Option-Based Risk Management in a Multi-Asset World

Edward Szado *

Thomas Schneeweis **

Original Version: November 2011
Current Update: April 17, 2012

*****Doctoral Candidate, Isenberg School of Management, Research Analyst at CISDM, University of Massachusetts, Amherst, MA 01003. CISDM gratefully acknowledges research support provided by the Options Industry Council. Research results, however, represent those of the author and do not necessarily represent the views of the OIC. Please address correspondence to Edward Szado, CISDM, University of Massachusetts, Amherst, MA 01003, 413-577-3166, or email: eszado@som.umass.edu.

******Michael and Cheryl Philipp Professor of Finance, Director of CISDM, Isenberg School of Management, University of Massachusetts, Amherst.

Abstract

The credit crisis and the associated decline in equity markets have rekindled new interest in Option-Based equity collars and in protective strategies in general. In this paper we consider the performance of passive collar strategies on a variety of long ETF positions covering a wide range of asset classes. As expected, the results of the analysis show that for most of the ETFs considered, the collar strategies provide improved risk adjusted performance as well as significant risk reduction. Not surprisingly, the collar strategy is most effective (relative to a long underlying position) in declining markets and less effective in rising markets. Judgments as to the particular benefits of the collar strategies are, of course, dependent on the risk tolerance of the individual investor.

Index

Introduction

The credit crisis and the associated decline in equity markets have rekindled new interest in Option-Based equity collars and in protective strategies in general. In 2008 the QQQ experienced a drawdown of about 50% from peak to trough. Many other asset classes which are generally considered effective equity diversifiers also faced significant losses. This type of contagion across asset classes suggests that in times of major systematic stress, direct hedges through protective option strategies may provide equity portfolios with greater downside risk protection than standard multi-asset diversification programs. There are a variety of option strategies which can provide capital protection for equity based portfolios. The focus of this paper is one of the more straightforward options based strategies – the collar. A collar is an Option-Based investment strategy that effectively limits (or collars) the returns on an investment in an underlying asset to fall within a chosen range. An investor who holds a long position in an underlying asset can convert that position into a collar (collar his position) by purchasing a put option on the underlying asset and simultaneously selling (writing) a call option on the underlying asset. The strike price on the call defines the upper bound of the collar and is set above the strike price for the put (which defines the lower bound of the collar). In a standard collar, the call and put have the same expiration dates. The value of a portfolio constructed in this manner will essentially be restricted to fluctuate within the bounds set by the strike prices of the options (adjusted for the net cost of the option positions).[1]

[1]Collars can be visualized as a combination of covered call and protective put strategies. The collar strategy essentially adds a long protective put to a covered call strategy. This provides the significant downside protection which the covered call strategy lacks. The purchase of the long put is financed by the sale of the call. In essence, the collar trades upside participation for downside protection. A tight collar provides less upside participation and more downside protection than a loose collar. At one extreme, the

In this paper, we extend previous research on collar strategies (Schneeweis and Spurgin [2001] and Szado and Schneeweis [2010]) by considering the performance and risk characteristics of passive collars on a wide range of asset classes. It is worth noting that this study does not address whether these strategies generate "alpha" based on any specific definition of investor risk aversion. The significance of the results may be interpreted differently by any individual based on their particular risk aversion.

In this study we consider the performance of passively implemented collars on 17 ETFs covering a wide range of asset classes. The collars are passive in the sense that they follow a rigid set of rules which do not vary with market conditions. The passive implementations do vary in their choice of the initial moneyness and time to expiration of the calls and puts. In addition to a range of equity based ETFs, the study considers ETFs which focus on other asset classes including currencies, commodities, fixed income, and real estate.

The list of ETFs is as follows:

Underlying	Company	Ticker
MSCI Emerging Markets	iShares	EEM
MSCI EAFE	iShares	EFA
Australian Dollar	CurrencyShares	FXA
British Pound Sterling	CurrencyShares	FXB
Canadian Dollar	CurrencyShares	FXC
Euro	CurrencyShares	FXE
Swiss Franc	CurrencyShares	FXF
Japanese Yen	CurrencyShares	FXY
SPDR Gold Trust	SPDR	GLD
S&P GSCI	iShares	GSG
iBoxx High Yield Corp	iShares	HYG
Russell 2000	iShares	IWM
Dow Jones US Real Estate	iShares	IYR
QQQ NASDAQ-100	PowerShares	QQQ
S&P 500	S&P	SPY
Barclays 20+ Treasury	iShares	TLT
United States Oil	United States Commodity Funds	USO

tightest collar (ATM puts and calls) effectively immunizes the portfolio from market movements. At the other extreme (very far OTM puts and calls), the collar is essentially equivalent to a long index position.

In the following sections we summarize the methodology and data used in this analysis. It is important to note that all empirical research may be data and time period dependent.

Data and Methodology

Data

The option price data is provided by Optionmetrics and the study covers the period from June 1, 2007 to December 31, 2011, with the exception of the GLD ETF which begins at first month-end after the inception of option trading on July 1, 2008. The period of study was chosen to capture the financial crisis and to provide a common period of study for a wide range of ETFs. Since options on a number of ETFs of interest began trading in the second week of May 2007, we chose June 1, 2007 as the beginning of the study period. Despite the later inception of its options, the GLD ETF was included in the study due to the particular interest investors place on gold as an investment vehicle.

Methodology

In order to assess the performance of passive collar strategies, we construct indices which represent the return streams generated by such strategies. The strategies follow a fixed set of option selection rules defining the initial moneyness and time to expiration of the calls and puts, regardless of market conditions.

We generate a daily time series of returns for each of the collar strategies. At the close on the day before the Saturday expiration of the 1-month calls, a 1-month call is written and a 6-month put is purchased. Depending on the particular passive implementation, the initial moneyness of the calls and puts are set at: 25%, 10%, 5%, or 2% OTM or ATM. At the close on

the Friday prior to the Saturday expiration, the calls are settled at intrinsic value and new 1-month calls with the specified moneyness are rolled into, while the longer term put is held for another month. When the new 1-month calls are written, the net proceeds from the sale of the calls and the expiration of the previous calls are fully invested in the strategy and the position is rebalanced to ensure a 1:1:1 ratio of the underlying, puts and calls. Once the 6-month put expires, it is settled at intrinsic value and we once again roll into new puts and calls with the specified moneyness and time to expiration. In order to include the impact of transaction costs, the puts are purchased at the ask price and the calls are written at the bid price when each new put or call position is established. Each trading day in between roll dates, the options are priced at the mid-point between the bid and ask prices. In this manner, daily returns are calculated for each passive strategy implementation. If the underlying price declines significantly after the initiation of the put and call positions it is possible for the previously established long puts to be deep ITM when the new calls are written. If the puts are deep ITM, with a delta which is essentially -100, the long put and long underlying would counteract each other and the new call would essentially be written naked. Since writing naked calls is inconsistent with the risk reduction purpose of the collar strategy, we implement a rule to avoid such a circumstance. In order to avoid a crossed-strike collar, we roll the put to the strategy's target moneyness based on the current underlying price on the day the new short call position is initiated. In such a case, we sell the put at the mid-point between the bid and ask and buy the new put at the ask price[2].

[2] We capture transaction costs on one side of the transaction only since the transactions would likely be initiated as a spread trade.

In addition to the 6-month put/1-month call collars, we also create a series of 1-month put/1-month call balanced moneyness collars for the purpose of analyzing realized and implied volatilities, bid/ask spreads and implied volatility skews.

Finally, we construct a series of 1-month put/1-month call "zero cost" in which the put moneyness is established and the cheapest call is written which will cover the cost of the put. These strategies are constructed for the purpose of further analyzing implied volatility skews and the corresponding tradeoff between downside protection and upside participation.

In all strategies, we only consider options which at the time of option position initiation, the bid/ask spread is less than 1% of the corresponding underlying price. There are two primary reasons behind this practice. First, the data includes spreads wider than 10% of the underlying. In such a case, it is very difficult to argue that the "fair market price" of the option is the mid-point between the bid and ask. It is also quite reasonable to argue that one may be able to trade at more favorable prices when the posted spread is so wide. Secondly, it is reasonable to argue that if legitimate spreads are excessively wide an investor interested in protecting their investment would have to decide whether the cost of the "insurance" is excessive due to the transaction costs. If transaction costs are excessive, the investor may consider not to hedge, or to liquidate the position and hold their funds in cash. When spreads over 1% are encountered, we look to the next available strike for the options. If no puts or no calls are available with "small" spreads, we roll the full position (long underlying, long put, and short call) into cash (as represented by the SHY ETF). We remain invested into cash until the next call roll date. If we then find puts and call with "small" spreads, we reinitiate the collar strategy (long underlying, long put, and short call).

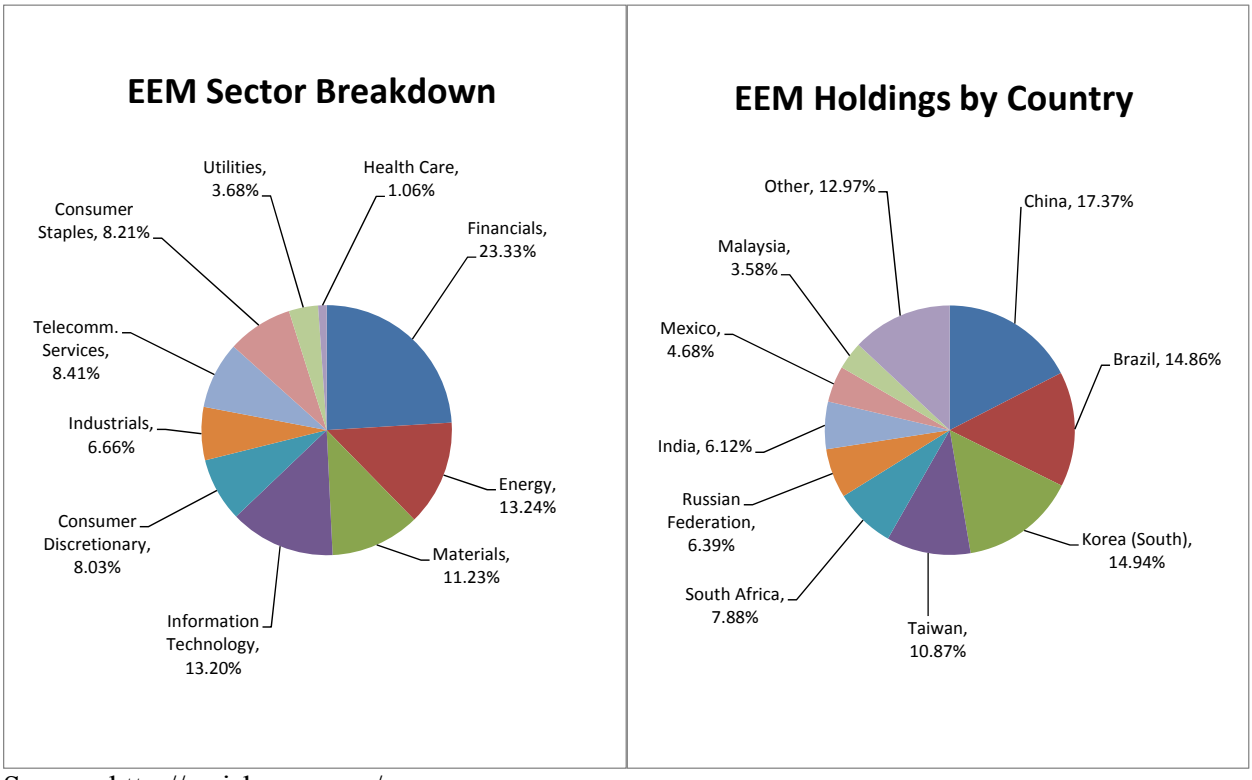
Empirical Results for EEM iShares MSCI Emerging Markets Index ETF, (NYSE Arca)

The EEM ETF provides access to the Emerging Markets asset class. iShares describes the EEM ETF as follows:

> "The iShares MSCI Emerging Markets Index Fund seeks to provide investment results that correspond generally to the price and yield performance, before fees and expenses, of publicly traded securities in emerging markets, as represented by the MSCI Emerging Markets Index ("the Index")."…" The index was developed by MSCI Inc. as an equity benchmark for emerging market stock performance. It is a capitalization-weighted index that aims to capture 85% of the (publicly available) total market capitalization. Component companies are adjusted for available float and must meet objective criteria for inclusion to the Index, taking into consideration unavailable strategic shareholdings and limitations to foreign ownership. MSCI reviews its indexes quarterly."

The inception date for the ETF was April 7, 2003, with option data available from March 9, 2006. As of December 31, 2011, the EEM ETF had net assets of $32.49 Billion, and 860 holdings. The EEM is traded on the NYSE Arca exchange and its CUSIP is 464287234. Further details of the fund holdings are provided in Exhibit 1a.

Exhibit 1a EEM ETF Characteristics



Source: http://us.ishares.com/

In this section, we compare the performance of the EEM ETF to the performance of EEM 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[3].

Exhibit 1b: Summary Statistics EEM 1-Month Call/6-Month Put Balanced Collars

EEM Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	EEM Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	-0.43%	4.56%	6.29%	5.87%	5.06%	3.11%
Annualized Standard Deviation	30.95%	8.54%	10.44%	14.05%	18.19%	22.87%
Mean Monthly Return	0.36%	0.40%	0.55%	0.56%	0.55%	0.47%
Median Monthly Return	-0.93%	0.43%	0.56%	0.48%	0.01%	-0.22%
Period Cumulative Return	-1.97%	22.69%	32.28%	29.88%	25.38%	15.06%
Sharpe Ratio	-0.05	0.41	0.50	0.34	0.22	0.09
Stutzer Index	-0.05	0.40	0.49	0.34	0.22	0.09
Treynor Ratio	-0.01	0.31	0.28	0.15	0.09	0.04
Modified Calmar Ratio	-0.03	1.90	2.48	1.70	0.98	0.38
Jensen Beta with EEM	1.00	0.11	0.19	0.32	0.46	0.59
Jensen Monthly Alpha	0.00%	0.30%	0.44%	0.43%	0.38%	0.24%
Leland Beta	1.00	0.11	0.18	0.31	0.44	0.56
Leland Monthly Alpha	0.00%	0.30%	0.44%	0.43%	0.38%	0.24%
Correlation with Underlying	1.00	0.43	0.59	0.75	0.83	0.85
Skewness	-0.21	-0.22	0.09	0.34	0.27	0.30
Excess Kurtosis	0.22	2.89	1.93	0.64	-0.39	-0.79
Minimum Monthly Return	-25.58%	-8.09%	-8.95%	-9.58%	-10.00%	-10.73%
Maximum Monthly Return	16.86%	7.65%	9.00%	12.50%	13.28%	15.27%
Maximum Drawdown	-60.44%	-11.94%	-13.01%	-17.61%	-25.85%	-39.42%
Maximum Run Up	142.96%	31.95%	40.99%	65.31%	83.01%	95.73%
% Down Months	55%	35%	44%	47%	49%	53%
% Up Months	45%	65%	56%	53%	51%	47%
Number of Months	55	55	55	55	55	55
Months in Cash		1	1	1	1	1
Months in Collar		54	54	54	54	54

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[4]. Exhibit 1b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk while increasing the realized returns relative to a long EEM position. The annualized returns are increased from a loss of -0.43% for the EEM to 5.87% for the 5% OTM collar. Despite the significantly increased returns, the

[3] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[4] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

standard deviation is reduced by more than 1/2 from 30.95% to 14.05%. The Stutzer index increased from -0.05 to 0.34, suggesting that the collar substantially improved risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -60.44% to -17.61%. Not surprisingly, the increased returns and reduced drawdown result in a modified Calmar ratio[5] for the collar which is significantly higher than that of the EEM at 1.70 (versus -0.03 for the EEM) for the 55 month period. Additional insight can be provided by Exhibit 1c and Exhibit 1d, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the over performance of the collar strategies is their protection from the large drawdown that the EEM ETF experienced in the second half of 2008. The performance of the 5% and greater OTM collars is quite similar to the EEM ETF from mid-2009 to the end of the period. Ultimately, while the 5% OTM collar improves the maximum drawdown from -60.44% to -17.61%, it also reduces the maximum run up from 142.96% to 65.31%.

In addition to providing results for 5% OTM collars, Exhibit 1b and Exhibit 1c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies significantly reduced the standard deviation of the EEM, the further OTM strategies underperformed the nearer to ATM collars from a raw return perspective, with the exception of the ATM collar. By most measures, the 2% OTM collar outperformed the other collars, as well as significantly outperforming the EEM ETF. For example, the Stutzer index of the 2% OTM collar is 0.49 versus 0.40, 0.34, 0.22, 0.09 and -0.05 for the ATM, 5% OTM, 10% OTM and 25% OTM collars and the EEM, respectively. Similarly, the monthly Leland alpha of the 2%

[5] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

OTM collar is 44 basis points versus 30, 43, 38, 24 and 0 basis points for the ATM, 5% OTM, 10% OTM and 25% OTM collars and the EEM, respectively. Thus, all of the collars have higher Leland alphas than the EEM, and thus they provide higher risk adjusted returns than the EEM.

Exhibit 1c: Growth of $100 EEM 1-Month Call/6-Month Put Balanced Collars

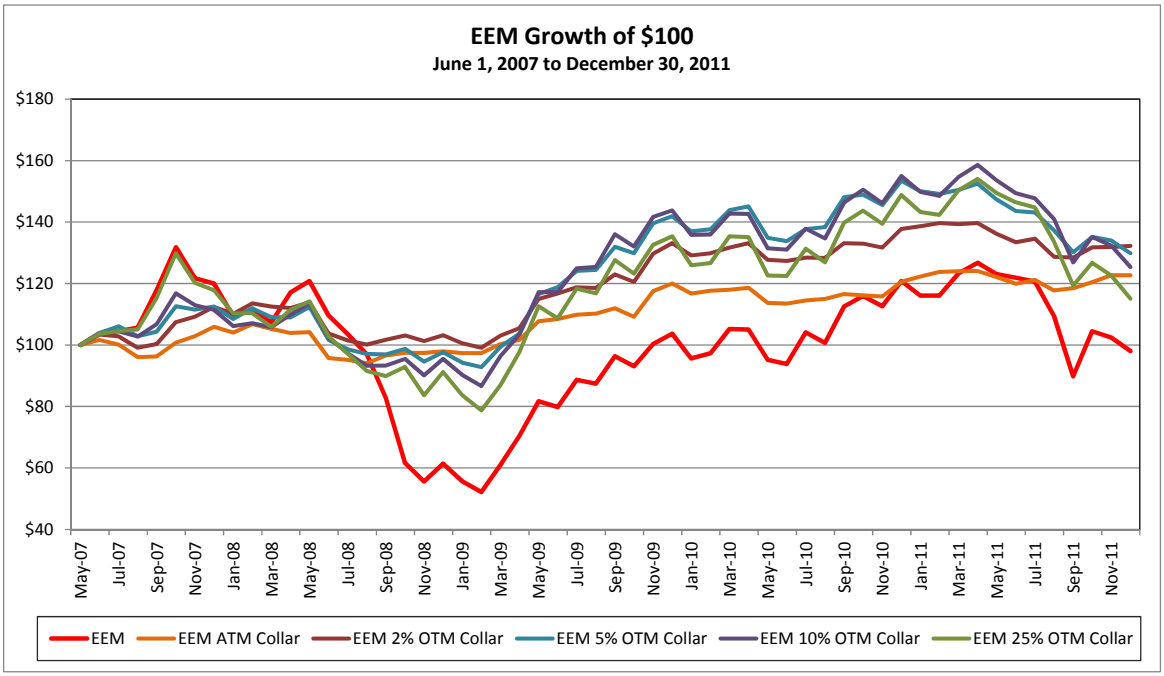


Exhibit 1d and Exhibit 1e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 1d it is clear that the collar strategies reduce drawdown in the first half of the period as well as reducing the run up in the middle of the period. The returns of the collar strategies are generally quite similar to those of the EEM in the second half of the period. The rolling standard deviations provided in Exhibit 1e are evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM, 5% OTM and 25% OTM collar strategies exhibit significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 7% to 30%. The volatility reduction of the collar strategies is evident in Exhibit 1e. It is clear that the volatility reduction is

driven by the moneyness of the options, with the closer to the ATM options providing the greatest volatility reduction.

Exhibit 1d: Rolling Returns EEM 1-Month Call/6-Month Put Collars

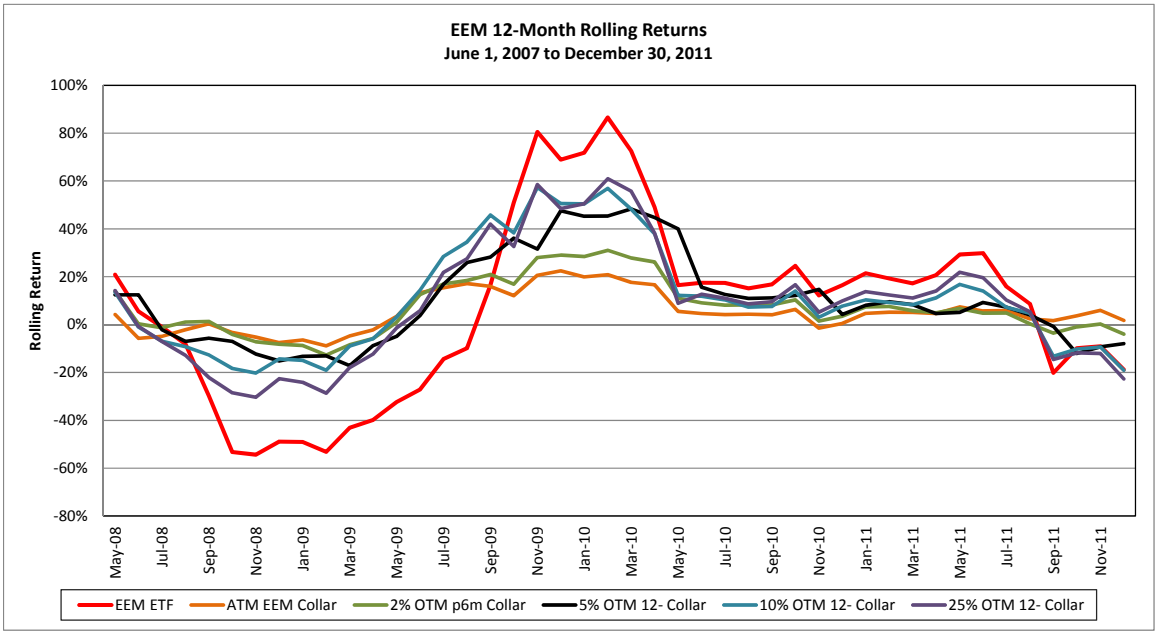
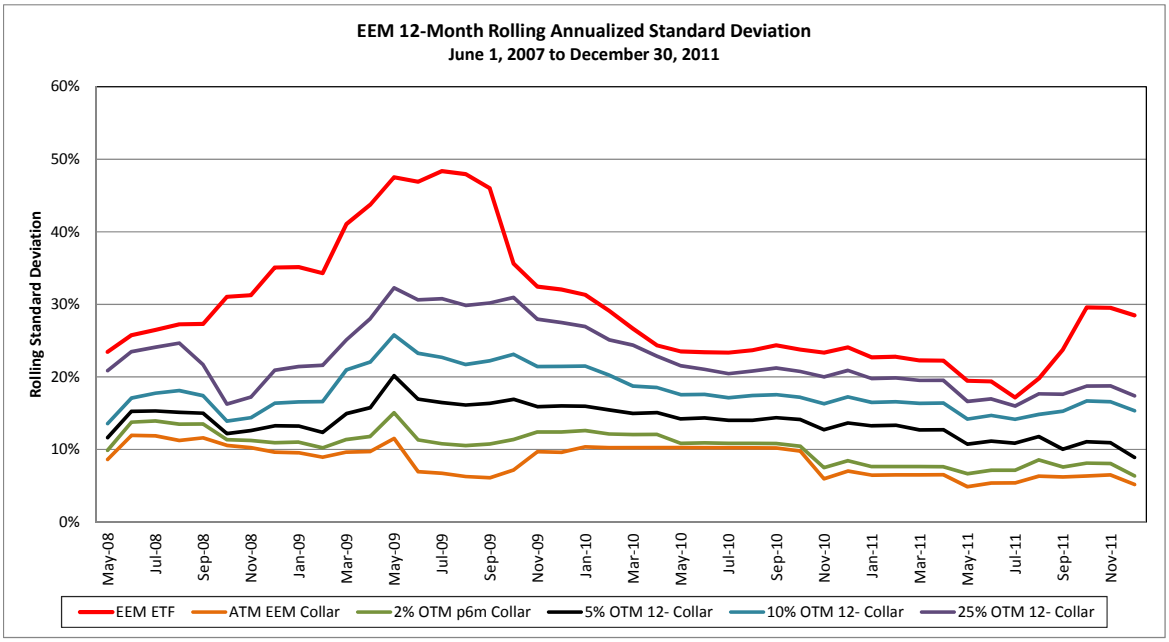
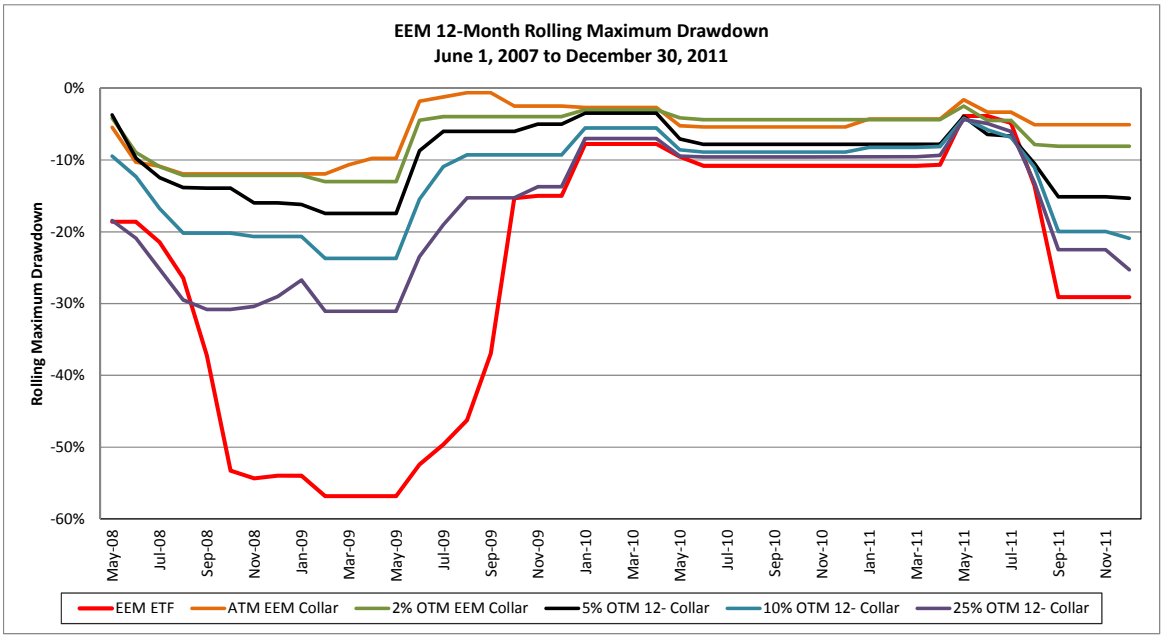


Exhibit 1e: Rolling Standard Deviation EEM 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 1f provides a graphical presentation of 12-month rolling maximum drawdowns for EEM collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. The EEM experienced large drawdowns in the first half of the period of study. It is clear in Exhibit 1f that the moneyness of the collar had a large impact on the degree of drawdown protection. While the near the money strategies provided significant protection, the deeper OTM collars had far less impact on drawdowns, particularly during the deep drawdowns in late 2008 and early 2009.

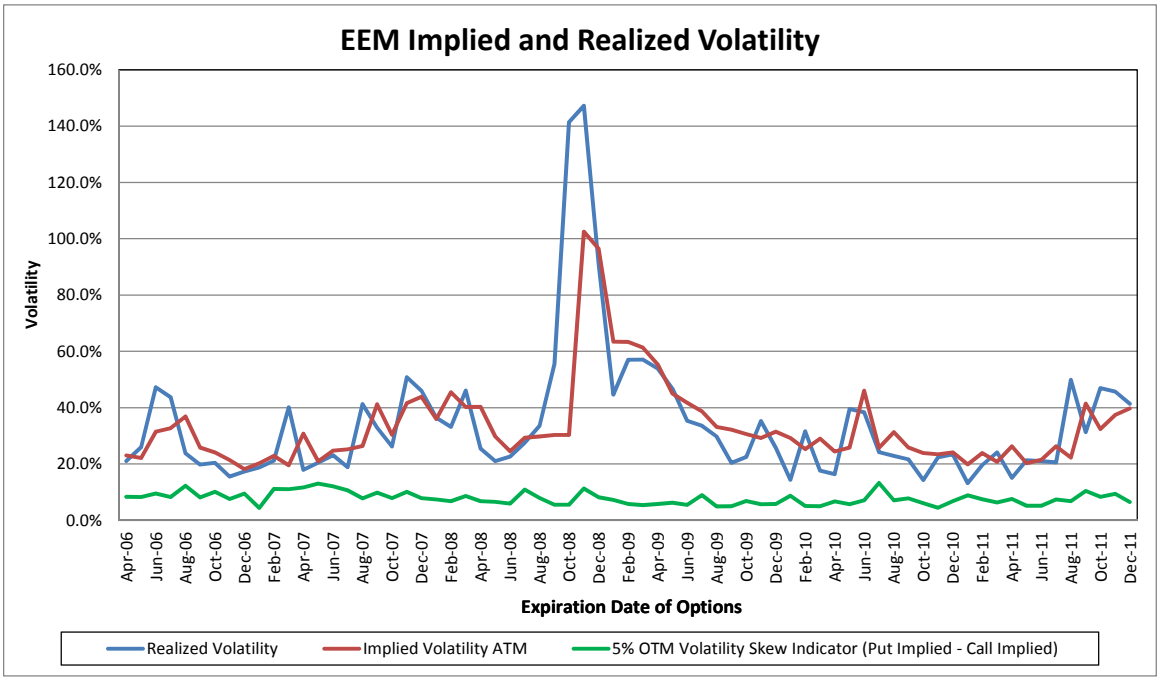
Exhibit 1f: Rolling Maximum Drawdown EEM 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying EEM ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 1g provides the levels of initial implied volatilities for 1-month ATM options on the EEM since inception as well as the ex-post realized

volatility over the life of the options[6] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[7]). While the volatility of volatility is quite high, the ATM implied volatility for the EEM options tends to fluctuate around the 30% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around the 5% to 10% level (with the puts exhibiting higher implied volatilities than the calls).

Exhibit 1g: Implied and Realized Volatility EEM 1-Month Collars Since Option Inception



[6] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.

[7] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

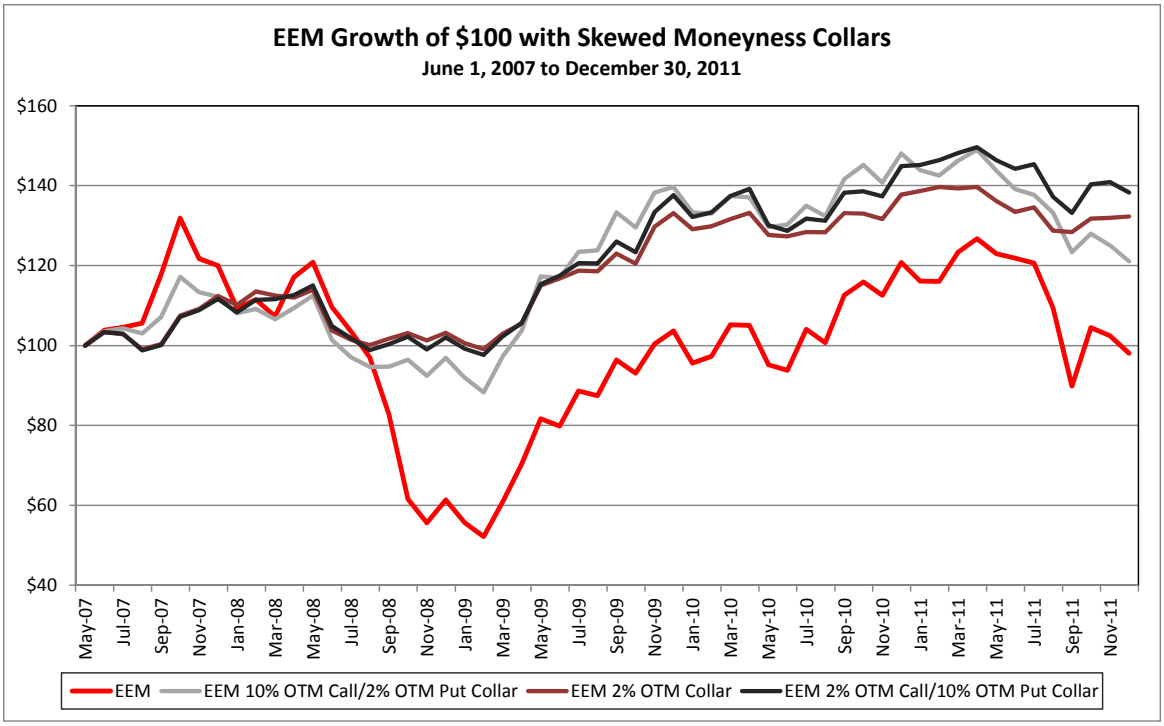
Exhibit 1h and Exhibit 1i provide summary statistics and a graphical presentation of performance, respectively for skewed EEM collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 1h: Summary Statistics EEM 1-Month Call/6-Month Put Skewed Collars

EEM Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	EEM Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	-0.43%	4.26%	6.29%	7.33%
Annualized Standard Deviation	30.95%	15.89%	10.44%	12.17%
Mean Monthly Return	0.36%	0.45%	0.55%	0.65%
Median Monthly Return	-0.93%	-0.20%	0.56%	0.86%
Period Cumulative Return	-1.97%	38.27%	32.28%	21.09%
Sharpe Ratio	-0.05	0.20	0.50	0.52
Stutzer Index	-0.05	0.20	0.49	0.50
Treynor Ratio	-0.01	0.08	0.28	0.24
Modified Calmar Ratio	-0.03	1.55	2.48	1.40
Jensen Beta with EEM	1.00	0.39	0.19	0.26
Jensen Monthly Alpha	0.00%	0.31%	0.44%	0.53%
Leland Beta	1.00	0.37	0.18	0.25
Leland Monthly Alpha	0.00%	0.31%	0.44%	0.53%
Correlation with Underlying	1.00	0.81	0.59	0.69
Skewness	-0.21	0.49	0.09	-0.08
Excess Kurtosis	0.22	0.21	1.93	0.48
Minimum Monthly Return	-25.58%	-9.87%	-8.95%	-8.84%
Maximum Monthly Return	16.86%	13.12%	9.00%	9.16%
Maximum Drawdown	-60.44%	-24.64%	-13.01%	-15.10%
Maximum Run Up	142.96%	53.24%	40.99%	68.64%
% Down Months	55%	51%	44%	38%
% Up Months	45%	49%	56%	62%

The net premium collection collar (2% OTM call/10% OTM put) outperforms the net premium payment collar and the balanced collar on an absolute basis and a risk adjusted return basis. For example, the net premium collection collar generates a 7.33% return at a standard deviation of 12.17% versus 6.29%/10.44%, 4.26%/15.89%, and -0.43%/30.95% for the balanced collar, the net premium payment collar and the underlying EEM ETF, respectively. Similarly, the Stutzer index for the net premium collection collar is higher than that of the other collars and the EEM at 0.50 versus 0.49, 0.20 and -0.05 for the balanced collar, the net premium payment collar and the underlying EEM ETF, respectively.

Exhibit 1i: Growth of $100 EEM 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit

1g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 1j: Protection Cost Index at Roll-In EEM 1-Month "Zero-Cost" Collars

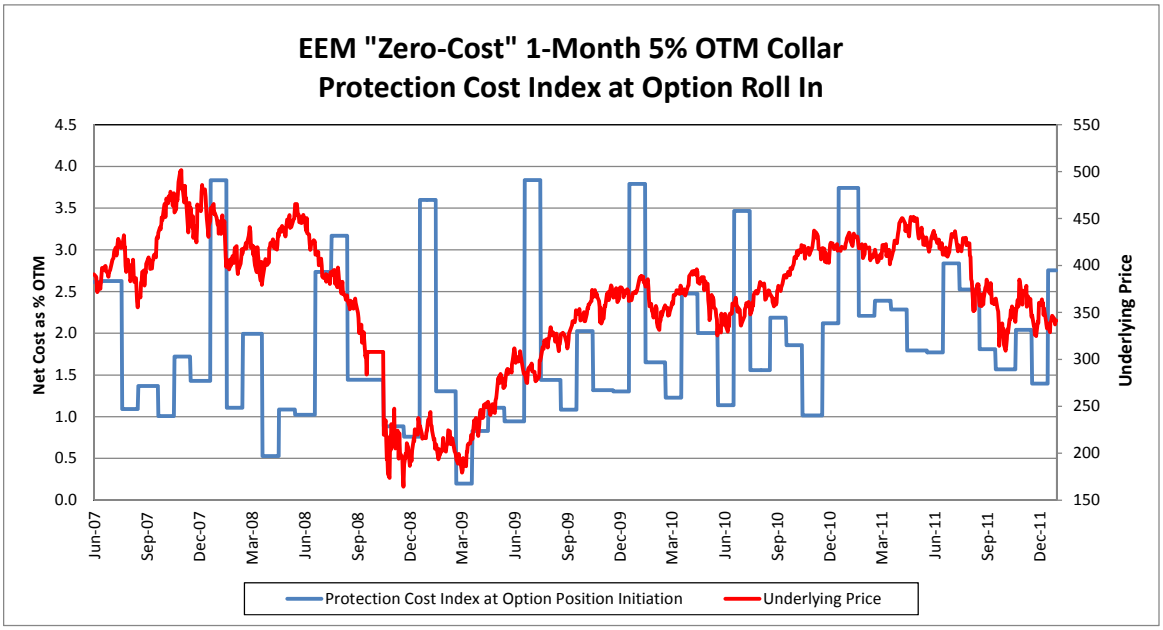


Exhibit 1k: Initial Option Moneyness EEM 1-Month "Zero-Cost" Collars

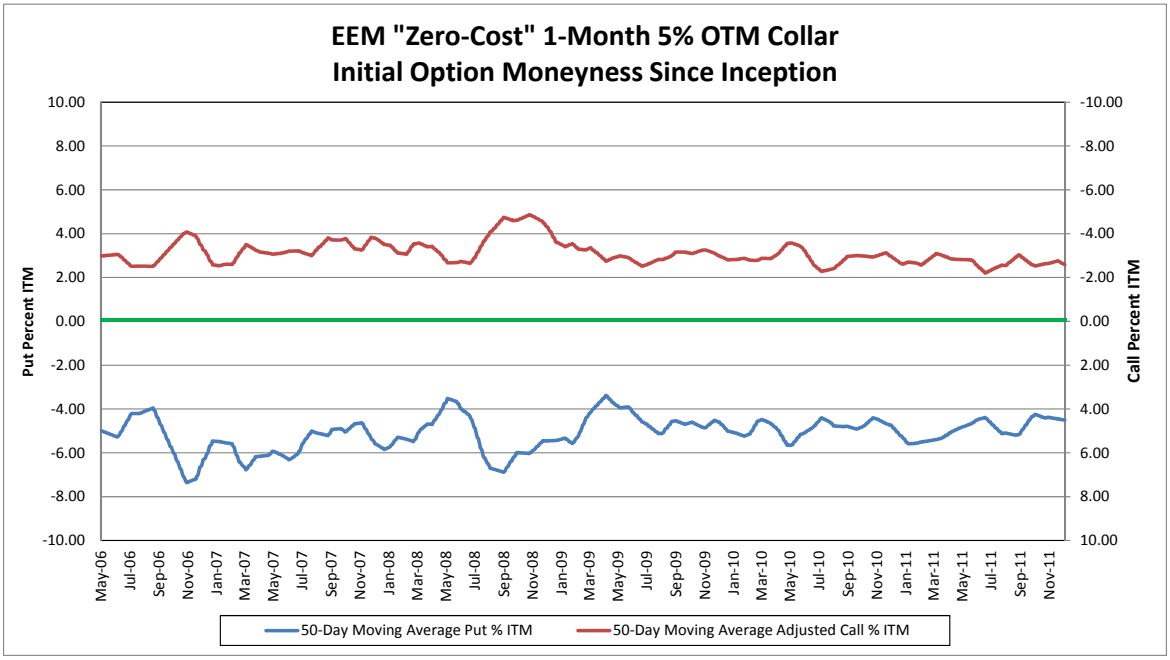


Exhibit 1j and Exhibit 1k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the EEM options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[8].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. It is worth noting that Exhibit 1j indicates missing options by a horizontal line for the underlying price as well as the PCI for the period in which no option position is available. This could occur either because all puts or calls have overly large bid/ask spreads (greater than 1% of the underlying price) or because no call is quoted which has a price as high as the chosen 5% OTM put. The Exhibit indicates a significant skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (as is typical of equity index options).While the rolling PCI index tends to average near the 2% level, the PCI varies significantly over time. Interestingly, the PCI reaches a local minimum in early-2008 just before the EEM faces a precipitous fall and again in early-2009, followed by a general upward trend. Exhibit 1k provides further evidence of the put skew by illustrating the rolling average put

[8] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

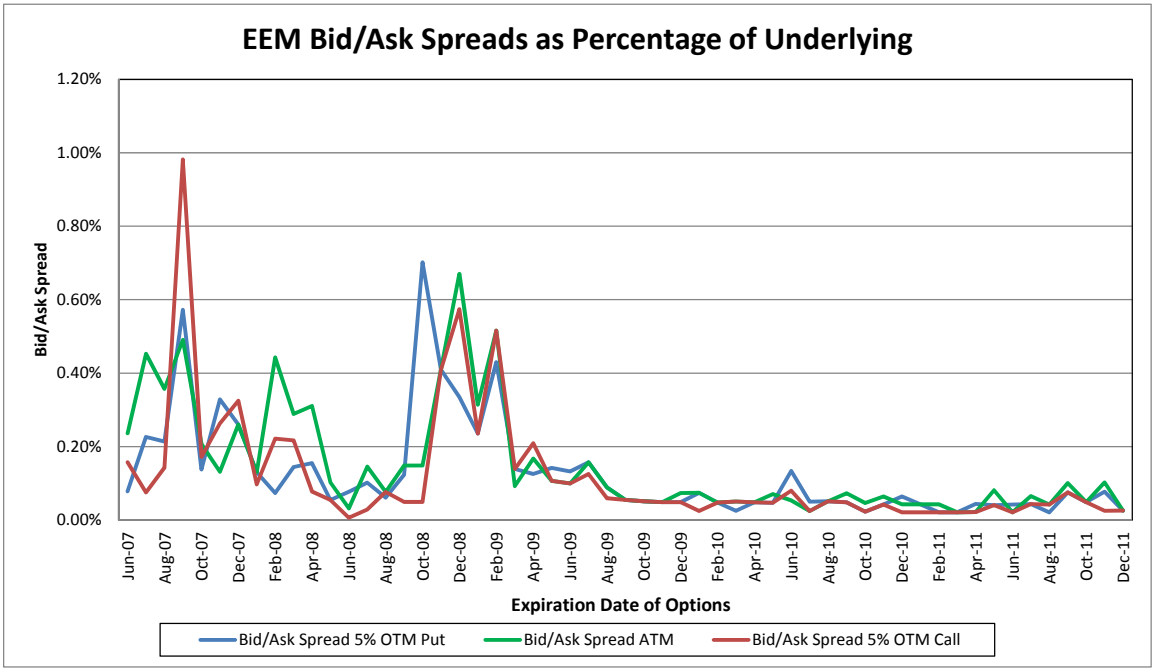
moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 1l provides a graphical presentation of bid/ask spreads as a percentage of the underlying EEM price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[9]. In general, bid/ask spreads tend to decrease over time. However, while there are a number of peaks in the spreads, the spreads tend to be around 5 basis points in the second half of the period. It is worth noting that the collar strategies presented in this section of the paper invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the EEM underlying price[10]. The EEM strategies were invested in SHY for 1 month of the 55 months covered in the study due to high bid/ask spreads.

[9] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[10] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 1l: Bid/Ask Spreads EEM 1-Month Collars



In conclusion, the EEM ETF experienced significant drawdowns over the period of study followed by a strong run up. During the financial crisis, the collar strategies on the EEM ETF provided significant return improvement and risk reduction. EEM options tend to exhibit significant put skew as is typical of equity index options. Finally, while EEM options used in this study exhibited bid/ask spreads of over ½% of the underlying price at times, the spreads were typically under 10 basis points, particularly in the later part of the period of study.

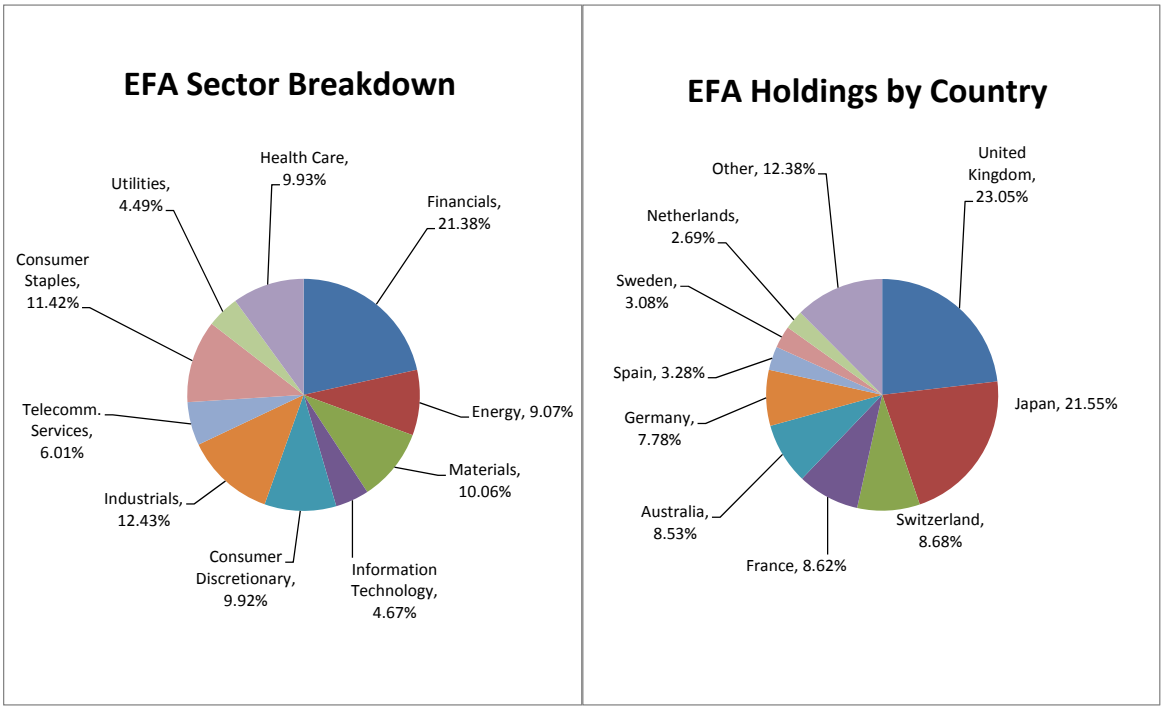
Empirical Results for EFA iShares MSCI EAFE Index Fund ETF, (NYSE Arca)

The EFA ETF provides access to the Emerging Markets asset class. iShares describes the EFA ETF as follows:

> "The iShares MSCI EAFE Index Fund seeks to provide investment results that correspond generally to the price and yield performance, before fees and expenses, of publicly traded securities in the European, Australasian, and Far Eastern markets, as represented by the MSCI EAFE Index ("the Index")."…" The index was developed by MSCI Inc. as an equity benchmark for international stock performance. It is a capitalization-weighted index that aims to capture 85% of the (publicly available) total market capitalization. Component companies are adjusted for available float and must meet objective criteria for inclusion to the Index, taking into consideration unavailable strategic shareholdings and limitations to foreign ownership. MSCI reviews its indexes quarterly."

The inception date for the ETF was August 14, 2001, with option data available from September 25, 2002. As of December 31, 2011, the EFA ETF had net assets of $36.5 Billion, and 925 holdings. The EFA is traded on the NYSE Arca exchange and its CUSIP is 464287465. Further details of the fund holdings are provided in Exhibit 2a.

Exhibit 2a EFA ETF Characteristics



Source: http://us.ishares.com/

In this section, we compare the performance of the EFA ETF to the performance of EFA 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[11].

Exhibit 2b: Summary Statistics EFA 1-Month Call/6-Month Put Balanced Collars

EFA Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	EFA Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	-7.32%	-0.68%	-1.26%	-3.66%	-5.04%	-6.63%
Annualized Standard Deviation	24.52%	7.53%	9.02%	12.24%	16.42%	18.26%
Mean Monthly Return	-0.38%	-0.03%	-0.07%	-0.25%	-0.32%	-0.43%
Median Monthly Return	-1.19%	-0.06%	-0.04%	-0.45%	-0.82%	-1.31%
Period Cumulative Return	-29.43%	-3.07%	-5.66%	-15.73%	-21.09%	-26.98%
Sharpe Ratio	-0.34	-0.23	-0.26	-0.39	-0.37	-0.42
Stutzer Index	-0.35	-0.23	-0.26	-0.39	-0.38	-0.43
Treynor Ratio	-0.08	-0.11	-0.09	-0.11	-0.10	-0.11
Modified Calmar Ratio	-0.51	-0.18	-0.25	-0.49	-0.54	-0.62
Jensen Beta with EFA	1.00	0.15	0.25	0.42	0.60	0.67
Jensen Monthly Alpha	0.00%	-0.04%	-0.01%	-0.10%	-0.08%	-0.18%
Leland Beta	1.00	0.15	0.25	0.42	0.61	0.67
Leland Monthly Alpha	0.00%	-0.03%	-0.01%	-0.09%	-0.08%	-0.17%
Correlation with Underlying	0.92	0.44	0.63	0.78	0.85	0.83
Skewness	-0.28	-0.42	-0.01	0.22	0.37	0.14
Excess Kurtosis	0.19	2.63	1.45	-0.25	-0.59	-0.54
Minimum Monthly Return	-20.83%	-7.81%	-8.30%	-8.56%	-8.79%	-11.05%
Maximum Monthly Return	13.19%	5.63%	6.55%	8.90%	11.60%	12.06%
Maximum Drawdown	-57.38%	-16.79%	-22.79%	-31.84%	-39.02%	-43.83%
Maximum Run Up	93.58%	15.73%	26.93%	42.67%	51.98%	58.38%
% Down Months	56%	51%	51%	56%	60%	62%
% Up Months	44%	49%	49%	44%	40%	38%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[12]. Exhibit 2b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk and improves realized returns relative to a long EFA position. The annualized returns are reduced from a loss of -7.32% for the EFA to -3.66% for the 5% OTM collar, so the loss is reduced by 1/2. Similarly, the standard deviation is

[11] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[12] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

reduced by about 1/2 from 24.52% to 12.24%. Certain performance measures such as the Stutzer index, Sharpe ratio and modified Calmar ratio[13] are non-informative when returns are negative, so for risk adjusted returns we will consider the Leland alpha. Despite the improved risk and returns, the 5% OTM collar provided a lower monthly Leland alpha (-0.09%) than the EFA ETF, suggesting that the collar slightly reduced risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -57.38% to -31.84%. However, the maximum run up was also reduced by the collar from 93.58% for the EFA to 42.67% for the collar. Additional insight can be provided by Exhibit 2c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the superior absolute performance of the collar strategies is their limited participation in the significant drawdown that the EFA ETF experienced from mid-2008 to early-2009. The performance of the 5% and greater OTM collars is quite similar to the EFA ETF from mid-2009 to the end of the period.

In addition to providing results for 5% OTM collars, Exhibit 2b and Exhibit 2c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies significantly reduced the standard deviation of the EFA, the nearer to ATM strategies outperformed the further OTM collars from a raw return perspective. The Leland alpha suggests that the 2% OTM collar outperformed the other collars on a risk adjusted basis (with further OTM collars generally performing worse) although the 2% OTM collar still slightly underperformed the EFA ETF. For example, the monthly Leland alpha of the 2% OTM collar is

[13] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

-1 basis point versus -3, -9, -8, -17 and 0 basis points for the ATM, 5% OTM, 10% OTM and 25% OTM collars and the EFA, respectively.

Exhibit 2c: Growth of $100 EFA 1-Month Call/6-Month Put Balanced Collars

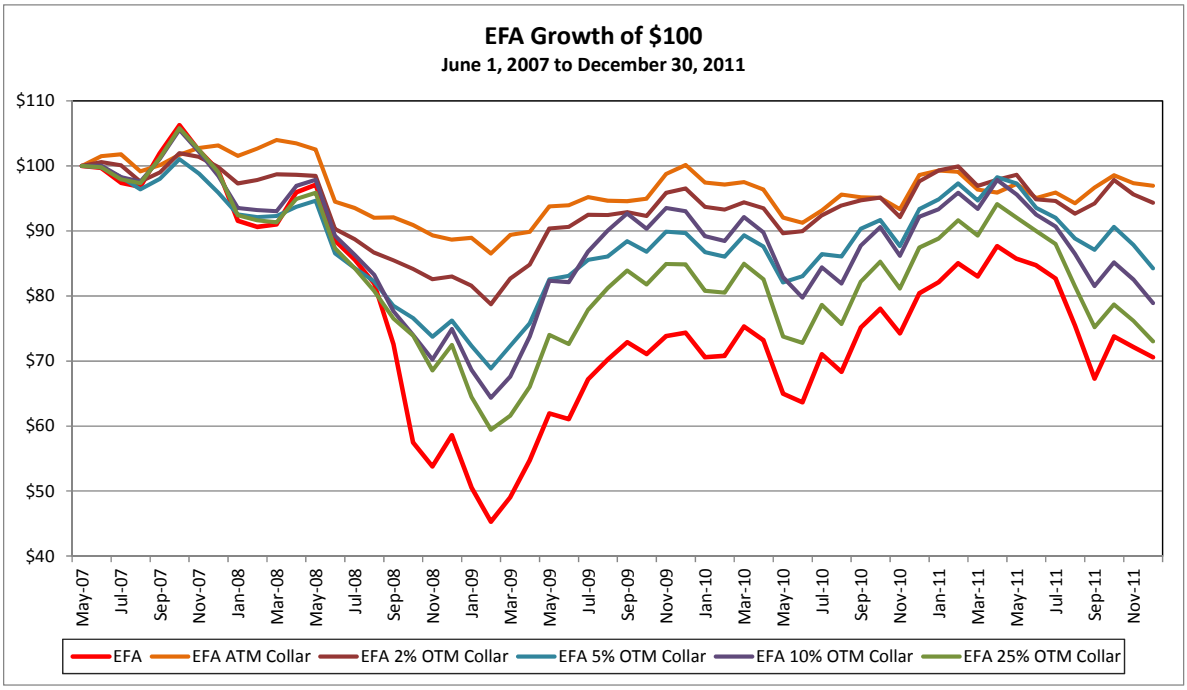


Exhibit 2d and Exhibit 2e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 2d it is clear that the collar strategies (particularly the nearer ATM strategies) have limited participation in the large downward and upward moves in the EFA ETF. In less volatile times, the returns of the deep OTM collar strategies are generally quite similar to those of the EFA. The rolling standard deviations provided in Exhibit 2e are further evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard deviations

throughout the entire period, with the difference for the 5% OTM collar ranging from about 5% to almost 25%.

Exhibit 2d: Rolling Returns EFA 1-Month Call/6-Month Put Collars

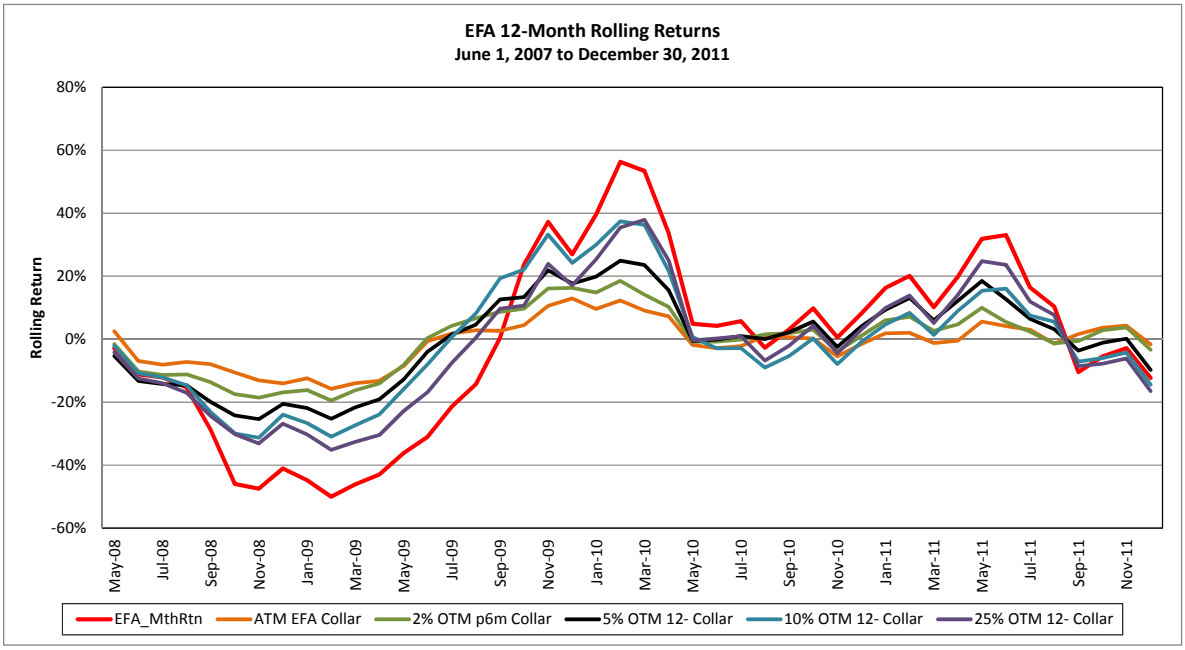
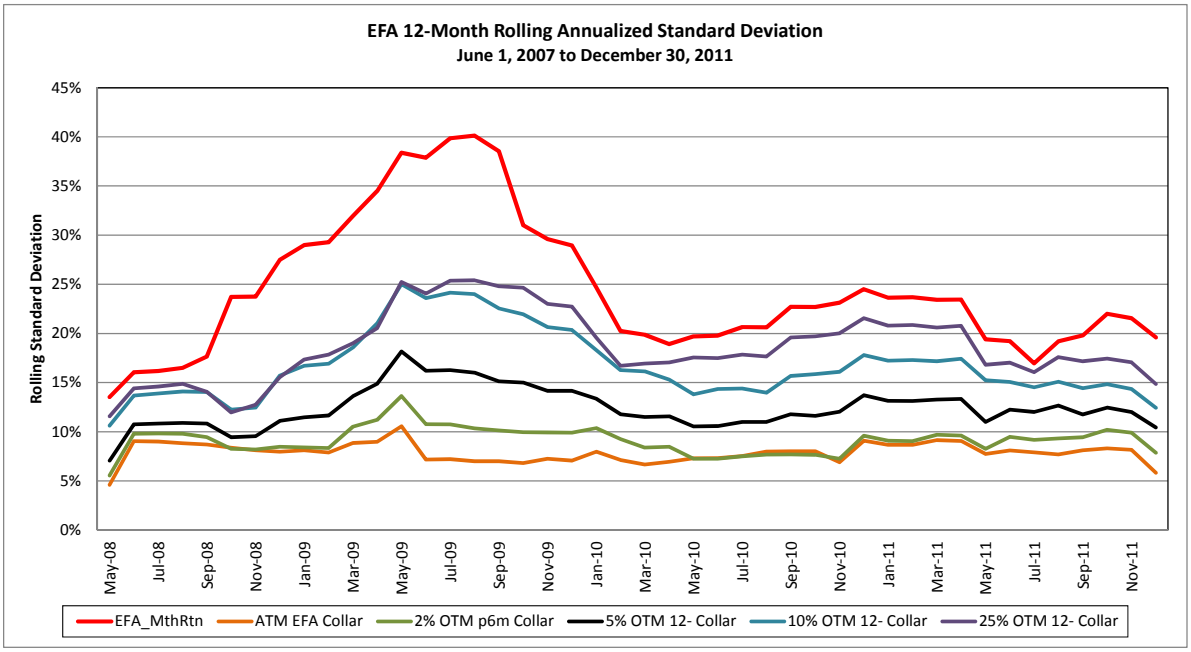
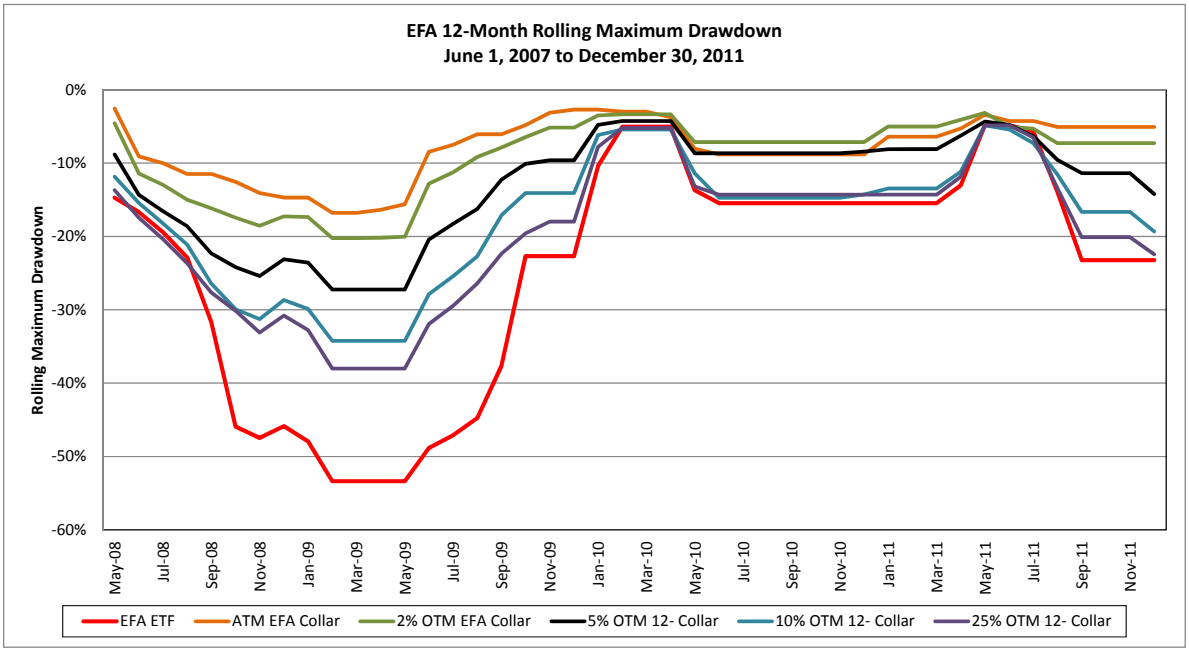


Exhibit 2e: Rolling Standard Deviation EFA 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 2f provides a graphical presentation of 12-month rolling maximum drawdowns for EFA collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the EFA experienced significant and sustained drawdowns in the first half of the period of study, the collar strategies provided significant mitigation to the losses. It is clear that the moneyness of the collar had a large impact on the degree of drawdown protection, particularly in the early part of the period. While the near the money strategies provided significant protection, the deeper OTM collars had far smaller, although still very significant, impact on drawdowns.

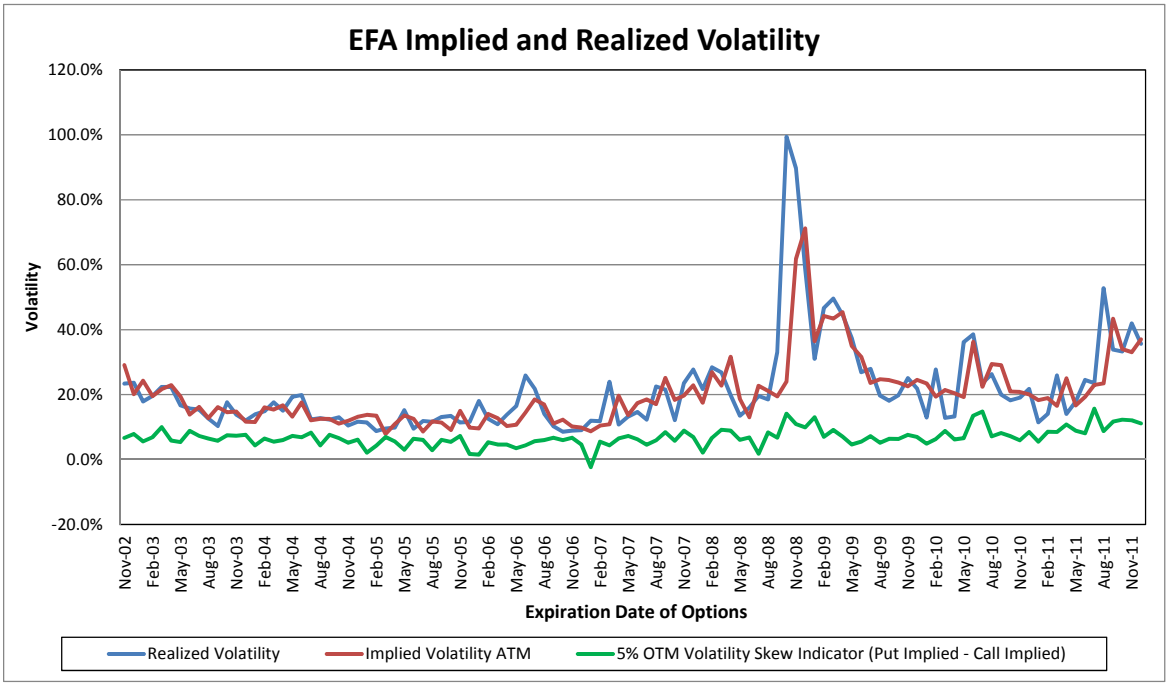
Exhibit 2f: Rolling Maximum Drawdown EFA 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying EFA ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities

also have a large impact on collar returns. Exhibit 2g provides the levels of initial implied volatilities for 1-month ATM options on the EFA since inception as well as the ex post realized volatility over the life of the options[14] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[15]).

Exhibit 2g: Implied and Realized Volatility EFA 1-Month Collars Since Option Inception



While the volatility of volatility is quite high, the ATM implied volatility for the EFA options tends to fluctuate around the 20% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around the 5% to

[14] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[15] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

10% level (with the puts exhibiting higher implied volatilities than the calls) and exhibits some very significant fluctuations over the period.

Exhibit 2h: Summary Statistics EFA 1-Month Call/6-Month Put Skewed Collars

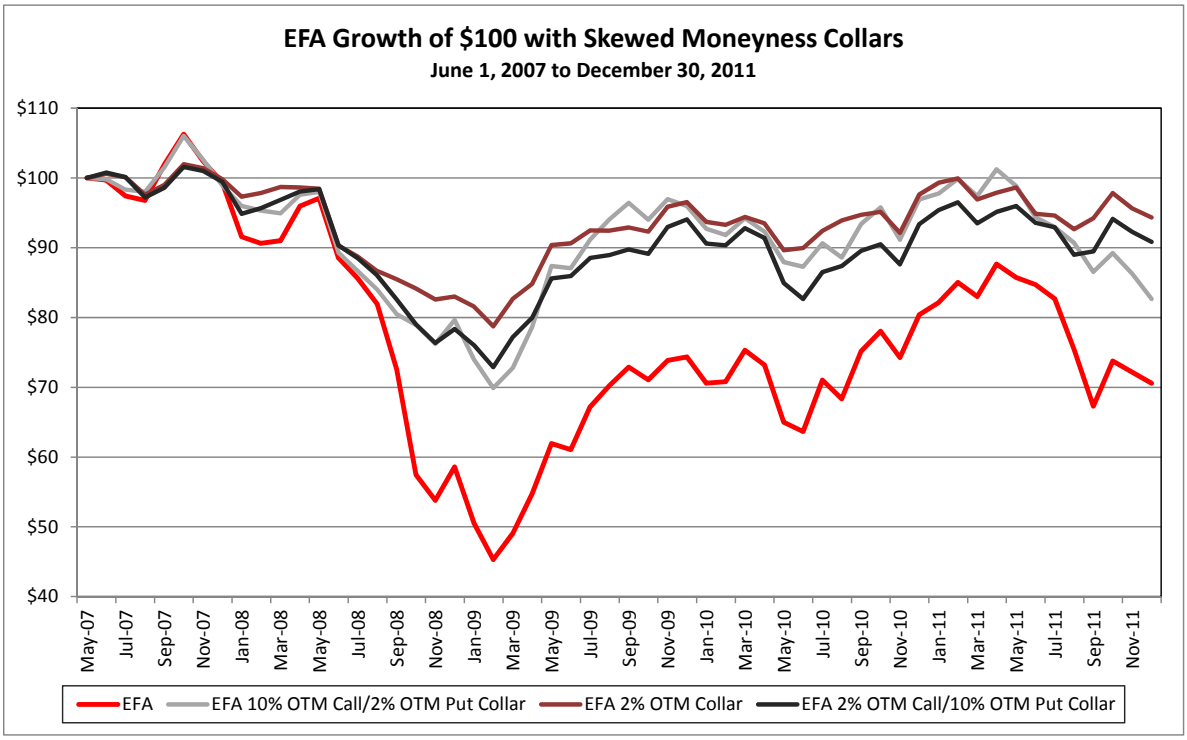
EFA Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	EFA Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	-7.32%	-4.07%	-1.26%	-2.08%
Annualized Standard Deviation	24.52%	13.74%	9.02%	11.31%
Mean Monthly Return	-0.38%	-0.27%	-0.07%	-0.12%
Median Monthly Return	-1.19%	-0.98%	-0.04%	0.39%
Period Cumulative Return	-29.43%	-9.17%	-5.66%	-17.35%
Sharpe Ratio	-0.34	-0.37	-0.26	-0.28
Stutzer Index	-0.35	-0.38	-0.26	-0.28
Treynor Ratio	-0.08	-0.11	-0.09	-0.08
Modified Calmar Ratio	-0.51	-0.27	-0.25	-0.61
Jensen Beta with EFA	1.00	0.47	0.25	0.38
Jensen Monthly Alpha	0.00%	-0.09%	-0.01%	0.01%
Leland Beta	1.00	0.47	0.25	0.38
Leland Monthly Alpha	0.00%	-0.09%	-0.01%	0.01%
Correlation with Underlying	0.92	0.80	0.63	0.77
Skewness	-0.28	0.47	-0.01	-0.01
Excess Kurtosis	0.19	0.09	1.45	-0.05
Minimum Monthly Return	-20.83%	-8.89%	-8.30%	-8.20%
Maximum Monthly Return	13.19%	11.07%	6.55%	7.07%
Maximum Drawdown	-57.38%	-34.08%	-22.79%	-28.26%
Maximum Run Up	93.58%	32.40%	26.93%	44.86%
% Down Months	56%	62%	51%	47%
% Up Months	44%	38%	49%	53%

Exhibit 2h and Exhibit 2i provide summary statistics and a graphical presentation of performance, respectively for skewed EFA collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness

levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

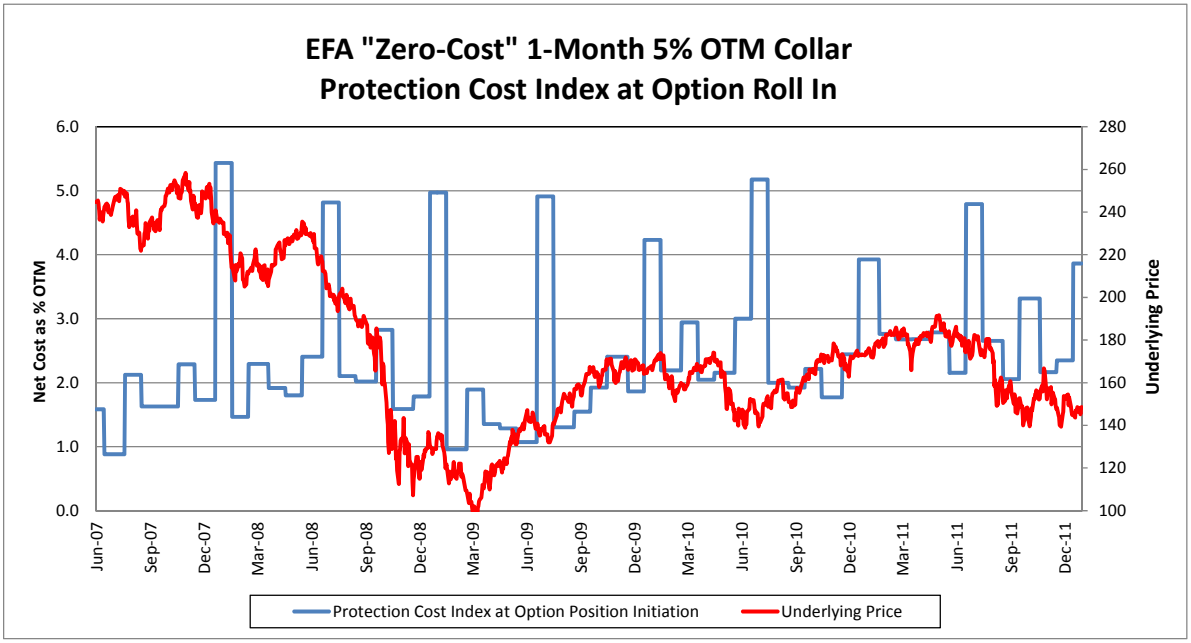
The balanced collar outperforms the net premium collection collar (2% OTM call/10% OTM put), the net premium payment collar and the EFA ETF on an absolute return and risk basis. For example, the balanced collar generates a -1.26% return at a standard deviation of 9.02% versus -2.08%/11.31%, -4.07%/13.74%, and -7.32%/24.52% for the net premium collection collar, the net premium payment collar and the underlying EFA ETF, respectively. Similarly, the maximum drawdown for the balanced collar is -22.79% versus -28.26%, -34.08%, and -57.38% for the net premium collection collar, the net premium payment collar and the underlying EFA ETF, respectively.

Exhibit 2i: Growth of $100 EFA 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 2g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

Exhibit 2j: Protection Cost Index at Roll-In EFA 1-Month "Zero-Cost" Collars



For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide

performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 2k: Initial Option Moneyness EFA 1-Month "Zero-Cost" Collars

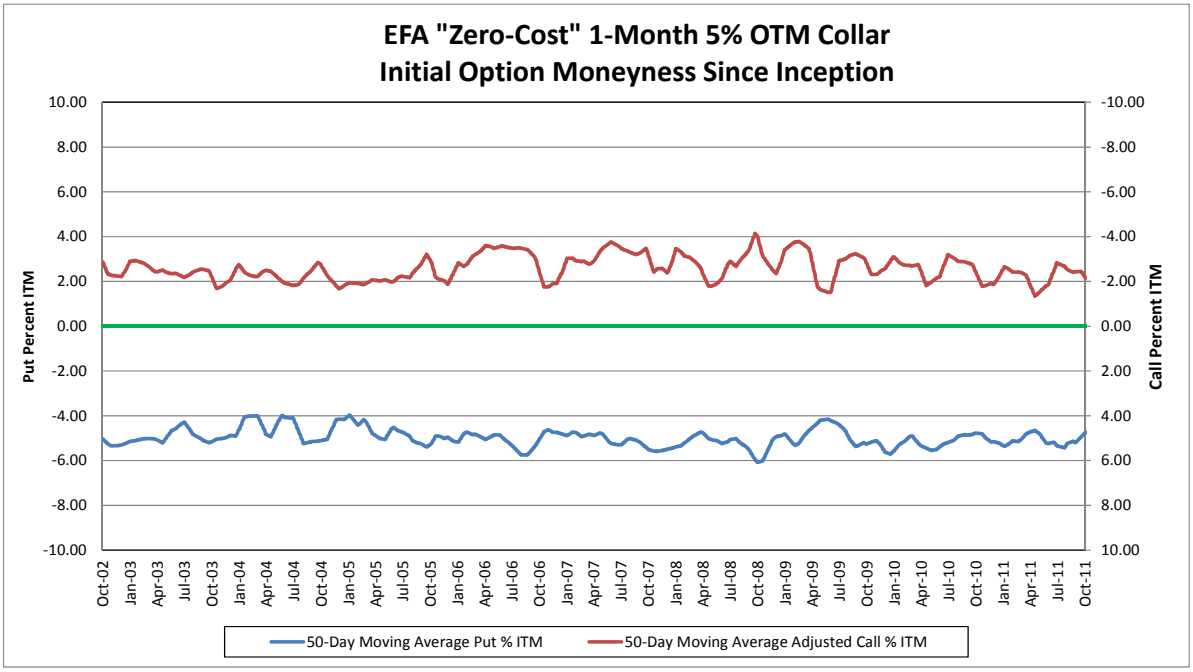


Exhibit 2j and Exhibit 2k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the EFA options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[16].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

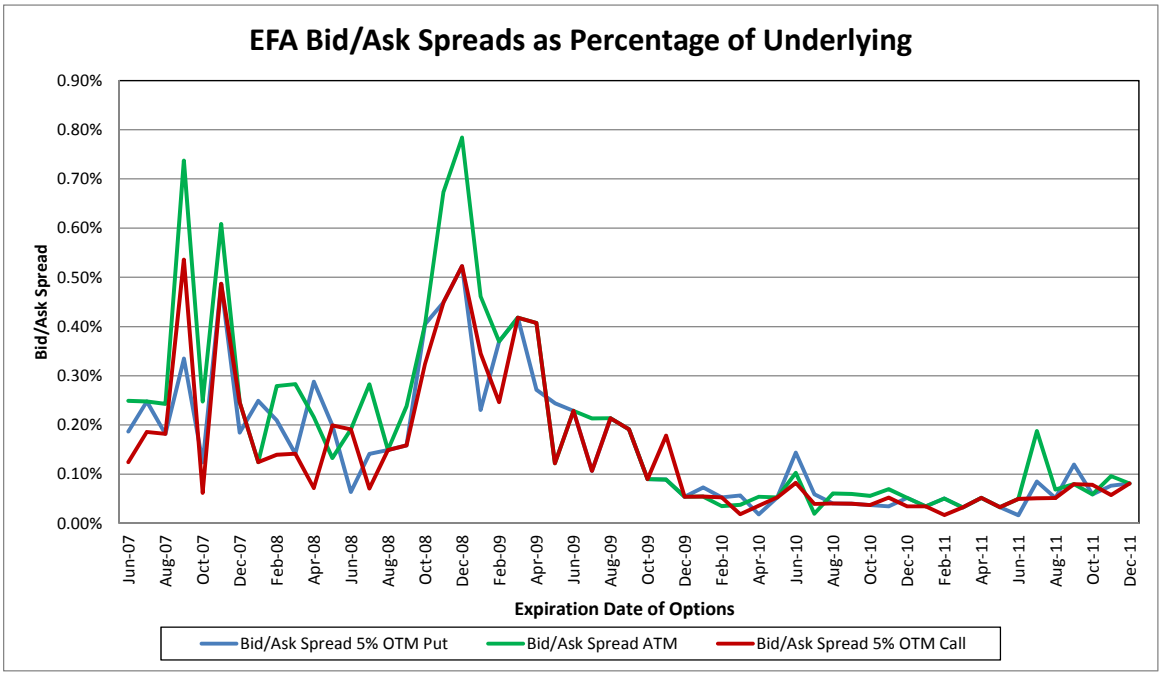
Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. The Exhibit indicates a significant skew in option implied volatilities toward the calls, indicating that calls tend to be more "expensive" than puts (unlike typical equity-based ETFs).While the rolling PCI index tends to average near the 2.5% level, the PCI varies significantly over time, with an apparent 6-month seasonality. The PCI experiences a peak in the beginning of 2008, followed by a drop to the 1% level at the beginning of 2009 and then a general upward trend since the start of 2010. Exhibit 2k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 2l provides a graphical presentation of

[16] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

bid/ask spreads as a percentage of the underlying EFA price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[17]. In general, bid/ask spreads tend to decrease over time. However, while there are a number of peaks in the spreads, the spreads tend to be below 10 basis points in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the EFA underlying price[18], such wide spreads were not encountered for the EFA ETF.

