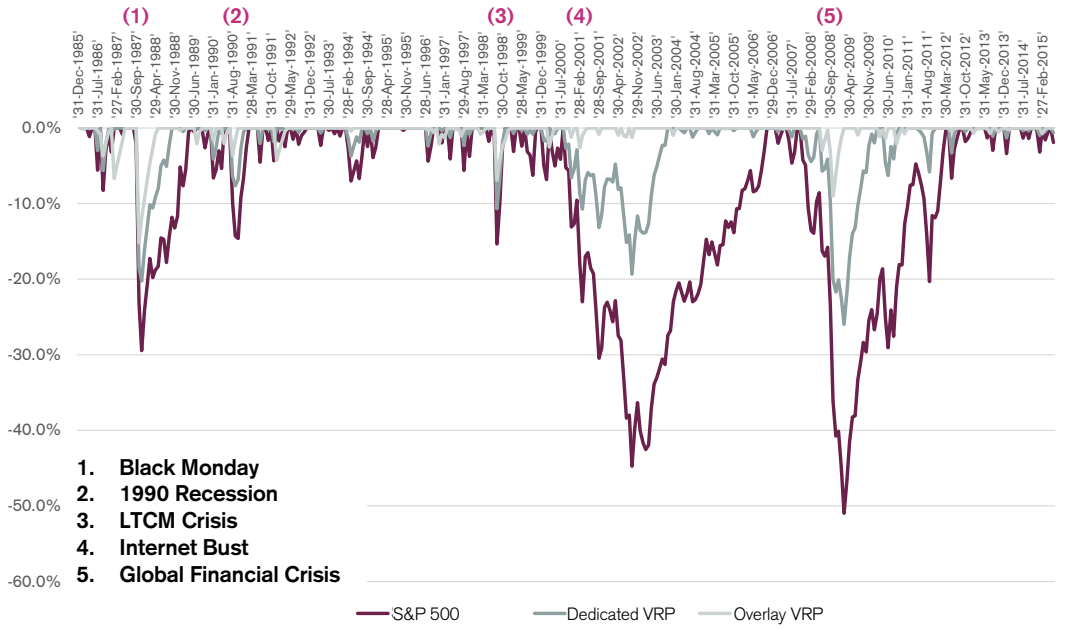
Source: Parametric, OptionMetrics, 5/31/2016. Simulated performance is hypothetical and is for illustrative purposes only; it does not represent actual returns of any investor, and may not be relied upon for investment decisions. Actual investor returns will vary. Performance is presented net of fees (35 bps); option trading costs are assumed to be 15% of premiums collected. All investments are subject to the risk of loss. Past performance, actual or hypothetical, is not indicative of future results. It is not possible to invest in an index. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Please refer to the Disclosure section for further information

▸▸ RESULTS OF SCENARIO ANALYSIS

The two VRP constructs have overall similar return levels (net of fees and costs) as the S&P 500 Index during the almost 30 years of the back-test. The S&P 500 Index returned an annualized 10.08%, comparing with the 10.44% and 10.16% for the Dedicated and Overlay VRP constructs, respectively. It is interesting to see both VRP portfolios have long-term returns higher than the S&P 500 TR Index and significantly lower volatility with annualized standard deviations of 8.57% (Dedicated VRP) and 5.18% (Overlay VRP), translating into superior Sharpe Ratios of 0.82 (Dedicated VRP) and 1.30 (Overlay VRP), respectively. However, the VRP constructs had returns with significantly more negative skewness. The negative skewness indicates the return series usually has small positive gains and large negative losses, return profiles which are generally shunned by investors.

Performance of the VRP constructs during financial crises indicates two general patterns.

Figure 4. Simulated Drawdown Charts of the Three Series During the Five Financial Crises (Net of Fees)



Source: Parametric, OptionMetrics, 5/31/2016. Simulated performance is hypothetical and is for illustrative purposes only; it does not represent actual returns of any investor, and may not be relied upon for investment decisions. Actual investor returns will vary. Performance is presented net of fees (35 bps); option trading costs are assumed to be 15% of premiums collected. All investments are subject to the risk of loss. Past performance, actual or hypothetical, is not indicative of future results. It is not possible to invest in an index. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Please refer to the Disclosure section for further information.

