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OPTION-BASED EQUITY STRATEGIES

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**ABSTRACT**

Options are derivatives contracts that provide investors the flexibility of constructing expected payoffs for their investment strategies. Option-based equity strategies incorporate the use of options with long positions in equities to achieve objectives such as drawdown protection and higher income. While the range of strategies available is wide, most strategies can be classified as insurance buying (net long options/volatility) or insurance selling (net short options/volatility).

The existence of the Volatility Risk Premium, a market anomaly that causes put options to be overpriced relative to what an efficient pricing model expects, has led to an empirical outperformance of insurance selling strategies relative to insurance buying strategies.

This paper explores whether, and to what extent, option-based equity strategies should be considered within the long-only equity investing toolkit, given that equity risk is still the main driver of returns for most of these strategies. It is important to note that while option-based strategies seek to design favorable payoffs, all such strategies involve trade-offs between expected payoffs and cost.

BACKGROUND

Options are derivatives¹ contracts that give the holder the right, but not the obligation, to buy or sell an asset at a given point in time and at a pre-determined price. In exchange for this benefit, option buyers pay a premium (the option price) to option sellers.

There are two types of options: calls and puts. The former gives the purchaser the right to buy an asset, and the latter gives the right to sell it. To explain how option contracts behave relative to their underlying assets, it is worth introducing the following terminology:

Table 1. Options Terminology

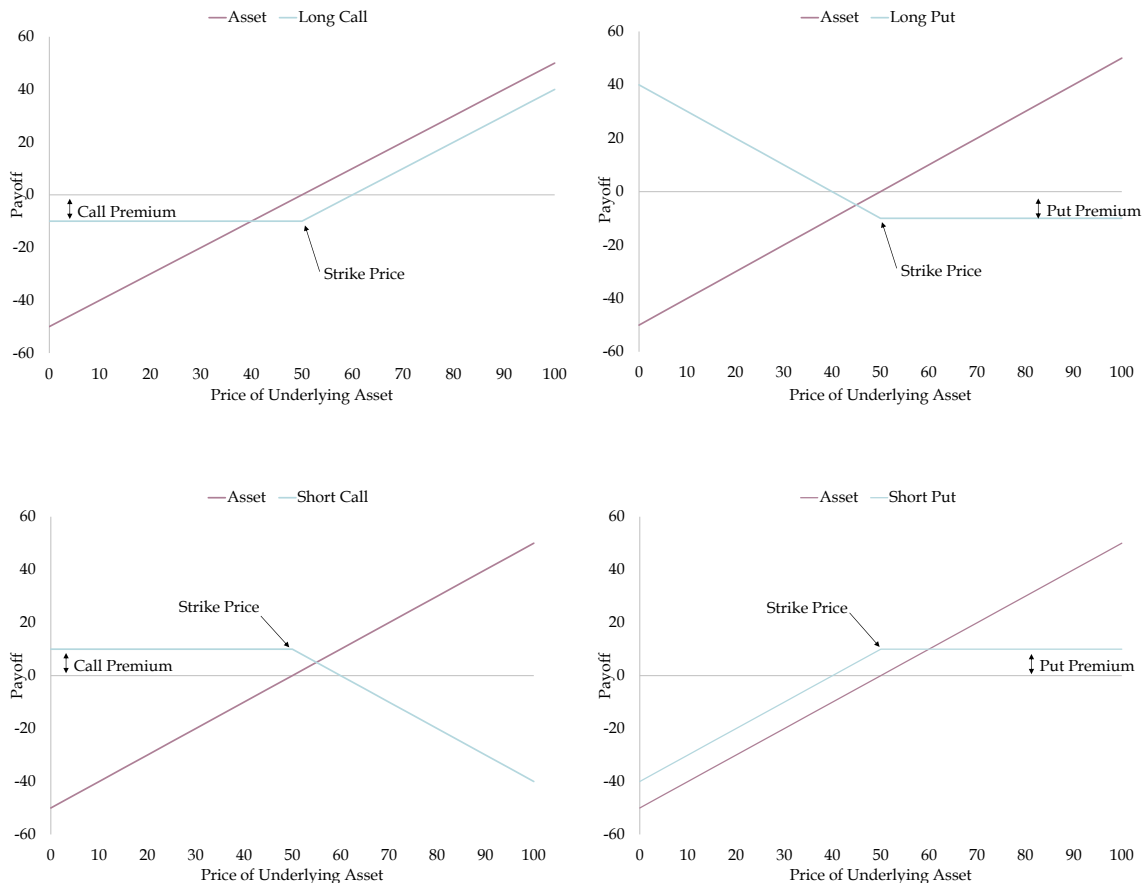
Terminology	Meaning
Option Premium	Price a buyer of an option pays to the seller
Expiration Date	Date at which the option expires
Strike Price	Price at which the option buyer can buy (sell) the underlying asset
Moneyness	Refers to the relationship between the strike price of the option and the current price of the underlying asset.
At the money (ATM)	Strike price equals underlying's price
In the money (ITM)	Strike price is lower (higher) than the underlying's price for a call (put)
Out of the money (OTM)	Strike price is higher (lower) than the underlying's price for a call (put)
Option Style	Refers to the ability of exercising the option
European	May only be exercised at the expiration date
American	Can be exercised at any time before expiration

¹ As a refresher, a derivative is any financial instrument that *derives* its value from another asset. Options, futures, and forwards and swaps are the most popular derivatives instruments.

For investors, the utility of options comes mainly from their flexibility. Option strategies are all about designing a desired payoff structure and evaluating the cost tradeoff of achieving such payoff.

As we can observe, buying an option gives its holder much flexibility. With a call option, it allows a holder to participate in the underlying asset's upside but not its downside. Similarly, the holder of a put can actually profit from the underlying's downside without participating in its upside. While the payoff profile is certainly asymmetric, option sellers can also create profitable strategies by collecting the option premiums, if the asymmetric scenario is not realized. In the example above, a call seller will profit if at expiration date, the price of the underlying asset is below 50.²

Chart 2. Payoff Structure for Call and Put Options³



² On the other hand, a put seller will profit if at expiration date, the price of the underlying asset is at or above 50.

³ These options positions are commonly known as "naked," because they don't include a position in the underlying asset, as opposed to "covered" positions, that do include a position in the underlying asset.

In general, buying an option is akin to buying insurance on the performance of the underlying asset. Focusing on the payoff of put options, the option buyer pays an insurance policy premium (option price) that grants her protection in the event that the underlying asset declines in value more than its deductible (option strike price). Following this reasoning, the option's expiration date would represent the length of the insurance policy. It is clear to see that selling a put option (i.e., the opposite transaction) is like selling insurance. The option seller collects the premium and, in exchange, is liable to cover any losses in the event the underlying asset declines in value more than its deductible (option strike price) during the length of the policy period. This is a very important concept because the most popular option-based equity strategies can be categorized as either buying or selling insurance on the performance of the underlying assets.

While payoffs at expiration are certain,⁴ there are several variables that influence the price/value of option contracts while they are current and that are, in general, all related to their underlying assets. These relationships are named for Greek letters; they describe the sensitivity of an option's price to the given underlying parameter and are generally referred to as the option's "Greeks." The primary Greeks are summarized in the table below.

Table 3. Option Greeks⁵

Greek Letter	Sensitivity of Option's Price to:	Long Call	Short Call	Long Put	Short Put
Delta	Underlying Asset's Price	Positive	Negative	Negative	Positive
Vega	Underlying Asset's Volatility	Positive	Negative	Positive	Negative
Theta	Passage of Time / Time Decay	Negative	Positive	Negative	Positive
Rho	Interest Rates	Positive	Negative	Negative	Positive

Delta: This is the most widely used Greek for options. It measures an option's price sensitivity to movements in the price of its underlying asset. Without getting into the specifics about option pricing, it is worth mentioning that the price of an option is determined by the value of a portfolio of assets that replicates the payoff of the option. Taking a stock option for example, this portfolio consists of the underlying stock and a zero coupon risk-free bond.

Call options are replicated with a long position in a stock and short position in a risk-free bond. Therefore, a long position in a call option has a positive beta to its underlying asset; and a short position in a call option has a negative beta to its underlying asset.⁶

Replicating Portfolios

$$\text{Call} \approx \Delta * \text{Stock} - \text{Risk Free Bond}$$

$$\text{Put} \approx -\Delta * \text{Stock} + \text{Risk Free Bond}$$

$$\Delta = \text{Delta}$$

⁴ Excluding counterparty or default risk.

⁵ For the purpose of this paper, we discuss only first-order sensitivities. Second order options sensitivities, such as Gamma, are widely followed by option traders, yet less relevant to this analysis.

⁶ On the other hand, put options are replicated with a short position in stock and a long position in a risk-free bond. This means that a long position in a put option has a negative beta to its underlying asset; and a short position in a put option has a positive beta to its underlying asset.

This is an important concept because equity option strategies usually either take advantage of this implicit beta exposure to capture equity-like returns or try to hedge it away to reduce equity exposure. Not surprisingly, hedging away the underlying equity exposure of an option is called “delta-hedging”.⁷ It is worth noting that the Delta of an option is not static; it consistently varies with the price of its underlying asset. In all cases, the closer an option, both calls and puts, is to being at the money, the higher its delta (in absolute value), meaning the value of the option is more greatly determined by the underlying asset than by a risk-free bond. Strategies that hedge delta exposure need to take this behavior into account to ensure effective results.

