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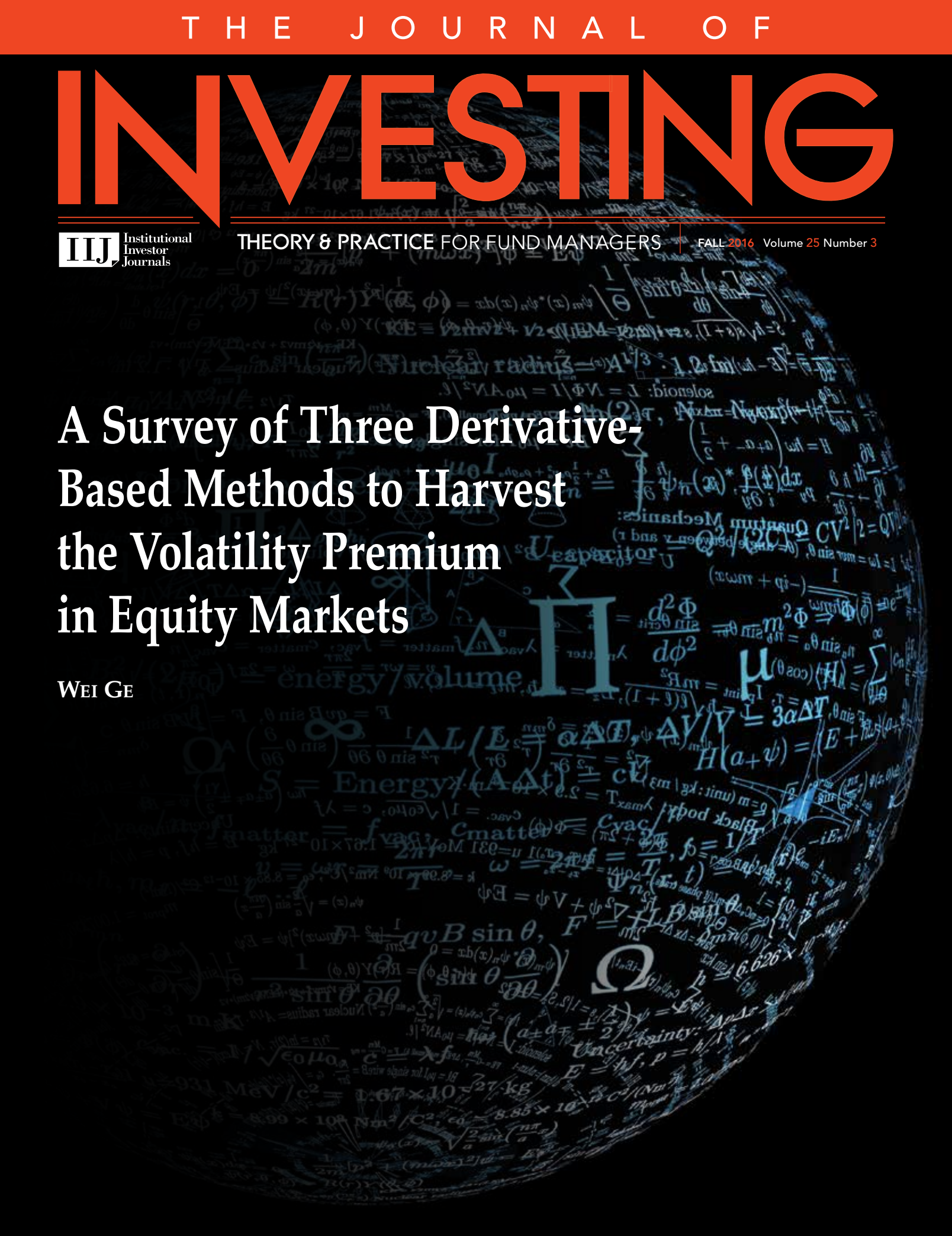

A Survey of Three Derivative-Based Methods to Harvest the Volatility Premium in Equity Markets

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At a time when interest rates are still at historically low levels and the equity market seems richly valued, a growing number of investors are seeking alternative sources of return. One such alternative source of return is the volatility risk premium (VRP), also known as the insurance risk premium (IRP). The VRP refers to the observation that the implied volatility embedded in derivatives, such as equity options or variance swaps, usually exceeds the subsequent realized volatility of the underlying asset. Generally, this difference is most significant in broad market equity indexes, such as the S&P 500 Index. The VRP can be harvested by mechanically shorting and rolling the derivatives priced with the high implied volatilities. When structured properly, the VRP can deliver attractive returns with low correlations to equities and fixed income assets.

The origins of the volatility risk premium include a combination of behavioral biases, economic factors, and structural constraints (Ge [2014]). Overall, the VRP does not represent a market anomaly that is expected to be arbitraged away. Instead, it is a unique risk premium that some investors may incorporate into their portfolios. These investors should have long investment horizons, stable financial foundations, and less cyclical income sources. Investors in the VRP behave as liquidity providers during a crisis and reap the elevated returns historically observed during such situations.