Exhibit 2l: Bid/Ask Spreads EFA 1-Month Collars



[17] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[18] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

In conclusion, the EFA ETF experienced significant drawdowns over the period of study followed by a strong, albeit faltering, run up. During the financial crisis, the collar strategies on the EFA ETF provided significant return improvement and risk reduction. EFA options tend to exhibit significant put skew as is typical of equity index options. Finally, while EFA options used in this study exhibited bid/ask spreads of well over ½% of the underlying price at times, the spreads were generally well under 10 basis points in the later part of the period of study.

Empirical Results for FXA CurrencyShares Australian Dollar ETF, (NYSE Arca)

The FXA ETF provides access to the Australian Dollar. CurrencyShares describes the FXA ETF as follows:

> "CurrencyShares Australian Dollar Trust is designed to track the price of the Australian Dollar net of Trust expenses, which are expected to be paid from interest earned on the deposited Australian Dollars."…" The Australian dollar is the national currency of Australia and the currency of the accounts of the Reserve Bank of Australia, the Australian central bank. The Australian dollar is the fifth-most-traded currency in the world, accounting for 7.6% of global foreign exchange transactions. The USD/Australian dollar pair is the fourth-most-traded currency pair. It is normally abbreviated with the dollar sign $, or A$ to distinguish it from other dollar-denominated currencies."

The inception date for the ETF was June 21, 2006, with option data available from May 18, 2007. As of March 1, 2012, the FXA ETF had net assets of $836.6 Million. The FXA is traded on the NYSE Arca exchange and its CUSIP is 23129U101. Further details of the fund are provided in Exhibit 3a.

Exhibit 3a FXA ETF Characteristics

Symbol	FXA
CUSIP	23129U101
Fund Inception Date	6/21/2006
Product Type	Equitized Single Currency Trust, ETP
Benchmark	WM/Reuters Australian Dollar Closing Spot Rate
Rebalance Schedule	Quarterly
Distribution Schedule	Monthly
Number of Australian Dollars Per Share	100
Short Sale/Margin Eligible	Yes

Source: http://www.currencyshares.com/products/overview.rails?symbol=FXA

In this section, we compare the performance of the FXA ETF to the performance of FXA 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[19].

Exhibit 3b: Summary Statistics FXA 1-Month Call/6-Month Put Balanced Collars

FXA Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXA Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	8.96%	1.10%	4.69%	5.24%	7.22%	10.68%
Annualized Standard Deviation	18.24%	4.44%	6.45%	10.92%	13.34%	14.27%
Mean Monthly Return	0.86%	0.10%	0.40%	0.47%	0.65%	0.93%
Median Monthly Return	1.11%	0.16%	0.50%	0.59%	0.70%	0.72%
Period Cumulative Return	48.16%	5.14%	23.36%	26.36%	37.63%	59.24%
Sharpe Ratio	0.43	0.01	0.56	0.38	0.46	0.68
Stutzer Index	0.41	0.01	0.55	0.37	0.45	0.64
Treynor Ratio	0.08	0.00	0.13	0.08	0.09	0.14
Modified Calmar Ratio	1.52	0.67	2.34	1.40	2.02	4.25
Jensen Beta with FXA	1.00	0.13	0.28	0.53	0.68	0.71
Jensen Monthly Alpha	0.00%	-0.08%	0.12%	0.01%	0.07%	0.32%
Leland Beta	1.00	0.13	0.27	0.51	0.66	0.68
Leland Monthly Alpha	0.00%	-0.08%	0.13%	0.02%	0.08%	0.33%
Correlation with Underlying	0.87	0.50	0.72	0.80	0.85	0.83
Skewness	-0.61	-0.29	0.05	0.07	0.02	-0.06
Excess Kurtosis	0.94	1.13	1.41	0.27	-0.05	0.30
Minimum Monthly Return	-15.42%	-3.68%	-5.08%	-6.91%	-7.86%	-8.94%
Maximum Monthly Return	10.33%	3.10%	6.07%	8.34%	9.82%	10.16%
Maximum Drawdown	-31.75%	-7.68%	-9.99%	-18.82%	-18.63%	-13.93%
Maximum Run Up	86.83%	12.46%	27.93%	53.78%	64.70%	78.38%
% Down Months	40%	45%	38%	44%	45%	45%
% Up Months	60%	55%	62%	56%	55%	55%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[20]. Exhibit 3b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces both the risk and the realized returns relative to a long FXA position. The annualized returns are reduced by almost 1/2 from 8.96% for the FXA to 5.24% for the 5% OTM collar. Similarly, the standard deviation is reduced by

[19] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[20] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

almost 1/2 from 18.24% to 10.92%. The evidence of the impact on risk adjusted performance is mixed. The Stutzer index decreased slightly from 0.41 to 0.37 and the modified Calmar ratio drops from 1.52 to 1.40, suggesting that the collar slightly reduced risk adjusted performance. In contrast, the monthly Leland alpha of the collar is slightly higher than that of the FXA ETF at 2 basis points (versus 0 basis points for the FXA). Perhaps the most visible impact of the collar strategy is a reduction of the maximum drawdown from -31.75% to -18.82%. Despite the reduction, the modified Calmar ratio[21] for the collar is less than that of the FXA at 1.40 (versus 1.52 for the FXA) for the 55 month period, suggesting that returns were reduced proportionally more than the reduction in the maximum drawdown. Additional insight can be provided by Exhibit 3c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the underperformance of the collar strategies is their limited participation in the run ups that the FXA ETF experienced since early 2009. While the 25% OTM collar outperforms the FXA after September 2008, the nearer ATM collars underperform the FXA through most of the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -31.75% to -18.82%, it also reduces the maximum run up from 86.83% to 53.78%. Since the FXA experienced much stronger run ups in the period than drawdowns, it is not surprising that the collar strategies did not generally provide performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 3b and Exhibit 3c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the FXA, the further OTM strategies outperformed

[21] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

nearer to ATM collars from a raw return perspective. It is clear that the 25% OTM collar outperformed the other collars as well as the FXA ETF. For example, the Stutzer index of the 25% OTM collar is 0.64 versus 0.01, 0.55, 0.37, 0.45 and 0.41 for the ATM, 2% OTM, 5% OTM, and 10% OTM collars and the FXA, respectively. Similarly, the monthly Leland alpha of the 25% OTM collar is 33 basis point versus -8, 13, 2, 8 and 0 basis points for the ATM, 2% OTM, 5% OTM and 10% OTM collars and the FXA, respectively. Thus, the 25% OTM outperforms the other collars and the FXA based on the Stutzer index and the Leland alpha. However, the ATM and 5% OTM collars underperform the FXA based on the Stutzer index, while only the ATM collar provides a lower risk adjusted return than the FXA based on the Leland alpha.

Exhibit 3c: Growth of $100 FXA 1-Month Call/6-Month Put Balanced Collars

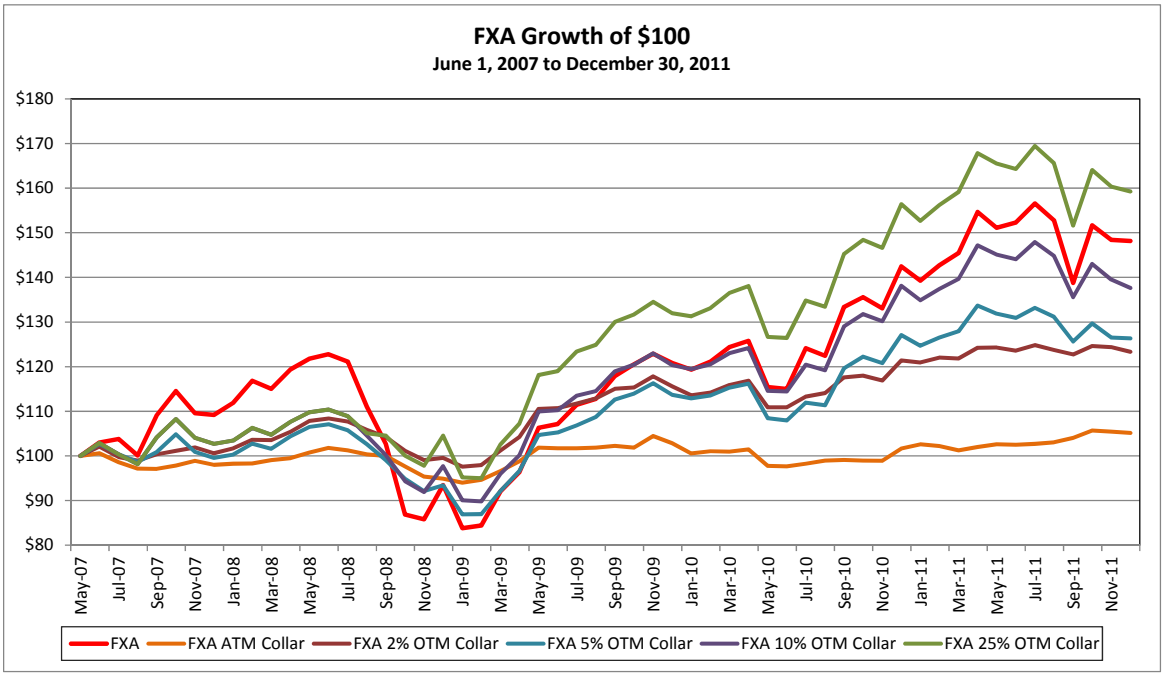


Exhibit 3d and Exhibit 3e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 3d it is clear that, prior to the third quarter of 2009, the returns of the deep OTM collar strategies are generally quite similar to those of the FXA. While the deep OTM collars provided almost full participation on the upside, they provided a limited downside participation in the FXA decline in late 2008. This is largely due to the fact that the drop was far more abrupt than the run ups. The rolling standard deviations provided in Exhibit 3e are evidence of the significant risk reduction potential of the collar strategies, particularly the near the money collars. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about zero to 10%.

Exhibit 3d: Rolling Returns FXA 1-Month Call/6-Month Put Collars

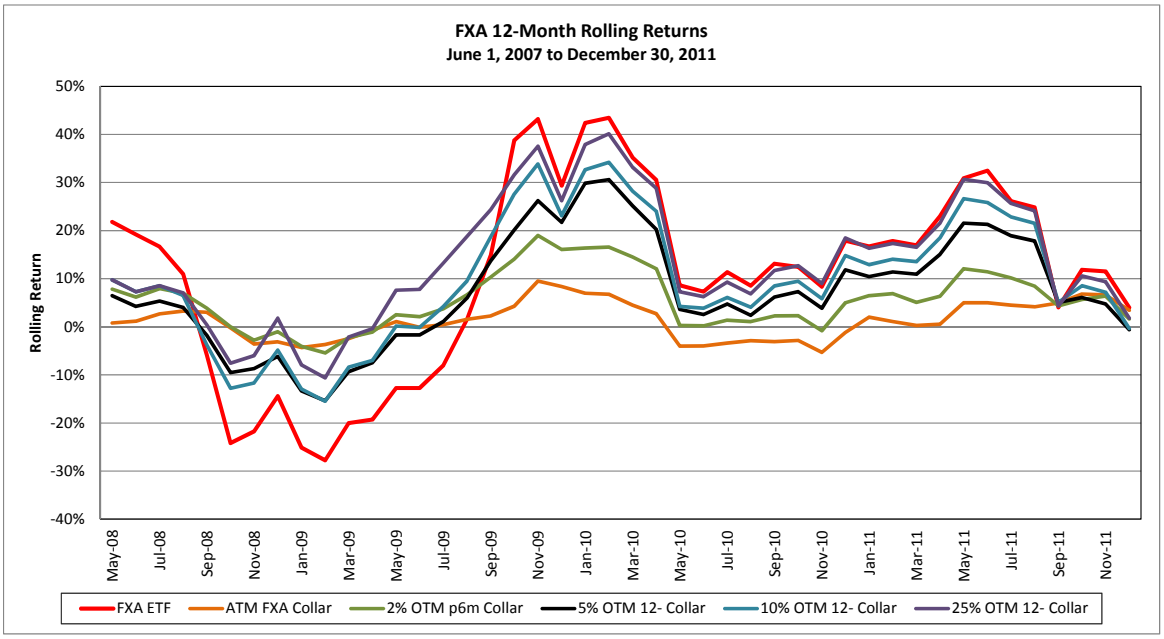
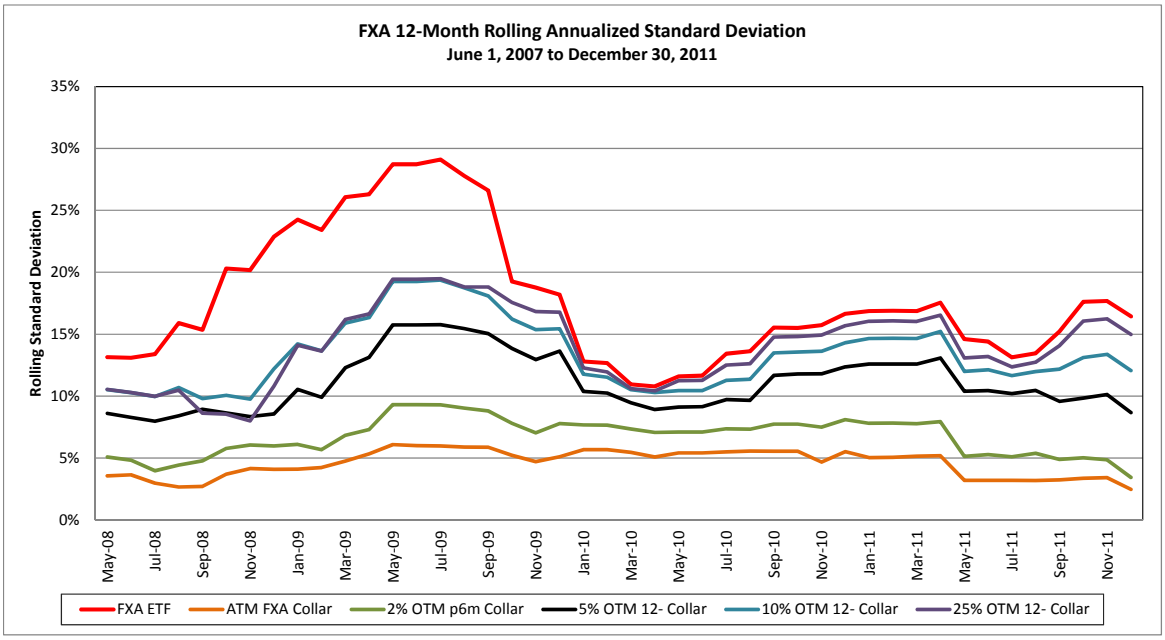
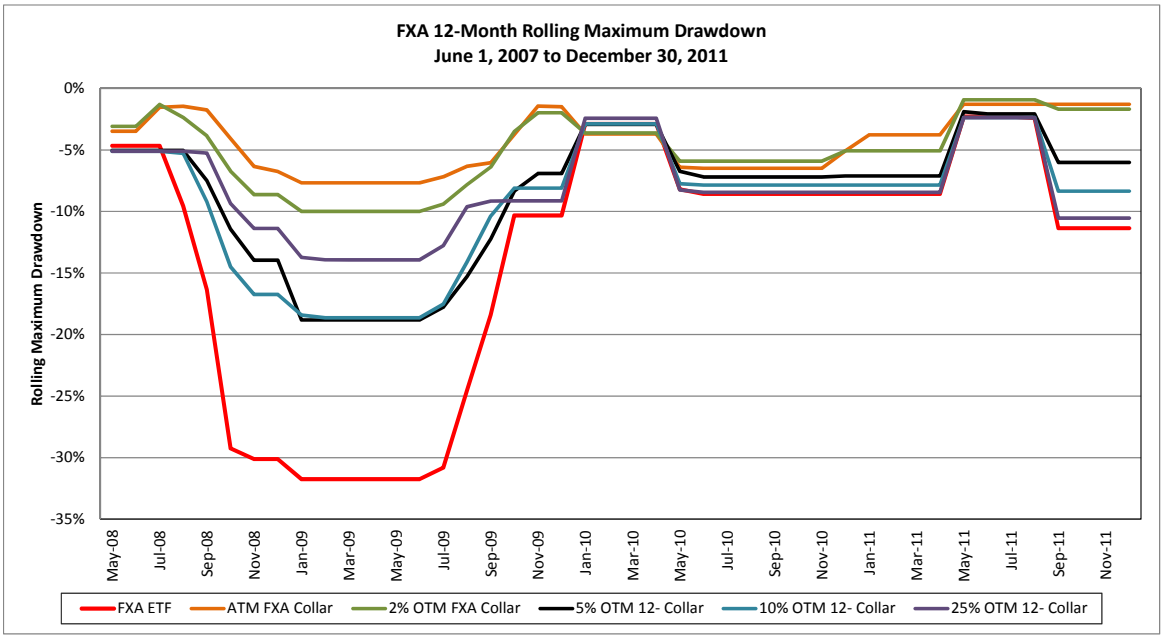


Exhibit 3e: Rolling Standard Deviation FXA 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 3f provides a graphical presentation of 12-month rolling maximum drawdowns for FXA collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the FXA experienced a significant drawdown in the second half of 2008, that is the period when we would expect to see large improvements from the collars. That is in fact what the Exhibit shows. Not surprising, in this period the moneyness of the collar had a large impact on the degree of drawdown protection. While the near the money strategies provided significant protection (around 25% improvement for the ATM), the deeper OTM collars had a lesser, although still very significant, impact on drawdowns. It is interesting to note that the 25% OTM collar actually experienced a lower drawdown than the 5% and 10% OTM collars.

Exhibit 3f: Rolling Maximum Drawdown FXA 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying FXA ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 3g provides the levels of initial implied volatilities for 1-month ATM options on the FXA since inception as well as the ex post realized volatility over the life of the options[22] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[23]). While the volatility of volatility is quite high, the ATM implied volatility for the FXA options tends to fluctuate around the 15% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential

[22] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[23] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

between the puts and calls tends to fluctuate around the zero to +5% level (with the puts generally exhibiting higher implied volatilities than the calls) and exhibits some very significant peaks over the period as well as an apparent slight upward trend. It is interesting to note that the skew indicator was negative on occasion.

Exhibit 3g: Implied and Realized Volatility FXA 1-Month Collars Since Option Inception

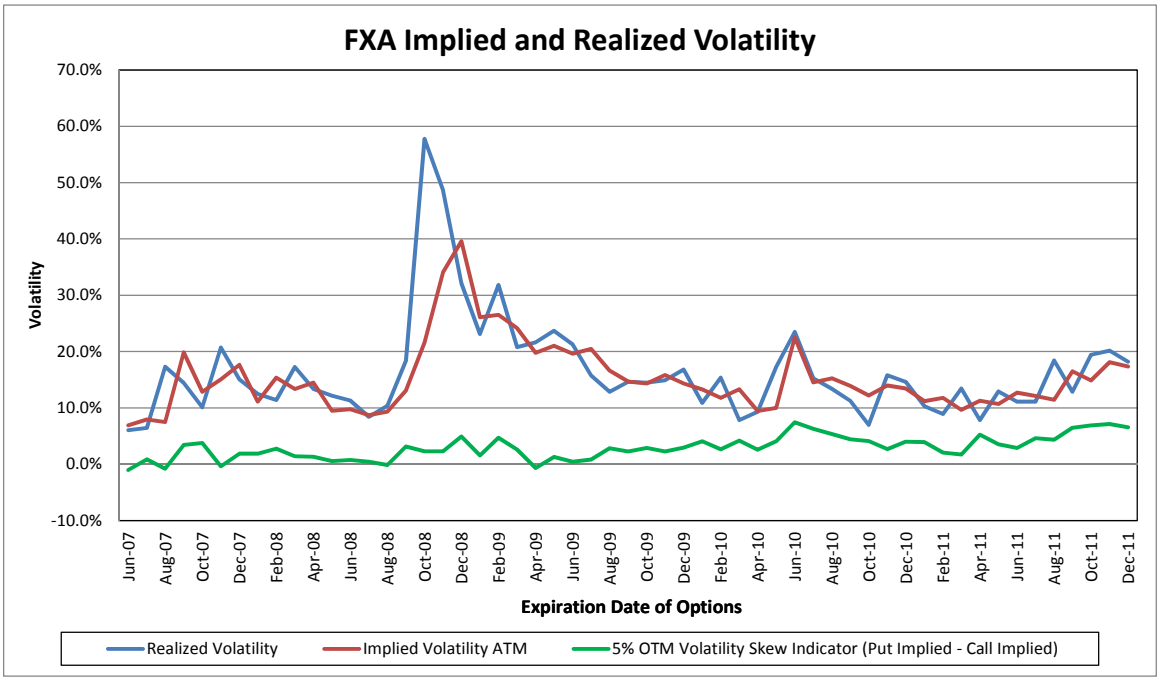


Exhibit 3h and Exhibit 3i provide summary statistics and a graphical presentation of performance, respectively for skewed FXA collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10%

OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

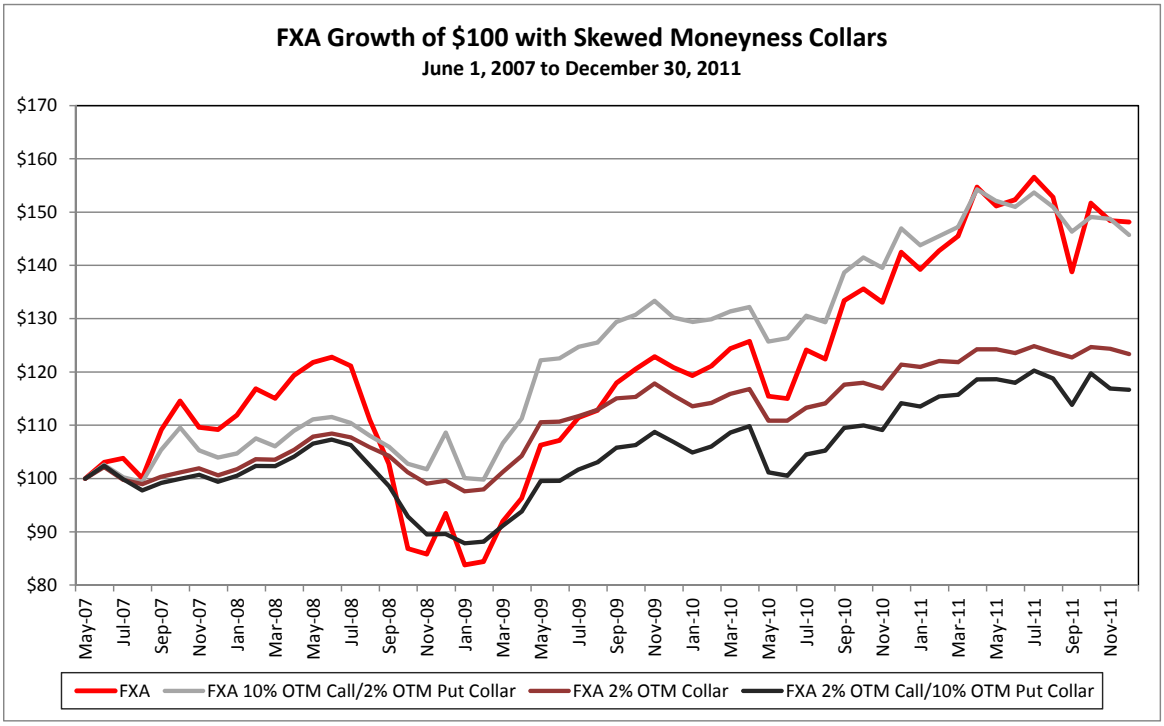
Exhibit 3h: Summary Statistics FXA 1-Month Call/6-Month Put Skewed Collars

FXA Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXA Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	8.96%	8.56%	4.69%	3.42%
Annualized Standard Deviation	18.24%	11.22%	6.45%	9.21%
Mean Monthly Return	0.86%	0.74%	0.40%	0.32%
Median Monthly Return	1.11%	0.51%	0.50%	0.47%
Period Cumulative Return	48.16%	16.67%	23.36%	45.72%
Sharpe Ratio	0.43	0.67	0.56	0.26
Stutzer Index	0.41	0.65	0.55	0.25
Treynor Ratio	0.08	0.14	0.13	0.06
Modified Calmar Ratio	1.52	1.58	2.34	2.52
Jensen Beta with FXA	1.00	0.53	0.28	0.43
Jensen Monthly Alpha	0.00%	0.27%	0.12%	-0.08%
Leland Beta	1.00	0.50	0.27	0.43
Leland Monthly Alpha	0.00%	0.28%	0.13%	-0.07%
Correlation with Underlying	0.87	0.78	0.72	0.78
Skewness	-0.61	0.38	0.05	-0.56
Excess Kurtosis	0.94	0.79	1.41	0.97
Minimum Monthly Return	-15.42%	-7.86%	-5.08%	-7.91%
Maximum Monthly Return	10.33%	9.82%	6.07%	6.07%
Maximum Drawdown	-31.75%	-10.52%	-9.99%	-18.14%
Maximum Run Up	86.83%	36.89%	27.93%	55.25%
% Down Months	40%	44%	38%	38%
% Up Months	60%	56%	62%	62%

While all three collars underperform the FXA on an absolute return basis, the net premium payment collar (10% OTM call/2% OTM put) and the balanced collar outperform the FXA and the net premium collection collar on a risk adjusted basis by most measures. Furthermore, the net premium payment collar underperforms the FXA by most measures. For example, the FXA ETF generates an 8.96% return at a standard deviation of 18.24% versus 4.69%/6.45%, 8.56%/11.22%, and 3.42%/9.21% for the balanced collar, the net premium

payment collar and the net premium collection collar, respectively. From a risk adjusted return perspective, the Stutzer index for the net premium payment collar is 0.65 versus 0.55, 0.25 and 0.41 for the balanced collar, the net premium collection collar and the underlying FXA ETF, respectively. Similarly, the Leland alpha for the net premium payment collar is 28 basis points versus 13, -7 and 0 basis points for the balanced collar, the net premium collection collar and the underlying FXA ETF, respectively.

Exhibit 3i: Growth of $100 FXA 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 3g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over

time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 3j: Protection Cost Index at Roll-In FXA 1-Month "Zero-Cost" Collars

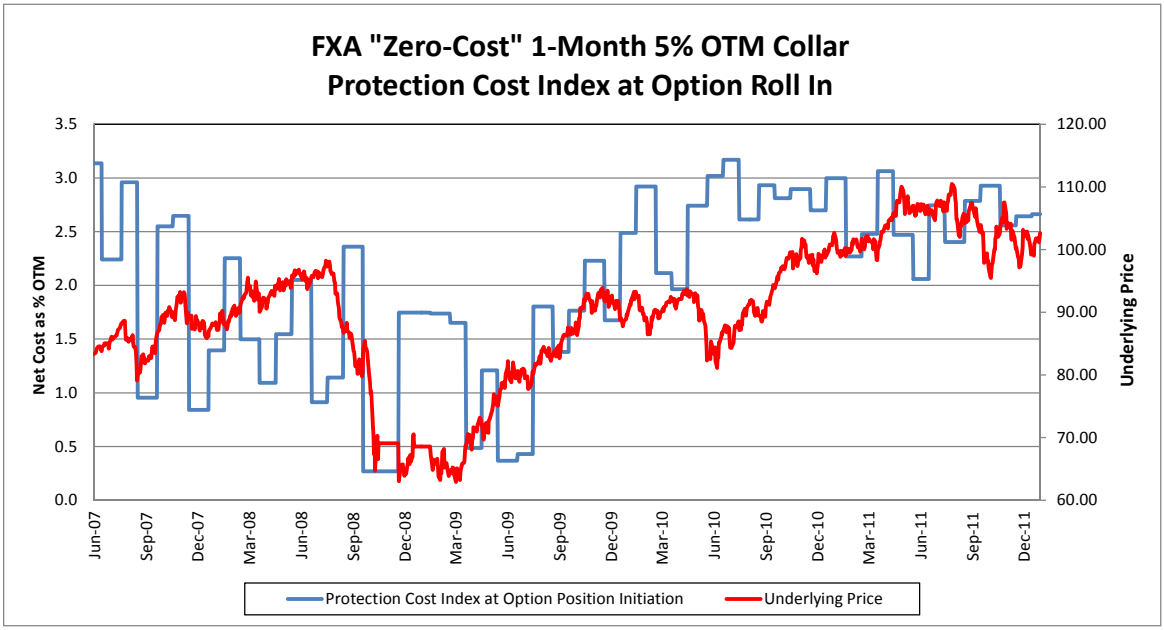


Exhibit 3k: Initial Option Moneyness FXA 1-Month "Zero-Cost" Collars

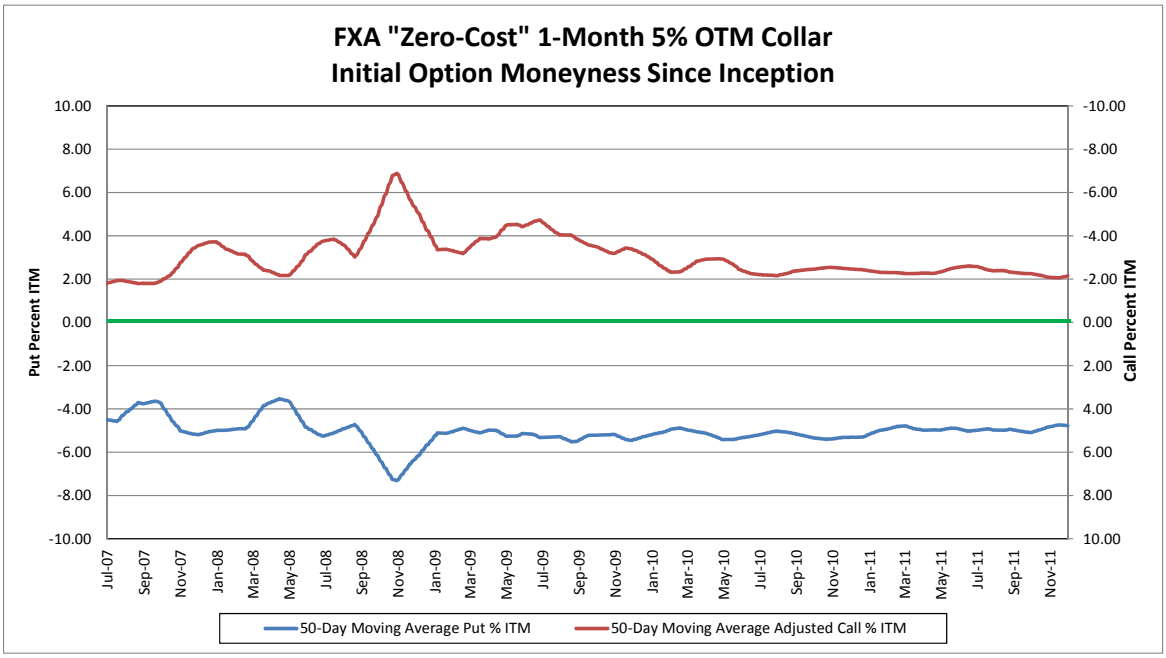


Exhibit 3j and Exhibit 3k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the FXA options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[24].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. It is worth noting that Exhibit 3j indicates missing options by a horizontal line for the underlying price as well as the PCI for the period in which no option position is available. This could occur either because all puts or calls have overly large bid/ask spreads (greater than 1% of the underlying price) or because no call is quoted which has a price as high as the chosen 5% OTM put. The Exhibit indicates a significant skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (like typical equity index-based ETFs).While the rolling PCI index tends to average near the 2% level, the PCI varies significantly over time, to some extent falling as the FXA falls and rising as the FXA rises. The PCI seems to have been quite steady near the 2.5% to 3% level in the last 1 ½ years of the study. Exhibit 3k provides further evidence of the put skew by illustrating the rolling average put

[24] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

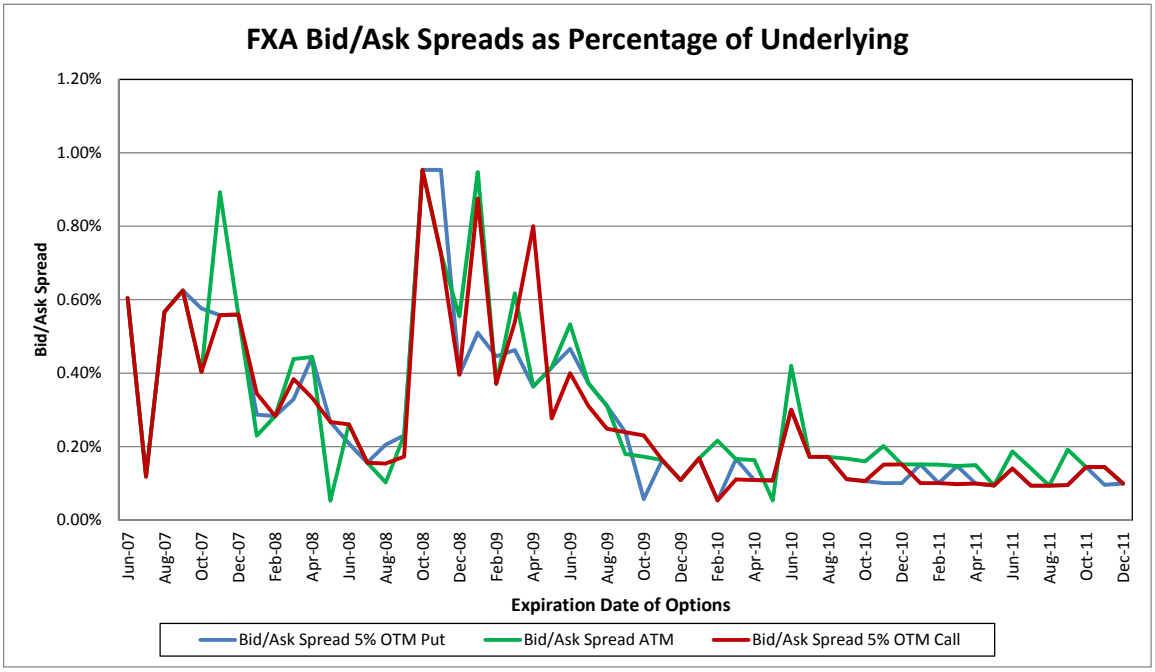
moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 3l provides a graphical presentation of bid/ask spreads as a percentage of the underlying FXA price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[25]. In general, bid/ask spreads tend to decrease over time. However, while there are a number of peaks in the spreads, the spreads tend to be below 20 basis points in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the FXA price[26] such wide spreads were not encountered for the FXA ETF.

[25] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[26] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 3l: Bid/Ask Spreads FXA 1-Month Collars



In conclusion, the FXA ETF experienced significant drawdowns over the period of study followed by a strong, relatively steady run up. With the exception of the 25% OTM collar, during the financial crisis the collar strategies on the FXA ETF provided decreased returns, albeit with a reduction in risk. However, from a risk adjusted perspective, the FXA collars generally outperformed the FXA ETF. Similar to equity index options, FXA options tend to exhibit significant put skew. Finally, while FXA options used in this study exhibited bid/ask spreads approaching 1% of the underlying price at times, the spreads were generally under 20 basis points in the later part of the period of study.

Empirical Results for FXB CurrencyShares British Pound Sterling ETF, (NYSE Arca)

The FXB ETF provides access to the British Pound. CurrencyShares describes the FXB ETF as follows:

> "CurrencyShares British Pound Sterling Trust is designed to track the price of the British Pound Sterling net of Trust expenses, which are expected to be paid from interest earned on the deposited British Pound Sterlings."…" About the British Pound Sterling: The British pound sterling is the official currency of the United Kingdom (England, Wales, Scotland and Northern Ireland). Within the UK, the British pound sterling is commonly referred to as simply the "pound" or "sterling. The British pound sterling is the fourth-most-traded currency in the world, accounting for 12.9% of global foreign exchange transactions. The USD/British pound sterling pair is the third-most-traded currency pair, accounting for 9% of the global foreign exchange transactions."

The inception date for the ETF was June 21, 2006, with option data available from May 18, 2007. As of March 1, 2012, the FXB ETF had net assets of $87.0 Million. The FXB is traded on the NYSE Arca exchange and its CUSIP is 23129S106. Further details of the fund are provided in Exhibit 4a.

Exhibit 4a FXB ETF Characteristics

Symbol	FXB
CUSIP	23129S106
Fund Inception Date	6/21/2006
Product Type	Equitized Single Currency Trust, ETP
Benchmark	WM/Reuters British Pound Sterling Closing Spot Rate
Rebalance Schedule	Quarterly
Distribution Schedule	Monthly
Number of British Pound Sterling Per Share	100
Short Sale/Margin Eligible	Yes

Source: http://www.currencyshares.com/products/overview.rails?symbol=FXB

In this section, we compare the performance of the FXB ETF to the performance of FXB 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[27].

Exhibit 4b: Summary Statistics FXB 1-Month Call/6-Month Put Balanced Collars

FXB Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXB Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	-3.98%	-1.07%	-0.98%	-2.78%	-3.44%	-0.71%
Annualized Standard Deviation	10.78%	2.69%	5.11%	7.00%	8.79%	8.99%
Mean Monthly Return	-0.29%	-0.09%	-0.07%	-0.21%	-0.26%	-0.03%
Median Monthly Return	0.05%	-0.07%	-0.01%	-0.21%	-0.12%	-0.07%
Period Cumulative Return	-16.99%	-4.83%	-4.42%	-12.13%	-14.82%	-3.20%
Sharpe Ratio	-0.47	-0.79	-0.40	-0.55	-0.51	-0.20
Stutzer Index	-0.48	-0.79	-0.40	-0.55	-0.52	-0.20
Treynor Ratio	-0.05	-0.15	-0.05	-0.07	-0.06	-0.02
Modified Calmar Ratio	-0.60	-0.73	-0.38	-0.66	-0.70	-0.22
Jensen Beta with FXB	1.00	0.14	0.41	0.58	0.75	0.72
Jensen Monthly Alpha	0.00%	-0.12%	0.01%	-0.07%	-0.06%	0.16%
Leland Beta	1.00	0.14	0.42	0.60	0.77	0.75
Leland Monthly Alpha	0.00%	-0.12%	0.01%	-0.07%	-0.05%	0.17%
Correlation with Underlying	0.57	0.37	0.44	0.43	0.45	0.43
Skewness	-0.20	-0.07	0.12	0.47	0.44	0.50
Excess Kurtosis	1.73	0.17	0.90	0.84	1.75	2.03
Minimum Monthly Return	-9.32%	-2.16%	-3.74%	-3.97%	-5.12%	-5.35%
Maximum Monthly Return	9.27%	1.54%	4.37%	6.25%	8.63%	9.20%
Maximum Drawdown	-28.09%	-6.65%	-11.52%	-18.41%	-21.10%	-14.41%
Maximum Run Up	16.52%	3.17%	8.70%	10.79%	13.98%	16.21%
% Down Months	49%	55%	51%	56%	55%	53%
% Up Months	51%	45%	49%	44%	45%	47%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[28]. Exhibit 4b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk and improves realized returns relative to a long FXB position. The annualized losses are reduced by about 1/4 from -3.98% for the FXB to -2.78% for the 5% OTM collar. Similarly, the standard deviation is reduced by over 1/3

[27] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[28] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

from 10.78% to 7.00%. Certain performance measures such as the Stutzer index, Sharpe ratio and modified Calmar ratio[29] are non-informative when returns are negative, so for risk adjusted returns we will consider the Leland alpha. Despite the improved risk and returns, the 5% OTM collar provided a lower monthly Leland alpha (-0.07%) than the FXB ETF, suggesting that the collar slightly reduced risk adjusted performance (although the 2% and 25% OTM collars exhibited higher Leland alphas than the FXB). Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -28.09% to -18.41%. However, the maximum run up was also reduced by the collar from 16.52% for the FXB to 10.79% for the collar. Additional insight can be provided by Exhibit 2c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the superior absolute performance of the collar strategies is their limited participation in the significant drawdown that the FXB ETF experienced in the second half of 2008. The performance of the 5% and greater OTM collars is generally quite similar to the FXB ETF from early-2009 to the end of the period.

In addition to providing results for 5% OTM collars, Exhibit 4b and Exhibit 4c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies significantly reduced the standard deviation of the FXB, the 5% and 10% OTM strategies underperformed the other collars from a raw return perspective. The Leland alpha suggests that the 25% OTM collar significantly outperformed the other collars as well as the FXB ETF. For example, the monthly Leland alpha of the 25% OTM collar is 17 basis points versus -12,1,-7,-5 and 0 basis points the ATM, 2% OTM, 5% OTM and10% OTM collars and

[29] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

the FXB, respectively. Thus, only the 2% OTM and 25% OTM collars have higher Leland alphas than the FXB, while the other collars provide a lower risk adjusted return than the FXB.

Exhibit 4c: Growth of $100 FXB 1-Month Call/6-Month Put Balanced Collars

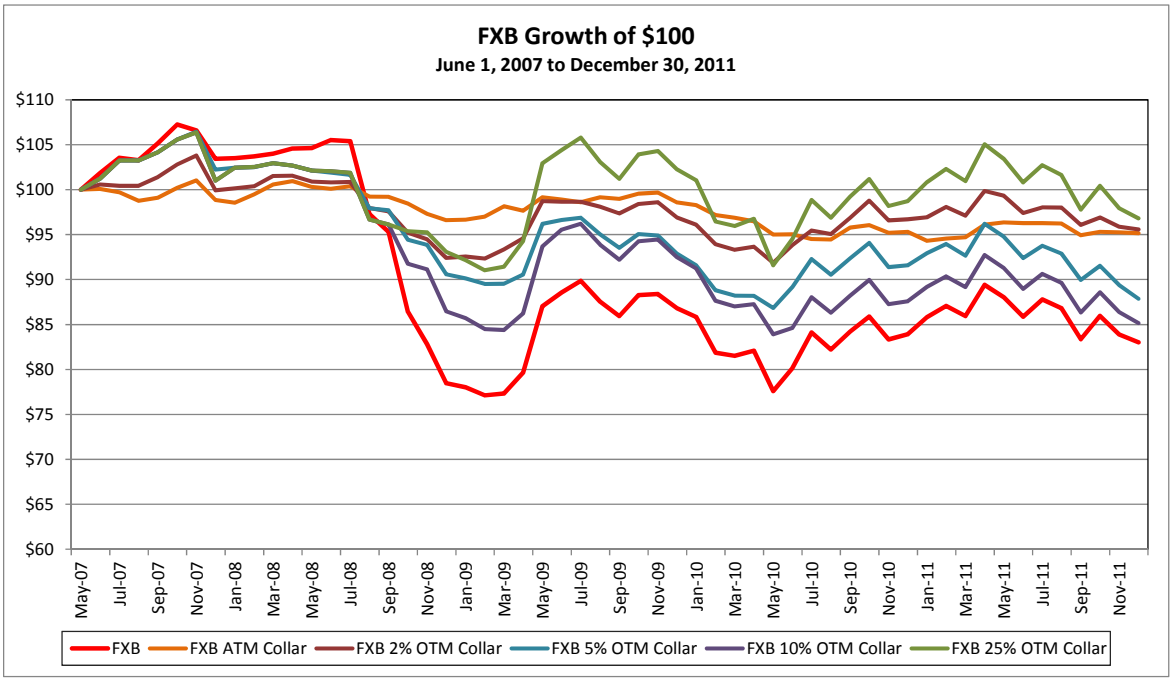


Exhibit 4d and Exhibit 4e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 4d it is clear that, after the end of 2009, the returns of the deep OTM collar strategies are generally quite similar to those of the FXB. The rolling standard deviations provided in Exhibit 4e are evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 1% to 9%.

Exhibit 4d: Rolling Returns FXB 1-Month Call/6-Month Put Collars

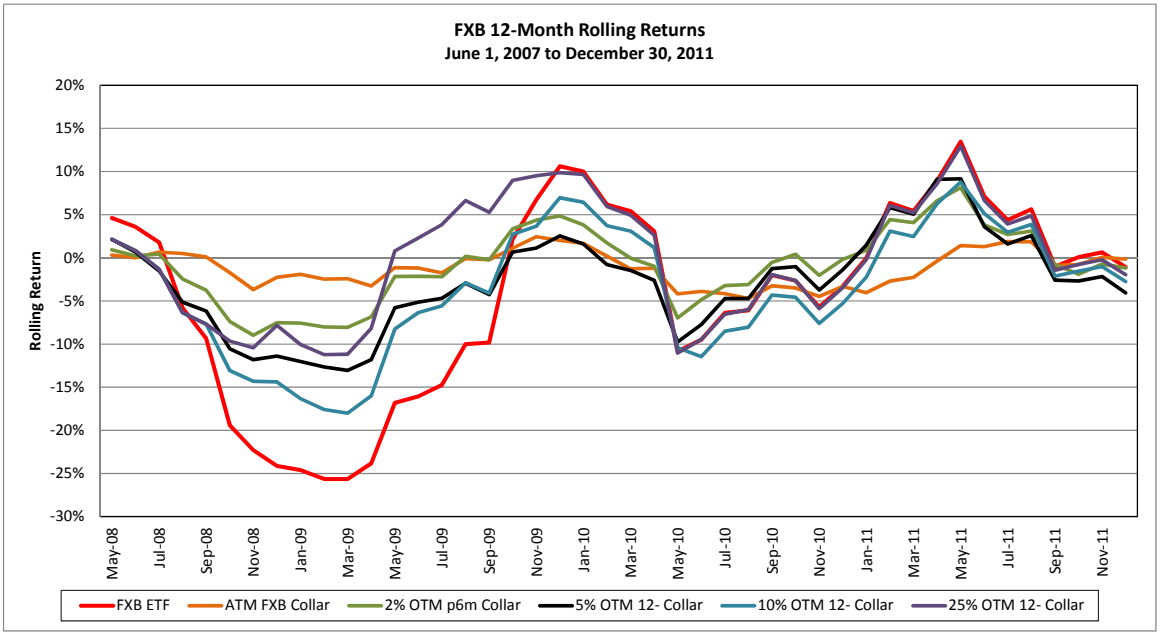
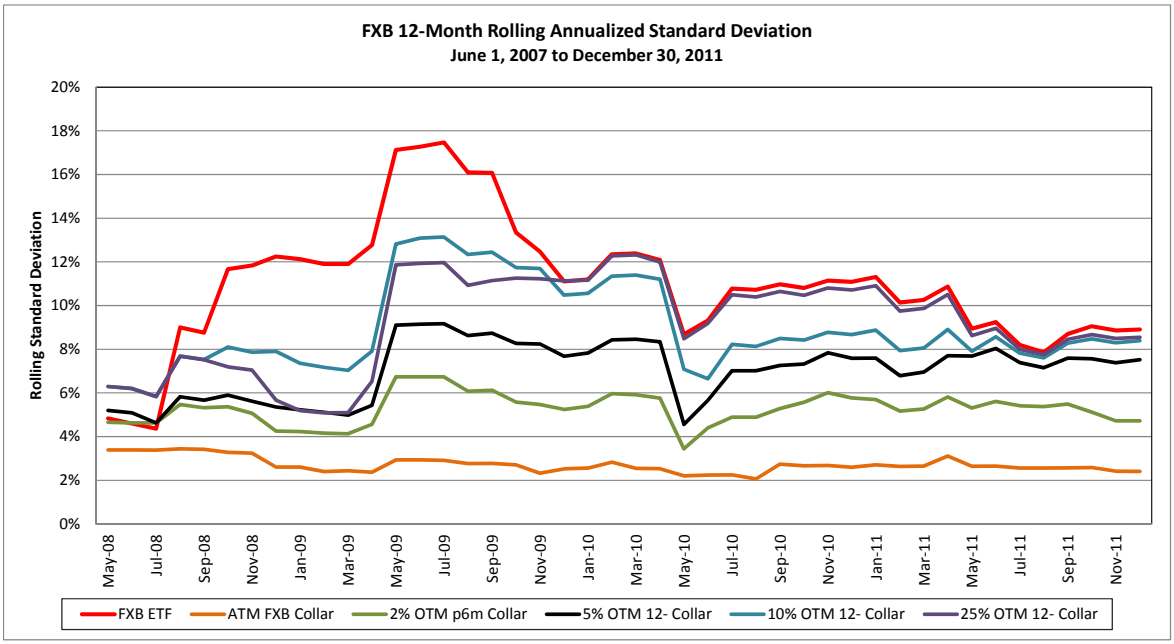


Exhibit 4e: Rolling Standard Deviation FXB 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 4f provides a graphical presentation of 12-month rolling maximum drawdowns for FXB collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the FXB experienced a significant drawdown from mid-2008 to early-2009, one would expect that the collar strategies would improve returns in this sub-period of study, and that the moneyness of the collar would have a large impact on the degree of drawdown protection seen in this period. This is in fact the case. While the near the money strategies provided significant protection (reducing rolling drawdowns by over 20%), the deeper OTM collars had far smaller (yet still very significant) impact on drawdowns.

Exhibit 4f: Rolling Maximum Drawdown FXB 1-Month Call/6-Month Put Collars

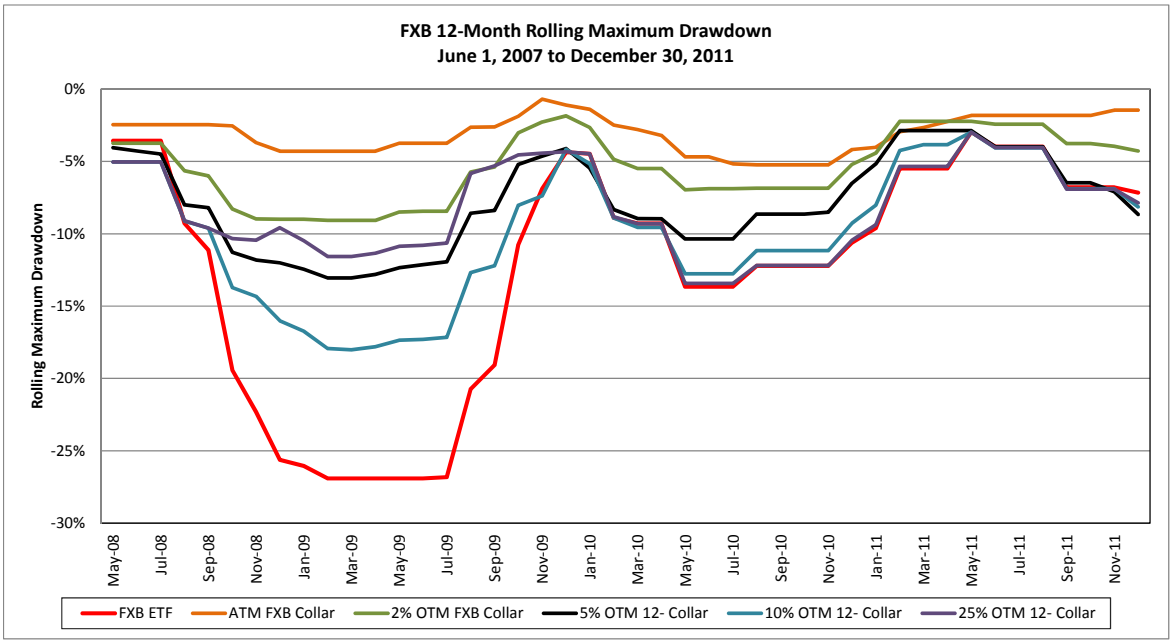
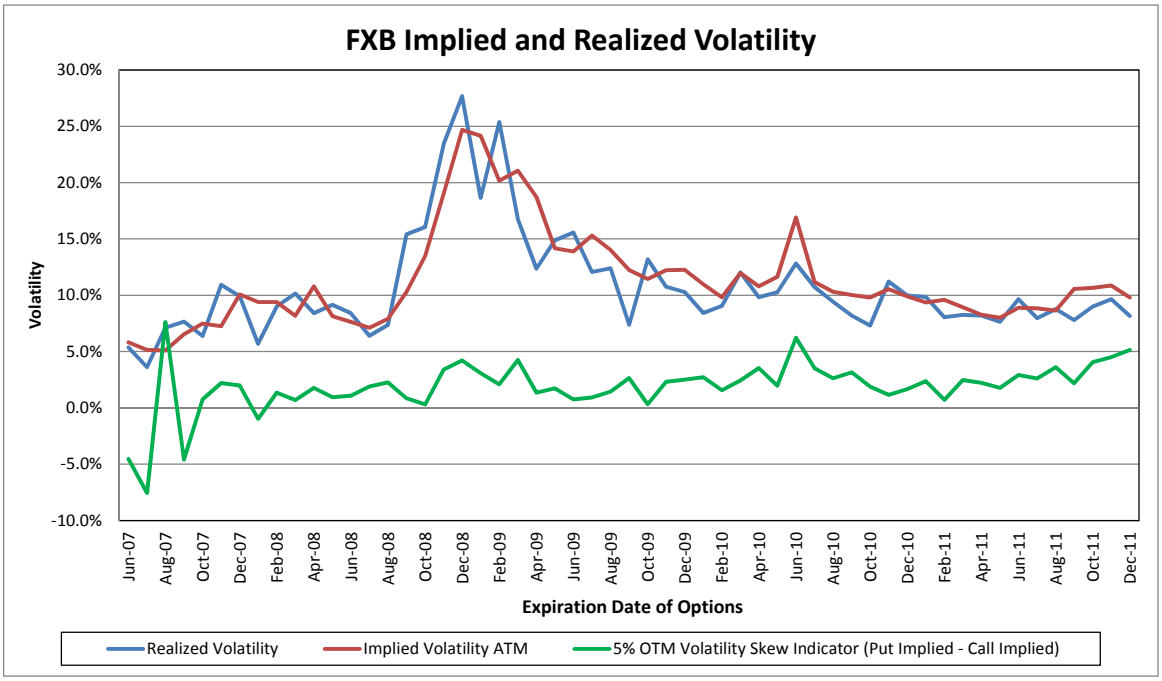


Exhibit 4g: Implied and Realized Volatility FXB 1-Month Collars Since Option Inception



While collar performance is primarily driven by the returns of the underlying FXB ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 4g provides the levels of initial implied volatilities for 1-month ATM options on the FXB since inception as well as the ex post realized volatility over the life of the options[30] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[31]). While the volatility of volatility is quite high, the ATM implied volatility for the FXB options tends to fluctuate around the 10% level. A number of significant and sustained peaks in implied and realized volatilities

[30] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[31] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around the 2.5% level (with the puts exhibiting higher implied volatilities than the calls) and exhibits some very significant peaks over the period as well as an apparent slight upward trend. It is worth noting that the skew indicator is negative at times, reaching a minimum of about -7.5% in late-2007.

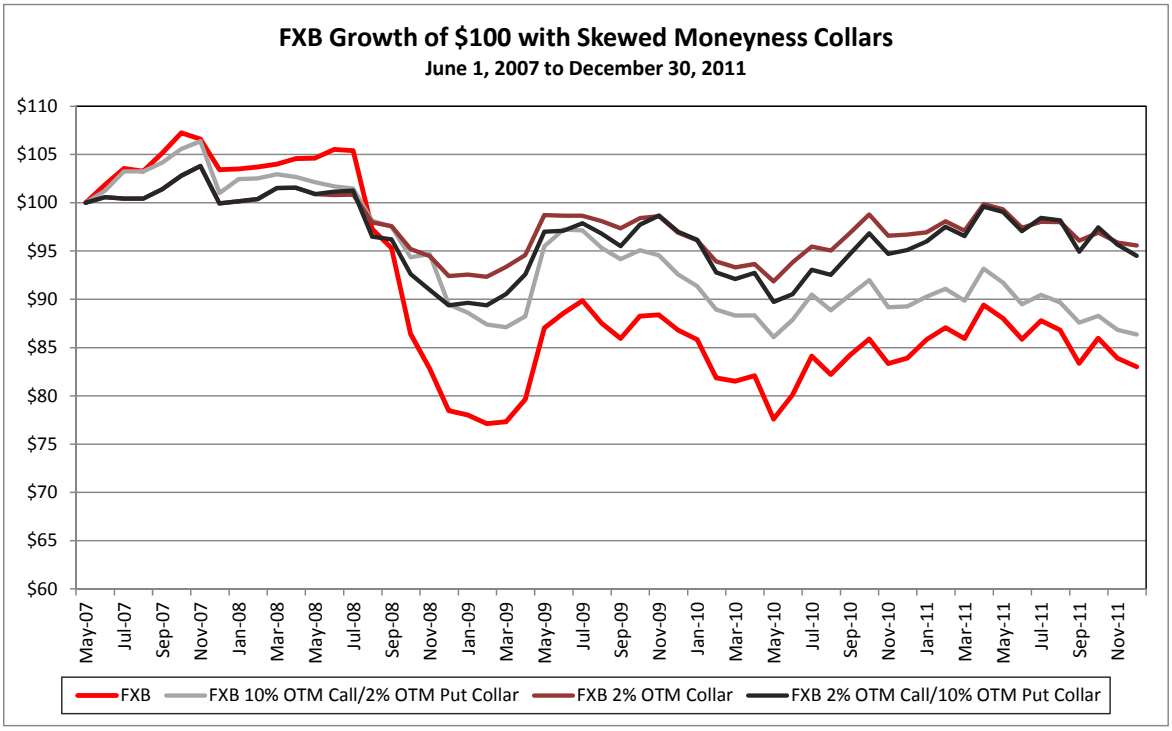
Exhibit 4h: Summary Statistics FXB 1-Month Call/6-Month Put Skewed Collars

FXB Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXB Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	-3.98%	-3.15%	-0.98%	-1.23%
Annualized Standard Deviation	10.78%	7.54%	5.11%	6.62%
Mean Monthly Return	-0.29%	-0.24%	-0.07%	-0.08%
Median Monthly Return	0.05%	-0.27%	-0.01%	0.09%
Period Cumulative Return	-16.99%	-5.50%	-4.42%	-13.63%
Sharpe Ratio	-0.47	-0.56	-0.40	-0.34
Stutzer Index	-0.48	-0.56	-0.40	-0.35
Treynor Ratio	-0.05	-0.07	-0.05	-0.04
Modified Calmar Ratio	-0.60	-0.29	-0.38	-0.98
Jensen Beta with FXB	1.00	0.60	0.41	0.56
Jensen Monthly Alpha	0.00%	-0.10%	0.01%	0.05%
Leland Beta	1.00	0.62	0.42	0.57
Leland Monthly Alpha	0.00%	-0.09%	0.01%	0.05%
Correlation with Underlying	0.57	0.36	0.44	0.53
Skewness	-0.20	0.68	0.12	-0.20
Excess Kurtosis	1.73	3.52	0.90	0.21
Minimum Monthly Return	-9.32%	-5.52%	-3.74%	-4.70%
Maximum Monthly Return	9.27%	8.21%	4.37%	4.78%
Maximum Drawdown	-28.09%	-19.07%	-11.52%	-13.90%
Maximum Run Up	16.52%	11.44%	8.70%	11.59%
% Down Months	49%	56%	51%	47%
% Up Months	51%	44%	49%	53%

Exhibit 4h and Exhibit 4i provide summary statistics and a graphical presentation of performance, respectively for skewed FXB collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to

reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 4i: Growth of $100 FXB 1-Month Call/6-Month Put Skewed Collars



The balanced collar outperforms the net premium collection collar (2% OTM call/10% OTM put) and the net premium payment collar on an absolute return basis. For example, the balanced collar generates a -0.98% return at a standard deviation of 5.11% versus -1.23%/6.62%,

-3.15%/7.54%, and -3.98%/10.78% for the net premium collection collar, the net premium payment collar and the underlying FXB ETF, respectively. From a risk adjusted perspective, the balanced collar under performs the net premium collection collar (Leland alpha of 1 basis point versus 5 basis points), while both outperform the net premium payment collar (-9 basis points) and the underlying FXB ETF (0 basis points).

The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 4g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 4j: Protection Cost Index at Roll-In FXB 1-Month "Zero-Cost" Collars

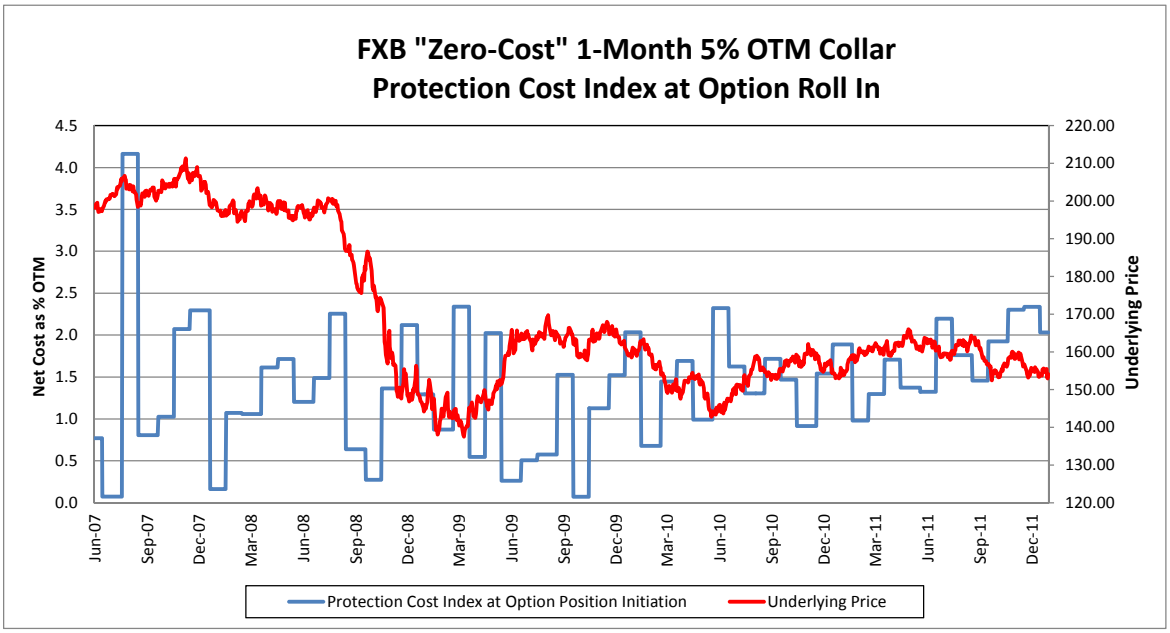


Exhibit 4k: Initial Option Moneyness FXB 1-Month "Zero-Cost" Collars

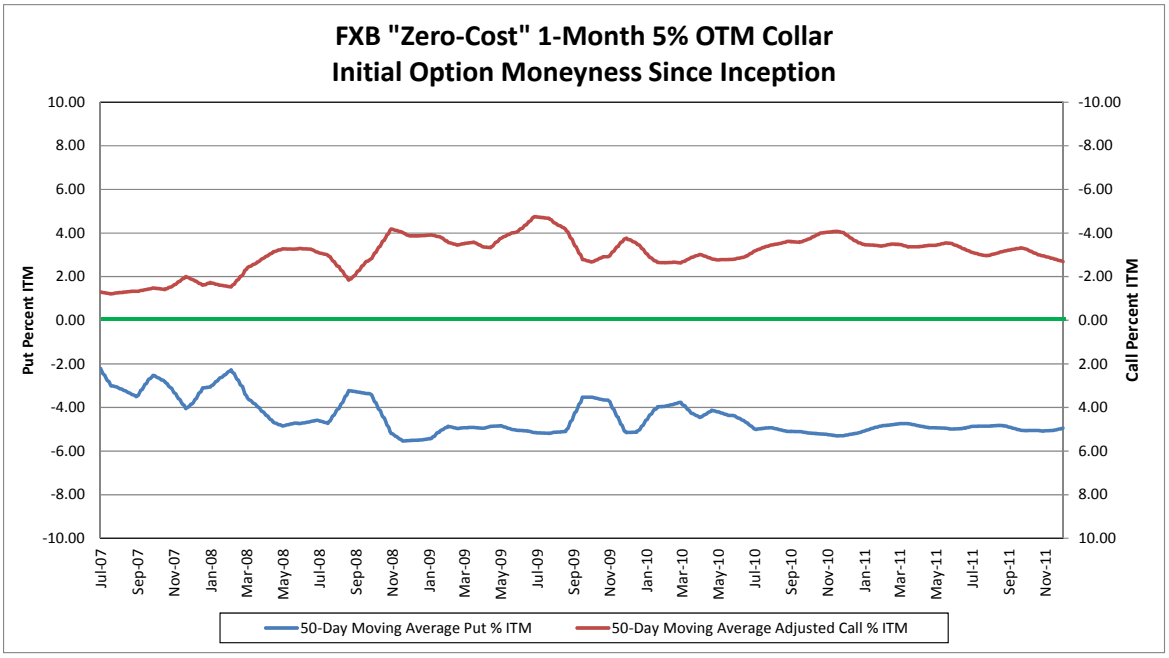


Exhibit 4j and Exhibit 4k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the FXB options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[32].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. The Exhibit indicates a significant skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (similar to equity index-based

[32] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

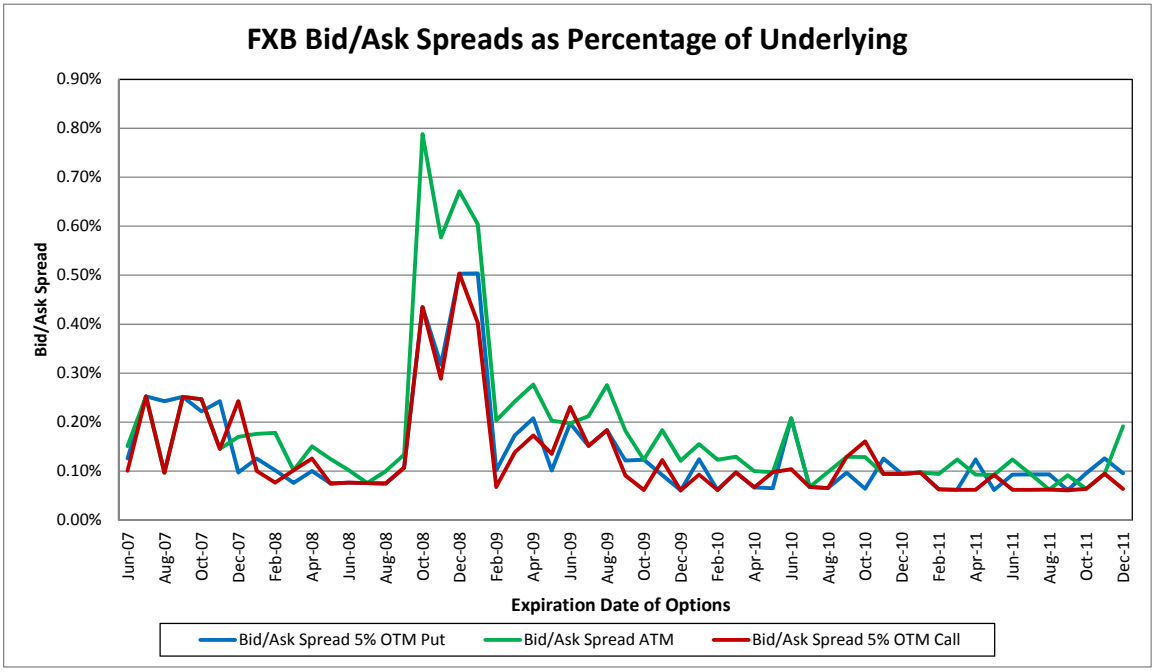
ETFs).While the rolling PCI index tends to average near the 1.5% level, the PCI varies significantly over time, reaching maximum magnitude in August 2007 followed by a minimum in October 2009 and then a general trend upward. Exhibit 4k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 4l provides a graphical presentation of bid/ask spreads as a percentage of the underlying FXB price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[33]. In general, bid/ask spreads tend to slightly decrease over time. However, while there are a number of peaks in the spreads, the spreads tend to be around 10 basis points in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the FXA underlying price[34] such wide spreads were not encountered for the FXB ETF.

[33] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[34] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 4l: Bid/Ask Spreads FXB 1-Month Collars



In conclusion, the FXB ETF experienced significant drawdowns over the period of study followed by a recovery and then relatively steady price levels for the final two years of the period. During the financial crisis, all of the collar strategies on the FXB ETF provided increased returns with a significant reduction in risk. However, from a risk adjusted perspective, only the 2% OTM and 25% OTM collars outperformed the FXB ETF (based on the Leland alpha). Similar to equity index options, FXB options tend to exhibit significant put skew. Finally, while FXB options used in this study exhibited bid/ask spreads approaching 1% of the underlying price at times, the spreads were generally around 10 basis points in the later part of the period of study.

Empirical Results for FXC CurrencyShares Canadian Dollar ETF, (NYSE Arca)

The FXC ETF provides access to the Canadian Dollar. CurrencyShares describes the FXC ETF as follows:

> "CurrencyShares Canadian Dollar Trust is designed to track the price of the Canadian Dollar net of Trust expenses, which are expected to be paid from interest earned on the deposited Canadian Dollars."…" About the Canadian Dollar: The Canadian dollar is the national currency of Canada and the currency of the accounts of the Bank of Canada, the Canadian central bank. The official currency code for the Canadian dollar is "CAD." The Canadian dollar is the seventh-most-traded currency in the world, accounting for 5.3% of global foreign exchange transactions. The USD/Canadian dollar pair is the sixth-most-traded currency pair in the world. The Canadian dollar is normally abbreviated with the dollar sign $, or C$ to distinguish it from other dollar-denominated currencies.."

The inception date for the ETF was June 21, 2006, with option data available from May 18, 2007. As of March 1, 2012, the FXC ETF had net assets of $584.8 Million. The FXC is traded on the NYSE Arca exchange and its CUSIP is 23129X105. Further details of the fund are provided in Exhibit 5a.

Exhibit 5a FXC ETF Characteristics

Symbol	FXC
CUSIP	23129X105
Fund Inception Date	6/21/2006
Product Type	Equitized Single Currency Trust, ETP
Benchmark	WM/Reuters Canadian Dollar Closing Spot Rate
Rebalance Schedule	Quarterly
Distribution Schedule	Monthly
Number of Canadian Dollar Per Share	100
Short Sale/Margin Eligible	Yes

Source: http://www.currencyshares.com/products/overview.rails?symbol=FXC

In this section, we compare the performance of the FXC ETF to the performance of FXC 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[35].

Exhibit 5b: Summary Statistics FXC 1-Month Call/6-Month Put Balanced Collars

FXC Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXC Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	1.95%	0.61%	3.03%	2.84%	2.88%	3.66%
Annualized Standard Deviation	12.66%	4.03%	6.18%	8.19%	9.66%	10.28%
Mean Monthly Return	0.23%	0.06%	0.26%	0.26%	0.28%	0.34%
Median Monthly Return	0.21%	0.21%	0.37%	0.39%	0.48%	0.26%
Period Cumulative Return	9.26%	2.82%	14.65%	13.67%	13.92%	17.92%
Sharpe Ratio	0.07	-0.11	0.32	0.22	0.19	0.25
Stutzer Index	0.07	-0.11	0.32	0.22	0.19	0.25
Treynor Ratio	0.01	-0.03	0.05	0.03	0.03	0.04
Modified Calmar Ratio	0.39	0.51	2.58	1.50	1.31	1.56
Jensen Beta with FXC	1.00	0.16	0.37	0.53	0.65	0.67
Jensen Monthly Alpha	0.00%	-0.05%	0.13%	0.11%	0.10%	0.16%
Leland Beta	1.00	0.16	0.36	0.53	0.64	0.66
Leland Monthly Alpha	0.00%	-0.05%	0.13%	0.11%	0.10%	0.16%
Correlation with Underlying	0.84	0.53	0.67	0.70	0.69	0.66
Skewness	-0.23	-0.26	-0.03	0.22	0.25	0.39
Excess Kurtosis	1.31	2.01	0.18	0.08	0.73	1.07
Minimum Monthly Return	-11.30%	-3.56%	-3.84%	-5.07%	-5.67%	-6.18%
Maximum Monthly Return	9.27%	3.59%	4.97%	6.29%	8.35%	9.31%
Maximum Drawdown	-23.74%	-5.56%	-5.69%	-9.13%	-10.62%	-11.52%
Maximum Run Up	33.71%	8.61%	20.84%	24.87%	27.28%	32.68%
% Down Months	44%	47%	38%	45%	45%	45%
% Up Months	56%	53%	62%	55%	55%	55%
Number of Months	55	55	55	55	55	55
Months in Cash		1	1	1	1	1
Months in Collar		54	54	54	54	54

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[36]. Exhibit 5b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk and increases realized returns relative to a long FXC position. The annualized returns are increased by almost 1/3 from 1.95% for the FXC to 2.84% for the 5% OTM collar. Meanwhile, the standard deviation is reduced by about

[35] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[36] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

1/3 from 12.66% to 8.19%. The Stutzer index increased from 0.07 to 0.22, and the monthly Leland alpha increased from 0 to 11 basis points, suggesting that the collar significantly improved risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -23.74% to -9.13%. Not surprisingly, the modified Calmar ratio[37] for the collar is greater than that of the FXC at 1.50 (versus 0.39 for the FXC) for the 55 month period, providing further evidence of the collar outperformance. Additional insight can be provided by Exhibit 5c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the outperformance of the collar strategies is their limited participation in the drawdowns that the FXC ETF experienced in late-2008. This is somewhat mitigated by the limited participation in the strong run up in late-2007. The performance of the 2% and greater OTM collars is quite similar to the FXC ETF from early-2009 to the end of the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -23.74% to -9.13%, it also reduces the maximum run up from 33.71% to 24.87%. Since the FXC experienced such a significant and rapid drawdown in late-2008, it is not surprising that the collar strategies provided performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 5b and Exhibit 5c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While the ATM strategy reduced the returns of the FXC, all the other collar strategies increased the returns and reduced the standard deviation of the FXC, with the further OTM strategies outperforming nearer to ATM collars from a raw return perspective. By most measures, the 2% OTM and 25% OTM collars outperformed the other collars, as well as the FXC ETF. For example, the Stutzer index

[37] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

of the 2% OTM and 25% OTM collars are 0.32 and 0.25, respectively, versus -0.11, 0.22, 0.19 and 0.07 for the ATM, 5% OTM, and 10% OTM collars and the FXC, respectively. Similarly, the monthly Leland alpha of the 2% OTM and 25% OTM collars are 13 and 16 basis points, respectively, versus -5, 11, 10 and 0 basis points for the ATM, 5% OTM and 10% OTM collars and the FXC, respectively. Thus, only the 2% OTM collar has a lower Leland alpha and Stutzer index than the FXC, and all the other collars provide a higher risk adjusted returns than the FXC.

Exhibit 5c: Growth of $100 FXC 1-Month Call/6-Month Put Balanced Collars

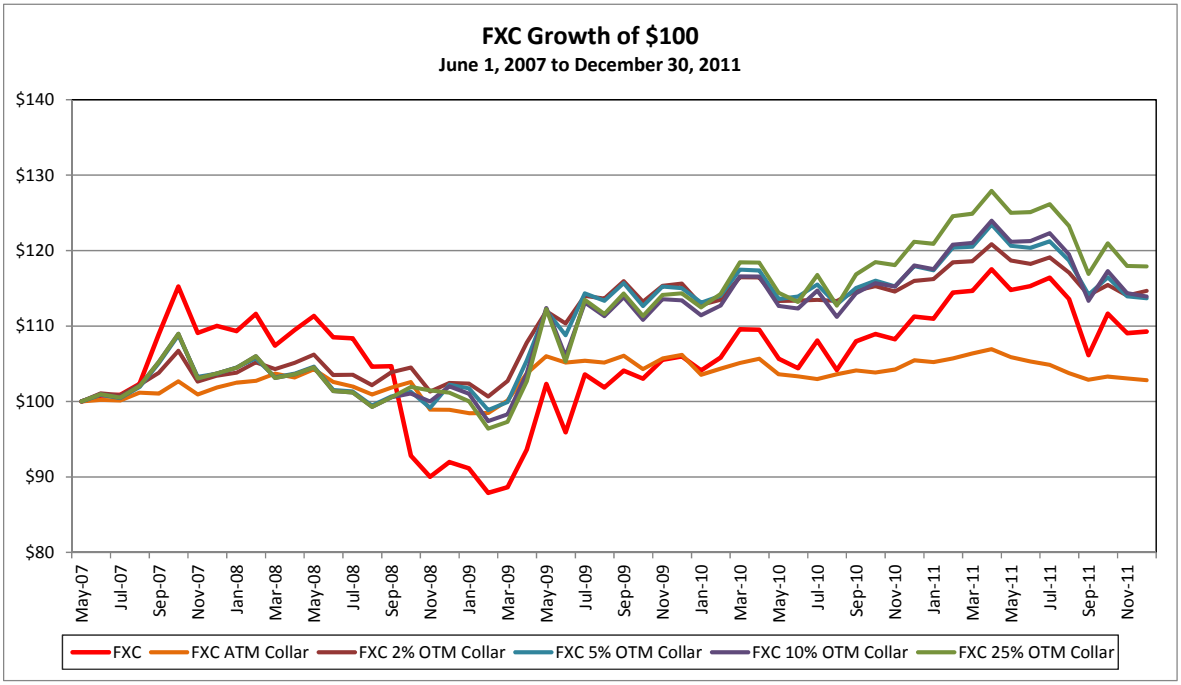
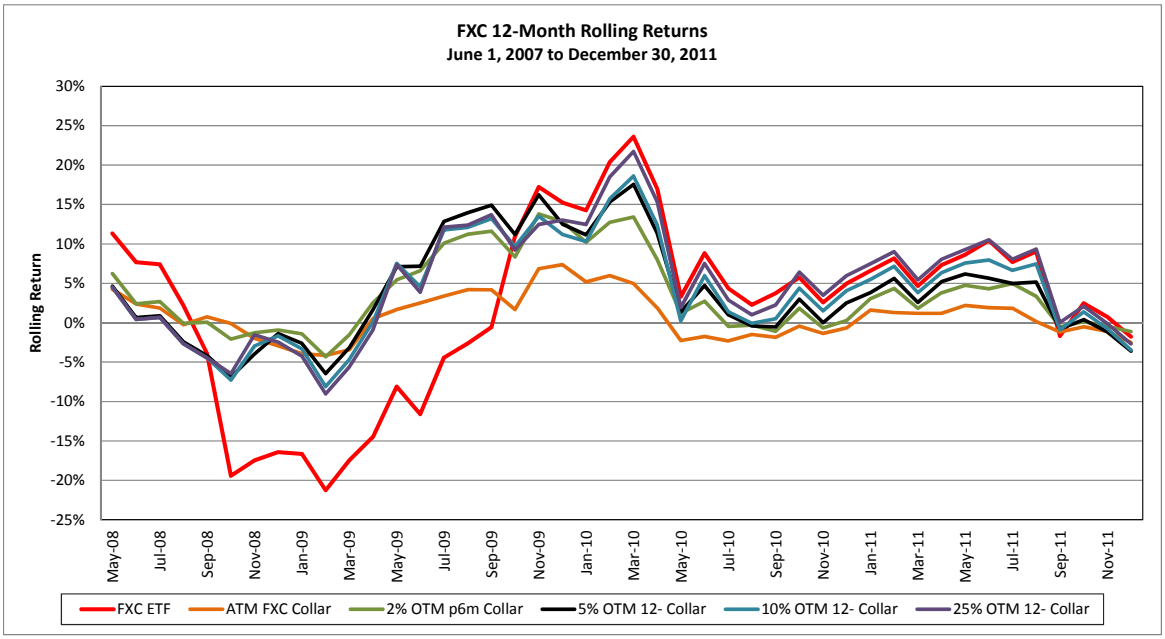


Exhibit 5d and Exhibit 5e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 5d it is clear that, after October 2009, the rolling returns of the deep OTM collar strategies are generally quite similar to those of the FXC. The rolling standard deviations provided in Exhibit 5e are evidence of the significant risk reduction potential

of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 1% to almost 10%.