Vega: holding all else equal, long positions in options (calls and puts) benefit from increased volatility in the underlying asset. The more volatile an underlying asset is, the greater the probability that its option will end up at or in the money during its life, making the derivative more valuable. Options are priced more in terms of the volatility of its underlying asset than the price of the asset itself.⁸

However, there is a slight, but very important distinction: options are priced in terms of *implied* volatility, or the market’s expectations of volatility, for the underlying asset. Yet option payoffs are determined by the realized volatility of the underlying asset. Many option-based strategies, which we describe in greater detail later, take advantage of this relationship.

Theta: This variable refers to how the value of an option is affected by the passage of time. Unlike equities, which in general are perpetual assets, option contracts expire, and given that we know their payoff at expiration (dependent on the underlying asset of course), its value needs to converge to this payoff by expiration. In general, the passage of time is negative for long options positions and positive for short option positions. As an “out of the money” option approaches expiration, the probability that it becomes “in the money,” and thus valuable at expiration, diminishes.

Because option buyers pay a premium for the right to access their desired payoffs, the longer an option has before it expires, the more opportunity the contract has to realize the payoff. The losses generated by purchasing options that expire worthless is generally referred to as “Theta bleed.”

⁷ Delta-Gamma hedging is a more sophisticated way to hedge the underlying asset exposure of an option; however, it is beyond the breadth of this paper.

⁸ The price of the underlying is also an input to pricing an option yet options traders think about buying and selling options in terms of buying and selling volatility, hence the concepts of being long or short volatility when buying or selling options.

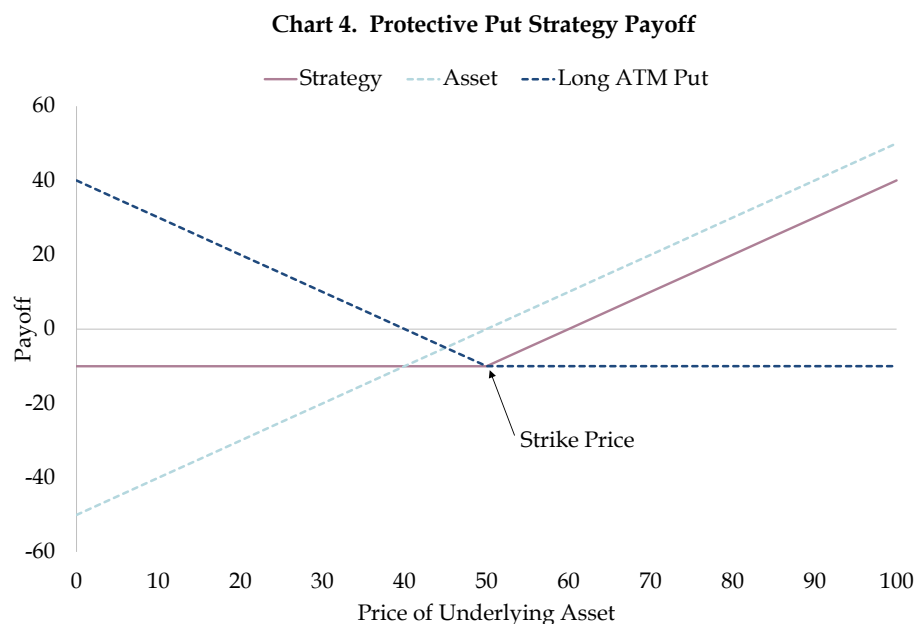
TYPES OF STRATEGIES

There is a wide range of equity option-based strategies available. Given the asymmetries that exist with options payoffs, there are an infinite number of strategies that can be constructed by combining long and short positions in calls and puts. However, all strategies can be divided into two main groups: those that are long volatility (i.e., buy insurance), and those that are short volatility (i.e., sell insurance). Furthermore, the differences between those that have the same objective, either buying or selling insurance, generally come from the tradeoffs investors make between cost and payoff.

Below we expand on the most popular equity option-based strategies, paying special interest to strategies that include or complement a long position in equities. Note that all payoff charts shown assume fully collateralized option positions⁹ and are for illustrative purposes only.

Buying Insurance

Protective Put: Long Stock + Long Put



This is the most direct way to buy insurance on the performance of a long stock position. Buying a put option of the underlying asset allows the option holder to avoid losses if its long stock position decreases in value below the option's strike price. The chart above shows the payoff for buying at the money puts; as is the case with this strategy and all subsequent ones that will be reviewed, the strategy payoff is obtained by vertically adding the corresponding components, in this case long the asset and long the put. It is important to point out the kinks

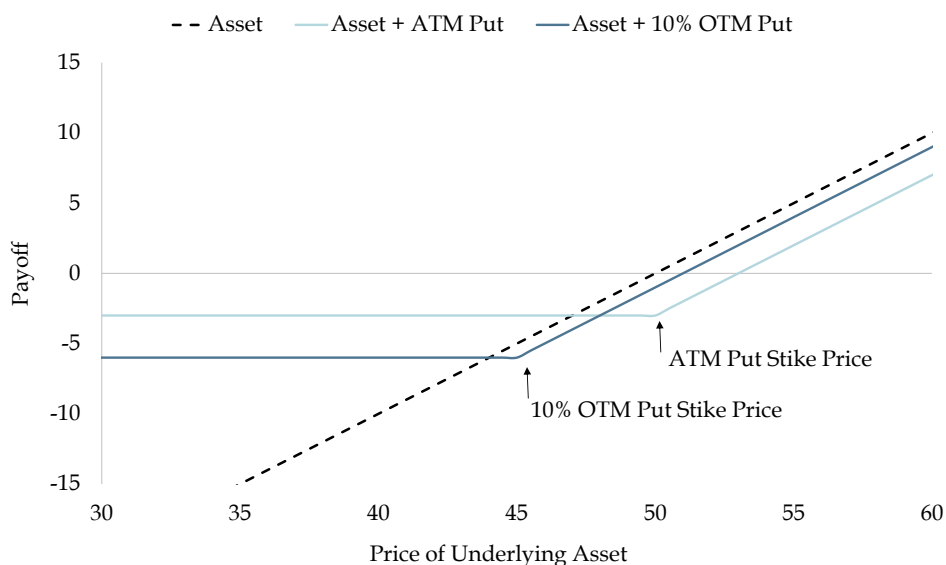
⁹ Fully collateralized option positions assume no leverage (implicit or explicit). This means that the complete notional exposure of the options is "collateralized" by holding cash.

on the lines always refer to the effect of adding an option strategy, as their payoffs are non-linear, unlike those of traditional assets.

Similar to an insurance policy, an investor has the flexibility to select an out of the money option (lower strike price) to reduce premium payments, but at the expense of increasing the deductible (i.e., its exposure to the underlying's drawdown).

Below we observe how the selection of strike price affects the expected payoffs of the protective put strategy. Assuming a current asset price of 50, a 10% out of the money (OTM) Put requires lower premium output, which helps outperform an ATM Put in scenarios of moderate or no drawdowns (ending price of underlying greater or equal than 48), but this comes at the expense of underperforming in all other drawdown scenarios.

Chart 5. Put Strike Price as Deductible

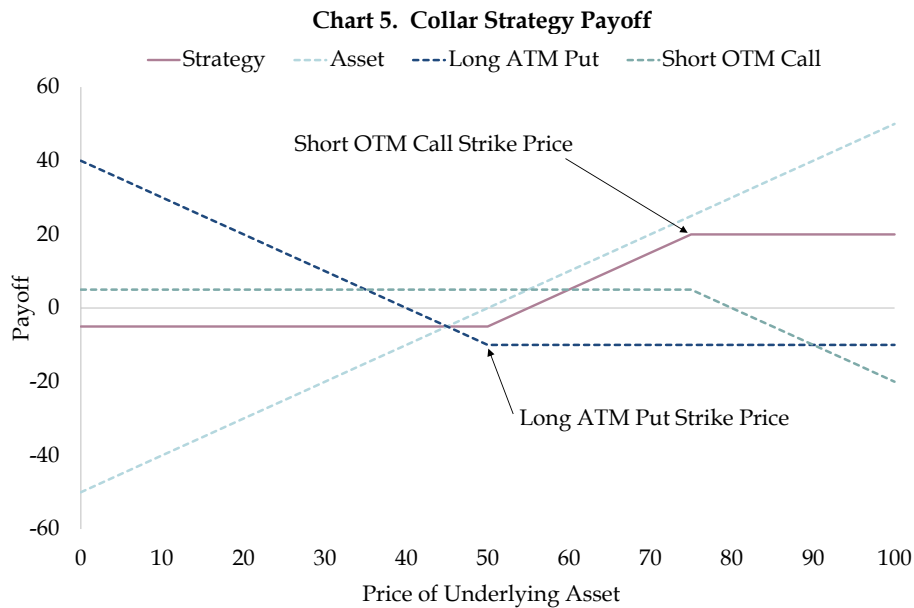


In general, the cost of implementing this strategy is not trivial, and perhaps even prohibitive. A protective put strategy requires rolling expiring put option positions by periodically¹⁰ paying the option premium, detracting from the performance of the long stock position in most market environments.

Collar: Long Stock + Long Put + Short Call

To mitigate the cost of outright buying insurance (i.e., buying puts), investors are sometimes willing to give up some of the upside of their long option positions to generate additional income to cover the cost of buying a put option. A collar on a long stock position combines the long put option with a short call option, which generates premium income in exchange of limiting equity upside.

¹⁰ Periodicity of option rolling varies by strategy, it can range from daily or weekly and all the way up to multiple years, yet rolling option positions every month is the most common case.

