Loosening Your Collar: Alternative Implementations of QQQ Collars

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Abstract

The credit crisis and the associated decline in equity markets has rekindled new interest in option based equity collars and in protective strategies in general. In this paper we consider the performance of passive and active implementations of the collar strategy on the QQQ ETF as well as on a sample small cap equity mutual fund. As expected, the results of the analysis show that a passive collar is most effective (relative to a long underlying position) in declining markets and less effective in rising markets. This study also considers a more active implementation of the collar strategy. Rather than simply applying a set of fixed rules as for the passive collar, in the active collar adjusted strategy, we apply a set of rules which adapt the collar to varying economic and market conditions. This approach is similar to applying a set of tactical asset allocation rules to a set of investments. There are of course an unlimited number of conditioning factors that can be used to determine the strategy implementation. In this paper, for purposes of presentation, we combine three conditioning factors that have been suggested in academic literature (momentum, volatility, and a compound macroeconomic factor (unemployment and business cycle)) to generate a dynamic collar adjusted trading strategy. For the period of analysis, the active collar adjustment strategy tends to outperform the passive collar. Judgments as to the particular benefits of the passive and active collar strategies are, of course, dependent on the risk tolerance of the individual investor.

Introduction

The credit crisis and the associated decline in equity markets has 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 Kazemi [2009]) by considering the performance and risk characteristics of active as well as passive collars. In addition, we provide an example of the effectiveness of applying a collar strategy to a sample equity mutual fund on which options are not available. 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 the performance of passively implemented collars on the Powershares QQQ ETF (ticker: QQQQ) is analyzed. 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. This study also considers a more active implementation of the collar strategy. Rather than simply applying a set of fixed rules as for the passive collar, for the active collar adjustment strategy, we apply a set of rules which adapt the collar to varying economic and market conditions. This approach is similar to applying a set of tactical asset allocation rules to a set of investments. There are of course an unlimited number of conditioning factors that can be used to determine the strategy implementation. In this paper, for purposes of presentation, we combine three conditioning factors that have been suggested in academic literature (momentum, volatility, and a compound macroeconomic factor (unemployment and business cycle)) to generate a dynamic collar adjusted trading strategy.[2] Finally, the study considers the implementation of an active and

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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.

[2] While these collar implementations are active in the sense that the rules are dependent on manager decisions, they are implemented systematically with no additional manager discretion.

passive collar strategy using QQQ options applied to a non-QQQ equity portfolio represented by a small cap equity mutual fund. This provides an additional analysis of the use of the collar strategy for a wider range of market participants.

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. This analysis covers the period from the introduction of options on the QQQ (March 19, 1999) through May 31, 2009. This period is broken into various sub-periods to offer a better picture of the benefits and risk of the implemented collar strategies in various market environments. In the methodology section we describe both the passive and active collar implementations. In the active collar section we describe how we combine the momentum, volatility and macroeconomic signals to generate a dynamic collar adjustment trading strategy process[3]. In this process, the initial moneyness of the puts and calls is determined based on the momentum and macroeconomic signals and the ratio of written calls is determined by the volatility signal. The marginal effect of the momentum signal is to widen or tighten the collar by increasing or decreasing the amount OTM, respectively. The marginal effect of the macroeconomic signal is to shift the collar up by increasing the amount OTM of the calls and decreasing the amount OTM of the puts, or shift the collar down by moving the strikes in the opposite direction. The marginal effect of the volatility signal is to increase or decrease the number of calls written per QQQ and put purchased.

Results show that the passive and active collar strategies underperformed the QQQ in the strong market climb of October 2002 to September 2007. However, in the period around the tech

[3] While we combine the three signals to generate the strategy, any one of the signals could be used on its own to generate an active strategy.

bubble and in the credit crisis the passive and active collar strategies provided capital protection and, in the case of the tech bubble, generated significant returns at relatively low volatility. In addition, we provided evidence of the effectiveness of wrapping a passive or active collar strategy around a portfolio for which no options are available (in this case, represented by a small cap mutual fund). Results for the mutual fund collars are similar to those reported for the collar strategies on the QQQ. Finally, results show that active collar strategies on the QQQ and on a small cap mutual fund which use a set of three simple trading rules to create a dynamic collar adjustment process could provide added benefits over similar passive collars.

Data and Methodology

Data

The option price data is provided by Optionmetrics and covers the period from the first expiration after the introduction of QQQ options on March 19, 1999 to May 31, 2009. The QQQ, NDX, Treasury bill and VIX data is provided by Datastream[4], while mutual fund data is provided by Morningstar. Business cycle announcement data are provided by the National Bureau of Economic Research.

Methodology

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

[4] NDX, VIX and Initial Unemployment Claims data is collected from March 1998 to ensure sufficient lag time for signal generation.

of the calls and puts, regardless of market conditions. In contrast, the active[5] collar strategies base their option selection rules on a combination of three simple market/economic based signals (momentum, volatility, and a macroeconomic factor) and thus adjust to various market conditions.

Passive Collar Strategy: We generate a daily time series of returns for each of the passive strategies beginning on March 19, 1999[6]. At the close on this day a 1-month call is written and a 1, 3 or 6-month put is purchased. Depending on the particular passive implementation, the initial moneyness of the calls and puts are set at either 5%, 4%, 3%, 2%, 1% OTM or ATM. At the close on the Friday prior to the following expiration, we take one of two actions: If 1-month puts are used, the puts and calls are settled at intrinsic value and we roll into new 1-month puts and calls with the specified moneyness. If a 3- or 6-month put is used, 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 3- or 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

[5] It should be noted that while we use the term active to represent these strategies, they are not truly actively managed. They still follow an established set of selection rules, but the rules include a dynamic element conditioned on economic variables.