Exhibit 5d: Rolling Returns FXC 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 5f provides a graphical presentation of 12-month rolling maximum drawdowns for FXC collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the FXC experienced a significant drawdown from mid-2008 to early-2009, one would expect that the collar strategies would improve returns in this sub-period of study, and that the moneyness of the collar would have a large impact on the degree of drawdown protection seen in this period. Surprisingly, the moneyness of the collar had little impact on the maximum drawdown in this period. While the near the money strategies provided more significant protection (reducing rolling drawdowns by about 16%), the deeper

OTM collars provided almost as much protection (for example, the 25% OTM collar reduced rolling drawdowns by about 12% at their worst).

Exhibit 5e: Rolling Standard Deviation FXC 1-Month Call/6-Month Put Collars

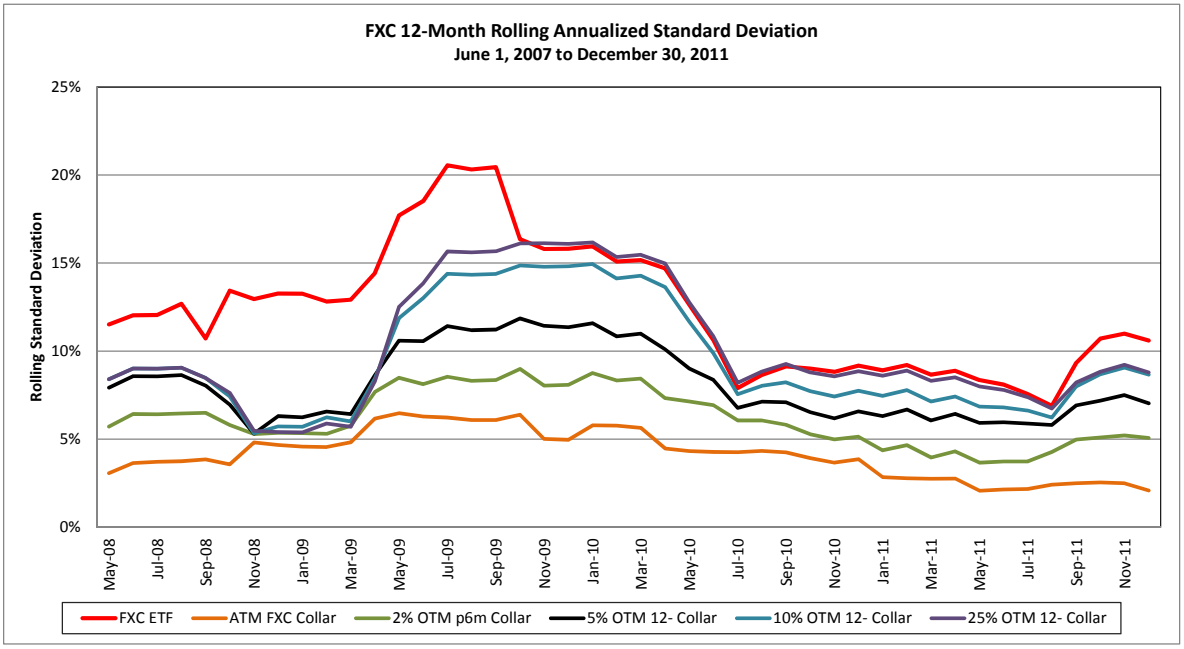
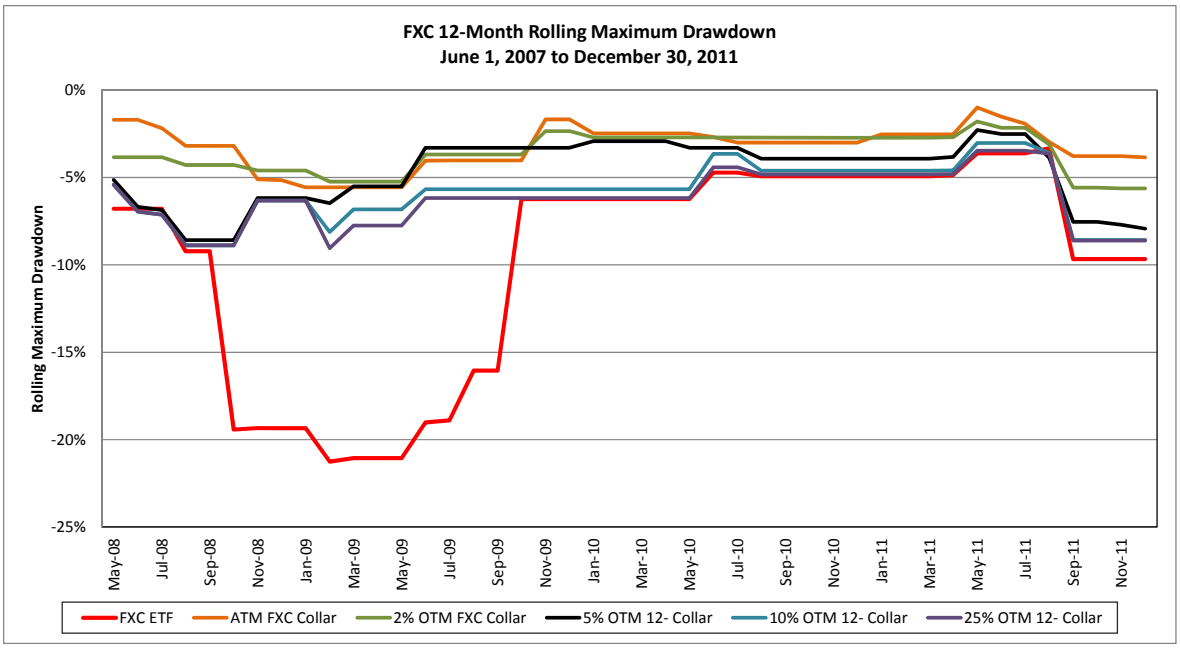


Exhibit 5f: Rolling Maximum Drawdown FXC 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying FXC ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 5g provides the levels of initial implied volatilities for 1-month ATM options on the FXC since inception as well as the ex post realized volatility over the life of the options[38] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[39]). While the volatility of volatility is quite high, the ATM implied volatility for the FXC options tends to fluctuate around the 10% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around the 2% level (with the puts exhibiting higher implied volatilities than the calls) and exhibits some very significant peaks and valleys over the period as well as an apparent slight upward trend in the second half of the period. It is interesting to note that in the first half of the period, the skew indicator fluctuates from positive to negative repeatedly.

[38] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[39] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

Exhibit 5g: Implied and Realized Volatility FXC 1-Month Collars Since Option Inception

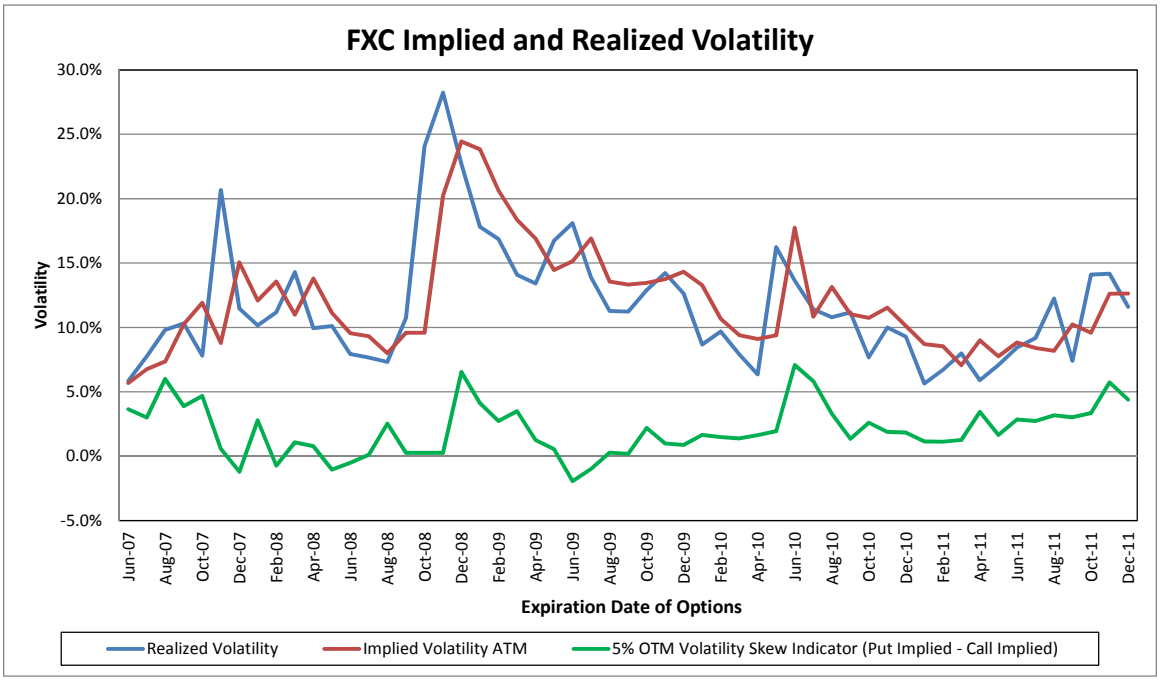


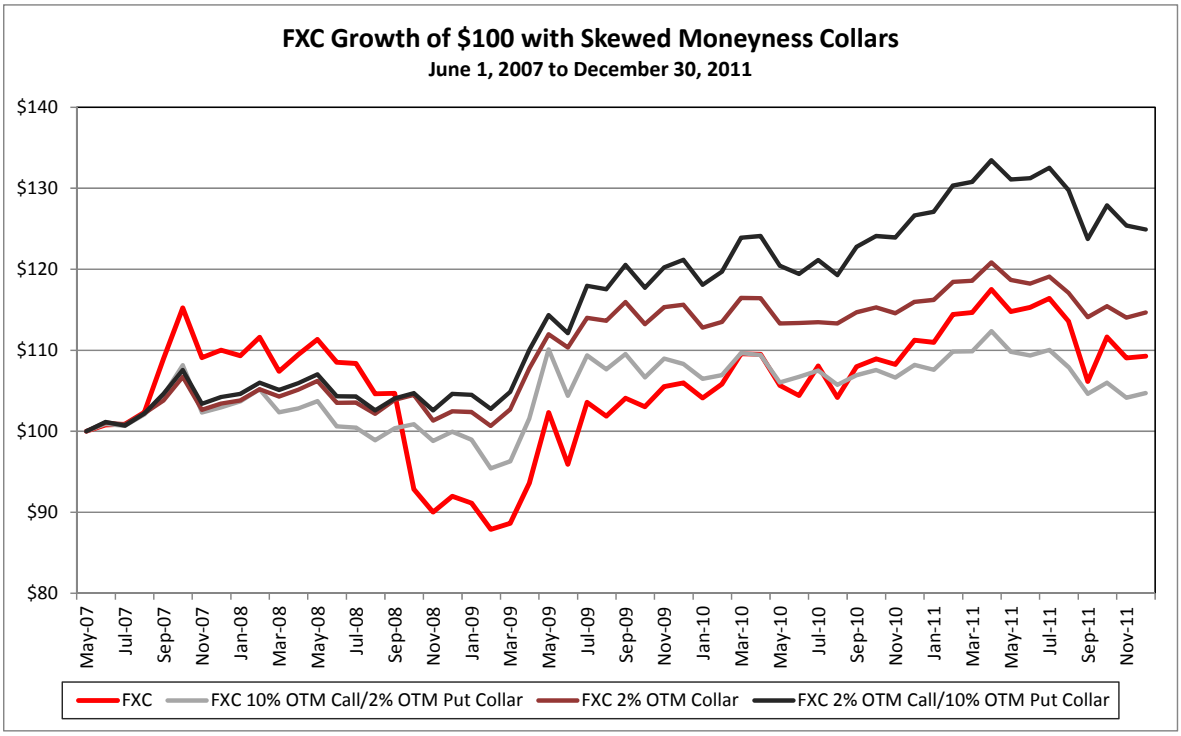
Exhibit 5h and Exhibit 5i provide summary statistics and a graphical presentation of performance, respectively for skewed FXC collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 5h: Summary Statistics FXC 1-Month Call/6-Month Put Skewed Collars

FXC Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXC Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	1.95%	1.01%	3.03%	4.97%
Annualized Standard Deviation	12.66%	8.47%	6.18%	7.41%
Mean Monthly Return	0.23%	0.11%	0.26%	0.43%
Median Monthly Return	0.21%	0.50%	0.37%	0.62%
Period Cumulative Return	9.26%	24.91%	14.65%	4.71%
Sharpe Ratio	0.07	0.00	0.32	0.53
Stutzer Index	0.07	0.00	0.32	0.52
Treynor Ratio	0.01	0.00	0.05	0.08
Modified Calmar Ratio	0.39	2.12	2.58	0.65
Jensen Beta with FXC	1.00	0.54	0.37	0.48
Jensen Monthly Alpha	0.00%	-0.04%	0.13%	0.28%
Leland Beta	1.00	0.53	0.36	0.47
Leland Monthly Alpha	0.00%	-0.04%	0.13%	0.28%
Correlation with Underlying	0.84	0.64	0.67	0.74
Skewness	-0.23	0.48	-0.03	-0.07
Excess Kurtosis	1.31	1.84	0.18	-0.21
Minimum Monthly Return	-11.30%	-5.39%	-3.84%	-4.65%
Maximum Monthly Return	9.27%	8.35%	4.97%	5.22%
Maximum Drawdown	-23.74%	-11.77%	-5.69%	-7.27%
Maximum Run Up	33.71%	33.46%	20.84%	17.75%
% Down Months	44%	44%	38%	40%
% Up Months	56%	56%	62%	60%

The net premium collection collar (2% OTM call/10% OTM put) outperforms the net premium payment collar and the balanced collar as well as the FXC ETF on an absolute return basis. For example, the net premium collection collar generates a 4.97% return at a standard deviation of 7.41% versus 3.03%/6.18%, 1.01%/8.47%, and 1.95%/12.66% for the balanced collar, the net premium payment collar and the underlying FXC ETF, respectively. Similarly, from a risk adjusted perspective the net premium collection collar outperforms the other two collars and the FXC ETF. For example, the Stutzer index for the net premium collection collar is 0.52 versus 0.32, 0.00 and 0.07 for the balanced collar, the net premium payment collar and the underlying FXC ETF, respectively. A similar pattern can be seen in the Leland alphas. By most measures, only the premium payment collar underperforms the FXC ETF.

Exhibit 5i: Growth of $100 FXC 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 5g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level –

in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 5j: Protection Cost Index at Roll-In FXC 1-Month "Zero-Cost" Collars

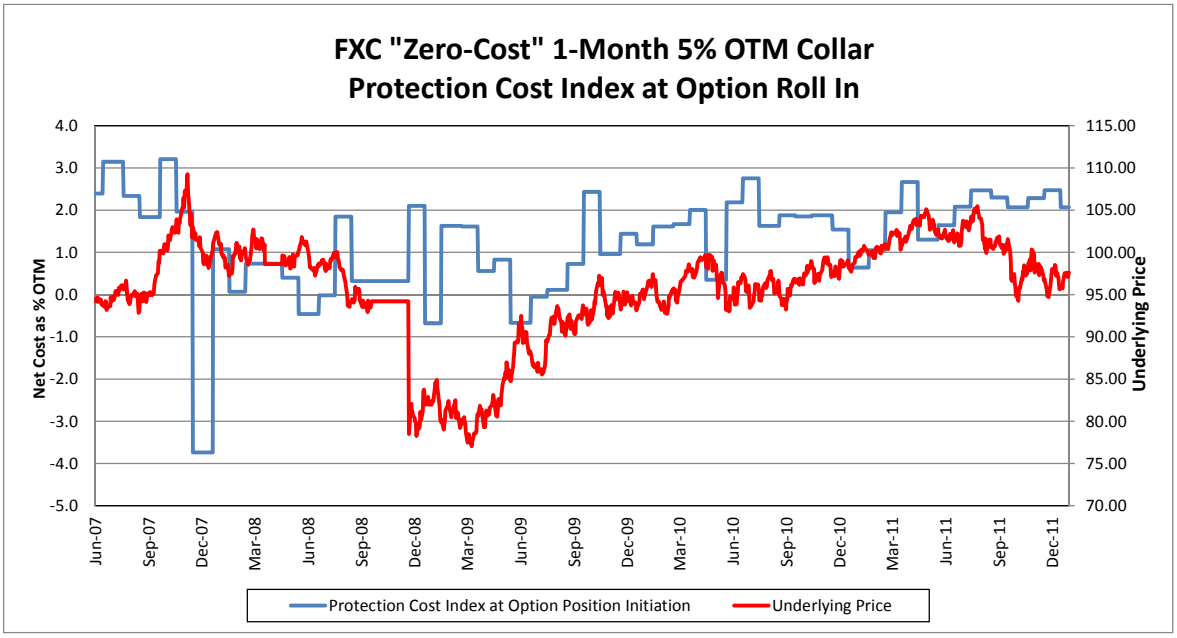


Exhibit 5k: Initial Option Moneyness FXC 1-Month "Zero-Cost" Collars

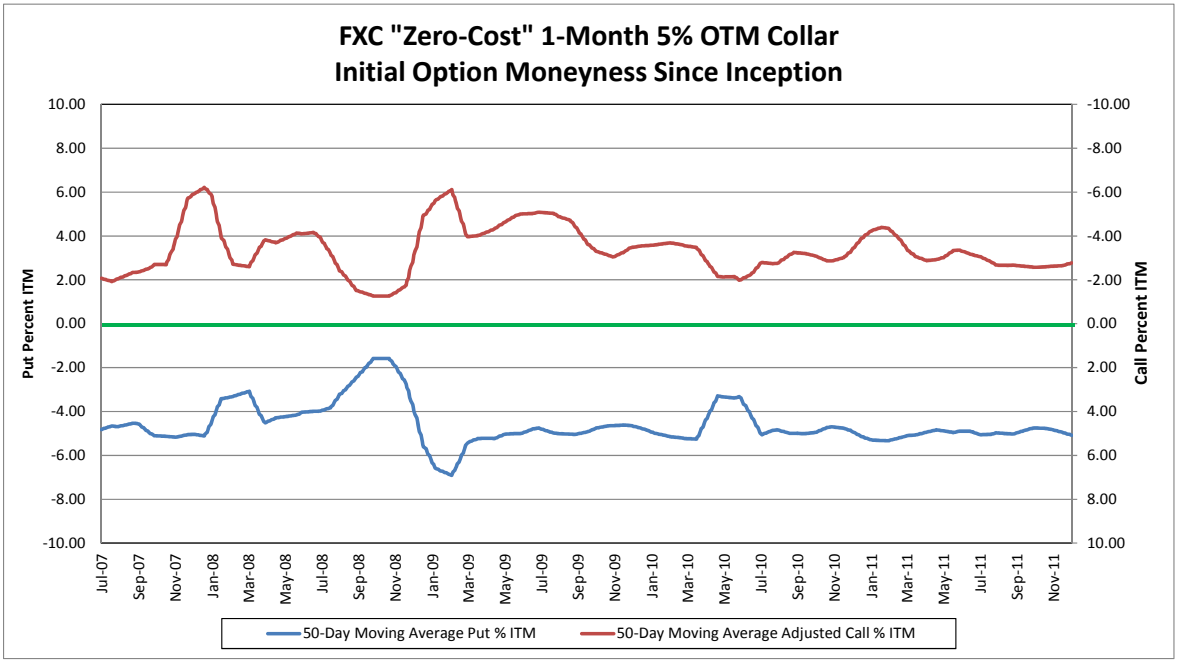


Exhibit 5j and Exhibit 5k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the FXC options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[40].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. It is worth noting that Exhibit 5j indicates missing options by a horizontal line for the underlying price as well as the PCI for the period in which no option position is available. This could occur either because all puts or calls have overly large bid/ask spreads (greater than 1% of the underlying price) or because no call is quoted which has a price as high as the chosen 5% OTM put. The Exhibit indicates a volatile skew in option implied volatilities which is generally toward the puts, indicating that puts tend to be more "expensive" than calls (similar to typical equity index-based ETFs), however, there are a number of instances where the skew is towards the calls, particularly in December 2007.While the rolling PCI index tends to average near the 1% level, the PCI varies significantly over time, ranging from about -4% to 3% reaching minimum in December 2007 followed by a general trend upward. Exhibit 5k provides further

[40] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

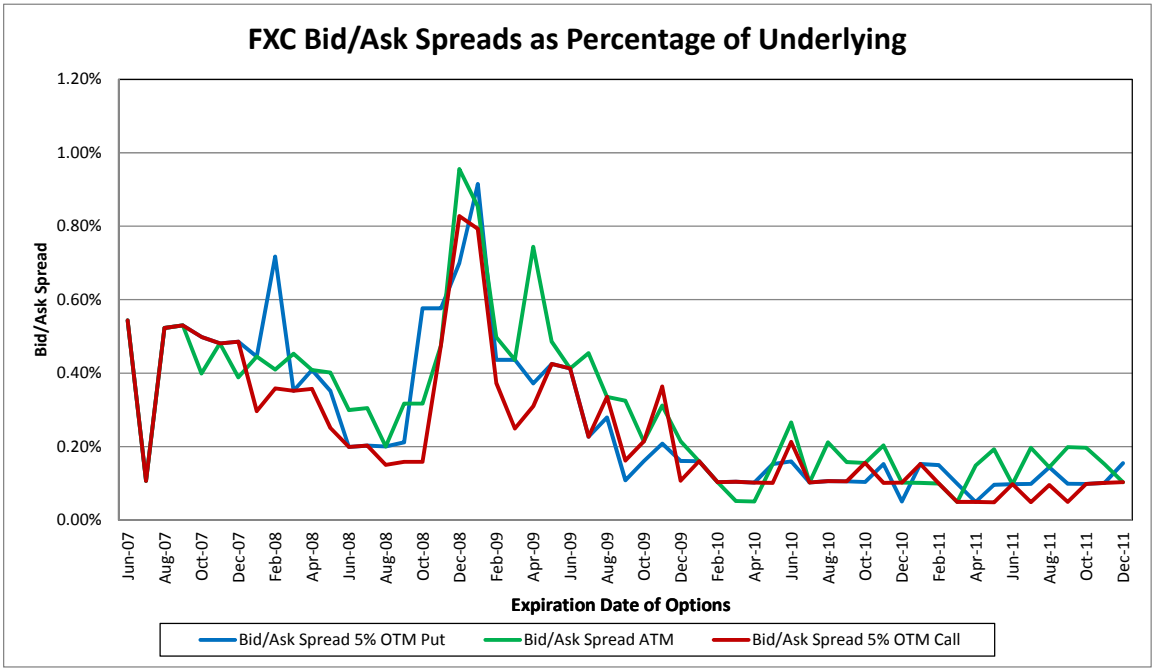
evidence of the varying skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 5l provides a graphical presentation of bid/ask spreads as a percentage of the underlying FXC price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[41]. In general, bid/ask spreads tend to decrease over time with spreads generally below 20 basis points in the second half of the period. However, there are a number of peaks in the spreads, particularly in late-2008 when spreads approached 1%. It is worth noting that the collar strategies presented in this section of the paper invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the FXC underlying price[42]. The FXC strategies were invested in SHY for 1 month of the 55 months covered in the study due to high bid/ask spreads.

[41] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[42] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 5l: Bid/Ask Spreads FXC 1-Month Collars



In conclusion, the FXC ETF is somewhat unique in that the options exhibit significant call skew at times and significant put skew at others. During the financial crisis the FXC collar strategies, with the exception of the ATM collar, tended to outperform the FXC ETF both on an absolute and risk adjusted basis. The FXC ETF experienced significant drawdowns over the period of study followed by a recovery and then partial retracement at the end of the period. Finally, while FXC options used in this study exhibited bid/ask spreads approaching 1% of the underlying price at times, the spreads were generally under 20 basis points in the later part of the period of study.

Empirical Results for FXE CurrencyShares Euro ETF, (NYSE Arca)

The FXE ETF provides access to the Euro. CurrencyShares describes the FXE ETF as follows:

> "CurrencyShares Euro Trust is designed to track the price of the euro net of Trust expenses, which are expected to be paid from interest earned on the deposited euros."…" About the Euro: The euro is the currency of 17 European Union countries. Euro banknotes and coins are a part of daily life for 330 million people living in the euro area. The Eurosystem, which consists of the European Central Bank (ECB) and the national central banks of the 17 countries belonging to the euro area, is in charge of defining and implementing the monetary policy of the euro area. What other information is good to know regarding the euro? Introduced January 2002; pre-existing currencies were phased out;Used by 17 European countries: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia and Spain;More countries may adopt the euro in the future;Denmark and the United Kingdom are members of the EU that chose not have the euro as their currency, while many of the newest EU members plus Sweden have yet to meet the conditions for adopting the single currency;The second-most traded currency worldwide accounting for 39.1% of currency transactions.."

The inception date for the ETF was February 12, 2007, with option data available from May 18, 2007. As of March 1, 2012, the FXE ETF had net assets of $331.8 Million. The FXE is traded on the NYSE Arca exchange and its CUSIP is 23130C108. Further details of the fund are provided in Exhibit 6a.

Exhibit 6a FXE ETF Characteristics

Symbol	FXE
CUSIP	29871P109
Fund Inception Date	12/8/2005
Product Type	Equitized Single Currency Trust, ETP
Benchmark	WM/Reuters Euro Closing Spot Rate
Rebalance Schedule	Quarterly
Distribution Schedule	Monthly
Number of Euro Per Basket	4,980,235
Short Sale/Margin Eligible	Yes

Source: http://www.currencyshares.com/products/overview.rails?symbol=FXE

In this section, we compare the performance of the FXE ETF to the performance of FXE 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[43].

Exhibit 6b: Summary Statistics FXE 1-Month Call/6-Month Put Balanced Collars

FXE Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXE Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	0.31%	-1.13%	-0.48%	0.73%	0.45%	-0.43%
Annualized Standard Deviation	13.62%	3.61%	6.24%	9.27%	11.62%	11.72%
Mean Monthly Return	0.10%	-0.09%	-0.02%	0.10%	0.09%	0.02%
Median Monthly Return	0.03%	-0.05%	0.15%	0.13%	0.05%	0.05%
Period Cumulative Return	1.43%	-5.10%	-2.16%	3.40%	2.06%	-1.96%
Sharpe Ratio	-0.05	-0.60	-0.24	-0.03	-0.05	-0.13
Stutzer Index	-0.05	-0.63	-0.25	-0.03	-0.05	-0.13
Treynor Ratio	-0.01	-0.16	-0.04	-0.01	-0.01	-0.02
Modified Calmar Ratio	0.07	-0.41	-0.13	0.26	0.13	-0.09
Jensen Beta with FXE	1.00	0.14	0.36	0.58	0.83	0.78
Jensen Monthly Alpha	0.00%	-0.17%	-0.10%	0.01%	0.00%	-0.08%
Leland Beta	1.00	0.14	0.36	0.58	0.83	0.78
Leland Monthly Alpha	0.00%	-0.17%	-0.10%	0.01%	0.00%	-0.08%
Correlation with Underlying	0.68	0.17	0.42	0.57	0.62	0.59
Skewness	-0.17	-1.20	-0.58	-0.11	0.10	-0.28
Excess Kurtosis	0.44	3.06	0.70	0.18	0.19	0.36
Minimum Monthly Return	-9.12%	-4.06%	-5.68%	-6.54%	-6.68%	-8.19%
Maximum Monthly Return	10.07%	1.64%	3.55%	5.98%	8.84%	7.55%
Maximum Drawdown	-21.19%	-12.54%	-16.40%	-13.20%	-16.44%	-21.58%
Maximum Run Up	21.39%	5.57%	13.42%	18.97%	19.22%	20.37%
% Down Months	45%	51%	49%	47%	49%	49%
% Up Months	55%	49%	51%	53%	51%	51%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[44]. Exhibit 6b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk and slightly increases realized returns relative to a long FXE position. The annualized returns are increased from 0.31% for the FXE to 0.73% for the 5% OTM collar. Meanwhile, the standard deviation is reduced by about 1/3 from

[43] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[44] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

13.62% to 9.27%. Certain performance measures such as the Stutzer index, Sharpe ratio and are non-informative when excess returns are negative, so for risk adjusted returns we will consider the Leland alpha. The 5% OTM collar provided a very slightly higher monthly Leland alpha (0.01%) than the FXE ETF (0.00%), suggesting that the collar slightly improved risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -21.19% to -13.20%. The modified Calmar ratio[45] for the 5% OTM collar is greater than that of the FXE at 0.26 (versus 0.07 for the FXE) for the 55 month period, once again suggesting outperformance by the collar strategy. Additional insight can be provided by Exhibit 6c, which provides a graphical presentation of the performance of the collar strategies. The performance of the 5% and greater OTM collars is quite similar to the FXE ETF throughout the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -21.19% to -13.20%, it also reduces the maximum run up from 21.39% to 18.97%. Since the FXE experienced generally balanced run ups and drawdowns over the period, it is not surprising that the collar strategies provided slight performance improvements and somewhat more significant volatility reductions.

In addition to providing results for 5% OTM collars, Exhibit 6b and Exhibit 6c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the FXE, the absolute return and risk adjusted return results are mixed. Certain performance measures such as the Stutzer index, Sharpe ratio and modified Calmar ratio are non-informative when returns are negative, so for risk adjusted returns we will once again consider the Leland alpha. While the 5% and 10% OTM collars provided

[45] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

higher absolute returns than the FXE at 0.73% and 0.45% versus 0.31%, respectively, the other collars underperformed the FXE. From a risk adjusted perspective, only 5% OTM collar provided a (very slightly) higher monthly Leland alpha (0.01%) than the FXE ETF (0.00%). The other collars provided negative Leland alphas (-17, -10, and -8 basis points for the ATM, 2% OTM, and 25% OTM collars, respectively).

Exhibit 6c: Growth of $100 FXE 1-Month Call/6-Month Put Balanced Collars

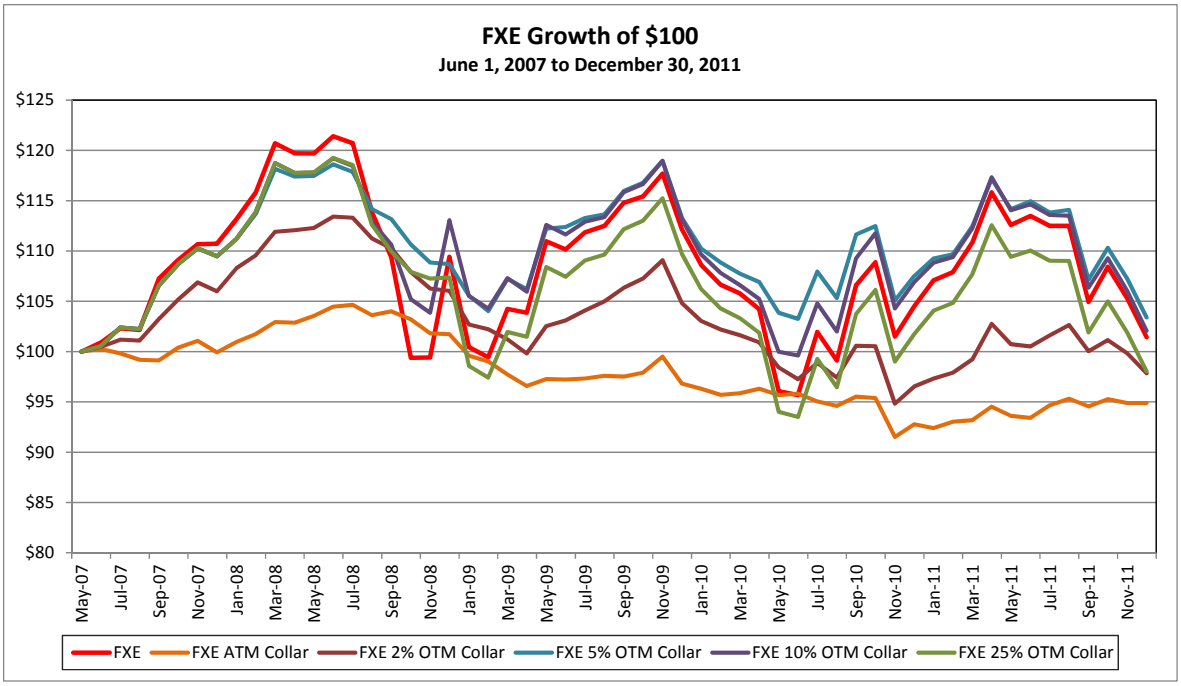


Exhibit 6d and Exhibit 6e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 6d it is clear that the returns of the deep OTM collar strategies are generally quite similar to those of the FXE. The rolling standard deviations provided in Exhibit 6e are evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly

lower standard deviations through most of the period, with the difference for the 5% OTM collar ranging from about 0% to 7%.

Exhibit 6d: Rolling Returns FXE 1-Month Call/6-Month Put Collars

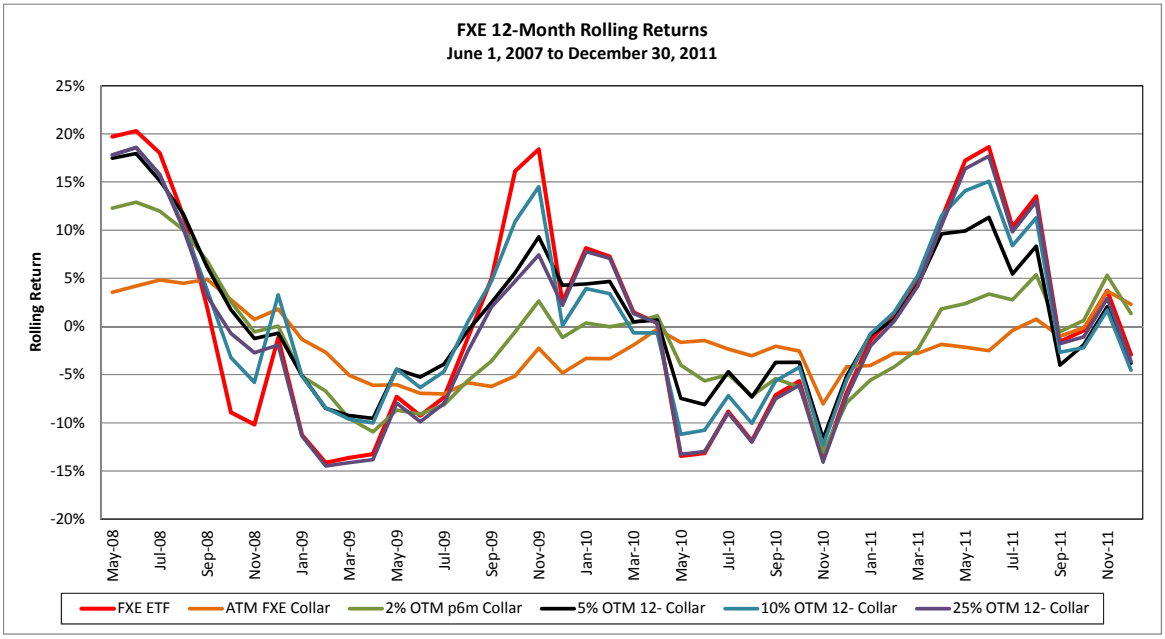
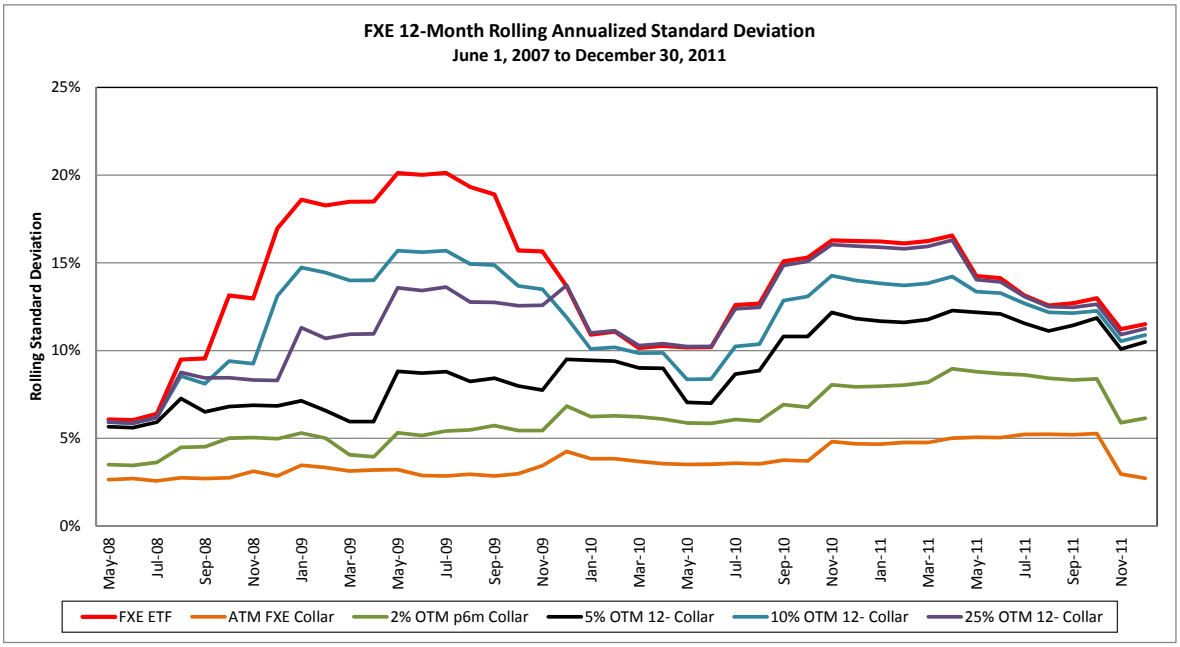
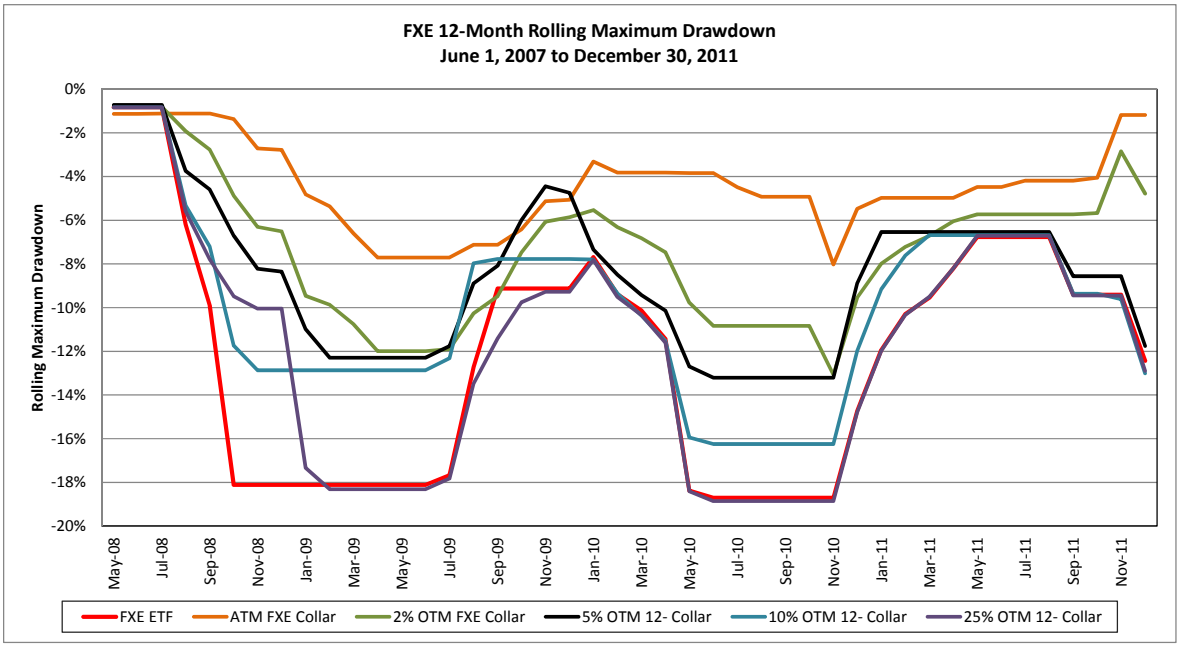


Exhibit 6e: Rolling Standard Deviation FXE 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 6f provides a graphical presentation of 12-month rolling maximum drawdowns for FXE collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the FXE experienced large drawdowns during the period of study, the moneyness of the collar had a large impact on the degree of drawdown protection. While the near the money strategies provided significant protection, the deeper OTM collars had far less impact on drawdowns. For example, in the major drawdown of late-2008 to early-2009, the 25% OTM collar provided little benefit, while the 2%, 5% and 20% OTM collars all provided essentially the same drawdown protection. There is more variation in the drawdowns of 2010.

Exhibit 6f: Rolling Maximum Drawdown FXE 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying FXE ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 6g provides the levels of initial implied volatilities for 1-month ATM options on the FXE since inception as well as the ex post realized volatility over the life of the options[46] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[47]). While the volatility of volatility is quite high, the ATM implied volatility for the FXE options tends to fluctuate around the 10% to 15% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around the 2% level (with the calls exhibiting higher implied volatilities than the puts) and exhibits some very significant peaks over the period as well as an apparent upward trend in the second half of the period. It is interesting to note that the spread fluctuates between positive and negative in the first half of the period.

[46] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[47] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

Exhibit 6g: Implied and Realized Volatility FXE 1-Month Collars Since Option Inception

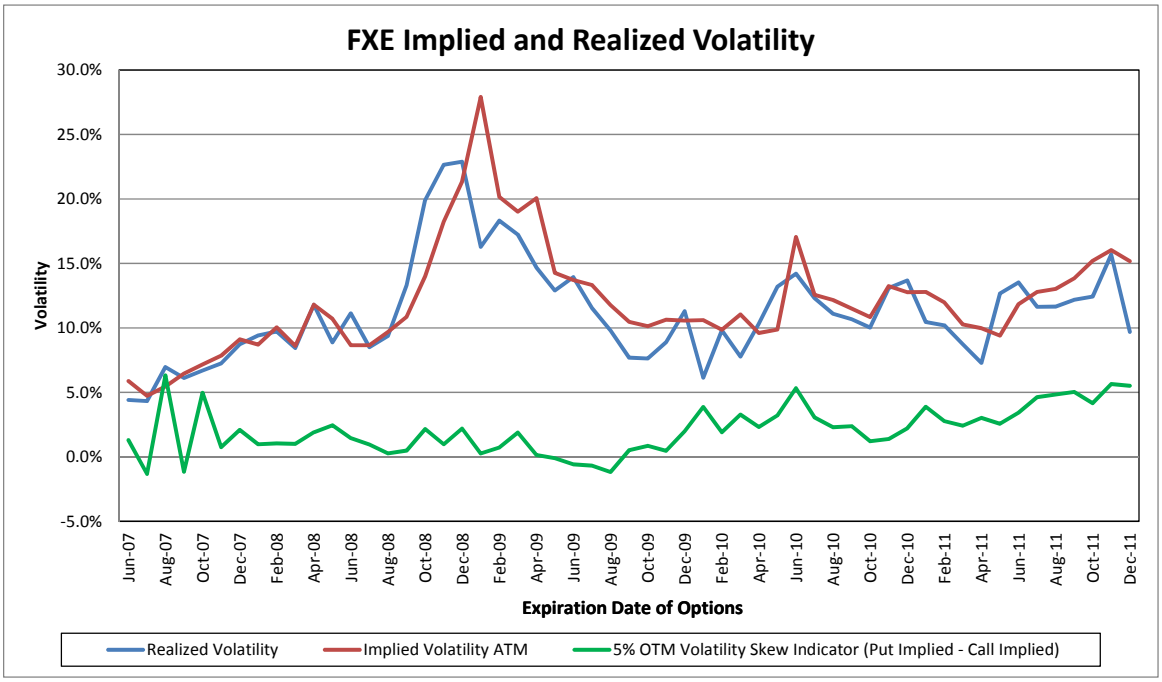


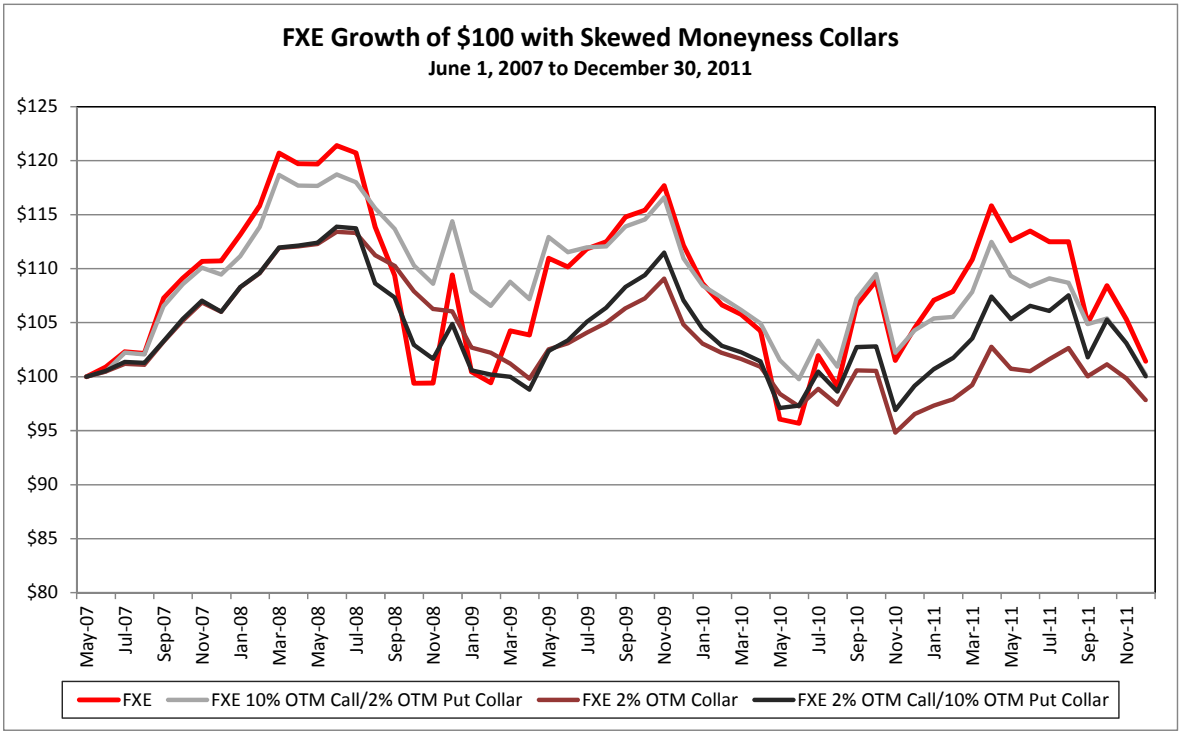
Exhibit 6h and Exhibit 6i provide summary statistics and a graphical presentation of performance, respectively for skewed FXE collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 6h: Summary Statistics FXE 1-Month Call/6-Month Put Skewed Collars

FXE Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXE Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	0.31%	0.04%	-0.48%	0.01%
Annualized Standard Deviation	13.62%	9.34%	6.24%	8.33%
Mean Monthly Return	0.10%	0.04%	-0.02%	0.03%
Median Monthly Return	0.03%	-0.02%	0.15%	0.26%
Period Cumulative Return	1.43%	0.05%	-2.16%	0.20%
Sharpe Ratio	-0.05	-0.11	-0.24	-0.12
Stutzer Index	-0.05	-0.11	-0.25	-0.13
Treynor Ratio	-0.01	-0.02	-0.04	-0.02
Modified Calmar Ratio	0.07	0.00	-0.13	0.01
Jensen Beta with FXE	1.00	0.63	0.36	0.56
Jensen Monthly Alpha	0.00%	-0.04%	-0.10%	-0.05%
Leland Beta	1.00	0.63	0.36	0.56
Leland Monthly Alpha	0.00%	-0.04%	-0.10%	-0.05%
Correlation with Underlying	0.68	0.55	0.42	0.57
Skewness	-0.17	0.06	-0.58	-0.60
Excess Kurtosis	0.44	0.17	0.70	-0.20
Minimum Monthly Return	-9.12%	-6.64%	-5.68%	-5.72%
Maximum Monthly Return	10.07%	6.22%	3.55%	4.16%
Maximum Drawdown	-21.19%	-15.97%	-16.40%	-14.90%
Maximum Run Up	21.39%	13.90%	13.42%	18.72%
% Down Months	45%	51%	49%	44%
% Up Months	55%	49%	51%	56%

The skewed collars outperform the balanced collar on an absolute and risk adjusted basis, although all collars underperform the FXE ETF. For example, the net premium collection collar and the net premium payment collar generate 0.01% and 0.04% returns, respectively versus -0.48% and 0.31%, respectively for the balanced collar and the FXE. Similarly, the Leland alpha for the net premium collection collar and the net premium payment collar are -4 and -5 basis points, respectively versus -10 and 0 basis points for the balanced collar and the FXE.

Exhibit 6i: Growth of $100 FXE 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 6g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 6j: Protection Cost Index at Roll-In FXE 1-Month "Zero-Cost" Collars

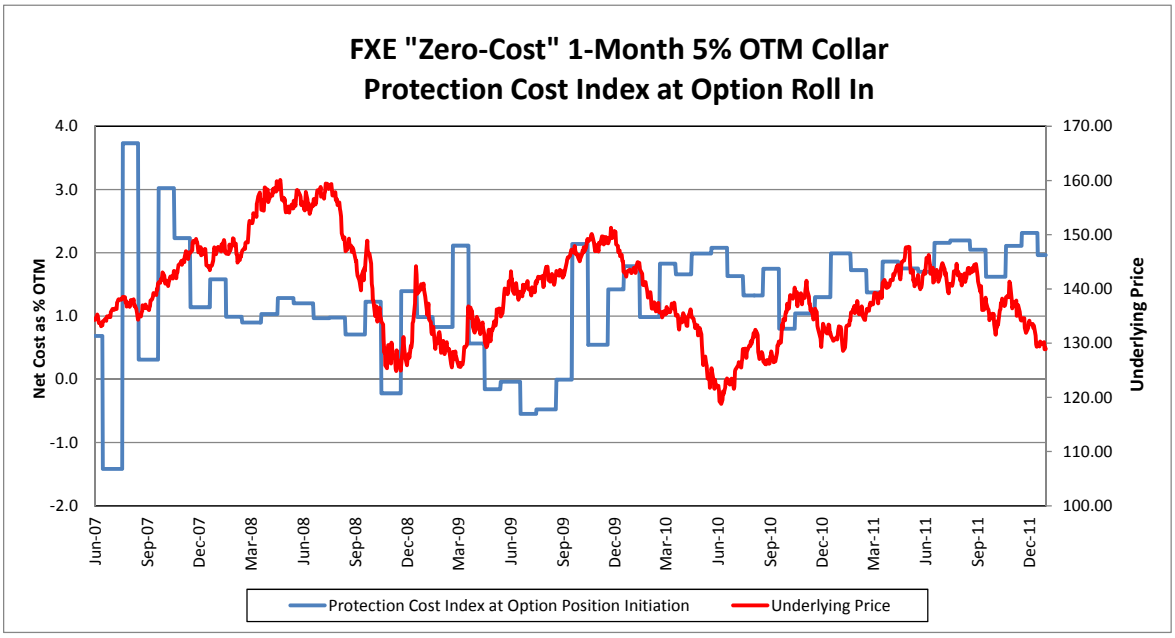


Exhibit 6k: Initial Option Moneyness FXE 1-Month "Zero-Cost" Collars

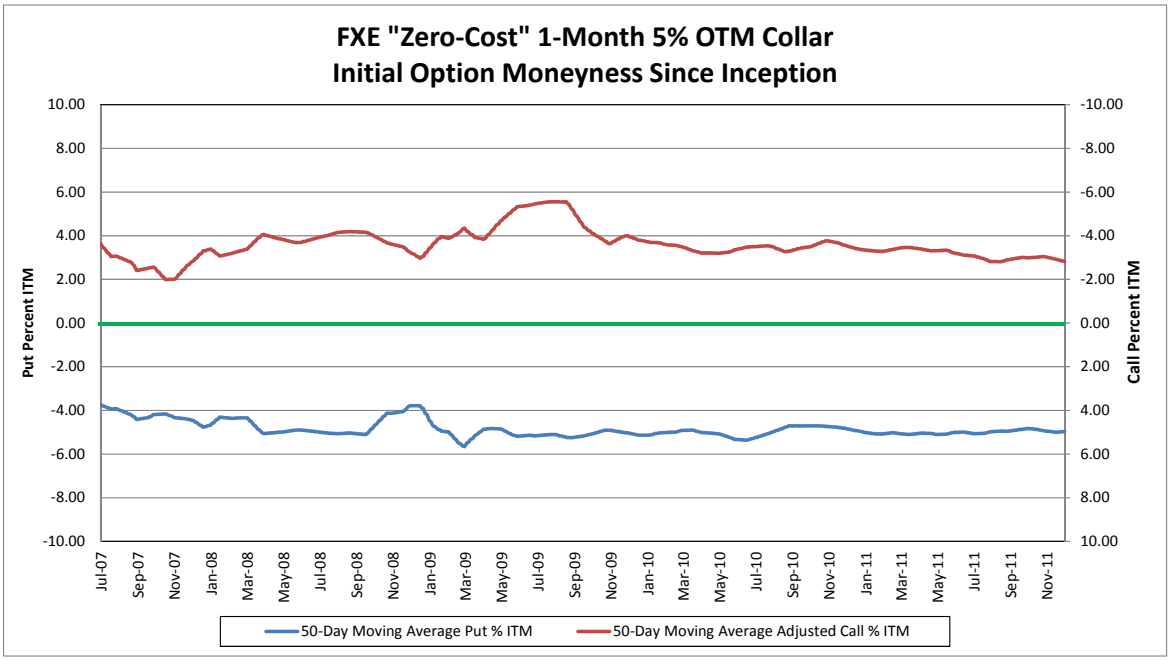


Exhibit 6j and Exhibit 6k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the FXE options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[48].

[48] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. The Exhibit generally indicates a skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (similar to typical equity index-based ETFs), although there are a number of instances when the skew is towards the calls. While the rolling PCI index tends to average near the 1% to 2% level, the PCI varies significantly over time, starting with a swing form -1.5% to over 3.5% at the start of the period followed by a general trend upward with somewhat smaller swings. Exhibit 6k provides further evidence of the generally widening put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

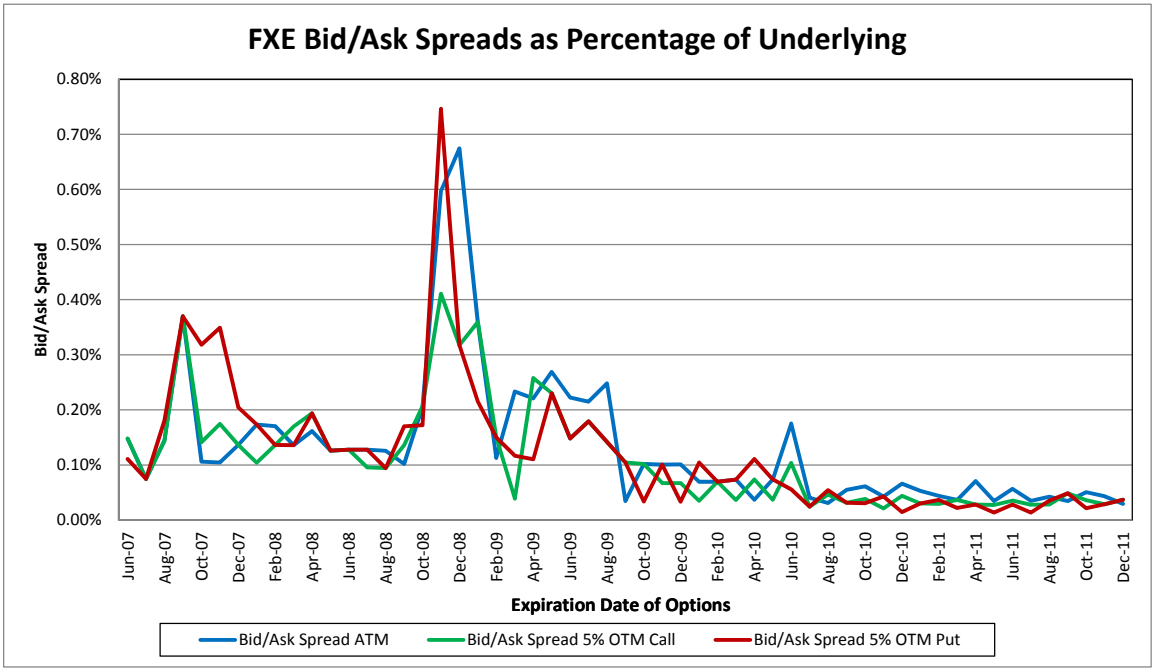
Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 6l provides a graphical presentation of bid/ask spreads as a percentage of the underlying FXE price for 5% OTM 1-month puts and calls

---

change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

as well as ATM options over the period of the study[49]. In general, bid/ask spreads tend to decrease over time. However, there are a number of peaks in the spreads, particularly in late-2008. While the spreads are generally between 10 and 20 basis points in the first half of the period, they tend to fluctuate around the 5 basis point level near the end of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the FXE underlying price[50], such wide spreads were not encountered for the FXE ETF.

Exhibit 6l: Bid/Ask Spreads FXE 1-Month Collars



[49] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[50] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

In conclusion, the FXE ETF is somewhat unique in that the options exhibit call skew at times and significant put skew at others, particularly in the first half of the period. During the financial crisis the performance of the FXE collar strategies was mixed when compared to the FXE ETF, both on an absolute and risk adjusted basis. Some collars underperformed the FXE while others outperformed the FXE. The FXE ETF experienced significant whipsaws throughout the period of study. While the collars significantly reduced the volatility of the FXE, they did little for the returns. Finally, while FXE options used in this study exhibited bid/ask spreads approaching 0.8% of the underlying price at times, the spreads were generally near 5 basis points in the later part of the period of study.

Empirical Results for FXF CurrencyShares Swiss Franc ETF, (NYSE Arca)

The FXF ETF provides access to the Swiss Franc. CurrencyShares describes the FXF ETF as follows:

> "CurrencyShares Swiss Franc Trust is designed to track the price of the Swiss Franc net of Trust expenses, which are expected to be paid from interest earned on the deposited Swiss Francs."…" About the Swiss Franc: The Swiss franc is the national currency of Switzerland and Liechtenstein and the currency of the accounts of the Swiss National Bank, the central bank of Switzerland. The Swiss franc is the sixth-most-traded currency in the world, accounting for 6.4% of global foreign exchange transactions. The USD/Swiss franc pair is the fifth-most-traded currency pair."

The inception date for the ETF was June 21, 2006, with option data available from May 18, 2007. As of March 1, 2012, the FXF ETF had net assets of $442.1 Million. The FXF is traded on the NYSE Arca exchange and its CUSIP is 23129V109. Further details of the fund holdings are provided in Exhibit 7a.

Exhibit 7a FXF ETF Characteristics

Symbol	FXF
CUSIP	23129V109
Fund Inception Date	6/21/2006
Product Type	Equitized Single Currency Trust, ETP
Benchmark	WM/Reuters Swiss Franc Closing Spot Rate
Rebalance Schedule	Quarterly
Distribution Schedule	Monthly
Number of Swiss Franc Per Share	100
Short Sale/Margin Eligible	Yes

Source: http://www.currencyshares.com/products/overview.rails?symbol=FXF

In this section, we compare the performance of the FXF ETF to the performance of FXF 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[51].

Exhibit 7b: Summary Statistics FXF 1-Month Call/6-Month Put Balanced Collars

FXF Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXF Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	6.09%	-0.53%	1.86%	6.63%	4.29%	4.32%
Annualized Standard Deviation	14.70%	4.89%	7.00%	9.51%	12.29%	11.86%
Mean Monthly Return	0.58%	-0.03%	0.17%	0.57%	0.41%	0.41%
Median Monthly Return	0.91%	-0.07%	0.03%	0.34%	0.26%	0.28%
Period Cumulative Return	31.10%	-2.42%	8.82%	34.20%	21.21%	21.37%
Sharpe Ratio	0.34	-0.32	0.12	0.59	0.26	0.28
Stutzer Index	0.34	-0.33	0.11	0.57	0.26	0.27
Treynor Ratio	0.05	-0.07	0.02	0.09	0.04	0.04
Modified Calmar Ratio	1.76	-0.32	1.02	3.30	1.39	1.36
Jensen Beta with FXF	1.00	0.24	0.41	0.60	0.82	0.74
Jensen Monthly Alpha	0.00%	-0.23%	-0.10%	0.20%	-0.07%	-0.04%
Leland Beta	1.00	0.25	0.42	0.61	0.82	0.76
Leland Monthly Alpha	0.00%	-0.23%	-0.10%	0.20%	-0.07%	-0.04%
Correlation with Underlying	0.52	0.40	0.48	0.47	0.53	0.49
Skewness	0.14	-0.73	-0.28	-0.13	0.21	-0.50
Excess Kurtosis	1.59	1.60	0.66	0.88	1.49	1.39
Minimum Monthly Return	-11.12%	-4.27%	-5.65%	-7.51%	-9.51%	-10.54%
Maximum Monthly Return	14.04%	2.92%	4.62%	7.24%	11.57%	7.25%
Maximum Drawdown	-17.65%	-7.58%	-8.62%	-10.37%	-15.30%	-15.67%
Maximum Run Up	56.91%	8.43%	22.63%	49.72%	43.11%	45.08%
% Down Months	44%	51%	49%	42%	45%	45%
% Up Months	56%	49%	51%	58%	55%	55%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[52]. Exhibit 7b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk and slightly increases realized returns relative to a long FXF position. The annualized returns are increased slightly from 6.09% for the FXF to 6.63% for the 5% OTM collar. The standard deviation is reduced by about 1/3 from

[51] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[52] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

14.70% to 9.51%. The Stutzer index increased from 0.34 to 0.57 and the monthly Leland alpha increased from 0 to 20 basis points, suggesting that the collar significantly increased risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -17.65% to -10.37%. Not surprisingly, the modified Calmar ratio[53] for the collar far greater than that of the FXF at 3.30 (versus 1.75 for the FXF) for the 55 month period. Additional insight can be provided by Exhibit 7c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the underperformance of the collar strategies is their limited participation in the run up and following drawdown that the FXF ETF experienced in the first 1 ½ years of the period. The performance of the 5% and greater OTM collars is quite similar to the FXF ETF in the remainder of the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -17.65% to -10.37%, it also reduces the maximum run up from 56.91% to 49.72%. Since the FXF essentially retraced its run ups prior to May 2010, and retraced much of its run up after that date, it is not surprising that the collar strategies did not provide greater performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 7b and Exhibit 7c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the FXF, only the 5% OTM collar improved returns (albeit, slightly) from a raw return perspective. The same pattern can be seen from a risk adjusted return perspective. For example, the Stutzer index of the 5% OTM collar is 0.57 versus -0.33, 0.11, 0.26, 0.27 and 0.34 for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the

[53] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

FXF, respectively. Similarly, the monthly Leland alpha of the 5% OTM collar is 20 basis points versus -23, -10, -7, -4 and 0 basis points for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the FXF, respectively. Thus, only the 5% OTM collar has a higher Leland alpha and Stutzer index than the FXF. All the other collars provide a lower risk adjusted return than the FXF.

Exhibit 7c: Growth of $100 FXF 1-Month Call/6-Month Put Balanced Collars

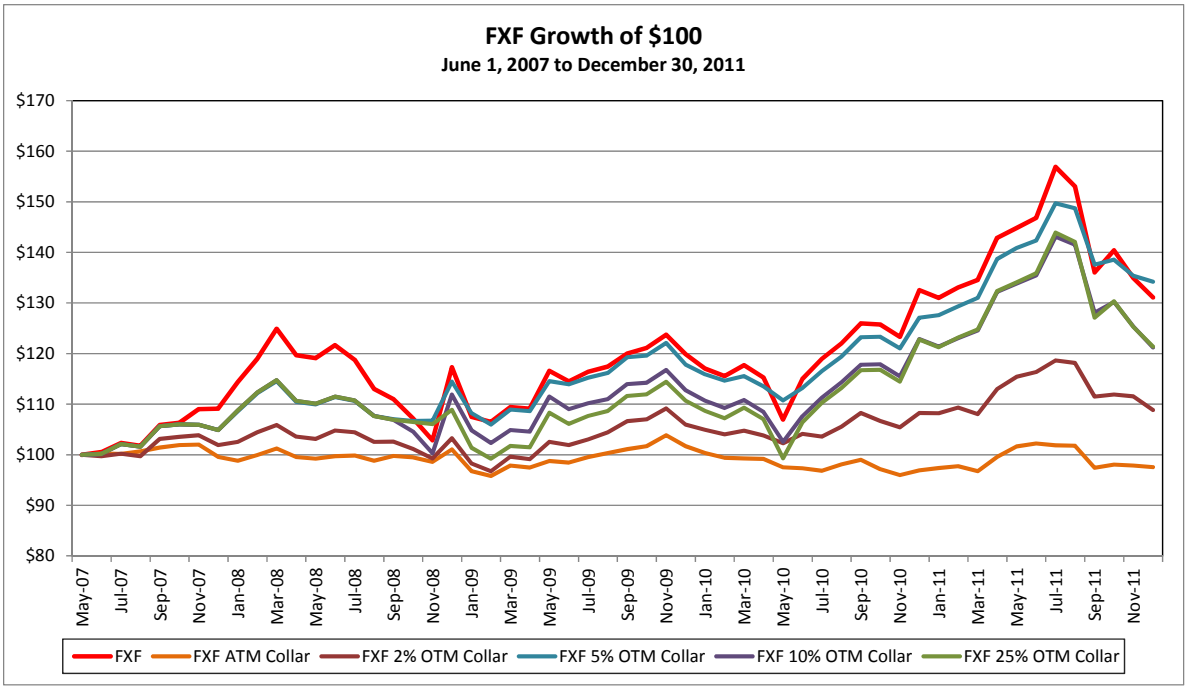


Exhibit 7d and Exhibit 7e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 7d it is clear that, in 2010 and 2011, the returns of the deep OTM collar strategies are generally quite similar to those of the FXF. The rolling standard deviations provided in Exhibit 7e are evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit

generally significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 1% to 9%.

Exhibit 7d: Rolling Returns FXF 1-Month Call/6-Month Put Collars

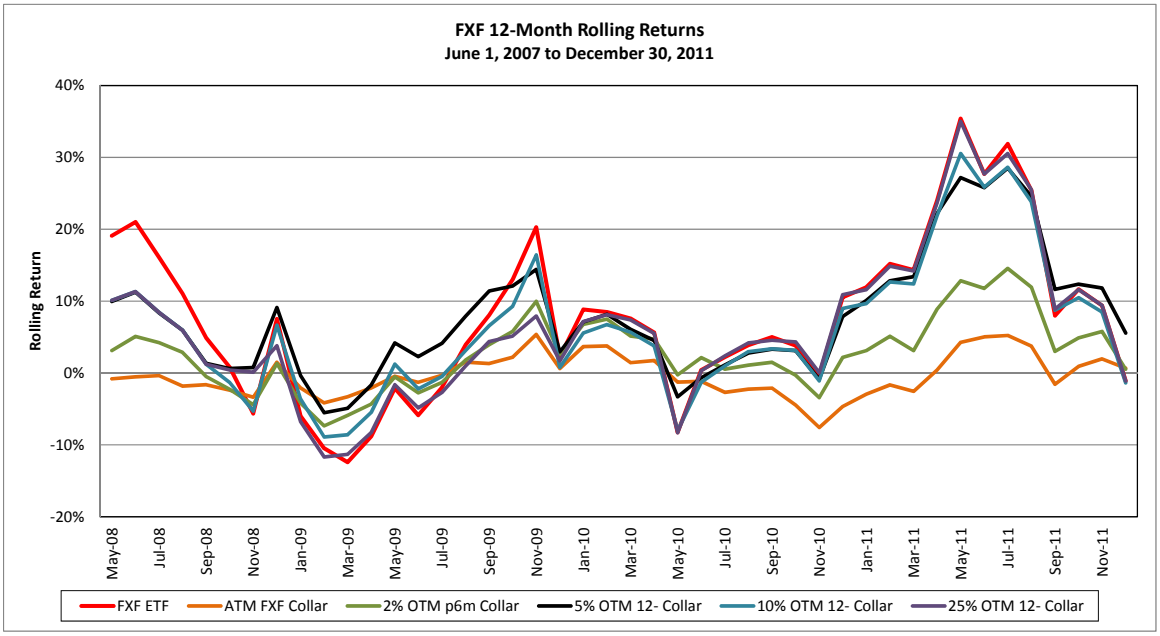
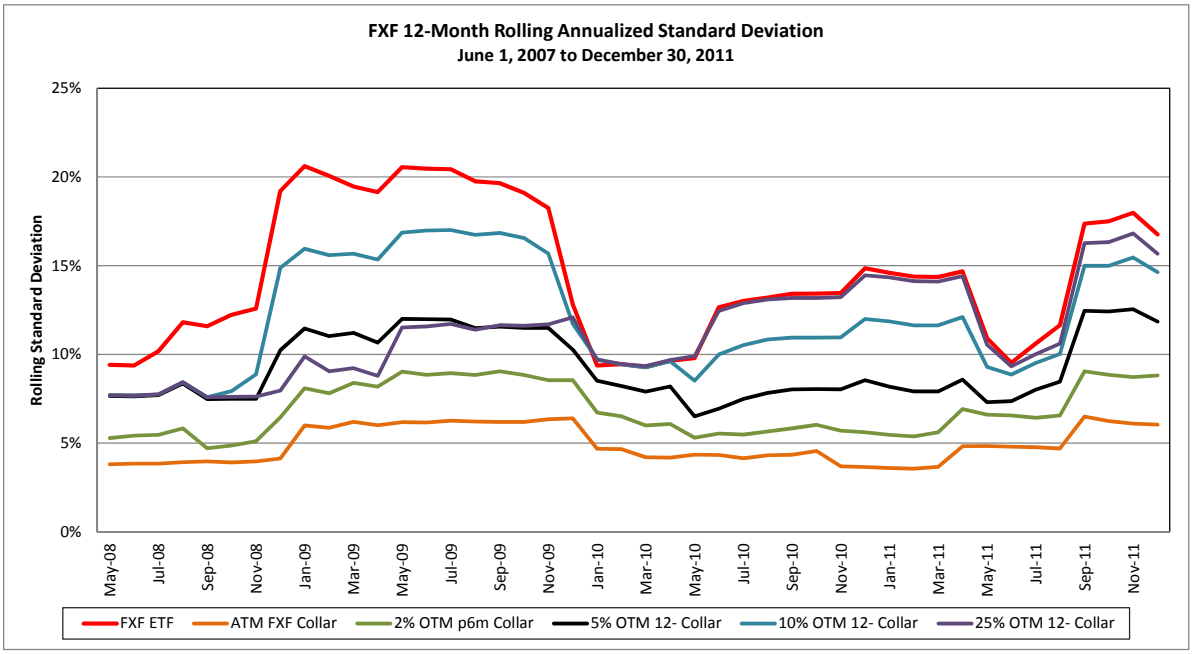
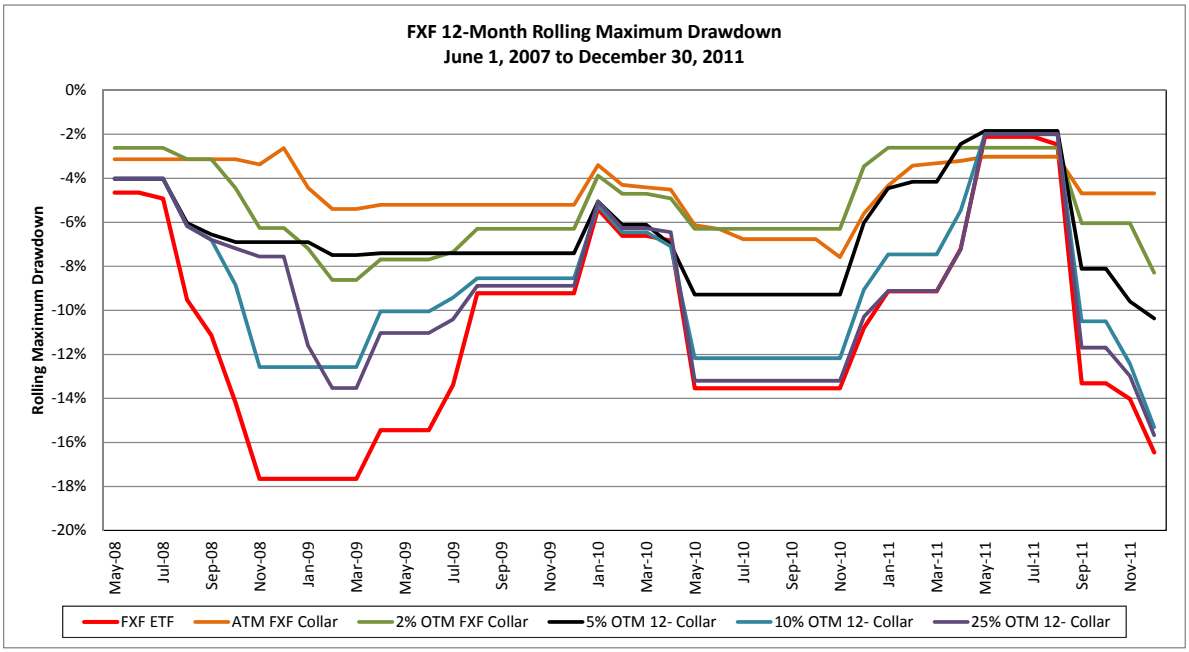


Exhibit 7e: Rolling Standard Deviation FXF 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 7f provides a graphical presentation of 12-month rolling maximum drawdowns for FXF collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the FXF experienced a variety of drawdowns during the period of study, the moneyness of the collar had a varying degrees of impact on the drawdown protection. While the near the money strategies provided significant protection from all drawdowns, the deeper OTM collars had the most impact on the largest drawdowns. For example, the 25% OTM collar reduces the rolling maximum drawdown in early-2009 by over 4% while it has virtually no impact on the drawdown in mid-2010.

Exhibit 7f: Rolling Maximum Drawdown FXF 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying FXF ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 7g provides the levels of initial implied volatilities for 1-month ATM options on the FXF since inception as well as the ex post realized volatility over the life of the options[54] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[55]). While the volatility of volatility is quite high, the ATM implied volatility for the FXF options tends to fluctuate around the 10% to 15% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the late-2008 and late-2011. The implied volatility differential between the puts and calls tends to fluctuate around zero (with the calls exhibiting about the same implied volatilities as the puts, on average) and exhibits some very significant peaks and swings over the period without any visible trend.