Financial derivatives, such as equity options, variance and volatility swaps, and VIX Index-linked (Chicago Board Options Exchange Market Volatility Index) options or futures (Whaley [1993], Chicago Board Options Exchange [2014]) that can be used to harvest the volatility risk premium, were in most cases developed as risk-management tools. Activity in these volatility-related instruments and products experienced significant growth during the past decade, especially after the Global Financial Crisis. In particular, instruments related to the VIX, especially exchange-traded VIX futures, have gained considerable popularity among investors recently. Interestingly, most investors use these derivatives mainly to protect their portfolios from "tail risks," essentially purchasing expensive insurance policies for their portfolios. Investors who wish to harvest the VRP should be on the other side of the trade, taking advantage of the high embedded VRP and adding a valuable additional return source to their portfolios.

This article examines and compares the most commonly used strategies to monetize the VRP with three types of derivatives: equity index options, variance swaps, and VIX futures. The article discusses the strengths and weaknesses of the three types of derivatives and how they can be structured

as overlay strategies to enhance returns and keep risks in check. The article also discusses the historical return and risk profiles of these strategies and, most importantly, evaluates their feasibility in portfolios from an investor's point of view.

OPTION STRATEGIES

Options represent a financial contract that gives the holder the right, but not the obligation, to buy or sell a security at an agreed-upon price within a defined period or at a specified date. Options can be traded individually or combined to form complex option constructs with specific functions. Different forms of options have been traded since ancient times. Modern-day equity options were traded soon after the establishment of formal stock exchanges. The Chicago Board Options Exchange (CBOE) was established in 1973 to promote standardized and exchange-traded options. Many types of options, option trading tactics, and option-based portfolios have been developed and thoroughly studied. Originally developed as a risk management tool, options evolved to become the versatile instruments that they are today. Investors utilize options in a surprisingly wide array of financial functions, from risk management to return enhancement, including the harvesting of the volatility premium in equity markets.

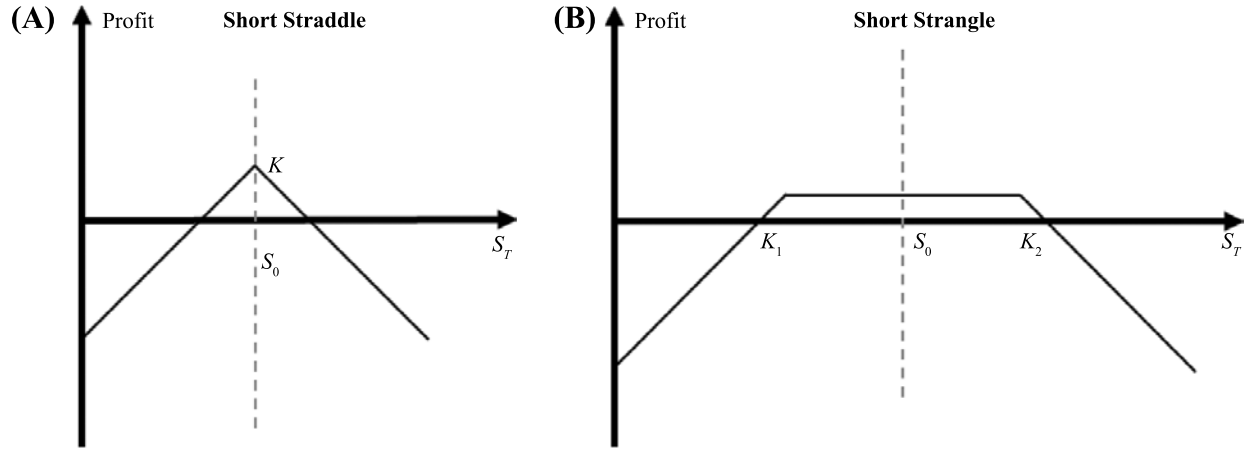
The VRP may be defined as the premium paid by option buyers to option sellers, observed as the difference between option-implied volatility and subsequent realized volatility. One straightforward method of harvesting the VRP is to sell index options and roll the contracts over mechanically.[1] The performance of these options is primarily driven by two factors: the directional movement of the underlying asset and the VRP (Israelov and Nielsen [2014], Ge and Bouchey [2015]).

Two option constructs have been developed to remove the directional bet component, retaining only the volatility premium component of option trades—a short straddle and a short strangle. In essence, straddles and strangles are of the same design, each consisting of a put option and a call option at the same expiration date, with different strike prices for strangles and the same strike price for straddles. Straddles are essentially a special type of strangle. Exhibit 1 shows the profit profiles of a short straddle and a short strangle.

At initiation, an investor can short a strangle or a straddle to collect the option premium that is primarily determined by the level of implied volatility. The investor can make money if the ending prices of the underlying asset are close to the asset price when the contracts were initiated—a likely situation when the market exhibits less volatility. In contrast, straddles and strangles lose money when the prices change significantly during the life of the option contracts, which tends to happen when the asset prices exhibit high volatility. The profitability of these two constructs depends on the difference between the implied volatility locked in at