[6] This is the Friday prior to the first expiration Saturday following the introduction of QQQ options.

are calculated for each passive strategy implementation. The following example illustrates this process:

Passive 2% OTM 1-Month Call 6-Month Put Implementation

	Date		Exdate		Quantity				Wealth	
Roll In	3/19/1999	Purchase QQQ			1.000	@	$ 102.44		$ 108.69	(Initial)
		Purchase a 6-month 2% OTM put expiring on:	9/17/1999	(Strike price = 100)	1.000	@	$ 9.50	(at ask)		
		Sell a 1-month 2% OTM call expiring on:	4/16/1999	(Strike price = 104)	1.000	@	$ (3.25)	(at bid)		
Roll Out	4/16/1999	QQQ value			1.000	@	$ 103.94		$ 112.37	
		Keep the put (now 5-month 4% OTM) expiring on:	9/17/1999	(Strike price = 100)	1.000	@	$ 8.44	(mid of bid/ask)		
		Payout value of previous call at expiration:	4/16/1999	(Strike price = 104)	1.000	@	$ -	(intrinsic value)		
Roll In	4/16/1999	Purchase QQQ			1.037	@	$ 103.94		$ 112.37	
		Keep the put (now 5-month 4% OTM) expiring on:	9/17/1999	(Strike price = 100)	1.037	@	$ 8.44	(mid of bid/ask)		
		Sell a 1-month 2% OTM call expiring on:	5/22/1999	(Strike price = 106)	1.037	@	$ (4.00)	(at bid)		
		Repeat until put expires								
Roll Out	9/17/1999	QQQ value			1.045	@	$ 126.63		$ 123.31	
		Payout value of the put at expiration:	9/17/1999	(Strike price = 100)	1.045	@	$ -	(intrinsic value)		
		Payout value of the call at expiration:	9/17/1999	(Strike price = 118)	1.045	@	$ (8.63)	(intrinsic value)		
Roll In	9/17/1999	Purchase QQQ			0.924	@	$ 126.63		$ 123.31	
		Purchase a 6-month 2% OTM put expiring on:	3/18/2000	(Strike price = 124)	0.924	@	$ 10.25	(at ask)		
		Sell a 1-month 2% OTM call expiring on:	10/16/1999	(Strike price = 129)	0.924	@	$ (3.38)	(at bid)		

Active Strategy Market Signals

For the active implementations, a series of three market signals determine the choice of initial call and put moneyness, as well as the ratio of the number of calls written to the number of puts and QQQ shares purchased, while the time to expiration is fixed at one month for the calls and 6 months for the puts.

Active Collar Adjustment Strategy: Three different sets of active market signals are used for the strategy implementations, differing by their time horizon; short, medium and long-term. The three signals are based on momentum, volatility and a compound macroeconomic indicator

(unemployment claims and business cycle), respectively. In order to ensure that the strategies are investable, all signals use contemporaneously lagged data[7].

Momentum Signal: The momentum signal is a simple moving average cross-over (SMACO) of the NASDAQ-100 index (NDX)[8]. A SMACO compares a short-term moving average (SMA) and a long-term moving average (LMA) to determine whether an upward or downward trend exists. The rule is defined by the number of days covered by each of the moving averages. For example, a 5/150 SMACO rule compares a 5 day SMA with a 150 day LMA. If the SMA is greater (less) than the LMA, then an upward (downward) trend indicated, suggesting a buy (sell) signal. Our choice of signals is based on Szakmary, Davidson, Schwarz [1999] and Lento [2008][9], which both consider 1/50, 1/150, 5/150, 1/200 and 2/200 SMACO rules on the NDX. Szakmary et al apply NASDAQ index SMACOs as buy/sell signals for individual stocks for the period from 1973 to 1991[10]. They find some significant excess returns, although their significance does not survive transactions costs. Similarly, Lento finds some significant forecasting abilities in the same SMACO rules on the NASDAQ at a 10-day lag over the period of 1995 to 2008. Following their methodology, we use 1/50, 5/150, and 1/200 SMACO rules on the NDX. This provides us with a short, medium and long-term momentum signal. Each roll date, we calculate the SMA and LMA for each of the three momentum rules and use them to generate the momentum signals. All else equal, if the calculation results in a buy signal, the

[7] The signals are designed so that they are based only on data which existed prior to the date on which the signal would have been generated in practice. For example, a signal for the March 19, 1999 option roll-in date would only use data which existed on March 18, 1999 or earlier.

[8] The use of the NDX rather than the QQQ provides us with historical data beyond the introduction of the QQQ. In this way, we can generate signals from the beginning of the QQQ data series.

[9] Additional evidence of the existence of momentum and potential explanations for its existence can be found in Jegadeesh and Titman [2001] and Schneeweis, Kazemi and Spurgin [2008].

[10] In this paper they do not take short positions. They use the signals as in/out position indicators.

collar would widen (increasing upside participation with a corresponding reduction in downside protection). In contrast, all else equal, the collar would be tightened in response to sell signal (increasing downside protection while reducing upside participation).

The following example illustrates the process for the momentum signal calculation:

Momentum Signal Calculation for the 3/19/1999 Roll Date

1 Day SMA	5 Day SMA	50 Day SMA	150 Day SMA	200 Day SMA
2102.77	2061.98	1998.76	1629.73	1554.89

Short Term Momentum Signal Calculation:

1 Day SMA = 2102.77 **>** 50 Day SMA = 1998.76 — Since the 1 day SMA is greater than the 50 day SMA, the NDX is trending upwards. This is a bullish signal, so the momentum signal = +1. Holding the macroeconomic signal constant, this would widen the collar (move the put 1% further OTM and the call 1% further OTM).

Medium Term Momentum Signal Calculation:

5 Day SMA = 2061.98 **>** 150 Day SMA = 1629.73 — Since the 5 day SMA is greater than the 50 day SMA, the NDX is trending upwards. This is a bullish signal, so the momentum signal = +1. Holding the macroeconomic signal constant, this would widen the collar (move the put 1% further OTM and the call 1% further OTM).