[54] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[55] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

Exhibit 7g: Implied and Realized Volatility FXF 1-Month Collars Since Option Inception

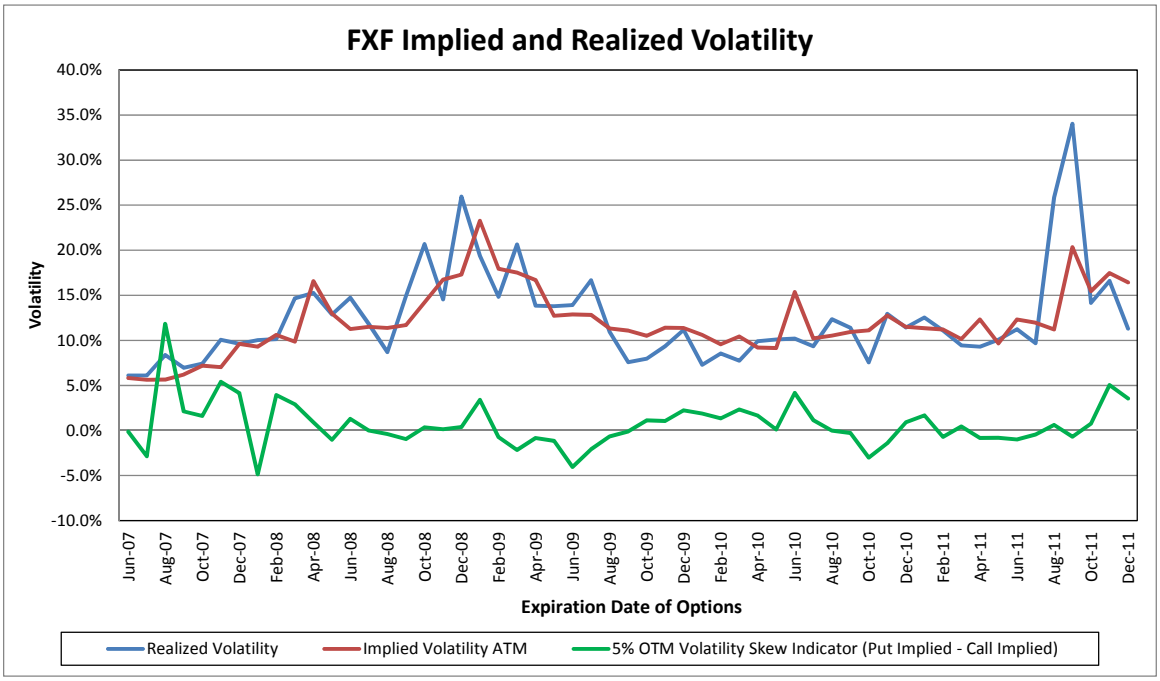


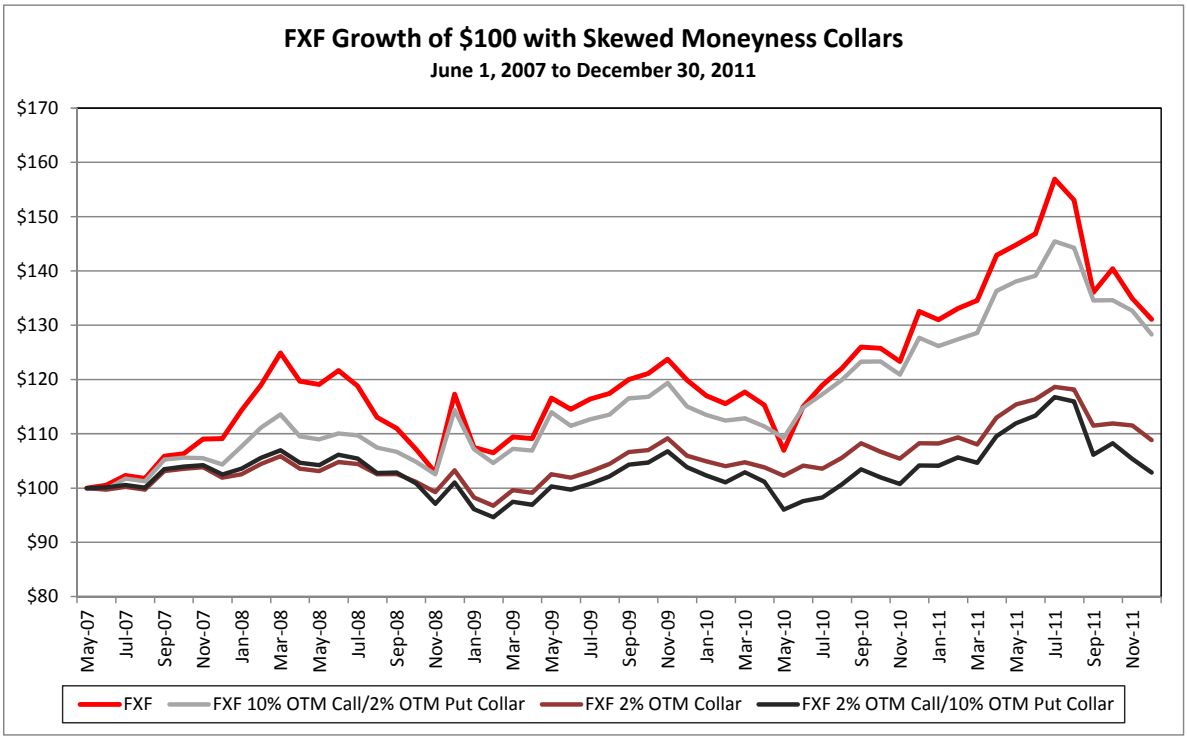
Exhibit 7h and Exhibit 7i provide summary statistics and a graphical presentation of performance, respectively for skewed FXF collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 7h: Summary Statistics FXF 1-Month Call/6-Month Put Skewed Collars

FXF Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXF Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	6.09%	5.59%	1.86%	0.62%
Annualized Standard Deviation	14.70%	10.85%	7.00%	8.60%
Mean Monthly Return	0.58%	0.50%	0.17%	0.08%
Median Monthly Return	0.91%	0.05%	0.03%	0.30%
Period Cumulative Return	31.10%	2.88%	8.82%	28.29%
Sharpe Ratio	0.34	0.42	0.12	-0.05
Stutzer Index	0.34	0.42	0.11	-0.05
Treynor Ratio	0.05	0.07	0.02	-0.01
Modified Calmar Ratio	1.76	0.24	1.02	2.38
Jensen Beta with FXF	1.00	0.69	0.41	0.54
Jensen Monthly Alpha	0.00%	0.09%	-0.10%	-0.25%
Leland Beta	1.00	0.68	0.42	0.55
Leland Monthly Alpha	0.00%	0.09%	-0.10%	-0.26%
Correlation with Underlying	0.52	0.48	0.48	0.55
Skewness	0.14	0.71	-0.28	-0.80
Excess Kurtosis	1.59	2.24	0.66	1.43
Minimum Monthly Return	-11.12%	-6.74%	-5.65%	-8.43%
Maximum Monthly Return	14.04%	11.57%	4.62%	4.71%
Maximum Drawdown	-17.65%	-11.79%	-8.62%	-11.89%
Maximum Run Up	56.91%	23.37%	22.63%	45.75%
% Down Months	44%	47%	49%	45%
% Up Months	56%	53%	51%	55%

The net premium payment collar (10% OTM call/2% OTM put) outperforms the net premium collection collar and the balanced collar by most measures, on an absolute return and risk adjusted return basis. For example, the net premium payment collar generates a 5.59% return at a standard deviation of 10.85% versus 1.86%/7.00%, 0.62%/8.60%, and 6.09%/14.70% for the balanced collar, the net premium collection collar and the underlying FXF ETF, respectively. Similarly, the Stutzer index for the net premium payment collar is 0.42 versus 0.11, -0.05 and 0.34 for the balanced collar, the net premium collection collar and the underlying FXF ETF, respectively.

Exhibit 7i: Growth of $100 FXF 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 7g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 7j: Protection Cost Index at Roll-In FXF 1-Month "Zero-Cost" Collars

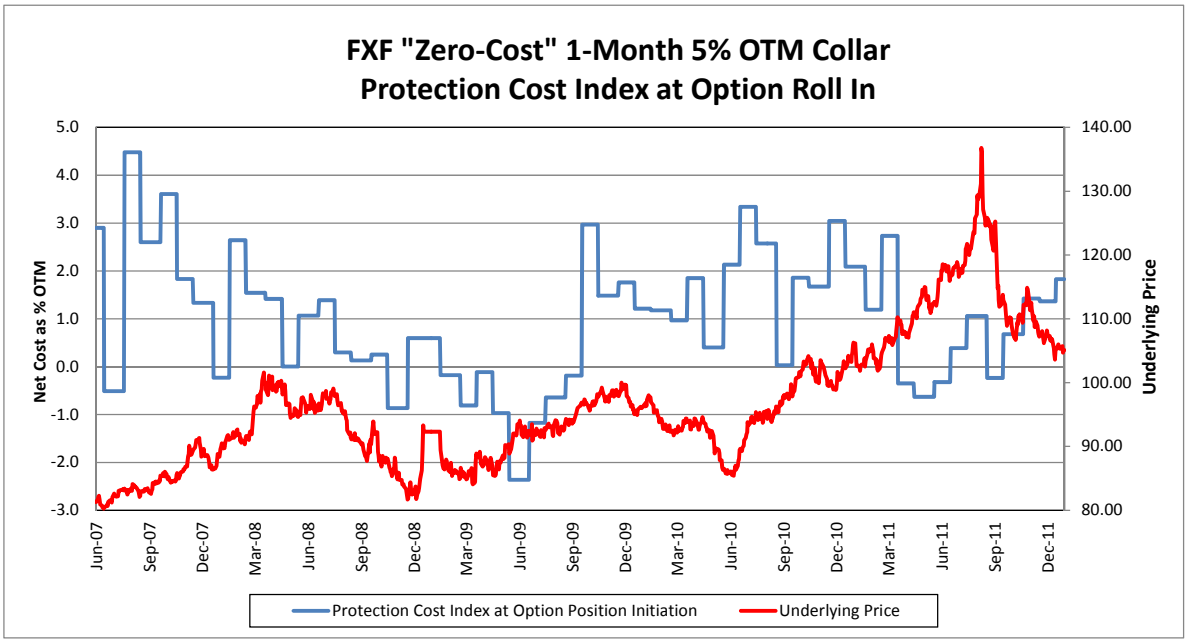


Exhibit 7k: Initial Option Moneyness FXF 1-Month "Zero-Cost" Collars

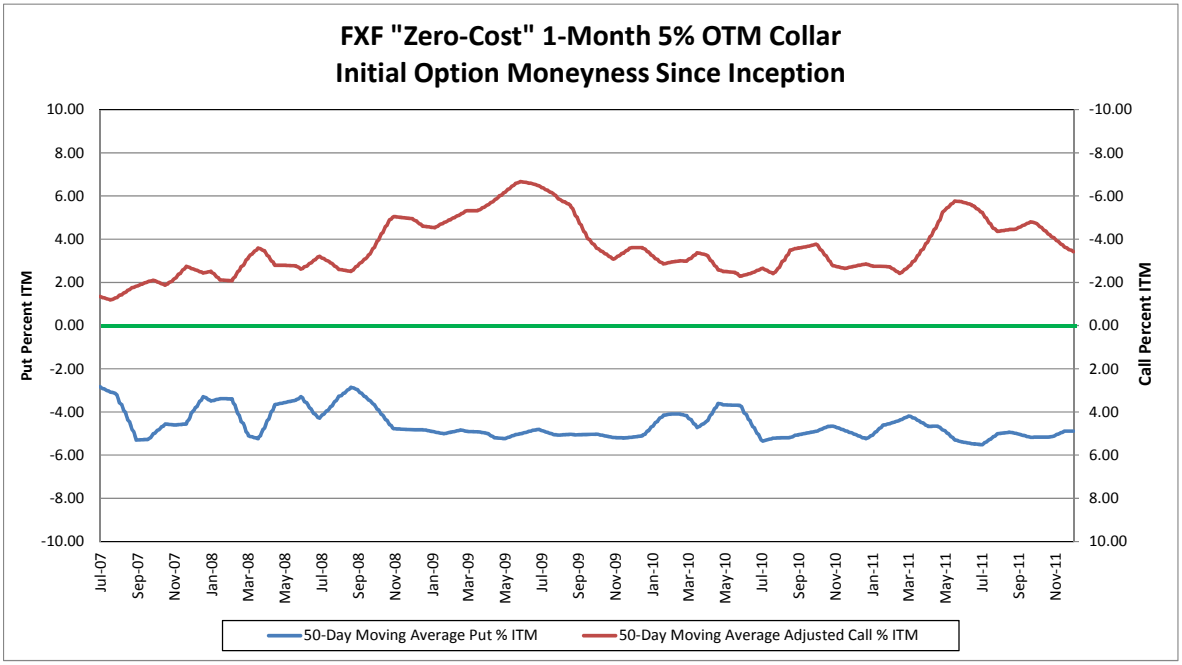


Exhibit 7j and Exhibit 7k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the FXF options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[56].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. It is worth noting that Exhibit 7j indicates missing options by a horizontal line for the underlying price as well as the PCI for the period in which no option position is available. This could occur either because all puts or calls have overly large bid/ask spreads (greater than 1% of the underlying price) or because no call is quoted which has a price as high as the chosen 5% OTM put. The Exhibit indicates a varying skew in option implied volatilities which is sometimes toward the calls and sometimes toward the puts, indicating a lack of a stable relationship between the "richness" of puts and calls (unlike typical equity index-based ETFs, in which puts are quite consistently more "expensive" than calls).While the rolling PCI index tends to average near the zero to 1% level, the PCI varies significantly over time, reaching maximum magnitude of 4 ½% at the start of the period and a minimum of about -2.5% in the middle of the period. While the

[56] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

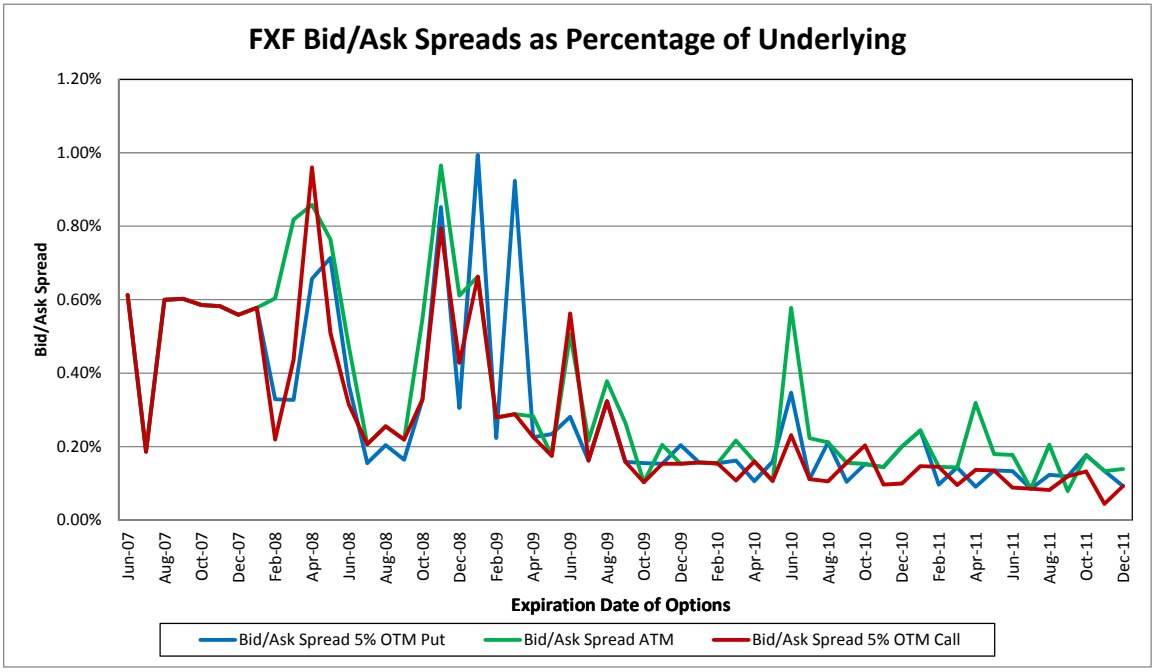
skew seems to spend more time skewed towards the puts, it is far too inconsistent to conclude there is any stable relationship. Exhibit 7k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 7l provides a graphical presentation of bid/ask spreads as a percentage of the underlying FXF price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[57]. In general, bid/ask spreads tend to decrease over time. However, there are a number of significant peaks in the spreads. While they reach peaks approaching 1%, they are usually between 10 and 20 basis points in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the FXF price[58], such wide spreads were not encountered for the FXF ETF.

[57] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[58] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 7l: Bid/Ask Spreads FXF 1-Month Collars



In conclusion, the FXF ETF is somewhat unique in that the options exhibit call skew at times and significant put skew at others. During the financial crisis the performance of the FXF collar strategies was mixed when compared to the FXF ETF, both on an absolute and risk adjusted basis. Most collars underperformed the FXF. Only the 5% OTM collar outperformed the FXF. The FXF ETF experienced significant whipsaws throughout the period of study. While the collars significantly reduced the volatility of the FXF, in general they did little for the returns. Finally, while FXF options used in this study exhibited bid/ask spreads approaching 1% of the underlying price at times, the spreads were generally between 10 and 20 basis points in the later part of the period of study.

Empirical Results for FXY CurrencyShares Japanese Yen Trust ETF, (NYSE Arca)

The FXY ETF provides access to the Japanese Yen. CurrencyShares describes the FXY ETF as follows:

> "CurrencyShares Japanese Yen Trust is designed to track the price of the Japanese Yen net of Trust expenses, which are expected to be paid from interest earned on the deposited Japanese Yen."…" About the Japanese Yen: The Japanese yen is the national currency of Japan and the currency of the accounts of the Bank of Japan, the Japanese central bank. As of April 2010, average daily turnover of the Japanese yen in the foreign exchange market is the third-most-traded currency in the world, accounting for 19% of global foreign exchange transactions. The USD/Japanese yen pair is the second-most-traded currency pair, accounting for 14% of the global foreign exchange transactions."

The inception date for the ETF was February 12, 2007, with option data available from May 18, 2007. As of March 1, 2012, the FXY ETF had net assets of $718.7 Million. The FXY is traded on the NYSE Arca exchange and its CUSIP is 23130A102. Further details of the fund are provided in Exhibit 8a.

Exhibit 8a FXY ETF Characteristics

Symbol	FXY
CUSIP	23130A102
Fund Inception Date	2/12/2007
Product Type	Equitized Single Currency Trust, ETP
Benchmark	WM/Reuters Japanese Yen Closing Spot Rate
Rebalance Schedule	Quarterly
Distribution Schedule	Monthly
Number of Japanese Yen Per Share	10,000
Short Sale/Margin Eligible	Yes

Source: http://www.currencyshares.com/products/overview.rails?symbol=FXY

In this section, we compare the performance of the FXY ETF to the performance of FXY 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[59].

Exhibit 8b: Summary Statistics FXY 1-Month Call/6-Month Put Balanced Collars

FXY Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXY Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	10.14%	2.85%	5.51%	8.77%	8.55%	9.30%
Annualized Standard Deviation	10.37%	3.35%	5.40%	8.13%	9.60%	10.22%
Mean Monthly Return	0.85%	0.24%	0.46%	0.73%	0.72%	0.79%
Median Monthly Return	0.76%	0.34%	0.63%	0.89%	0.91%	0.78%
Period Cumulative Return	55.69%	13.77%	27.85%	47.00%	45.66%	50.34%
Sharpe Ratio	0.88	0.54	0.83	0.95	0.78	0.81
Stutzer Index	0.82	0.53	0.80	0.91	0.75	0.75
Treynor Ratio	0.09	0.10	0.11	0.10	0.08	0.08
Modified Calmar Ratio	5.95	3.96	4.59	6.03	5.29	5.42
Jensen Beta with FXY	1.00	0.18	0.42	0.74	0.90	0.98
Jensen Monthly Alpha	0.00%	0.02%	0.06%	0.08%	-0.05%	-0.05%
Leland Beta	1.00	0.18	0.42	0.73	0.89	0.98
Leland Monthly Alpha	0.00%	0.02%	0.06%	0.09%	-0.04%	-0.05%
Correlation with Underlying	-0.16	-0.14	-0.17	-0.16	-0.20	-0.15
Skewness	-0.70	-0.77	-0.42	-0.32	-0.37	-0.71
Excess Kurtosis	1.11	0.94	0.24	0.13	0.35	0.99
Minimum Monthly Return	-8.01%	-2.66%	-3.60%	-5.50%	-6.74%	-7.85%
Maximum Monthly Return	7.55%	2.10%	3.32%	5.88%	6.76%	6.76%
Maximum Drawdown	-9.36%	-3.48%	-6.07%	-7.79%	-8.63%	-9.29%
Maximum Run Up	58.51%	15.38%	29.88%	50.27%	49.04%	53.64%
% Down Months	38%	35%	40%	40%	40%	38%
% Up Months	62%	65%	60%	60%	60%	62%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[60]. Exhibit 8b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar reduces risk and realized returns relative to a long FXY position. The annualized returns are reduced from 10.14% for the FXY to 8.77% for the 5%

[59] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[60] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

OTM collar. Similarly, the standard deviation is reduced from 10.37% to 8.13%. Despite the reduced absolute returns, the Stutzer index increased from 0.82 to 0.91, suggesting that the collar improved risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -9.36% to -7.79%. The reduction in drawdown was significant enough to increase the modified Calmar ratio[61] for the collar to 6.03 (versus 5.95 for the FXY) for the 55 month period, suggesting that returns were reduced proportionally less than the reduction in the maximum drawdown. Additional insight can be provided by Exhibit 8c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the underperformance of the collar strategies is their limited participation in the run ups that the FXY ETF experienced, particularly in the last 2 years of the period. The performance of the 5% and greater OTM collars is generally quite similar to the FXY ETF throughout the period, particularly after March 2008. Ultimately, while the 5% OTM collar reduces maximum drawdown from -9.36% to -7.79%, it also reduces the maximum run up from 558.51% to 50.27%. Since the FXY did not experience significant sustained drawdowns over the period, it is not surprising that the collar strategies did not provide performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 8b and Exhibit 8c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the FXY, the further OTM strategies significantly outperformed nearer to ATM collars from a raw return perspective, although all the collars had lower returns than the FXY. From a risk adjusted perspective, the 5% OTM, 2% OTM and ATM

[61] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

collars outperformed the deeper OTM collars, although the results are mixed as to whether they outperformed the FXY. For example, the Stutzer index of the 5% OTM collar is 0.91 versus 0.53, 0.80, 0.75, 0.75 and 0.82 for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the FXY, respectively, so only the 5% OTM collar had a higher Stutzer ratio than the FXY. In contrast, the monthly Leland alpha of the 5% OTM collar is 9 basis points versus 2, 6, -4, -5 and 0 basis points for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the FXY, respectively. Thus, the ATM, 2% OTM, and 5% OTM collars all had higher Leland alphas than the FXY. The 10% OTM and 25% OTM collars provide a lower risk adjusted return than the FXY by both measures.

Exhibit 8c: Growth of $100 FXY 1-Month Call/6-Month Put Balanced Collars

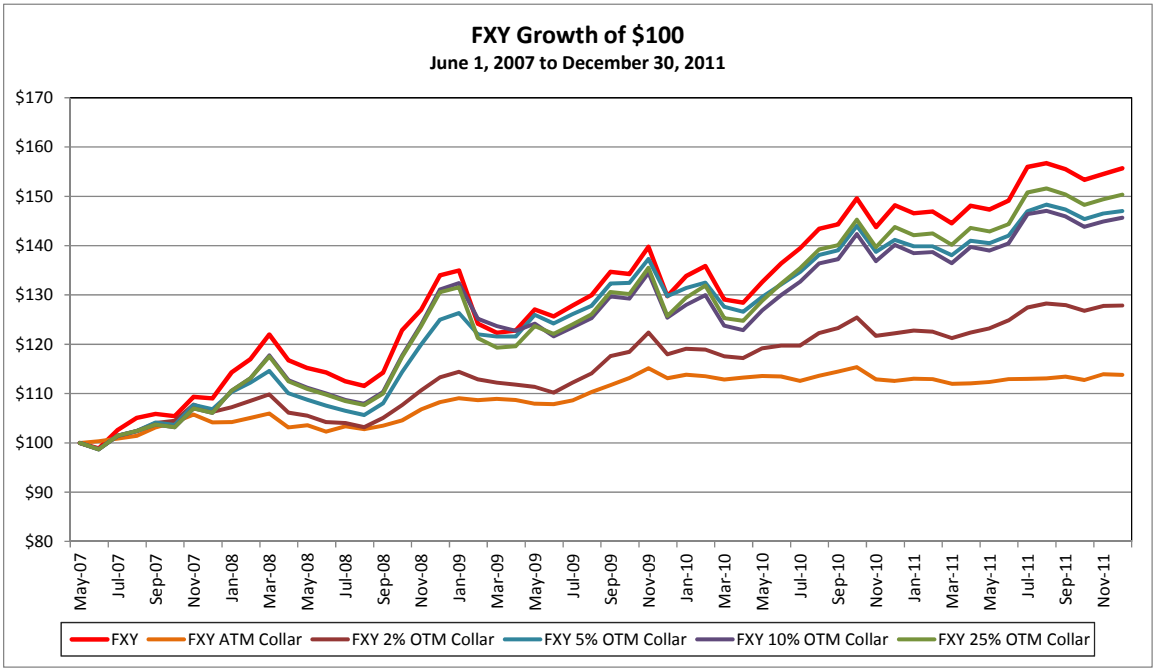


Exhibit 8d and Exhibit 8e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 8d it is clear that the returns of the deep OTM collar

strategies are generally quite similar to those of the FXY, particularly in the second half of the period. The rolling standard deviations provided in Exhibit 8e are evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 1% to 4%.

Exhibit 8d: Rolling Returns FXY 1-Month Call/6-Month Put Collars

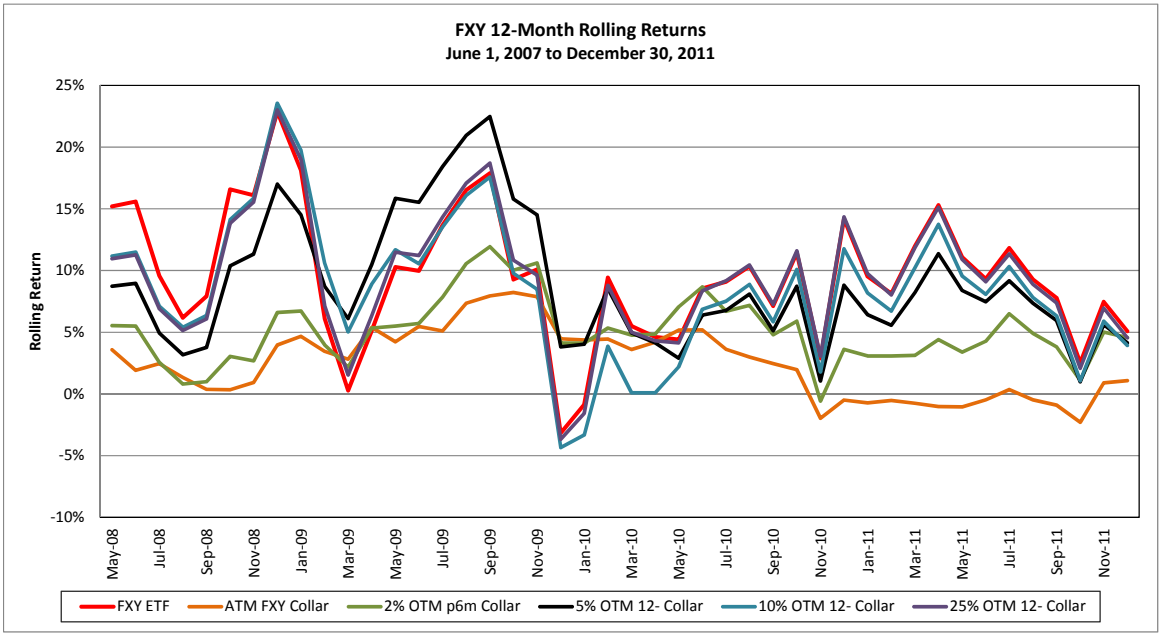
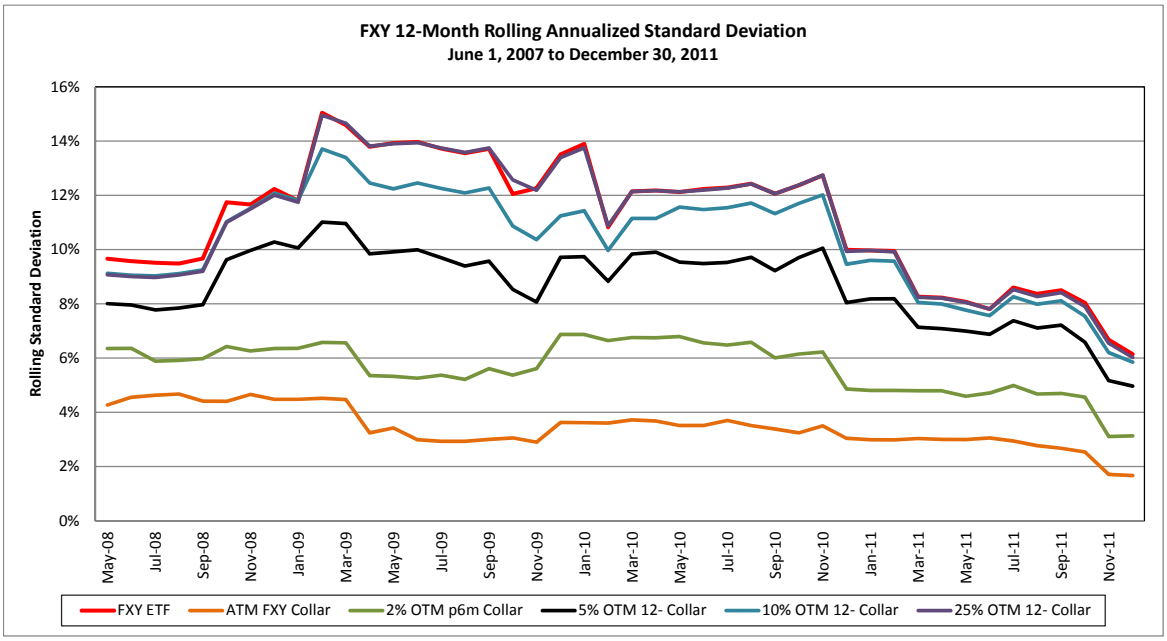
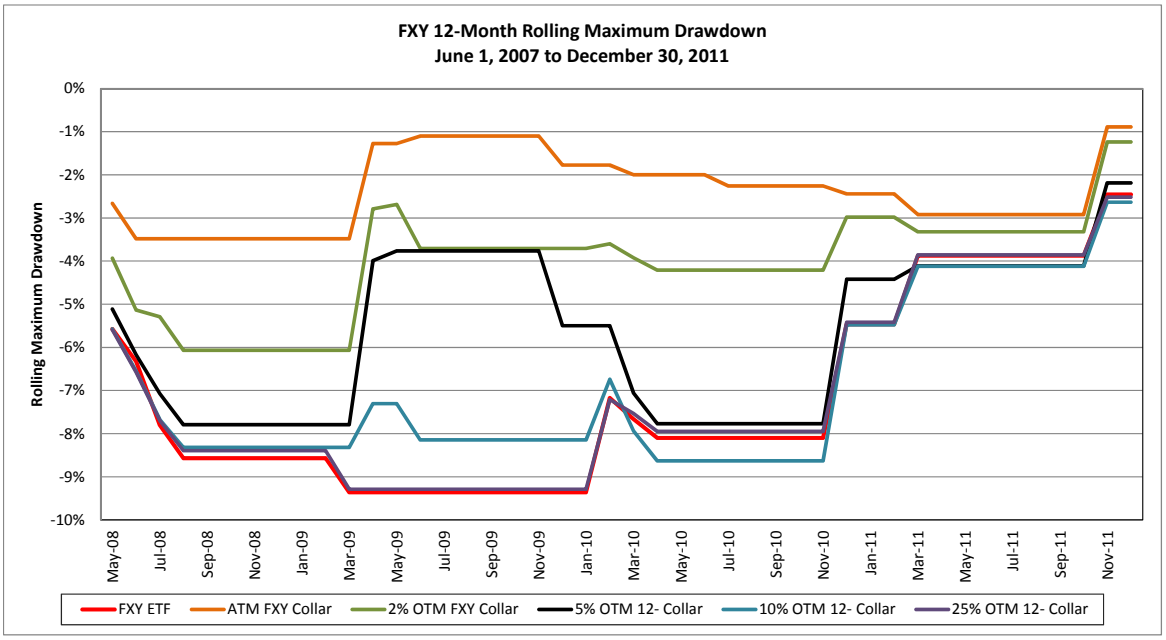


Exhibit 8e: Rolling Standard Deviation FXY 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 8f provides a graphical presentation of 12-month rolling maximum drawdowns for FXY collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the FXY did not experience any large sustained drawdowns during the period of study, the moneyness of the collar had a large impact on the degree of drawdown protection. While the near the money strategies provided significant protection, the deep OTM collars generally had little impact on drawdowns. For example, in mid-2010, the 10% OTM collar actually had a higher rolling drawdown than the FXY.

Exhibit 8f: Rolling Maximum Drawdown FXY 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying FXY ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 8g provides the levels of initial implied volatilities for 1-month ATM options on the FXY since inception as well as the ex post realized volatility over the life of the options[62] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[63]). While the volatility of volatility is quite high, the ATM implied volatility for the FXY options tends to fluctuate around the 10% level. A number of significant peaks in implied and realized volatilities are clearly evident throughout the period, particularly in the third quarter of 2008. The implied volatility

[62] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[63] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

differential between the puts and calls tends to fluctuate around the zero to -5% level (with the calls usually exhibiting higher implied volatilities than the puts) and exhibits some very significant peaks over the period as well as an apparent slight trend towards the puts in the second half of the period.

Exhibit 8g: Implied and Realized Volatility FXY 1-Month Collars Since Option Inception

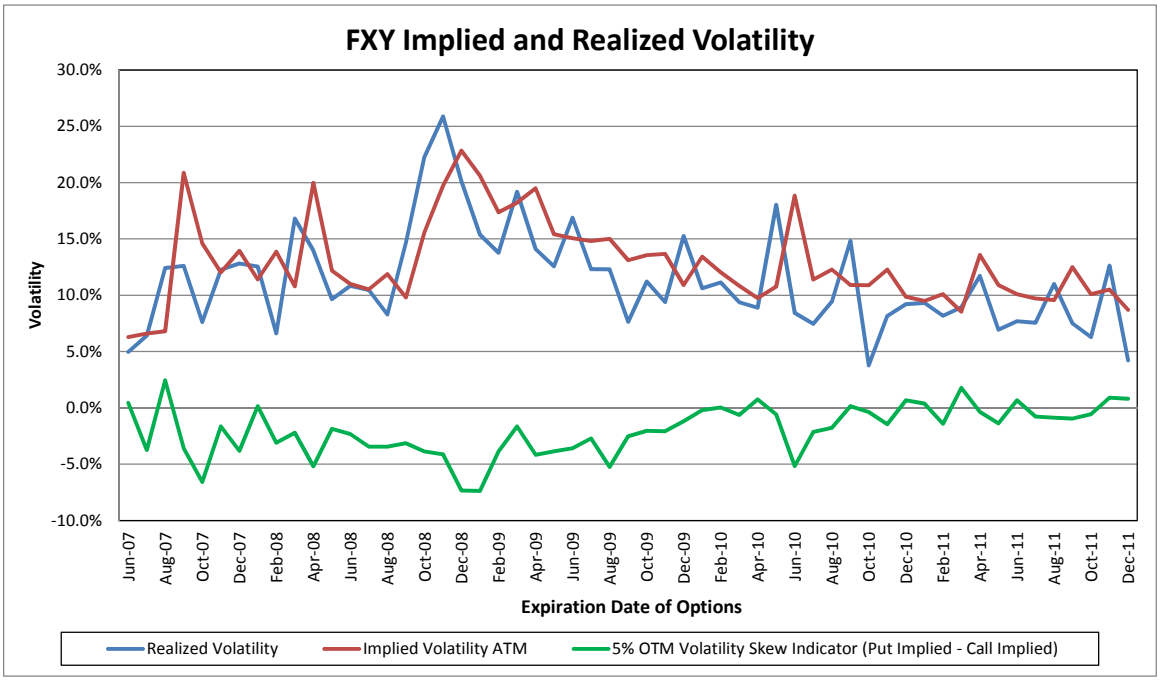


Exhibit 8h and Exhibit 8i provide summary statistics and a graphical presentation of performance, respectively for skewed FXY collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10%

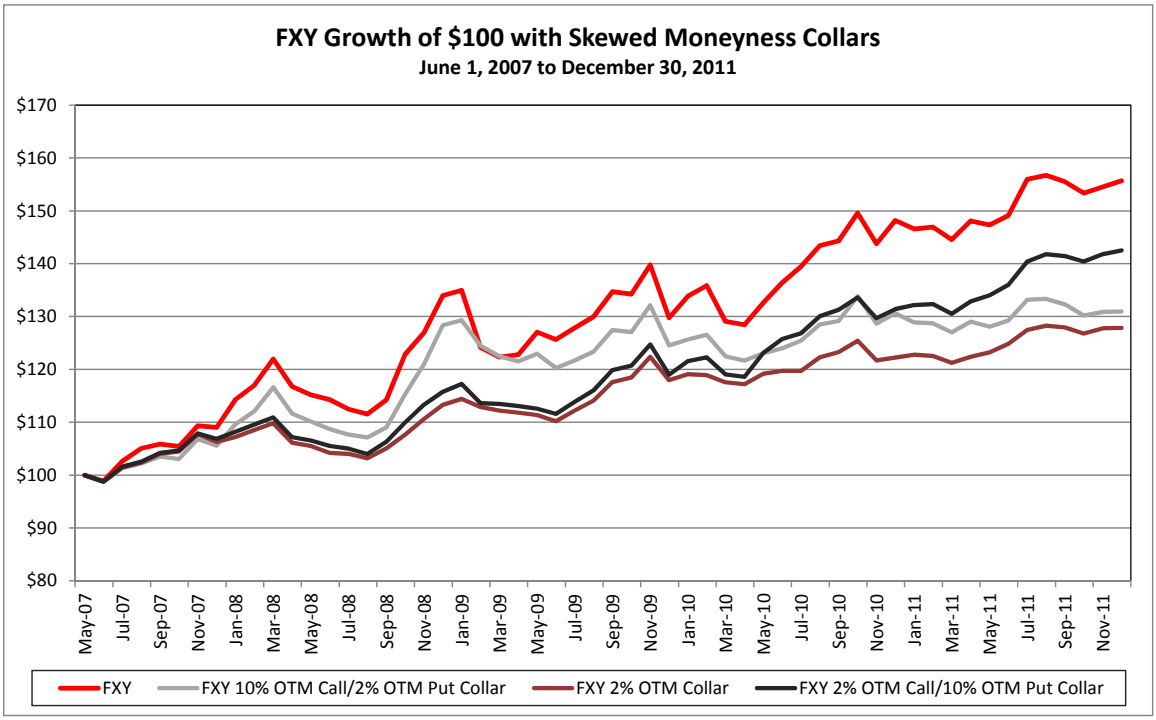
OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 8h: Summary Statistics FXY 1-Month Call/6-Month Put Skewed Collars

FXY Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	FXY Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	10.14%	6.06%	5.51%	8.04%
Annualized Standard Deviation	10.37%	8.53%	5.40%	6.46%
Mean Monthly Return	0.85%	0.52%	0.46%	0.66%
Median Monthly Return	0.76%	0.73%	0.63%	0.91%
Period Cumulative Return	55.69%	42.52%	27.85%	30.96%
Sharpe Ratio	0.88	0.59	0.83	1.08
Stutzer Index	0.82	0.58	0.80	1.02
Treynor Ratio	0.09	0.07	0.11	0.13
Modified Calmar Ratio	5.95	5.21	4.59	4.97
Jensen Beta with FXY	1.00	0.77	0.42	0.55
Jensen Monthly Alpha	0.00%	-0.15%	0.06%	0.16%
Leland Beta	1.00	0.74	0.42	0.56
Leland Monthly Alpha	0.00%	-0.13%	0.06%	0.16%
Correlation with Underlying	-0.16	-0.18	-0.17	-0.21
Skewness	-0.70	-0.01	-0.42	-0.64
Excess Kurtosis	1.11	0.20	0.24	0.29
Minimum Monthly Return	-8.01%	-5.76%	-3.60%	-4.59%
Maximum Monthly Return	7.55%	6.04%	3.32%	3.85%
Maximum Drawdown	-9.36%	-8.16%	-6.07%	-6.23%
Maximum Run Up	58.51%	44.33%	29.88%	35.58%
% Down Months	38%	42%	40%	35%
% Up Months	62%	58%	60%	65%

The net premium collection collar (2% OTM call/10% OTM put) outperforms the net premium payment collar, the balanced collar and the FXY by most measures. For example, the net premium collection collar generates an 8.04% return at a standard deviation of 6.46% versus 6.06%/8.53%, 5.51%/5.40%, and 10.14%/10.37% for the balanced collar, the net premium payment collar and the underlying FXY ETF, respectively. Similarly, the Stutzer index for the net premium collection collar is 1.02 versus 0.58, 0.80 and 0.82 for the balanced collar, the net premium payment collar and the underlying FXY ETF, respectively.

Exhibit 8i: Growth of $100 FXY 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 8g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level –

in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 8j: Protection Cost Index at Roll-In FXY 1-Month "Zero-Cost" Collars

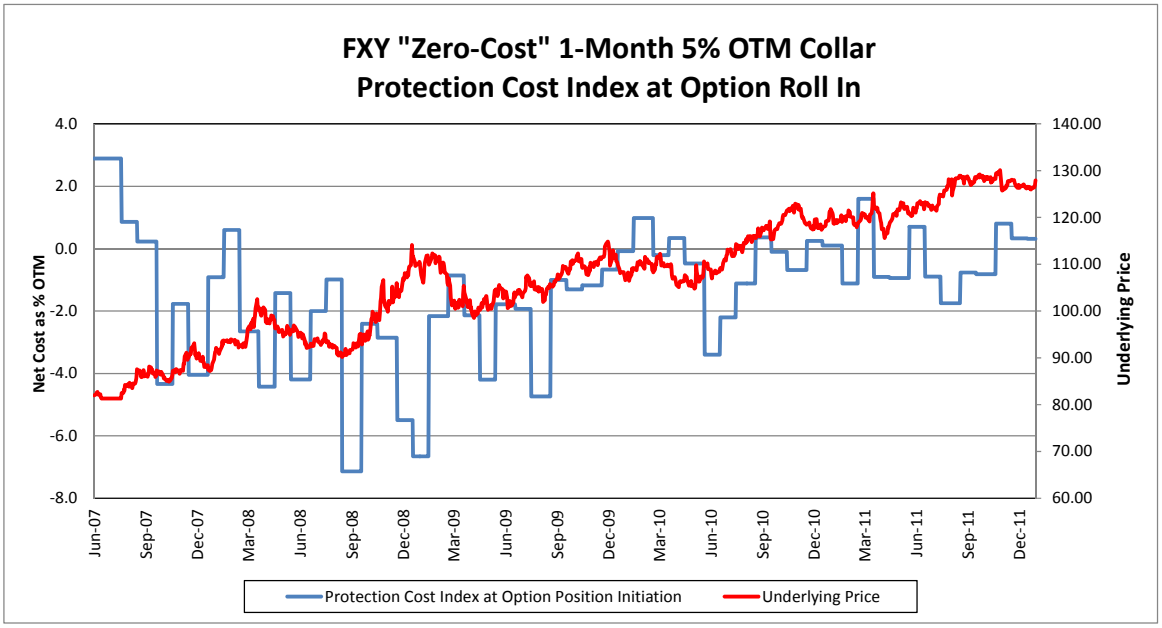


Exhibit 8k: Initial Option Moneyness FXY 1-Month "Zero-Cost" Collars

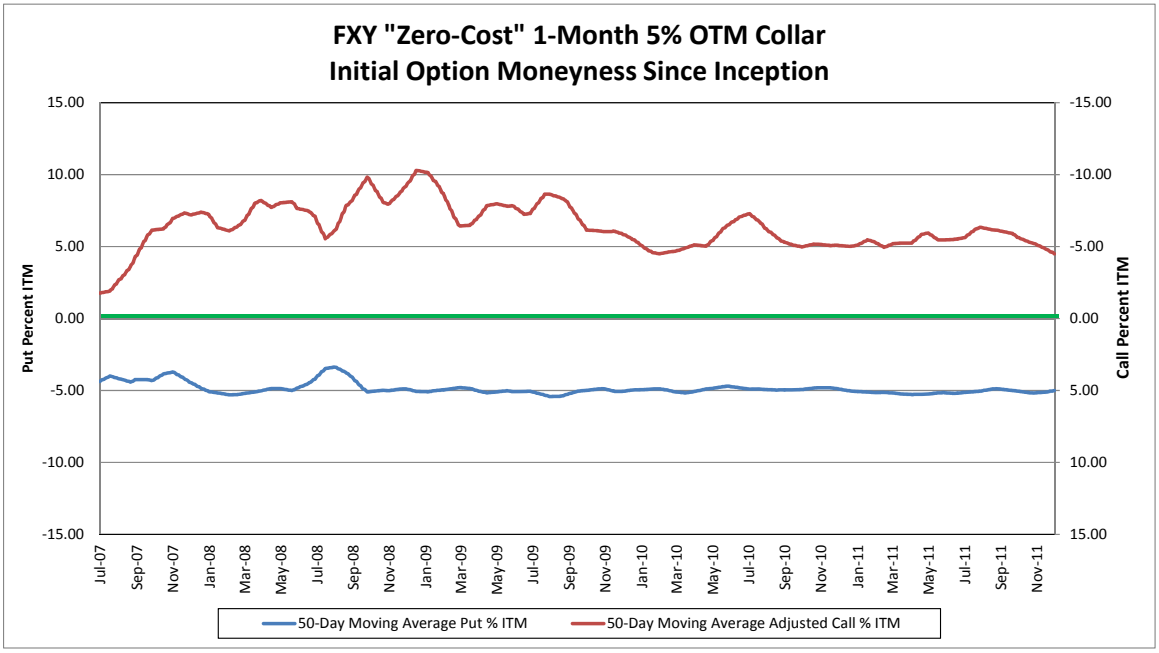


Exhibit 8j and Exhibit 8k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the FXY options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[64].

[64] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. It is worth noting that Exhibit 8j indicates missing options by a horizontal line for the underlying price as well as the PCI for the period in which no option position is available. This could occur either because all puts or calls have overly large bid/ask spreads (greater than 1% of the underlying price) or because no call is quoted which has a price as high as the chosen 5% OTM put. The Exhibit indicates a significant skew in option implied volatilities toward the calls, indicating that calls tend to be more "expensive" than puts (unlike typical equity index-based ETFs).While the rolling PCI index tends to average near the -2% level, the PCI varies significantly over time, beginning the period at about 3% towards the puts and reaching maximum magnitude in late-2008 of about -7% towards the calls, followed by a general trend towards zero. Exhibit 8k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

---

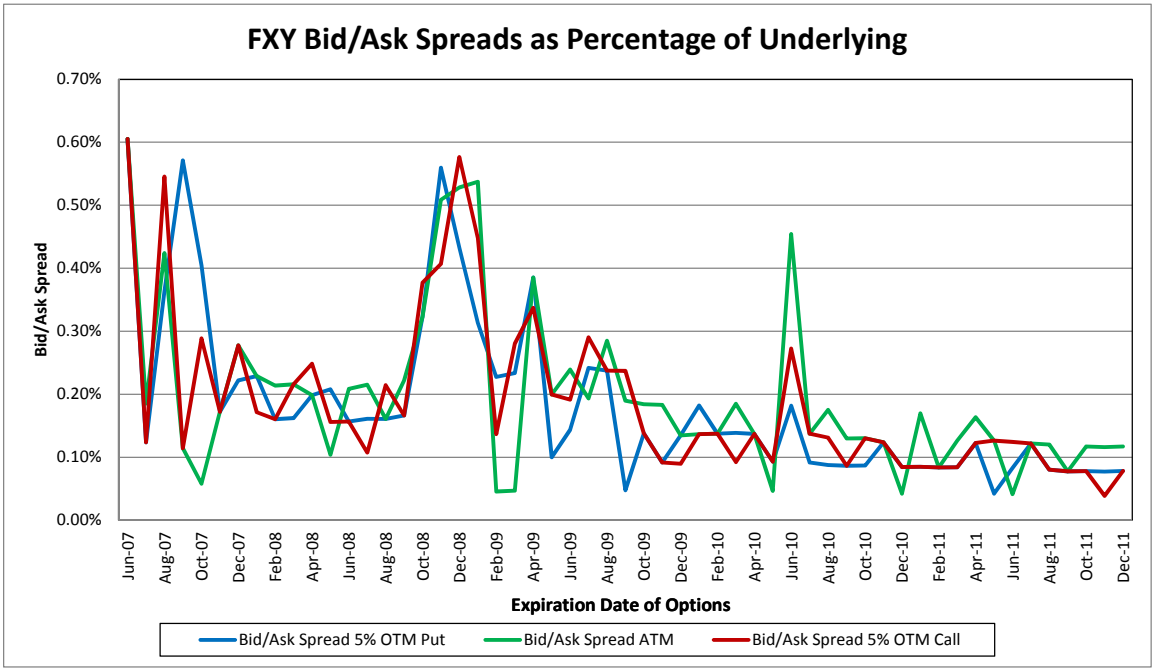
change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 8l provides a graphical presentation of bid/ask spreads as a percentage of the underlying FXY price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[65]. In general, bid/ask spreads tend to decrease over time. However, there are a number of peaks in the spreads particularly in late-2007 and late-2008. While the spreads reach peaks around 60 basis points, they tend to fluctuate around the 10 basis point level near the end of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the FXY price[66], such wide spreads were not encountered for the FXY ETF.

[65] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[66] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 8l: Bid/Ask Spreads FXY 1-Month Collars



In conclusion, the FXY ETF is somewhat unique in that the options generally exhibit significant call skew. During the financial crisis the performance of the collar strategies relative to the FXY was mixed. All of the collars underperformed the FXY ETF from an absolute return perspective, while some collar strategies outperformed the FXY from a risk adjusted perspective. Some collars underperformed the FXY while others outperformed the FXY. The FXY ETF experienced a relatively steady, although volatile, upward trend throughout the period of study. While the collars significantly reduced the volatility of the FXY, they did little for the returns. Finally, while FXY options used in this study exhibited bid/ask spreads approaching 0.6% of the underlying price at times, the spreads were generally near 10 basis points in the later part of the period of study.

Empirical Results for GLD SPDR Gold Trust ETF, (NYSE Arca)

The GLD ETF provides access to the returns of Gold bullion. SSGA describes the GLD ETF as follows:

> "The objective of the SPDR® Gold Trust is for the Shares to reflect the performance of the price of gold bullion, less the Trust's expenses."…"The spot price for gold bullion is determined by market forces in the 24-hour global over-the-counter (OTC) market for gold. The OTC market accounts for most global gold trading, and prices quoted reflect the information available to the market at any given time. The price, holdings, and net asset value of Gold Shares, as well as market data for the overall gold bullion market, can be tracked daily at spdrgoldshares.com."

The inception date for the ETF was November 18, 2004, with option data available from June 20, 2008. As of February 29, 2012, the GLD ETF had net assets of $73.6 Billion. The GLD is traded on the NYSE Arca exchange and its CUSIP is 78463V107. Further details of the fund are provided in Exhibit 9a.

Exhibit 9a GLD ETF Characteristics

CUSIP	78463V107
Inception Date:	11/12/2004
Ticker:	GLD
Gross Expense Ratio:	0.40%
Value of Gold in Trust	71.3 billion
Ounces of Gold in Trust	41.6 million
Tonnes of Gold in Trust	1,294
Expense Ratio	0.40%
Locations of Vaults	London, England
EXCHANGE	NYSE Arca

Source: http://www.spdrgoldshares.com

In this section, we compare the performance of the GLD ETF to the performance of GLD 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[67].

Exhibit 9b: Summary Statistics GLD 1-Month Call/6-Month Put Balanced Collars

GLD Collar Summary Statistics July 1, 2008 to Dec. 30, 2011	GLD Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	15.64%	-1.04%	4.34%	8.80%	11.67%	13.11%
Annualized Standard Deviation	22.82%	7.05%	9.65%	13.65%	17.70%	20.16%
Mean Monthly Return	1.43%	-0.07%	0.39%	0.78%	1.05%	1.20%
Median Monthly Return	2.37%	0.48%	1.38%	1.48%	1.86%	2.05%
Period Cumulative Return	66.29%	-3.59%	16.03%	34.35%	47.14%	53.91%
Sharpe Ratio	0.62	-0.37	0.29	0.53	0.57	0.57
Stutzer Index	0.61	-0.19	0.40	0.59	0.61	0.59
Treynor Ratio	0.14	-0.14	0.08	0.14	0.14	0.14
Modified Calmar Ratio	3.02	-0.30	1.47	3.04	3.49	3.43
Jensen Beta with GLD	1.00	0.18	0.34	0.53	0.73	0.85
Jensen Monthly Alpha	0.00%	-0.33%	-0.07%	0.05%	0.03%	-0.01%
Leland Beta	1.00	0.19	0.34	0.53	0.72	0.84
Leland Monthly Alpha	0.00%	-0.33%	-0.08%	0.05%	0.05%	0.00%
Correlation with Underlying	0.04	0.06	0.10	0.08	0.05	0.04
Skewness	-0.54	-1.33	-1.00	-0.52	-0.25	-0.37
Excess Kurtosis	0.22	1.94	0.93	0.01	-0.04	-0.11
Minimum Monthly Return	-16.14%	-6.78%	-8.06%	-9.52%	-10.48%	-10.85%
Maximum Monthly Return	12.79%	3.12%	4.89%	7.80%	12.74%	12.74%
Maximum Drawdown	-21.95%	-12.02%	-10.92%	-11.30%	-13.50%	-15.71%
Maximum Run Up	149.12%	18.43%	40.50%	63.34%	87.87%	113.97%
% Down Months	36%	38%	36%	36%	38%	33%
% Up Months	64%	62%	64%	64%	62%	67%
Number of Months	42	42	42	42	42	42
Months in Cash		0	0	0	0	0
Months in Collar		42	42	42	42	42

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[68]. Exhibit 9b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 42 months of the study[69], the 5% OTM collar significantly reduces risk and realized returns relative to a long GLD position. The annualized returns are reduced by almost 1/2 from 15.64% for the GLD

[67] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[68] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.
[69] A shorter time series is used for the GLD ETF than for other ETFs in the study due to a later inception date of the GLD.

to 8.80% for the 5% OTM collar. Similarly, the standard deviation is reduced by almost 1/2 from 22.82% to 13.65%. The Stutzer index decreased slightly from 0.61 to 0.59, suggesting that the collar slightly reduced risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -21.95% to -11.30%. Despite the reduction in return, the modified Calmar ratio[70] for the 5% OTM collar is slightly higher than that of the GLD at 3.04 (versus 3.02 for the GLD) for the 42 month period, suggesting that returns were reduced proportionally less than the reduction in the maximum drawdown. Additional insight can be provided by Exhibit 9c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the underperformance of the collar strategies is their limited participation in the run up that the GLD ETF experienced from early-2009 to late-2011. During the run up, the collars essentially acted as delivered GLD positions, with the closer to ATM performing the worst and the deep OTM collars acting very much like the GLD. Ultimately, while the 5% OTM collar reduces maximum drawdown from -21.95% to -11.30%, it also reduces the maximum run up from 149.12% to 63.34%. Since the GLD did not experience any significant drawdowns over the period, it is not surprising that the collar strategies did not provide performance improvements. In fact, one could argue that ex post over this period, the GLD ETF provided a nearly text book worst case scenario for a collar strategy.

In addition to providing results for 5% OTM collars, Exhibit 9b and Exhibit 9c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the GLD, the further OTM strategies outperformed

[70] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

nearer to ATM collars from a raw return perspective, although all collars had lower returns than the GLD. From a risk adjusted perspective, the results are mixed. The Stutzer index suggested only the 10% OTM collar matches the performance of the GLD, while the Leland alpha suggests that the 5% OTM and 10% OTM collars outperform the GLD, while the 25% OTM matches the GLD performance. For example, the Stutzer index of the 10% OTM collar is 0.61 versus -0.19, 0.40, 0.59, 0.59 and 0.61 for the ATM, 2% OTM, 5% OTM and 25% OTM collars and the GLD, respectively. In contrast, the monthly Leland alpha of the 10% OTM collar is 5 basis points versus 0, -33, -8, 5 and 0 basis points for the ATM, 2% OTM, 5% OTM and 25% OTM collars and the GLD, respectively. Thus, only the 5% OTM and 10% OTM collars have higher Leland alphas than the GLD and none of the collars outperform the GLD based on the Stutzer index.

Exhibit 9c: Growth of $100 GLD 1-Month Call/6-Month Put Balanced Collars

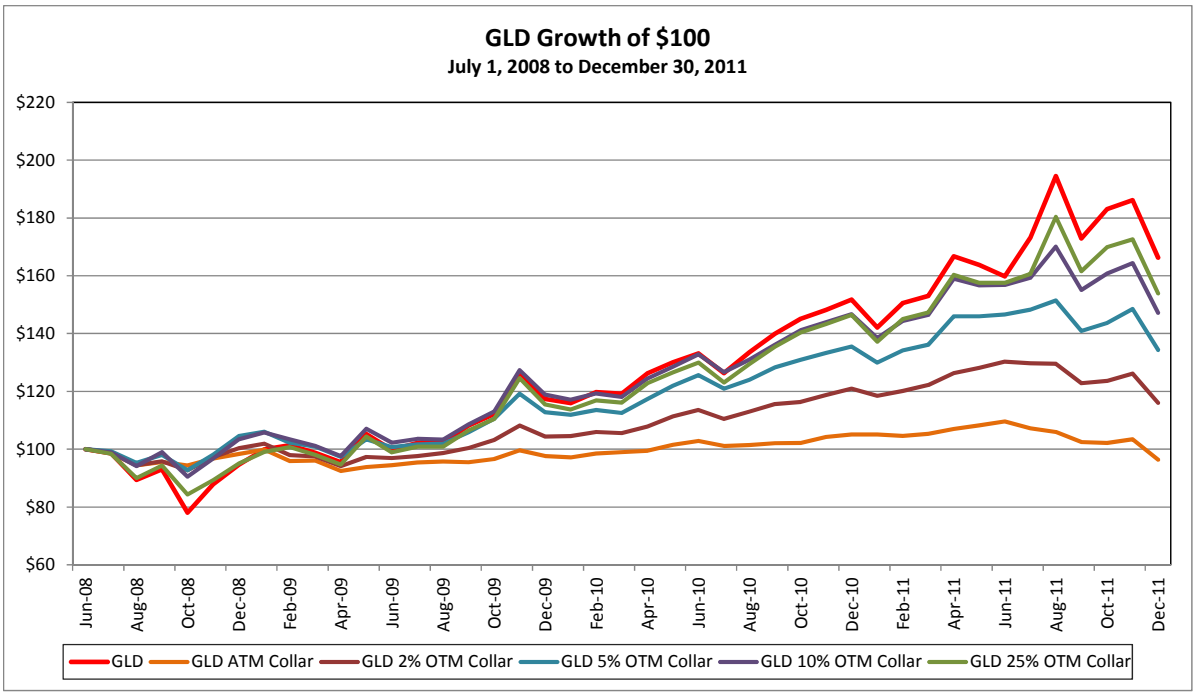


Exhibit 9d and Exhibit 9e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 9d it is clear that the rolling collar returns are regularly below the GLD returns throughout the period with the closer to ATM consistently experiencing the lowest returns. The rolling standard deviations provided in Exhibit 9e are evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 4% to 12%.

Exhibit 9d: Rolling Returns GLD 1-Month Call/6-Month Put Collars

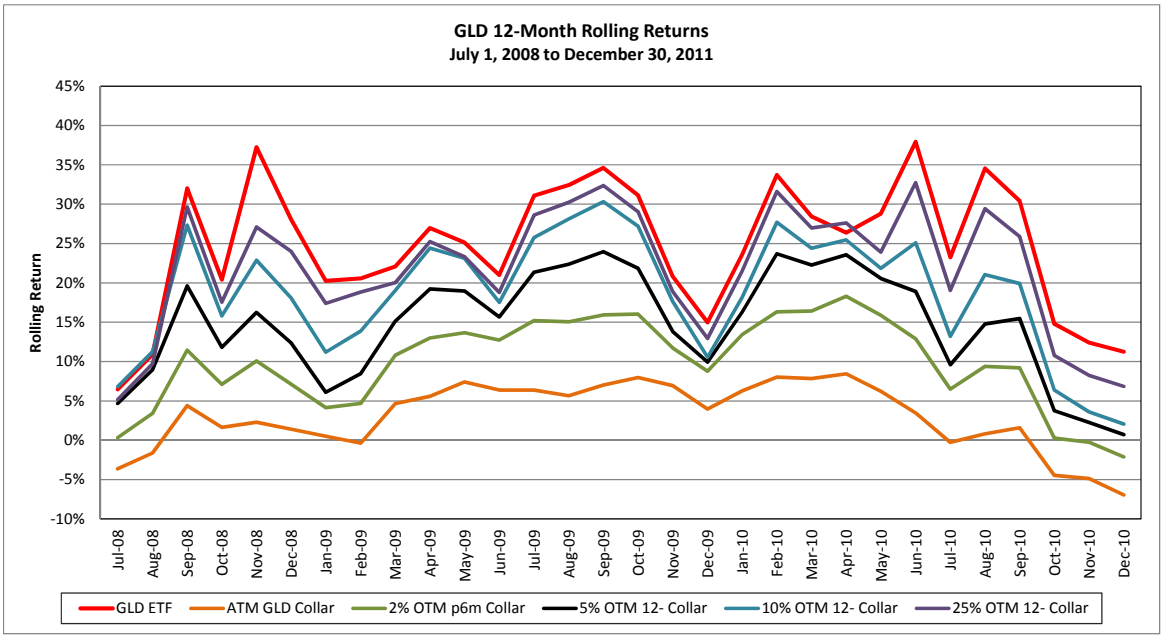
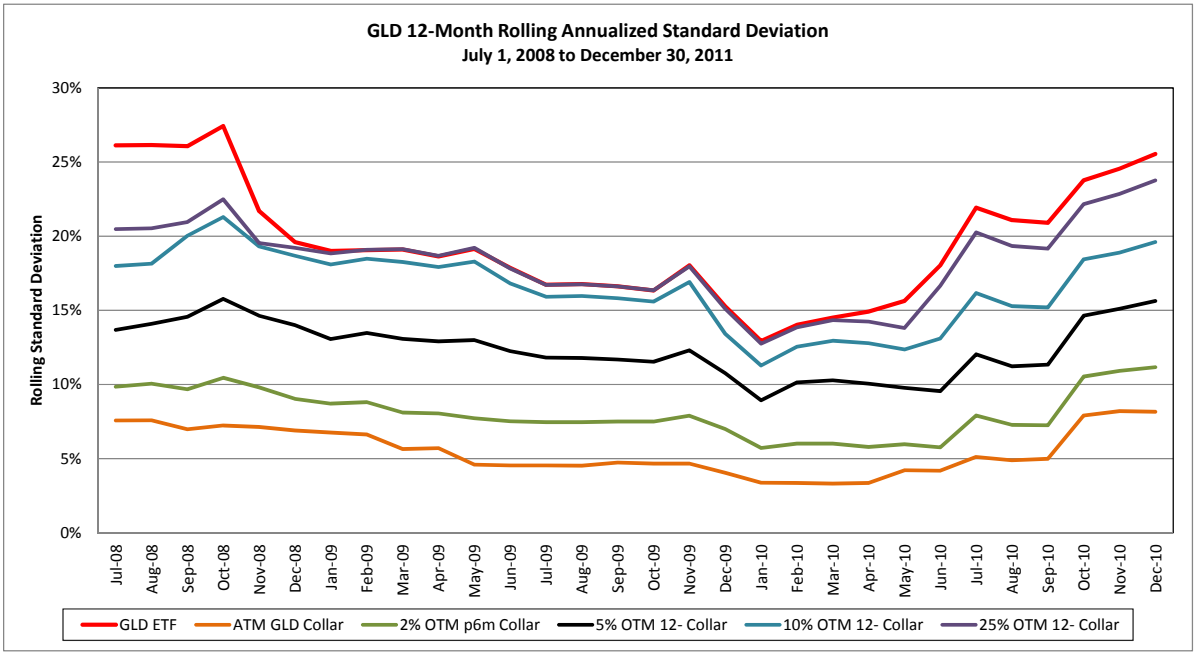
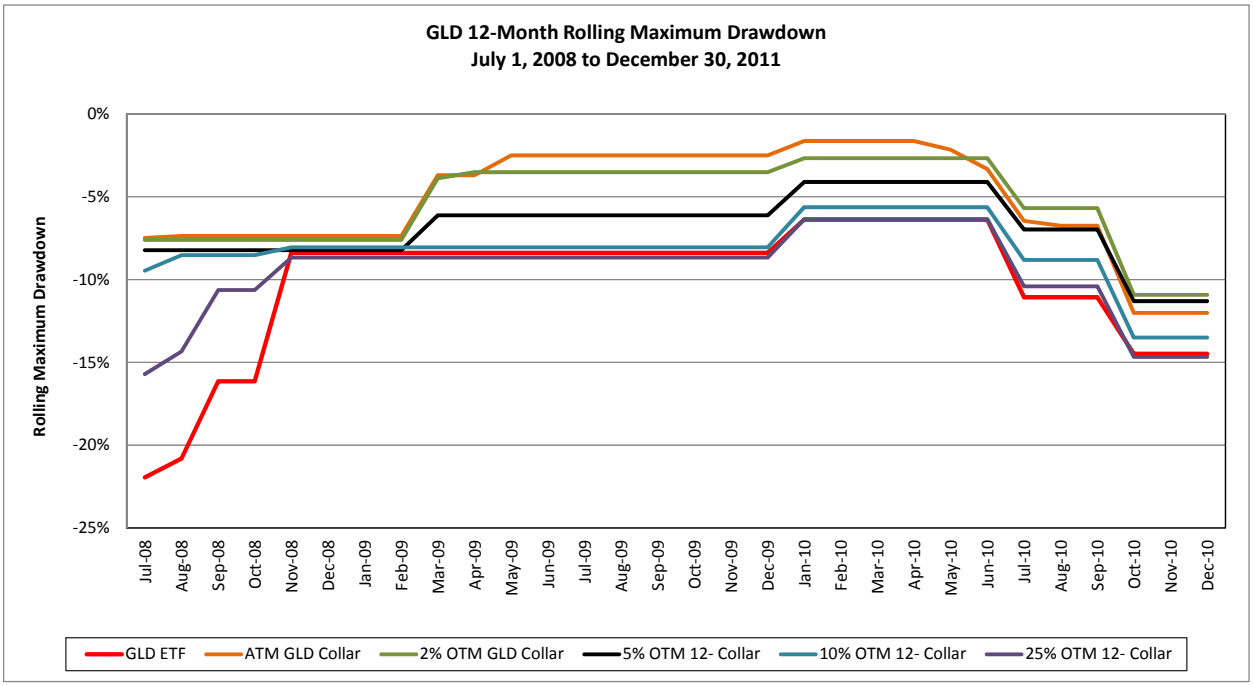


Exhibit 9e: Rolling Standard Deviation GLD 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 9f provides a graphical presentation of 12-month rolling maximum drawdowns for GLD collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the GLD did not experience any large drawdowns during the period of study, the drawdown improvements of the collars were generally moderate, particularly for the deep OTM collars. While the near the money strategies provided significant protection at the start of the period, the deeper OTM collars had little impact on drawdowns throughout the period.

Exhibit 9f: Rolling Maximum Drawdown GLD 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying GLD ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 9g provides the levels of initial implied volatilities for 1-month ATM options on the GLD since inception as well as the ex post realized volatility over the life of the options[71] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[72]). While the volatility of volatility is quite high, particularly at the start of the period, the ATM implied volatility for the GLD options tends to fluctuate around the 20% level. A number of significant peaks in implied

[71] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[72] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around zero (with the neither the calls or puts exhibiting consistently higher implied volatilities) and exhibits some little volatility over the period with no apparent trend.

Exhibit 9g: Implied and Realized Volatility GLD 1-Month Collars Since Option Inception

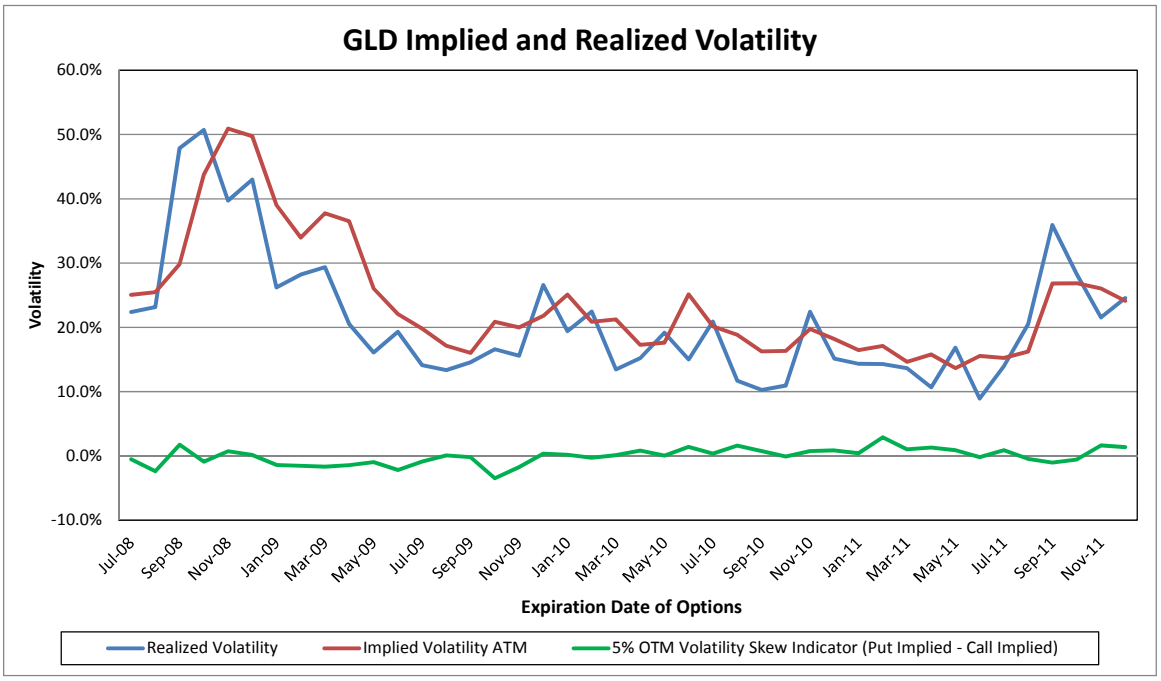


Exhibit 9h and Exhibit 9i provide summary statistics and a graphical presentation of performance, respectively for skewed GLD collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2%

OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

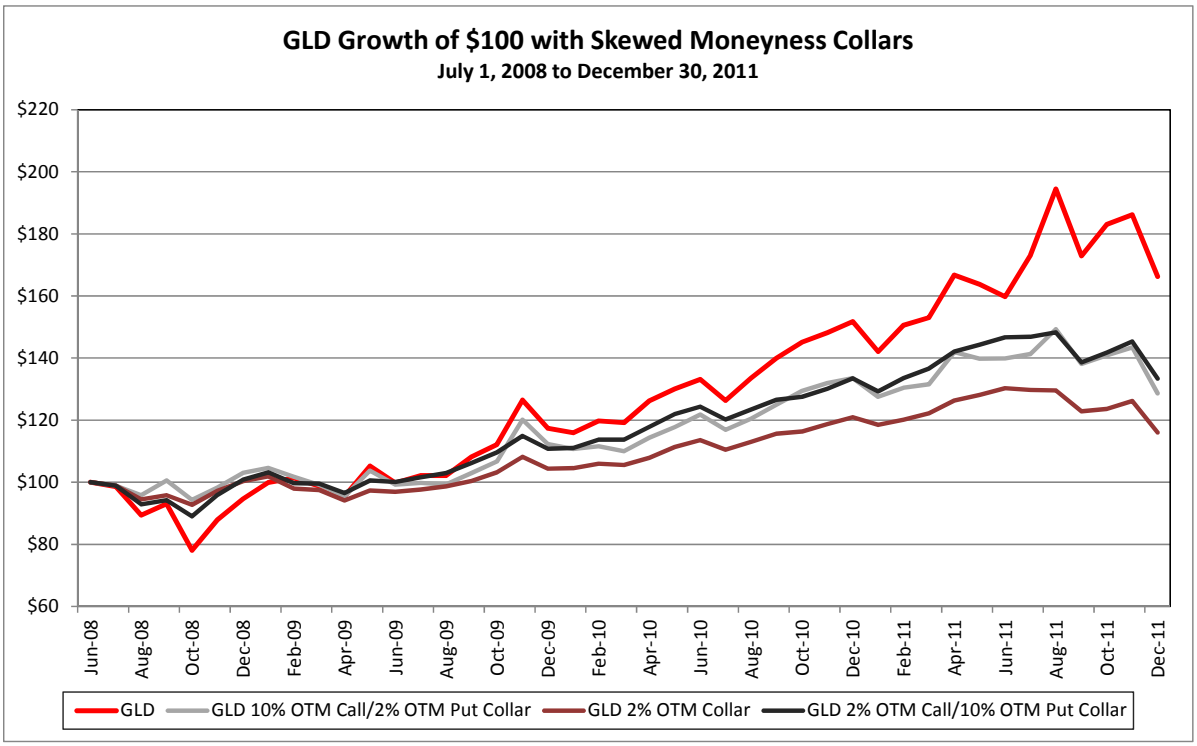
Exhibit 9h: Summary Statistics GLD 1-Month Call/6-Month Put Skewed Collars

GLD Collar Summary Statistics July 1, 2008 to Dec. 30, 2011	GLD Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	15.64%	7.47%	4.34%	8.58%
Annualized Standard Deviation	22.82%	15.69%	9.65%	11.88%
Mean Monthly Return	1.43%	0.70%	0.39%	0.75%
Median Monthly Return	2.37%	1.12%	1.38%	1.60%
Period Cumulative Return	66.29%	33.38%	16.03%	28.66%
Sharpe Ratio	0.62	0.38	0.29	0.59
Stutzer Index	0.61	0.45	0.40	0.65
Treynor Ratio	0.14	0.10	0.08	0.16
Modified Calmar Ratio	3.02	2.42	1.47	2.60
Jensen Beta with GLD	1.00	0.61	0.34	0.45
Jensen Monthly Alpha	0.00%	-0.15%	-0.07%	0.12%
Leland Beta	1.00	0.60	0.34	0.46
Leland Monthly Alpha	0.00%	-0.13%	-0.08%	0.12%
Correlation with Underlying	0.04	0.05	0.10	0.09
Skewness	-0.54	-0.03	-1.00	-0.83
Excess Kurtosis	0.22	0.54	0.93	0.49
Minimum Monthly Return	-16.14%	-10.29%	-8.06%	-8.23%
Maximum Monthly Return	12.79%	12.68%	4.89%	7.82%
Maximum Drawdown	-21.95%	-13.81%	-10.92%	-11.02%
Maximum Run Up	149.12%	66.69%	40.50%	58.23%
% Down Months	36%	38%	36%	29%
% Up Months	64%	62%	64%	71%

The net premium collection collar (2% OTM call/10% OTM put) outperforms the net premium payment collar and the balanced collar by most measures. For example, the net premium collection collar generates an 8.58% return at a standard deviation of 11.88% versus 7.47%/15.69%, 4.34%/9.65%, and 15.64%/22.82% for the balanced collar, the net premium payment collar and the underlying GLD ETF, respectively. Similarly, the Stutzer index for the net premium collection collar is 0.65 versus 0.45, 0.40 and 0.61 for the balanced collar, the net premium payment collar and the underlying GLD ETF, respectively. Thus, from a risk adjusted

perspective, only the premium collection collar outperforms the GLD (although it underperforms from an absolute return perspective). A similar pattern is seen with the Leland alphas.

Exhibit 9i: Growth of $100 GLD 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 9g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5%

OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 9j: Protection Cost Index at Roll-In GLD 1-Month "Zero-Cost" Collars

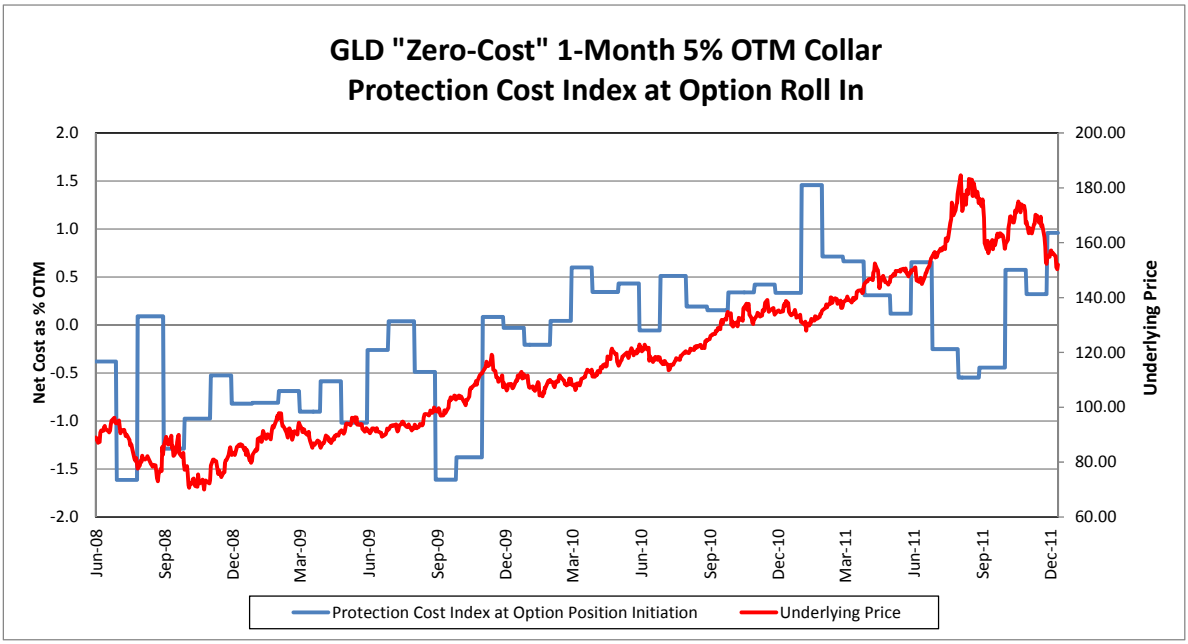


Exhibit 9k: Initial Option Moneyness GLD 1-Month "Zero-Cost" Collars

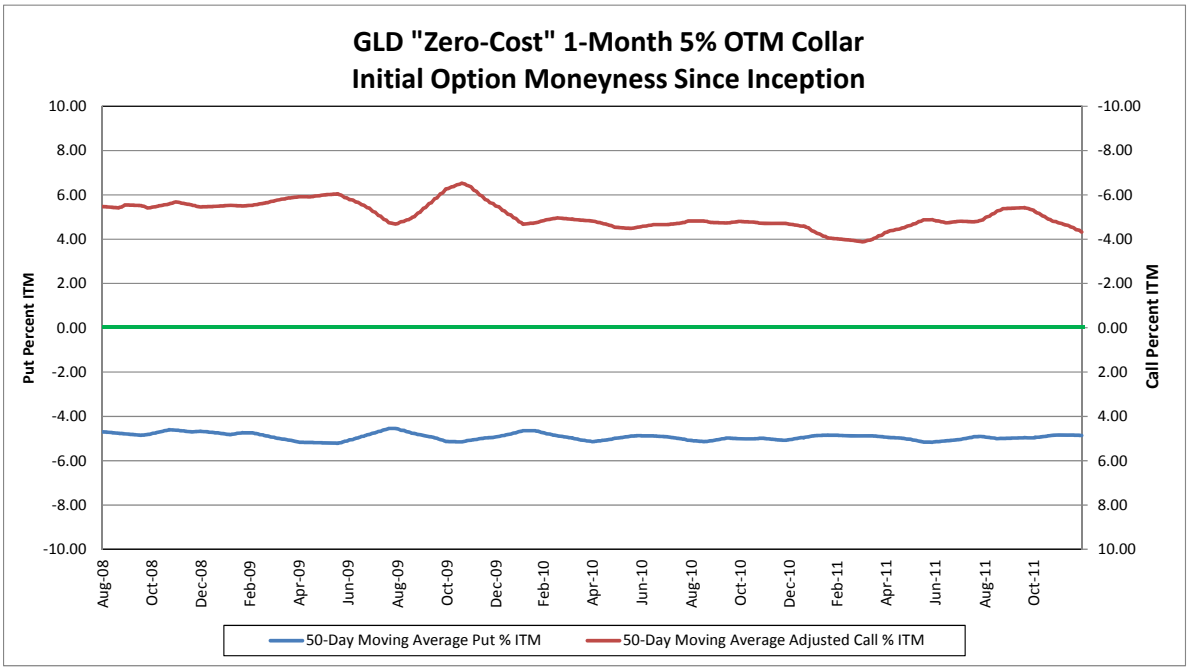


Exhibit 9j and Exhibit 9k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the GLD options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[73].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. The Exhibit indicates a no consistent skew in option implied volatilities, but rather a trend in skew - initially toward the calls (indicating that calls tend to be more "expensive" than puts) and trending to a put skew (although the trend reverses back to a call skew briefly near the end of the period). The trend in skew appears to follow the movement in the underlying GLD suggesting puts have become more "expensive" as GLD price has risen. While the rolling PCI index tends to average near zero, the PCI varies significantly over time, reaching a low of about -1.6% near the start of the period and a maximum of about 1.5% near the end of the period. Exhibit 9k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

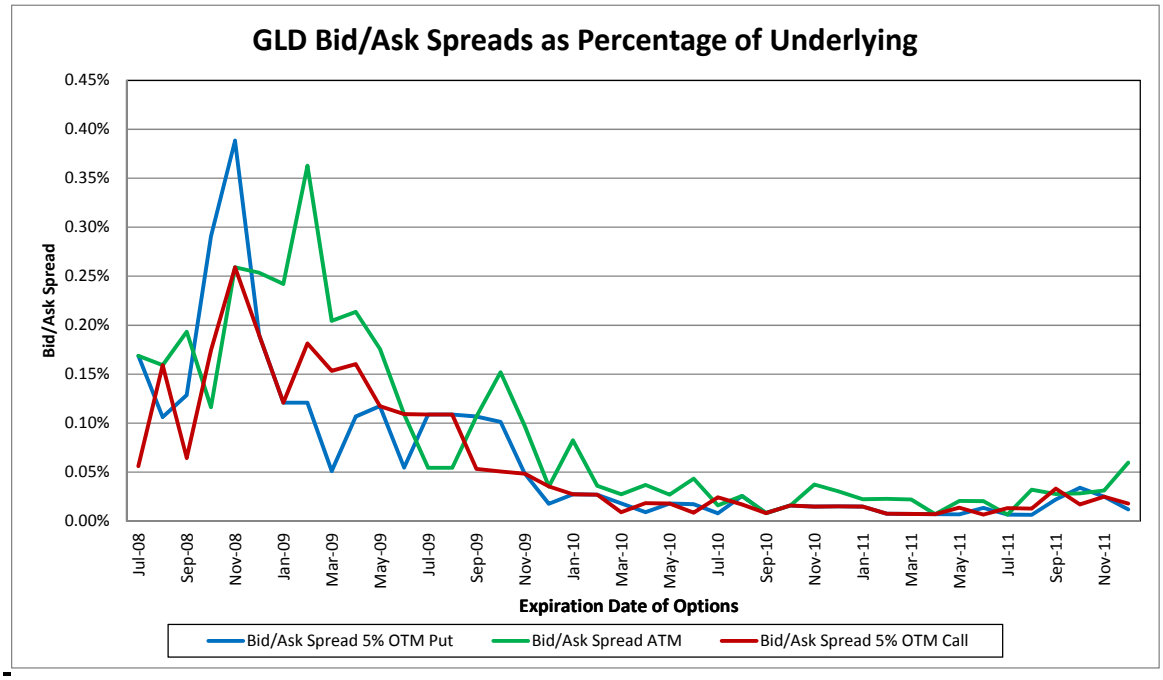
[73] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 9l provides a graphical presentation of bid/ask spreads as a percentage of the underlying GLD price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[74]. In general, bid/ask spreads tend to decrease over time. However, there are a number of peaks in the spreads. While they peak near 40 basis points in late-2008, the spreads are generally well below 5 basis points in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the GLD underlying price[75], such wide spreads were not encountered for the GLD ETF in the 42 months covered by the study.