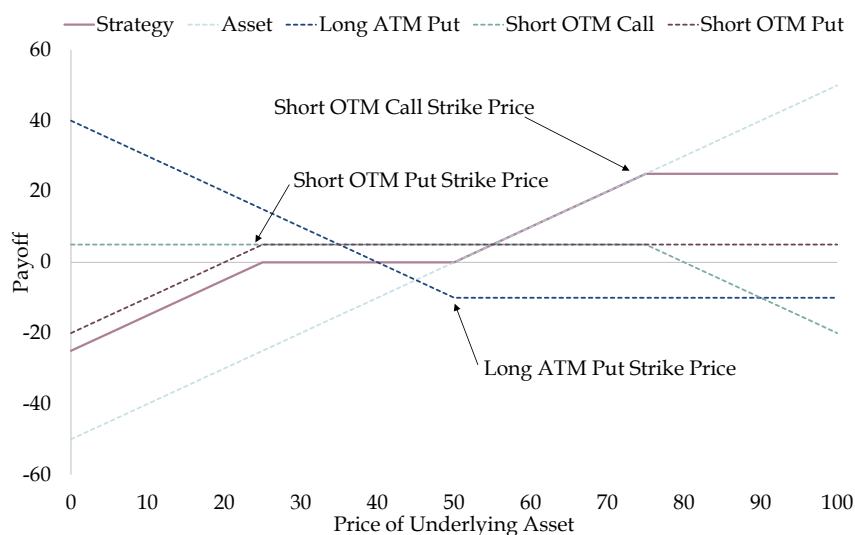


While this strategy partially mitigates the premium payment, it does so at the expense of giving up some of the equity upside. This may seem counterintuitive, as most institutional investors hold equities for upside potential; yet some investors may be willing to give up part of this upside potential in exchange for additional income, especially if they believe that an equity rally is unlikely. It is worth noting that strike prices on the options can be selected such that the premium received for selling the call completely offsets the premium paid for buying the put. This version of the strategy is referred to as a “zero-cost collar.”¹¹

¹¹ Due to pricing dynamics discussed later in the paper (see Chart 20: Implied Volatility Skew), in order to establish a true zero cost collar, an investor is generally required to give up more upside than the relative downside protection received.

Put Spread Collar: Long Stock + Long Put + Short Call + Short Put

The final strategy we review looks to further mitigate the cost of paying for insurance by reintroducing *some* downside protection. In addition to the premium income from selling the call, a put spread collar provides additional income by selling a put option that is further out of the money than the purchased put option.¹² However, the tradeoff for adding this income is eliminating downside protection on losses greater than the short put's strike price.

Chart 6. Put Spread Collar Strategy Payoff

While the payoff structure may seem complicated, comparing it to the Collar, it simply adds a short put option in order to generate more premium income. The net effect is that it participates in the upside of the underlying equity, to a point, while reducing losses.

Performance Review:

Table 7. Options Strategies Risk Table – Buying Insurance¹³
Monthly Returns: January 1990 – August 2017

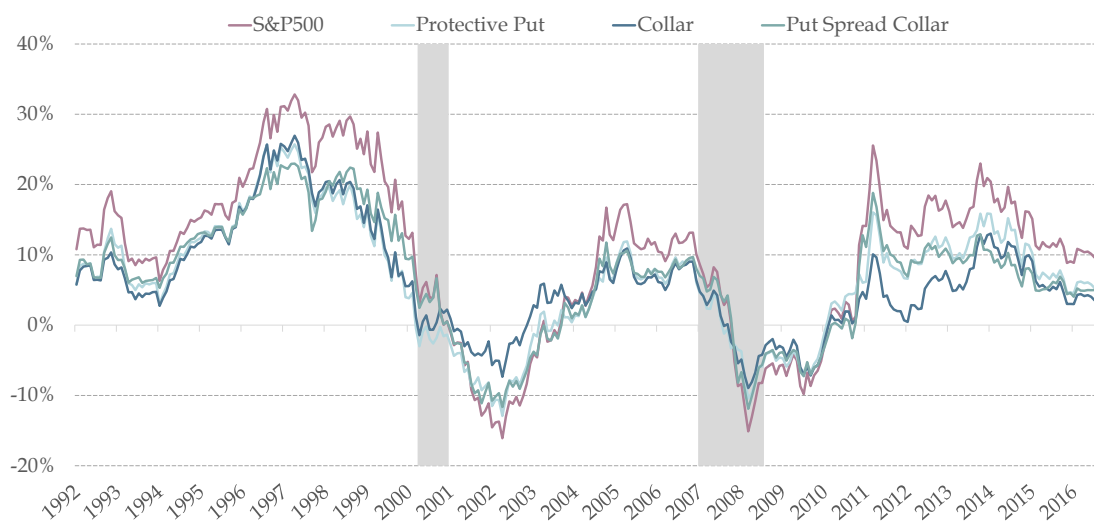
	S&P 500	Protective Put	Collar	Put Collar Spread
Annualized Return	9.6%	6.2%	6.0%	6.4%
Standard Deviation	15.8%	12.4%	10.9%	11.8%
Sharpe Ratio	0.69	0.54	0.52	0.55
Max Drawdown	-50.9%	-38.9%	-35.5%	-43.0%
Skewness	-0.60	-0.32	-0.17	-0.92
Kurtosis	1.32	0.33	-0.19	2.85
Beta to S&P 500	1.00	0.74	0.66	0.74

¹² The combination of a long put with a short put farther out of the money is called a Put Spread.

¹³ Protective Put, Collar, and Put Collar Spread strategies represented by CBOE S&P 500 5% Put Protection index, CBOE S&P 500 95-110 Collar Index and CBOE S&P 500 Zero-Cost Put Spread Collar Index respectively. Source: Bloomberg. More details in Appendix 1.

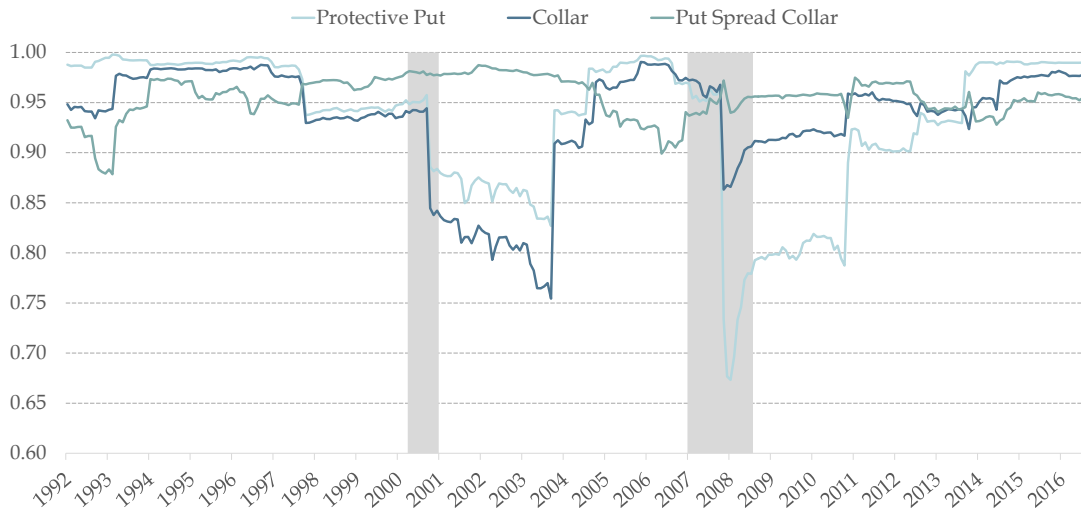
From the table above, it is clear that option-based equity strategies that buy protection for drawdowns have not been worth the effort historically, neither in absolute nor risk adjusted terms. All strategies underperformed broad equities by at least 320 bps annualized, while at the same time offering inferior Sharpe Ratios. The better drawdown behavior they offer has not compensated investors enough to overcome the drag caused by paying option premiums or selling equity upside, or both. As a silver lining, reduced kurtosis and negative skewness for the Protective Put and Collar strategies are a clear sign of defensive capabilities, as these strategies have exhibited negative tail events less frequently and in lower magnitude when compared to the S&P 500.

Chart 8. Options Strategies Rolling 36-Month Performance - Buying Insurance
Monthly Returns: January 1990 - August 2017



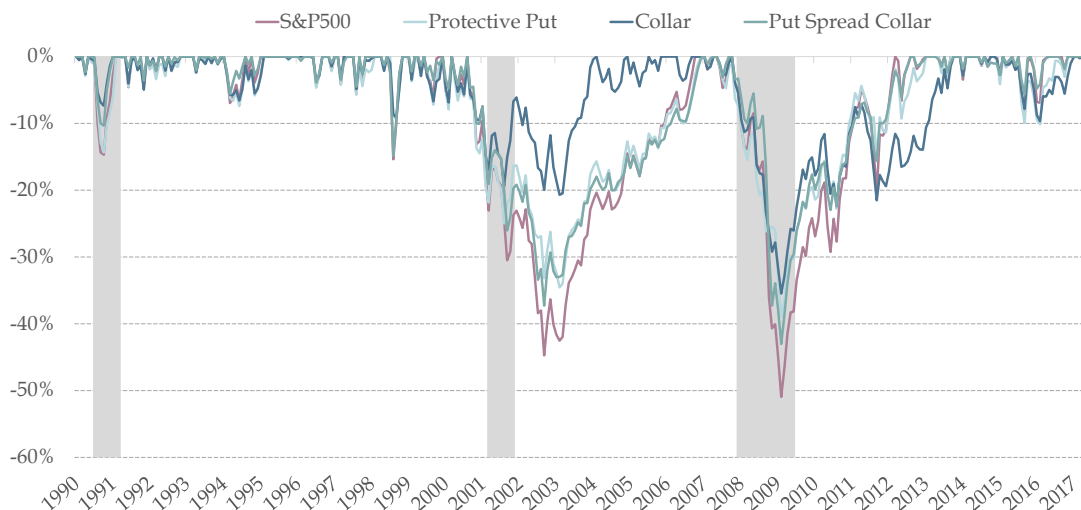
When considering rolling periods, we can observe that while option-based strategies in general outperformed during down markets, they trailed equities by wide margins during bull markets, contributing to their overall underperformance. However, as a caveat, we should not discard that the considered period included at least three very strong bull markets for equities.