Long Term Momentum Signal Calculation:

1 Day SMA = 2102.77 **>** 200 Day SMA = 1554.89 — Since the 1 day SMA is greater than the 200 day SMA, the NDX is trending upwards. This is a bullish signal, so the momentum signal = +1. Holding the macroeconomic signal constant, this would widen the collar (move the put 1% further OTM and the call 1% further OTM).

LONG NDX Momentum Signal	MEDIUM NDX Momentum Signal	SHORT NDX Momentum Signal
+1	+1	+1

Note: All moving averages using data up to the prior day's close (e.g. 3/18/1999)

Volatility Signal: The volatility signal is based on Renicker and Mallick [2005]. Renicker and Mallick create an "enhanced" S&P 500 buy-write strategy and back test it over the period from 1997 to September 2005.[11] They find excess returns to a strategy which writes 0.75 calls to each long index position when the markets short-term anxiety level is high (as indicated by a situation

[11] Note that since the Renicker and Mallick study reported results based on the period used in this study, the use of this variable is not independent from the period used to analze its impact on the collar strategy.

in which the 1-month ATM S&P 500 implied volatility is more than 1 standard deviation above its current 250-day moving average level), and writes 1.25 calls per index position when the anxiety level is low (when the 1-month implied volatility is more than 1 standard deviation below the 250-day average level)[12]. Their goal in varying the quantity of written calls is to have a longer exposure to the market in times of high anxiety and shorter exposure in times of complacency. We make two minor modifications to their strategy. First, we use the daily VIX close as an indicator of implied volatility levels. Second, we consider a short, medium and long-term time frame to generate the 3 corresponding signals. In order to match the time frames of our momentum signals our short, medium and long-term volatility signals use 50, 150 and 250-day windows respectively. In keeping with the methodology of Renicker and Mallick, on roll dates we sell 0.75 (1.25) calls per index position when the previous day's VIX close is more than 1 standard deviation above (below) its current moving average level, otherwise we sell 1 call per index position as illustrated by the following formula:

*# of Calls Written per Long Put and Long QQQ Position = 1 + (0.25 * Volatility Signal),*

where the volatility signal is -1, 0 or +1.

[12] When the 1-month implied volatility level is within the 1 standard deviation bounds, they follow a standard 1:1 ratio buy-write.

Volatility Signal Calculation for the 3/19/1999 Roll Date

Spot VIX	VIX 250-Day Standard Deviation	VIX 250-Day Moving Average	VIX 150-Day Standard Deviation	VIX 150-Day Moving Average	VIX 50-Day Standard Deviation	VIX 50-Day Moving Average
24.3	6.5	27.0	5.9	30.4	2.5	27.8

Short Term Volatility 1-Standard Deviation Range Calculation:

1-Standard Deviation Range = VIX 50-Day Moving Average +/- VIX 50-Day Standard Deviation

= 27.8 - 2.5 to 27.8 + 2.5

= 25.3 to 30.3

Medium Term Volatility 1-Standard Deviation Range Calculation:

1-Standard Deviation Range = VIX 150-Day Moving Average +/- VIX 150-Day Standard Deviation

= 30.4 - 5.9 to 30.4 + 5.9

= 24.6 to 36.3

Long Term Volatility 1-Standard Deviation Range Calculation:

1-Standard Deviation Range = VIX 250-Day Moving Average +/- VIX 250-Day Standard Deviation

= 27.0 - 6.5 to 27.0 + 6.5

= 20.5 to 33.5

VIX 50-Day 1 Std. Dev. Range	VIX 150-Day 1 Std. Dev. Range	VIX 250-Day 1 Std. Dev. Range
25.3 to 30.3	24.6 to 36.3	20.5 to 33.5

Short Term Momentum Signal Calculation:

Spot VIX = 24.3 < Lower Bound of the 50-Day 1-Standard Deviation Range = 25.3

Spot VIX is below the lower bound of the 1-standard deviation range around the 50-day moving average of VIX. This indicates a low level of anxiety, suggesting that we should sell more calls. This a bearish signal, so the volatility signal = +1. This signal would result in selling 1.25 calls for each long put and long QQQ position.

Medium Term Momentum Signal Calculation:

Spot VIX = 24.3 < Lower Bound of the 150-Day 1-Standard Deviation Range = 24.6

Spot VIX is below the lower bound of the 1-standard deviation range around the 150-day moving average of VIX. This indicates a low level of anxiety, suggesting that we should sell more calls. This a bearish signal, so the volatility signal = +1. This signal would result in selling 1.25 calls for each long put and long QQQ position.

Long Term Momentum Signal Calculation:

Spot VIX = 24.3 is Between the Lower Bound of the 250-Day 1-Standard Deviation Range = 20.5 and the the Upper Bound of the 250-Day 1-Standard Deviation Range = 33.5

Spot VIX is between the lower bound and the upper bound of the 1-standard deviation range around the 250-day moving average of VIX. This indicates a medium level of anxiety, suggesting that we should sell the standard number of calls. This a neutral signal, so the volatility signal = 0. This signal would result in selling 1 call for each long put and long QQQ position.

LONG Volatility Signal	MEDIUM Volatility Signal	SHORT Volatility Signal
0	+1	+1

Note: Spot VIX level and all calculations use data up to the prior day's close (e.g. 3/18/1999)

It is worth noting that the volatility signal only affects the call writing portion of the strategy, puts are always purchased at a 1:1 ratio with the index[13].

[13] While we could apply these signals to both the put and call positions, we chose to apply them only to the call writing to be consistent with Renicker and Mallick.