[74] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[75] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 9l: Bid/Ask Spreads GLD 1-Month Collars



In conclusion, the GLD ETF is somewhat unique in that the options exhibit call skew at times and put skew at others with a trend from a call skew to a put skew throughout the period. During the financial crisis, the performance of the GLD collar strategies was inferior to the GLD on an absolute return basis and was mixed when compared to the GLD ETF on a risk adjusted basis. Some collars underperformed the GLD while others outperformed the GLD. The GLD ETF experienced a strong sustained upward trend throughout the period of study. Such an environment generally does not benefit a collar strategy. While the collars significantly reduced the volatility of the GLD, they also reduced the returns. Finally, while GLD options used in this study exhibited bid/ask spreads approaching 0.4% of the underlying price at times, the spreads were generally well under 5 basis points in the later part of the period of study.

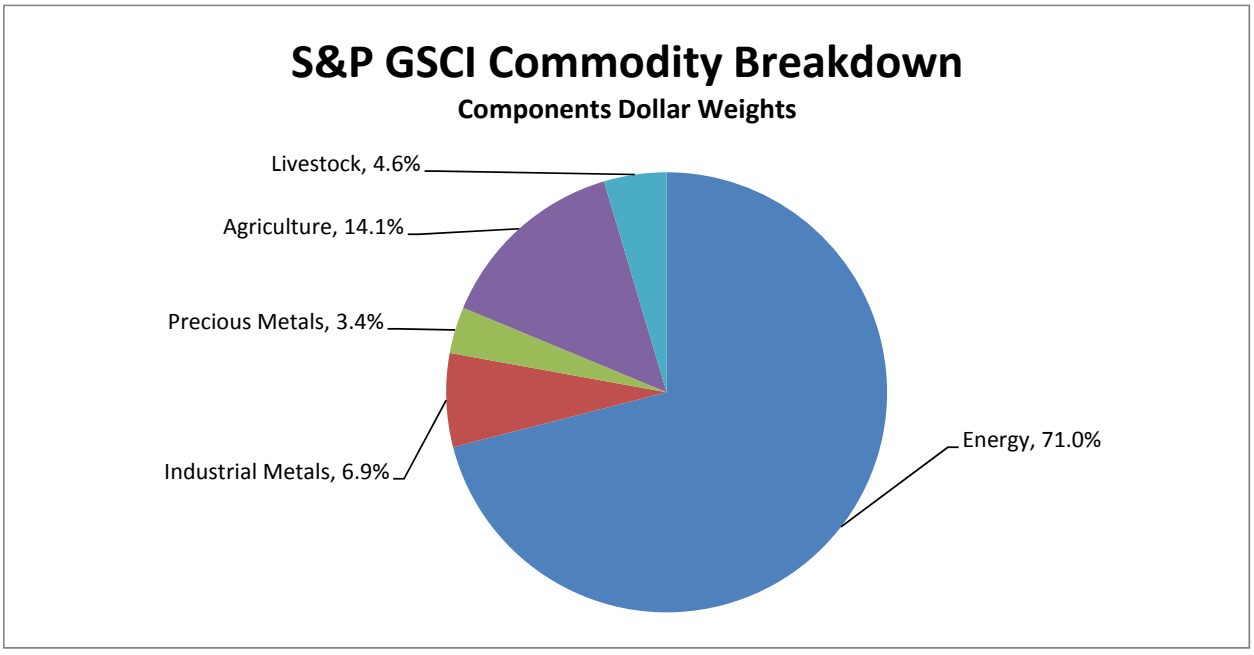
Empirical Results for iShares S&P GSCI ETF, (NYSE Arca)

The GSG ETF provides access to the S&P Goldman Sachs Commodity Index. iShares describes the GSG ETF as follows:

> "The investment objective of the iShares S&P GSCI Commodity-Indexed Trust ("the Trust") is to seek investment results, through the Trust's investment in the iShares S&P GSCI Commodity-Indexed Investing Pool ("Investing Pool"), that correspond generally to the performance of the S&P GSCI Total Return Index ("the Index") before payment of the Trust's and the Investing Pool's expenses and liabilities. The Index is intended to reflect the performance of a diversified group of commodities."

The inception date for the ETF was July 10, 2006, with option data available from May 18, 2007. As of December 31, 2011, the GSG ETF had net assets of $1.31 Billion and 6 holdings. The GSG is traded on the NYSE Arca exchange and its CUSIP is 46428R107. Further details of the fund are provided in Exhibit 10a.

Exhibit 10a GSG ETF Characteristics



Source: http://us.ishares.com

In this section, we compare the performance of the GSG ETF to the performance of GSG 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[76].

Exhibit 10b: Summary Statistics GSG 1-Month Call/6-Month Put Balanced Collars

GSG Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	GSG Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	-4.74%	-0.71%	0.65%	2.62%	5.80%	6.01%
Annualized Standard Deviation	28.83%	8.51%	9.64%	11.37%	14.01%	16.99%
Mean Monthly Return	-0.04%	-0.03%	0.09%	0.27%	0.55%	0.61%
Median Monthly Return	0.98%	0.06%	0.18%	0.58%	0.66%	0.66%
Period Cumulative Return	-19.95%	-3.20%	3.02%	12.59%	29.48%	30.66%
Sharpe Ratio	-0.20	-0.21	-0.04	0.14	0.34	0.29
Stutzer Index	-0.20	-0.21	-0.04	0.14	0.33	0.28
Treynor Ratio	-0.06	-0.16	-0.02	0.07	0.15	0.13
Modified Calmar Ratio	-0.29	-0.21	0.16	0.65	1.47	1.37
Jensen Beta with GSG	1.00	0.11	0.17	0.23	0.31	0.39
Jensen Monthly Alpha	0.00%	-0.09%	0.05%	0.24%	0.54%	0.59%
Leland Beta	1.00	0.11	0.16	0.23	0.30	0.38
Leland Monthly Alpha	0.00%	-0.09%	0.05%	0.24%	0.53%	0.59%
Correlation with Underlying	0.67	0.22	0.26	0.32	0.36	0.43
Skewness	-0.77	0.26	-0.13	-0.16	0.02	-0.32
Excess Kurtosis	2.22	0.84	0.49	-0.11	-0.08	0.58
Minimum Monthly Return	-29.67%	-5.38%	-6.80%	-7.34%	-8.23%	-12.20%
Maximum Monthly Return	21.50%	7.48%	7.48%	8.02%	9.62%	11.44%
Maximum Drawdown	-67.85%	-15.46%	-19.05%	-19.34%	-20.11%	-22.31%
Maximum Run Up	81.82%	15.27%	21.06%	29.89%	53.46%	57.43%
% Down Months	42%	47%	47%	42%	42%	42%
% Up Months	58%	53%	53%	58%	58%	58%
Number of Months	55	55	55	55	55	55
Months in Cash		5	5	5	5	5
Months in Collar		50	50	50	50	50

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[77]. Exhibit 10b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk and increases realized returns relative to a long GSG position. The annualized returns are improved from a loss of -4.74% for the GSG to a gain of 2.62% for the 5% OTM collar. Meanwhile, the standard deviation is reduced by well

[76] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[77] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

over 1/2 from 28.83% to 11.37%. The Stutzer index decreased from -0.20 to 0.14, suggesting that the collar improved risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -67.85% to -19.34%. Not surprisingly, the modified Calmar ratio[78] for the collar is greater than that of the GSG at 0.65 (versus -0.29 for the GSG) for the 55 month period, providing further evidence of the outperformance of the collar. Additional insight can be provided by Exhibit 10c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the relative performance of the collar strategies is their limited participation in the run ups that the GSG ETF experienced in the first year of the period as well the limited participation in the extreme drawdown that followed. The performance of the 5% and greater OTM collars is quite similar to the GSG ETF from mid-2009 to the end of the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -67.85% to -19.34%, it also reduces the maximum run up from 81.82% to 29.89%. Since the GSG experienced such a significant drawdown in the second half of 2008, it is not surprising that the collar strategies provided significant performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 10b and Exhibit 10c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the GSG, the further OTM strategies outperformed nearer to ATM collars from a raw return perspective. By most measures, the further OTM collars outperformed the nearer ATM collars on a risk adjusted basis as well, although all collars with the exception of the ATM outperformed the GSG ETF. For example, the Stutzer index of the 5%

[78] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

OTM collar is 0.14 versus -0.21, -0.04, 0.33, 0.28 and -0.20 for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the GSG, respectively. More importantly, since some of the Stutzer index values are negative (and thus uninformative) we consider the monthly Leland alphas. The monthly Leland alpha of the 5% OTM collar is 24 basis points versus -9, 5, 53, 59 and 0 basis points for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the GSG, respectively. Thus, only the ATM collar has a lower Leland alpha than the GSG, while the other collars provide a higher risk adjusted returns than the GSG.

Exhibit 10c: Growth of $100 GSG 1-Month Call/6-Month Put Balanced Collars

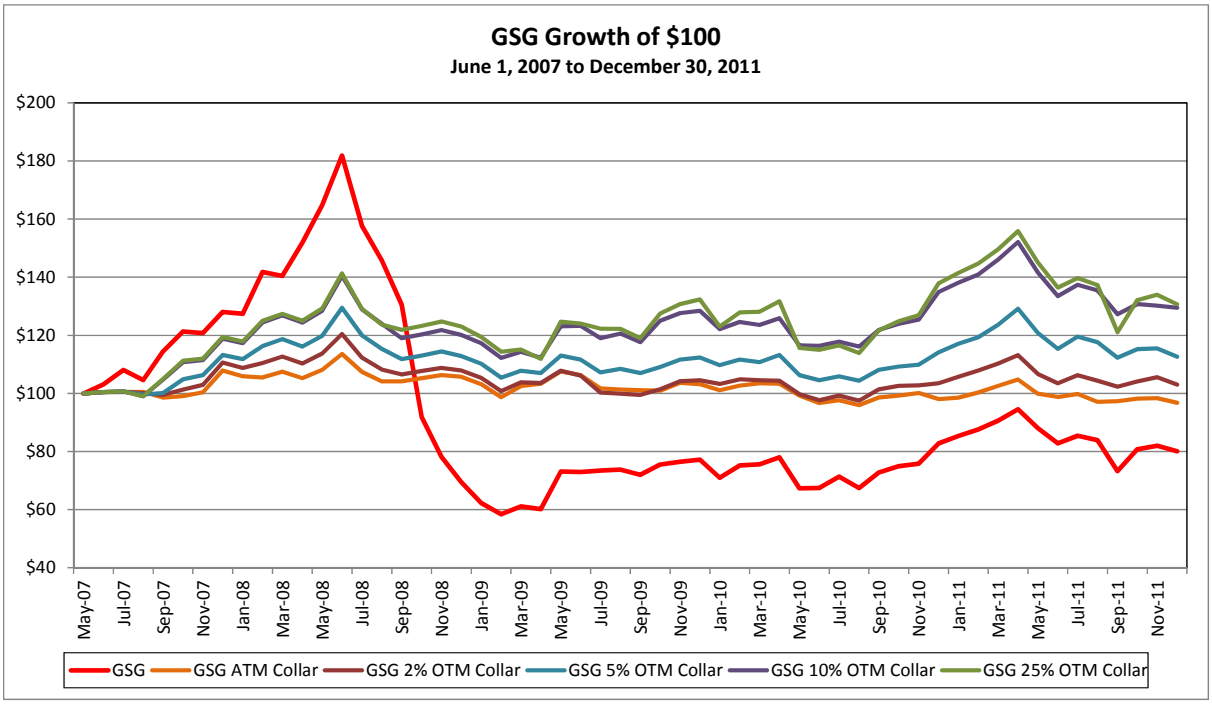


Exhibit 10d and Exhibit 10e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 10d it is clear that in the second half of the period the returns of the deep OTM collar strategies are generally quite similar to those of the GSG. In contrast, in

the first half of the period, the swings in the GSG are so extreme that all of the collars provided far more stable returns than the GSG. The rolling standard deviations provided in Exhibit 10e are evidence of the significant risk reduction potential of all of the collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard deviations throughout the entire period and the deep OTM strategies act similarly in the first half of the period. The standard deviation reduction for the 5% OTM collar ranges from about 5% to 30%.

Exhibit 10d: Rolling Returns GSG 1-Month Call/6-Month Put Collars

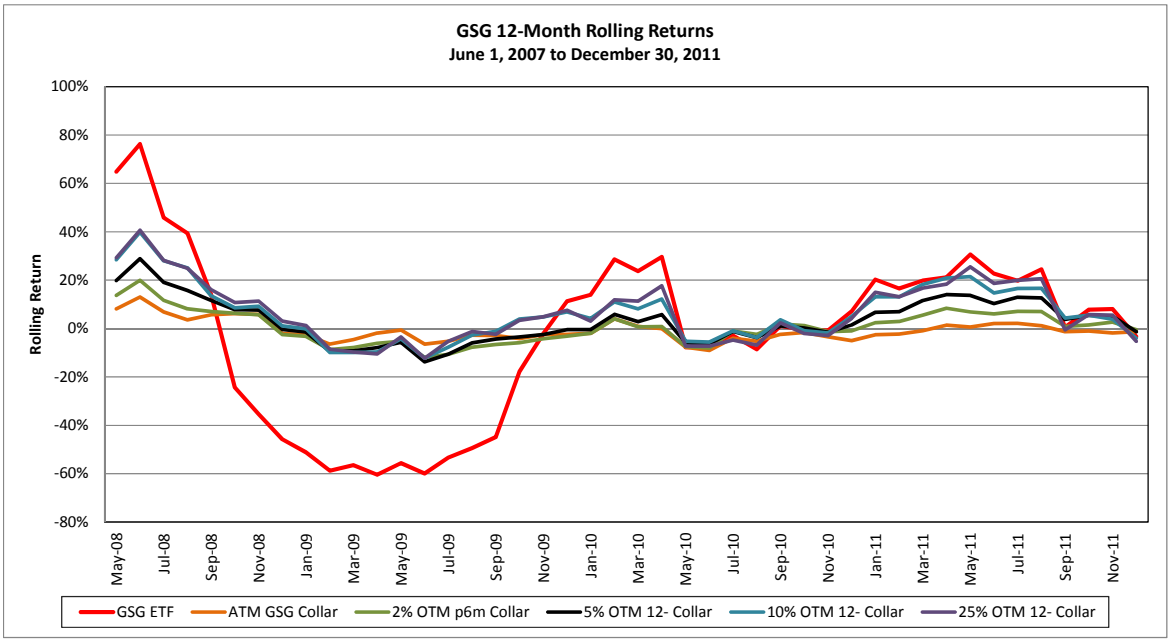
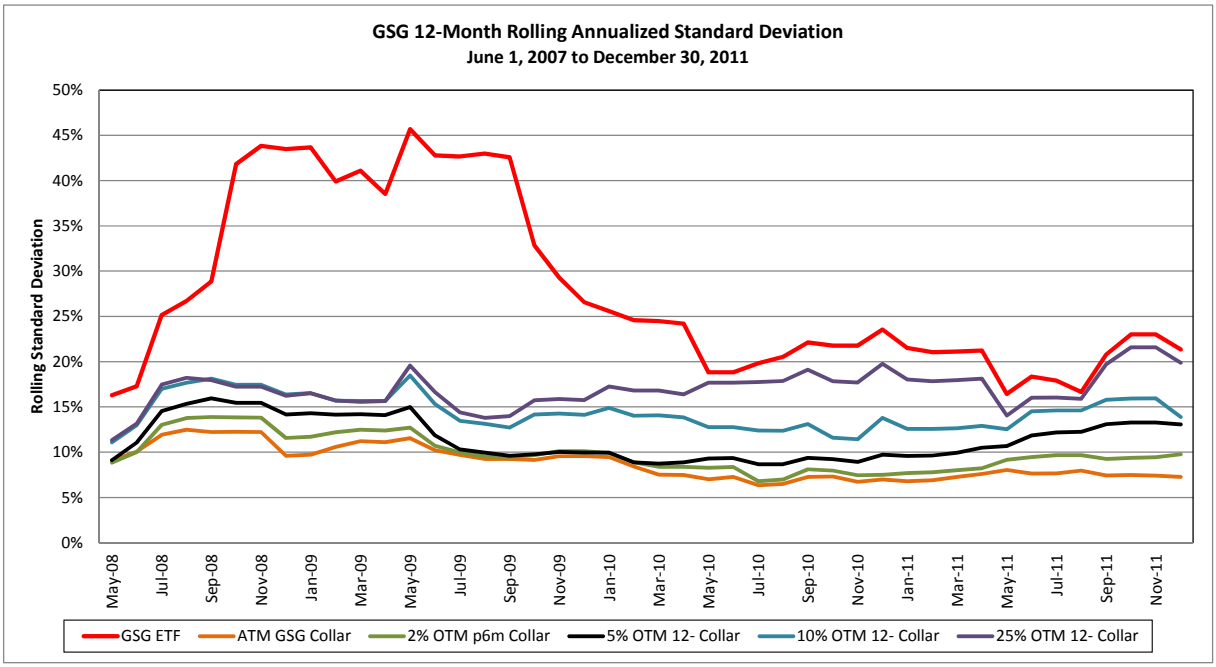
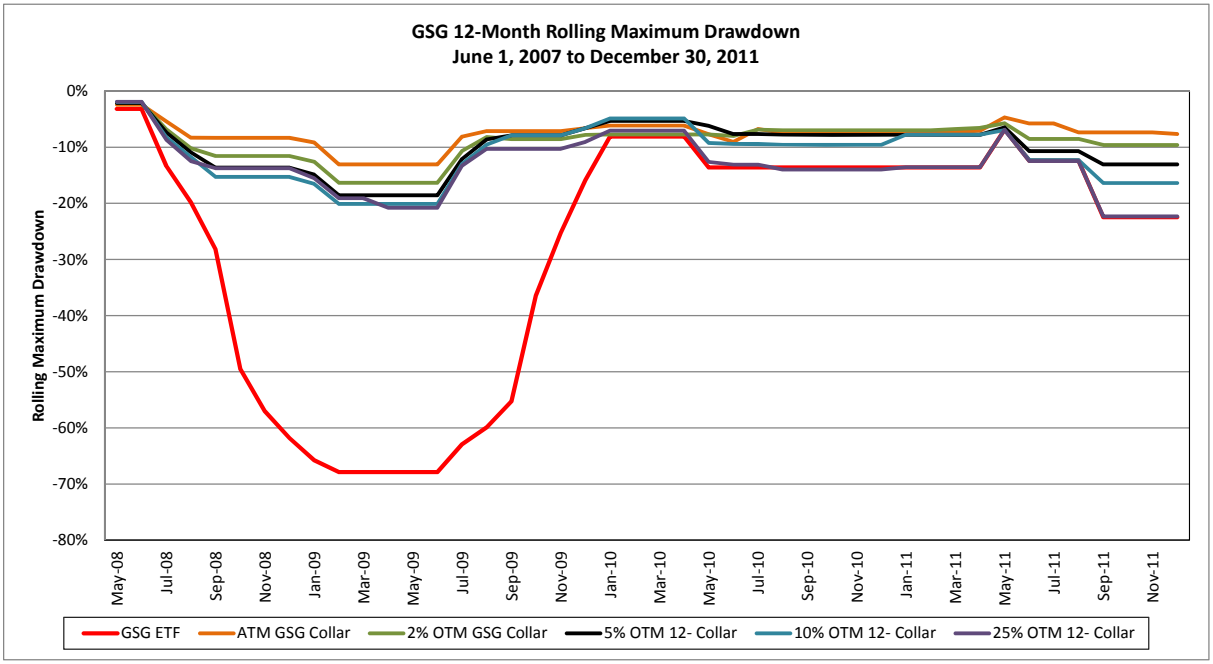


Exhibit 10e: Rolling Standard Deviation GSG 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 10f provides a graphical presentation of 12-month rolling maximum drawdowns for GSG collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the GSG experienced such a significant drawdown during the period of study, it is not surprising that the collars provided a great degree of drawdown protection. The drawdown improvements of all the collar strategies were very similar. The 5% OTM collar reduced maximum drawdown by about 50% at the worst drawdowns of the GSG.

Exhibit 10f: Rolling Maximum Drawdown GSG 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying GSG ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 10g provides the levels of initial implied volatilities for 1-month ATM options on the GSG since inception as well as the ex post realized volatility over the life of the options[79] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[80]). While the volatility of volatility is quite high, the ATM implied volatility for the GSG options tends to fluctuate around the 20% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential

[79] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[80] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

between the puts and calls tends to fluctuate around the 2 to 5% level (with the puts exhibiting higher implied volatilities than the calls) and exhibits some very significant peaks over the period.

Exhibit 10g: Implied and Realized Volatility GSG 1-Month Collars Since Option Inception

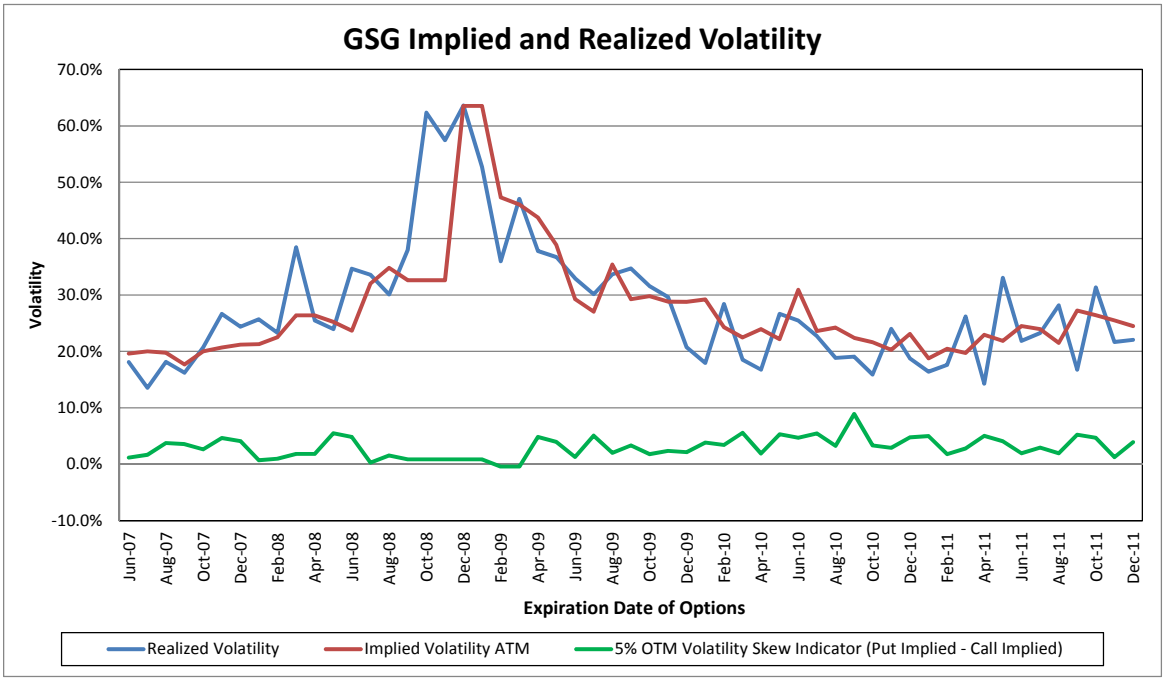


Exhibit 10h and Exhibit 10i provide summary statistics and a graphical presentation of performance, respectively for skewed GSG collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10%

OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

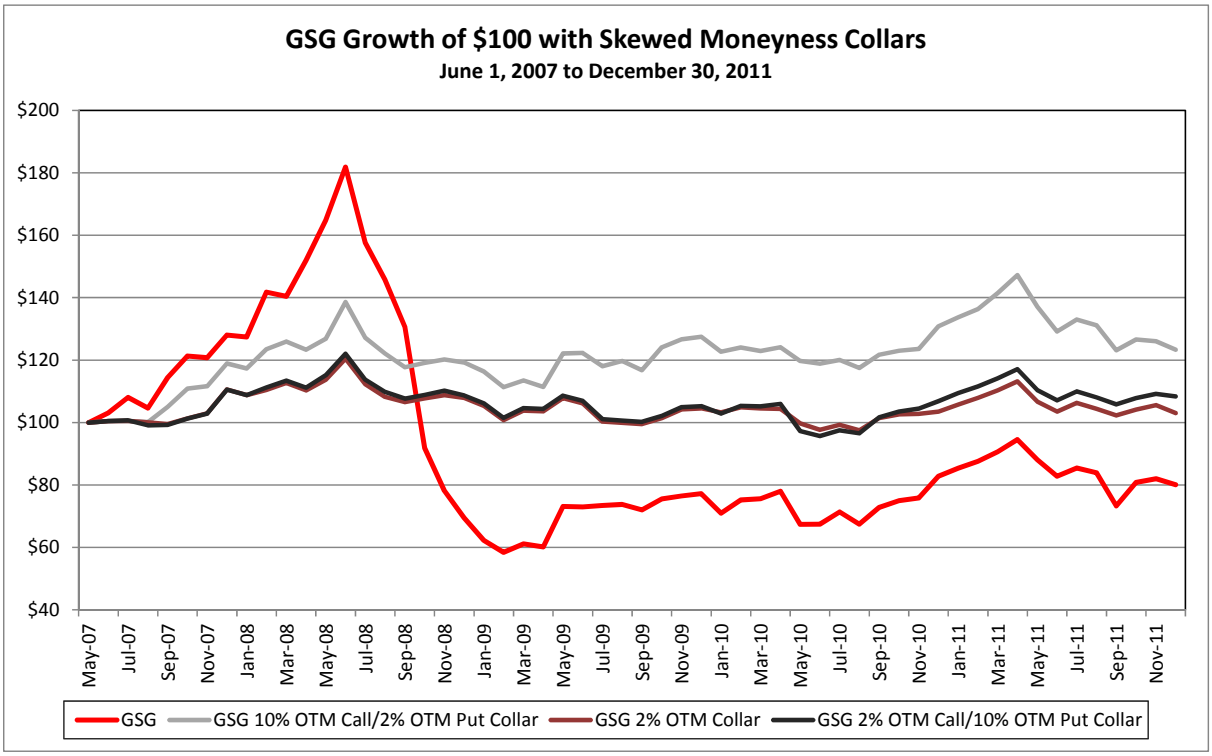
Exhibit 10h: Summary Statistics GSG 1-Month Call/6-Month Put Skewed Collars

GSG Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	GSG Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	-4.74%	4.68%	0.65%	1.77%
Annualized Standard Deviation	28.83%	13.09%	9.64%	10.51%
Mean Monthly Return	-0.04%	0.45%	0.09%	0.19%
Median Monthly Return	0.98%	0.59%	0.18%	0.47%
Period Cumulative Return	-19.95%	8.36%	3.02%	23.32%
Sharpe Ratio	-0.20	0.28	-0.04	0.07
Stutzer Index	-0.20	0.27	-0.04	0.07
Treynor Ratio	-0.06	0.13	-0.02	0.04
Modified Calmar Ratio	-0.29	0.43	0.16	1.08
Jensen Beta with GSG	1.00	0.28	0.17	0.20
Jensen Monthly Alpha	0.00%	0.43%	0.05%	0.16%
Leland Beta	1.00	0.27	0.16	0.19
Leland Monthly Alpha	0.00%	0.43%	0.05%	0.15%
Correlation with Underlying	0.67	0.34	0.26	0.29
Skewness	-0.77	0.14	-0.13	-0.43
Excess Kurtosis	2.22	0.16	0.49	0.73
Minimum Monthly Return	-29.67%	-8.23%	-6.80%	-8.25%
Maximum Monthly Return	21.50%	9.62%	7.48%	7.53%
Maximum Drawdown	-67.85%	-19.63%	-19.05%	-21.62%
Maximum Run Up	81.82%	23.20%	21.06%	47.26%
% Down Months	42%	42%	47%	44%
% Up Months	58%	58%	53%	56%

The net premium payment collar (10% OTM call/2% OTM put) outperforms the net premium collection collar and the balanced collar by most measures, while all three collars outperform the GSG. For example, the net premium payment collar generates a 4.68% return at a standard deviation of 13.09% versus 0.65%/9.64%, 1.77%/10.51%, and -4.74%/28.83% for the balanced collar, the net premium collection collar and the underlying GSG ETF, respectively. Similarly, the Stutzer index for the net premium payment collar is 0.27 versus -0.04, 0.07 and

-0.20 for the balanced collar, the net premium collection collar and the underlying GSG ETF, respectively. Likewise, the monthly Leland alpha for the net premium payment collar is 43 basis points versus 5, 16 and 0 basis points for the balanced collar, the net premium collection collar and the underlying GSG ETF, respectively.

Exhibit 10i: Growth of $100 GSG 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 10g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can

result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 10j: Protection Cost Index at Roll-In GSG 1-Month "Zero-Cost" Collars

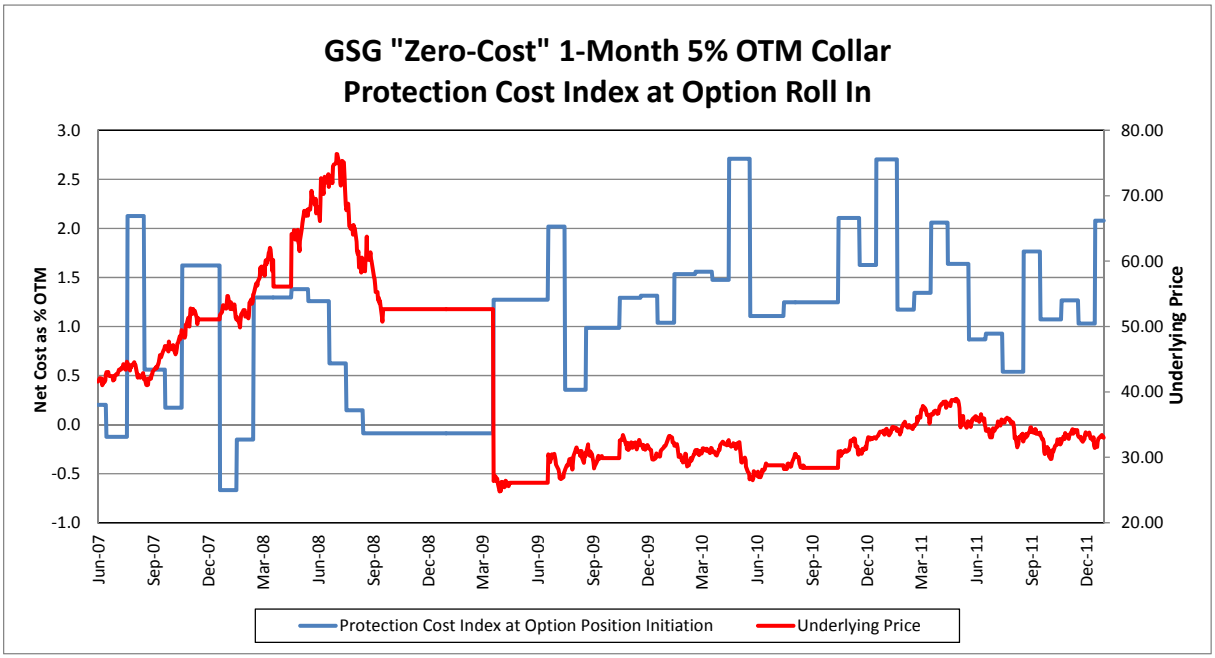


Exhibit 10k: Initial Option Moneyness GSG 1-Month "Zero-Cost" Collars

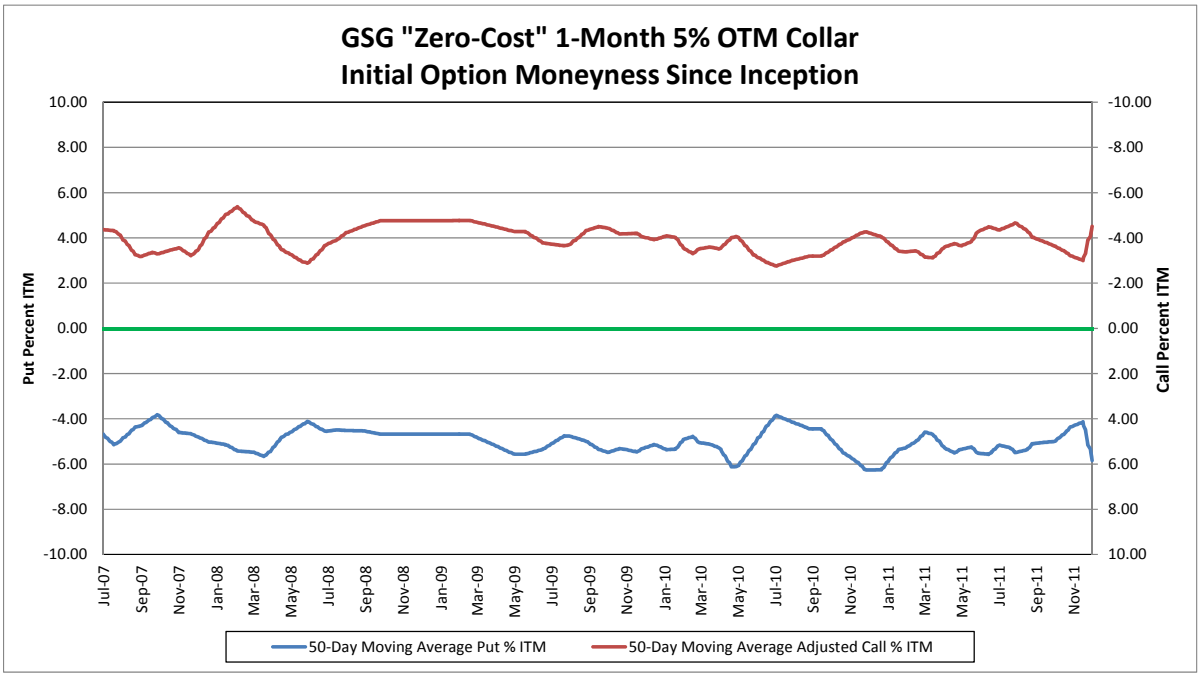


Exhibit 10j and Exhibit 10k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the GSG options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[81].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. It is worth noting that Exhibit 10j indicates missing options by a horizontal line for the underlying price as well as the PCI for the period in which no option position is available. This could occur either because all puts or calls have overly large bid/ask spreads (greater than 1% of the underlying price) or because no call is quoted which has a price as high as the chosen 5% OTM put. The Exhibit indicates a significant skew in option implied volatilities toward the puts in the second half of the period, indicating that puts tend to be more "expensive" than calls (similar to equity index-based ETFs). In the first half of the period, the skew is mixed – at times skewed towards the calls, at others it is skewed towards the puts. While the rolling PCI index tends to average near the 1.5% level, the PCI varies significantly over time, reaching a minimum of about -1.7% in early-2008 and a maximum of 2.7% in early-2010. Exhibit 10k provides

[81] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

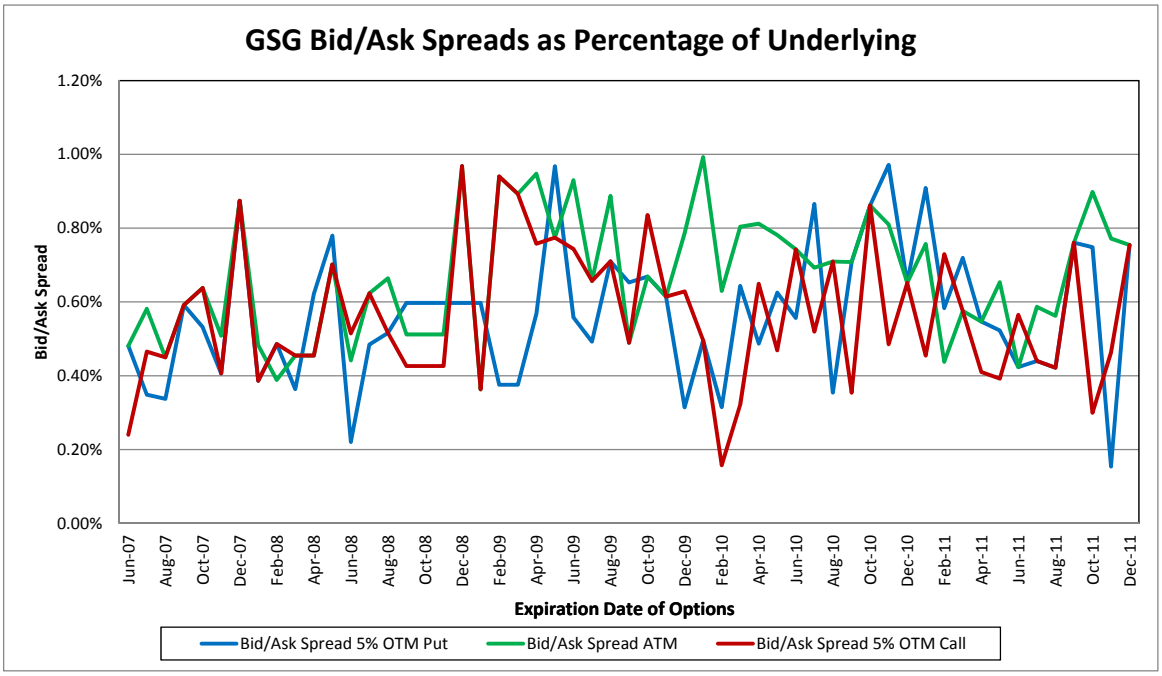
further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 10l provides a graphical presentation of bid/ask spreads as a percentage of the underlying GSG price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[82]. In general, bid/ask spreads tend to vary widely, but generally fluctuate around the 60 basis point level. It is worth noting that the collar strategies presented in this section of the paper invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the GSG underlying price[83]. The GSG strategies were invested in SHY for 5 months of the 55 months covered in the study due to high bid/ask spreads.

[82] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[83] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 10l: Bid/Ask Spreads GSG 1-Month Collars



In conclusion, the GSG ETF options tend to exhibit put skew, although at times they exhibit call skew particularly in the first half of the period. During the financial crisis the performance of the GSG collar strategies outperformed the GSG ETF, both on an absolute and risk adjusted basis, with the further OTM strategies outperforming those nearer the ATM. The GSG ETF experienced an extremely powerful run up at the start of the period followed by an even stronger drawdown. The collars significantly reduced the volatility of the GSG while simultaneously greatly improving returns. Finally, while GSG options used in this study varied significantly over time, they tended to fluctuate around the 60 basis point level throughout the period of study.

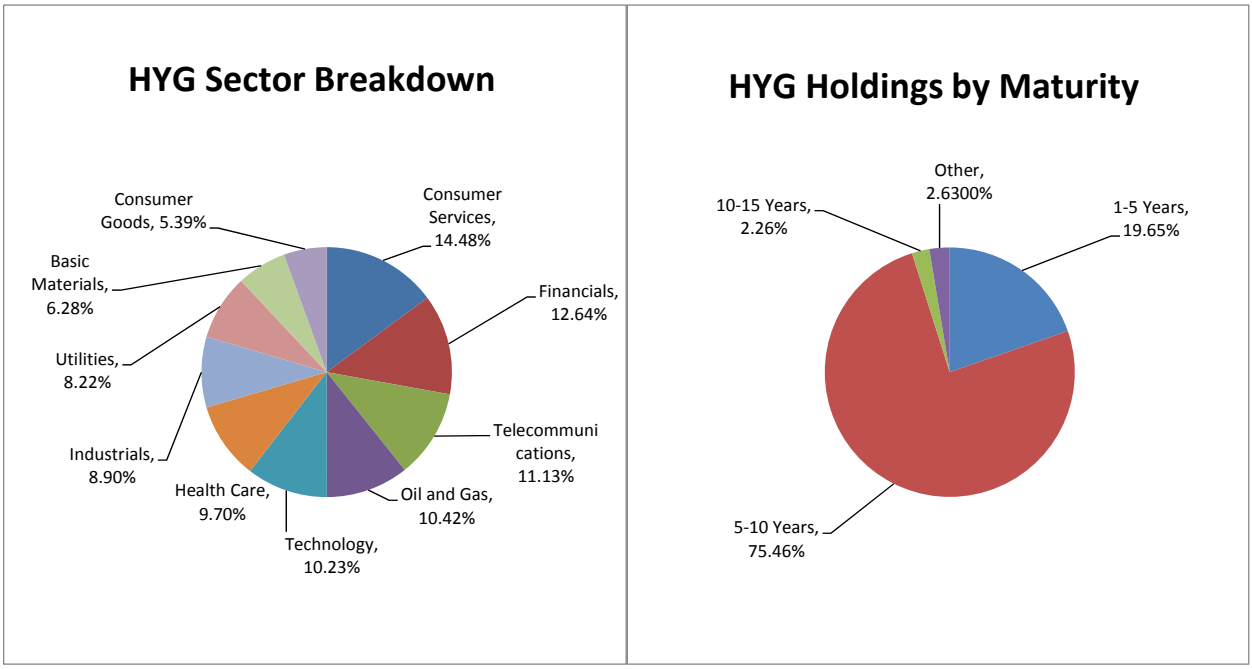
Empirical Results for iShares iBoxx High Yield Corporate Bond ETF, (NYSE Arca)

The HYG ETF provides access to High Yield Corporate Bonds. iShares describes the HYG ETF as follows:

> "The iShares iBoxx $ High Yield Corporate Bond Fund seeks investment results that correspond generally to the price and yield performance, before fees and expenses, of the iBoxx $ Liquid High Yield Index ("the Index"), a corporate bond market index compiled by the International Index Company Limited."…" The iBoxx $ Liquid High Yield Index is a rules-based index consisting of liquid U.S. dollar-denominated, high yield corporate bonds for sale in the United States, as determined by the Index Provider. The Index is designed to provide a broad representation of the U.S. dollar-denominated high yield liquid corporate bond market. There is no limit to the number of issues in the Index."

The inception date for the ETF was April 4, 2007, with option data available from April 20, 2007. As of December 31, 2011, the HYG ETF had net assets of $10.64 Billion, and 463 holdings. The HYG is traded on the NYSE Arca exchange and its CUSIP is 464288513. Further details of the fund holdings are provided in Exhibit 11a.

Exhibit 11a HYG ETF Characteristics



Source: http://us.ishares.com/

In this section, we compare the performance of the HYG ETF to the performance of HYG 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[84].

Exhibit 11b: Summary Statistics HYG 1-Month Call/6-Month Put Balanced Collars

HYG Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	HYG Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	5.29%	-5.55%	-1.44%	0.54%	5.03%	7.06%
Annualized Standard Deviation	17.01%	5.77%	5.76%	7.26%	9.46%	11.03%
Mean Monthly Return	0.55%	-0.46%	-0.11%	0.07%	0.45%	0.62%
Median Monthly Return	0.48%	-0.10%	0.08%	0.24%	0.64%	0.86%
Period Cumulative Return	26.63%	-23.04%	-6.42%	2.50%	25.24%	36.71%
Sharpe Ratio	0.25	-1.14	-0.43	-0.07	0.42	0.55
Stutzer Index	0.25	-1.24	-0.43	-0.07	0.41	0.53
Treynor Ratio	0.04	-3.90	-0.19	-0.02	0.11	0.14
Modified Calmar Ratio	0.88	-0.97	-0.44	0.16	2.11	2.61
Jensen Beta with HYG	1.00	0.02	0.13	0.24	0.37	0.44
Jensen Monthly Alpha	0.00%	-0.57%	-0.25%	-0.12%	0.20%	0.33%
Leland Beta	1.00	0.01	0.13	0.24	0.36	0.43
Leland Monthly Alpha	0.00%	-0.57%	-0.25%	-0.12%	0.20%	0.34%
Correlation with Underlying	0.75	0.06	0.23	0.40	0.51	0.51
Skewness	0.42	-1.16	-0.20	-0.34	0.40	0.55
Excess Kurtosis	2.63	1.50	0.45	-0.03	2.52	4.21
Minimum Monthly Return	-11.48%	-5.54%	-4.26%	-4.91%	-6.63%	-8.89%
Maximum Monthly Return	16.79%	2.44%	4.04%	4.46%	10.28%	13.03%
Maximum Drawdown	-30.28%	-23.75%	-14.57%	-15.30%	-11.99%	-14.07%
Maximum Run Up	79.38%	5.83%	14.06%	25.07%	44.37%	60.75%
% Down Months	44%	51%	47%	44%	42%	42%
% Up Months	56%	49%	53%	56%	58%	58%
Number of Months	55	55	55	55	55	55
Months in Cash		9	9	9	9	9
Months in Collar		46	46	46	46	46

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[85]. Exhibit 11b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces both risk and realized returns relative to a long HYG position. The annualized returns are reduced from 5.29% for the HYG to 0.54% for the 5% OTM collar. The standard deviation is reduced from 17.01% to 7.26%. The Stutzer index

[84] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[85] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

decreased from 0.25 to -0.07, suggesting that the 5% OTM collar significantly reduced risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -30.28% to -15.30%. Despite the reduction, the modified Calmar ratio[86] for the collar is less than that of the HYG at 0.16 (versus 0.88 for the HYG) for the 55 month period, suggesting that returns were reduced proportionally more than the reduction in the maximum drawdown. Additional insight can be provided by Exhibit 11c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the underperformance of the near the money collar strategies is their limited participation in the run up that the HYG ETF experienced in the second half of the period. The performance of the 10% OTM and 25% OTM collars is quite similar to the HYG ETF after mid-2009, while the closer to ATM collars significantly underperform in this period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -30.28% to -15.30%, it also reduces the maximum run up from 79.38% to 25.07%. Since the HYG experienced such a strong and sustained run up in half of the second half of the period, it is not surprising that the collar strategies generally did not provide performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 11b and Exhibit 11c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies significantly reduced the standard deviation of the HYG, the further OTM strategies significantly outperformed nearer to ATM collars from both a raw return and risk adjusted perspective. The 25% OTM collar outperformed the other collars as well as the HYG ETF. For example, the Stutzer index of the 25% OTM collar is 0.53 versus -1.24, -0.43, -0.07, 0.41 and

[86] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

0.25 for the ATM, 2% OTM, 5% OTM and 10% OTM collars and the HYG, respectively. Similarly, the monthly Leland alpha of the 25% OTM collar is 34 basis points versus -57, -25, -12, 20 and 0 basis points for the ATM, 2% OTM, 5% OTM and 10% OTM collars and the HYG, respectively. Thus, only the 25% OTM and 10% OTM collars provided higher risk adjusted returns than the HYG.

Exhibit 11c: Growth of $100 HYG 1-Month Call/6-Month Put Balanced Collars

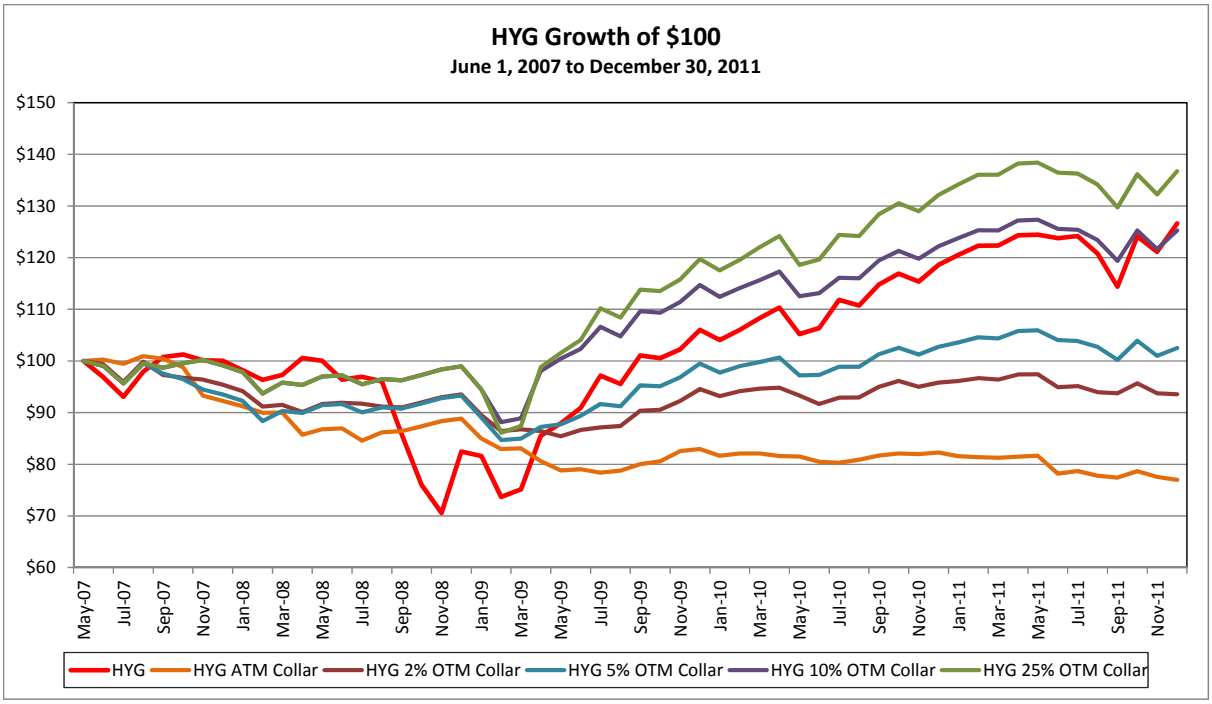


Exhibit 11d and Exhibit 11e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 11d it is clear that the collar strategies have limited participation in both the run ups in the HYG and the drawdowns. The rolling standard deviations provided in Exhibit 11e are further evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit

significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 1% to 25%.

Exhibit 11d: Rolling Returns HYG 1-Month Call/6-Month Put Collars

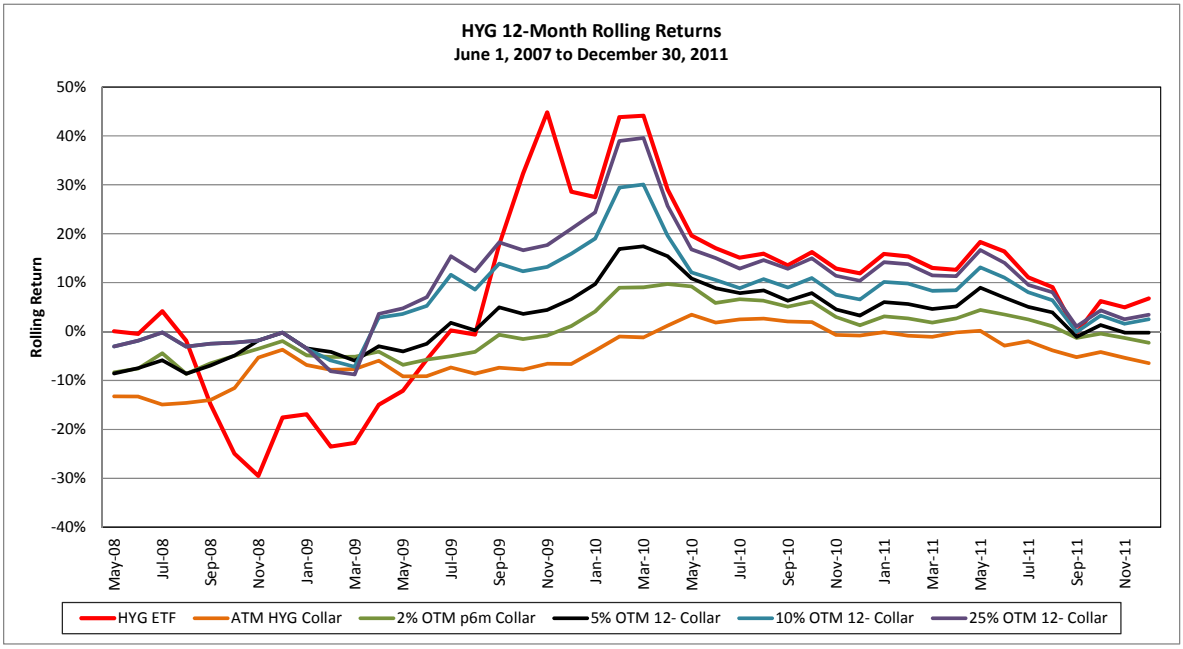
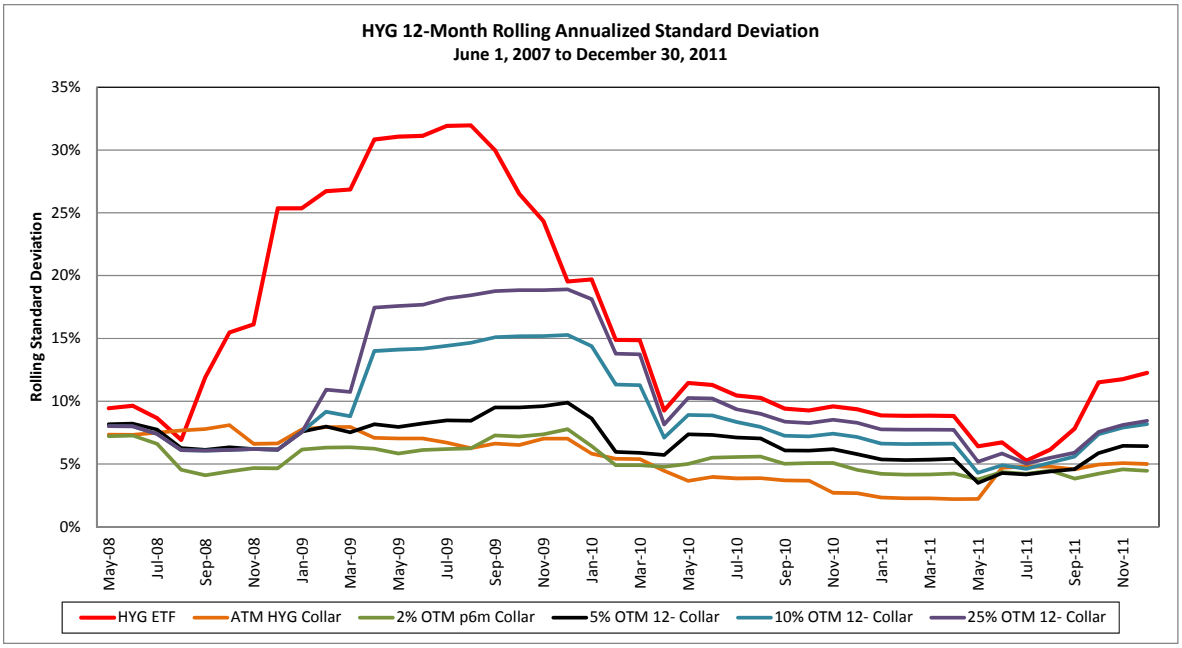
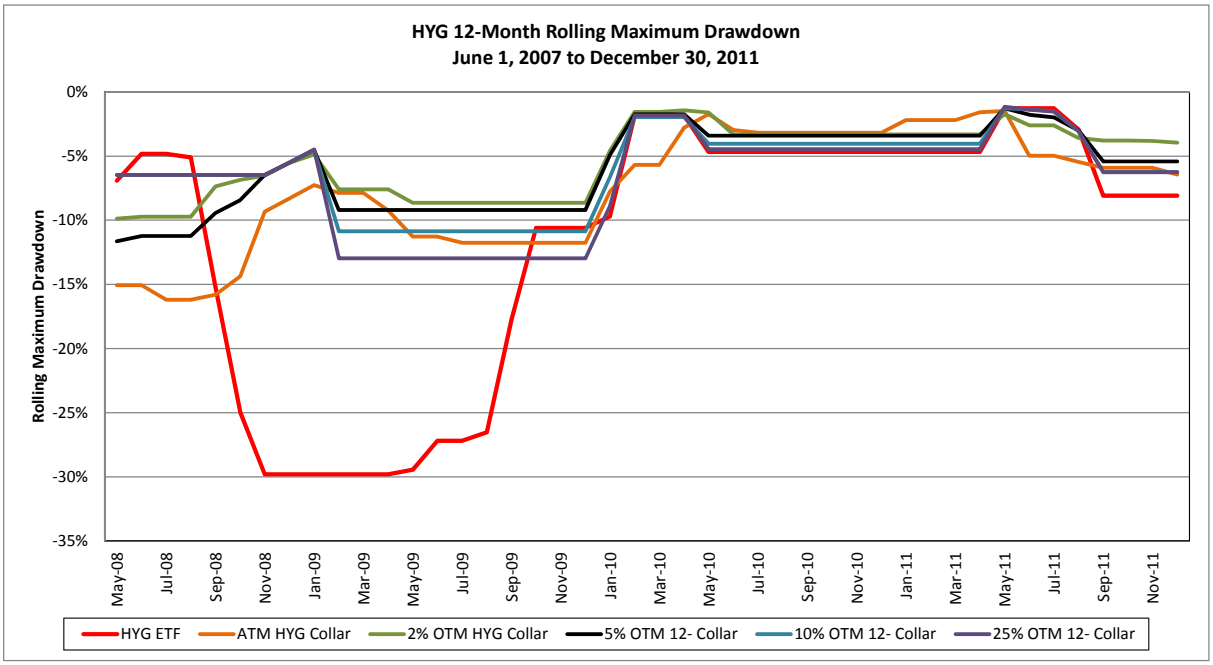


Exhibit 11e: Rolling Standard Deviation HYG 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 11f provides a graphical presentation of 12-month rolling maximum drawdowns for HYG collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the HYG experienced a significant drawdown in the first half of the period of study the collar strategies provided significant drawdown protection in this part of the period. All the collar strategies reduced drawdowns significantly, with the 5% OTM improving the worst rolling drawdown by over 20%.

Exhibit 11f: Rolling Maximum Drawdown HYG 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying HYG ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 11g provides the levels of initial implied

volatilities for 1-month ATM options on the HYG since inception as well as the ex post realized volatility over the life of the options[87] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[88]). While the volatility of volatility is quite high at times, the ATM implied volatility for the HYG options tends to fluctuate around the 5% to 10% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around the 5% level (with the puts exhibiting higher implied volatilities than the calls) although the skew repeatedly swings towards the calls. It is worth noting that Exhibit 11g indicates missing options by a horizontal line for the implied volatility as well as the skew indicator for the period in which no call position or put position is available due to excessively wide spreads.

[87] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[88] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

Exhibit 11g: Implied and Realized Volatility HYG 1-Month Collars Since Option Inception

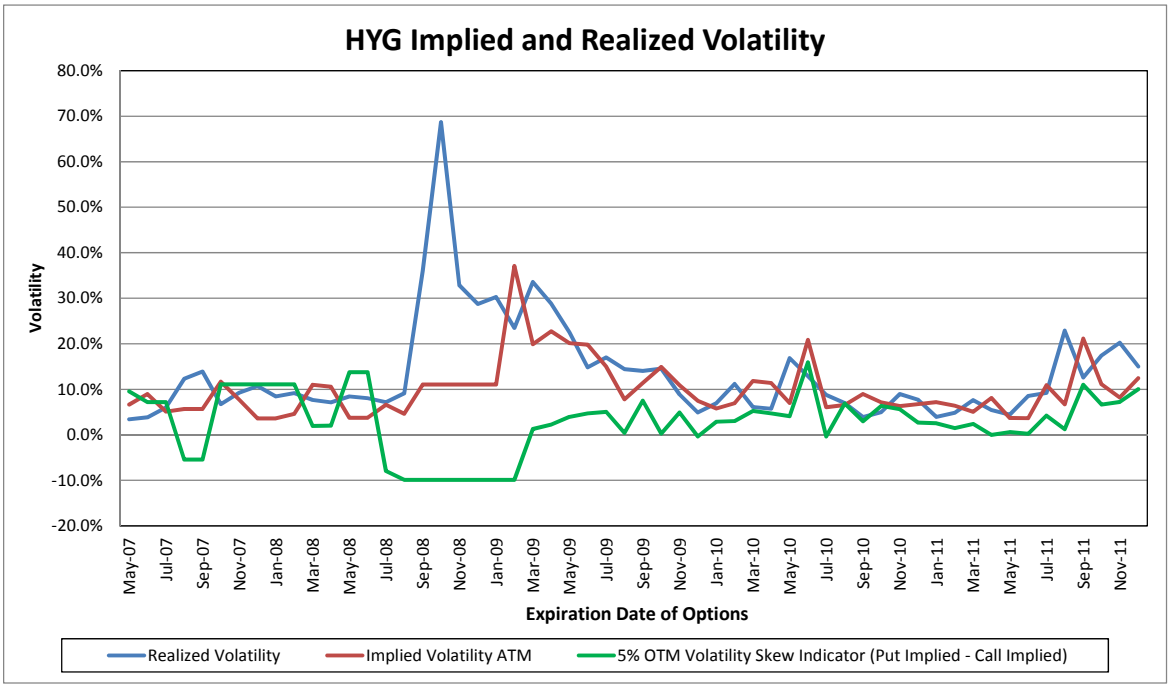


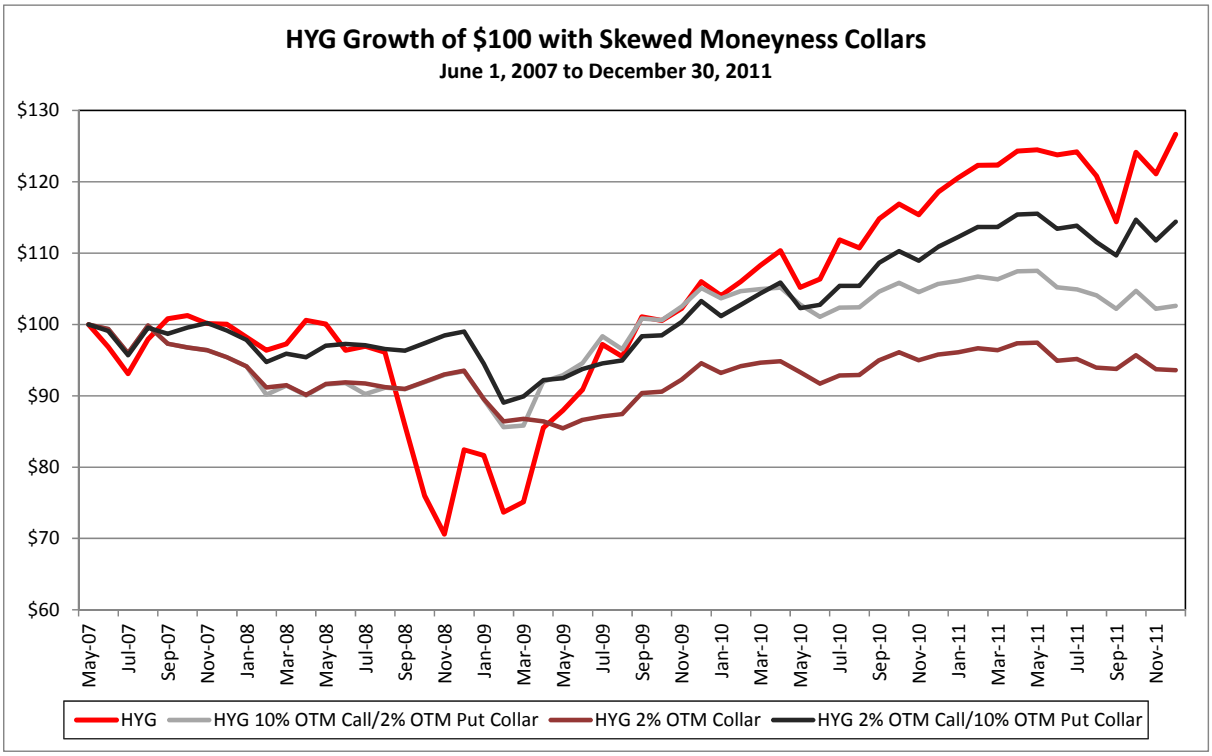
Exhibit 11h and Exhibit 11i provide summary statistics and a graphical presentation of performance, respectively for skewed HYG collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 11h: Summary Statistics HYG 1-Month Call/6-Month Put Skewed Collars

HYG Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	HYG Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	5.29%	0.56%	-1.44%	2.98%
Annualized Standard Deviation	17.01%	7.52%	5.76%	7.16%
Mean Monthly Return	0.55%	0.07%	-0.11%	0.27%
Median Monthly Return	0.48%	0.21%	0.08%	0.45%
Period Cumulative Return	26.63%	14.39%	-6.42%	2.60%
Sharpe Ratio	0.25	-0.06	-0.43	0.27
Stutzer Index	0.25	-0.06	-0.43	0.26
Treynor Ratio	0.04	-0.02	-0.19	0.08
Modified Calmar Ratio	0.88	1.00	-0.44	0.23
Jensen Beta with HYG	1.00	0.25	0.13	0.24
Jensen Monthly Alpha	0.00%	-0.13%	-0.25%	0.07%
Leland Beta	1.00	0.24	0.13	0.24
Leland Monthly Alpha	0.00%	-0.12%	-0.25%	0.07%
Correlation with Underlying	0.75	0.39	0.23	0.44
Skewness	0.42	0.46	-0.20	-0.61
Excess Kurtosis	2.63	1.39	0.45	0.70
Minimum Monthly Return	-11.48%	-4.31%	-4.26%	-5.80%
Maximum Monthly Return	16.79%	7.15%	4.04%	4.54%
Maximum Drawdown	-30.28%	-14.38%	-14.57%	-11.14%
Maximum Run Up	79.38%	29.74%	14.06%	25.57%
% Down Months	44%	45%	47%	36%
% Up Months	56%	55%	53%	64%

The net premium collection collar (2% OTM call/10% OTM put) outperforms the net premium payment collar and the balanced collar by most measures. From an absolute return perspective, all collars underperform the HYG. From a risk adjusted return perspective, the net premium collection collar outperforms the HYG. For example, the net premium collection collar generates a 2.98% return at a standard deviation of 7.16% versus 0.56%/7.52%, -1.44%/5.76%, and 5.29%/17.01% for the balanced collar, the net premium payment collar and the underlying HYG ETF, respectively. Similarly, the Stutzer index for the net premium collection collar is 0.08 versus -0.06, -0.43 and 0.25 for the balanced collar, the net premium payment collar and the underlying HYG ETF, respectively.

Exhibit 11i: Growth of $100 HYG 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 11g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 11j: Protection Cost Index at Roll-In HYG 1-Month "Zero-Cost" Collars

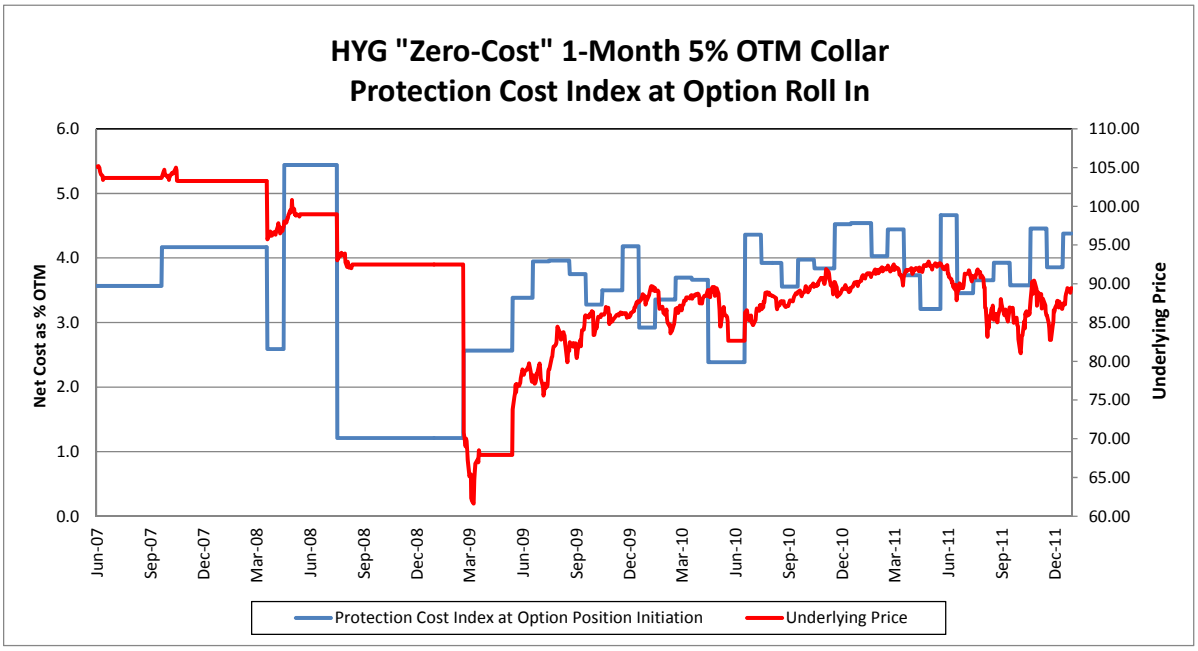


Exhibit 11k: Initial Option Moneyness HYG 1-Month "Zero-Cost" Collars

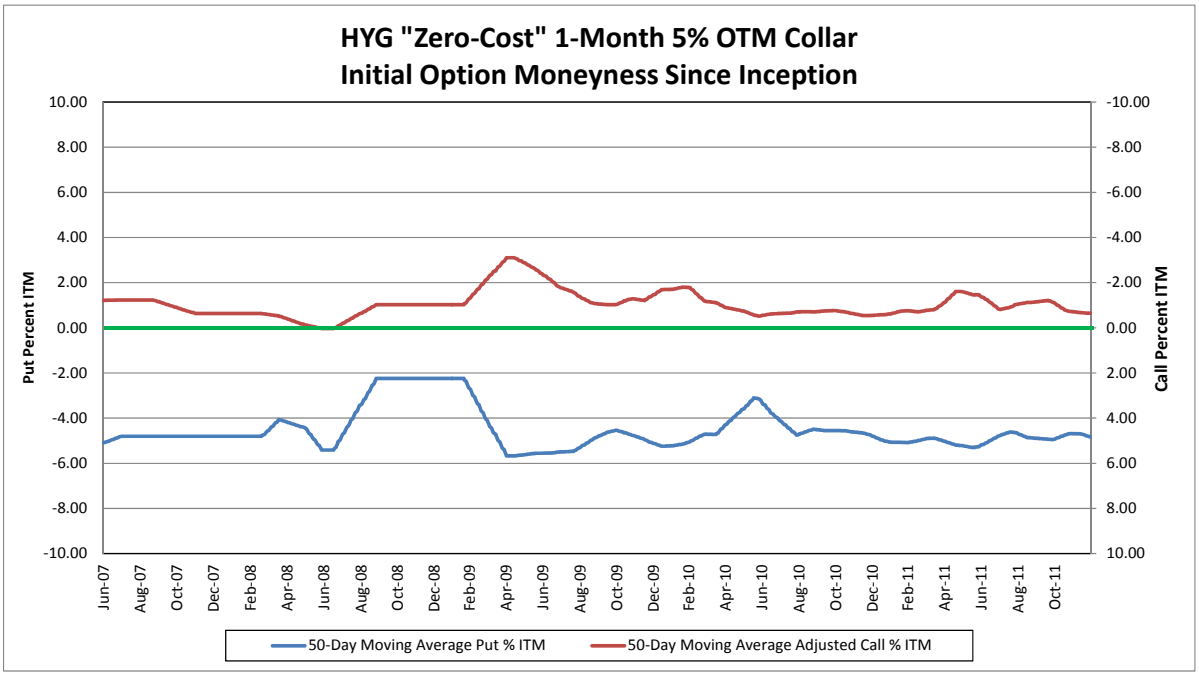


Exhibit 11j and Exhibit 11k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the HYG options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[89].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. It is worth noting that Exhibit 11j indicates missing options by a horizontal line for the underlying price as well as the PCI for the period in which no option position is available. This could occur either because all puts or calls have overly large bid/ask spreads (greater than 1% of the underlying price) or because no call is quoted which has a price as high as the chosen 5% OTM put. The Exhibit indicates a significant skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (similar to typical equity index-based ETFs).While the rolling PCI index tends to average near the 3.5% level, the PCI varies significantly over time. Exhibit 11k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

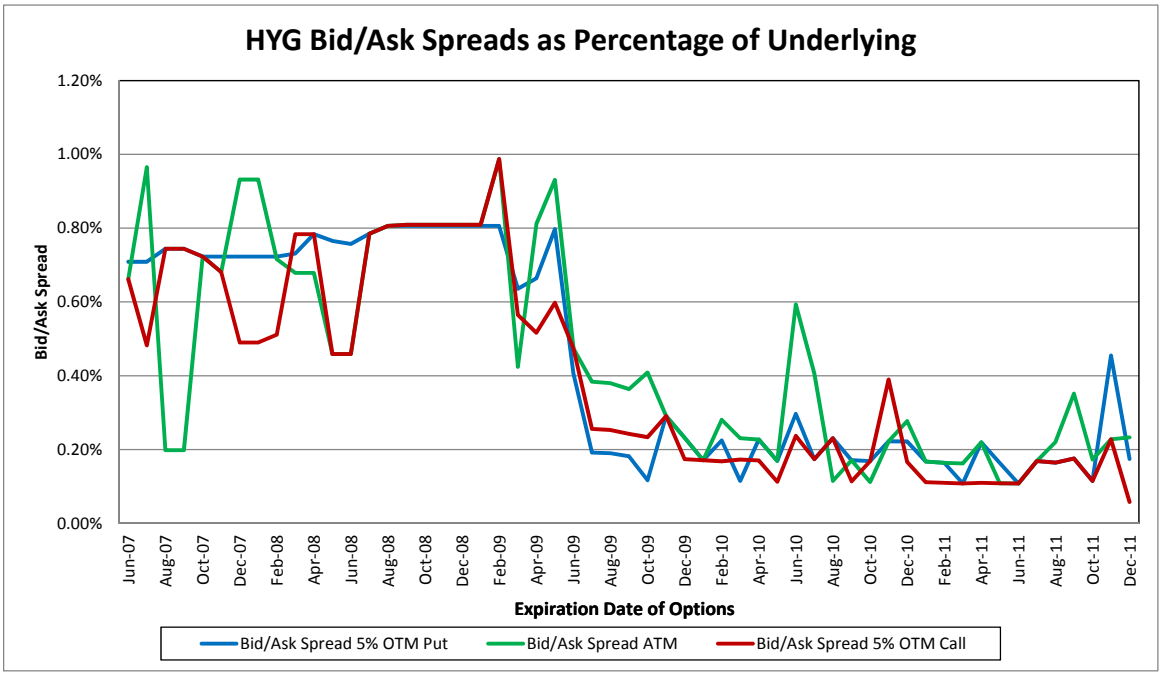
[89] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 11l provides a graphical presentation of bid/ask spreads as a percentage of the underlying HYG price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[90]. In general, bid/ask spreads tend to decrease over time. The first half of the period experienced far higher spreads (generally around 70 basis points) than the second half of the period (generally around 20 basis points). It is worth noting that the collar strategies presented in this section of the paper invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the HYG underlying price[91]. The HYG strategies were invested in SHY for 9 months of the 55 months covered in the study due to high bid/ask spreads.

[90] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[91] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 11l: Bid/Ask Spreads HYG 1-Month Collars



In conclusion, the HYG ETF options generally exhibit significant put skew. During the financial crisis the performance of the HYG collar strategies was mixed when compared to the HYG ETF, both on an absolute and risk adjusted basis. The deep OTM collars outperformed the HYG while others underperformed the HYG. The HYG ETF experienced a significant drawdown in late-2008 followed by a strong run up for most of the remainder of the period of study. While the collars significantly reduced the volatility of the HYG, they generally did little for the returns. Finally, while HYG options used in this study exhibited bid/ask spreads approaching 0.7% of the underlying price in the first half of the period, the spreads were generally near 20 basis points in the later part of the period of study.