1. Not All Financial Crises are Created Equal

Each financial market crisis is different. Crises may be caused by different events, show different paths, and vary in pace in both descent and recovery. From a VRP investor's point of view, however, the most crucial factor is the speed with which the market goes down. During some crises, the market collapses suddenly and violently, such as Black Monday of 1987 or the Long Term Capital Management (LTCM) crisis during the summer of 1998. VRP portfolios tend to perform worse during such sudden crashes as the premiums collected have not embedded the heightened volatilities and are not able to significantly offset the option payouts. However, the VRP strategies tend to recover rapidly once rich volatility premiums are priced into the options. This tendency is shown in Figure 4 as the recovery of both VRP strategies occurs sooner, and both strategies recover lost ground significantly earlier than the underlying S&P 500 Index.

During some other crises, the market moves down slowly over longer periods of time, such as the burst of the Internet Bubble, or the first stage of the Global Financial Crisis (prior to the bankruptcy of Lehman Brothers). As predicted by option payout formulas illustrated in Figure 1, VRP portfolios tend to perform significantly better during such times, as the premiums collected have higher embedded volatilities and offset more of the option payouts, making VRP portfolios suffer less severe losses or even remain profitable during such times.

The data reported in Figure 3 clearly reflects this pattern. The S&P 500 Index fell 29.5% and 15.4% during the two acute crises, Black Monday and LTCM crisis, respectively. The Dedicated VRP Construct fell 20.3% and 10.7%, corresponding to 69% of the S&P Index drops in both episodes. The Overlay VRP Construct fell 15.2% and 6.9%, corresponding to 52% and 45% of the drops of the S&P 500 Index.

In comparison, the S&P 500 fell 14.6%, 44.7%, and 51.0% during the three crises with slower market descent (the 1990 Recession, the Internet Bust, and the Global Financial Crisis). The Dedicated VRP Construct fell 7.7%, 19.3%, and 26.0%, corresponding to 53%, 43%, and 51% of the S&P Index drops in these episodes. The Overlay VRP construct fell 3.7%, 2.6%, and 9.0%, corresponding to 25%, 6%, and 18% of the drops of the S&P 500 Index. The VRP constructs suffered significantly lower losses during these crises marked with slower market descent.

This pattern is reflected in the drawdown chart in Figure 4. The episodes of Black Monday and LTCM crises are numbered 1 and 3 in this chart. The Dedicated VRP and the Overlay VRP both showed drawdowns closer in scale to the drawdowns of the S&P 500 Index. In contrast, the Dedicated and Overlay VRP constructs showed drawdowns much smaller in scale comparing with the S&P 500 Index in other episodes.

2. VRP Portfolios With Different Beta Perform Differently.

VRP portfolios of different compositions perform differently as predicted in Figure 1. The key differentiating factor is the beta levels of the VRP portfolios. During a crisis time, the overall equity market tends to perform poorly and any beta exposure will detract from portfolio performance. The Dedicated VRP Construct, with 50% S&P 500 exposure and a beta of 0.54, tends to perform worse during such a time, as compared with the Overlay VRP Construct, which has zero exposure to the S&P 500 Index and a beta of only 0.08. On the other hand, this beta exposure will help the portfolio during more normal times when the market is ascending.

Performance statistics in Figure 3 confirm this pattern. During each of the five examined crises, the Dedicated VRP construct suffered larger losses (ranging from 7.70% to 26.0%) than the Overlay VRP construct (ranging from 2.60% to 15.2%), corresponding to larger loss scales relative to the S&P 500 Index (43% to 69% for the Dedicated VRP construct vs. 6% to 52% for the Overlay VRP construct).

The drawdown chart in Figure 4 tells the same story. The line representing the Dedicated VRP construct, showed significantly less drawdowns than the S&P 500 Index. The line representing the Overlay VRP construct, in turn showed significantly less drawdowns than the Dedicated VRP in all five crises.

The overall message of this analysis is that VRP constructs performed significantly better than the underlying equity market (represented by the S&P 500 Index) during all crisis times, as predicted by Figure 1. Overall, the performance advantage for VRP constructs may be larger (in crises marked by slower market descent) or smaller (in crises marked by the violent market collapse), but the advantage always exists.