EXHIBIT 1

Profit Profile of a Short Straddle and a Short Strangle

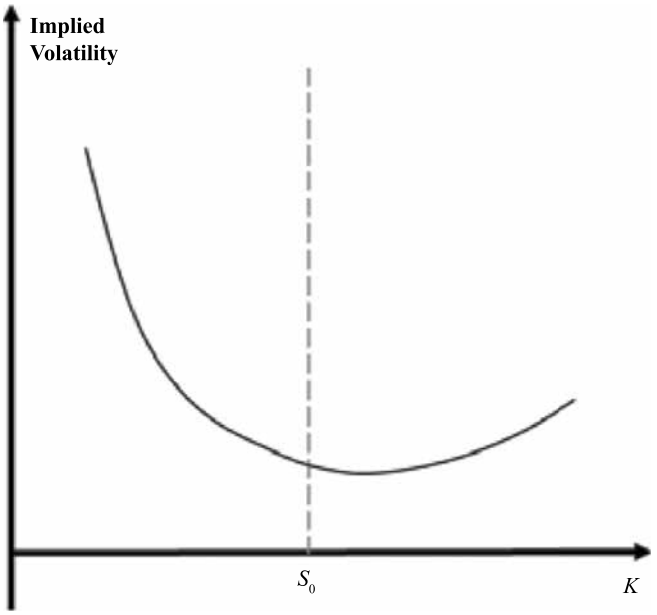


Notes: K, K_1, K_2 are strike prices; S_0 is the asset price when the option contract is initiated; S_T is the asset price when the option contract expires.

the time of sale and the subsequent realized volatility of the underlying asset. Over many trades, if the implied volatilities embedded in option prices are higher than the subsequent realized asset volatilities, the premiums collected by selling the options are expected to be higher than the total payouts of the option contracts caused by the realized volatilities. Short straddles and strangles are methods an investor can use to monetize the volatility risk premium indirectly. Studies show that using options to collect equity VRP was profitable in most historical periods (Bakshi and Kapadia [2003], Ge and Bouchey [2015]).

We generally recommend using call and put options with the same delta magnitude to construct strangles, creating a delta-neutral construct with the lowest potential correlations with the underlying asset.[2] When the option contracts are initiated, the strike prices (K) need to be different from the underlying asset price S_0 in order to make the option trade more profitable. The rationale is explained by the so-called "volatility smile" curve, which plots the implied volatility against the strike price of an equity index option. Under normal conditions, most index options will have an implied volatility curve similar to Exhibit 2. Options with strike prices close to the spot price S_0 tend to embed low implied volatilities, making it less likely that the subsequently realized volatility be lower than the implied level. Such options are less likely to be profitable as the ending prices are more likely to be in the money, necessitating a payout from the option sellers. The premiums of such options tend to be higher, though, owing to the heightened chance of payout. On the contrary, when the strike prices of options are far away from S_0, they tend to embed much higher levels of implied volatility, making subsequent profits more likely, even though the premiums collected tend to be lower owing to the lowered chance of payout. As Exhibit 2 demonstrates, this outcome is particularly true for out-of-the-money puts (e.g., strikes below S_0). Lastly, note that options with strike prices significantly different from S_0 tend to have low liquidity and should also be avoided.

EXHIBIT 2
Volatility Smile (Smirk) Observed in Option Markets



Using an option strategy to monetize the volatility risk premium has many advantages. Options are standardized, exchange-traded, and there is significant liquidity, depth, and diversity in the marketplace for many index and single name options. Furthermore, options can be customized easily to fit investors' needs and objectives. Because of the long history of option trading and extensive option-related research, the depth of knowledge on options cannot be matched by the two newer strategies (variance swaps and VIX futures). Short option strategies tend to have good returns and low volatility compared with the other two methods. When incorporated into a fully collateralized portfolio, the concerns for margin calls can be minimized. Lastly, carefully constructed option strategies can have an equity beta of close to zero so that the beta level stays relatively stable during market swings, providing a more predictable and uncorrelated return source to investor's portfolios.

Using an option strategy in this way also has disadvantages. One common criticism is that the profits from options may be only indirectly linked to volatility. Indeed, an option's ultimate profitability at expiration depends on the price of the underlying asset relative to the option strike price and not on the realized volatility levels. Option strategies are thus an impure form of trading volatility, even though over longer periods, the profitability of an option strategy should converge to the levels predicted theoretically by the implied volatility-realized volatility differentials. Strangles or straddles are complex constructs with potentially uncertain and undefinable losses consisting of two option contracts. Also, an option strategy's equity beta can change when

market conditions change, although significantly less than the market beta of variance swaps or VIX futures. Finally, many types of options are available for trading, and it can be daunting for inexperienced investors to manage an option strategy.