Chart 9. Options Strategies Rolling 36-Month Correlations to S&P 500 - Buying Insurance
Monthly Returns: January 1990 - August 2017



A rolling correlation analysis shows that, while correlations tend to be high during most periods, they considerably decline during periods of equity market stress, creating a diversification effect exactly when it is needed most.

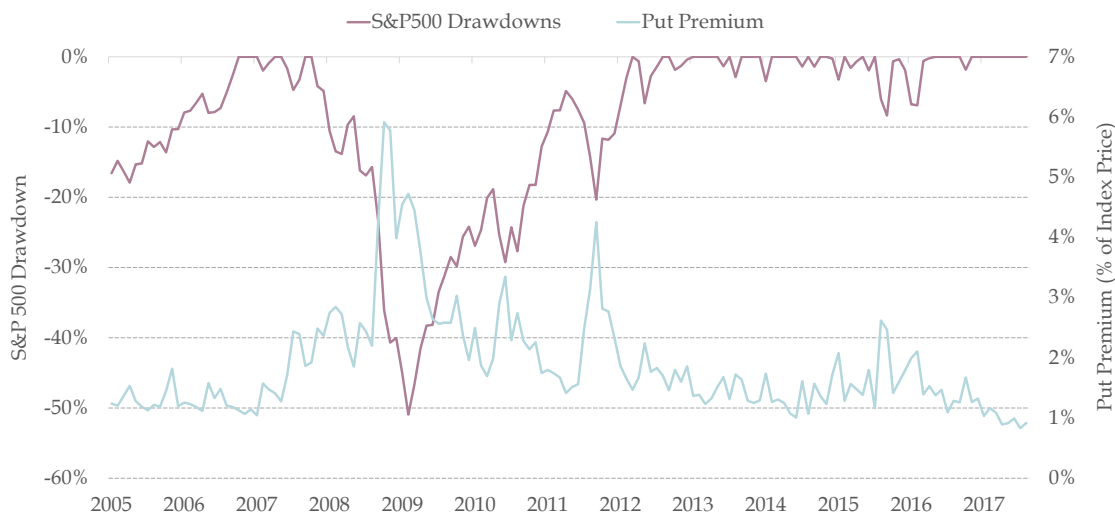
Chart 10. Options Strategies Drawdowns - Buying Insurance
Monthly Returns: January 1990 - August 2017



When we reviewed the expected payoffs for each strategy, we saw that, with the exception of the put spread collar, they should not participate in these drawdowns at all, or perhaps at most by the amount of the insurance premium paid. However, as shown in chart 10, each of the

option-based strategies suffered meaningful, though smaller, losses during drawdowns. The primary explanation for this disconnect can be seen in chart 11.

Chart 11. S&P Drawdowns vs. Put Premium¹⁴
Monthly Returns: January 2005 - August 2017



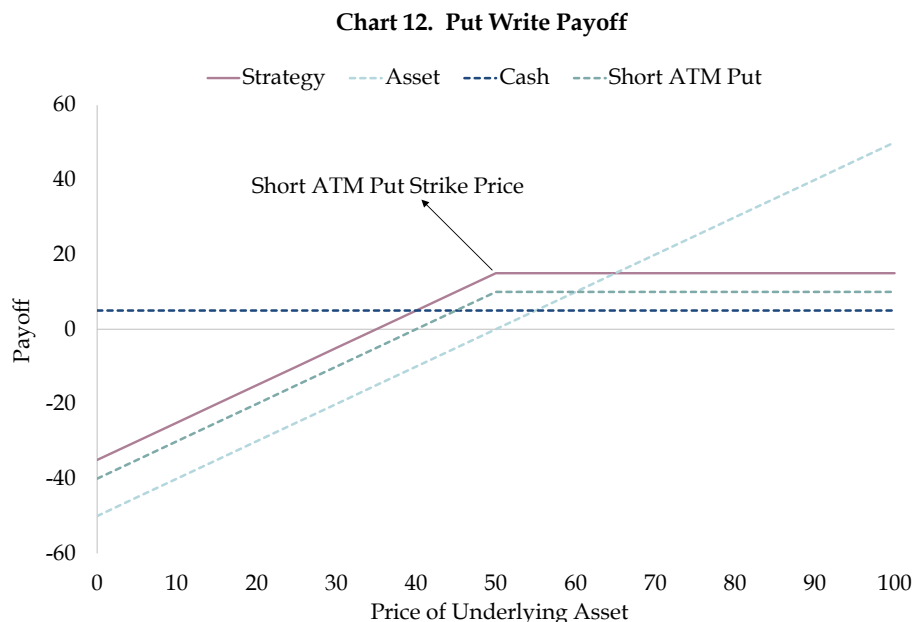
This is a clear example of how real market behavior does not quite fit with the assumptions of financial models. The payoff charts we reviewed for the option strategies were based on buying an option and holding it to expiration. Yet investors who want to implement this strategy over the long term must buy options that expire monthly¹⁵ on a continual basis. Therefore, at each expiry date they must buy an option to replace the expired one. Option prices are not very stable, and unsurprisingly, the price of insurance increases dramatically when it is most needed. This is a non-trivial effect for the strategies we reviewed because, to maintain the desired exposures during equity market drawdowns, they needed to buy insurance at very high prices, detracting heavily from performance and contributing to the drawdown behaviors we saw above.

¹⁴ Put premium estimated based on Black-Scholes-Merton option pricing model and 30-day ATM implied volatilities on S&P 500 options. Source: Bloomberg and MIG.

¹⁵ Other lengths of expiration such as weekly, quarterly or annual can be used without changing the intuition.

Selling Insurance

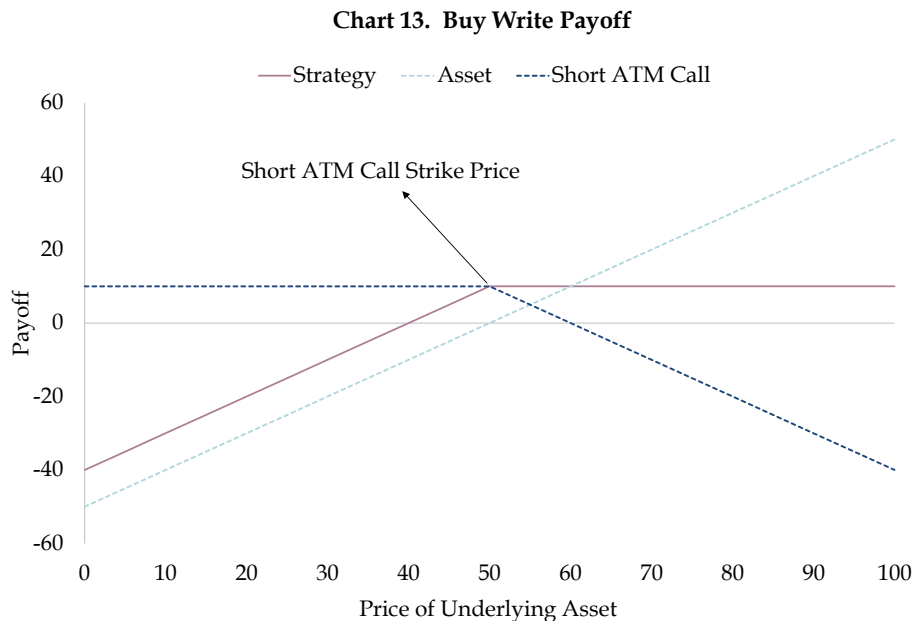
Put Write: Cash + Short ATM Put



Put Write is the classic “short volatility” strategy and is the exact opposite of the protective put strategy. Here, an investor sells put options on the underlying asset and holds cash as collateral. As with any insurance underwriter, the objective of this strategy is that over time, the income collected from selling the put options (more than) compensates for any potential losses in a drawdown event for the underlying asset. In general, this strategy should outperform holding the underlying asset in down markets as the premium collected creates a buffer in performance. However, this comes at the expense of trailing the underlying asset in most bull markets. As we see from the payoff diagram, the put write strategy may outperform its underlying asset in modest up markets as long as the premium collected on the option sold is higher than the gains on the underlying asset.

As we saw when reviewing the Option’s Greeks, short put options have a positive exposure to the price movements of its underlying asset, or put another way, it has a positive beta. This beta tends to hover between 0.5 and 1 for options that are close to at the money,¹⁶ so a put write strategy can be thought of as a low beta equity strategy. It is important to reinforce the notion that, while these strategies may have low positive beta, they are not necessarily “defensive,” as they offer a payoff structure of capped gains and unlimited losses.

¹⁶ The delta of short put option and also its beta to the underlying approaches 1 as its price moves closer to at the money.

Buy Write: Long Stock + Short ATM Call

The payoff of a Buy Write strategy is equivalent to that of a Put Write strategy,¹⁷ yet it is implemented with a different pair of assets. In this case, we combine a long position in the underlying asset with a short call option.

Even though Buy Write and Put Write are equivalent in principle, the prior approach may be more convenient to implement for investors who hold a long position in equities, as they can add a short call option position as an overlay if they are comfortable with the tradeoff of giving up equity upside in exchange for a fixed amount of premium income. Investors may generally accept this tradeoff if they view an equity rally as unlikely in the near future. Furthermore, referring again to the analogy of the option strike price as an insurance policy deductible, selling a call option that is out of the money (i.e., has a higher strike price) generates less premium income but allows the option seller to participate in some of the upside of the underlying. These reasons have made Buy Write a more common strategy to implement than Put Write for institutional investors¹⁸.