▸▸ DETAILED EXAMINATION OF DAILY DRAWDOWNS

The performance statistics examined in Figures 2 - 4 are based on monthly returns. Using monthly returns significantly simplifies the back-test and data analysis, but also mitigates the perceived severity of the drawdowns. Some investors may feel that drawdown analysis based on daily returns is merited. Of the five financial crises examined in this study, many investors are especially concerned with two

events, the Black Monday of 1987 and the Global Financial Crisis (especially after the bankruptcy of Lehman Brothers). In both scenarios, the stock market experienced wild swings in just a few days' time. A detailed analysis of daily drawdowns was conducted to examine how the VRP portfolios performed during these two highly stressful events. The maximum drawdowns based on daily returns are computed for all three series and compared in Figure 5.

Figure 5. Simulated Maximum Drawdown Statistics During Black Monday and the Global Financial Crisis Based On Daily Returns (Net of Fees)

	Global Financial Crisis (2007-2009)		Black Monday (1987)	
	Max DD	**% of S&P 500 DD**	**Max DD**	**% of S&P 500 DD**
S&P 500 Index	-55.2%		-31.5%	
Dedicated VRP	-31.6%	57%	-28.6%	91%
Overlay VRP	-18.0%	33%	-25.6%	81%

Source: Parametric, OptionMetrics, 5/31/2016. Simulated performance is hypothetical and is for illustrative purposes only; it does not represent actual returns of any investor, and may not be relied upon for investment decisions. Actual investor returns will vary. Performance is presented net of fees (35 bps); option trading costs are assumed to be 15% of premiums collected. All investments are subject to the risk of loss. Past performance, actual or hypothetical, is not indicative of future results. It is not possible to invest in an index. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Please refer to the Disclosure section for further information.

Figure 5 confirms the intuition that the daily drawdown statistics paint a grimmer picture of the series performance during the two extreme events. All three series showed increased maximum drawdowns compared to the monthly returns data. On the other hand, the two patterns observed earlier still hold. The Overlay VRP construct had better performance statistics than the Dedicated VRP construct, and both VRP constructs performed better than the S&P 500 Index. During the Global Financial Crisis, which was marked by slower market descent, the VRP constructs showed smaller drawdowns in scale than during the Black Monday crisis. Overall, the analysis based on daily drawdowns further confirmed the predicted benefit of VRP constructs in protecting assets during crises compared to the underlying equity index.

COMPARING DRAWDOWNS BASED ON SYNTHESIZED EXTREME HISTORICAL SCENARIOS

The detailed analysis of VRP portfolios (Figures 2 – 5) are based on extensive market data of the past 30 years. However, the equity market has been in existence for hundreds of years. A logical next step is to expand the analysis based on more extreme tail risk or "Black Swan" scenarios. There are two possible ways of doing this: creating simulated extreme events, or using other extreme historical scenarios and filling in the data gap with estimates. The second approach is used in this paper. The first approach of simulations may have the potential to test various unexperienced extreme events. However, conducting such extreme scenario analysis requires the synthesis of several related time-series of data, such as prices, volatility, interest rates, dividend yields, and the relationship between them are complex and not yet fully understood, especially during hypothetical scenarios. On the other hand, such series can be assembled based on historical sources.

In Figure 6, three extreme historical scenarios are examined in full detail with daily returns and valuations computed. The three historical periods are:

1. **Great Depression (Initial phase of the Great Depression, September 1929 – December 1932)**: this initial period of the Great Depression was probably the gloomiest period of the U.S. stock market in history. The economic recession was further exacerbated by political inaction,

Fed mismanagement, and global trade wars (triggered by the notorious Smoot–Hawley Tariff Act). The GDP of the U.S. fell by 25%, the peak unemployment rate increased to 25%, stock market fell by ~90%, and international trade diminished to a trickle.

2. **1938 Recession (Second Dip in the Great Depression, July 1937 – July 1939)**: this recession was mild compared with the first phase of the Great Depression. However, with the U.S. GDP contracting by 18%, its scale made this recession one of the worst recessions in the 20th century. The stock market fell by almost 50% during this period.
3. **Stagflation (OPEC Embargo/Oil Crisis and Stagflation, January 1973 – December 1974)**: this episode is unique due to the stagflation (occurrence of both high inflation and negative growth) caused by the massive supply shock initiated by the OPEC Oil Embargo. The GDP of the U.S. only suffered a minor loss (-3.2%), but interest rates sky-rocketed, and the equity market suffered large losses. The stock market fell by more than 40% during this period.