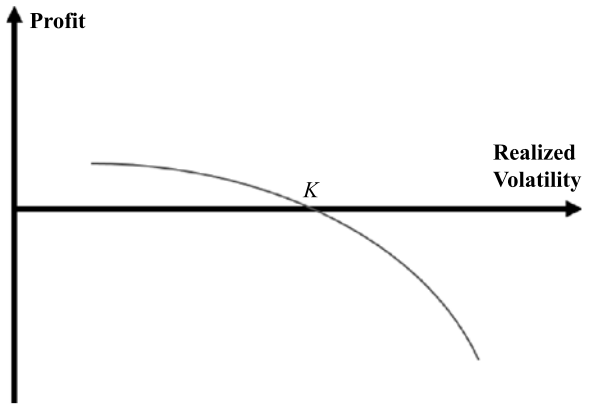
VARIANCE SWAPS

The "swap" in variance swap may be a misnomer. A traditional swap contract covering bonds or currencies requires the two parties to exchange cash flows based on a theoretical common underlying principal amount (notional), which is not exchanged. A variance swap is different from a traditional swap in many ways. It does not have the periodic cash exchanges, and it is a structured contract that stipulates a strike level at the initiation date and pays out only at the expiration date, based on the difference between the realized variance (volatility squared) of a given asset (usually an equity index) and the strike level.[3] A variance swap, much like a traditional swap, has a theoretical notional that is used to compute gains or losses but is not exchanged. The notional of a traditional swap is usually straightforward to compute. The notional of a variance swap, however, can be tricky to compute or understand. It is derived from another theoretical value called the *vega notional*. The vega notional is specified in terms of vega, that is, the metric used to measure the sensitivity of a derivative's value to the changes in volatility. There are no objective rules to convert variance swap notionals or vega notionals to actual assets under management, and traders usually rely on rules of thumb to specify the notional sizes of variance swaps.

Exhibit 3 plots an example of the return profile of a short variance swap (i.e., sell volatility). The strategy in this example makes steady profits mostly when realized volatility is below the strike level. When realized volatility surpasses variance strikes, however, losses occur and the losses have the potential to be significant.

Variance swaps are bilateral over-the-counter (OTC) trades that require specific contractual agreements to execute. The instrument gained significant popularity in the mid-2000s when market volatility was subdued. Many variance swap strategies suffered large losses during the Global Financial Crisis. Recently, some investors have shifted away from trading variance swaps to trading VIX futures, but variance swaps are still popular with sophisticated investors wishing to harvest the VRP.

EXHIBIT 3
Return Profile of Shorting a Variance Swap



Note: The strike level (K) of variance swap is chosen so that the expected value of the swap contract is zero at the initiation of the contract.

Source: Parametric, 2015.

Using variance swaps to harvest the volatility risk premium has many advantages. One major advantage is that variance swaps offer the purest exposure to the VRP. The payout formula depends directly on realized variance (volatility) during the full life of the variance swap. Investors do not need to be concerned with a single volatility reading, which is not representative of the full period, determining the payout of the instrument. Variance swap trading may not require a capital allocation beyond the needed collateral, making leverage easy. The OTC instrument is customizable and can be created to meet an investor's specifications.

The main disadvantage of variance swaps is the quadratic form of the payoff function. When the market enters a highly tumultuous period, the quadratic function can amplify the losses significantly. For example, some investors have stated that in a few weeks during the Global Financial Crisis, they lost the accumulated profits of the previous decade.[4] The equity beta of variance swap strategies can be large and volatile through time, making the diversification contribution less prominent and complicating the portfolio construction. Variance swaps are only traded OTC, and this may make the instrument more costly than exchange-traded instruments and introduce counterparty risk for investors. Lastly, the notional of a variance swap is a rather abstract concept, and investors may have trouble sizing variance swaps properly for their portfolios.

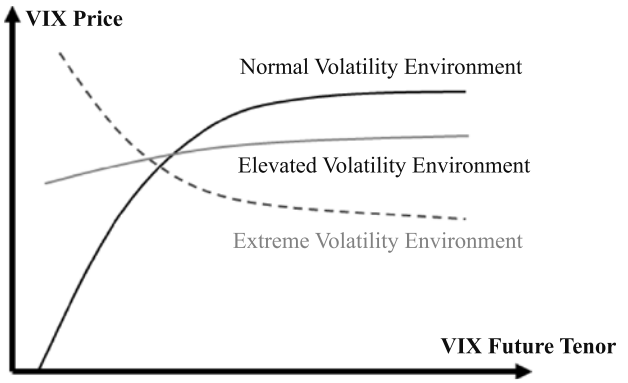
VIX INDEX FUTURES

VIX Index futures are the newest class of instruments that can be used to harvest the volatility risk premium. The CBOE introduced the VIX in 1993 as a benchmark for equity market risk, computed from the implied volatility of near-term, at-the-money S&P 100 Index options (Whaley [1993]). The VIX index quickly became a widely watched gauge of the market's sentiment, the risk appetite of investors, and the expectation of equity volatility over the next month, acquiring the nickname "fear index" (Whaley [2009]; CBOE [2014]). Studies have established the negative correlations between the VIX levels and the returns of several asset classes, such as equity, credit, commodities, and alternative investments (e.g., hedge funds and private equity funds; see Anson and Ho [2003]; Whaley [2009]; Goldwhite [2009]). Thus, derivatives linked to the VIX offer investors a direct approach to monetize the premium embedded in equity volatility. However, the original formulation of the VIX made it inconvenient to link derivatives to this index (Whaley [2009]).

The CBOE modified the computation method of the VIX in 2003, linking it to the broad-based S&P 500 Index and expanding the range of options from which the index price is computed. The VIX methodology change made it easier to link derivatives to the index. Exchange-traded VIX future contracts were offered by the CBOE beginning in March 2004, and CBOE VIX options started trading in February 2006. Many investors became interested in volatility hedging after the Global Financial Crisis, and VIX derivatives became the instrument of choice for adding protection for portfolios. Today, VIX-based derivatives, especially VIX futures, have surpassed variance swaps in terms of popularity.