Finally, it is important to reinforce the notion that, while both Put Write and Buy Write strategies may have low positive beta (since they are equivalent), they are not necessarily defensive, as they offer a negative asymmetric payoff structure of capped gains and -almost-unlimited losses¹⁹.

¹⁷ This relationship holds thanks to a principle of option pricing known as “Put-Call Parity.”

¹⁸ Furthermore, it can be argued that investors prefer a Buy Write strategy over a Put Write strategy (even though they should be equivalent) to avoid the reputational risk of having to completely sell out of their equities positions.

¹⁹ In reality, in absence of leverage, losses are limited by the amount of capital invested, in the -unlikely- scenario that the equities position value goes to zero. See Appendix 3.

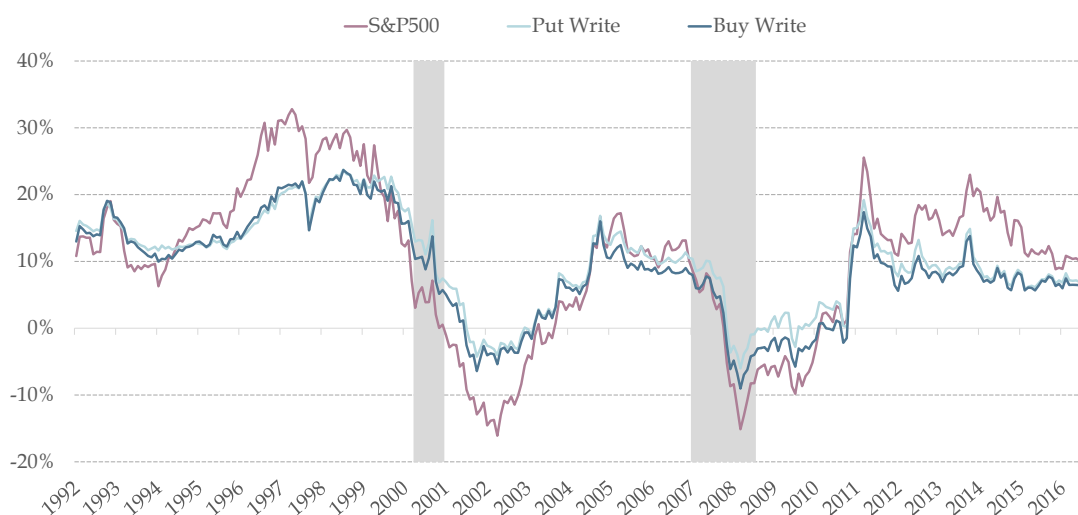
Performance:

Table 14. Options Strategies Risk Table - Selling Insurance²⁰
Monthly Returns: January 1990 - August 2017

	S&P 500	Put Write	Buy Write
Annualized Return	9.6%	9.9%	8.6%
Standard Deviation	15.8%	10.6%	11.0%
Sharpe Ratio	0.42	0.65	0.52
Max Drawdown	-50.9%	-32.7%	-35.8%
Skewness	-0.60	-1.94	-1.30
Kurtosis	1.32	9.36	5.00
Beta to S&P 500	1.00	0.56	0.62

Short volatility strategies exhibited superior risk-adjusted returns and lower drawdowns relative to equities in the studied sample. Put Write even outperformed equities with much lower volatility. However, consistent with their asymmetric payoff profiles, both Put Write and Buy Write realized high negative skewness and kurtosis, a sign of a strategy that is prone to negative tail events more regularly and with higher magnitude than equities.

Chart 15. Options Strategies Rolling 36-Month Performance - Selling Insurance
Monthly Returns: January 1990 - August 2017

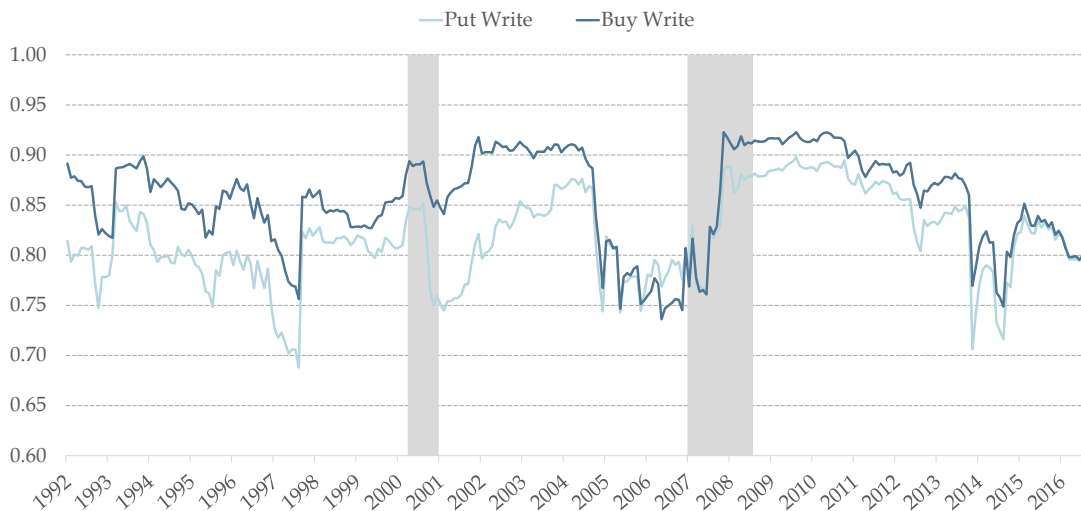


Rolling performance shows how both option strategies underperformed equities during bull markets (i.e., Tech Bubble in late '90s), yet they offered some drawdown protection during times of market drawdowns. Interestingly, even though we should expect these strategies to

²⁰ Put Write and Buy Write represented by CBOE S&P 500 Put Write Index and CBOE S&P 500 Buy Write Index respectively. Source: Bloomberg. More details in Appendix 1.

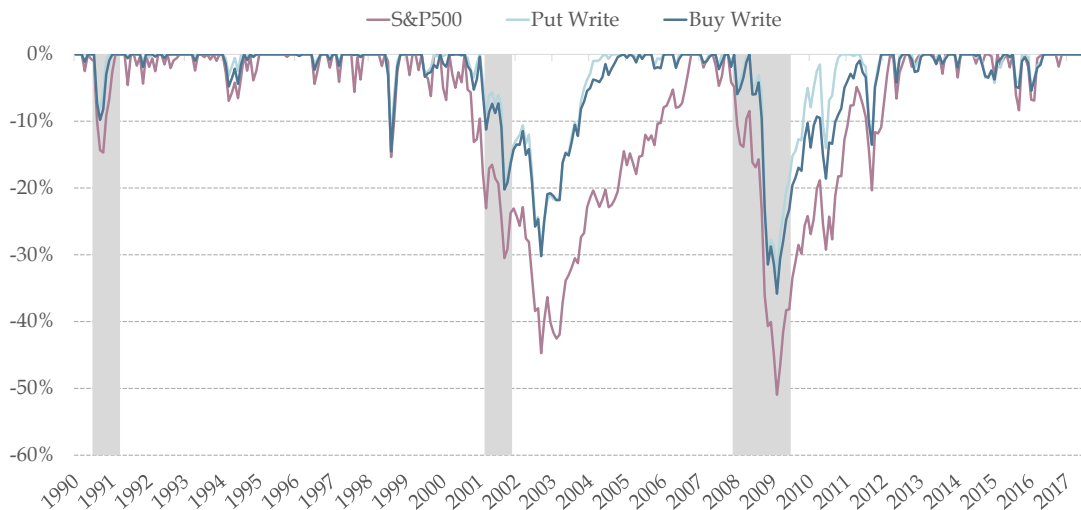
have equivalent payoffs, Put Write consistently outperformed Buy Write historically (more on this later).

Chart 16. Options Strategies Rolling 36-Month Correlations to S&P 500 - Selling Insurance
Monthly Returns: January 1990 - August 2017



While historical performance has been attractive, a rolling correlation analysis allows shows that option strategies that sell insurance offer a payoff profile that increasingly correlates with its underlying asset when it experiences drawdowns. In other words, any diversification benefit that may appear to exist during calm times quickly disappears when it is most needed.

Chart 17. Options Strategies Drawdowns - Selling Insurance
Monthly Returns: January 1990 - August 2017



Drawdowns for both option strategies are comparable in occurrence relative to equities, yet in lower magnitude given the premium income they capture regularly from selling options. The market dynamic that has historically made insurance (i.e., option prices) more expensive to buy during times of market stress has likewise helped insurance-selling strategies recover quicker than equities from drawdowns. This is contrary to what we saw with strategies that buy insurance, which suffered from buying more expensive premiums at these times.

THE VOLATILITY RISK PREMIUM

To this point in our analysis, we have reviewed option strategies that, by design, either buy or sell insurance on the performance of an underlying asset. However, when reviewing historical performance we saw that the strategies that should theoretically protect from drawdowns have historically been more impacted by them than those that in theory are more exposed to such drawdowns. Additionally, over the studied period, selling insurance has been much more profitable from both an absolute and risk-adjusted return basis than buying insurance. Finally, when comparing the historical performance of two strategies (Put Write and Buy Write) that, by design, should be equivalent, we found that one, Put Write, has greatly outperformed the other, Buy Write.