Macroeconomic Signal: The final variable used in the active collar adjustment strategy signal process is based on the trend of initial unemployment claims and the state of the economy with respect to the business cycle. Boyd, Hu and Jagannathan [2005] consider the impact of unemployment rate surprise on the stock market in the period from 1973 to 2000. They find that in expansionary periods, stocks typically rise on bad unemployment news, while the opposite relationship holds in contractionary periods[14]. This is consistent with Veronesi [1999] which suggests that bad news in expansionary periods and good news in contractionary periods are typically correlated with an increase in uncertainty and an increase in the equity risk premium (corresponding to an increase in expected returns and reduction in current prices). We use these findings to construct a signal based on initial unemployment claims. The announcements from the NBER's Business Cycle Dating Committee are used to identify the state of the business cycle. It is worth noting that NBER does not define a recession as two consecutive quarters of negative GDP growth. They define it as follows: "A recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production and wholesale-retail sales"[15]. These announcements are generally considered the authority on the current state of the business cycle. Since there is often a significant delay in announcement dates, we base the signals on announcement dates to avoid hindsight biases. For example, the December 2007 peak was

[14] These results are somewhat counter-intuitive in the case of expansionary economies. One might expect rising unemployment to negatively affect stock prices regardless of the business cycle, but the literature cited above suggests that rising unemployment in expansionary economies causes expected future interest rates to decline, increasing the value of equities, while rising unemployment in contractions indicates slower future earnings growth rates, reducing the value of equities.

[15] See http://www.nber.org/cycles.html

announced about one year later on December 1, 2008. Our signal would be based on an expansionary economy until December 1, 2008. Since initial unemployment claims are released on a weekly basis, we include a one-week lag in the calculations to ensure the investability of our strategy. In order to closely match the macroeconomic signal methodology with those of the momentum and volatility signals, we base our short, medium and long-term macroeconomic signals on 1/10, 1/30 and 1/40 week SMACOs for weekly initial unemployment claims. Since rising unemployment claims in an expansionary economy is a bullish stock market price and volatility signal, if the SMA is greater than the LMA, we shift the collar towards the ATM put and OTM call (increasing both strike prices) thereby increasing the portfolio's exposure to upside moves as well as increasing its vega[16]. In contractionary periods, rising unemployment claims would cause us to shift the strike prices in the opposite direction.

[16] Since vega is highest for ATM options, moving the short call further OTM and moving the long put towards the ATM will increase the vega of both option positions.

These calculations can be illustrated with the following example:

Macroeconomic Signal Calculation for the 3/19/1999 Roll Date

NBER Announcements

Date	Indication
12/22/1992	Trough
11/26/2001	Peak

(3/19/1999 is during an expansionary economy)
So on 3/19/1999, a downward trend in unemployment is a bearish signal.

1 Week SMA	40 Week SMA	30 Week SMA	10 Week SMA	LONG Unemployment Trend	MEDIUM Unemployment Trend	SHORT Unemployment Trend
308.0	317.1	311.8	311.4	Down	Down	Down

Short Term Macroeconomic Signal Calculation:

1 Week SMA = 308.0 < 10 Week SMA = 311.4 — Since the 1 week SMA is less than the 10 week SMA, unemployment is falling. In an expansionary economy this is a bearish signal, so the signal = -1. Holding the momentum signal constant, this would shift the collar up (move the put 1% less OTM and the call 1% further OTM).

Medium Term Macroeconomic Signal Calculation:

1 Week SMA = 308.0 < 30 Week SMA = 311.8 — Since the 1 week SMA is less than the 30 week SMA, unemployment is falling. In an expansionary economy this is a bearish signal, so the signal = -1. Holding the momentum signal constant, this would shift the collar up (move the put 1% less OTM and the call 1% further OTM).

Long Term Macroeconomic Signal Calculation:

1 Week SMA = 308.0 < 40 Week SMA = 317.1 — Since the 1 week SMA is less than the 40 week SMA, unemployment is falling. In an expansionary economy this is a bearish signal, so the signal = -1. Holding the momentum signal constant, this would shift the collar up (move the put 1% less OTM and the call 1% further OTM).

LONG Macroeconomic Signal	MEDIUM Macroeconomic Signal	SHORT Macroeconomic Signal
-1	-1	-1

Note: All moving averages using data up to the prior week's close (e.g. 3/12/1999)

Trading Rules: We combine the momentum, volatility and macroeconomic signals for each time frame to generate our short, medium and long-term active strategies. Due to the excessive transactions costs that would be associated with daily rolling of option positions, changes in the signals are not incorporated into the strategies on any days except the roll dates[17]. On each roll

[17] In the case of strategies where the put and call expirations are not coincident, such as the 1-month call/3-month put strategies, the put moneyness will only be reset when it is rolled (in this example, once every 3 months), while the call moneyness is reset at each call roll (every month, since we only consider strategies with 1-month calls).

date, the initial moneyness of the puts and calls is determined based on the momentum and macroeconomic signals and the ratio of written calls is determined by the volatility signal. Our rules are constructed in such a manner to ensure that the target initial percentage moneyness of the options will be an integer which falls between ATM and 5% OTM. The signals adjust the initial moneyness of the puts and calls from a level near the center of the range at 3% OTM and 2% OTM, respectively[18]. From this central point, the momentum signal will serve to widen or tighten the collar by increasing or decreasing the amount OTM, respectively. The macroeconomic signal will shift the collar up by increasing the amount OTM of the calls and decreasing the amount OTM of the puts, or shift the collar down by moving the strikes in the opposite direction. The net effect can be illustrated by the following formulas for the call strikes:

Call % OTM = 2 + (Momentum signal + Macroeconomic signal),

and for puts:

Put % OTM = 3 + (Momentum signal - Macroeconomic signal),

where the momentum signal and the macroeconomic signal are +1/-1 binary signals.

The following example provides an illustration of the trading signal calculation:

[18] Puts tend to cost more than calls for a given level of moneyness, so we start the puts further OTM to allow the option component of the strategy to be close to zero cost.