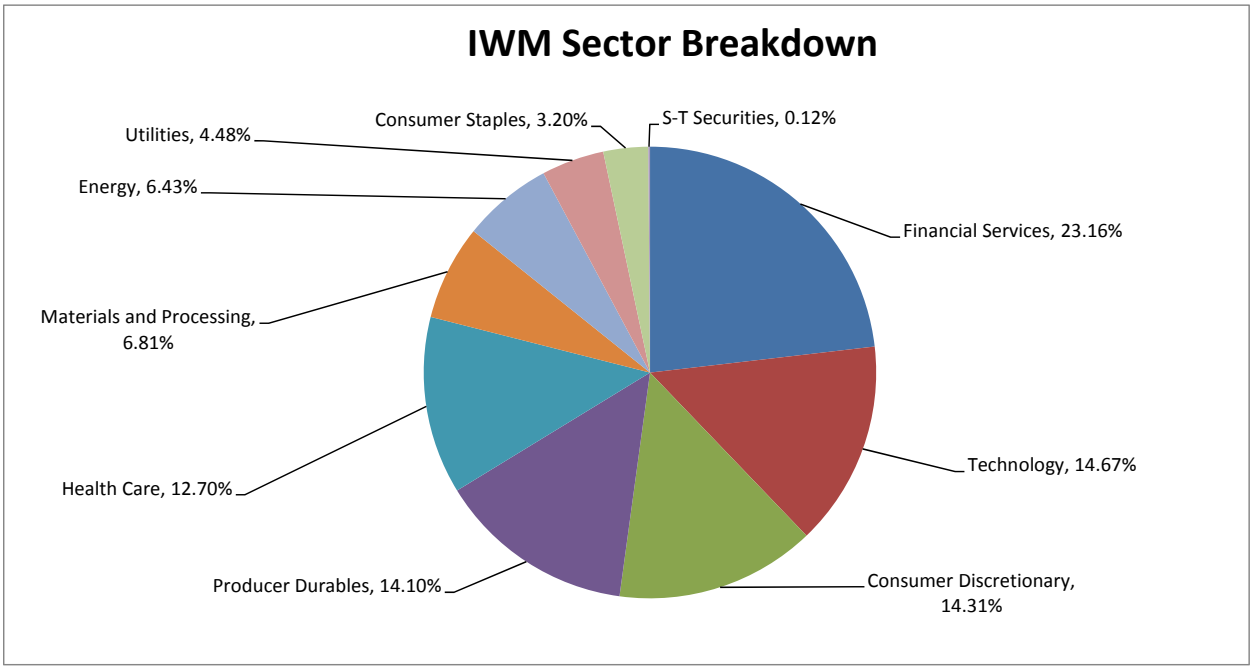
Empirical Results for iShares Russell 2000 ETF, (NYSE Arca)

The IWM ETF provides access to Small Capitalization Equities. iShares describes the IWM ETF as follows:

> "The iShares Russell 2000 Index Fund seeks investment results that correspond generally to the price and yield performance, before fees and expenses, of the small capitalization sector of the U.S. equity market as represented by the Russell 2000 Index ("the Index"). The Index represents the approximately 2,000 smallest companies in the Russell 3000 Index."…" The Index measures the small-capitalization sector of the U.S. equity market. It is a subset of the Russell 3000 Index and serves as the underlying index for the Russell 2000 Growth and Value index series. The Index is capitalization-weighted and consists of the 2000 smallest companies in the Russell 3000 Index. Component companies are adjusted for available float and must meet objective criteria for inclusion to the Index. Reconstitution is annual."

The inception date for the ETF was May 22, 2000, with option data available from October 20, 2000. As of December 31, 2011, the IWM ETF had net assets of $14.19 Billion, and 1971 holdings. The IWM is traded on the NYSE Arca exchange and its CUSIP is 464287655. Further details of the fund holdings are provided in Exhibit 12a.

Exhibit 12a IWM ETF Characteristics



Source: http://us.ishares.com/

In this section, we compare the performance of the IWM ETF to the performance of IWM 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[92].

Exhibit 12b: Summary Statistics IWM 1-Month Call/6-Month Put Balanced Collars

IWM Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	IWM Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	-1.51%	-1.10%	-0.77%	-0.09%	-2.30%	-0.95%
Annualized Standard Deviation	25.13%	10.69%	12.03%	14.17%	17.50%	20.35%
Mean Monthly Return	0.14%	-0.04%	0.00%	0.08%	-0.06%	0.09%
Median Monthly Return	1.92%	0.63%	0.78%	0.71%	0.68%	1.36%
Period Cumulative Return	-6.72%	-4.93%	-3.49%	-0.42%	-10.11%	-4.29%
Sharpe Ratio	-0.10	-0.20	-0.15	-0.08	-0.19	-0.10
Stutzer Index	-0.10	-0.20	-0.15	-0.08	-0.19	-0.10
Treynor Ratio	-0.03	-0.10	-0.06	-0.03	-0.06	-0.03
Modified Calmar Ratio	-0.13	-0.25	-0.18	-0.02	-0.28	-0.11
Jensen Beta with IWM	1.00	0.21	0.32	0.44	0.59	0.72
Jensen Monthly Alpha	0.00%	-0.13%	-0.08%	0.00%	-0.15%	-0.01%
Leland Beta	1.00	0.21	0.32	0.44	0.59	0.72
Leland Monthly Alpha	0.00%	-0.13%	-0.08%	0.00%	-0.15%	-0.01%
Correlation with Underlying	0.83	0.37	0.49	0.58	0.65	0.72
Skewness	-0.35	-2.15	-1.82	-1.12	-0.76	-0.33
Excess Kurtosis	0.24	9.44	6.47	2.14	0.83	-0.61
Minimum Monthly Return	-20.96%	-15.03%	-15.53%	-14.91%	-16.83%	-13.32%
Maximum Monthly Return	15.39%	5.23%	6.26%	7.33%	7.66%	12.04%
Maximum Drawdown	-52.42%	-19.75%	-19.86%	-23.87%	-36.24%	-38.81%
Maximum Run Up	127.00%	23.83%	34.79%	54.08%	76.63%	99.16%
% Down Months	45%	42%	33%	45%	45%	45%
% Up Months	55%	58%	67%	55%	55%	55%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[93]. Exhibit 12b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk and increases realized returns relative to a long IWM position. The annualized returns are improved from -1.51% for the IWM to

[92] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[93] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

-0.09% for the 5% OTM collar. The standard deviation is reduced from 25.13% to 14.17%. More importantly, since the Stutzer index values are negative (and thus uninformative) we consider the monthly Leland alphas. The monthly Leland alpha of the 5% OTM collar is 0 basis points versus -13, -8, -15, -1 and 0 basis points for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the IWM, respectively. Thus, none of the collars provide higher risk adjusted returns than the IWM and only the 5% OTM collar matches the risk adjusted performance of the IWM. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -52.42% to -23.87%. Additional insight can be provided by Exhibit 12c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the relative performance of the collar strategies is their limited participation in the strong run ups and the drawdowns that the IWM ETF experienced throughout the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -52.42% to -23.87%, it also reduces the maximum run up from 127.00% to 54.08%. The protection from the large drawdowns was largely countered by the limited participation in the strong run ups.

In addition to providing results for 5% OTM collars, Exhibit 12b and Exhibit 12c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the IWM, only the 10% OTM collar underperformed the IWM ETF from a raw return perspective. However, from a risk adjusted perspective, none of the collars outperformed the IWM.

Exhibit 12c: Growth of $100 IWM 1-Month Call/6-Month Put Balanced Collars

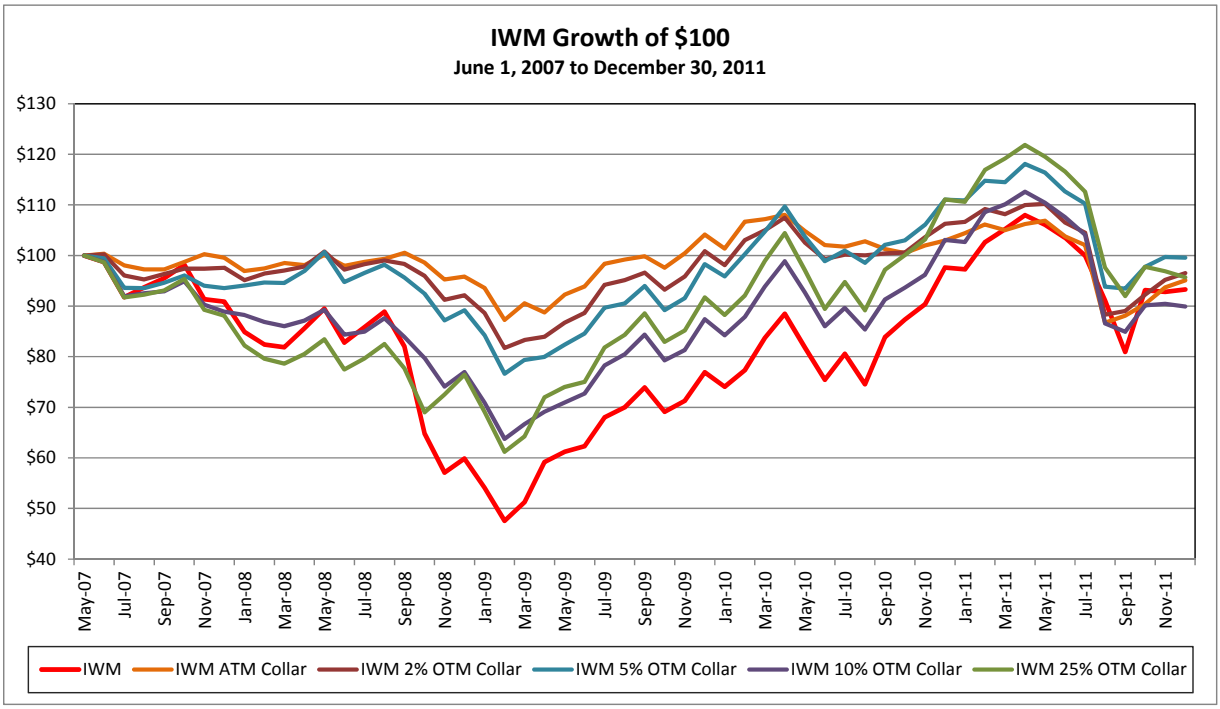


Exhibit 12d and Exhibit 12e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 12d it is clear that the collar strategies experience limited participation in both the run ups and drawdowns of the IWM, particularly the near the ATM collars. The rolling standard deviations provided in Exhibit 12e are further evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 2% to 22%.

Exhibit 12d: Rolling Returns IWM 1-Month Call/6-Month Put Collars

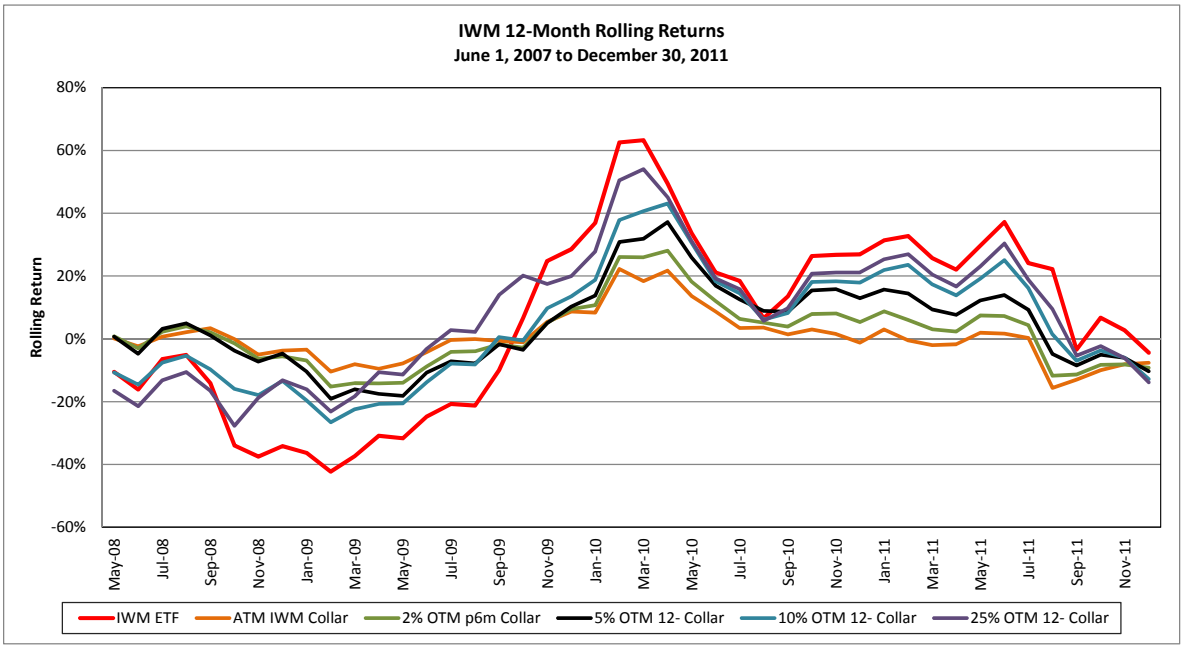
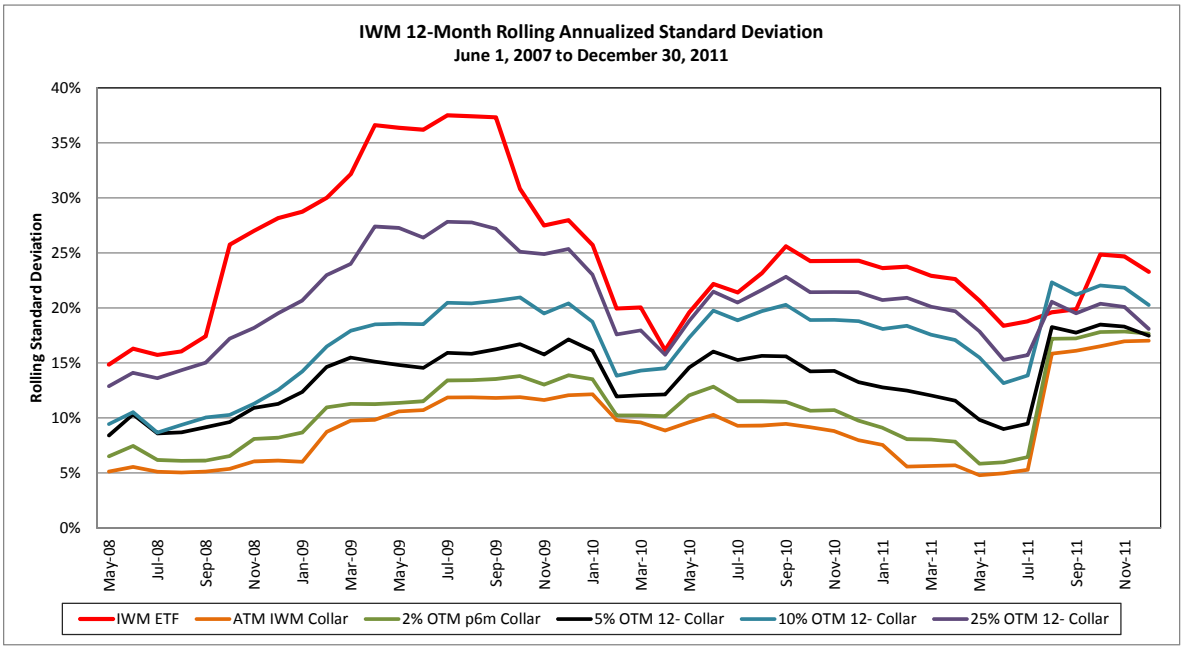
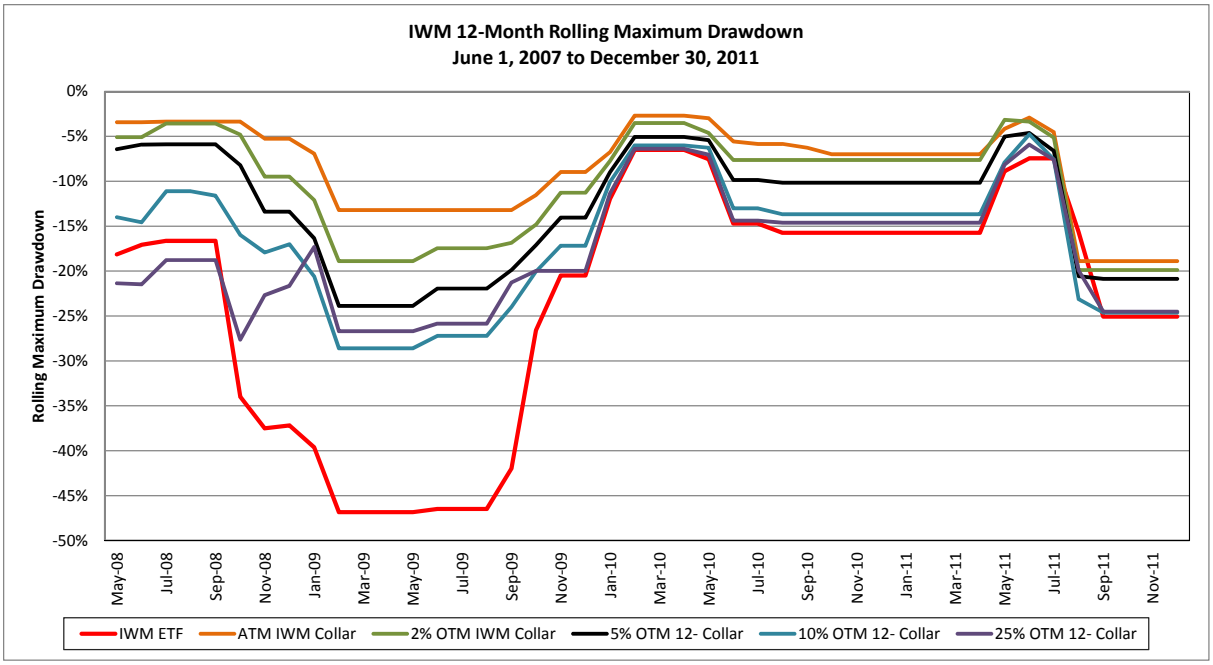


Exhibit 12e: Rolling Standard Deviation IWM 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 12f provides a graphical presentation of 12-month rolling maximum drawdowns for IWM collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the IWM experienced an extremely large drawdown in late-2008 and early-2009, the moneyness of the collar had a large impact on the degree of drawdown protection. While the near the money strategies provided significant protection, the deeper OTM collars had far less (although still very significant) impact on drawdowns.

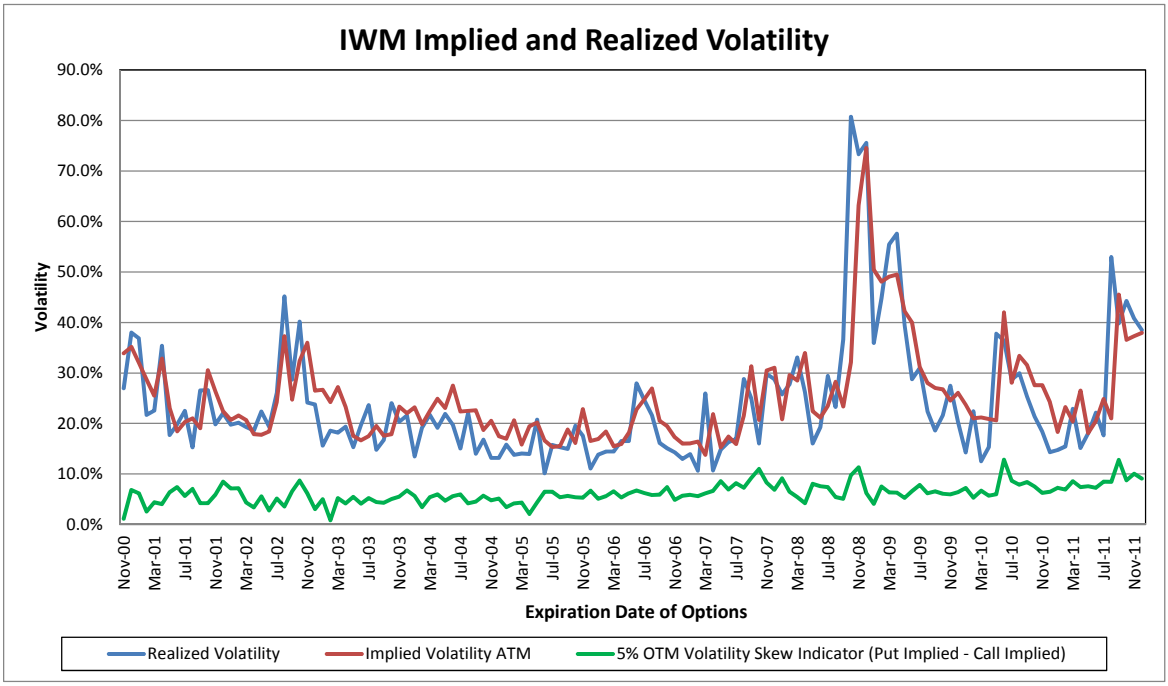
Exhibit 12f: Rolling Maximum Drawdown IWM 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying IWM ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 12g provides the levels of initial implied

volatilities for 1-month ATM options on the IWM since inception as well as the ex post realized volatility over the life of the options[94] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[95]). While the volatility of volatility is quite high, the ATM implied volatility for the IWM options tends to fluctuate around the 20% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around the 5% level (with the puts exhibiting higher implied volatilities than the calls as is typical of equity index-based ETFs) and exhibits some very significant peaks over the period as well as an apparent slight upward trend.

Exhibit 12g: Implied and Realized Volatility IWM 1-Month Collars Since Option Inception



[94] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.

[95] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

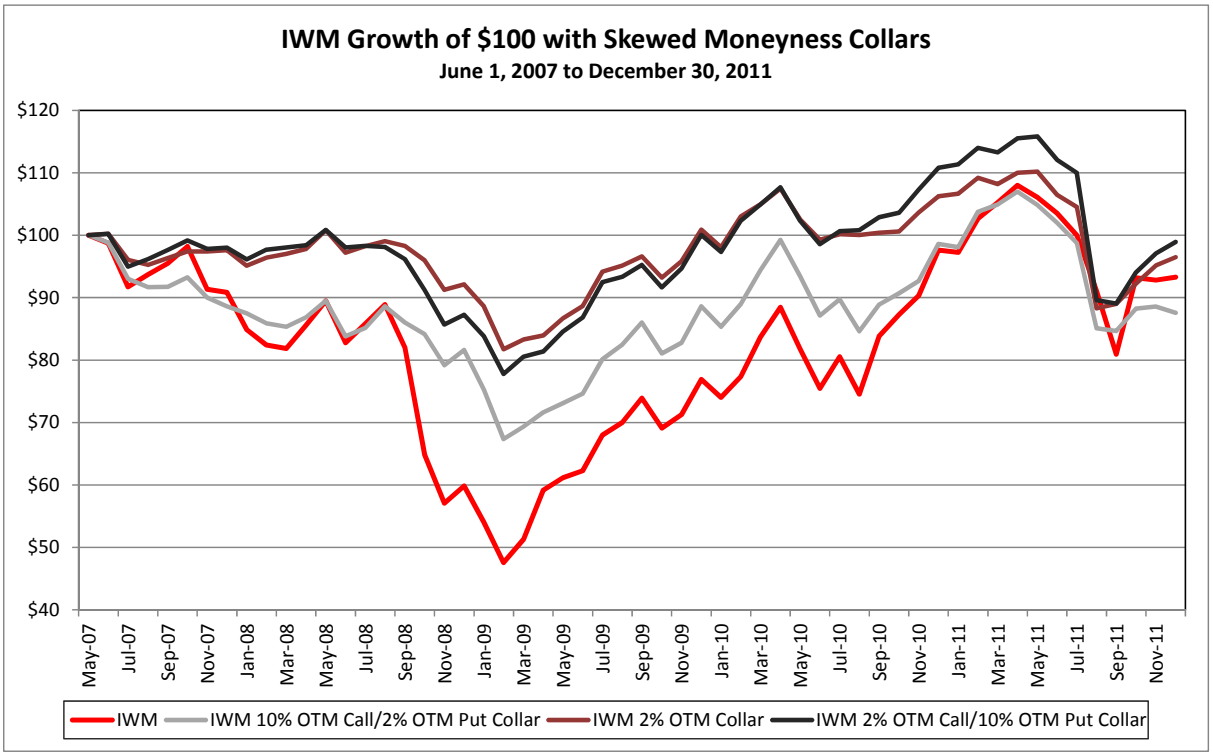
Exhibit 12h and Exhibit 12i provide summary statistics and a graphical presentation of performance, respectively for skewed IWM collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 12h: Summary Statistics IWM 1-Month Call/6-Month Put Skewed Collars

IWM Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	IWM Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	-1.51%	-2.85%	-0.77%	-0.23%
Annualized Standard Deviation	25.13%	15.78%	12.03%	13.86%
Mean Monthly Return	0.14%	-0.14%	0.00%	0.06%
Median Monthly Return	1.92%	0.35%	0.78%	0.71%
Period Cumulative Return	-6.72%	-1.06%	-3.49%	-12.41%
Sharpe Ratio	-0.10	-0.25	-0.15	-0.09
Stutzer Index	-0.10	-0.25	-0.15	-0.09
Treynor Ratio	-0.03	-0.08	-0.06	-0.03
Modified Calmar Ratio	-0.13	-0.03	-0.18	-0.54
Jensen Beta with IWM	1.00	0.51	0.32	0.41
Jensen Monthly Alpha	0.00%	-0.22%	-0.08%	-0.02%
Leland Beta	1.00	0.51	0.32	0.40
Leland Monthly Alpha	0.00%	-0.22%	-0.08%	-0.02%
Correlation with Underlying	0.83	0.58	0.49	0.58
Skewness	-0.35	-0.68	-1.82	-1.98
Excess Kurtosis	0.24	0.36	6.47	7.46
Minimum Monthly Return	-20.96%	-13.83%	-15.53%	-18.51%
Maximum Monthly Return	15.39%	7.40%	6.26%	6.53%
Maximum Drawdown	-52.42%	-32.66%	-19.86%	-23.14%
Maximum Run Up	127.00%	48.98%	34.79%	58.91%
% Down Months	45%	47%	33%	35%
% Up Months	55%	53%	67%	65%

The net premium collection collar (2% OTM call/10% OTM put) outperforms the net premium payment collar, the balanced collar and the IWM on an absolute return basis. For example, the net premium collection collar generates a -0.23% return at a standard deviation of 13.86% versus -2.85%/15.78%, -0.77%/12.03%, and -1.51%/25.13% for the balanced collar, the net premium payment collar and the underlying IWM ETF, respectively. From a risk adjusted perspective, the monthly Leland alpha for the net premium collection collar is -2 basis points versus -22, -8 and 0 basis points for the balanced collar, the net premium payment collar and the underlying IWM ETF, respectively. Thus, none of the collars outperform the IWM from a risk adjusted perspective.

Exhibit 12i: Growth of $100 IWM 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 12g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 12j: Protection Cost Index at Roll-In IWM 1-Month "Zero-Cost" Collars

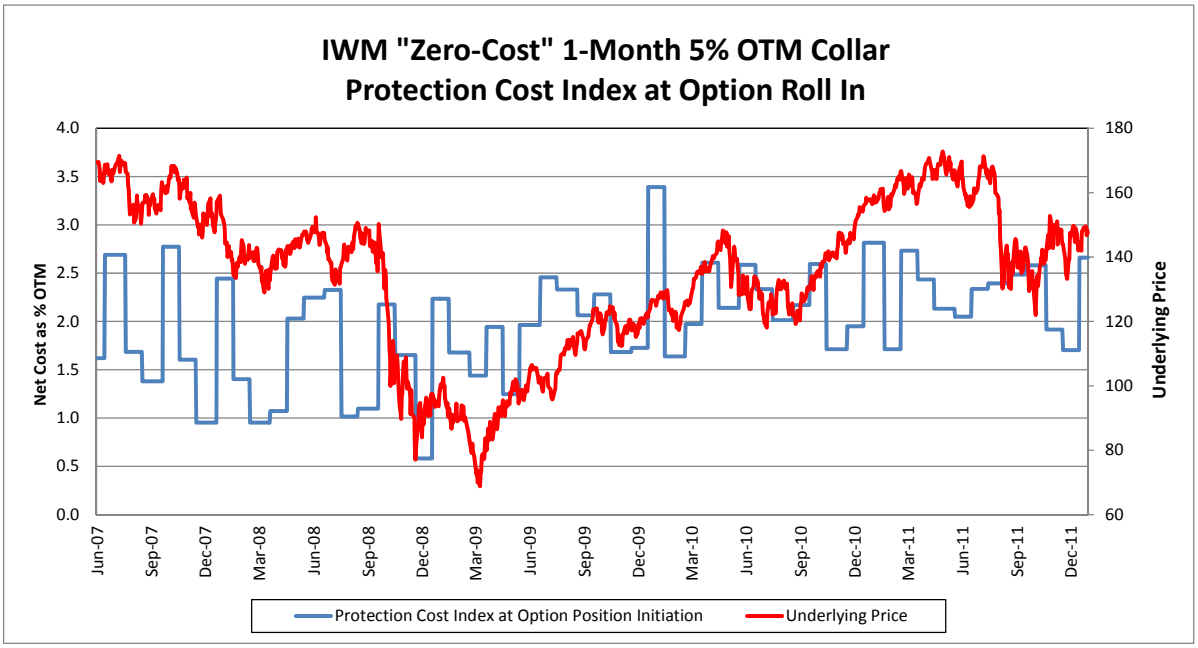


Exhibit 12k: Initial Option Moneyness IWM 1-Month "Zero-Cost" Collars

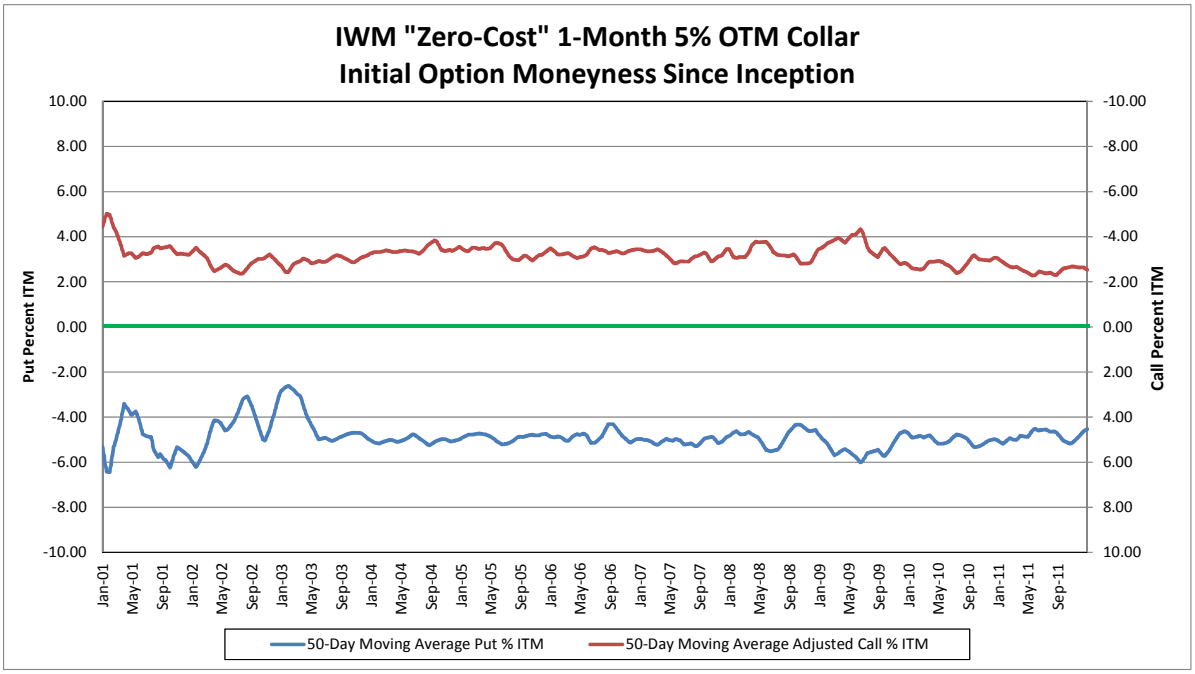


Exhibit 12j and Exhibit 12k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the IWM options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[96].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. The Exhibit indicates a significant skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (this is typical of equity index-based ETFs).While the rolling PCI index tends to average near the 2% level, the PCI varies

[96] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

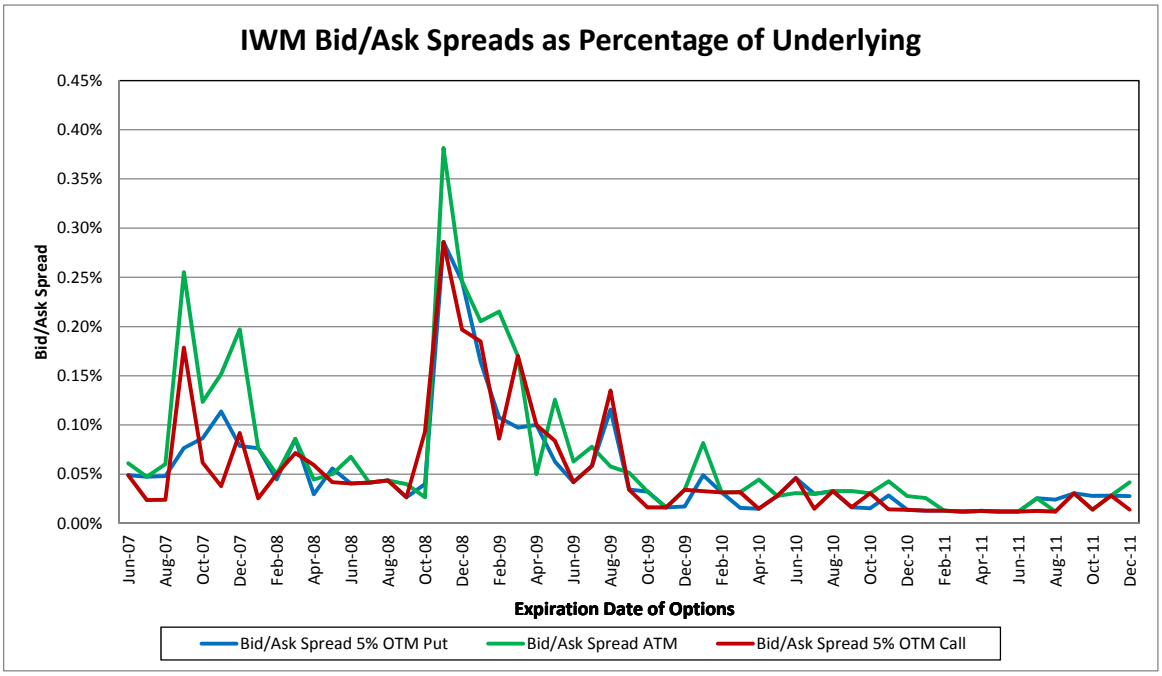
significantly over time, reaching minimum in December 2008 followed by a general upward trend. Exhibit 12k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 12l provides a graphical presentation of bid/ask spreads as a percentage of the underlying IWM price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[97]. In general, bid/ask spreads tend to decrease over time. However, there are a number of peaks in the spreads. While the spreads peak near 40 basis points in late-2008, they are generally under 5 basis points, particularly in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the IWM price[98], such wide spreads were not encountered for the IWM ETF.

[97] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[98] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 12l: Bid/Ask Spreads IWM 1-Month Collars



In conclusion, the IWM ETF options exhibit significant put skew, particularly in the second half of the period. During the financial crisis the performance of the IWM collar strategies was mixed when compared to the IWM ETF. All collars outperformed the IWM on an absolute return basis, but none outperformed on a risk adjusted basis. The IWM ETF experienced significant drawdowns and run ups in the period of study. While the collars significantly reduced the volatility of the IWM, they had smaller impacts on returns. Finally, while IWM options used in this study exhibited bid/ask spreads approaching 0.4% of the underlying price at times, the spreads were generally near 3 basis points in the later part of the period of study.

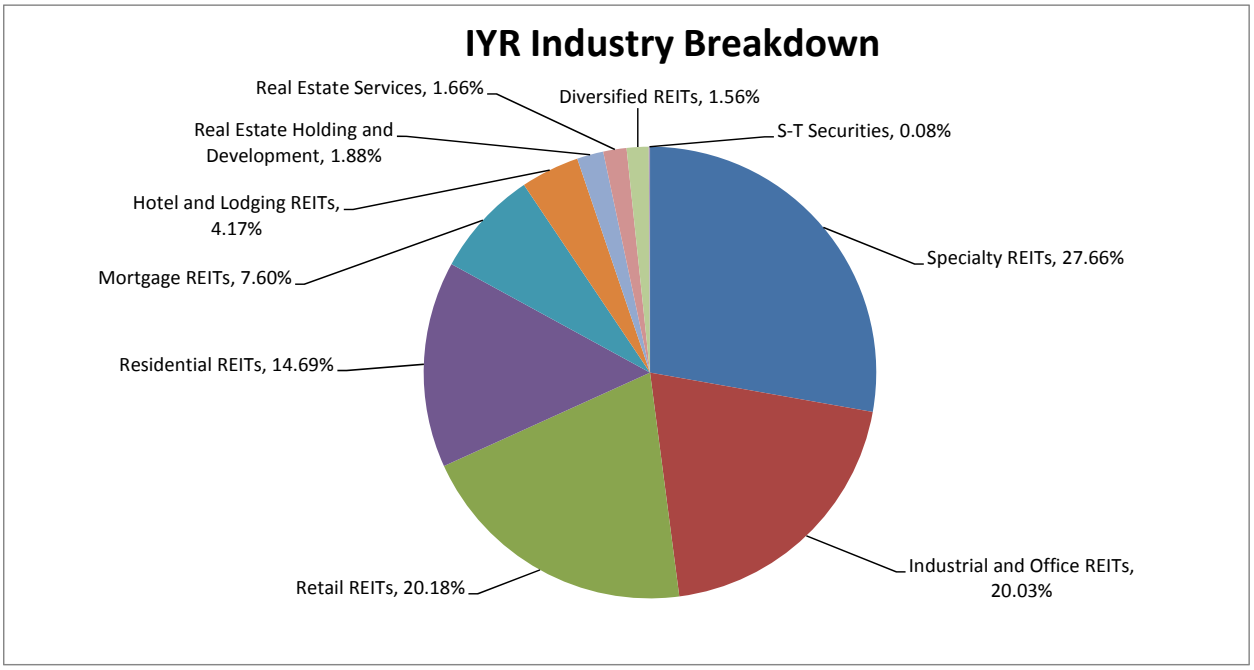
Empirical Results for IYR iShares Dow Jones U.S. Real Estate ETF, (NYSE Arca)

The IYR ETF provides access to the Real Estate asset class. iShares describes the IYR ETF as follows:

> "The iShares Dow Jones U.S. Real Estate Index Fund seeks investment results that correspond generally to the price and yield performance, before fees and expenses, to the performance of the real estate sector of the U.S. equity market, as represented by the Dow Jones U.S. Real Estate Index."…"The iShares Dow Jones U.S. Real Estate Index Fund seeks investment results that correspond generally to the price and yield performance, before fees and expenses, to the performance of the real estate sector of the U.S. equity market, as represented by the Dow Jones U.S. Real Estate Index."

The inception date for the ETF was June 12, 2000, with option data available from May 19, 2004. As of December 31, 2011, the IYR ETF had net assets of $3.29 Billion, and 83 holdings. The IYR is traded on the NYSE Arca exchange and its CUSIP is 464287739. Further details of the fund holdings are provided in Exhibit 13a.

Exhibit 13a IYR ETF Characteristics



Source: http://us.ishares.com/

In this section, we compare the performance of the IYR ETF to the performance of IYR 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[99].

Exhibit 13b: Summary Statistics IYR 1-Month Call/6-Month Put Balanced Collars

IYR Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	IYR Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	-4.02%	-0.56%	0.69%	-1.46%	-4.61%	0.06%
Annualized Standard Deviation	33.27%	8.92%	10.80%	13.33%	16.68%	22.74%
Mean Monthly Return	0.13%	-0.01%	0.11%	-0.05%	-0.28%	0.22%
Median Monthly Return	1.01%	0.25%	0.72%	1.34%	0.60%	0.45%
Period Cumulative Return	-17.14%	-2.53%	3.21%	-6.51%	-19.46%	0.29%
Sharpe Ratio	-0.15	-0.18	-0.03	-0.19	-0.34	-0.04
Stutzer Index	-0.15	-0.18	-0.03	-0.19	-0.34	-0.04
Treynor Ratio	-0.05	-0.09	-0.01	-0.08	-0.13	-0.02
Modified Calmar Ratio	-0.25	-0.11	0.12	-0.20	-0.42	0.01
Jensen Beta with IYR	1.00	0.17	0.24	0.31	0.43	0.53
Jensen Monthly Alpha	0.00%	-0.06%	0.07%	-0.08%	-0.29%	0.15%
Leland Beta	1.00	0.17	0.24	0.31	0.43	0.53
Leland Monthly Alpha	0.00%	-0.06%	0.07%	-0.08%	-0.30%	0.14%
Correlation with Underlying	0.71	0.48	0.53	0.52	0.62	0.57
Skewness	-0.46	-0.88	-0.78	-0.73	-0.70	-0.43
Excess Kurtosis	2.61	2.30	1.60	0.21	-0.12	0.36
Minimum Monthly Return	-31.32%	-7.57%	-8.38%	-9.52%	-11.41%	-18.45%
Maximum Monthly Return	29.62%	6.59%	8.39%	8.15%	7.55%	12.85%
Maximum Drawdown	-67.89%	-22.64%	-26.10%	-32.58%	-46.27%	-41.52%
Maximum Run Up	176.82%	23.48%	36.98%	44.26%	67.39%	89.76%
% Down Months	42%	45%	42%	38%	38%	44%
% Up Months	58%	55%	58%	62%	62%	56%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[100]. Exhibit 13b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk and improves realized returns relative to a long IYR position. The annualized returns are improved from -4.02% for the IYR to -1.46% for the 5% OTM collar. Meanwhile, the standard deviation is reduced by almost 2/3 from 33.27% to 13.33%. More importantly, since the Stutzer index values are negative (and thus

[99] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[100] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

uninformative) we consider the monthly Leland alphas. The monthly Leland alpha of the 5% OTM collar is -8 basis points versus -6, 7, -30, 14 and 0 basis points for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the IYR, respectively. Thus, the 5% OTM collar underperforms the IYR on a risk adjusted basis according to the Leland alpha. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -67.89% to -32.58%. Additional insight can be provided by Exhibit 13c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the superior returns of the collar strategies is their limited participation in the extreme drawdowns the IYR experienced in the first half of the period, particularly in late-2008. The performance of the 5% and greater OTM collars is quite similar to the IYR ETF last two years of the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -67.89% to -32.89% it also reduces the maximum run up from 176.82% to 44.26%. Since the IYR experienced such significant drawdowns over the period, it is not surprising that the collar strategies provided performance improvements (although the improvements were mitigated by the limited participation in the run up in the second half of the period).

In addition to providing results for 5% OTM collars, Exhibit 13b and Exhibit 13c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies significantly reduced the standard deviation of the IYR, the performance of the collars is mixed from both a raw return and risk adjusted return perspective. Since the Stutzer index values are negative (and thus uninformative) we consider the monthly Leland alphas. The monthly Leland alpha of the 5% OTM collar is -8 basis points versus -6, 7, -30, 14 and 0 basis points for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the IYR, respectively. Thus, only the 2% OTM and 10% OTM collars provided higher risk adjusted returns than the

IYR. In contrast, only the 5% OTM collar provided a lower absolute return than the IYR. The annualized return of the 5% OTM collar is -1.46% versus -0.56%, 0.69%, -4.61%, 0.06% and -4.02% for the ATM, 2% OTM, 10% OTM and 25% OTM collars and the IYR, respectively.

Exhibit 13c: Growth of $100 IYR 1-Month Call/6-Month Put Balanced Collars

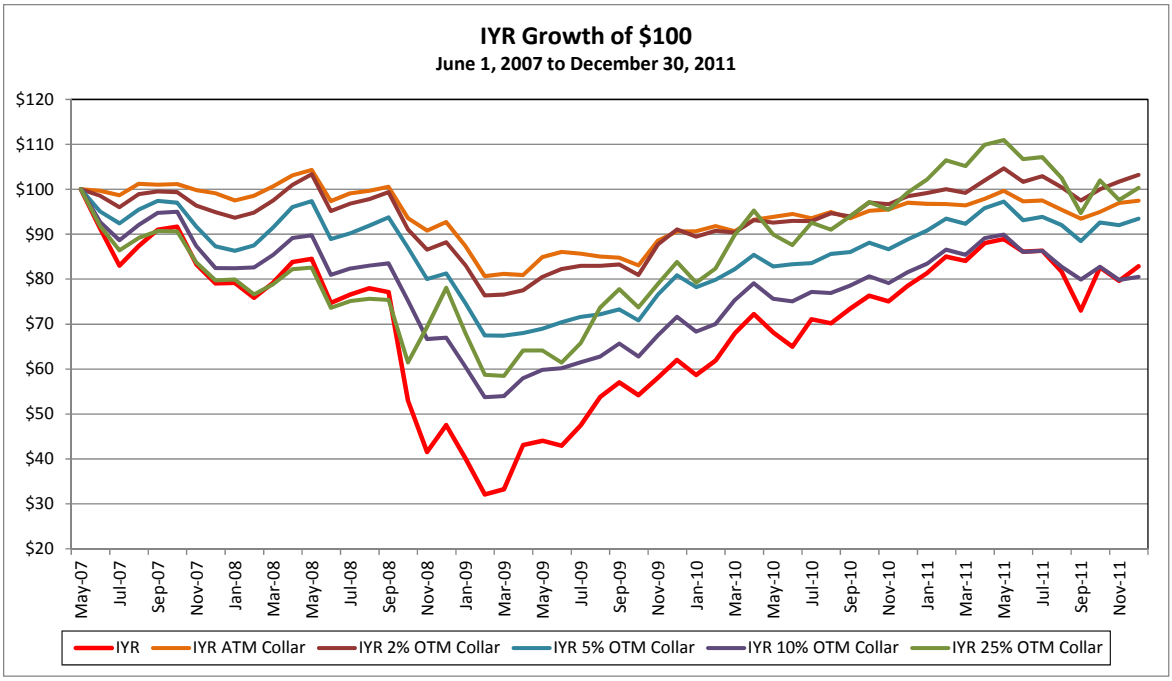


Exhibit 13d and Exhibit 13e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 13d it is clear that the collar strategies provide limited participation in the run ups of the IYR as well as limited participation in the drawdowns. The rolling standard deviations provided in Exhibit 13e are further evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 2% to 45%.

Exhibit 13d: Rolling Returns IYR 1-Month Call/6-Month Put Collars

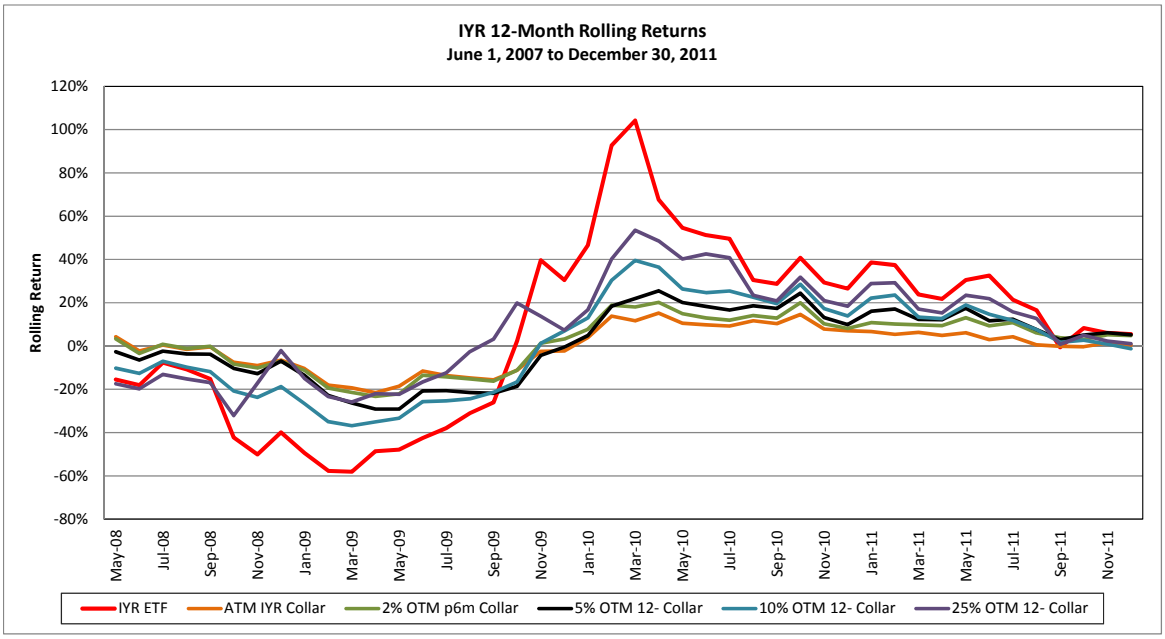
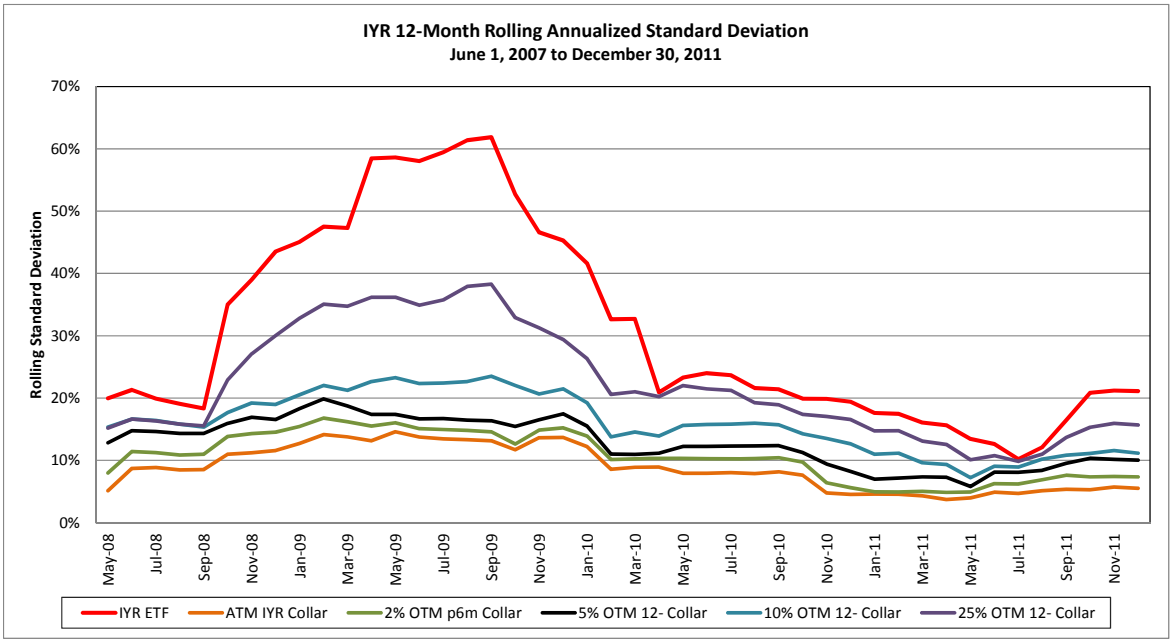


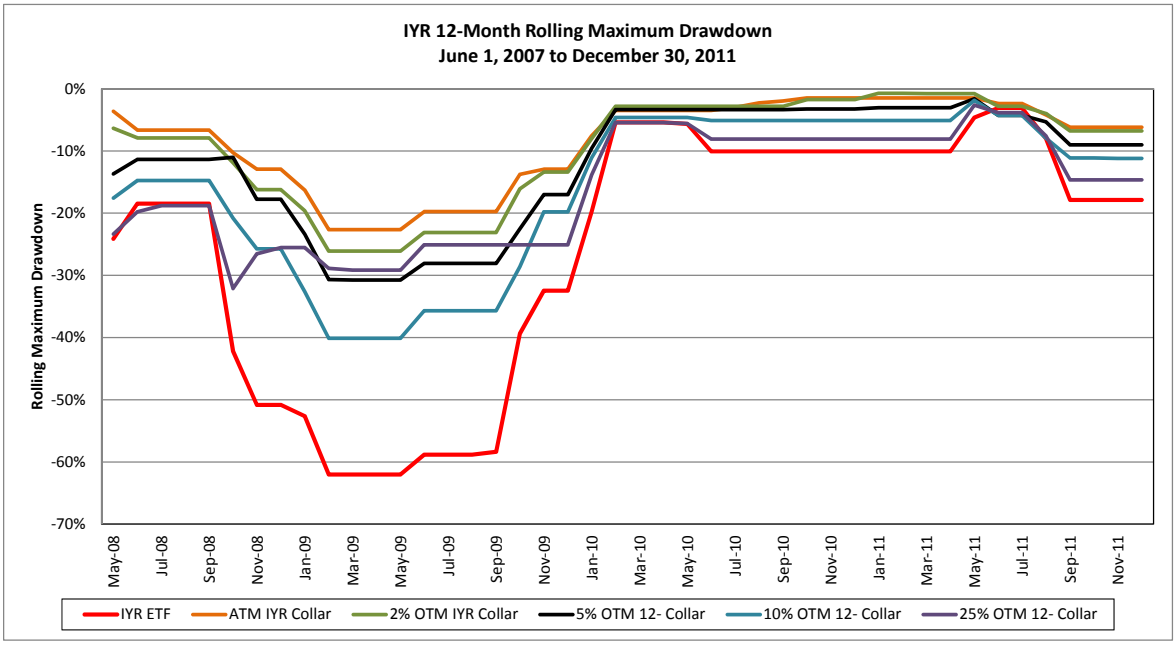
Exhibit 13e: Rolling Standard Deviation IYR 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 13f provides a graphical presentation of 12-month rolling

maximum drawdowns for IYR collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the IYR experienced a very significant drawdown during the first half of the period of study, the collars provided a great deal of drawdown protection, with the moneyness of the collar having a large impact on the degree of drawdown protection. While the near the money strategies provided significant protection, the deeper OTM collars had far less (although still very significant) impact on drawdowns.

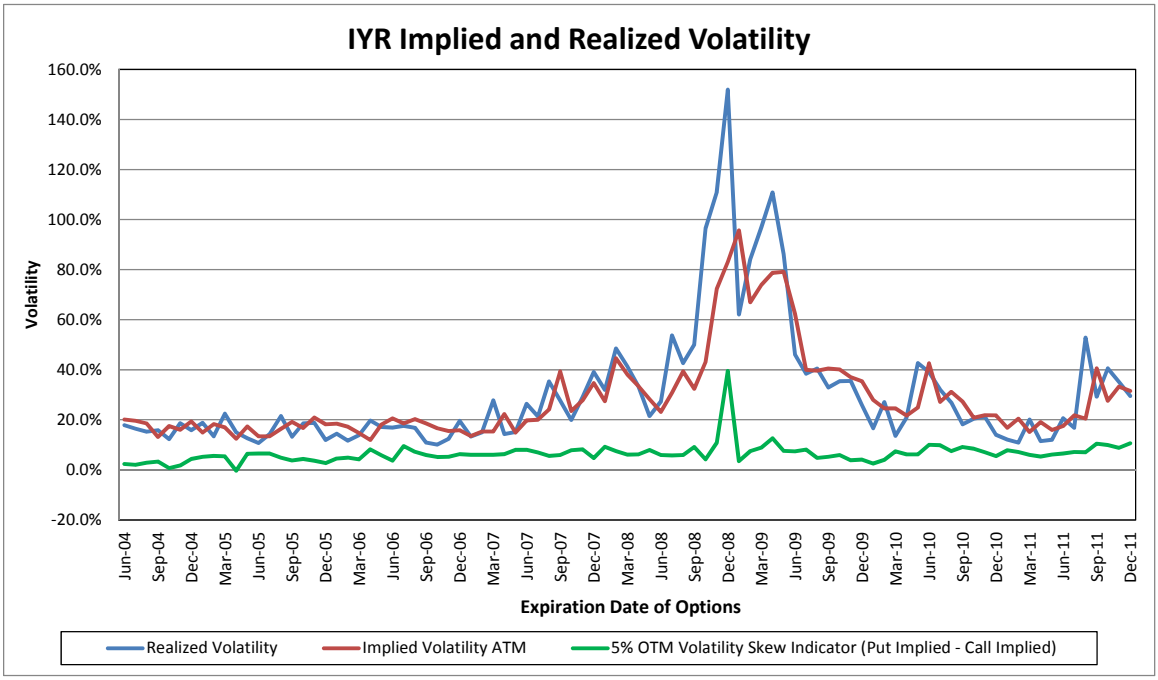
Exhibit 13f: Rolling Maximum Drawdown IYR 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying IYR ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 13g provides the levels of initial implied volatilities for 1-month ATM options on the IYR since inception as well as the ex post realized

volatility over the life of the options[101] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[102]). While the volatility of volatility is quite high, the ATM implied volatility for the IYR options tends to fluctuate around the 20% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in late-2008 and early-2009. The implied volatility differential between the puts and calls tends to fluctuate around the 5% to 10% level (with the puts exhibiting higher implied volatilities than the calls, similar to typical equity index-based ETFs) and exhibits some very significant peaks over the period (particularly in late-2008) as well as an apparent slight upward trend.

Exhibit 13g: Implied and Realized Volatility IYR 1-Month Collars Since Option Inception



[101] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[102] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

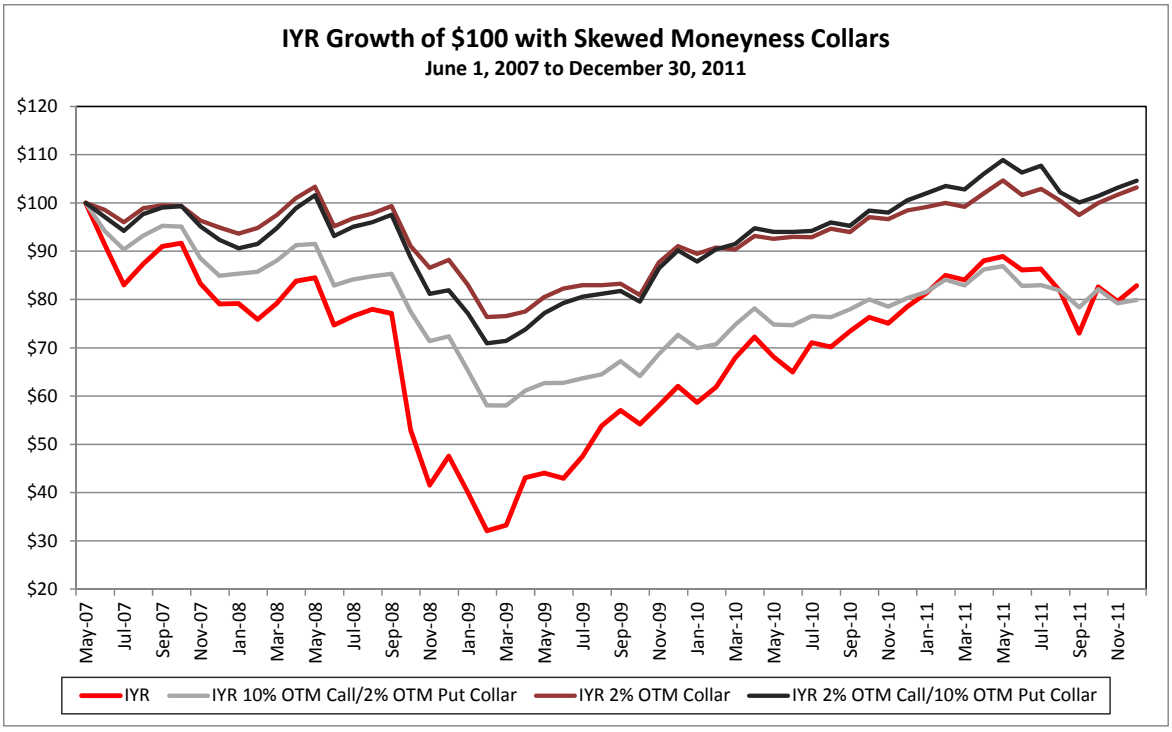
Exhibit 13h and Exhibit 13i provide summary statistics and a graphical presentation of performance, respectively for skewed IYR collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 13h: Summary Statistics IYR 1-Month Call/6-Month Put Skewed Collars

IYR Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	IYR Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	-4.02%	-4.77%	0.69%	0.99%
Annualized Standard Deviation	33.27%	14.83%	10.80%	12.43%
Mean Monthly Return	0.13%	-0.31%	0.11%	0.15%
Median Monthly Return	1.01%	0.59%	0.72%	1.03%
Period Cumulative Return	-17.14%	4.63%	3.21%	-20.09%
Sharpe Ratio	-0.15	-0.39	-0.03	0.00
Stutzer Index	-0.15	-0.40	-0.03	0.00
Treynor Ratio	-0.05	-0.15	-0.01	0.00
Modified Calmar Ratio	-0.25	0.11	0.12	-0.67
Jensen Beta with IYR	1.00	0.38	0.24	0.29
Jensen Monthly Alpha	0.00%	-0.33%	0.07%	0.12%
Leland Beta	1.00	0.38	0.24	0.29
Leland Monthly Alpha	0.00%	-0.33%	0.07%	0.12%
Correlation with Underlying	0.71	0.62	0.53	0.55
Skewness	-0.46	-0.76	-0.78	-0.83
Excess Kurtosis	2.61	0.05	1.60	0.91
Minimum Monthly Return	-31.32%	-11.14%	-8.38%	-9.09%
Maximum Monthly Return	29.62%	7.20%	8.39%	8.71%
Maximum Drawdown	-67.89%	-41.95%	-26.10%	-30.19%
Maximum Run Up	176.82%	53.50%	36.98%	49.77%
% Down Months	42%	40%	42%	35%
% Up Months	58%	60%	58%	65%

The net premium collection collar (2% OTM call/10% OTM put) outperforms the net premium payment collar, the balanced collar and the IYR ETF by most measures. For example, the net premium collection collar generates a 0.99% return at a standard deviation of 12.43% versus -4.77%/14.83%, 0.69%/10.80%, and -4.02%/33.27% for the balanced collar, the net premium payment collar and the underlying IYR ETF, respectively. Similarly, the monthly Leland alpha for the net premium collection collar is 12 basis points versus -33, 7 and 0 basis points for the balanced collar, the net premium payment collar and the underlying IYR ETF, respectively.

Exhibit 13i: Growth of $100 IYR 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 13g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 13j: Protection Cost Index at Roll-In IYR 1-Month "Zero-Cost" Collars

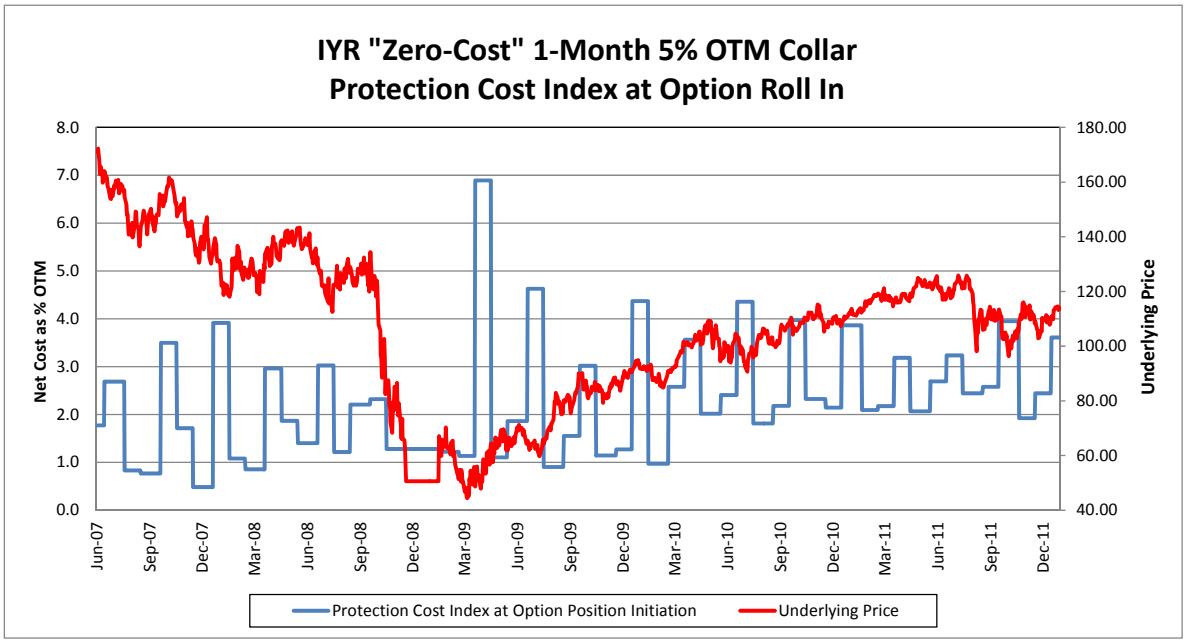


Exhibit 13k: Initial Option Moneyness IYR 1-Month "Zero-Cost" Collars

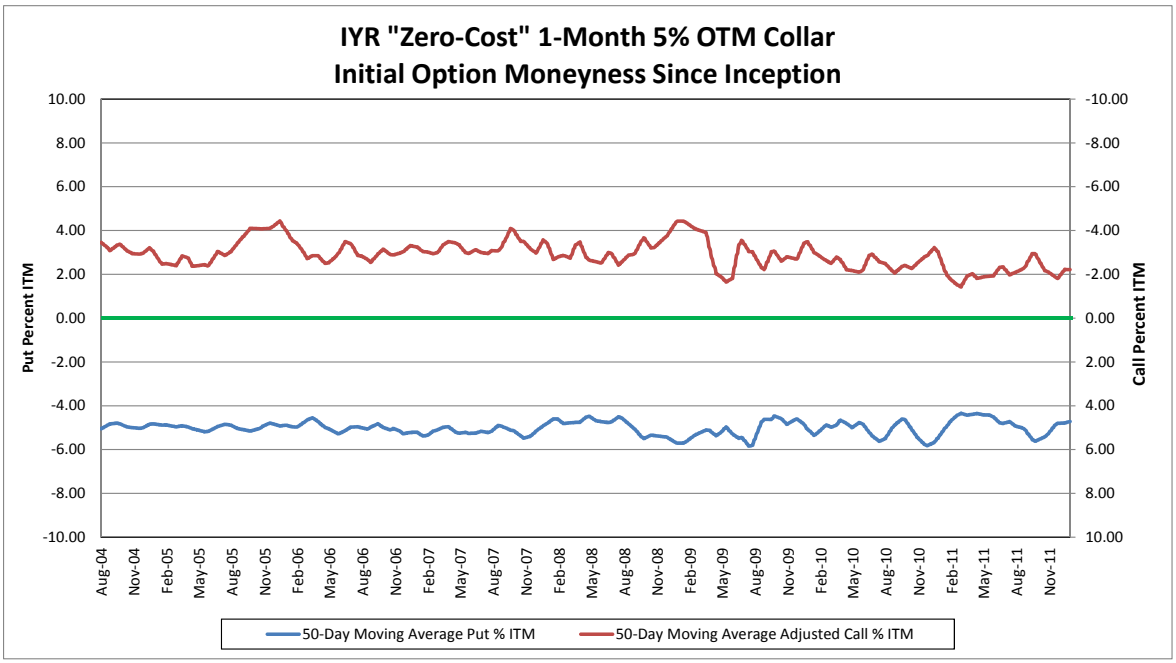


Exhibit 13j and Exhibit 13k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the IYR options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[103].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. It is worth noting that Exhibit 13j indicates missing options by a horizontal line for

[103] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

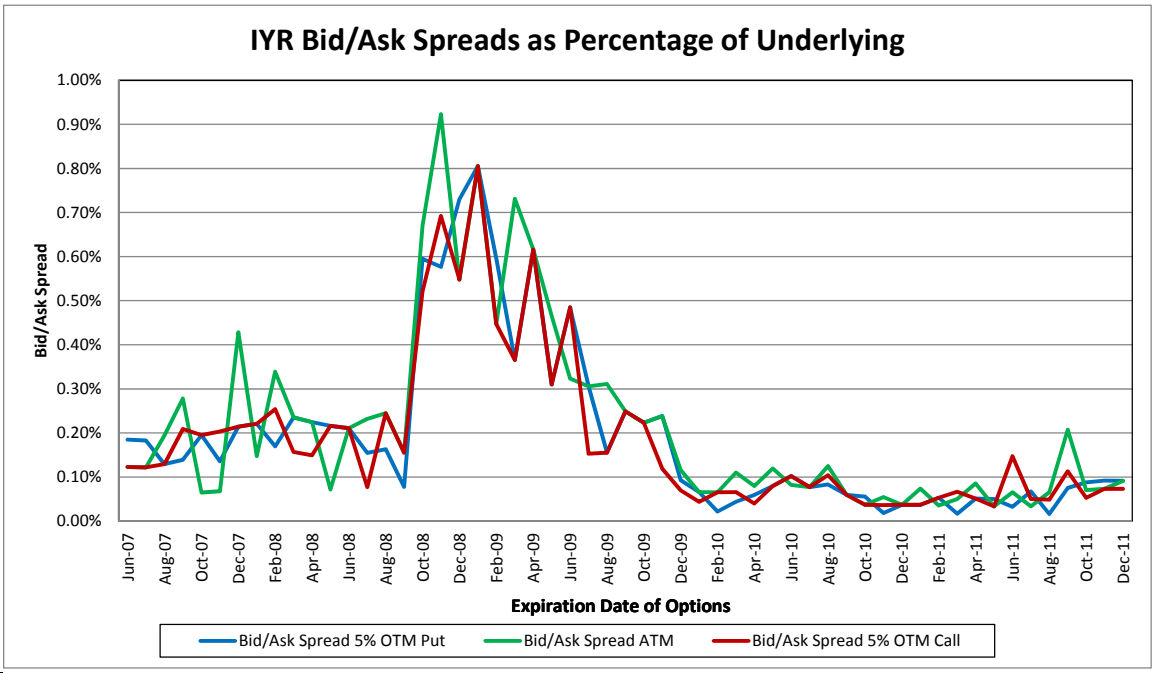
the underlying price as well as the PCI for the period in which no option position is available. This could occur either because all puts or calls have overly large bid/ask spreads (greater than 1% of the underlying price) or because no call is quoted which has a price as high as the chosen 5% OTM put. The Exhibit indicates a significant skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (similar to typical equity-based ETFs).While the rolling PCI index tends to average near the 2% level, the PCI varies significantly over time, reaching maximum magnitude of 7% in April 2009. The PCI appears to follow a general upward trend over the period. Exhibit 13k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 13l provides a graphical presentation of bid/ask spreads as a percentage of the underlying IYR price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[104]. In general, bid/ask spreads tend to decrease over time. However, there are a number of peaks in the spreads, particularly in late-2009 and early-2009. While spreads approach 1% in the middle of the period, they tend to fluctuate around the 10 basis point level in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in

[104] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the IYR price[105], such wide spreads were not encountered for the IYR ETF.

Exhibit 13l: Bid/Ask Spreads IYR 1-Month Collars



In conclusion, the IYR ETF options generally exhibit significant put skew. During the financial crisis the IYR collar strategies generally outperformed the IYR by a large margin on an absolute return basis. However, the results were mixed on a risk adjusted basis. Some collars underperformed the IYR while others outperformed the IYR. The IYR ETF experienced a very significant drawdown in the first half of the period of study followed by a relatively consistent

[105] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

and strong run up in the second half of the period. All the collars significantly reduced the volatility of the IYR, and generally provided significant improvements to the returns. Finally, while IYR options used in this study exhibited bid/ask spreads approaching 1% of the underlying price at times, the spreads were generally near 10 basis points in the later part of the period of study.

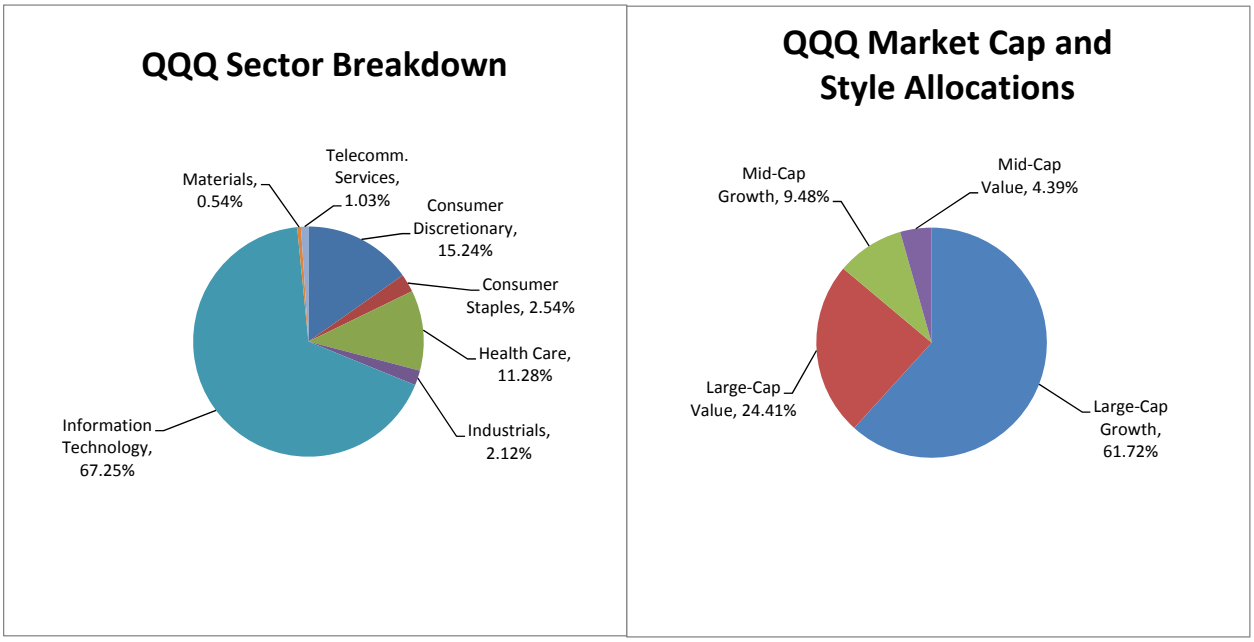
Empirical Results for PowerShares QQQ ETF, (Nasdaq)

The QQQ ETF provides access to the Technology Sector of U.S. Equities. PowerShares describes the QQQ ETF as follows:

> "The PowerShares QQQ, formerly known as 'QQQ' or the 'Nasdaq-100 Index Tracking Stock,' is based on the Nasdaq-100 Index. The Fund will, under most circumstances, consist of all the stocks in the Index. The Index includes 100 of the largest, most innovative nonfinancial companies that trade on The Nasdaq Stock Market, based on market capitalization. The portfolio is rebalanced quarterly and reconstituted annually."

The inception date for the ETF was March 10, 1999, with option data available from March 19, 1999. As of December 31, 2011, the QQQ ETF had net assets of $24.21 Billion, and 102 holdings. The QQQ is traded on the Nasdaq exchange and its CUSIP is 73935A104. Further details of the fund holdings are provided in Exhibit 14a.

Exhibit 14a QQQ ETF Characteristics



Source: http://invescopowershares.com/

In this section, we compare the performance of the QQQ ETF to the performance of QQQ 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[106].

Exhibit 14b: Summary Statistics QQQ 1-Month Call/6-Month Put Balanced Collars

QQQ Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	QQQ Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	4.25%	-1.21%	0.64%	1.75%	3.07%	5.18%
Annualized Standard Deviation	22.79%	8.09%	10.21%	13.16%	16.58%	19.28%
Mean Monthly Return	0.56%	-0.07%	0.10%	0.22%	0.37%	0.58%
Median Monthly Return	1.47%	0.52%	0.43%	0.54%	1.26%	0.93%
Period Cumulative Return	21.01%	-5.44%	2.95%	8.28%	14.89%	26.04%
Sharpe Ratio	0.14	-0.28	-0.04	0.05	0.12	0.21
Stutzer Index	0.14	-0.28	-0.04	0.05	0.12	0.21
Treynor Ratio	0.03	-0.10	-0.01	0.01	0.03	0.05
Modified Calmar Ratio	0.42	-0.33	0.13	0.29	0.42	0.65
Jensen Beta with QQQ	1.00	0.22	0.35	0.50	0.68	0.80
Jensen Monthly Alpha	0.00%	-0.24%	-0.13%	-0.07%	-0.01%	0.13%
Leland Beta	1.00	0.22	0.35	0.50	0.67	0.79
Leland Monthly Alpha	0.00%	-0.25%	-0.13%	-0.07%	-0.01%	0.13%
Correlation with Underlying	0.86	0.46	0.63	0.72	0.76	0.79
Skewness	-0.46	-1.20	-0.84	-0.61	-0.37	-0.32
Excess Kurtosis	0.06	1.98	1.31	0.40	-0.16	0.02
Minimum Monthly Return	-15.58%	-8.12%	-9.75%	-10.91%	-12.40%	-14.19%
Maximum Monthly Return	13.17%	4.15%	5.99%	7.18%	10.68%	12.80%
Maximum Drawdown	-49.74%	-16.32%	-22.42%	-28.80%	-35.32%	-40.02%
Maximum Run Up	117.69%	20.90%	40.11%	57.99%	73.91%	95.70%
% Down Months	44%	38%	40%	42%	44%	44%
% Up Months	56%	62%	60%	58%	56%	56%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[107]. Exhibit 14b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk as well as reducing realized returns relative to a long QQQ position. The annualized returns are reduced from 4.25% for the QQQ to 1.75% for the 5% OTM collar. The standard deviation is reduced by almost 1/2 from 22.79% to

[106] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[107] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

13.16%. The Stutzer index decreased from 0.14 to 0.05, suggesting that the collar reduced risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -49.74% to -28.80%. Despite the reduction, the modified Calmar ratio[108] for the collar is less than that of the QQQ at 0.29 (versus 0.42 for the QQQ) for the 55 month period, suggesting that returns were reduced proportionally more than the reduction in the maximum drawdown. Additional insight can be provided by Exhibit 14c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the underperformance of the collar strategies is their limited participation in the run ups that the QQQ ETF experienced in late-2010 and early-2011, although the collars' limited participation in the drawdowns of late-2008 certainly helped their relative performance. The performance of the 5% and greater OTM collars is quite similar to the QQQ ETF for much of the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -49.74% to -28.80%, it also reduces the maximum run up from 117.69% to 57.99%. Since the QQQ experienced such strong run ups relative to the drawdowns in the period, it is not surprising that the collar strategies did not provide performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 14b and Exhibit 14c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the QQQ, the further OTM strategies outperformed nearer to ATM collars from a raw return perspective as well as from a risk adjusted return perspective. By most measures, the 25% OTM collar outperformed the other collars as well as outperforming the QQQ. In fact, the 25% OTM collar is the only one that outperformed the

[108] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

QQQ. For example, the Stutzer index of the 25% OTM collar is 0.21 versus- 0.28, -0.04, 0.05, 0.12 and 0.14 for the ATM, 2% OTM, 5% OTM and 10% OTM collars and the QQQ, respectively. Similarly, the monthly Leland alpha of the 25% OTM collar is 13 basis points versus -25, -13, -7, -1 and 0 basis points for the ATM, 2% OTM, 5% OTM and 10% OTM collars and the QQQ, respectively. Thus, only the 25% OTM collar has a higher Leland alpha and Stutzer index than the QQQ.