Figure 6. Simulated Maximum Drawdown Statistics in Three Extreme Historical Scenarios Based On Daily Returns (Net of Fees)

	Great Depression (1929-1932)		1938 Recession (1937-1939)		Stagflation (1973 - 1974)	
	Max DD	**% of Equity DD**	**Max DD**	**% of Equity DD**	Max DD	% of Equity DD
Equity Index TR	-87.8%		-45.6%		-41.2%	
Dedicated VRP	-67.3%	77%	-29.8%	65%	-19.0%	46%
Overlay VRP	-48.9%	56%	-28.6%	63%	-9.4%	23%

Source: Parametric, OptionMetrics, 5/31/2016. Simulated performance is hypothetical and is for illustrative purposes only; it does not represent actual returns of any investor, and may not be relied upon for investment decisions. Actual investor returns will vary. Performance is presented net of fees (35 bps); option trading costs are assumed to be 15% of premiums collected. All investments are subject to the risk of loss. Past performance, actual or hypothetical, is not indicative of future results. It is not possible to invest in an index. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Indexes are unmanaged and do not reflect the deduction of fees and transaction costs. Please refer to the Disclosure section for further information.

The data used in the scenario analysis for the three extreme periods are from the following sources: risk-free rate data was obtained from the Fama-French dataset[3]; stock prices were computed based on the returns of the Dow Jones Industrial Index[4]; implied volatility was computed based on stock returns of the 20 previous business days plus a constant 4% volatility risk premium; and the Black-Scholes model was used to compute the option strike prices (delta level 20%, expires in 30 days, month-end to month-end) and collected premiums. The same daily drawdown analysis on the market index, dedicated and overlay VRP portfolios are constructed and the results are reported in Figure 6.

Figure 6 further confirms the conclusions obtained earlier in the study. All previous observations still hold in Figure 6: (1) the daily drawdown statistics paint a grimmer picture of the series performance than monthly drawdown statistics (not shown); (2) the Overlay VRP construct had better performance statistics than the Dedicated VRP construct, and both VRP constructs performed better than the equity Index; (3) the speed of market descent affects the VRP portfolio performance. The VRP constructs showed smaller drawdowns in scale during the 1970s Stagflation, due to its slower speed of market descent, than the other two scenarios, both with significantly faster market crashes. Overall, the analysis based on extreme historical scenarios further confirmed the superiority of VRP-based constructs in asset protection during crises than the underlying equity market indexes.

[3] Available at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[4] S&P 500 Index in its current form only started on March 4, 1957.

▸▸ CONCLUSION

In this study, investors' aversion to volatility selling, due to the fear of significant losses in a financial crisis, are demonstrated to be unmerited. The VRP portfolios are designed to deliver superior risk-adjusted returns in the long term, and also to outperform the market index during financial distress. The performance of two VRP-based constructs, the Dedicated VRP construct and the Overlay VRP construct, is compared with the broad-based equity market, represented by the S&P 500 Index. The performance comparison is examined in the context of five historical crisis scenarios, including: Black Monday (1987), 1990 Recession, LTCM Crisis (1998), Internet Bust (2000-2002), and the Global Financial Crisis (2007-2009) and three additional extreme crisis episodes (Great Depression, 1938 Recession, and the 1970s Stagflation).

The study reveals that VRP constructs can achieve their objective of outperforming the market during financial crises. Their performance in a crisis depends on two main factors, the beta of the VRP strategy and the speed of the market crash. The higher the beta level and the faster the market crash, the larger losses the VRP strategies are expected to suffer. The VRP constructs fare significantly better in slow-motion crises than sudden and violent market crashes. The Overlay VRP construct tends to show less significant drawdowns than the Dedicated VRP construct and both perform better than the S&P 500 Index. It is true that VRP-based investment strategies suffered losses during market stress times, but less significantly than the S&P 500 Index as expected. Even with the worst scenarios, the VRP portfolios performed significantly better than the underlying S&P 500 Index.

The conclusion of the study is unambiguous. Investors may benefit significantly by taking advantage of the Volatility Risk Premium at all times. Besides the other benefits of including VRP in portfolios, VRP components suffer significantly less losses during market distress, both by design and in practice. When the market crash is slow, the drawdowns in VRP components are relatively shallow. Robust performance during a financial crisis is another potential benefit and motivation for including the VRP into investors' portfolios. The additional potential performance of the Volatility Risk Premium is especially valuable at a time when interest rates are at historically low levels and the equity market may be richly valued.

▸▸ REFERENCES

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