In the aftermath of the Global Financial Crisis, many investors saw the need for "tail hedging" via long positions in VIX futures, essentially buying insurance for their portfolios. But such downside protection does not come cheaply. Several studies indicate that such tactics usually have significant negative returns (Jones [2011], Whaley [2013], Jones and Allen [2015], Israelov and Nielsen [2015]), mainly attributable to the contango profile exhibited by the term structure of VIX futures (Exhibit 4). Contango refers to the condition that the prices of futures trade at higher levels than the spot prices. On the other side of the trade, shorting

EXHIBIT 4
Generic VIX Index Futures Term Structure



Notes: This diagram shows generic VIX futures term structures under different market conditions. The VIX term structure tends to be in contango under normal conditions but may shift to backwardation under highly volatile market conditions.

Source: Parametric (August 31, 2015).

VIX futures may be a straightforward way to harvest the volatility risk premium.

Like commodities and interest rate futures, the profitability of VIX trades depends, in part, on the term structure of VIX futures, which is usually in contango, as shown in Exhibit 4. Studies indicate that the VIX term structure is in contango 80% of the time (Whaley [2009]; Jones and Allen [2015]). In a normal volatility environment, where there are no relative changes to term structures, volatility investors can short VIX futures with a longer tenor, allowing them to capture positive carry costs and roll the contracts over to generate profits. The profitability of this strategy usually depends on the term of the futures and the changes in the marketplace. Research indicates that such simple futures rolling strategies can generate significant short-term risk attributable to the volatility of short-term VIX term structures (Goldwhite [2009], Jones and Allen [2015]). A more sophisticated hedged strategy (shorting short-term VIX futures and going long medium-term VIX futures) is recommended by practitioners. This strategy effectively mitigates the associated short-term risk of VIX futures trading (Cheeseman, Emrich, and Lerner [2011]) with only a small loss to the overall returns. Both the simple futures rolling strategies and the hedged VIX shorting strategy are examined in this article.

Trading VIX futures as a volatility harvesting strategy may offer many advantages. First and fore-

most, it can be a purer form of volatility trading than option strategies because the VIX directly reflects the volatility level in the marketplace.[5] VIX futures are exchange-traded and highly liquid instruments, with a deep and diversified marketplace. The cost for trading VIX futures is considered modest. VIX futures strategies can be adjusted easily using futures with different tenors. Lastly, when scaled and structured properly, VIX futures strategies can offer a good return–risk profile.

A VIX futures strategy also has some disadvantages. The short-term volatilities of VIX futures can be significant, and portfolios need to be constructed carefully to mitigate the risks. The equity beta of VIX futures strategies can be large and volatile through time, making the diversification effect subdued and portfolio construction complex. Similar to variance swaps, market notional exposure of VIX futures is expressed in terms of vega, making the sizing of VIX futures tricky. Finally, the selection of VIX futures needs to be managed with care and precision in order to maintain a consistent and profitable trading strategy.

DATA AND METHODOLOGY

The next step is to compare the historical performance of the three different volatility harvesting strategies. A short strangle strategy with delta 20% S&P 500 Index options (named "Short S&P 500 Index Delta 20% Strangle") was selected as the representative of options strategies.[6] The 20% delta level was chosen to give investors a balance of returns, volatility, and liquidity. Straddles and strangles may be customized in many ways to give investors different return and risk profiles. After scaling for volatility, option strategies provide a reasonably consistent profile of returns and risks. One-month term options rolled on month-ends are used, based on both empirical evidence that shorting such options tend to be more profitable and the insight that short-term options have a more concave return distribution and more negative skewness, which generates higher returns for the sellers owing to the unfavorable profiles (Cowan and Wilderman [2011]).

There are custom indexes tracking the performance of variance swaps, for example, the Merrill Lynch–Equity Volatility Arbitrage Index (MLHFEV1) and the Risklab Variance Premium Trading Index (VPT) (Hafner and Wallmeier [2007]). Disclosure of such indexes, however, is not detailed enough to create accurate replications. We therefore created two backtests using historical one-month variance swap strike levels.[7] The vega notional of the two series was scaled such that if a large theoretical turmoil hits with a realized monthly variance of 100 squared, the maximum drawdowns are 75% and 50%, respectively. These two return series are therefore named "Variance Swap 75 Series" and "Variance Swap 50 Series," with the latter chosen as the representative variance swap strategy in this article. Note that during the Global Financial Crisis, the VIX reached a peak daily closing value of 80.86 on November 20, 2008, less than the assumed worst-case scenario. The 100-squared monthly variance level represents highly volatile market conditions that have not yet happened in the stock market.

Two VIX futures strategies were employed that sell short-term or medium-term VIX Index futures and roll them monthly, maintaining average tenors of around one month and six months, respectively. Such strategies are tracked by two alternative beta indexes, the S&P 500 VIX Short-Term Futures Index and the S&P 500 VIX Medium-Term Futures Index (Deng, McCann, and Wang [2012]). The VRP collection via consistent VIX futures strategies can be simulated by shorting these two indexes. A third hedged VIX futures strategy was constructed with the two S&P VIX futures indexes, named "VIX Futures Hedged," by shorting the S&P 500 VIX Short-Term Futures Index and going long the S&P 500 VIX Medium-Term Futures Index. This hedged VIX futures strategy should mitigate the significant short-term volatility levels in short-term VIX future prices, sacrificing only modest levels of long-term returns, and is used as the representative VIX Index-based VRP-harvesting strategy in this study.