Exhibit 14c: Growth of $100 QQQ 1-Month Call/6-Month Put Balanced Collars

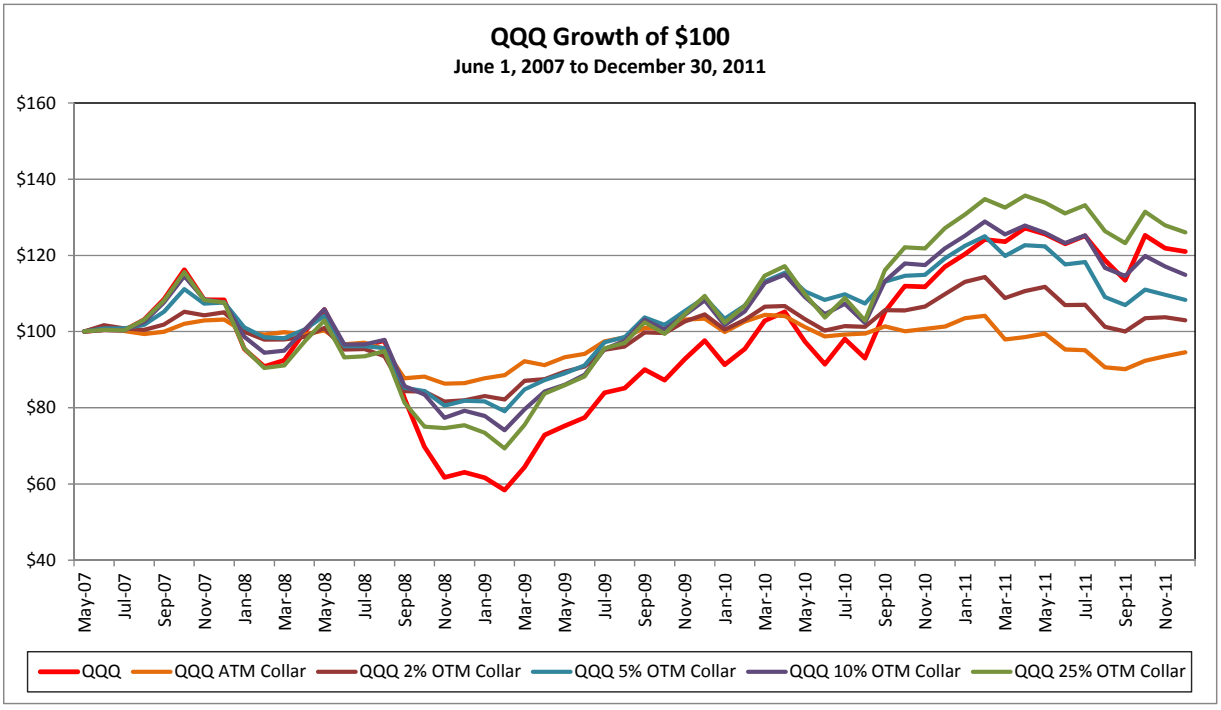


Exhibit 14d and Exhibit 14e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 14d it is clear that the collar strategies provide limited participation in the run ups of the QQQ as well as limited participation in the drawdowns. The rolling standard deviations provided in Exhibit 14e are further evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM

collar strategies exhibit significantly lower standard deviations through most of the period, with the difference for the 5% OTM collar ranging from about 0% to 17%.

Exhibit 14d: Rolling Returns QQQ 1-Month Call/6-Month Put Collars

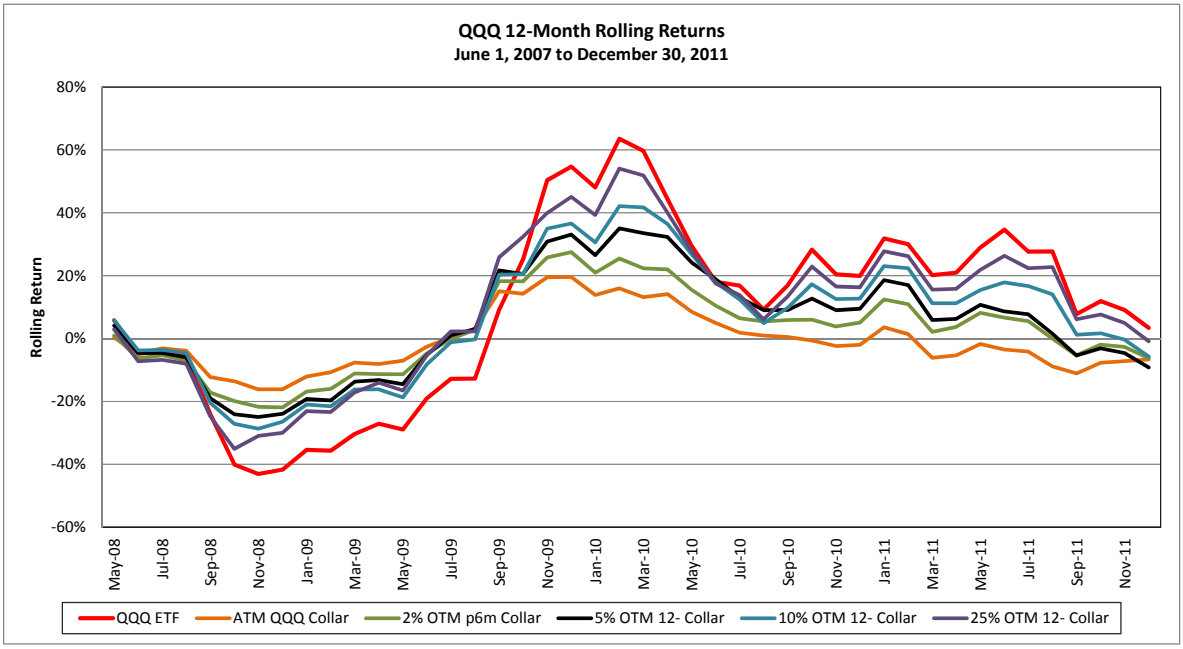
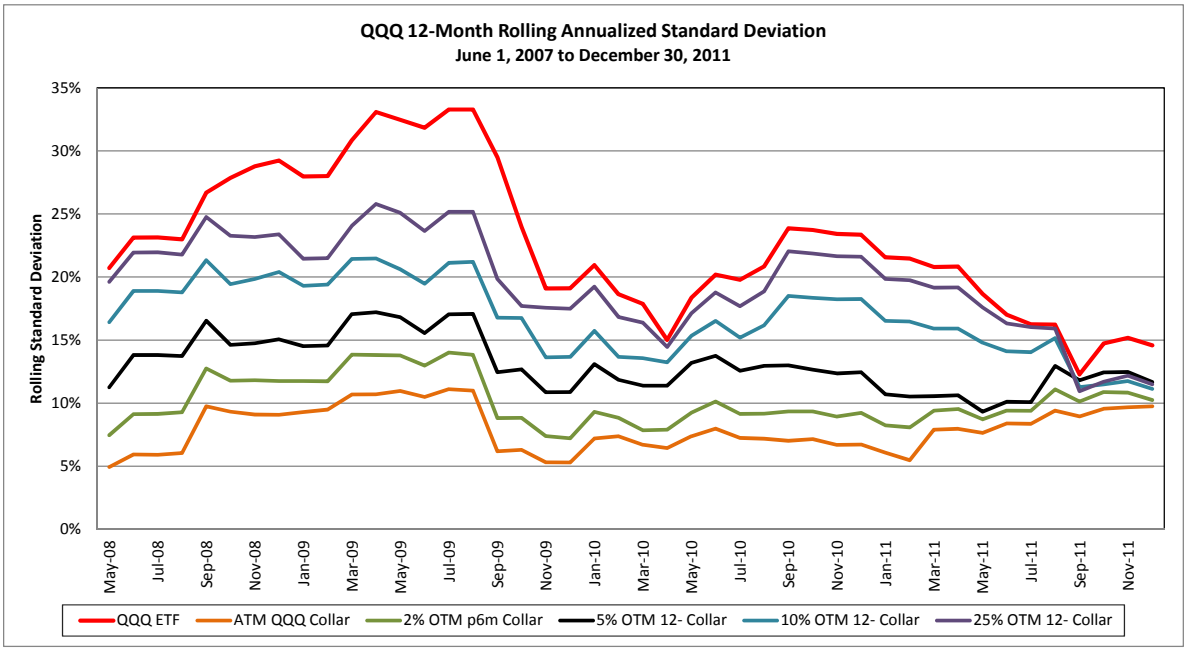
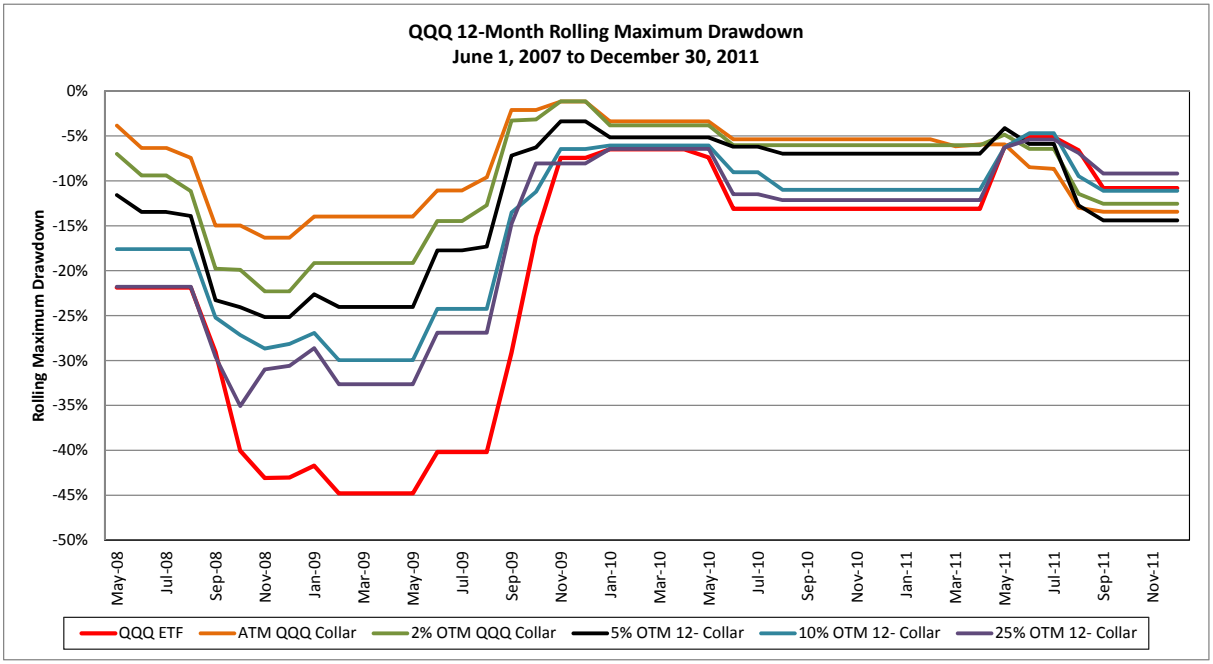


Exhibit 14e: Rolling Standard Deviation QQQ 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 14f provides a graphical presentation of 12-month rolling maximum drawdowns for QQQ collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the QQQ experienced a large drawdown in the first half of the period of study, the collars provided significant reductions in drawdowns in this portion of the period with the moneyness of the collar having a large impact on the degree of drawdown reduction. While the near the money strategies provided very significant protection, the deeper OTM collars had lower (although still significant) impact on drawdowns. The 5% OTM collar reduced rolling drawdowns by about 25% at their worst.

Exhibit 14f: Rolling Maximum Drawdown QQQ 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying QQQ ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 14g provides the levels of initial implied volatilities for 1-month ATM options on the QQQ since inception as well as the ex post realized volatility over the life of the options[109] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[110]). While the volatility of volatility is extremely high, the ATM implied volatility for the QQQ options tends to fluctuate around the 10% to 20% level when in a "low volatility" regime and around 40% when in a "high volatility" regime (1999 to 2003). The implied volatility differential between the puts and calls tends to fluctuate around the 5% level (with the puts exhibiting higher implied volatilities than the calls, as would be expected of an equity index-based ETF) and exhibits some very significant peaks over the period as well as an apparent slight upward trend.

[109] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[110] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

Exhibit 14g: Implied and Realized Volatility QQQ 1-Month Collars Since Option Inception

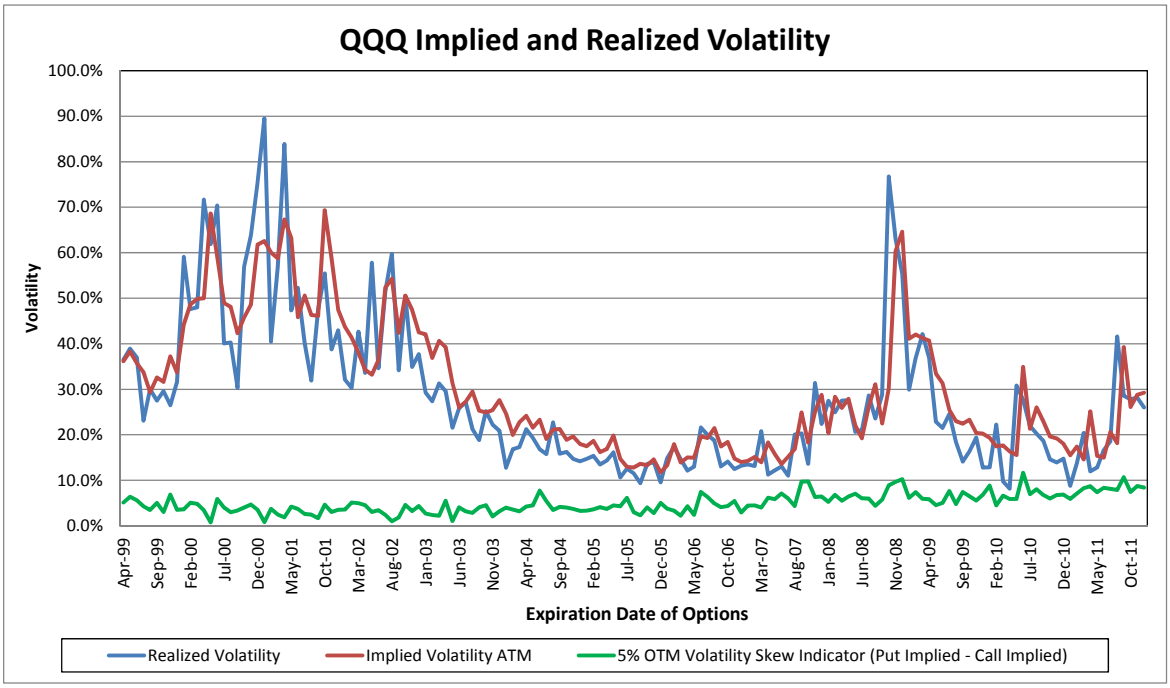


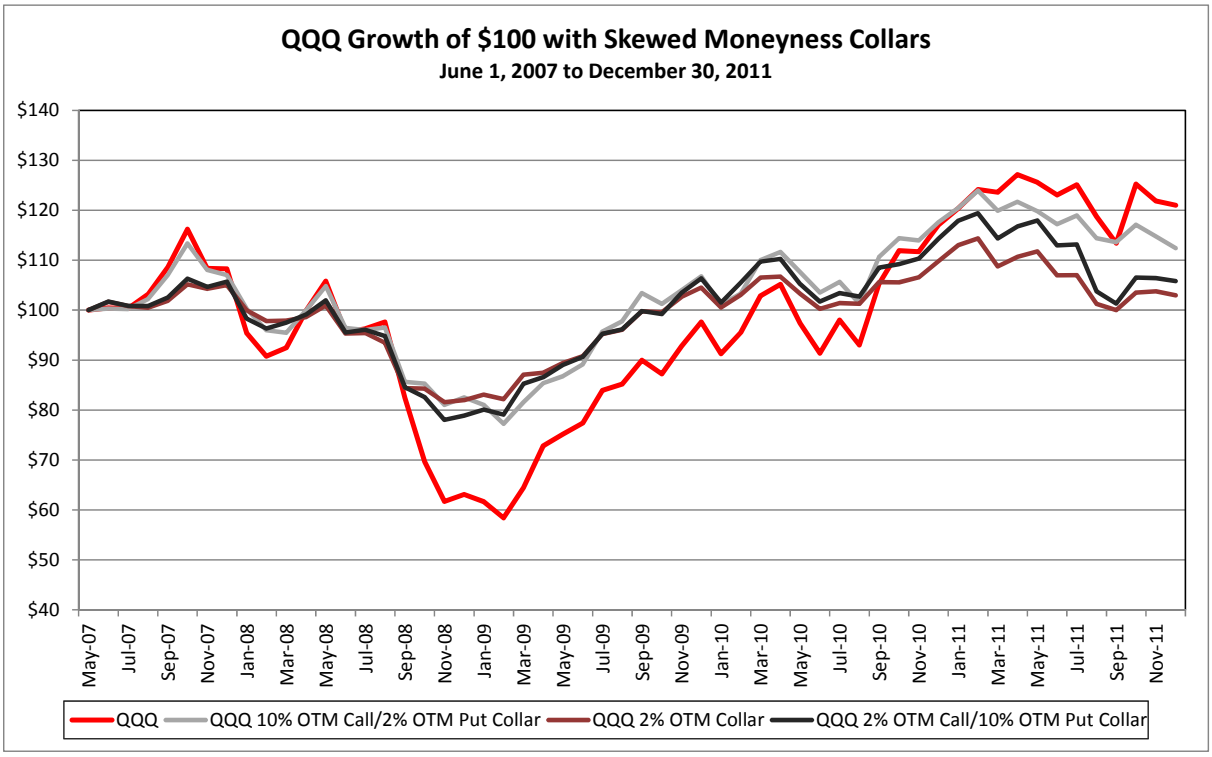
Exhibit 14h and Exhibit 14i provide summary statistics and a graphical presentation of performance, respectively for skewed QQQ collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 14h: Summary Statistics QQQ 1-Month Call/6-Month Put Skewed Collars

QQQ Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	QQQ Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	4.25%	2.59%	0.64%	1.24%
Annualized Standard Deviation	22.79%	14.19%	10.21%	12.62%
Mean Monthly Return	0.56%	0.30%	0.10%	0.17%
Median Monthly Return	1.47%	0.53%	0.43%	0.99%
Period Cumulative Return	21.01%	5.80%	2.95%	12.42%
Sharpe Ratio	0.14	0.11	-0.04	0.02
Stutzer Index	0.14	0.11	-0.04	0.01
Treynor Ratio	0.03	0.03	-0.01	0.00
Modified Calmar Ratio	0.42	0.18	0.13	0.47
Jensen Beta with QQQ	1.00	0.55	0.35	0.47
Jensen Monthly Alpha	0.00%	-0.02%	-0.13%	-0.11%
Leland Beta	1.00	0.55	0.35	0.47
Leland Monthly Alpha	0.00%	-0.02%	-0.13%	-0.11%
Correlation with Underlying	0.86	0.71	0.63	0.70
Skewness	-0.46	-0.33	-0.84	-0.78
Excess Kurtosis	0.06	0.12	1.31	0.83
Minimum Monthly Return	-15.58%	-11.31%	-9.75%	-10.82%
Maximum Monthly Return	13.17%	9.24%	5.99%	7.78%
Maximum Drawdown	-49.74%	-31.89%	-22.42%	-26.58%
Maximum Run Up	117.69%	53.02%	40.11%	60.49%
% Down Months	44%	47%	40%	40%
% Up Months	56%	53%	60%	60%

The net premium payment collar (2% OTM call/10% OTM put) outperforms the net premium collection collar and the balanced collar on a risk adjusted and an absolute return basis, although all three collars underperform the QQQ. For example, the net premium payment collar generates a 2.59% return at a standard deviation of 14.19% versus 0.64%/10.21%, 1.24%/12.62%, and 4.25%/22.79% for the balanced collar, the net premium collection collar and the underlying QQQ ETF, respectively. Similarly, the Stutzer index for the net premium payment collar is 0.11versus -0.04, 0.01 and 0.14 for the balanced collar, the net premium collection collar and the underlying QQQ ETF, respectively.

Exhibit 14i: Growth of $100 QQQ 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 14g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 14j: Protection Cost Index at Roll-In QQQ 1-Month "Zero-Cost" Collars

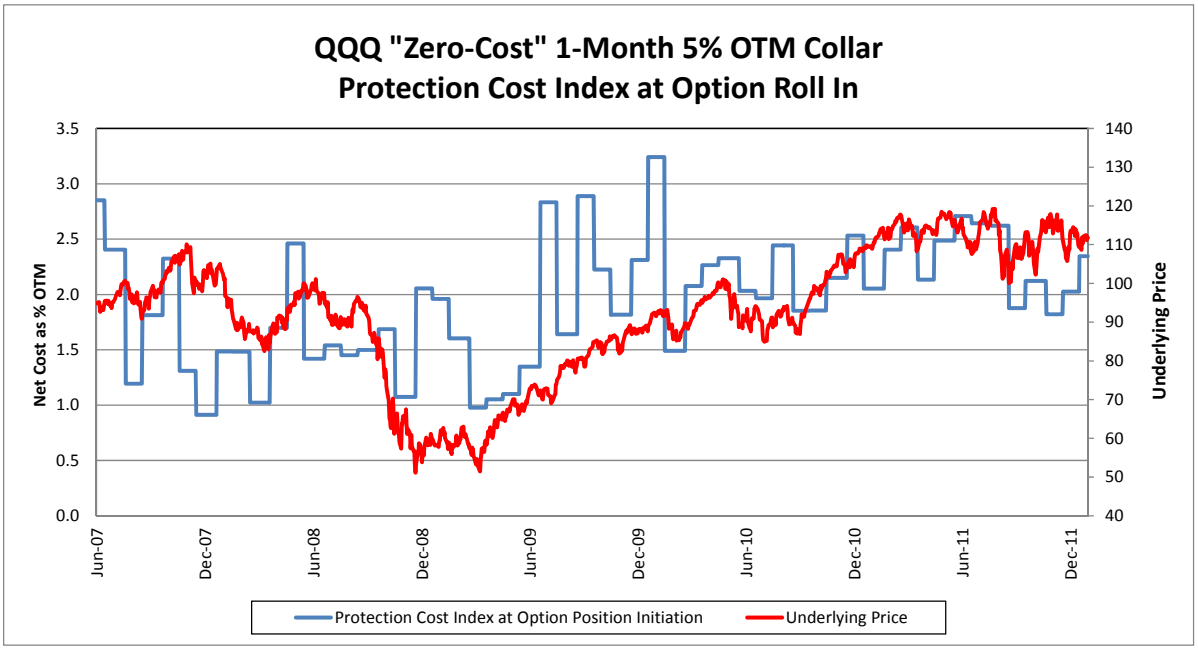


Exhibit 14k: Initial Option Moneyness QQQ 1-Month "Zero-Cost" Collars

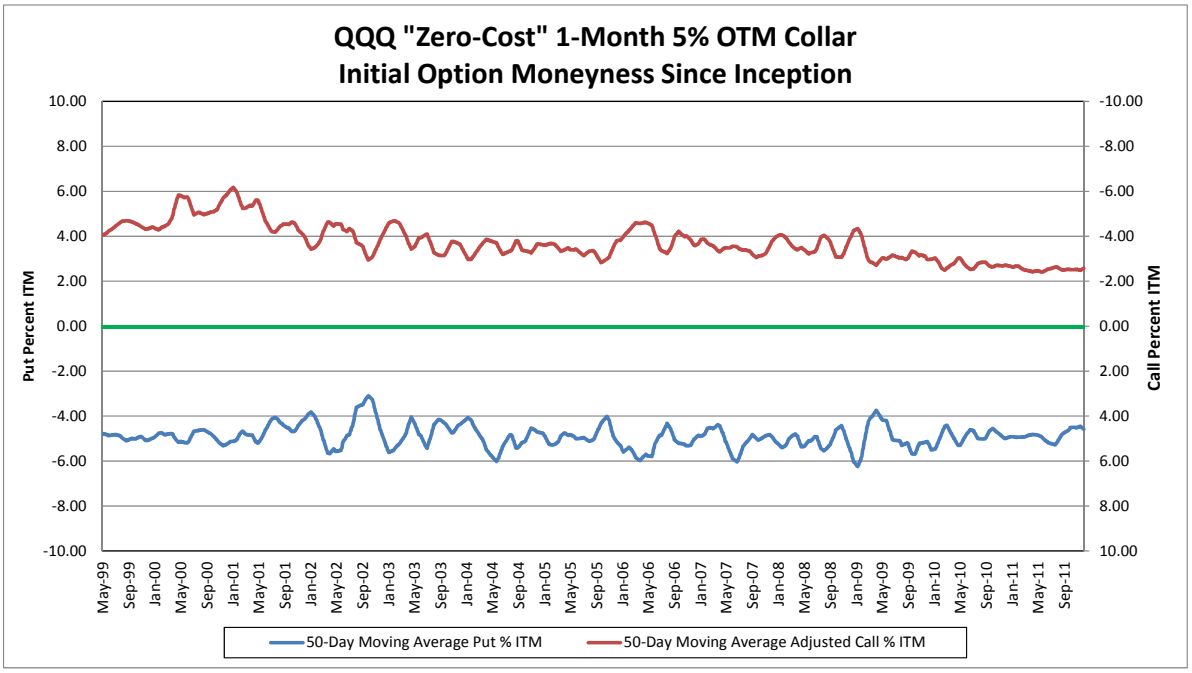


Exhibit 14j and Exhibit 14k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the QQQ options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[111].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

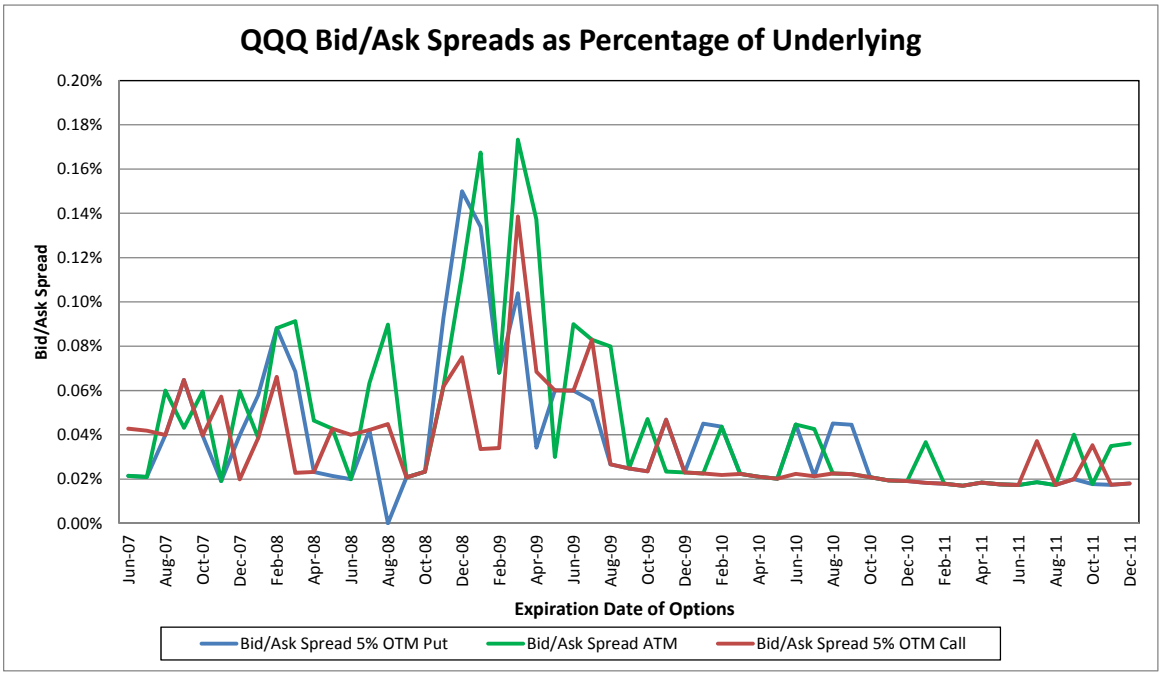
Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. The Exhibit indicates a significant skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (typical of equity index-based ETFs).While the rolling PCI index tends to average near the 2% level, the PCI varies significantly over time and appears to exhibit a slight upward trend. Exhibit 14k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 14l provides a graphical presentation of bid/ask spreads as a percentage of the underlying QQQ price for 5% OTM 1-month puts and

[111] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

calls as well as ATM options over the period of the study[112]. In general, bid/ask spreads tend to decrease over time. However, there are a number of peaks in the spreads, particularly in late-2008 and early-2009. While the peaks approach 18 basis points, the spreads tend to fluctuate between 2 and 4 basis points, particularly in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the QQQ price[113], such wide spreads were not encountered for the QQQ ETF.

Exhibit 14l: Bid/Ask Spreads QQQ 1-Month Collars



[112] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[113] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

In conclusion, the QQQ ETF options exhibit significant put skew, particularly in the second half of the period. During the financial crisis the performance of the QQQ collar strategies was generally inferior to the QQQ ETF, both on an absolute and risk adjusted basis (with the exception of the 25% OTM collar). The QQQ ETF experienced a significant drawdown in the first half of the period of study, followed by a very strong (although sometimes faltering) run up. While all of the collars significantly reduced the volatility of the QQQ, they generally did little for the returns. Finally, while QQQ options used in this study exhibited bid/ask spreads approaching 0.18% of the underlying price at times, the spreads were generally between 2 and 4 basis points in the later part of the period of study.

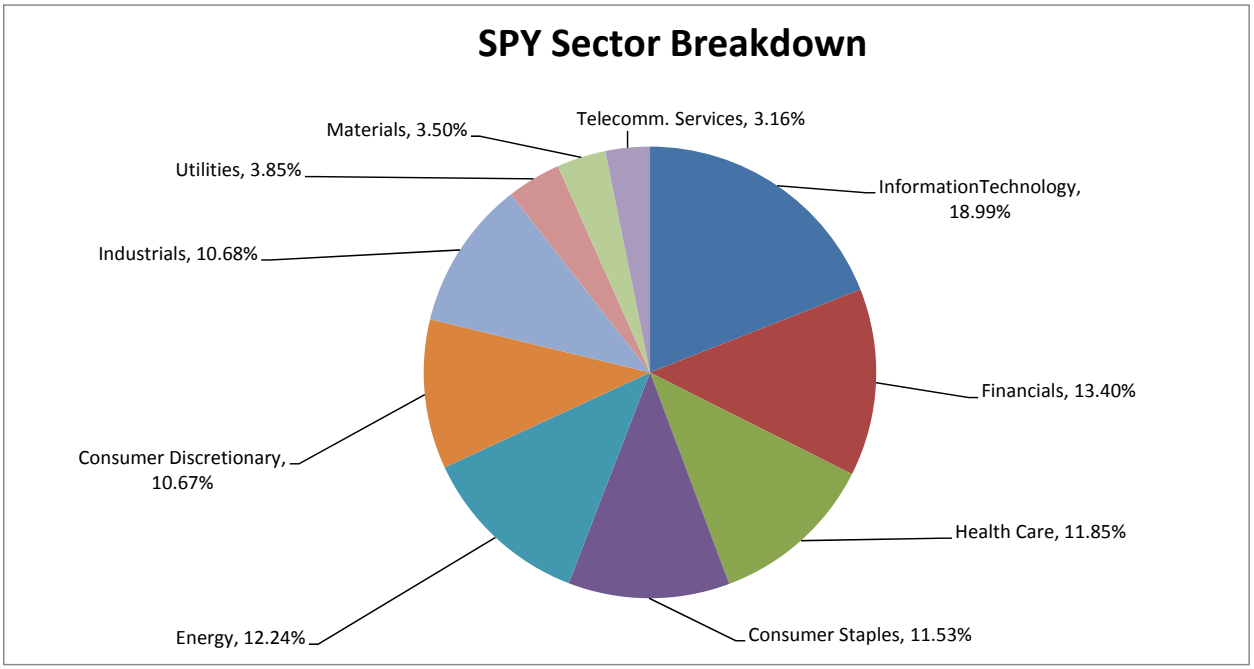
Empirical Results for SPDR S&P 500 ETF, (NYSE Arca)

The SPY ETF provides access to Large Capitalization Equities. SSGA describes the SPY ETF as follows:

> "The SPDR S&P 500 ETF is a fund that, before expenses, generally corresponds to the price and yield performance of the S&P 500 Index (Ticker: SPTR). Our approach is designed to provide portfolios with low portfolio turnover, accurate tracking, and lower costs."…"The S&P 500 Index is comprised of five hundred (500) selected stocks, all of which are listed on the NYSE Arca, and spans over 24 separate industry groups."

The inception date for the ETF was January 22, 1993, with option data available from January 21, 2005. As of February 29, 2012, the SPY ETF had net assets of $99.60 Billion, and 500 holdings. The SPY is traded on the NYSE Arca exchange and its CUSIP is 78462F103. Further details of the fund holdings are provided in Exhibit 15a.

Exhibit 15a SPY ETF Characteristics



Source: https://www.spdrs.com

In this section, we compare the performance of the SPY ETF to the performance of SPY 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[114].

Exhibit 15b: Summary Statistics SPY 1-Month Call/6-Month Put Balanced Collars

SPY Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	SPY Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	-2.14%	3.48%	4.47%	3.03%	0.24%	-0.14%
Annualized Standard Deviation	19.46%	6.68%	8.37%	10.42%	12.39%	15.43%
Mean Monthly Return	-0.02%	0.30%	0.39%	0.29%	0.08%	0.09%
Median Monthly Return	0.01%	0.41%	0.57%	-0.03%	-0.34%	0.14%
Period Cumulative Return	-9.45%	16.95%	22.17%	14.64%	1.08%	-0.64%
Sharpe Ratio	-0.16	0.36	0.41	0.19	-0.07	-0.08
Stutzer Index	-0.16	0.36	0.40	0.19	-0.07	-0.08
Treynor Ratio	-0.03	0.15	0.11	0.05	-0.01	-0.02
Modified Calmar Ratio	-0.19	1.88	1.99	0.74	0.04	-0.02
Jensen Beta with SPY	1.00	0.17	0.31	0.44	0.56	0.71
Jensen Monthly Alpha	0.00%	0.24%	0.36%	0.28%	0.08%	0.09%
Leland Beta	1.00	0.17	0.31	0.44	0.56	0.71
Leland Monthly Alpha	0.00%	0.24%	0.36%	0.28%	0.08%	0.09%
Correlation with Underlying	0.88	0.49	0.66	0.74	0.79	0.78
Skewness	-0.42	-0.26	-0.15	-0.08	0.03	-0.24
Excess Kurtosis	0.27	1.62	1.20	0.02	-0.60	-0.66
Minimum Monthly Return	-16.52%	-5.18%	-6.30%	-7.26%	-7.48%	-8.85%
Maximum Monthly Return	10.91%	5.24%	6.26%	6.73%	7.65%	7.58%
Maximum Drawdown	-50.80%	-8.99%	-11.13%	-19.81%	-30.76%	-35.89%
Maximum Run Up	93.38%	20.76%	35.85%	48.81%	54.09%	67.12%
% Down Months	47%	40%	36%	51%	53%	49%
% Up Months	53%	60%	64%	49%	47%	51%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[115]. Exhibit 15b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk while increasing realized returns relative to a long SPY position. The annualized returns are increased significantly from -2.14% for the SPY to 3.03% for the 5% OTM collar. Meanwhile, the standard deviation is reduced by

[114] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[115] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

about 1/2 from 19.46% to 10.42%. The Stutzer index increased from -0.16 to 0.19, suggesting that the collar substantially increased risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -50.80% to -19.81%. Not surprisingly, the modified Calmar ratio[116] for the collar is higher than that of the SPY at 0.74 (versus -0.19 for the SPY) for the 55 month period. It is worth noting that a negative Stutzer index (or Calmar ratio) is uninformative when compared to another negative Stutzer index, although it is clearly inferior to a positive Stutzer index. Additional insight can be provided by Exhibit 15c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the outperformance of the collar strategies is their limited participation in the very significant drawdown that the SPY ETF experienced in the first half of the period. The performance of the 5% and greater OTM collars is quite similar to the SPY ETF in the rest of the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -50.80% to -19.81%, it also reduces the maximum run up from 93.38% to 48.81%. Since the SPY experienced such a significant drawdown, it is not surprising that the collar strategies provided meaningful performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 15b and Exhibit 15c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the SPY, the nearer to ATM strategies generally outperformed the further OTM collars from both a raw return and risk adjusted perspective. The ATM and 2% OTM collars outperformed the other collars, as well as the SPY ETF. For example, the Stutzer index of the 2% OTM collar is 0.40 versus 0.36, 0.19, -0.07, -0.08 and -0.16

[116] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

for the ATM, 5% OTM, 10% OTM and 25% OTM collars and the SPY, respectively. Similarly, the monthly Leland alpha of the 2% OTM collar is 36 basis point versus 24, 28, 8, 9 and 0 basis points for the ATM, 5% OTM, 10% OTM and 25% OTM collars and the SPY, respectively. Thus, all of the collars exhibit higher Leland alphas than the SPY, with the 2% OTM collar generating over 1/3 of 1% *per month* of Leland alpha.

Exhibit 15c: Growth of $100 SPY 1-Month Call/6-Month Put Balanced Collars

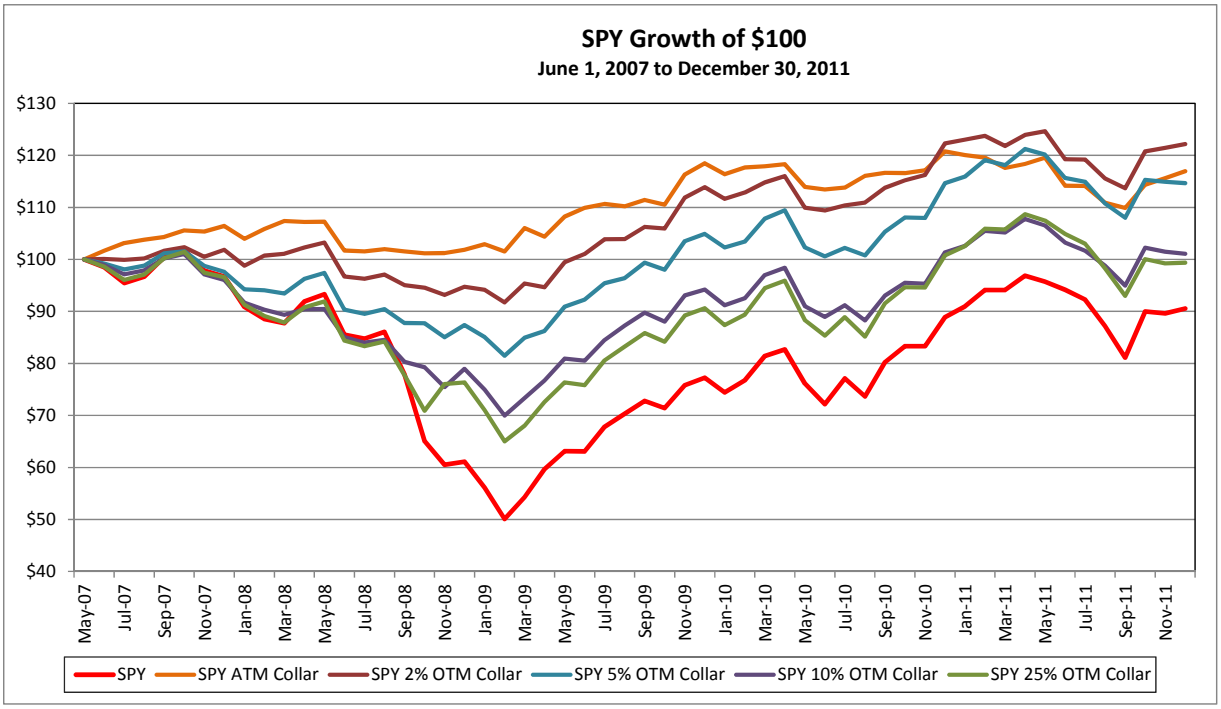


Exhibit 15d and Exhibit 15e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 15d it is clear that the collar strategies have limited participation in the run ups and drawdowns of the SPY. The rolling standard deviations provided in Exhibit 15e are evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower

standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 4% to 20%.

Exhibit 15d: Rolling Returns SPY 1-Month Call/6-Month Put Collars

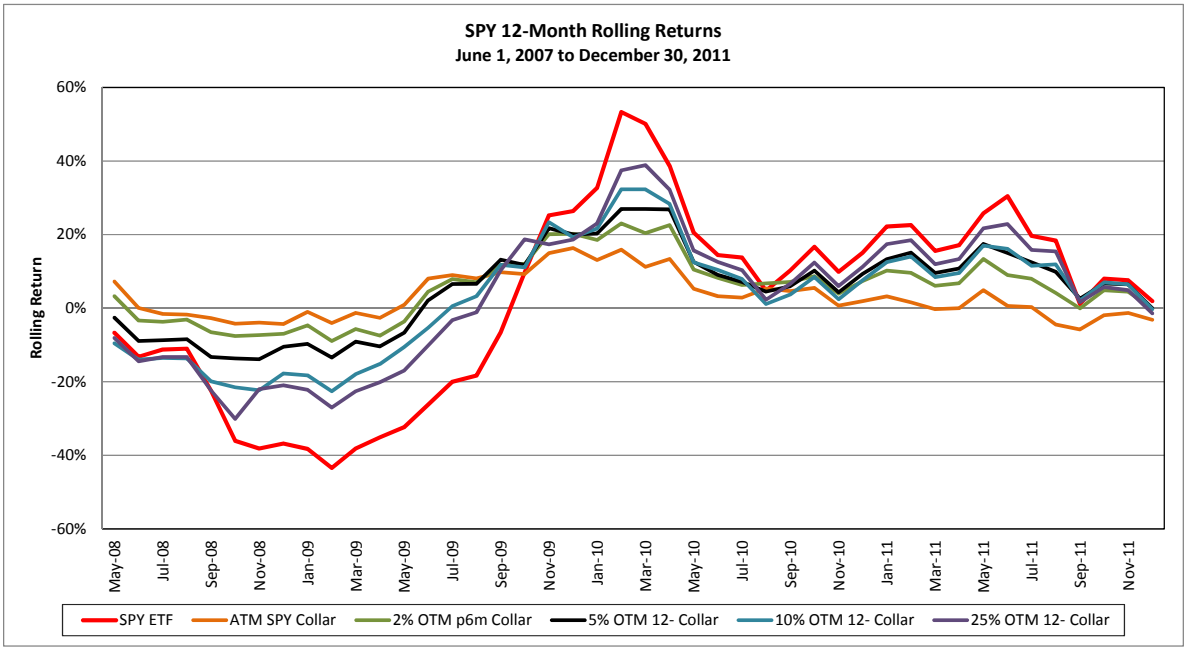
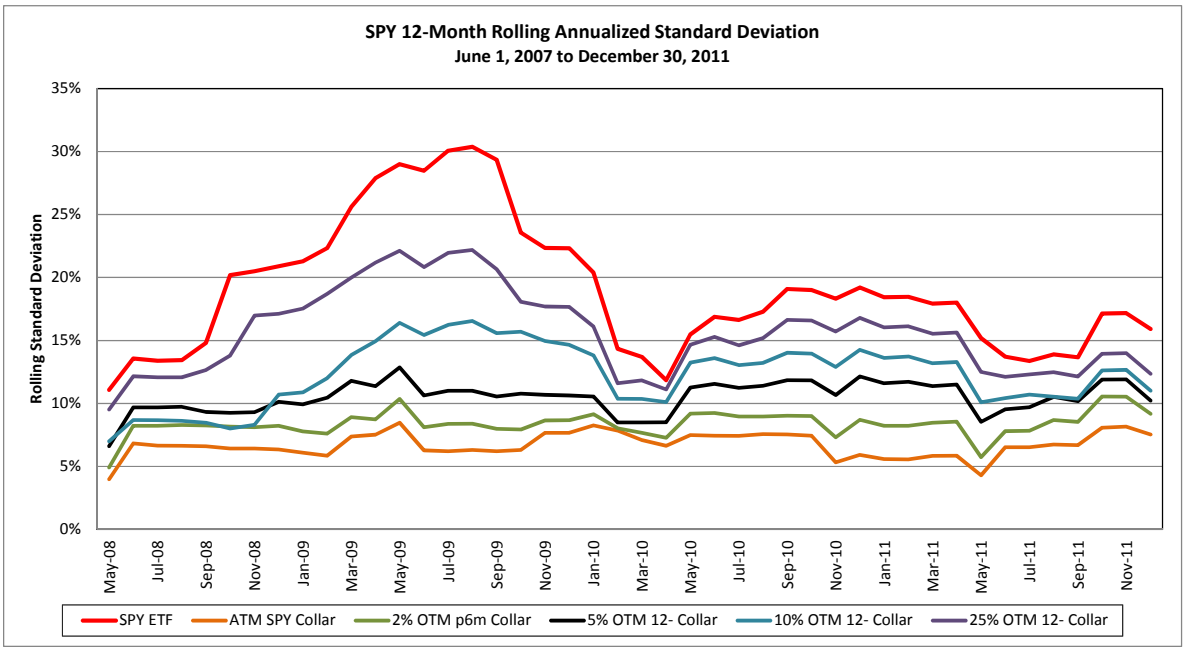
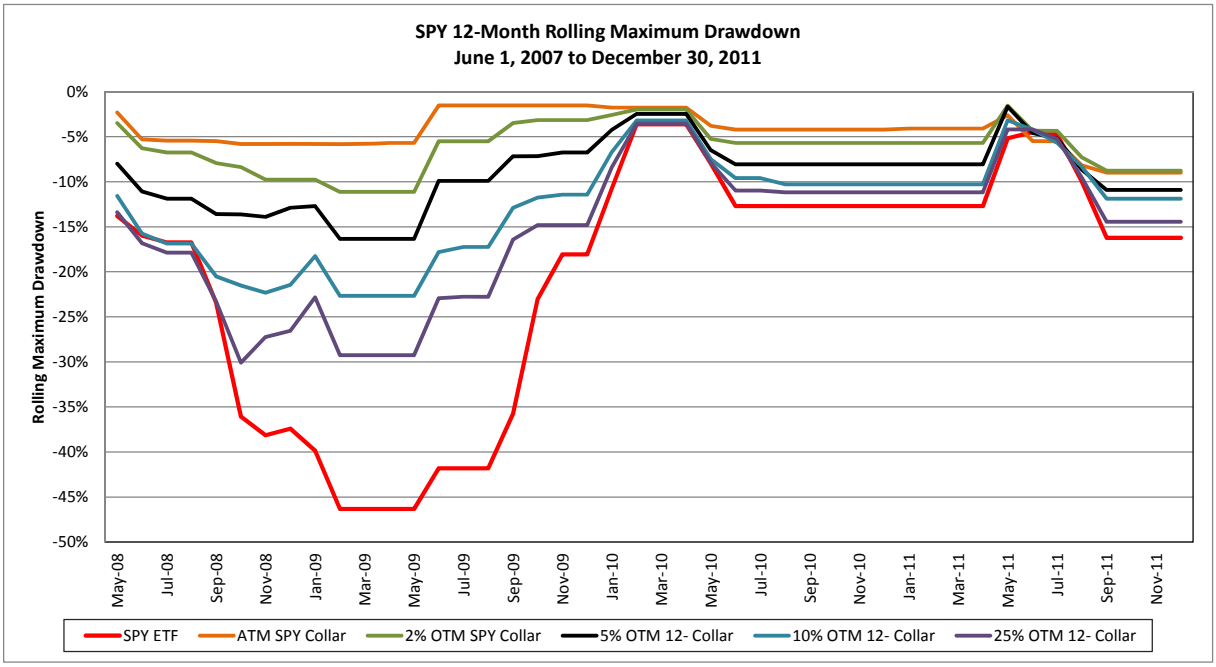


Exhibit 15e: Rolling Standard Deviation SPY 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 15f provides a graphical presentation of 12-month rolling maximum drawdowns for SPY collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the SPY experienced a substantial drawdown in the first half of the period of study, the collars provided significant drawdown protection, with the moneyness of the collars having a large impact on the degree of the observed protection. While the near the money strategies provided very significant protection, the deeper OTM collars had less (although still very significant) impact on drawdowns in the first half of the period.

Exhibit 15f: Rolling Maximum Drawdown SPY 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying SPY ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 15g provides the levels of initial implied

volatilities for 1-month ATM options on the SPY since inception as well as the ex post realized volatility over the life of the options[117] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[118]). While the volatility of volatility is very high, the ATM implied volatility for the SPY options tends to fluctuate around the 10% level prior to mid-2007 and the 20% level for the remainder of the period. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around the 5% to 10% level (with the puts exhibiting higher implied volatilities than the calls) and exhibits some very significant peaks over the period as well as an apparent upward trend.

[117] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[118] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

Exhibit 15g: Implied and Realized Volatility SPY 1-Month Collars Since Option Inception

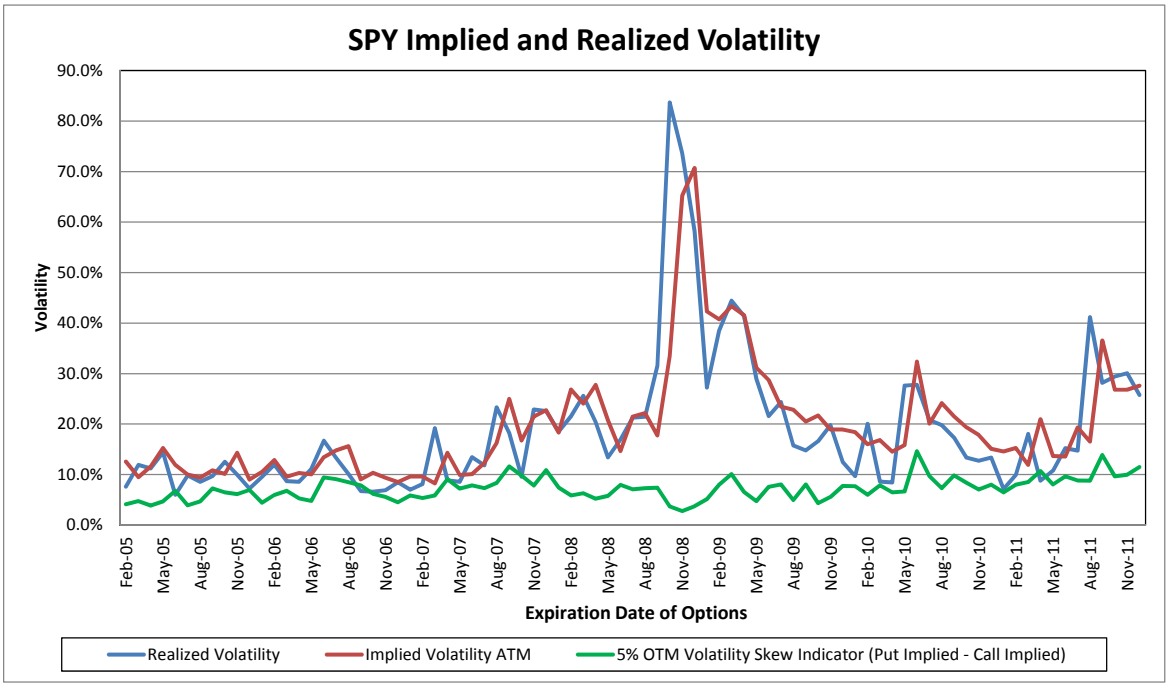


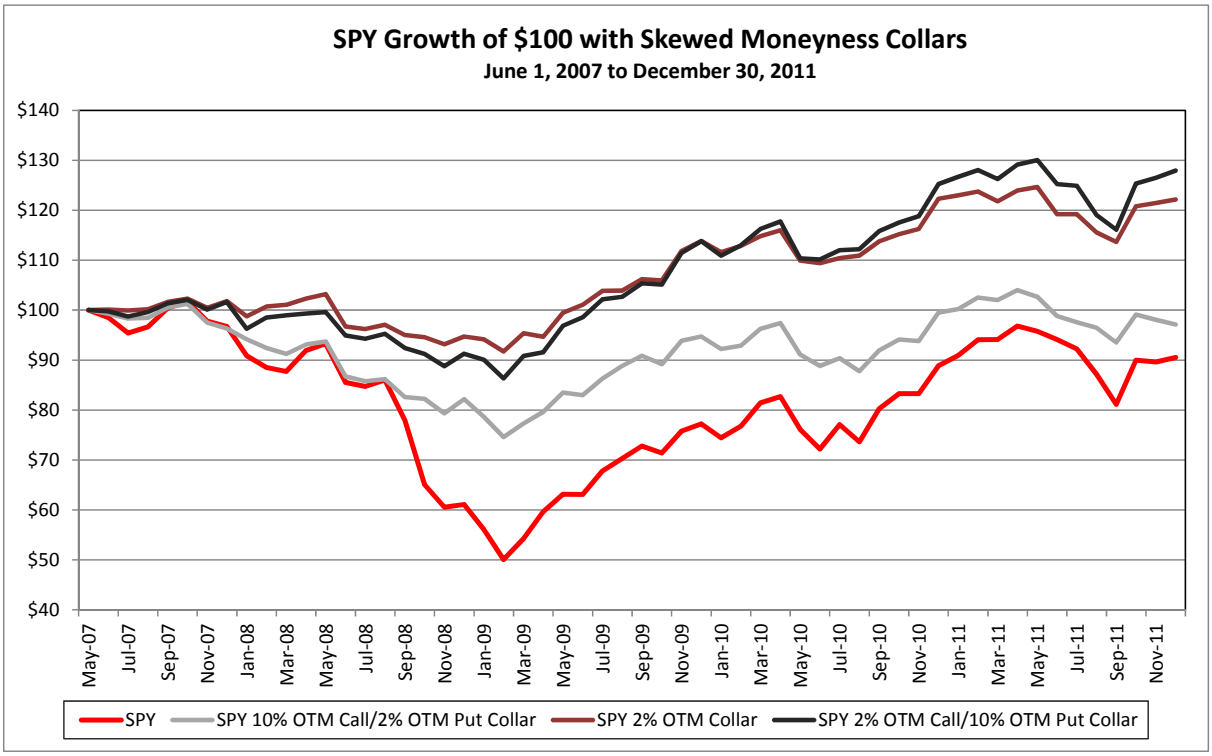
Exhibit 15h and Exhibit 15i provide summary statistics and a graphical presentation of performance, respectively for skewed SPY collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 15h: Summary Statistics SPY 1-Month Call/6-Month Put Skewed Collars

SPY Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	SPY Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	-2.14%	-0.63%	4.47%	5.53%
Annualized Standard Deviation	19.46%	10.67%	8.37%	9.97%
Mean Monthly Return	-0.02%	-0.01%	0.39%	0.49%
Median Monthly Return	0.01%	-0.44%	0.57%	0.79%
Period Cumulative Return	-9.45%	27.97%	22.17%	-2.88%
Sharpe Ratio	-0.16	-0.16	0.41	0.45
Stutzer Index	-0.16	-0.16	0.40	0.43
Treynor Ratio	-0.03	-0.04	0.11	0.11
Modified Calmar Ratio	-0.19	1.06	1.99	-0.19
Jensen Beta with SPY	1.00	0.46	0.31	0.40
Jensen Monthly Alpha	0.00%	-0.02%	0.36%	0.47%
Leland Beta	1.00	0.46	0.31	0.40
Leland Monthly Alpha	0.00%	-0.02%	0.36%	0.47%
Correlation with Underlying	0.88	0.75	0.66	0.73
Skewness	-0.42	-0.07	-0.15	-0.03
Excess Kurtosis	0.27	-0.27	1.20	0.45
Minimum Monthly Return	-16.52%	-7.49%	-6.30%	-6.26%
Maximum Monthly Return	10.91%	6.10%	6.26%	7.96%
Maximum Drawdown	-50.80%	-26.35%	-11.13%	-15.41%
Maximum Run Up	93.38%	50.58%	35.85%	39.44%
% Down Months	47%	53%	36%	36%
% Up Months	53%	47%	64%	64%

The net premium collection collar (2% OTM call/10% OTM put) outperforms the net premium payment collar, the balanced collar and the QQQ by a significant margin both on an absolute return and risk adjusted return basis. For example, the net premium collection collar generates a 5.53% return at a standard deviation of 9.97% versus -0.63%/10.67%, 4.47%/8.37%, and -2.14%/19.46% for the balanced collar, the net premium payment collar and the underlying SPY ETF, respectively. Similarly, the Stutzer index for the net premium collection collar is 0.43 versus -0.16, 0.40 and -0.16 for the balanced collar, the net premium payment collar and the underlying SPY ETF, respectively.

Exhibit 15i: Growth of $100 SPY 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 15g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 15j: Protection Cost Index at Roll-In SPY 1-Month "Zero-Cost" Collars

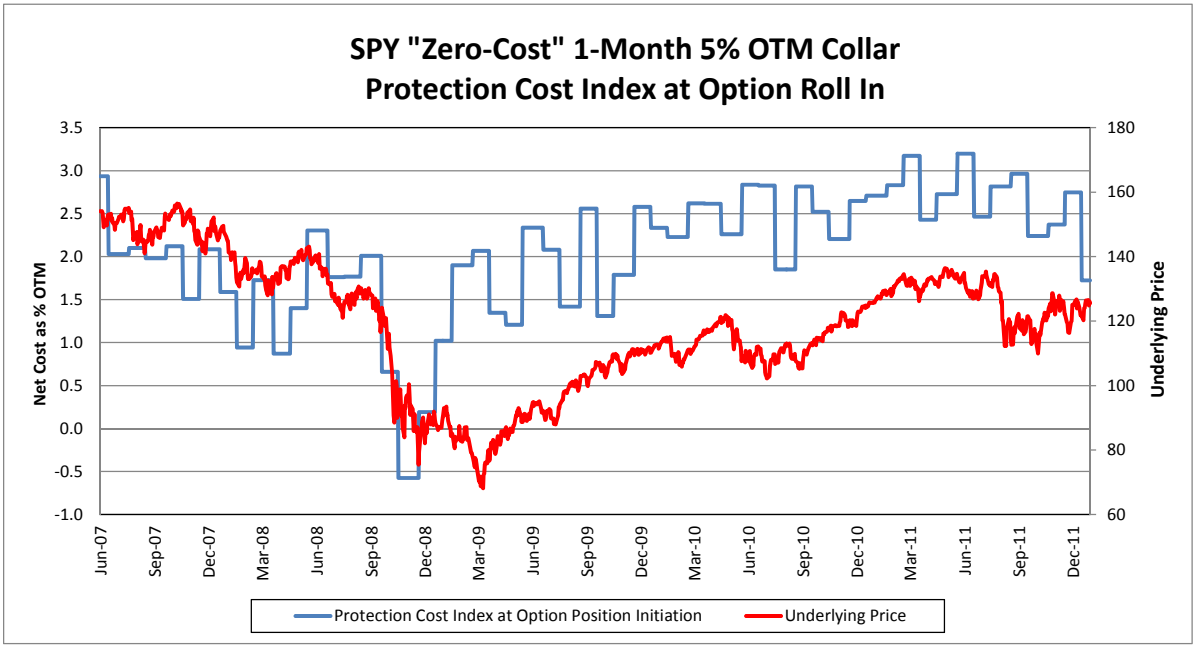


Exhibit 15k: Initial Option Moneyness SPY 1-Month "Zero-Cost" Collars

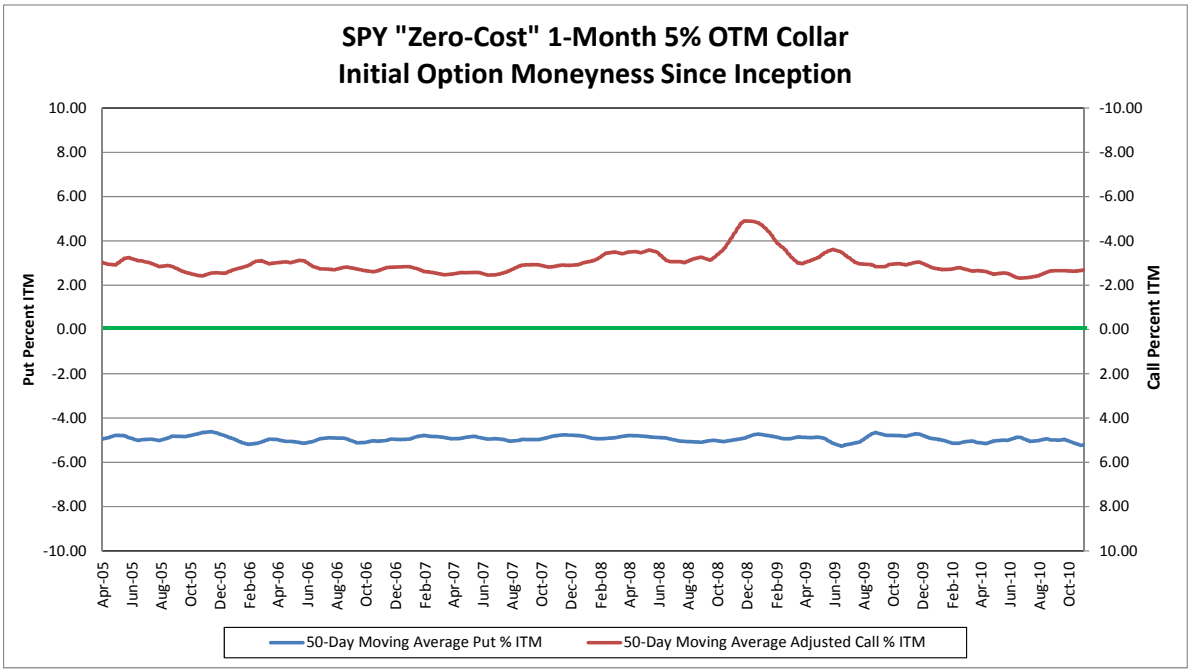


Exhibit 15j and Exhibit 15k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the SPY options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[119].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

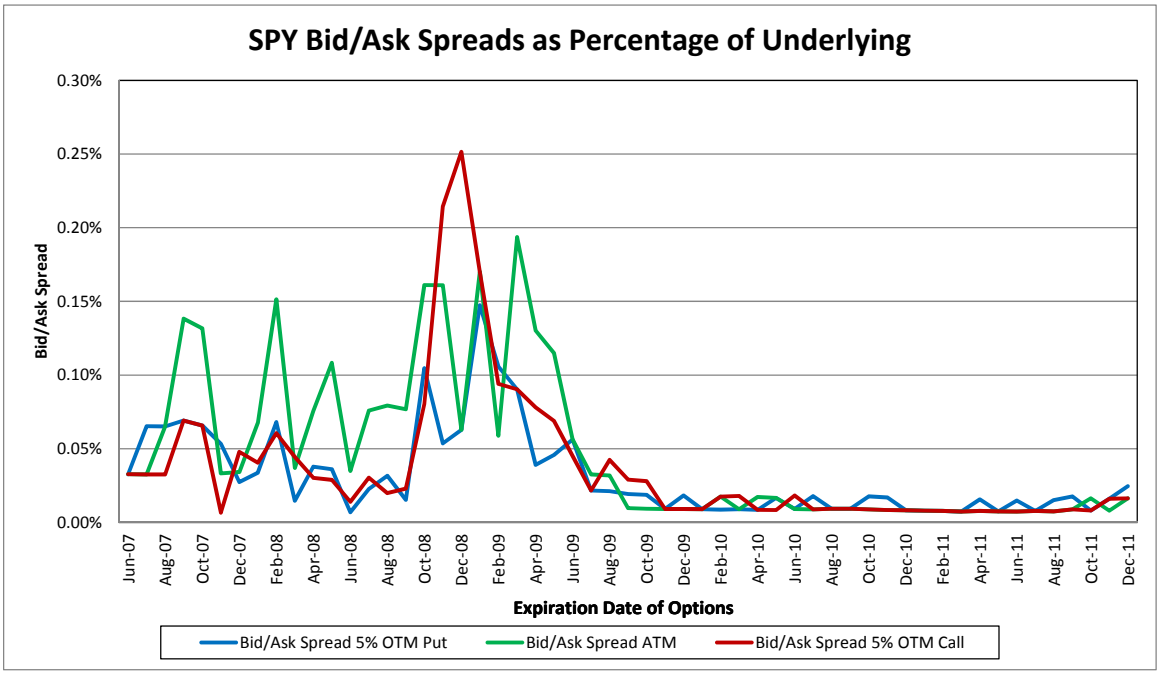
Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. The Exhibit indicates a significant skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (which is typical of equity index-based ETFs).While the rolling PCI index tends to average near the 2% level, the PCI varies significantly over time, reaching minimum of -0.5% (towards the calls) in late-2008 followed by a general trend towards upward corresponding with the rise in the SPY. Exhibit 15k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 15l provides a graphical presentation of bid/ask spreads as a percentage of the underlying SPY price for 5% OTM 1-month puts and calls

[119] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

as well as ATM options over the period of the study[120]. In general, bid/ask spreads tend to decrease over time. However, there are a number of peaks in the spreads, particularly in late-2008 and early-2009. While spreads hit 25 basis points at their peak, they are generally under 2 basis points in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the SPY price[121], such wide spreads were not encountered for the SPY ETF.

Exhibit 15l: Bid/Ask Spreads SPY 1-Month Collars



[120] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[121] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

In conclusion, the SPY ETF options exhibit significant put skew, particularly in the second half of the period. During the financial crisis the SPY collar strategies significantly increased realized returns while reducing standard deviations relative to the SPY ETF, both on an absolute and risk adjusted basis. The SPY ETF experienced a very significant drawdown in the first half of the period of study, followed by a very strong (although sometimes faltering) run up. Finally, while SPY options used in this study exhibited bid/ask spreads approaching 0.25% of the underlying price at times, the spreads were generally under 2 basis points in the later part of the period of study.

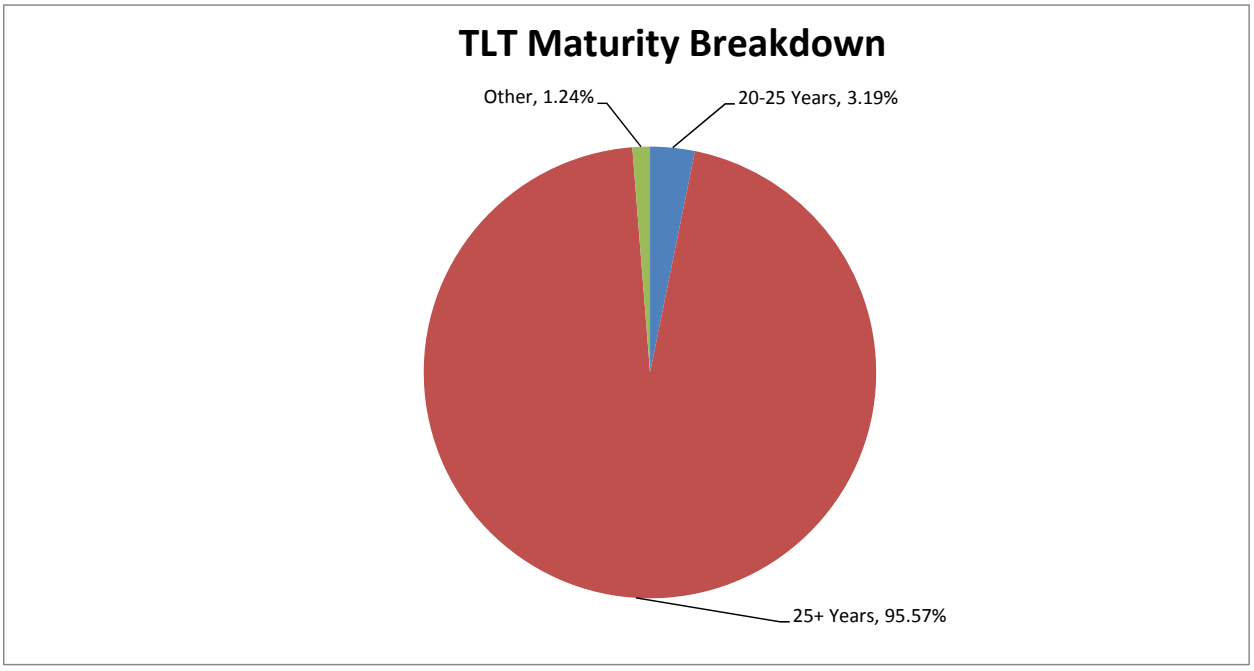
Empirical Results for iShares Barclays 20+ Treasury ETF, (NYSE Arca)

The TLT ETF provides access to Treasury Bonds. iShares describes the TLT ETF as follows:

> "The iShares Barclays 20+ Year Treasury Bond Fund seeks results that correspond generally to the price and yield performance, before fees and expenses, of the long-term sector of the United States Treasury market as defined by the Barclays Capital U.S. 20+ Year Treasury Bond Index ("the Index")."…" The index is market capitalization weighted and includes all of the securities that meet the Index criteria. The index includes all publicly issued, U.S. Treasury securities that have a remaining maturity greater than 20 years, are non-convertible, are denominated in U.S. dollars, are rated investment grade (Baa3 or better) by Moody's Investors Services, are fixed rate, and have more than $150 million par outstanding. Excluded from the index are certain special issues, such as flower bonds, targeted investor notes (TINs), and state and local government series bonds (SLGs), and coupon issues that have been stripped from assets already included."

The inception date for the ETF was July 22, 2002, with option data available from May16, 2003. As of December 31, 2011, the TLT ETF had net assets of $3.38 Billion, and 18 holdings. The TLT is traded on the NYSE Arca exchange and its CUSIP is 464287432. Further details of the fund holdings are provided in Exhibit 16a.

Exhibit 16a TLT ETF Characteristics



Source: http://us.ishares.com

In this section, we compare the performance of the TLT ETF to the performance of TLT 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[122].

Exhibit 16b: Summary Statistics TLT 1-Month Call/6-Month Put Balanced Collars

TLT Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	TLT Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	12.29%	3.52%	4.05%	5.85%	7.26%	9.55%
Annualized Standard Deviation	16.85%	5.62%	8.22%	10.97%	13.83%	14.99%
Mean Monthly Return	1.08%	0.30%	0.36%	0.52%	0.66%	0.85%
Median Monthly Return	1.21%	0.30%	0.09%	0.68%	0.81%	1.21%
Period Cumulative Return	70.12%	17.20%	19.98%	29.76%	37.88%	51.92%
Sharpe Ratio	0.67	0.44	0.37	0.44	0.45	0.57
Stutzer Index	0.65	0.44	0.37	0.44	0.45	0.56
Treynor Ratio	0.11	0.11	0.08	0.08	0.08	0.10
Modified Calmar Ratio	3.22	2.40	1.28	1.75	1.74	2.67
Jensen Beta with TLT	1.00	0.22	0.39	0.59	0.78	0.85
Jensen Monthly Alpha	0.00%	0.01%	-0.10%	-0.13%	-0.19%	-0.07%
Leland Beta	1.00	0.23	0.40	0.59	0.77	0.86
Leland Monthly Alpha	0.00%	0.00%	-0.11%	-0.13%	-0.18%	-0.08%
Correlation with Underlying	-0.28	-0.18	-0.22	-0.30	-0.36	-0.37
Skewness	0.46	0.83	0.50	0.60	0.73	0.53
Excess Kurtosis	1.94	6.75	3.36	1.67	2.19	2.20
Minimum Monthly Return	-13.07%	-5.03%	-6.95%	-7.10%	-9.03%	-11.46%
Maximum Monthly Return	14.34%	7.19%	8.95%	10.42%	13.79%	13.76%
Maximum Drawdown	-21.80%	-7.15%	-15.59%	-17.02%	-21.74%	-19.46%
Maximum Run Up	71.86%	17.20%	22.93%	30.07%	40.04%	54.31%
% Down Months	42%	45%	47%	44%	47%	40%
% Up Months	58%	55%	53%	56%	53%	60%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[123]. Exhibit 16b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces both risk and realized returns relative to a long TLT position. The annualized returns are reduced by about 1/2 from 12.29% for the TLT to 5.85% for the 5% OTM collar. Similarly, the standard deviation is reduced from 16.85% to

[122] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[123] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

10.97%. The Stutzer index decreased from 0.65 to 0.44, suggesting that the collar reduced risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -21.80% to -17.02%. Despite the reduction, the modified Calmar ratio[124] for the collar is less than that of the TLT at 1.75 (versus 3.22 for the TLT) for the 55 month period, suggesting that returns were reduced proportionally more than the reduction in the maximum drawdown. Additional insight can be provided by Exhibit 16c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the underperformance of the collar strategies is their limited participation in the run ups that the TLT ETF experienced, particularly the strong but short run up in late-2008. The performance of the 5% and greater OTM collars is quite similar to the TLT ETF through 2009 and 2010. Ultimately, while the 5% OTM collar reduces maximum drawdown from -21.80% to -17.02%, it also reduces the maximum run up from 71.86% to 30.07%. Since the TLT did not experienced repeated steep run ups with less aggressive drawdowns in the period of study, it is not surprising that the collar strategies did not provide performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 16b and Exhibit 16c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the TLT, the further OTM strategies outperformed nearer to ATM collars from both a raw return and risk adjusted perspective. By most measures, the 25% OTM collar outperformed the other collars, although they all underperformed the TLT ETF by most measures. For example, the Stutzer index of the 25% OTM collar is 0.56 versus

[124] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

0.44, 0.37, 0.44, 0.45 and 0.65 for the ATM, 2% OTM, 5% OTM and 10% OTM collars and the TLT, respectively. Similarly, the monthly Leland alpha of the 25% OTM collar is -8 basis points versus 0, -11, -13, -18 and 0 basis points for the ATM, 2% OTM, 5% OTM and 10% OTM collars and the TLT, respectively. Thus, only the ATM collar matches the Leland alpha of the TLT, although the collar has a lower Stutzer index than the TLT.

Exhibit 16c: Growth of $100 TLT 1-Month Call/6-Month Put Balanced Collars

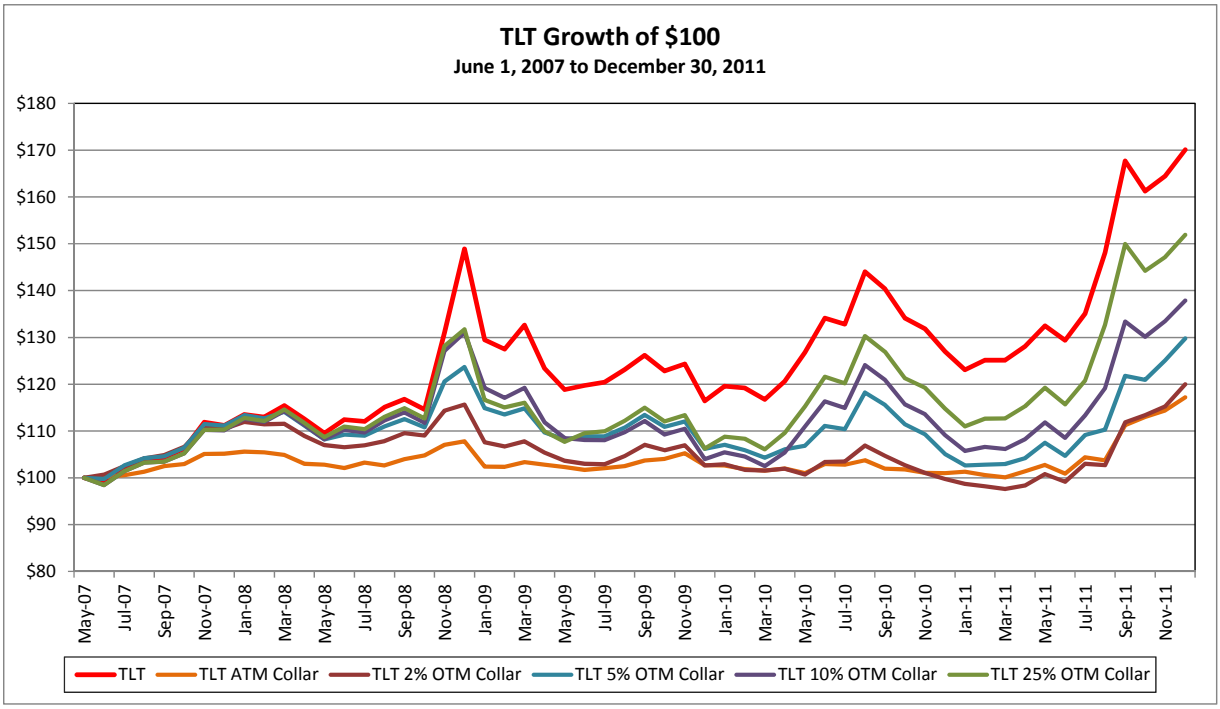


Exhibit 16d and Exhibit 16e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 16d it is clear that the collars had limited participation in both the run ups and drawdowns of the TLT. The rolling standard deviations provided in Exhibit 16e are evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit significantly lower standard

deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 1% to 14%.