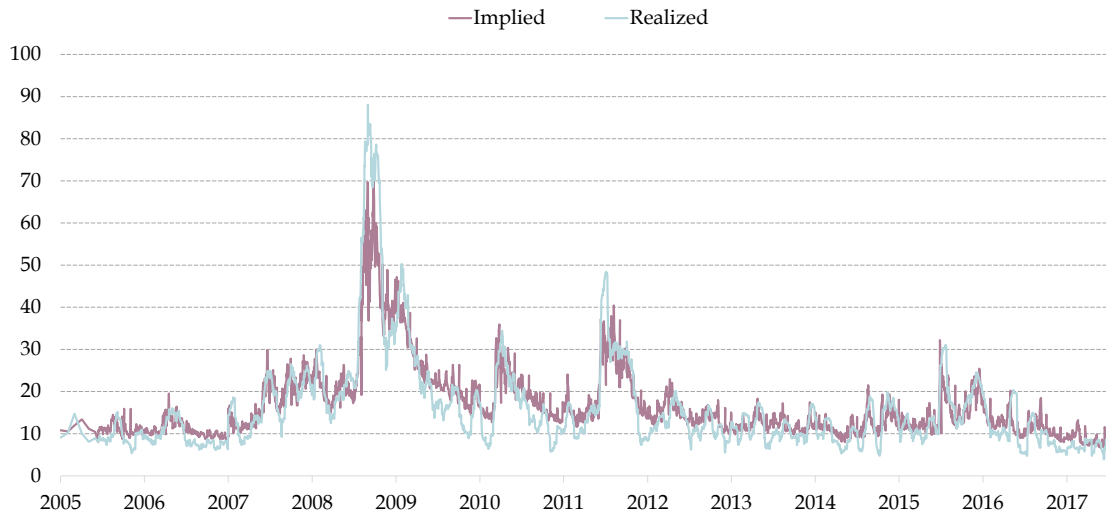
All of these apparent anomalies, inefficiencies, or disconnects between what option theory suggests the payoffs should be and what they have effectively realized can be explained by one broad concept: the Volatility Risk Premium.

During our review of the option's Greeks,²¹ we saw that options are priced in terms of implied (forward looking) rather than realized (backward looking) volatilities. While most option pricing models assume these two measures are equivalent,²² implied and realized volatilities rarely converge. In fact, the majority of time, implied volatility has been higher than realized. This phenomena is known as the Volatility Risk Premium.

²¹ As a refresher, Vega is the term used to measure the sensitivity of an option's price relative to changes in the underlying asset's -implied- volatility.

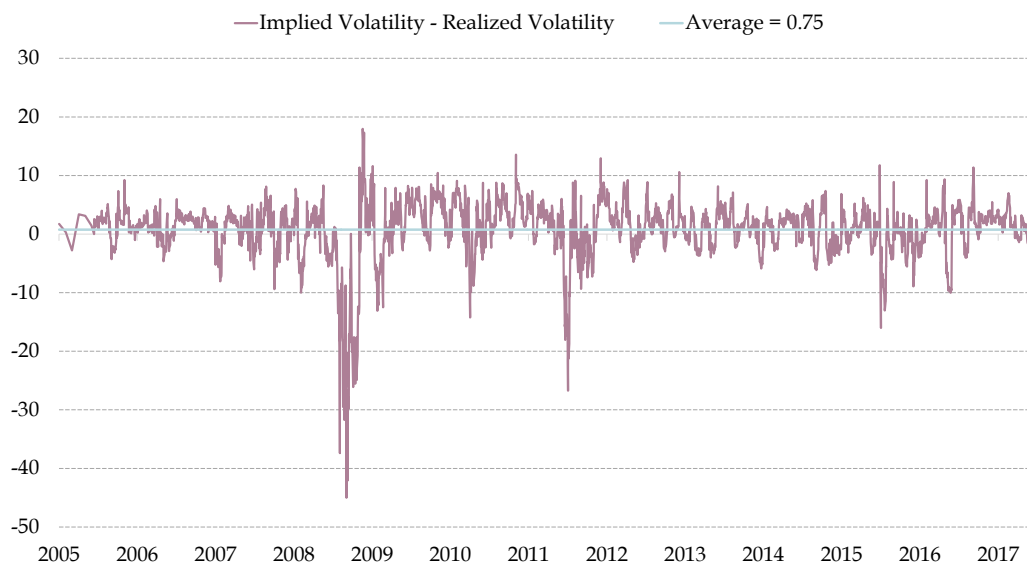
²² An implicit assumption in most academic asset pricing theories is that parameters such as variance (or volatility) are stationary, that is they don't vary over time.

Chart 18. Implied Volatility vs. Realized Volatility (Annualized %)²³
S&P 500: January 2006 - August 2017



This spread between implied and realized volatility explains our first observed anomaly, that of insurance-selling strategies outperforming insurance-buying strategies with lower risks and comparable drawdowns. Since implied volatility tends to be higher than what is ultimately realized, this means that option buyers are actually paying a higher price (in the form of option premium) for protection than what an efficient transaction would suggest, directly benefiting the performance of insurance sellers, who receive this extra premium.

Chart 19. Volatility Risk Premium (Annualized %)
S&P 500: January 2005 - August 2017



²³ Implied volatility is the market provided 30-day implied volatility for at the money options. Realized volatility is the one-month realized volatility over the same period. Source: Bloomberg and MIG.

The volatility risk premium is not an arbitrage²⁴ opportunity for option sellers though, as they are exposed to a risk that traditional risk metrics such as volatility and Sharpe ratio do not quite capture: tail risk.²⁵ Looking at the historical behavior of the premium, we see that it has been positive on average and most of the time, but when it is negative it tends to be negative at extremely large magnitudes (especially when compared to its magnitude when positive). Tail risk was captured in our performance review through skewness and kurtosis, and the characteristic of this premium with common but small positive gains accompanied with less common but very large losses has led many to categorize it as a “picking up nickels in front of a steamroller” type strategy.

A natural reaction that follows from learning about the volatility risk premium is “Why haven’t insurance buying investors taken notice of this and taken actions to eliminate it?” The answer to this question lies in behavioral finance; the support for the existence of the volatility premium is based on an “irrational” human behavior (or behavioral bias) known as loss aversion. Loss aversion refers to the tendency to prefer avoiding losses versus achieving equivalent gains. Behavioral experts²⁶ have argued that the pain of losing is much greater than the pleasure of gaining. Translating this to finance, we observe that investors are “content” with “overpaying” when buying insurance because it protects them from losses.

Loss aversion, the behavioral foundation of the volatility risk premium, may also help explain our second anomaly, or why the Put Write strategy has outperformed Buy Write even when in theory they are equivalent strategies.²⁷ If we believe that humans dislike losses more than equivalent gains, then the opposite should also be true. That is, investors tend to be more comfortable writing calls on their existing equities positions (thus giving away potential upside in exchange for current income) than exposing themselves to unlimited downside by selling puts.

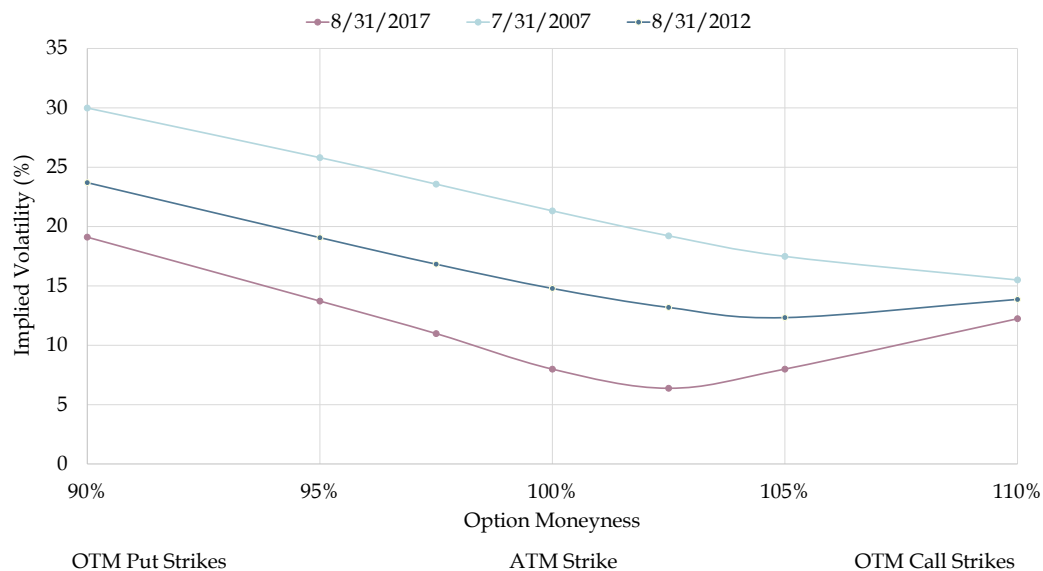
²⁴ Riskless profit.

²⁵ Volatility and Sharpe Ratio are risk metrics that assume returns follow a normal distribution with no skewness or excess kurtosis (i.e., no fat tails). See “Sharpening Sharpe Ratios” by Goetzmann, Ingersoll, Spiegel, and Welch (2002) for additional insight.

²⁶ Kahneman and Tversky, 1979.

²⁷ Ronen Israelov at AQR (see AQR’s “PutWrite versus BuyWrite: Yes, Put-Call Parity Holds Here Too”) argues that the outperformance difference between PutWrite and BuyWrite cannot be explained by the volatility risk premium since both strategies sell options at very similar moneyness levels (i.e., they should pick up very similar premiums). Mr. Israelov’s research indicated that most of the performance difference is actually attributed to a market infrastructure anomaly that occurs for a few hours every month while the indices rebalance. While this conclusion detracts from our argument when applied specifically to the Put Write and Buy Write indices, the existence of an implied volatility skew (chart 20) still supports selling volatility through puts rather than covered calls.