Trading Rule Calculation Based on the Three Signals for the 3/19/1999 Roll Date

Short Term Trading Rule Calculation:

Initial Call Moneyness = 2% OTM + (Momentum signal + Macroeconomic signal) = (2+1-1)% OTM = 2% OTM

Initial Put Moneyness = 3% OTM + (Momentum signal - Macroeconomic signal) = (3+1+1)% OTM = 5% OTM

Number of Calls per Put and QQQ Position = 1.00 + (0.25 * Volatility Signal) = 1 + (0.25 * 1) = 1.25 Calls

SHORT Macroeconomic Signal	SHORT NDX Momentum Signal	Call % OTM	Put % OTM
-1	1	2 % OTM	5 % OTM

SHORT Volatility Signal	QQQ/Put/Call Ratio
1	1/1/1.25

Medium Term Trading Rule Calculation:

Initial Call Moneyness = 2% OTM + (Momentum signal + Macroeconomic signal) = (2+1-1)% OTM = 2% OTM

Initial Put Moneyness = 3% OTM + (Momentum signal - Macroeconomic signal) = (3+1+1)% OTM = 5% OTM

Number of Calls per Put and QQQ Position = 1.00 + (0.25 * Volatility Signal) = 1 + (0.25 * 1) = 1.25 Calls

MEDIUM Macroeconomic Signal	MEDIUM NDX Momentum Signal	Call % OTM	Put % OTM
-1	1	2 % OTM	5 % OTM

MEDIUM Volatility Signal	QQQ/Put/Call Ratio
1	1/1/1.25

Long Term Trading Rule Calculation:

Initial Call Moneyness = 2% OTM + (Momentum signal + Macroeconomic signal) = (2+1-1)% OTM = 2% OTM

Initial Put Moneyness = 3% OTM + (Momentum signal - Macroeconomic signal) = (3+1+1)% OTM = 5% OTM

Number of Calls per Put and QQQ Position = 1.00 + (0.25 * Volatility Signal) = 1 + (0.25 * 0) = 1.00 Calls

LONG Macroeconomic Signal	LONG NDX Momentum Signal	Call % OTM	Put % OTM
-1	1	2 % OTM	5 % OTM

LONG Volatility Signal	QQQ/Put/Call Ratio
0	1/1/1

The trading rules which result from the signals are provided in Exhibit 1. The frequency distributions of the strike prices and call writing ratios are provided in Exhibit 2.

Exhibit 1: Trading Rules

	NDX Momentum Signal	Macroeconomic signal	Call %OTM = 2 + (Momentum Signal + Macroeconomic Signal)	Put %OTM = 3 + (Momentum Signal - Macroeconomic Signal)	Call Initial % OTM	Put Initial % OTM
Scenario 1	**-1**	**-1**	**= 2 - 1 - 1**	**= 3 - 1 - (-1)**	**0%**	**3%**
Scenario 2	**+1**	**-1**	**= 2 + 1 - 1**	**= 3 + 1 - (-1)**	**2%**	**5%**
Scenario 3	**-1**	**+1**	**= 2 - 1 + 1**	**= 3 - 1 - (+1)**	**2%**	**1%**
Scenario 4	**+1**	**+1**	**= 2 + 1 + 1**	**= 3 + 1 - (+ 1)**	**4%**	**3%**

	VIX Signal	QQQ/ Call Ratio
Scenario 1	**-1**	**1.0/0.75**
Scenario 2	**0**	**1.0/1.0**
Scenario 3	**1**	**1.0/1.25**

Exhibit 2: Trading Rule Frequency Distributions

	Short-Term Signals		Medium-Term Signals		Long-Term Signals	
Initial % OTM	Call Moneyness Frequency	Put Moneyness Frequency	Call Moneyness Frequency	Put Moneyness Frequency	Call Moneyness Frequency	Put Moneyness Frequency
ATM	20%	0%	16%	0%	15%	0%
1% OTM	0%	29%	0%	24%	0%	34%
2% OTM	58%	0%	65%	0%	69%	0%
3% OTM	0%	29%	0%	41%	0%	17%
4% OTM	22%	0%	19%	0%	15%	0%
5% OTM	0%	41%	0%	34%	0%	49%

QQQ/ Call Ratio	Call Ratio Frequency	Call Ratio Frequency	Call Ratio Frequency
1.0/ 0.75	20%	21%	20%
1.0/ 1.0	45%	42%	48%
1.0/ 1.25	36%	37%	32%

In a later section of the paper we also apply an active and passive collar to a typical small cap mutual fund. Since the beta of a fund will not necessarily be 1.0 with respect to the QQQ and the price level of the fund will not match the QQQ underlying price, we scale the option positions by the 65-day rolling 1 day lagged beta as well as by the relative price levels of the fund and the QQQ. To adjust for the relative price levels, each day we rebalance our portfolio so that the ratio of the number of options to the number of shares of the fund is equal to beta times the ratio of the mutual fund price over the QQQ price, as given by the following formula[19]:

$$\#\ of\ puts\ or\ calls = Beta_{mutual\ fund,\ QQQ} * Price_{mutual\ fund}/Price_{QQQ}$$

[19] For active strategies, we also apply the call ratio adjustment based on the volatility signal.

This process allows us to maintain the equivalent of a 1:1:1 ratio collar. While the beta is set at each roll date, the relative balance due to price changes is reset each day[20]. For example, if the rolling beta of the mutual fund is 0.75, the price of the mutual fund is $20 and the price of the QQQ is $60 on the roll in date, we write 0.25 calls and purchase 0.25 puts for each long position in the mutual fund, and rebalance each day (using the 0.75 beta and the current prices) until the expiration of the options at which time we rebalance using the new rolling beta level as well as the current prices. The following example provides an illustration of the process by which we generate the passive mutual fund collar:

Passive 2% OTM 1-Month Call 6-Month Put Mutual Fund Collar Implementation

	Date		Exdate		Quantity				Wealth		65-Day Rolling Beta with QQQ	Price of Mutual Fund	Price of QQQ	Mutual Fund:Put: Call Ratio
Roll In	3/19/1999	Purchase mutual fund			1.0000	@	$ 99.36		$ 101.76	(Initial)	0.396	99.355	102.437	1:0.38:0.38
		Purchase a 6-month 2% OTM QQQ put expiring on:	9/17/1999	(Strike price = 100)	0.3840	@	$ 9.50	(at ask)						
		Sell a 1-month 2% OTM QQQ call expiring on:	4/16/1999	(Strike price = 104)	0.3840	@	$ (3.25)	(at bid)						
Value	3/22/1999	Value of of mutual fund			1.0000	@	$ 99.17		$ 101.88					
		Value of of QQQ puts	9/17/1999	(Strike price = 100)	0.3840	@	$ 9.69	(mid of bid/ask)						
		Value of of QQQ calls	4/16/1999	(Strike price = 104)	0.3840	@	$ (2.63)	(mid of bid/ask)						
Rebalance	3/22/1999	Adjust quantities to maintain the ratio using current prices and the 3/19/1999 beta of 0.396												
		Adjust quantity of mutual fund			0.9997	@	$ 99.17		$ 101.88			99.171	101.187	1:0.39:0.39
		Adjust quantity of QQQ puts	9/17/1999	(Strike price = 100)	0.3880	@	$ 9.69	(mid of bid/ask)						
		Adjust quantity of QQQ calls	4/16/1999	(Strike price = 104)	0.3880	@	$ (2.63)	(mid of bid/ask)						
Roll Out	4/16/1999	Mutual fund value			0.9988	@	$ 112.34		$ 115.71			112.339	107.062	1:0.42:0.42
		Keep the put (now 5-month 4% OTM) expiring on:	9/17/1999	(Strike price = 100)	0.41543	@	$ 8.44	(mid of bid/ask)						
		Payout value of previous call at expiration:	4/16/1999	(Strike price = 104)	0.41543	@	$ -	(intrinsic value)						
Roll In	4/16/1999	Since this is a roll date, adjust quantities to the new 4/16/1999 beta of 0.340												
		Keep the mutual fund			1.015	@	$ 112.34		$ 115.71		0.340	112.339	103.937	1:0.37:0.37
		Keep the put (now 5-month 4% OTM) expiring on:	9/17/1999	(Strike price = 100)	0.373	@	$ 8.44	(mid of bid/ask)						
		Sell a 1-month 2% OTM QQQ call expiring on:	5/22/1999	(Strike price = 106)	0.373	@	$ (4.00)	(at bid)						
		Repeat until put expires, each day between roll dates rebalance quantities to the beta calculated on the previous roll date												
Roll Out	9/17/1999	Mutual fund value			0.966	@	$ 146.04		$ 145.61		0.469	146.041	126.625	
		Payout value of the put at expiration:	9/17/1999	(Strike price = 100)	0.523	@	$ -	(intrinsic value)						
		Payout value of the call at expiration:	9/17/1999	(Strike price = 118)	0.523	@	$ 8.63	(intrinsic value)						
Roll In	9/17/1999	Keep the mutual fund			0.972	@	$ 146.04		$ 145.61					
		Purchase a 6-month 2% OTM QQQ put expiring on:	3/18/2000	(Strike price = 124)	0.526	@	$ 10.25	(at ask)						
		Sell a 1-month 2% OTM QQQ call expiring on:	10/16/1999	(Strike price = 129)	0.526	@	$ (3.38)	(at bid)						

[20] Beta is reset only on roll dates to closely match the methodology of the passive collar strategies to the methodology of active collar strategies.

Trading Rule Calculation For Mutual Fund Collar

Short Term Trading Rule Calculation:

Initial Call Moneyness = 2% OTM + (Momentum signal + Macroeconomic signal) = (2+1-1)% OTM = 2% OTM

Initial Put Moneyness = 3% OTM + (Momentum signal - Macroeconomic signal) = (3+1+1)% OTM = 5% OTM

Number of Calls and Puts per Mutual Fund Position before Volatility Signal Impact = $\text{Beta}_{\text{Mutual Fund, QQQ}} * \text{Price}_{\text{Mutual Fund}}/\text{Price}_{\text{QQQ}}$

Number of Calls and Puts per Mutual Fund Position before Volatility Signal Impact = 0.396 * 99.36 / 102.44 = 0.38

Volatility Signal Impact:

Number of Calls per Put = 1.00 + (0.25 * Volatility Signal) = 1 + (0.25 * 1) = 1.25 Calls/Put

Number of Puts per Mutual Fund Position = 0.38

Number of Calls per Mutual Fund Position = 1.25 * 0.38 = 0.48

SHORT Macroeconomic Signal	SHORT NDX Momentum Signal	Call % OTM	Put % OTM
-1	+1	2 % OTM	5 % OTM

SHORT Volatility Signal	65-Day Rolling Beta with QQQ	Price of Mutual Fund	Price of QQQ	Mutual Fund/Put/Call Ratio
1	0.396	99.36	102.44	1/0.38/0.48

Medium Term Trading Rule Calculation:

Initial Call Moneyness = 2% OTM + (Momentum signal + Macroeconomic signal) = (2+1-1)% OTM = 2% OTM

Initial Put Moneyness = 3% OTM + (Momentum signal - Macroeconomic signal) = (3+1+1)% OTM = 5% OTM

Number of Calls and Puts per Mutual Fund Position before Volatility Signal Impact = $\text{Beta}_{\text{Mutual Fund, QQQ}} * \text{Price}_{\text{Mutual Fund}}/\text{Price}_{\text{QQQ}}$

Number of Calls and Puts per Mutual Fund Position before Volatility Signal Impact = 0.396 * 99.36 / 102.44 = 0.38

Volatility Signal Impact:

Number of Calls per Put = 1.00 + (0.25 * Volatility Signal) = 1 + (0.25 * 1) = 1.25 Calls/Put

Number of Puts per Mutual Fund Position = 0.38

Number of Calls per Mutual Fund Position = 1.25 * 0.38 = 0.48

MEDIUM Macroeconomic Signal	MEDIUM NDX Momentum Signal	Call % OTM	Put % OTM
-1	+1	2 % OTM	5 % OTM