All three representative strategies examined are overlay strategies that do not need full collateralization. Returns of selected comparison and component strategies are also examined. All the series of monthly excess returns are gross of management fees and scaled so that the resulting returns have an annualized standard deviation of 5% to facilitate comparison on equal footing. Exhibit 5 lists the performance track records of these scaled series. The statistics are based on excess returns from January 1990 to December 2014, with the exception of the VIX futures strategies, which have returns history only from January 2006 (both the S&P VIX Short-Term Futures Index and the S&P VIX Medium-Term Futures Index have data only from the end of 2005). Some of

EXHIBIT 5

Harvesting the Volatility Risk Premium: Comparison of Methods at Equal Risk Levels (5% annual standard deviation)

	10 Years			Since Inception			S&P 500 Exp.		
	Ex. Return	SR	Max DD	Ex. Return	SR	Max DD	Beta	5-yr Corrs	Inception
Option Strategies									
S&P 500 Index Call Selling (Delta 20%)	5.48%	1.10	–8.37%	4.63%	0.93	–16.48%	–0.17	–0.63	Jan-90
S&P 500 Index Put Selling (Delta 20%)	8.64%	1.73	–18.29%	7.16%	1.43	–18.05%	0.20	0.44	Jan-90
Short S&P 500 Index Delta 20% Strangle	**10.65%**	**2.13**	**–12.57%**	**8.94%**	**1.79**	**–11.97%**	**0.06**	**–0.36**	**Jan-90**
VIX Index Futures									
Short S&P 500 VIX Short-Term Futures Index				6.14%	1.23	–6.31%	0.25	0.81	Jan-06
Short S&P 500 VIX Medium-Term Futures Index				2.59%	0.52	–10.79%	0.23	0.75	Jan-06
VIX Futures Hedged				**8.77%**	**1.75**	**–5.50%**	**0.23**	**0.72**	**Jan-06**
Variance Swaps									
Variance Swap 75 Series	1.21%	0.24	–16.81%	7.75%	1.55	–20.27%	0.15	0.59	Jan-90
Variance Swap 50 Series	**1.44%**	**0.29**	**–18.24%**	**7.68%**	**1.54**	**–21.98%**	**0.15**	**0.59**	**Jan-90**

Notes: Ex. Return is excess returns; SR is Sharpe ratio; Max DD is maximum drawdown; Beta is regression beta of the series against the S&P 500 Total Return Index for the full period; 5-yr Corrs is correlations of returns of the series against the S&P 500 Total Return Index based on the past five years of returns. Representative series of the three strategies are highlighted in boldface. Returns represent hypothetical performance, which is for illustration purposes only and may not be relied upon for investment decisions. Actual returns will vary. All returns provided are excess returns gross of all fees. All investments are subject to losses.

Source: Parametric (August 31, 2015).

the original returns are levered up and some are levered down in the risk scaling steps, depending on the risk of the original series. Recent research (Cornell [2009], Frazzini and Pedersen [2014]) shows that high-volatility strategies generally hurt long-term returns, contrary to the implications of the capital asset pricing model (CAPM). One way to enhance returns is to leverage a low-volatility strategy or to add an overlay strategy on top of a traditional portfolio, as explained by Ilmanen [2011]. This intuition is consistent with the backtested returns in this study.