Chart 20. Implied Volatility Skew (Annualized %)
S&P 500 Index



While implied volatility levels should be equivalent in theory, the chart above shows that selling out of the money puts generates more premium than selling out of the money calls (at equivalent moneyness, (e.g., 95% for a put vs. 105% for a call) given their relative higher implied volatilities. Furthermore, this also means that for strategies such as zero cost collars, investors need to give up more upside than the drawdown protection they receive given the mismatch in premiums.²⁸ While we only show a few examples, this relationship, or curve shape, known as the volatility skew, has existed almost constantly in markets since the equities market crash of October 1987.²⁹

²⁸ Recall that a zero cost collar is established by buying puts and simultaneously selling calls to cover the cost of the puts. Since put prices skew higher, investors need to sell more calls (give up upside) to cover for the more expensive price of the drawdown protection gained by buying puts.

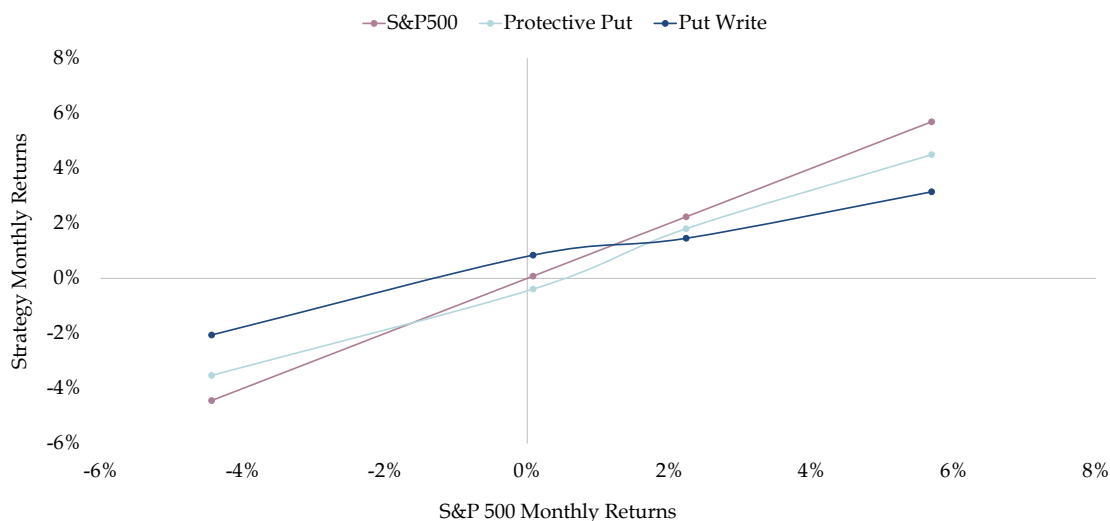
²⁹ Prior to the 1987 crash, the volatility curve tended to look more like a smile, with equivalent levels of premium available for equivalent out of the money puts and calls. It is believed that after the crash, the symmetry was lost because investors, fearful of a repeat of any large drawdown, started overpaying for insurance through the purchase of out of the money puts. Source: CBOE.

OPTION BASED EQUITY STRATEGIES PERFORMANCE BY EQUITIES ENVIRONMENT

Insurance Buying strategies (represented by Protective Put), given their requirement to regularly pay a premium to establish long options positions have underperformed equities in almost all market environments. The exception of a slight, on-average outperformance during the worst periods for equities, has not been enough to compensate for the underperformance during all other periods historically.

Insurance Selling strategies (represented by Put Write) on the other hand, show a clear behavior. These strategies have outperformed equities during calm markets at the expense of underperforming during bull markets. We have seen that their seemingly attractive behavior during the worst times for equities is driven by the Volatility Risk Premium, which has allowed them to outperform equities and insurance buying strategies on average. However, these strategies are fully exposed to equity drawdowns by design, so they should not be thought of as defensive equities strategies.³⁰ While the periodic pick up of premium may help them outperform equities during extended (multiple months) drawdowns, they can drastically underperform during larger and sharp (less than a month) drawdowns.

Chart 21. Option Based Equity Strategies Performance
Monthly Returns (smoothed by quartiles): January 1990 – August 2017



³⁰ See Appendix 3.

IMPLEMENTATION

Equity option strategies are widely available for investors of all size. Management fees for commingled strategies vary but tend to range from 0.20% to 1.00%.³¹ However, fees are generally negotiable depending on the size of the investment. Liquidity for these strategies tends to range from daily (required for mutual funds) to monthly. Given the characteristics of the underlying assets traded by these strategies (i.e., mostly cash and equity index futures), it is rare for vehicles to offer less than monthly liquidity.

In terms of implementation, the fee dispersion observed is driven by several factors that may vary across managers and can generate differentiation between products and thus expected performance:

Active vs. (Semi) Passive: Similarly to most equity strategies, option-based equity strategies can be active or passive. There are investment managers that act more like implementation agents and replicate available benchmark indices.³² Other managers will try to add value above these benchmarks by implementing more active strategies that may: trade more options, trade at different levels of moneyness, trade at different expiration dates, apply leverage,³³ trade more frequently, reduce/increase underlying equity beta, or perhaps even trade options on different markets (e.g., international markets).

Structuring (Overlay vs. Full Strategy): When reviewing the different option-based equity strategies available, we observed that some of them include long positions in equities or cash. Option strategies can be implemented as an overlay to an existing equity or cash position in order to create the desired exposure. For example, an investor could add a call-selling overlay to its long equity position to create a Covered Call strategy. On the other hand, they can allocate funds to a manager to build the strategy on its own by buying/selling all the required assets.

The range of available structures is wide, consistent with the ample flexibility in terms of expected payoffs that options can provide.

³¹ Based on MIG survey of investment managers. Note that the performance of the strategies shown throughout this paper do *not* include management fees.

³² See Appendix 1.

³³ All strategies reviewed assume fully collateralized option positions. However, option contracts can be implemented with implicit leverage by managing the levels of collateral required to hold the positions in an exchange. As is always the case with leverage, both implicit and explicit, it can help magnify returns but it also magnifies losses, and in the case of options and their non-linear payoffs, leverage can be even more harmful than for traditional strategies during negative scenarios.

SUMMARY AND CONCLUSIONS

Options are flexible derivatives contracts that allow investors to design a wide array of payoff structures for their strategies. Although the number of option-based strategies is potentially infinite, they can all be broadly classified based on their exposure to the underlying asset's volatility. Since buying an option (i.e., buying volatility) is akin to buying insurance on the performance of its underlying, option strategies that are long volatility can be classified as buying insurance. Conversely, those that are short volatility are in turn classified as selling insurance.

After reviewing the most popular option-based equity strategies, we observed that strategies that buy insurance generally attempt to balance the tradeoff between the level of drawdown protection and the cost to obtain it. Paying the premiums of puts (Protective Put) to achieve protection can be very costly, so investors may consider giving up (i.e., selling) some equity upside (Collar) or even selling upside and removing some level of downside protection (Put Spread Collar) to reduce the premium outlay.

On the other hand, strategies that sell insurance with the objective of collecting a regular premium fall into two main camps: those that sell puts and thus underwrite insurance on its underlying's drawdowns (Put Write), and those that sell calls and give up the underlying's upside (Buy Write).

The historical performance of these strategies showed some apparent contradictions relative to their theoretical and expected payoffs. Strategies that buy insurance on equity drawdowns seemed to participate much more than expected from them and greatly underperformed their underlying asset (over the long term). On the other hand, strategies that sold insurance fared quite well during drawdowns in comparison to the protection buyers, as well as outperforming them over the length of the examined period. Finally, we saw how Put Write greatly outperformed Buy Write, when in theory both strategies should be roughly equivalent.

This supposed contradiction is explained by the Volatility Risk Premium, a market phenomenon that, driven by investor's behavioral biases, causes options that provide insurance against market drawdowns to be overpriced relative to both what theory expects (the difference between realized and implied volatility) and also relative to options that provide access to market upside (volatility skew). This overpricing allows put option sellers to profit relative to put option buyers and call option sellers over the long term, holding all else equal.

Option-based equity strategies can be useful additions to an institutional portfolio, but with some caveats. Although options are more complex and are not as widely followed as assets such as equities and bonds, they provide much flexibility to investors to design strategies that can reduce exposure to equity market drawdowns, generate higher income, and sometimes even a combination of both. No strategy is perfect however, as they all offer different tradeoffs between expected payoff and price. Furthermore, the range of strategies available is vast. Option-based equity strategies can range from equity-like strategies (e.g., Put Write and

Protective Put) all the way to alternatives or hedge-fund like strategies (e.g., market neutral volatility risk premium strategies).

In the context of a strategic equity allocation, Meketa Investment Group does not recommend passive option-based strategies that buy insurance through short dated options.^{34,35} While their expected payoff seems theoretically attractive, this paper has shown that, given the existence of the Volatility Risk Premium, the price required to periodically implement the strategy ended up detracting so much from performance that, unless an investor is able to time a market drawdown (virtually impossible), over the long term these strategies should be expected to underperform just holding the underlying asset.

Finally, it seems beneficial to allocate to insurance selling strategies, particularly selling puts, because they benefit from the Volatility Risk Premium. However, it is important to note that while historical performance has been attractive, these strategies are not a hedge for equity market exposure as they have the same drawdown exposure timing as equities (i.e., they are increasingly correlated during equity market drawdowns)³⁶. Further, these strategies don't fully participate in bull markets as, by design, they "give away" equity upside. The tradeoff they offer relative to holding the underlying asset comes in the form of increased income from option premiums which can generate outperformance in relatively flat markets (i.e., no strong rallies or drawdowns).