MEDIUM Volatility Signal	65-Day Rolling Beta with QQQ	Price of Mutual Fund	Price of QQQ	Mutual Fund/Put/Call Ratio
1	0.396	99.36	102.44	1/0.38/0.48

Long Term Trading Rule Calculation:

Initial Call Moneyness = 2% OTM + (Momentum signal + Macroeconomic signal) = (2+1-1)% OTM = 2% OTM

Initial Put Moneyness = 3% OTM + (Momentum signal - Macroeconomic signal) = (3+1+1)% OTM = 5% OTM

Number of Calls and Puts per Mutual Fund Position before Volatility Signal Impact = $\text{Beta}_{\text{Mutual Fund, QQQ}} * \text{Price}_{\text{Mutual Fund}}/\text{Price}_{\text{QQQ}}$

Number of Calls and Puts per Mutual Fund Position before Volatility Signal Impact = 0.396 * 99.36 / 102.44 = 0.38

Volatility Signal Impact:

Number of Calls per Put = 1.00 + (0.25 * Volatility Signal) = 1 + (0.25 * 0) = 1.00 Calls/Put

Number of Puts per Mutual Fund Position = 0.38

Number of Calls per Mutual Fund Position = 1.00 * 0.38 = 0.38

LONG Macroeconomic Signal	LONG NDX Momentum Signal	Call % OTM	Put % OTM
-1	+1	2 % OTM	5 % OTM

LONG Volatility Signal	65-Day Rolling Beta with QQQ	Price of Mutual Fund	Price of QQQ	Mutual Fund/Put/Call Ratio
0	0.396	99.36	102.44	1/0.38/0.38

Results

Before reviewing the results of the passive and active approach to collar protection, it is perhaps important to briefly discuss three issues in option based risk management:

1) The use of alternative approaches to protecting equity investments,

2) the impact of option based strategies on traditional forms of risk comparisons (e.g. Sharpe Ratio), and

3) the necessity for analyzing results over alternative time periods.

Alternative Approaches to Option Based Risk Management: There are alternative option based approaches to protecting equity based investments. The most obvious choice is typically the use of protective puts. Unfortunately, the use of protective puts tends to be a relatively expensive method of capital protection, especially in periods of high volatility. The existence of a negative volatility risk premium and the resulting excess returns associated with put writing are indicative of the potential cost of purchasing protective puts[21]. Another option based approach is the buy-write or covered call strategy. The covered call strategy typically entails the writing of call options against a long underlying index position at a one-to-one ratio. A number of studies have suggested that covered call writing can provide return enhancement as well as a cushion to mitigate losses from market downturns. These include Schneeweis and Spurgin [2001], Whaley [2002] and Hill et al [2006] which apply the strategy to the S&P 500 and Kapadia and Szado [2007] which applies the buy-write to a broader index, the Russell 2000. Unfortunately, covered call writing still leaves an investor exposed to large down moves.

Impact of Option Use on Traditional Risk Measures: It should also be noted that we have included Sharpe ratios with our other performance measures for the sake of consistency with previous literature, but great care should be taken in interpreting the Sharpe ratios. First, a

[21] The richness of put prices is not without controversy. While a great deal of literature supports option richness (particularly for put options), extensive literature debates its existence (for example, see Ungar and Moran [2009] and Bakshi and Kapadia [2003]).

number of the calculated Sharpe ratios are negative. Negative Sharpe ratios are uninformative. Second, even with positive excess returns, traditional risk-adjusted performance measures such as the Sharpe ratio and Jensen's alpha can be misleading. This is particularly true for portfolios which include option strategies or other strategies which may result in skewed or kurtotic return distributions. The Sharpe ratio and Jensen's alpha assume normally distributed returns[22]. In recognition of the fact that the return distributions generated by our collar strategies may be non-normal, we utilize the Stutzer index and Leland's alpha as measures of risk adjusted performance. These measures adjust for the fact that investors which exhibit non-increasing absolute risk aversion prefer positive skewness[23]. Therefore positively skewed return distributions should exhibit lower expected returns than negatively skewed distributions, ceteris paribus.

Alternative Time Period Analysis: This paper does not assume any particular model of investor risk aversion. The significance of the results for any particular investor may therefore be dependent on that investor's individual risk tolerance. Results should therefore be presented over various market conditions which provide investors a wider range of results consistent with a particular risk environment. In order to assess the performance and risk management characteristics of the passive and active collar strategies in different market environments, we break up our time period into 3 sub-periods.

The first sub-period is April 1999 to September 2002. We would expect that this would be a relatively favorable period for the collar strategy, when compared to holding a long index

[22] It is also quite possible to manipulate the Sharpe ratio. For example, see Spurgin [2001].
[23] See Arditti [1967].

position. In this period the QQQ exhibited extremely high realized volatility and experienced a rapid loss of more than ¾ of its value from peak to trough. While one would expect that protective strategies would be very beneficial with a drop of this magnitude, there are two factors that mitigate the benefits of the protective puts. First, put options would likely be very expensive in this environment. Secondly, the short call position would greatly limit the upside participation of the collar in the incredibly strong run-up of the early part of the sub-period. This is a particularly interesting sub-period to study, because it captures the run-up and collapse of a bubble in the underlying.

The second sub-period, which covers October 2002 to September 2007, is less favorable for the collar strategy. In fact, one might argue that this time period is representative of nearly the worst environment for the collar (when compared to a long underlying position). In this period, the QQQ exhibits a steady growth rate with relatively low volatility[24] and few sharp downward moves. In this environment, the collar may lose significant revenue on the upside due to the short calls while it gains very little from the protective puts.