PERFORMANCE COMPARISON OF THE THREE DERIVATIVE-BASED METHODS

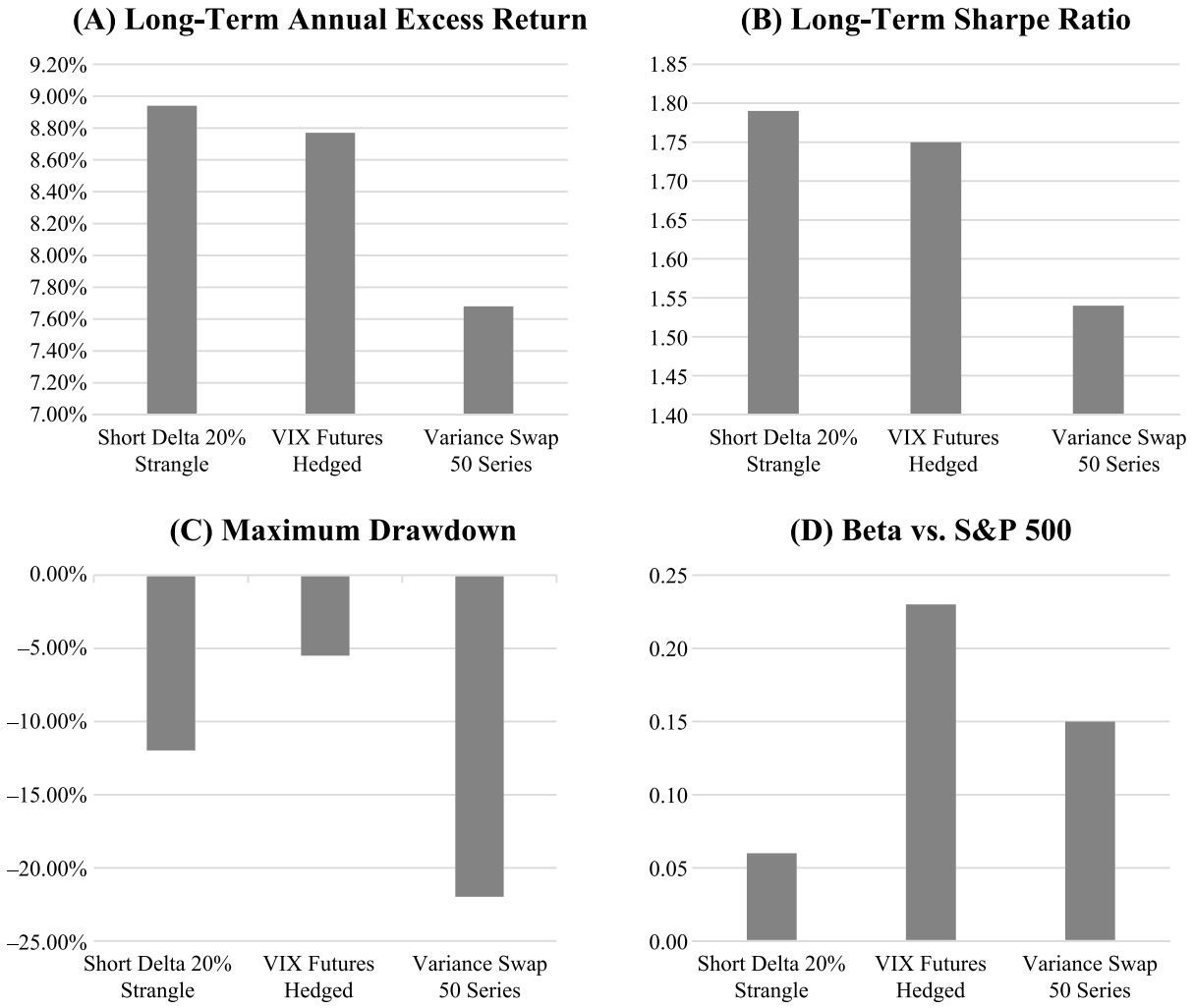
The return and Sharpe ratio statistics for the past five years seem overly optimistic for all backtested returns. The last five years, 2010 to 2014, witnessed a remarkable recovery in the U.S. equity market with high returns and subdued risk. Even the European debt crisis and U.S. debt-ceiling crisis in 2011 only temporarily disrupted the relentless ascent. The statistics for all volatility-selling strategies during the last five years are thus not representative of a full market cycle and not shown in this article.

The statistics for the past 10 years (Exhibit 5) are likely a better representation, as this period includes the turmoil of the Global Financial Crisis. The since-inception history includes three bear markets and three bull markets and should offer the most representative statistics, with two caveats. First, during the early 1990s, the world economy was still fragmented and the market conditions were different from those in the 2000s. Second, the VIX futures strategies have performance history dating back only to 2006.

Of the representative series of the three strategies, Short S&P 500 Index Delta 20% Strangle, VIX Futures Hedged strategy, and Variance Swap 50 Series (all marked in boldface), the statistics in Exhibit 5 confirm many of the pros and cons of the VRP harvesting techniques discussed. Overall, the option strategy offers the best return–risk profile, delivering a long-term 8.94% risk-scaled excess return, with a Sharpe ratio of 1.79 and a maximum drawdown of −12.0%. It is the best diversifier when used to enhance equity portfolios, with a long-term beta of 0.06 against the S&P 500 Index

EXHIBIT 6

Comparison of the Long-Term Return–Risk Profiles of the Three VRP-Harvesting Strategies



Notes: Four common metrics are examined in this exhibit to compare strategy returns: average annual excess return, Sharpe ratio, maximum drawdown, and beta against the S&P 500 Index. Still, volatility risk premium harvesting tends to have significant tail risks not reflected in these statistics, so other metrics may be examined, such as skewness. Excess returns represent hypothetical performance, which is for illustration purposes only and may not be relied upon for investment decisions. Actual returns will vary. All returns provided are gross of all fees. All investments are subject to losses.

Source: Parametric (August 31, 2015).

and a five-year correlation of −0.36 with the S&P 500 returns. The rolling three-year regression beta against the S&P 500 Index has the lowest volatilities among the three strategies (data not shown). The key statistics of the three strategies are compared in Exhibit 6.

The VIX futures strategy is also promising, delivering a 8.77% long-term risk-scaled excess return and a Sharpe ratio of 1.75. Its maximum drawdown was a modest −5.5%. However, its track record was shorter than those of the other two strategies. It had the highest long-term regression beta of 0.23 against the S&P 500 Index and the highest five-year correlation of 0.72 with S&P 500 returns. The rolling three-year regression beta against the S&P 500 has the highest volatility (data not shown). The high correlation with the equity market and the high beta levels may hurt this strategy's diversifying effect on portfolios.