In summary, investors comfortable with giving up some equity upside in exchange for increased income (through option premium income and the Volatility Risk Premium), should consider an allocation to insurance selling strategies within their equities portfolio, with the important caveat that higher income and lower beta (i.e., exposure to rallies) does not mean defensive equities, as these strategies are fully exposed to equity market crashes.³⁷

³⁴ The benchmarks reviewed buy 1-month options, but the reasoning can be extended to 3-month and perhaps even 6-month options.

³⁵ While outside the breadth of this paper, within the context of an overall portfolio and a strategic asset allocation, and argument can be made for insurance buying strategies in equities. Essentially, an equity strategy that is systematically protected from drawdowns (no matter the price) could allow an investor to increase its exposure to the asset class, reduce it from lower volatility/lower returning asset classes (e.g., fixed income) and still come out at a similar or perhaps even more beneficial return/volatility trade-off in expectation.

³⁶ See Appendix 3.

³⁷ While we have seen that the existence of the Volatility Risk Premium has historically helped insurance selling strategies have lower total drawdown exposures than equities, they are still constructed to be fully exposed to equity drawdowns, and will be most affected during large and sudden crashes. See Appendix 3 for additional information.

APPENDIX 1. DESCRIPTION OF BENCHMARK INDICES USED:

Protective Put: CBOE S&P 500 5% Put Protection Index (Bloomberg ticker: PPUT Index). The PPUT index tracks the performance of a strategy that holds a long position indexed to the S&P 500 index and buys a monthly 5% out of the money S&P 500 Index put option.

Collar: CBOE S&P 500 95-110 Collar Index (Bloomberg ticker: CLL Index). The CLL index tracks the performance of a passive strategy that holds a long position indexed to the S&P 500 index, buys three month S&P 500 5% OTM put options and sells one month S&P 500 10% OTM call options.

Put Spread Collar: CBOE S&P 500 Zero-Cost Put Spread Collar Index (Bloomberg ticker: CLLZ Index). The CLLZ index tracks the performance of a strategy that holds a long position indexed to the S&P 500 index, buys one month S&P 500 2.5% OTM put option, sells one month S&P 500 5% OTM put option and sells one month OTM S&P 500 call option at the strike required to cover the cost of the put spread.

Put Write: CBOE S&P 500 Put Write Index (Bloomberg ticker: PUT Index). The PUT index sells one month, at the money S&P 500 index puts and invests cash at one and three month Treasury Bill rates.

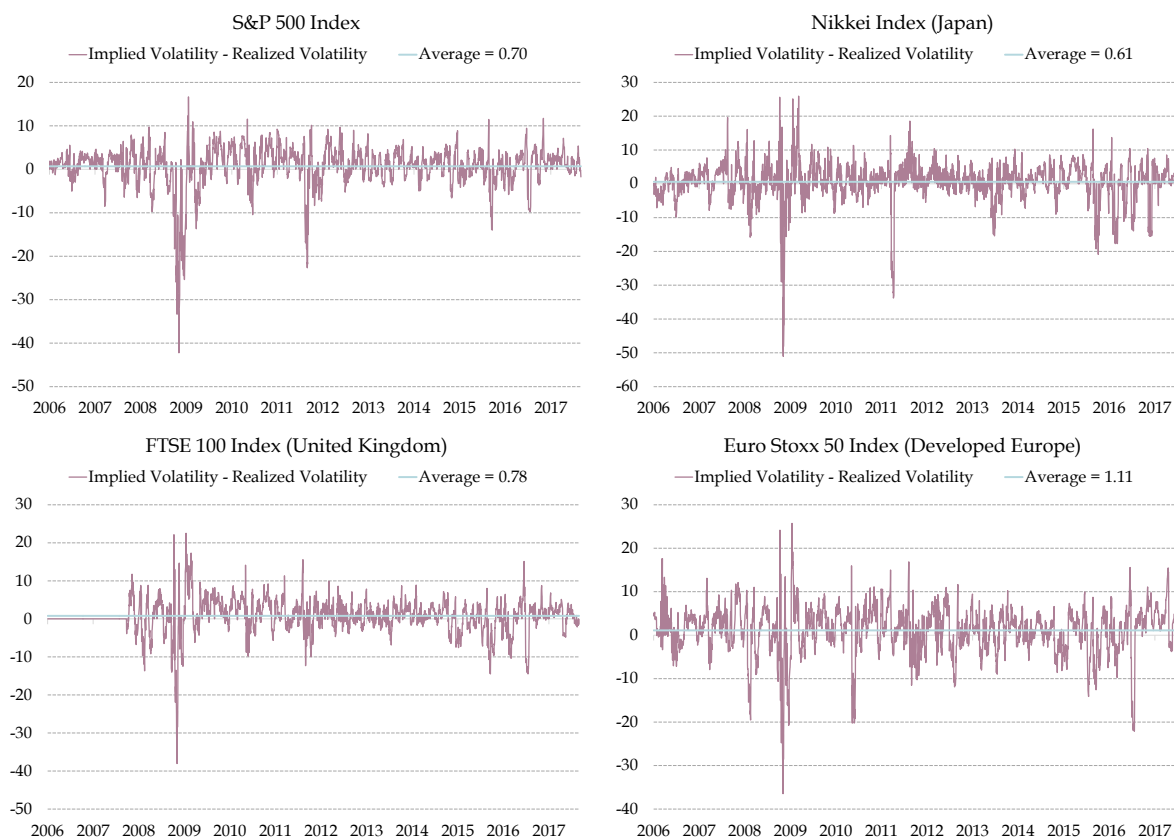
Buy Write: CBOE S&P 500 Buy Write Index (Bloomberg ticker BXM Index). The BXM is a passive total return index based on buying an S&P 500 stock index portfolio and selling the near term S&P 500 call option, generally on the third Friday of each month.

APPENDIX 2. OPTION BASED EQUITY STRATEGIES IN INTERNATIONAL MARKETS

This white paper focused on Option Based Equity strategies using the S&P 500 as the underlying equity index and thus the United States as the market. However, while the options market for the S&P 500 is probably the most liquid in the world, options on equity indices of international developed countries indices are also available for investors. It is worth pointing out however, that benchmarks such as the CBOE indices used throughout the paper are not as widely available for international equity markets.

Regarding the volatility risk premium, the chart below shows that it is not a U.S.-only phenomenon, but it can be seen across geographies. A positive difference between implied and realized volatility on average, means there exists a volatility risk premium in these markets. Most active managers of option based equity strategies that aim to harvest the volatility risk premium focus exclusively on S&P 500 options. However, some managers have recently allocated capital to international developed markets equity indices options to capture additional sources of return. Liquidity is a constraint though, as international equity option markets may not be as liquid as the S&P 500 options market.

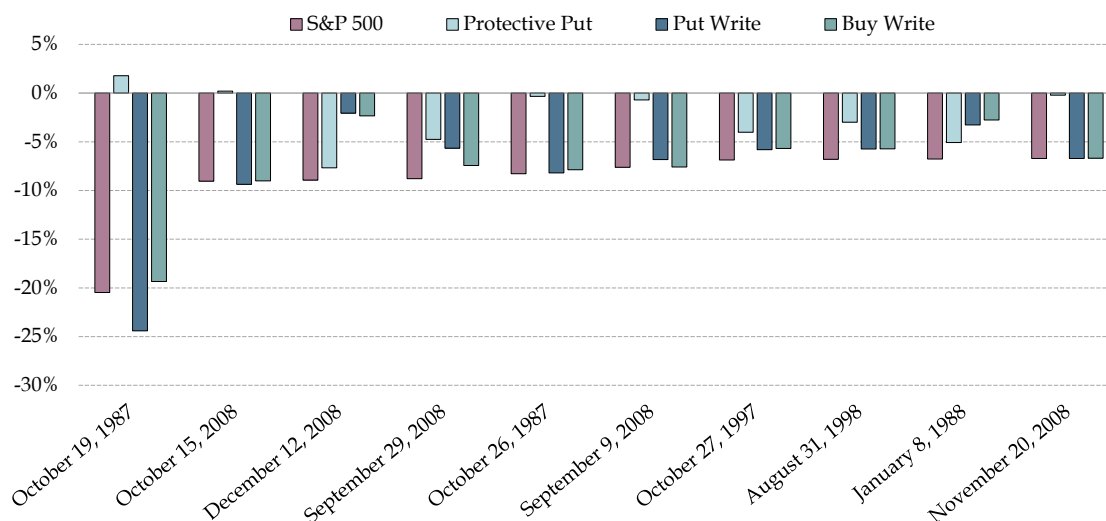
Chart 22. Volatility Risk Premium by Region (Annualized %)
January 2006 – August 2017



APPENDIX 3. OPTION BASED EQUITY STRATEGIES DAILY DOWNSIDE

We have argued throughout the paper that although strategies that sell insurance have historically exhibited lower drawdowns relative to equities when evaluated over long horizons, their payoff structure of capped upside and unlimited downside still exposes them to sharp drawdowns, leading us to conclude that these strategies should not be considered defensive relative to equities.

Chart 23. Performance during S&P 500's 10 Worst Days
June 1986 - August 2017



The “Black Monday” on October 19th, 1987 perfectly reflected the return potential of option based equity strategies. As strategies that sell volatility, Put Write and Buy Write were fully exposed to this sharp equity drawdown, with Put Write even underperforming Equities during the day, whereas the insurance bought by Protective Put helped the strategy end the day with a positive return (~2%).

The rest of the days in the chart show similar behavior, with Put Write and Buy Write exhibiting drawdowns comparable to equities and Protective Put capitalizing (to different degrees) on the insurance bought through its long option position.

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