Exhibit 16d: Rolling Returns TLT 1-Month Call/6-Month Put Collars

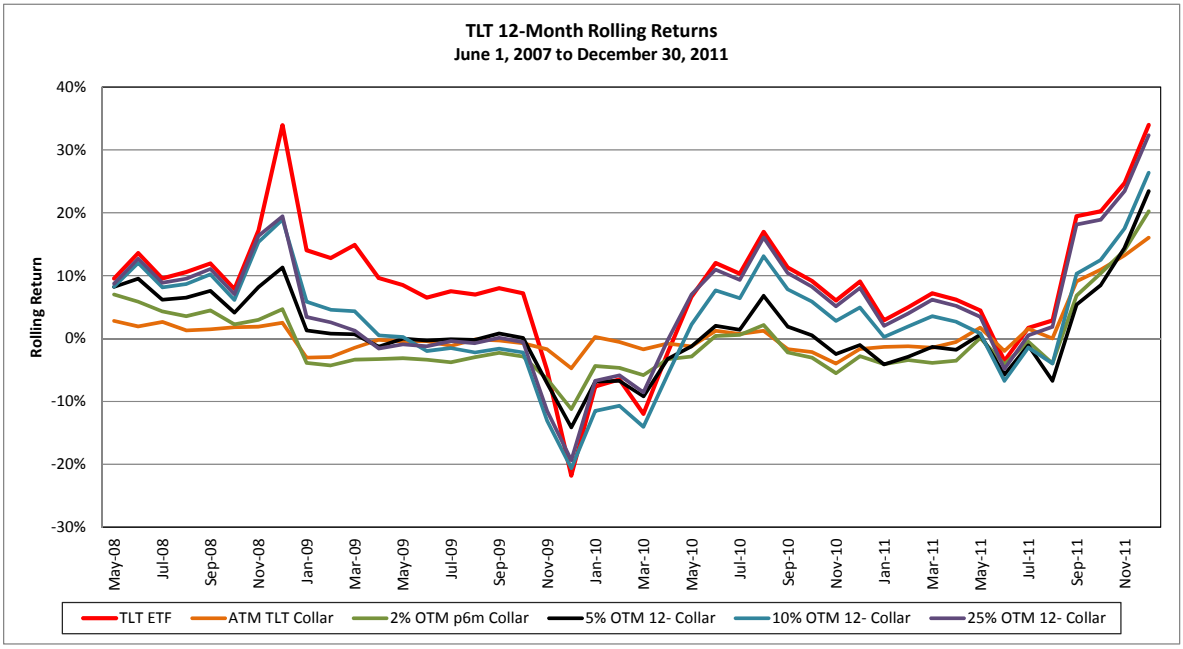
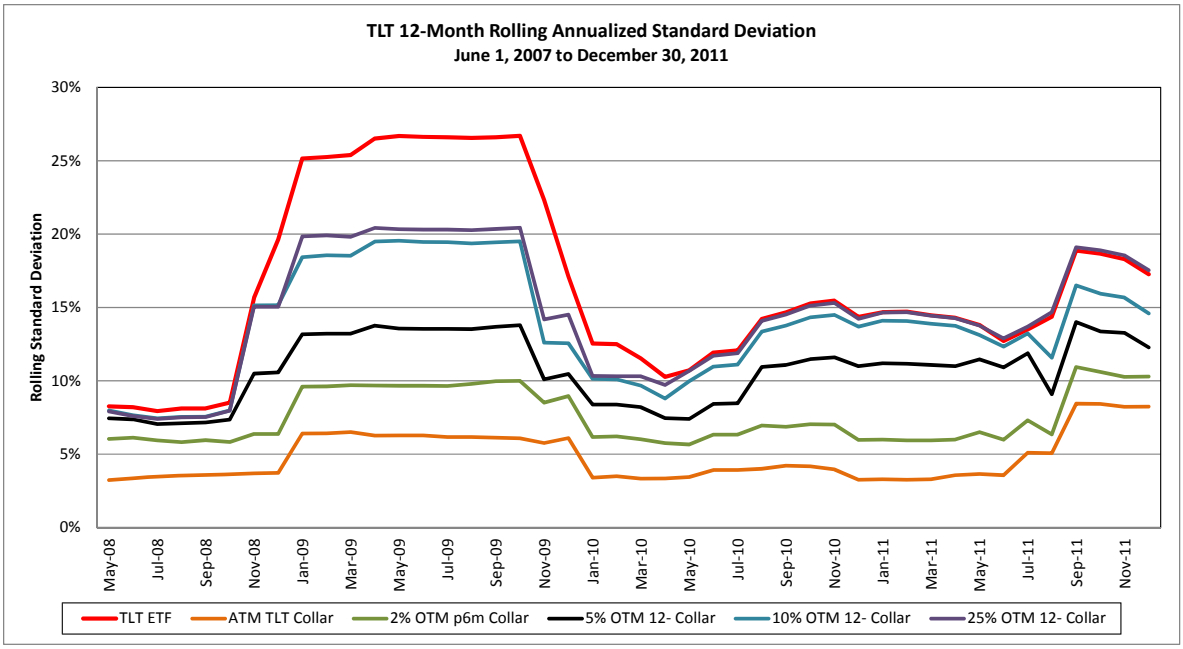
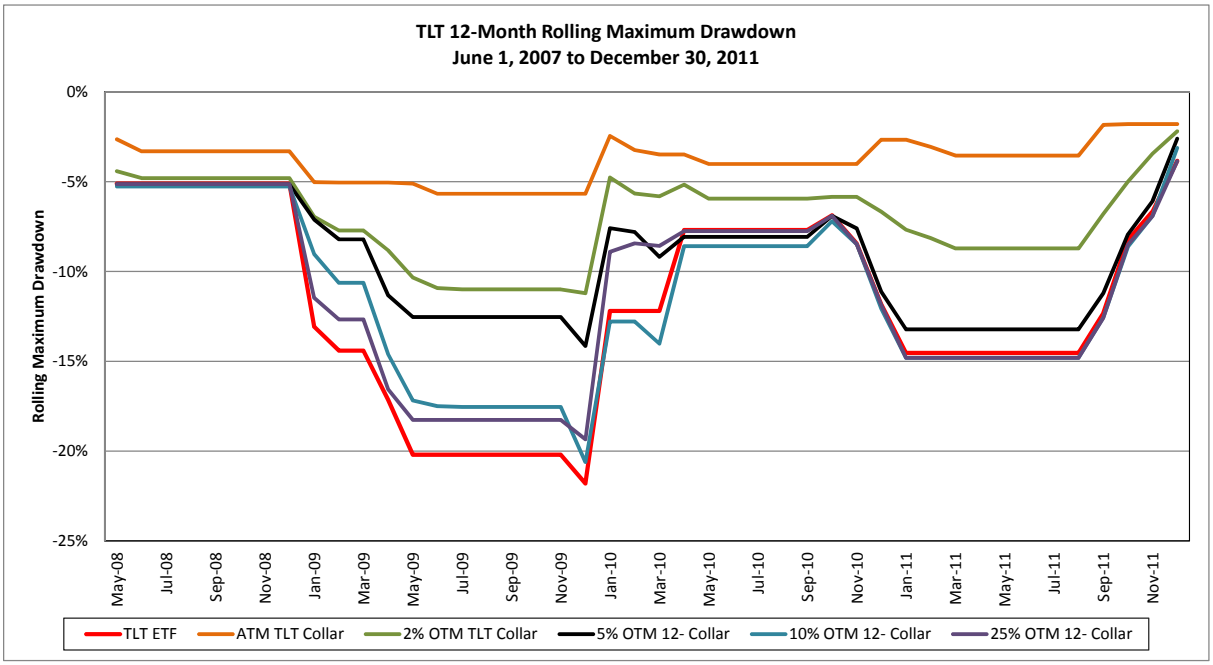


Exhibit 16e: Rolling Standard Deviation TLT 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 16f provides a graphical presentation of 12-month rolling maximum drawdowns for TLT collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the TLT experienced a series of rapid drawdowns during the period of study, it is not surprising that the moneyness of the collar had a large impact on the degree of observed drawdown protection. While the near the money strategies provided significant protection, the deeper OTM collars had far less impact on drawdowns.

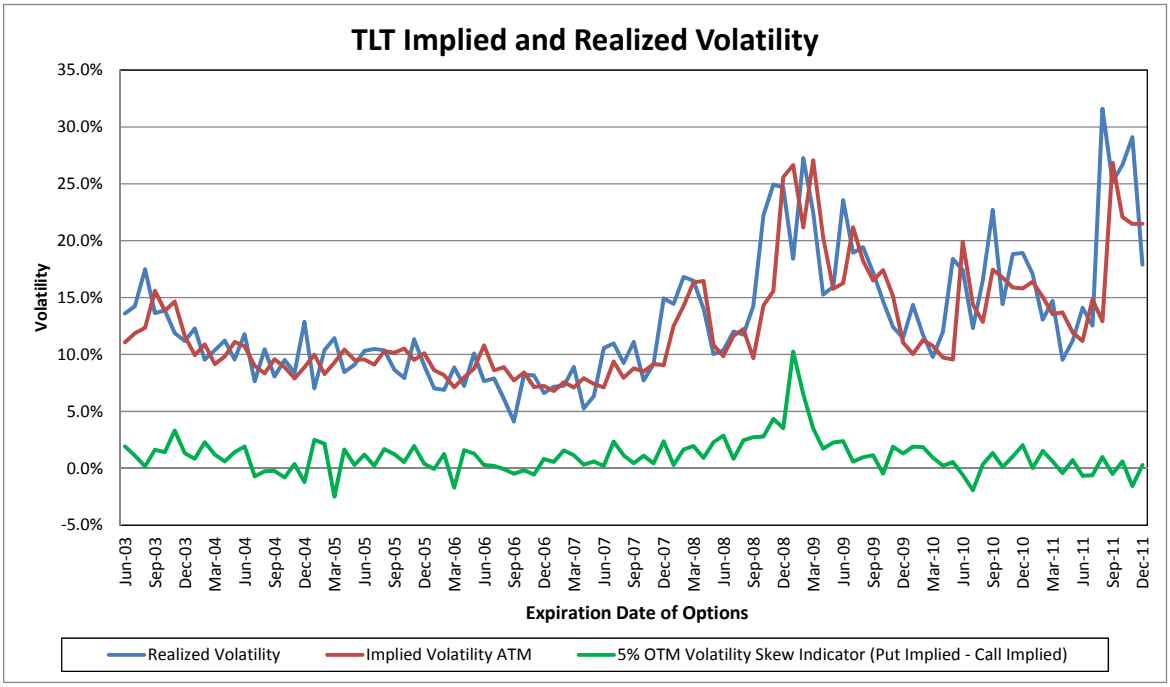
Exhibit 16f: Rolling Maximum Drawdown TLT 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying TLT ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities also have a large impact on collar returns. Exhibit 16g provides the levels of initial implied

volatilities for 1-month ATM options on the TLT since inception as well as the ex post realized volatility over the life of the options[125] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[126]). While the volatility of volatility is quite high, the ATM implied volatility for the TLT options tends to fluctuate around the 10% level prior to 2008 and around 20% for the remainder of the period. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in 2008 and 2011. The implied volatility differential between the puts and calls tends to fluctuate around the zero level (with the calls exhibiting about the same implied volatilities as the puts on average) although there is a very significant put skew in late-2008 and early-2009.

Exhibit 16g: Implied and Realized Volatility TLT 1-Month Collars Since Option Inception



[125] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[126] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

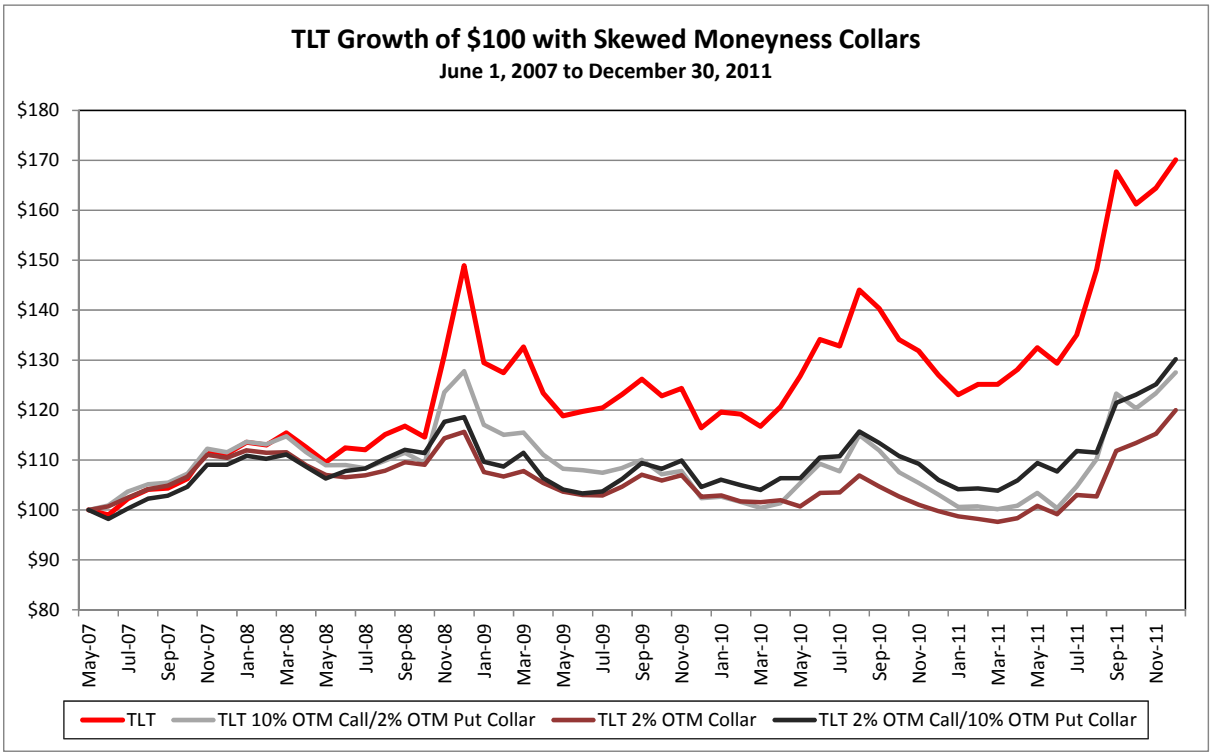
Exhibit 16h and Exhibit 16i provide summary statistics and a graphical presentation of performance, respectively for skewed TLT collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 16h: Summary Statistics TLT 1-Month Call/6-Month Put Skewed Collars

TLT Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	TLT Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	12.29%	5.45%	4.05%	5.93%
Annualized Standard Deviation	16.85%	12.52%	8.22%	9.46%
Mean Monthly Return	1.08%	0.51%	0.36%	0.52%
Median Monthly Return	1.21%	0.28%	0.09%	0.45%
Period Cumulative Return	70.12%	30.20%	19.98%	27.54%
Sharpe Ratio	0.67	0.35	0.37	0.52
Stutzer Index	0.65	0.36	0.37	0.51
Treynor Ratio	0.11	0.06	0.08	0.10
Modified Calmar Ratio	3.22	1.40	1.28	2.14
Jensen Beta with TLT	1.00	0.69	0.39	0.48
Jensen Monthly Alpha	0.00%	-0.25%	-0.10%	-0.03%
Leland Beta	1.00	0.68	0.40	0.50
Leland Monthly Alpha	0.00%	-0.24%	-0.11%	-0.04%
Correlation with Underlying	-0.28	-0.35	-0.22	-0.26
Skewness	0.46	1.10	0.50	0.03
Excess Kurtosis	1.94	3.30	3.36	1.62
Minimum Monthly Return	-13.07%	-8.43%	-6.95%	-7.53%
Maximum Monthly Return	14.34%	12.99%	8.95%	8.95%
Maximum Drawdown	-21.80%	-21.64%	-15.59%	-12.86%
Maximum Run Up	71.86%	32.55%	22.93%	27.80%
% Down Months	42%	45%	47%	40%
% Up Months	58%	55%	53%	60%

The net premium collection collar (2% OTM call/10% OTM put) outperforms the net premium payment collar and the balanced collar by most measures, although all three collars underperform the TLT. For example, the net premium collection collar generates a 5.93% return at a standard deviation of 9.46% versus 5.45%/12.52%, 4.05%/8.22%, and 12.29%/16.85% for the balanced collar, the net premium payment collar and the underlying TLT ETF, respectively. Similarly, the Stutzer index for the net premium collection collar is 0.51 versus 0.36, 0.37 and 0.65 for the balanced collar, the net premium payment collar and the underlying TLT ETF, respectively.

Exhibit 16i: Growth of $100 TLT 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 16g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 16j: Protection Cost Index at Roll-In TLT 1-Month "Zero-Cost" Collars

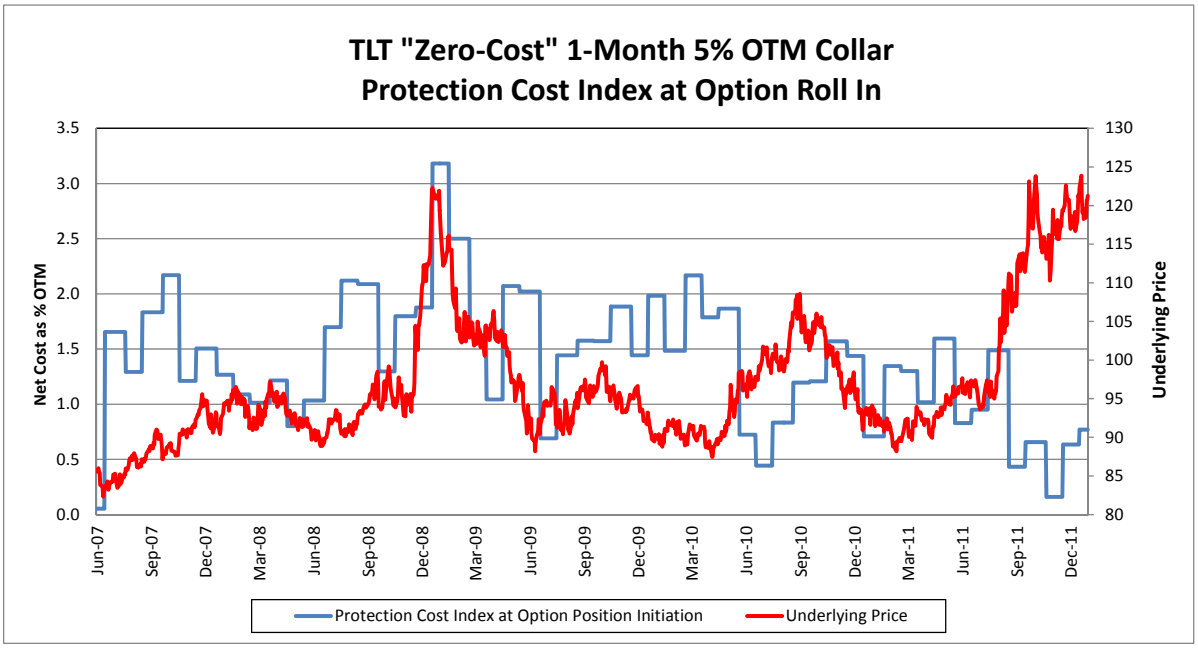


Exhibit 16k: Initial Option Moneyness TLT 1-Month "Zero-Cost" Collars

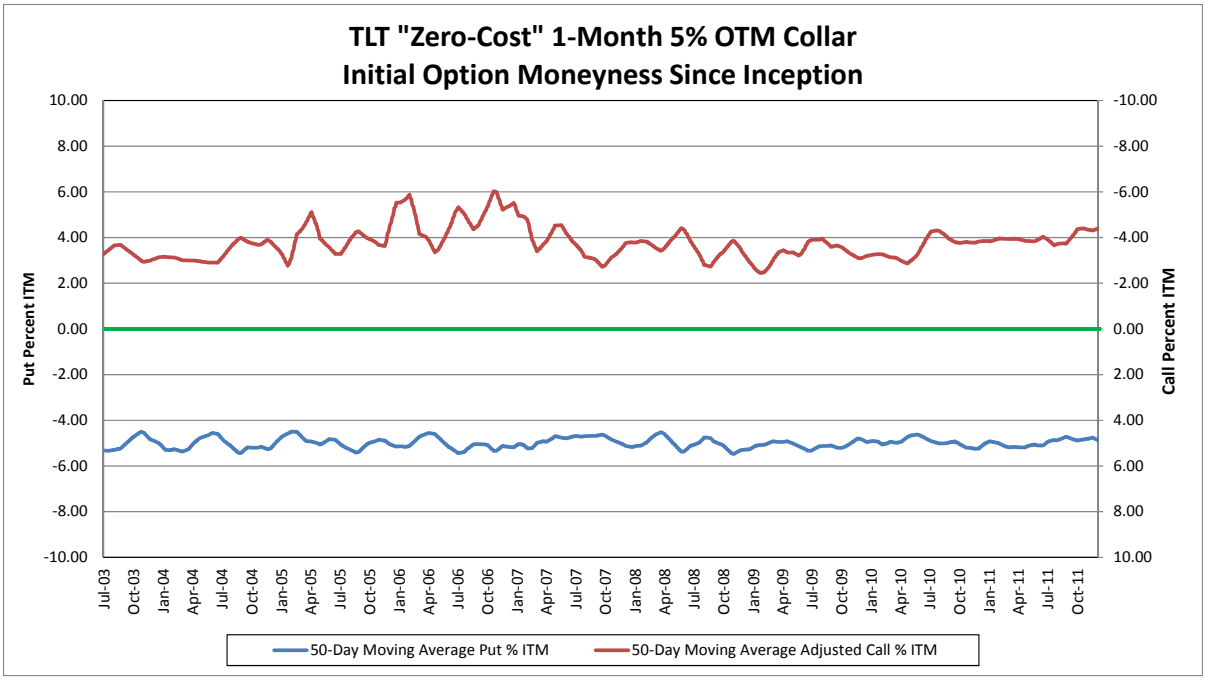


Exhibit 16j and Exhibit 16k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the TLT options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[127].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. The Exhibit indicates a skew in option implied volatilities toward the puts, indicating that puts tend to be more "expensive" than calls (similar to equity index-based ETFs).While the rolling PCI index tends to average near the 1% level, the PCI varies significantly over time,

[127] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

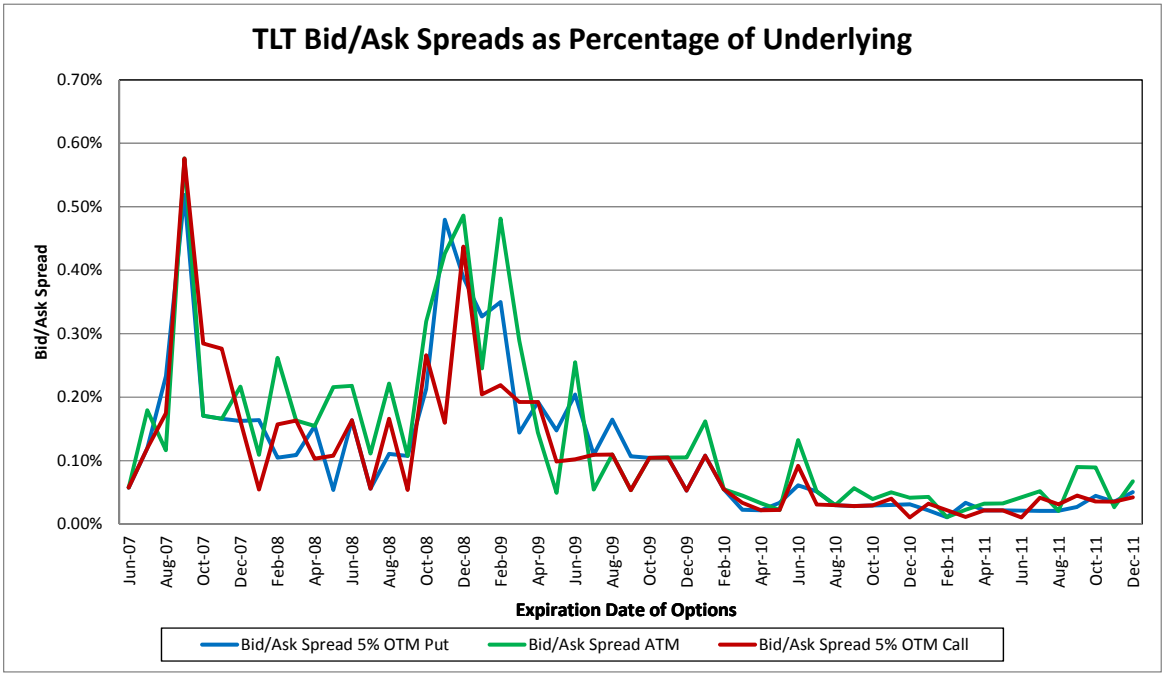
ranging from about 0% to 3.2% over the period. Exhibit 16k provides further evidence of the put skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 16l provides a graphical presentation of bid/ask spreads as a percentage of the underlying TLT price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[128]. In general, bid/ask spreads tend to decrease over time. However, there are a number of peaks in the spreads. While the spreads approach 0.6% of the TLT price at their peak, they tend to fluctuate around the 5 basis point level in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the TLT price[129], such wide spreads were not encountered for the TLT ETF.

[128] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[129] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 16l: Bid/Ask Spreads TLT 1-Month Collars



In conclusion, the TLT ETF is somewhat unique in that the options exhibit call skew at times and significant put skew at others, although the skew is consistently towards the puts in the June 2007 to December 2011 period upon which the main analysis focuses. During the financial crisis the TLT collar strategies underperformed the TLT ETF, both on an absolute and risk adjusted basis. The TLT ETF experienced significant whipsaws in the period of study. While the collars significantly reduced the volatility of the TLT, they did little for the returns. Finally, while TLT options used in this study exhibited bid/ask spreads approaching 0.6% of the underlying price at times, the spreads were generally near 5 basis points in the later part of the period of study.

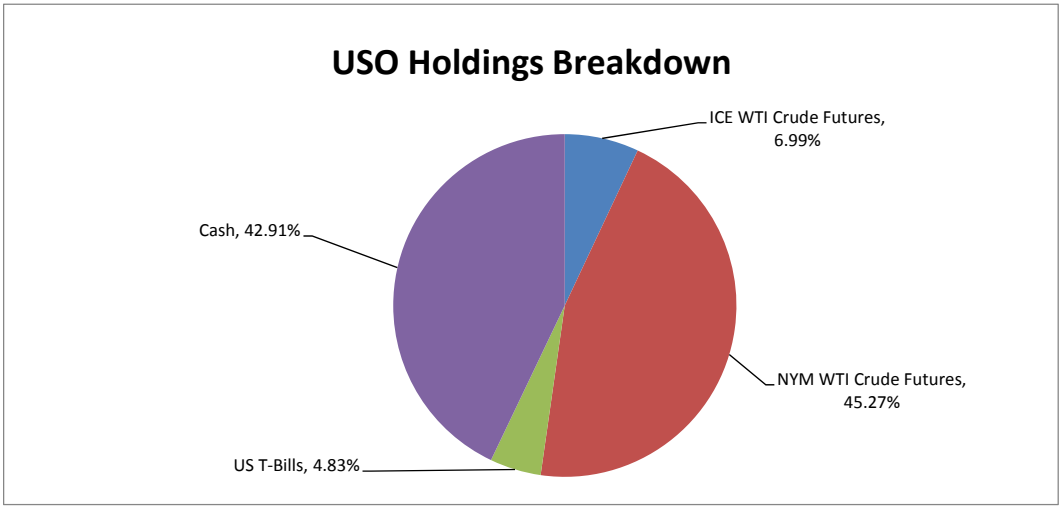
Empirical Results for United States Oil ETF, (NYSE Arca)

The USO ETF provides access to light, sweet ("West Texas Intermediate") crude oil. United States Commodity Funds, LLC describes the USO ETF as follows:

> "The United States Oil Fund LP is a domestic exchange traded security designed to track the movements of light, sweet crude oil ("West Texas Intermediate").USO is a commodity pool organized as a Delaware limited partnership that issues units that may be purchased and sold on the NYSE Arca."…" The investment objective of USO is for the changes in percentage terms of its units' net asset value ("NAV") to reflect the changes in percentage terms of the spot price of light, sweet crude oil delivered to Cushing, Oklahoma, as measured by the changes in the price of the futures contract for light, sweet crude oil traded on the New York Mercantile Exchange (the "NYMEX"), less USO's expenses. Crude oil is one of the most important physical commodities in the global economy. WTI light, sweet crude oil futures contracts are also the most actively traded, and WTI light, sweet crude oil is the primary US benchmark for crude oil. The portfolio will consist of listed crude oil futures contracts and other oil related futures, forwards, and swap contracts. USO will also invest in obligations of the United States government with remaining maturities of two years or less and hold cash and cash equivalents to be used to meet its current or potential margin or collateral requirements with respect to its investments in crude oil futures contracts and other oil interests."

The inception date for the ETF was April 10, 2006, with option data available from May18, 2007. As of March 1, 2012, the USO ETF had net assets of $1.63 Billion. The USO is traded on the NYSE Arca exchange and its CUSIP is 9132N108. Further details of the fund holdings are provided in Exhibit 16a.

Exhibit 17a EEM ETF Characteristics



Source: http://www.unitedstatesoilfund.com

In this section, we compare the performance of the USO ETF to the performance of USO 1-month call/6-month put collar strategies in which the 6-month put is held until expiration[130].

Exhibit 17b: Summary Statistics USO 1-Month Call/6-Month Put Balanced Collars

USO Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	USO Total Return	ATM 1-Month Call, ATM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	5% OTM 1-Month Call, 5% OTM 6-Month Put	10% OTM 1-Month Call, 10% OTM 6-Month Put	25% OTM 1-Month Call, 25% OTM 6-Month Put
Annualized Return	-5.32%	1.01%	1.45%	5.19%	8.40%	5.32%
Annualized Standard Deviation	37.79%	10.83%	13.16%	17.03%	23.04%	28.02%
Mean Monthly Return	0.16%	0.13%	0.19%	0.54%	0.89%	0.75%
Median Monthly Return	0.48%	0.32%	-0.05%	0.59%	0.27%	0.61%
Period Cumulative Return	-22.16%	4.70%	6.83%	26.11%	44.71%	26.83%
Sharpe Ratio	-0.17	0.00	0.03	0.24	0.32	0.15
Stutzer Index	-0.17	0.00	0.03	0.24	0.31	0.15
Treynor Ratio	-0.06	0.00	0.02	0.12	0.14	0.07
Modified Calmar Ratio	-0.29	0.22	0.24	0.77	0.98	0.50
Jensen Beta with USO	1.00	0.18	0.26	0.36	0.52	0.64
Jensen Monthly Alpha	0.00%	0.09%	0.18%	0.53%	0.87%	0.69%
Leland Beta	1.00	0.17	0.26	0.35	0.51	0.63
Leland Monthly Alpha	0.00%	0.09%	0.17%	0.52%	0.86%	0.69%
Correlation with Underlying	0.66	0.35	0.43	0.44	0.50	0.59
Skewness	-0.47	-0.02	0.35	0.47	0.29	0.12
Excess Kurtosis	0.84	0.68	0.25	0.33	-0.44	-0.25
Minimum Monthly Return	-32.22%	-6.73%	-7.30%	-8.13%	-10.41%	-15.96%
Maximum Monthly Return	27.14%	8.03%	10.65%	15.55%	18.25%	22.46%
Maximum Drawdown	-76.20%	-20.92%	-28.73%	-33.76%	-45.53%	-53.17%
Maximum Run Up	132.15%	22.38%	37.65%	62.20%	105.90%	129.59%
% Down Months	45%	44%	51%	47%	49%	47%
% Up Months	55%	56%	49%	53%	51%	53%
Number of Months	55	55	55	55	55	55
Months in Cash		0	0	0	0	0
Months in Collar		55	55	55	55	55

While the exhibits provide statistics for a wide range of collar implementations, our discussion focuses on the 5% OTM strategies[131]. Exhibit 17b provides summary statistics for 1-month call/6-month put collar strategies utilizing ATM, 2% OTM, 5% OTM, 10% OTM, and 25% OTM puts and calls, (with matching moneyness for the puts and calls). Over the 55 months of the study, the 5% OTM collar significantly reduces risk and greatly improves realized returns relative to a long USO position. The annualized returns are increased from -5.32% for the USO to 5.19% for the 5% OTM collar. Meanwhile, the standard deviation is reduced by over 1/2 from

[130] Previous research indicates that these strategies have typically outperformed 1-month call/1-month put strategies in the recent past. See, for example Szado and Kazemi [2008].
[131] We focus on the 5% OTM strategies since it is a middle ground between the ATM collars and the deep ITM collars.

37.79% to 17.03%. The Stutzer index increased from -0.17 to 0.24 and the Leland alpha increased from 0 basis points for the USO to 52 basis points *per month*, suggesting that the collar significantly increased risk adjusted performance. Perhaps the most visible impact of implementing the collar strategy is a reduction of the maximum drawdown from -76.20% to -33.76%. Not surprisingly, the modified Calmar ratio[132] for the collar is higher than that of the USO at 0.77 (versus -0.29 for the USO) for the 55 month period. Additional insight can be provided by Exhibit 17c, which provides a graphical presentation of the performance of the collar strategies. It is clear that a significant contributor to the outperformance of the collar strategies is their limited participation in the very significant drawdown that the USO ETF experienced from mid-2008 to early-2009. The performance of the 5% and greater OTM collars is quite similar to the USO ETF in the rest of the period. Ultimately, while the 5% OTM collar reduces maximum drawdown from -76.20% to -33.76%, it also reduces the maximum run up from 132.15% to 62.20%. Since the USO experienced such a significant drawdown in the first half of the period, it is not surprising that the collar strategies provided substantial performance improvements.

In addition to providing results for 5% OTM collars, Exhibit 17b and Exhibit 17c also provide results for ATM, 2% OTM, 10% OTM and 25% OTM collars. While all the collar strategies reduced the standard deviation of the USO and enhanced returns, the further OTM strategies generally outperformed nearer to ATM collars from an absolute return and a raw return perspective. The 10% OTM collars outperformed the other collars as well as the USO ETF. For example, the Stutzer index of the 10% OTM collar is 0.31 versus 0.00, 0.03, 0.24, 0.15 and -0.17

[132] A modified Calmar ratio is used which divides the cumulative period return by the maximum drawdown rather than using the annualized return. This modified ratio is more comparable across varying period lengths.

for the ATM, 2% OTM, 5% OTM and 25% OTM collars and the USO, respectively. Similarly, the monthly Leland alpha of the 10% OTM collar is 86 basis point versus 9, 17, 52, 69 and 0 basis points for the ATM, 2% OTM, 5% OTM and 25% OTM collars and the USO, respectively. Thus, all the collars provided superior risk adjusted returns to the USO ETF.

Exhibit 17c: Growth of $100 USO 1-Month Call/6-Month Put Balanced Collars

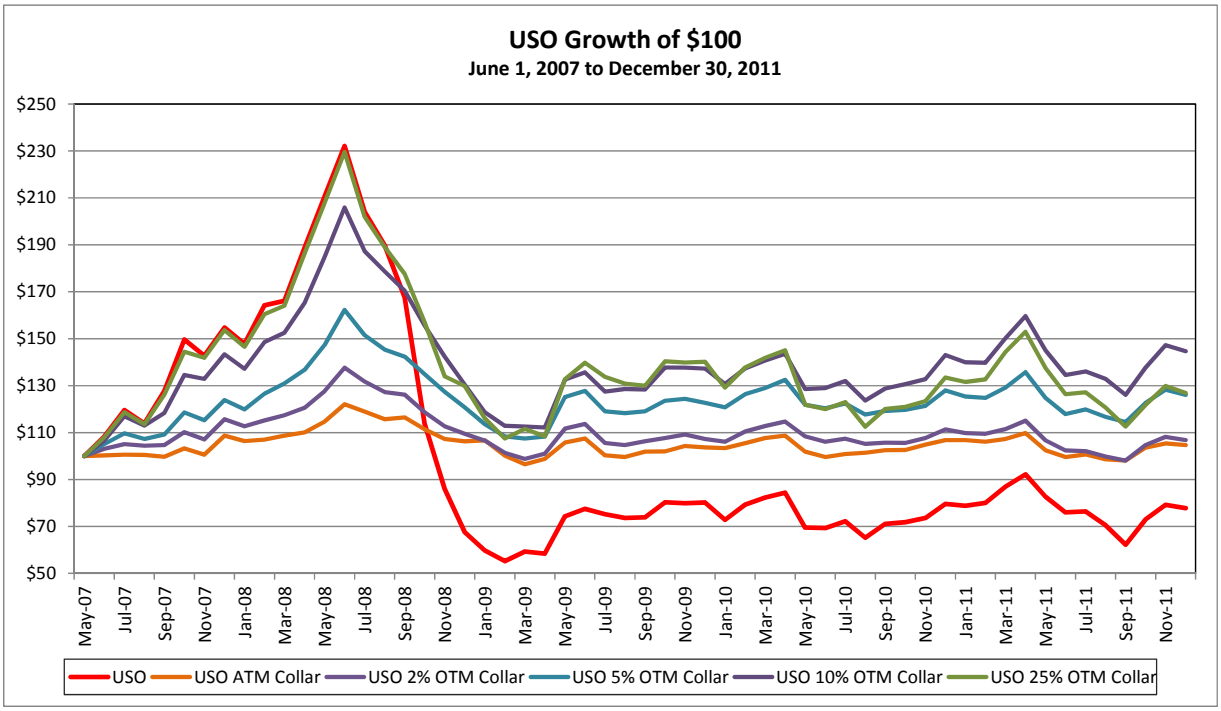


Exhibit 17d and Exhibit 17e provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 17d it is clear that the collar strategies exhibit limited participation in the run ups and drawdowns of the USO. After May 2010, the returns of the deep OTM collar strategies are generally quite similar to those of the USO. The rolling standard deviations provided in Exhibit 17e are evidence of the significant risk reduction potential of the near the money collar strategies. The ATM, 2% OTM and 5% OTM collar strategies exhibit

significantly lower standard deviations throughout the entire period, with the difference for the 5% OTM collar ranging from about 10% to 34%.

Exhibit 17d: Rolling Returns USO 1-Month Call/6-Month Put Collars

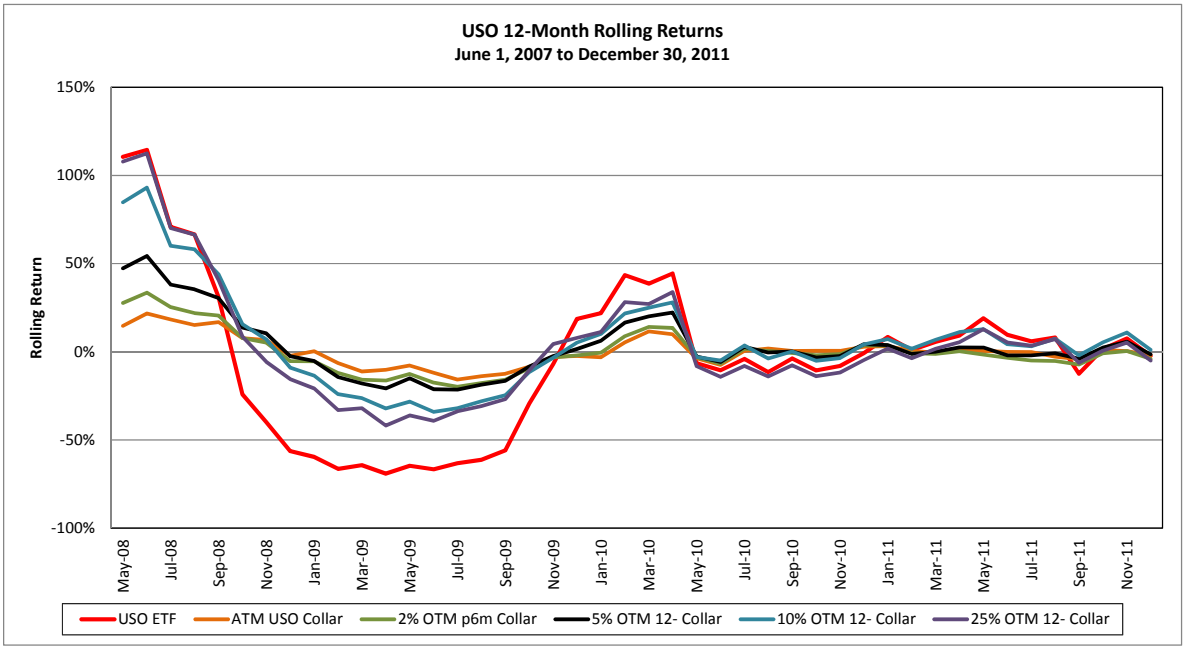
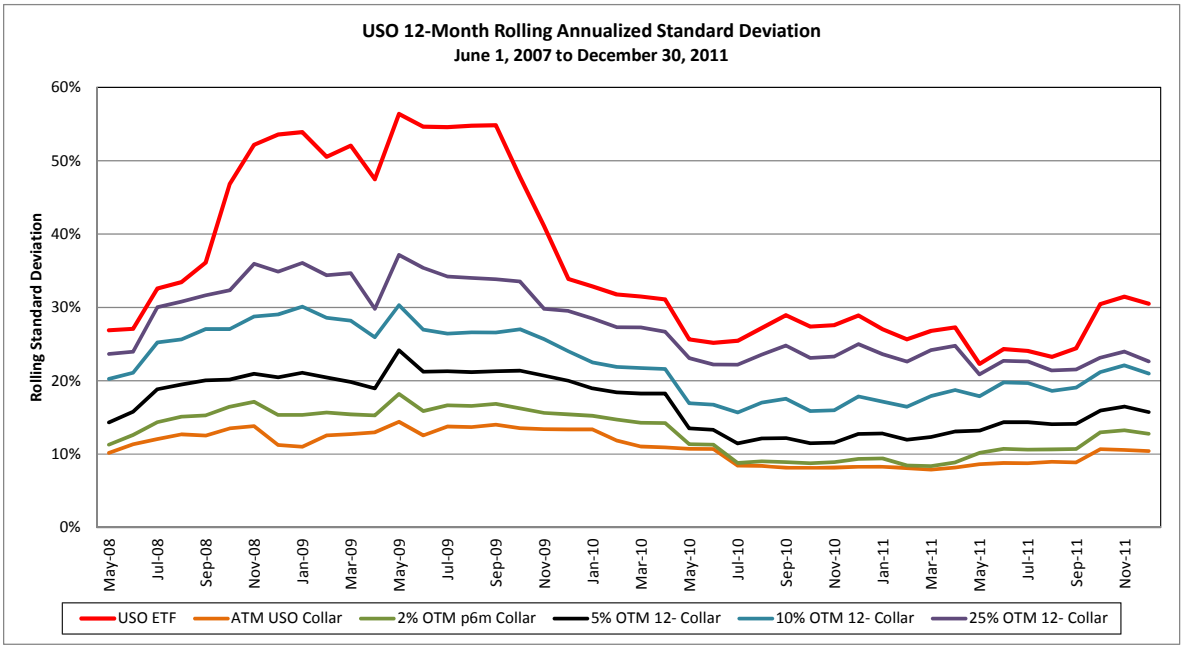
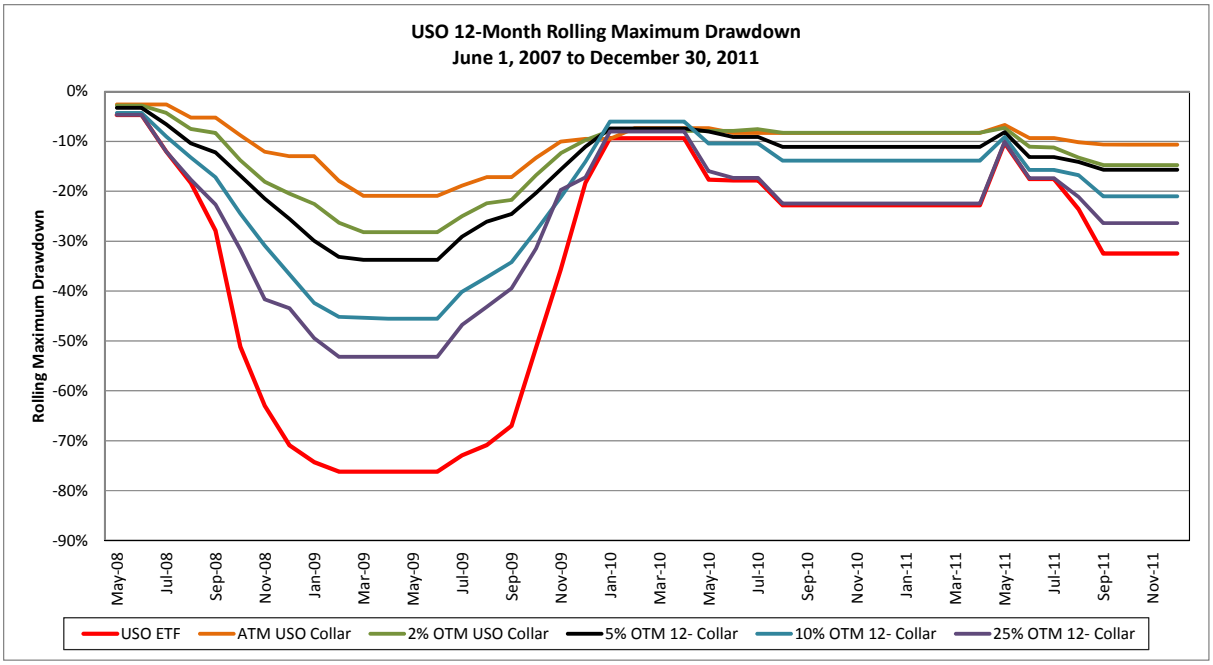


Exhibit 17e: Rolling Standard Deviation USO 1-Month Call/6-Month Put Collars



As mentioned earlier, one of the primary benefits of collar strategies is their protection from large drawdowns. Exhibit 17f provides a graphical presentation of 12-month rolling maximum drawdowns for USO collars. Thus, the Exhibit provides a rolling window of maximum losses over any 12-month period. Since the USO experienced an extremely large drawdown in the first half of period of study, the moneyness of the collar had a large impact on the degree of drawdown protection. While the near the money strategies provided significant protection, the deeper OTM collars had less (although still very significant) impact on drawdowns.

Exhibit 17f: Rolling Maximum Drawdown USO 1-Month Call/6-Month Put Collars



While collar performance is primarily driven by the returns of the underlying USO ETF, the choice of moneyness for the options and the level and degree of skew of implied volatilities

also have a large impact on collar returns. Exhibit 17g provides the levels of initial implied volatilities for 1-month ATM options on the USO since inception as well as the ex post realized volatility over the life of the options[133] and a simple volatility skew indicator (which measures the difference between the implied volatilities of the 5% OTM put and call[134]). While the volatility of volatility is quite high, the ATM implied volatility for the USO options tends to fluctuate around the 30% level. A number of significant peaks in implied and realized volatilities are clearly evident in the Exhibit, particularly in the third quarter of 2008. The implied volatility differential between the puts and calls tends to fluctuate around the 2% to 5% level (with the puts exhibiting higher implied volatilities than the calls) and exhibits some very significant peaks over the period.

[133] It is worth noting that the realized volatility is a forward looking measure. At the time that the implied volatility is measured, the investor does not know what volatility will be realized over the remaining life of the option.
[134] Of course, as mentioned earlier the actual options used will not be exactly 5% OTM due to discrete strikes and limited data availability. Thus this is simply representative of volatility skew and is far from a perfect measure of implied volatility skew.

Exhibit 17g: Implied and Realized Volatility USO 1-Month Collars Since Option Inception

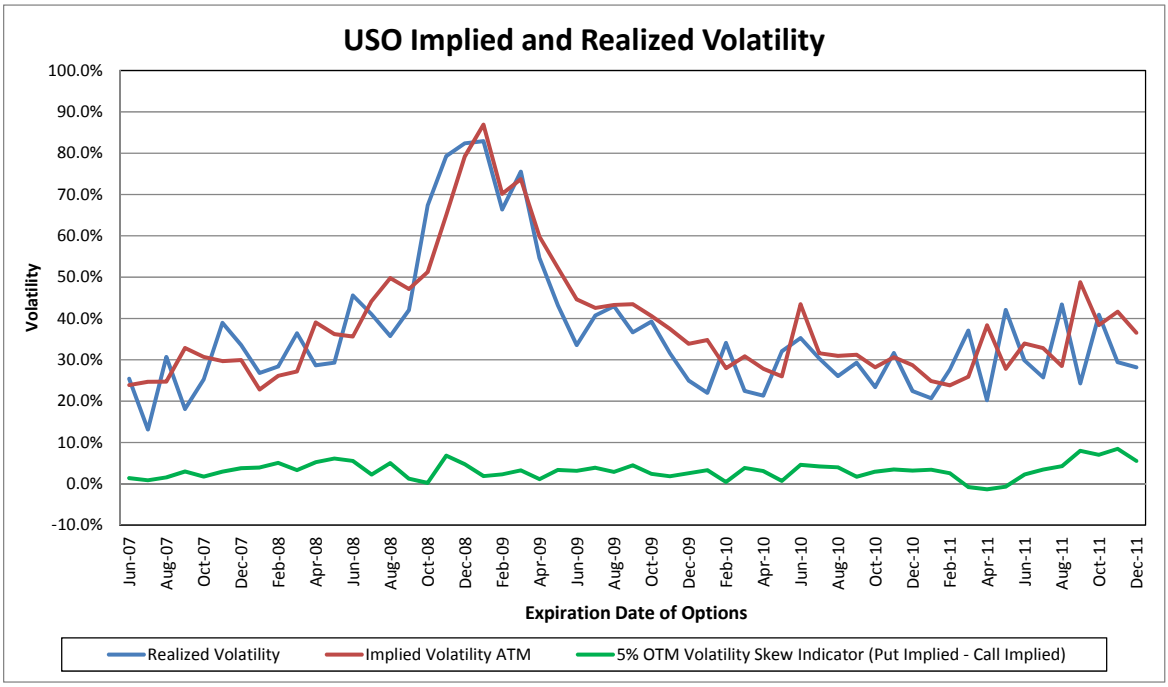


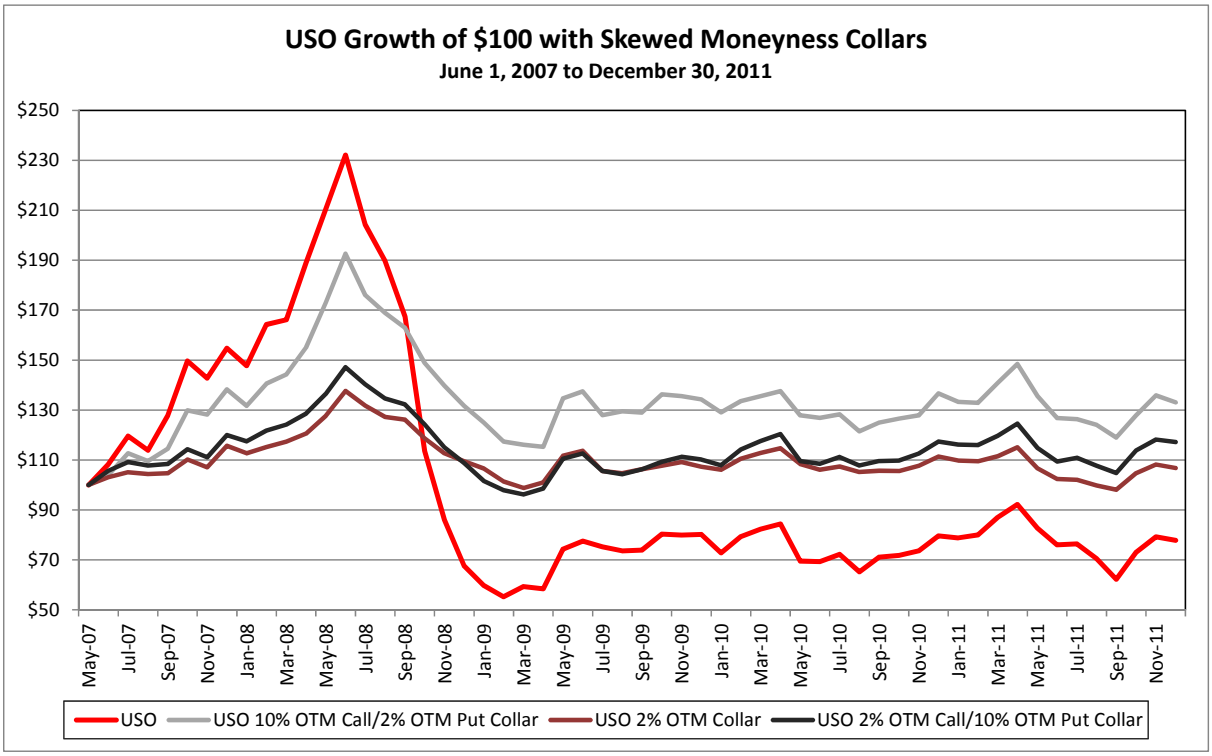
Exhibit 17h and Exhibit 17i provide summary statistics and a graphical presentation of performance, respectively for skewed USO collars in which the initial moneyness of the calls and puts do not match. In general, one would expect such collars to behave similar to buy-writes at one extreme (significant net premium collection collars) and similar to protective put strategies at the other extreme (significant net premium payment collars). While balanced collars tend to reduce the kurtosis of the underlying's return distribution, skewed collars tend to positively or negatively skew the distribution. Three strategies are presented: 2% OTM call/10% OTM put; 2% OTM call/2% OTM put; and 10% OTM call/2% OTM put. Thus a balanced 2% OTM collar is compared to collars which are skewed to the 10% OTM on either side. These moneyness levels were chosen to provide a net premium collection collar (2% OTM call/10% OTM put) and a net premium payment collar (10% OTM call/2% OTM put).

Exhibit 17h: Summary Statistics USO 1-Month Call/6-Month Put Skewed Collars

USO Collar Summary Statistics June 1, 2007 to Dec. 30, 2011	USO Total Return	10% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 2% OTM 6-Month Put	2% OTM 1-Month Call, 10% OTM 6-Month Put
Annualized Return	-5.32%	6.43%	1.45%	3.52%
Annualized Standard Deviation	37.79%	20.46%	13.16%	15.61%
Mean Monthly Return	0.16%	0.69%	0.19%	0.39%
Median Monthly Return	0.48%	-0.34%	-0.05%	0.58%
Period Cumulative Return	-22.16%	17.17%	6.83%	33.07%
Sharpe Ratio	-0.17	0.26	0.03	0.16
Stutzer Index	-0.17	0.26	0.03	0.16
Treynor Ratio	-0.06	0.12	0.02	0.07
Modified Calmar Ratio	-0.29	0.43	0.24	0.95
Jensen Beta with USO	1.00	0.44	0.26	0.34
Jensen Monthly Alpha	0.00%	0.67%	0.18%	0.38%
Leland Beta	1.00	0.43	0.26	0.33
Leland Monthly Alpha	0.00%	0.67%	0.17%	0.38%
Correlation with Underlying	0.66	0.47	0.43	0.49
Skewness	-0.47	0.53	0.35	0.08
Excess Kurtosis	0.84	-0.10	0.25	-0.21
Minimum Monthly Return	-32.22%	-8.66%	-7.30%	-8.93%
Maximum Monthly Return	27.14%	16.80%	10.65%	12.03%
Maximum Drawdown	-76.20%	-40.17%	-28.73%	-34.64%
Maximum Run Up	132.15%	47.15%	37.65%	92.67%
% Down Months	45%	53%	51%	47%
% Up Months	55%	47%	49%	53%

The net premium payment collar (2% OTM call/10% OTM put) outperforms the net premium collection collar, the balanced collar and the USO ETF on an absolute return as well as a risk adjusted return basis. For example, the net premium payment collar generates a 6.43% return at a standard deviation of 20.46% versus 1.45%/13.16%, 3.52%/15.61%, and -5.32%/37.79% for the balanced collar, the net premium collection collar and the underlying USO ETF, respectively. Similarly, the Stutzer index for the net premium payment collar is 0.26 versus 0.03, 0.16 and -0.17 for the balanced collar, the net premium collection collar and the underlying USO ETF, respectively.

Exhibit 17i: Growth of $100 USO 1-Month Call/6-Month Put Skewed Collars



The choice of initial moneyness of puts and calls not only impacts the degree of downside protection and upside participation, it also impacts the net premium payment. Exhibit 17g indicates that the relative cost of fixed moneyness calls and puts can vary significantly over time. It may be more comfortable for some investors to focus on the initial (net option premium) cost of a collar rather than basing a strategy on fixed levels of initial moneyness (which can result in widely varying premium costs over time). In order to consider the impact on protection and participation levels of a stable net premium strategy, we now consider a "zero-cost" 5% OTM collar strategy. In such a strategy, the investor determines their desired protection level – in this case a 5% OTM put, and sells the closest call to the ATM which will result in a zero (or the smallest positive) net premium collection.

For logistical reasons, we implement this strategy with 1-month puts and calls. This allows a clear matching of cash flows from call and put premiums. We do not provide performance results in this section since our purpose in this section is simply to provide an indication of the relative protection/participation levels.

Exhibit 17j: Protection Cost Index at Roll-In USO 1-Month "Zero-Cost" Collars

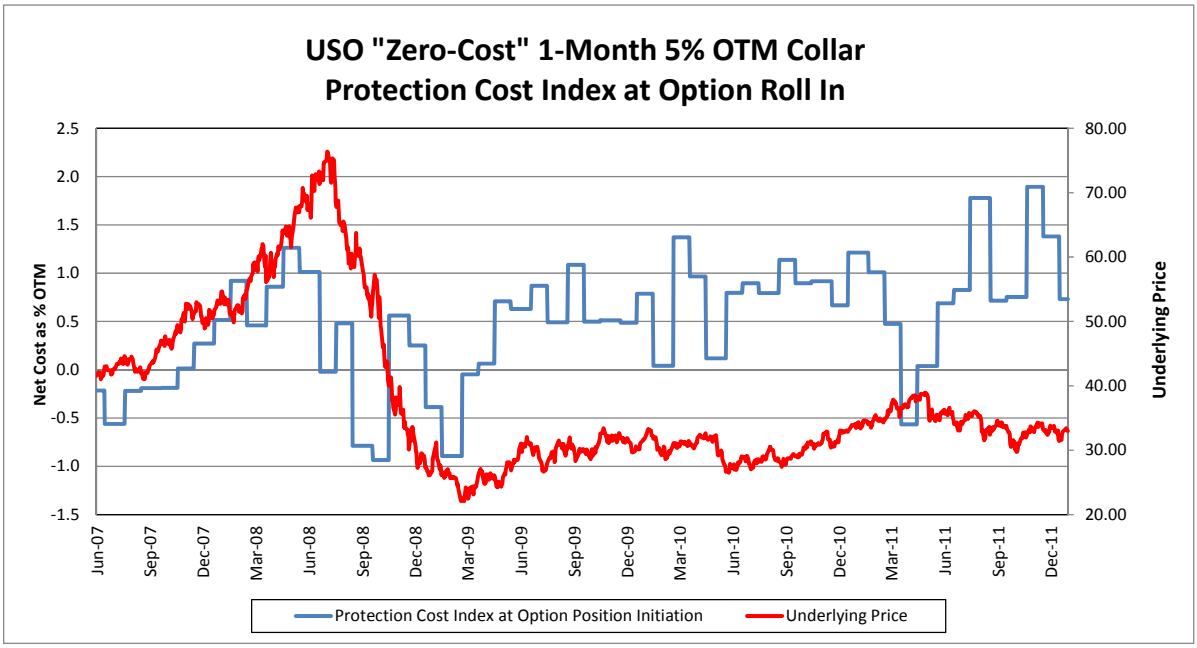


Exhibit 17k: Initial Option Moneyness USO 1-Month "Zero-Cost" Collars

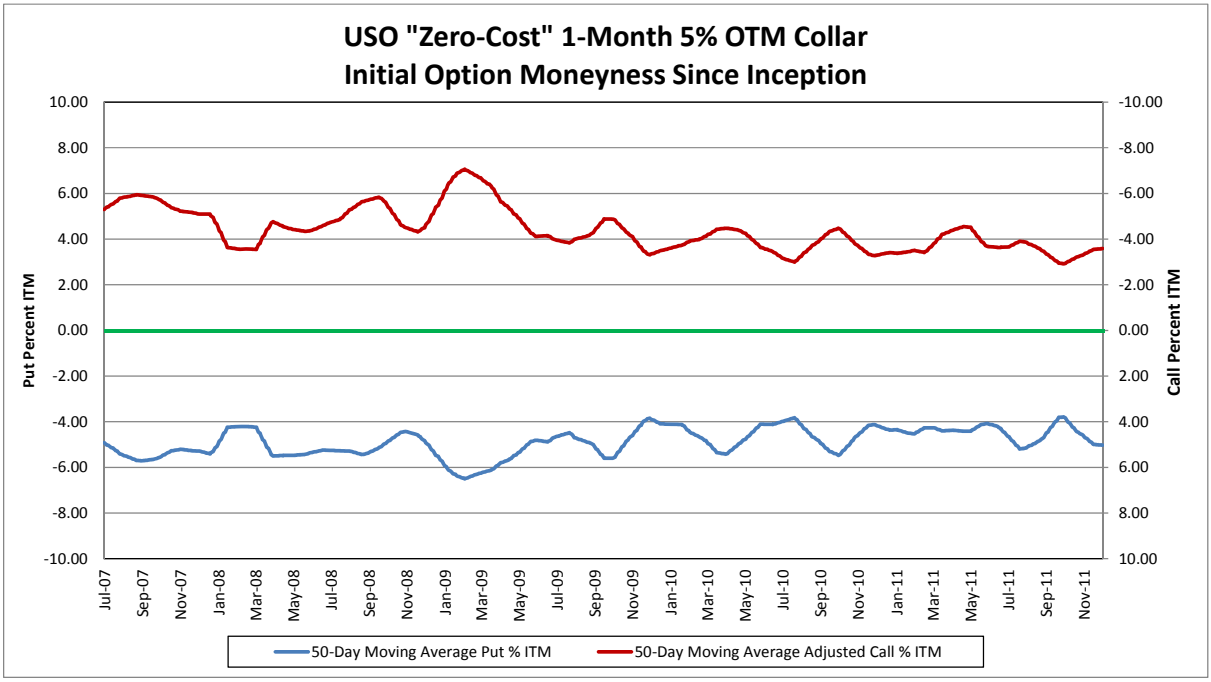


Exhibit 17j and Exhibit 17k provide graphical presentations of the relative skew in initial call and put strike prices (mid-point of the bid and ask) at the initialization of option positions for the "zero-cost" collar. Since options have discrete strike prices, the collar is rarely truly "zero-cost". Generally a small net premium is collected. The larger the premium collected, the more the observed "zero-cost" collar option moneyness will overstate the effective put skew in the options. In order to capture the effective skew in a single parsimonious measure we calculate a Protection Cost Index (PCI) for the USO options. The PCI of the 5% OTM put is simply the actual put percent OTM minus the effective call percent OTM, where the effective call percent

OTM equals the actual call moneyness plus the premium collected divided by the call dual delta and the underlying ETF price[135].

The formula is as follows:

$$PCI = \%OTM_{PUT} - \left(\%OTM_{CALL} + \frac{\text{Premium Collected}}{\text{Call Dual Delta x Underlying Price}} \right)$$

Thus, if skew is flat one would expect that the moneyness of the call and put would be approximately equal and the net premium would be zero, resulting in a zero PCI. If the call is further OTM than the put, and the net premium is zero then the PCI would be negative, reflecting the fact that a proportionally less upside participation must be sacrificed for the desired downside protection. The Exhibit indicates a varying skew in option implied volatilities which is sometimes toward the calls and sometimes toward the puts, indicating a lack of a stable relationship between the "richness" of puts and calls (unlike typical equity index-based ETFs, in which puts are quite consistently more "expensive" than calls).While the rolling PCI index tends to average near the zero to 1% level, the PCI varies significantly over time, ranging from about -0.9% to 1.9% and apparently trending slightly upward. While the skew seems to spend more time skewed towards the puts, it is far too inconsistent to conclude there is any stable put or call skew. Exhibit 17k provides further evidence of the pattern in the skew by illustrating the rolling average put moneyness and adjusted call moneyness (using the dual delta to adjust for the premium collected).

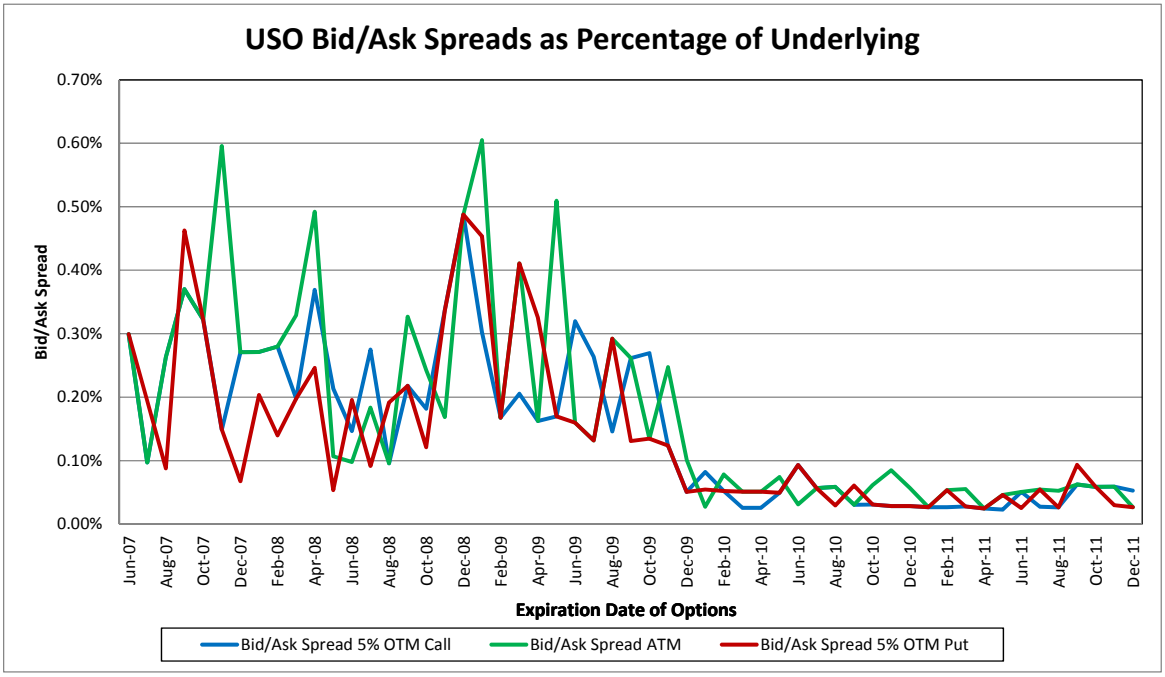
[135] The dual delta is the first derivative of option price with respect to strike. Therefore, its reciprocal is the change in strike for a change in call price. Dividing by the ETF price provides the effective change in moneyness for a given change in call price. It is worth noting that since this is a linear approximation of a non-linear relationship the adjustment will become less accurate as the size of the premium collected increases.

Transaction costs can have a significant impact on option-based trading strategies. In this study, we capture transaction costs by selling calls at the bid price and buying puts at the ask price when we initiate new option positions. Exhibit 17l provides a graphical presentation of bid/ask spreads as a percentage of the underlying USO price for 5% OTM 1-month puts and calls as well as ATM options over the period of the study[136]. In general, bid/ask spreads tend to decrease over time. However, there are a number of peaks in the spreads. While the spreads peak around 0.6% of the USO price in the first half of the period, they tend to fluctuate around 5 basis points in the second half of the period. It is worth noting that while the collar strategies presented in this section of the paper are designed to invest fully in cash (SHY ETF) when bid/ask spreads at option position initialization are greater than 1% of the USO price[137], such wide spreads were not encountered for the USO ETF.

[136] 1-Month puts and calls were utilized for this chart rather than 6-month puts and 1-month calls to allow a like-for-like comparison between puts and calls. Therefore, the bid/ask spreads experienced by the 6-month put/1-month call collars will vary somewhat from the results presented in this exhibit.

[137] The logic behind this practice is two-fold. First, with overly wide spreads (spreads over 10% were encountered for some ETFs) it is impossible to know how close the "market value" of the option is to the mid-point between the bid and ask. Secondly, the transaction costs could overwhelm the benefit of protection. In the case of excessively high insurance, individuals often self-insure.

Exhibit 17l: Bid/Ask Spreads USO 1-Month Collars



In conclusion, the USO ETF is somewhat unique in that the options exhibit call skew at times and significant put skew at others, particularly in the first half of the period. During the financial crisis the USO collar strategies significantly outperformed the USO ETF, both on an absolute and risk adjusted basis. The USO ETF experienced an extremely strong run up followed by an even stronger drawdown in the first half of the period. While the collars underperformed in the run up, they significantly outperformed during the drawdown and reduced volatility throughout the period. Finally, while USO options used in this study exhibited bid/ask spreads as high as 0.6% of the underlying price at times, the spreads were generally near 5 basis points in the later part of the period of study.

Summary of Empirical Results Multi Asset ETF Collars

Exhibits 18a, 18b and 18c provide summaries of the basic performance statistics of the range of collars considered in the study.

Exhibit 18a: Summary Statistics 2% OTM 1-Month Call/6-Month Put Collars

ETF	ETF Annualized Return	2% OTM Collar Annualized Return	ETF Annualized Standard Deviation	2% OTM Collar Annualized Standard Deviation	ETF Period Cumulative Return	2% OTM Collar Period Cumulative Return
EEM	-0.43%	6.29%	30.95%	10.44%	-1.97%	32.28%
EFA	-7.32%	-1.26%	24.52%	9.02%	-29.43%	-5.66%
FXA	8.96%	4.69%	18.24%	6.45%	48.16%	23.36%
FXB	-3.98%	-0.98%	10.78%	5.11%	-16.99%	-4.42%
FXC	1.95%	3.03%	12.66%	6.18%	9.26%	14.65%
FXE	0.31%	-0.48%	13.62%	6.24%	1.43%	-2.16%
FXF	6.09%	1.86%	14.70%	7.00%	31.10%	8.82%
FXY	10.14%	5.51%	10.37%	5.40%	55.69%	27.85%
GLD	15.64%	4.34%	22.82%	9.65%	66.29%	16.03%
GSG	-4.74%	0.65%	28.83%	9.64%	-19.95%	3.02%
HYG	5.29%	-1.44%	17.01%	5.76%	26.63%	-6.42%
IWM	-1.51%	-0.77%	25.13%	12.03%	-6.72%	-3.49%
IYR	-4.02%	0.69%	33.27%	10.80%	-17.14%	3.21%
QQQ	4.25%	0.64%	22.79%	10.21%	21.01%	2.95%
SPY	-2.14%	4.47%	19.46%	8.37%	-9.45%	22.17%
TLT	12.29%	4.05%	16.85%	8.22%	70.12%	19.98%
USO	-5.32%	1.45%	37.79%	13.16%	-22.16%	6.83%

Exhibit 18b: Summary Statistics 5% OTM 1-Month Call/6-Month Put Collars

ETF	ETF Annualized Return	5% OTM Collar Annualized Return	ETF Annualized Standard Deviation	5% OTM Collar Annualized Standard Deviation	ETF Period Cumulative Return	5% OTM Collar Period Cumulative Return
EEM	-0.43%	5.87%	30.95%	14.05%	-1.97%	29.88%
EFA	-7.32%	-3.66%	24.52%	12.24%	-29.43%	-15.73%
FXA	8.96%	5.24%	18.24%	10.92%	48.16%	26.36%
FXB	-3.98%	-2.78%	10.78%	7.00%	-16.99%	-12.13%
FXC	1.95%	2.84%	12.66%	8.19%	9.26%	13.67%
FXE	0.31%	0.73%	13.62%	9.27%	1.43%	3.40%
FXF	6.09%	6.63%	14.70%	9.51%	31.10%	34.20%
FXY	10.14%	8.77%	10.37%	8.13%	55.69%	47.00%
GLD	15.64%	8.80%	22.82%	13.65%	66.29%	34.35%
GSG	-4.74%	2.62%	28.83%	11.37%	-19.95%	12.59%
HYG	5.29%	0.54%	17.01%	7.26%	26.63%	2.50%
IWM	-1.51%	-0.09%	25.13%	14.17%	-6.72%	-0.42%
IYR	-4.02%	-1.46%	33.27%	13.33%	-17.14%	-6.51%
QQQ	4.25%	1.75%	22.79%	13.16%	21.01%	8.28%
SPY	-2.14%	3.03%	19.46%	10.42%	-9.45%	14.64%
TLT	12.29%	5.85%	16.85%	10.97%	70.12%	29.76%
USO	-5.32%	5.19%	37.79%	17.03%	-22.16%	26.11%

Exhibit 18c: Summary Statistics 10% OTM 1-Month Call/6-Month Put Collars

ETF	ETF Annualized Return	10% OTM Collar Annualized Return	ETF Annualized Standard Deviation	10% OTM Collar Annualized Standard Deviation	ETF Period Cumulative Return	10% OTM Collar Period Cumulative Return
EEM	-0.43%	5.06%	30.95%	18.19%	-1.97%	25.38%
EFA	-7.32%	-5.04%	24.52%	16.42%	-29.43%	-21.09%
FXA	8.96%	7.22%	18.24%	13.34%	48.16%	37.63%
FXB	-3.98%	-3.44%	10.78%	8.79%	-16.99%	-14.82%
FXC	1.95%	2.88%	12.66%	9.66%	9.26%	13.92%
FXE	0.31%	0.45%	13.62%	11.62%	1.43%	2.06%
FXF	6.09%	4.29%	14.70%	12.29%	31.10%	21.21%
FXY	10.14%	8.55%	10.37%	9.60%	55.69%	45.66%
GLD	15.64%	11.67%	22.82%	17.70%	66.29%	47.14%
GSG	-4.74%	5.80%	28.83%	14.01%	-19.95%	29.48%
HYG	5.29%	5.03%	17.01%	9.46%	26.63%	25.24%
IWM	-1.51%	-2.30%	25.13%	17.50%	-6.72%	-10.11%
IYR	-4.02%	-4.61%	33.27%	16.68%	-17.14%	-19.46%
QQQ	4.25%	3.07%	22.79%	16.58%	21.01%	14.89%
SPY	-2.14%	0.24%	19.46%	12.39%	-9.45%	1.08%
TLT	12.29%	7.26%	16.85%	13.83%	70.12%	37.88%
USO	-5.32%	8.40%	37.79%	23.04%	-22.16%	44.71%

Conclusions

In the previous pages, we have provided extensive analysis of the performance of a wide range of collar strategies implemented on a wide variety of ETFs, covering such diverse asset classes as Equities, Currencies, Commodities, Fixed Income, and Real Estate. The study covers the period from June 1, 2007 to December 31, 2011, with the exception of the GLD ETF which begins at first month-end after the inception of option trading on July 1, 2008. The period of study was chosen to capture the financial crisis and to provide a common period of study for a wide range of ETFs.

The drawdown protection ability is clearly evident in the results provided across all ETFs. From a return perspective, the results are mixed. Collars tend to outperform in cases in which drawdowns are more aggressive than run ups. The implied volatility skew can significantly impact collar returns. The ETFs presented in the analysis exhibit a mix of put skew and call skew, affecting the relative tradeoff between downside protection and the sacrifice of upside participation.

The analysis also provides evidence of significant variability in implied and realized volatilities as well as bid/ask spreads across the range of ETFs.

In conclusion, while collars are not “silver bullets” for all products, in all market conditions, it is clear that collars can provide significant risk controls across a wide variety of asset classes, significantly reducing volatility and drawdowns, and in certain market environments, enhancing returns.

REFERENCES

Arditti, F. D., "Risk and the required return on equity." *Journal of Finance*, 1967, Vol. 22, No. 1: 19-36.

Bakshi, G., and N. Kapadia, "Delta-Hedged Gains and the Negative Market Volatility Risk Premium," Review of Financial Studies, 2003, 16(2), pp. 527-566

Callan Associates Inc., "Profit/Loss an Historical Evaluation of the CBOE S&P 500 Buy-Write Index Strategy," Callan Associates Inc., Oct 2006

Feldman, Barry, and Dhruv Roy, "Passive Options-Based Investment Strategies: The Case of the CBOE S&P 500 Buy Write Index," Ibbotson Associates, July 28, 2004

Hill, Joanne M., Venkatesh Balasubramanian, Krag (Buzz) Gregory, and Ingrid Tierens, "Finding Alpha via Covered Call Writing," Financial Analysts Journal, Sept/Oct 2006, pp. 27-46

Jegadeesh, Narasimhan and Sheridan Titman, "Momentum," University Of Illinois Working Paper, October 23, 2001

Kapadia, Nikunj and Edward Szado, "The Risk Return Characteristics of the Buy-Write Strategy on the Russell 2000 Index," Journal of Alternative Investments, Spring 2007, pp. 39-56

Leland, Hayne E., "Beyond Mean-Variance: Performance Measurement in a Non-Symmetrical World," Financial Analysts Journal, Jan/Feb 1999, pp. 27-35

Renicker, Ryan and Devapriya Mallick., "Enhanced Call Overwriting," Lehman,Brothers Global Equity Research, Nov 17, 2005

Schneeweis, thomas, Hossein Kazemi, and Richard Spurgin, "Momentum in Asset Returns: Are Commodity Returns a Special Case?" Journal of Alternative Investments, Spring 2008, pp. 23-36

Schneeweis , thomas and Richard B Spurgin., **"**The Benefits of Index Option-Based Strategies for Institutional Portfolios**,"** Journal of Alternative Investments, Spring 2001, pp. 44-53

Spurgin, R., "How to Game your Sharpe Ratio," Journal of Alternative Investments, Winter 2001, pp. 38-46

Stutzer, Michael, "A Portfolio Performance Index," Financial Analysts Journal, May/June 2000, Vol. 56, No. 3, pp. 52-61

Szado, Edward and Hossein Kazemi "Collaring the Cube: Protection Options for a QQQ ETF Portfolio," Journal of Alternative Investments, Spring 2009, pp. 24-42

Ungar, J., and M.T. Moran, "The Cash-secured Put-Write Strategy and Performance of Related Benchmark Indexes," Journal of Alternative Investments, Spring 2009, pp. 43-56

Whaley, Robert E., “Return and Risk of CBOE Buy Write Monthly Index,” The Journal of Derivatives Winter 2002, pp. 35-42

Appendix: Robust Measures of Risk-adjusted Returns

Stutzer Index

Stutzer (2000) begins with a manager whose motivation is to have his average returns exceed the returns of a particular benchmark. Provided that the expected return of the manager's portfolio is greater than that of the benchmark, the probability that the manager's average returns will underperform the benchmark decays to zero exponentially with time. Since the manager would like to ensure that he does not underperform the benchmark, he would like to maximize the rate at which the probability of underperformance decays to zero. Therefore, Stutzer uses the decay rate as a performance index.

Stutzer's information statistic I_p is given as:

$$I_p = \underset{\theta}{Max}\left[-\log\left(\frac{1}{T}\sum_{t=1}^{T} e^{\theta r_t}\right)\right],$$

Where r_t is the excess return of the portfolio and θ is chosen to maximize I_p. The Stutzer index is derived from the information statistic using the following formula:

$$Stutzer\ Index = \frac{Abs[\bar{r}]}{\bar{r}}\sqrt{2I_p},$$

Where $\bar{r}$ is the mean excess return and Abs($\bar{r}$) is the absolute value of the mean excess return. When returns are normally distributed, the performance ratio is:

$$I_p = \frac{1}{2}\lambda_p^2,$$

where λ is the Sharpe ratio.

Thus, if returns are normally distributed, the expected values of the Sharpe ratio and the Stutzer index are equal. Otherwise, the Stutzer index penalizes high kurtosis and negative skewness.

Leland's Alpha and Beta

Leland's (1999) alpha and beta assume that market returns are normal but allow for non-normality in security or portfolio returns. Consistent with the Stutzer index, Leland's measures reflect the preference for low kurtosis and positive skewness.

Utilizing Rubinstein's (1976) equilibrium pricing equation,

$$P_o = \frac{E[(1+r_p)P_o] - \lambda\rho\left[(1+r_p)P_o, -(1+r_{mkt})^{-b}\right] Stdev[(1+r_p)P_o]}{1+r_f},$$

where ρ[x,y] is the correlation of x and y, and –b is the exponent of the average investor's marginal utility function, Leland models portfolio returns as:

$$E(r_p) = r_f + B_p\left[E(r_{mkt}) - r_f\right],$$

where Leland's beta is given by:

$$B_p = \frac{cov\left[r_p, -(1+r_{mkt})^{-b}\right]}{cov\left[r_{mkt}, -(1+r_{mkt})^{-b}\right]},$$

and *b* is a market price of risk. If market returns are normally distributed, *b* is given by:

$$b = \frac{\log[E(1+r_{mkt})] - \log\left(1+r_f\right)}{var[\log(1+r_{mkt})]},$$

Thus, the Leland alpha follows:

$$A_p = E[r_p] - B_p\left[E(r_{mkt}) - r_f\right] - r_f,$$