The variance swap strategy also delivered decent returns, a long-term risk-scaled average excess return

of 7.68% and a Sharpe ratio of 1.54. But its maximum drawdown was a sharp −22.0%, four times that of the VIX futures strategy and twice that of the option-based strategy. Its diversifying effect is in the middle, with a long-term beta of 0.15 against the S&P 500 and a positive correlation of 0.59 with S&P 500 returns during the past five years.

CONCLUSION

In this article, three common derivative-based strategies to harvest the volatility risk premium are introduced: 1) option strategies, represented by the Short S&P 500 Index Delta 20% Strangle strategy; 2) VIX Index futures strategies, represented by the VIX Futures Hedged strategy; 3) and variance swap strategies, represented by the Variance Swap 50 Series. All three strategies, when examined in an overlay context, delivered good long-term excess returns—Sharpe ratios higher than 1 and significantly smaller maximum drawdowns than the S&P 500 Index. The results confirmed that historically harvesting the VRP is a good and persistent strategy, capable of delivering significant diversification and return enhancements to investors' portfolios.

The analysis shows that the three common volatility risk premium harvesting strategies are not created equal. These strategies harvest the VRP either directly or indirectly, via exchange-traded or OTC instruments, and with different market depth, liquidity, and trading costs. Although each strategy has its unique advantages and disadvantages and may fulfill the needs of different investors, using variance swaps is generally considered less preferable when compared with the other two methods.

The option-based VRP-harvesting strategy is recommended as the default strategy for most investors. Options have a long trading history, are exchange-traded and highly liquid, and can easily be customized for different purposes. The short strangle option strategy delivers good long-term risk-adjusted returns and provides significant and stable diversification to investors' portfolios. The returns of this strategy have the lowest beta exposure to the equity market and the lowest correlations with S&P 500 Index returns. One main caveat of an option strategy is that it harvests volatility only indirectly and may not please theoretical purists. In the long term, however, the returns of this option strategy should converge to the theoretical volatility risk premium, that is, the difference between the higher implied volatilities in options and the lower subsequently realized volatilities.

VIX futures offer another good strategy for investors to harvest the volatility risk premium. VIX futures are exchange-based and highly liquid, with modest trading costs. They are efficient to implement, offer good long-term returns, and suffer the smallest maximum drawdown. But they have a relatively short history, high short-term volatility, and provide returns more correlated with the equity market. VIX futures should be used with caution in the context of equity volatility harvesting.

Variance swaps may not be recommended as a good volatility risk premium harvesting strategy. The main risk is that variance swaps have historically performed dismally in a tumultuous market as exemplified in the Global Financial Crisis. Variance swaps are traded OTC and may compare unfavorably with VIX futures or stock index options in terms of market depth, liquidity, and trading costs.

Investors can attempt to harvest the volatility risk premium with either an overlay strategy or a standalone strategy. The volatility risk premium can provide a persistent source of extra returns, and harvesting this premium via either equity index options or VIX futures may give investors a better chance to achieve their long-term investment goals.

ENDNOTES

I owe gratitude to Tom Lee, Jack Hansen, Paul Bouchey, Jay Strohmaier, Joel Marcus, and Ben Hammes for their helpful comments and suggestions in writing this article.

[1]Rolling over financial derivatives, such as options, futures, or swaps, means replacing expiring derivative contracts with new contracts with similar terms. The process of rolling over may incur transaction costs.

[2]The delta of an option is defined as the sensitivity of the option value to the change in the price of the underlying asset. Expressed mathematically,

$$\Delta = \frac{\partial c}{\partial S}$$

where c is the value of the contract and S is the price of the underlying asset.

[3]The payout of a variance swap is computed as:

$$\text{payout} = \text{variance notional} \times (\text{realized variance} - \text{variance strike})$$

The variance notional is computed as:

$$\text{variance notional} = \frac{\text{vega notional}}{2 \times \sqrt{\text{variance strike}}}$$

The realized variance is computed somewhat differently from the traditional variance:

$$\text{realized variance} = 252 \times \left(\sum_{i=1}^{Na} \frac{R_i^2}{N_e} \right) \times 100^2$$

R_i refers to the daily returns, N_e refers to the expected number of trading days, and N_a refers to the actual number of trading days. In the traditional formula, the denominator should be $N - 1$ rather than the N_e here. Note that N_e refers to the number of returns, and it must be computed from $N_e + 1$ prices.

[4]The statement is based on our conversations with several clients. The phenomenon can also be observed in the wealth chart of the Merrill Lynch Equity Volatility Arbitrage Index (MLHFEV1), which tracks a strategy that consists of shorting and rolling variance swaps and was discontinued after October 2012 (Figure 5, Berggren [2014]). This index can be viewed on Bloomberg.

[5]The profitability of a VIX futures strategy is related to both the VIX index level and the VIX term structure. It is considered a purer form of volatility trading than option strategies, but less pure than variance swaps, with its profitability depending solely on the difference between the realized variance and the variance strike level.

[6]Historical options price and premium data after December 1995 were obtained from OptionMetrics, Options data prior to Jan 1996 were derived from historical implied volatility provided by the Chicago Board Options Exchange. Option transaction costs are incorporated into the backtested returns.

[7]The variance swap strike prices were provided by Goldman Sachs.

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