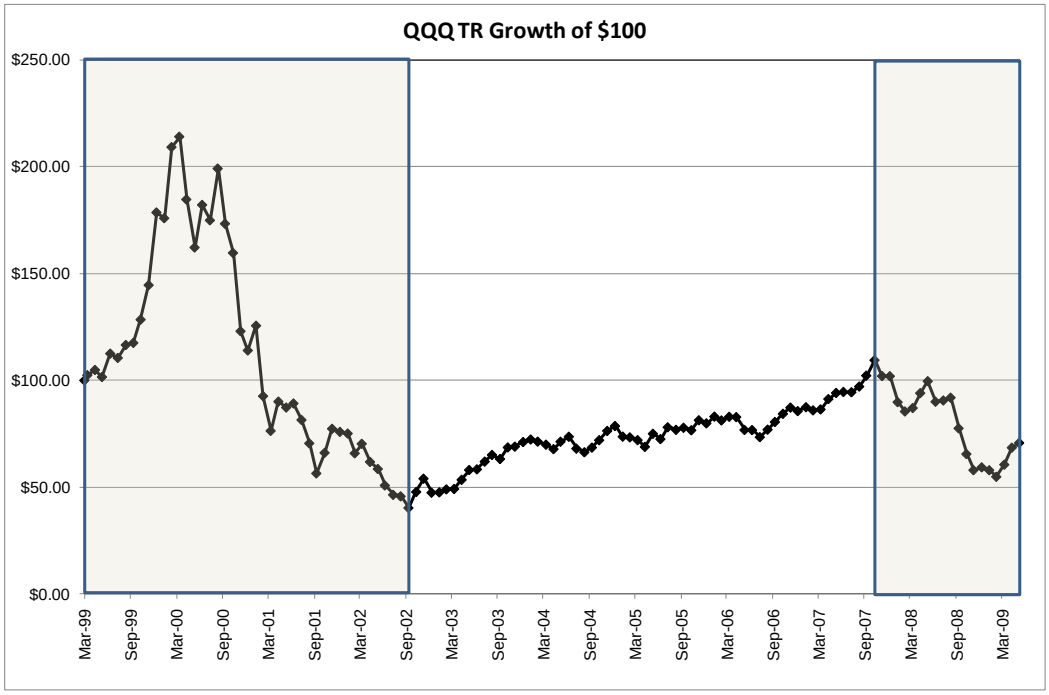
The final sub-period covers October 2007 to May 2009. This is another favorable period for the collar and covers a major financial crisis which negatively impacted most asset classes. Unlike the first sub-period, this favorable period does not include a strong run-up in the underlying. Thus we have two relatively favorable sub-periods to consider (one that covers the tech bubble and one that covers the credit crisis) as well as one clearly unfavorable sub-period.

Before discussing the performance of the collar strategies, it is worth noting that the 1-month/6-month and 1-month/3-month strategies require rebalancing each month in order to

[24] The 17.5% volatility in this sub-period is quite high, but much smaller than the 30% volatility of the overall period or the 42% of the early sub-period.

reinvest the funds that are collected from the sale of the calls and the funds that are disbursed to cover the cost of calls that expire ITM between put expirations. No adjustment is made for the transactions costs that would be incurred by these rebalancing activities.

Exhibit 3: Growth of $100 in QQQ March 1999 to May 2009



Empirical Results

Passive Collars: We first consider the performance of passive collar strategies. Our discussion is centered on 1-month call/6-month put collar strategies[25]. Results comparing the 1-month call/6-month put collars to the 1-month call/1-month put collars are provided in Appendix B. While the exhibits provide statistics for a wide range of collar implementations, our discussion is focused on the 2% OTM strategies, since they represent a middle ground between the ATM and the far OTM strategies. Exhibits 4a, 4b, 4c and 4d provide summary statistics for passive 1-month call/6-month put collar strategies utilizing 2% OTM puts with ATM to 5% OTM calls for the full period as well as the three sub-periods. Similarly, Exhibits 5a, 5b, 5c and 5d provide summary statistics for 2% OTM call collars which use ATM to 5% OTM puts. It is immediately apparent when reviewing the exhibits that, while the performance characteristics of the strategy are sensitive to the choice of moneyness for the options, they are far more sensitive to the market environment (rising and/or falling) in which the strategy is implemented. In contrast, the choice of time to maturity for the calls of 1-month versus 6-month can have a far more significant impact, as evidenced by the results provided in Appendix B.

The summary statistics for the overall period are provided in Exhibits 4a and 5a. Over the 122 months of the study, the 2% OTM collar significantly reduces risk and improves realized returns. The returns are improved from a -3.6% annualized loss to a 9.3% gain, meanwhile standard deviation is reduced by about 1/3 from 30.4% to 11.0%. Similarly, the sign of the Stutzer index is turned from negative to positive, and the information ratio (relative to the QQQ) for the collar is positive at 0.45. Perhaps the most visible impact of implementing the collar

[25] 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].

strategy is a reduction of the maximum drawdown from -81.1% to -17.9% for the 10+ year overall period.

Exhibit 4a Passive Collars with 2% OTM Puts – April 1999 to May 2009

Monthly Data: April, 1999-May, 2009	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 0% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 1% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 3% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 4% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 5% OTM, 1 Mo Call.2% OTM. 6 Mo Put.
Annualized Return	-3.57%	10.69%	9.12%	9.26%	9.23%	8.84%	7.61%
Annualized Std Dev	30.40%	9.86%	10.45%	10.98%	11.54%	11.94%	12.37%
Sharpe Ratio	-0.22	0.77	0.58	0.56	0.53	0.48	0.37
Annual Stutzer Index	-0.07	0.79	0.60	0.59	0.57	0.52	0.41
CAPM Beta	1.00	0.02	0.11	0.13	0.17	0.21	0.23
Leland Beta	1.00	0.01	0.10	0.13	0.17	0.20	0.23
Monthly Leland Alpha	0.00%	0.64%	0.54%	0.56%	0.57%	0.55%	0.46%
Information Ratio	0.00	0.45	0.44	0.45	0.47	0.47	0.44
Skew	-0.21	0.45	0.18	0.16	0.14	0.09	0.03
Kurtosis	0.55	2.75	3.34	3.52	3.51	2.95	2.99
Maximum Drawdown	-81.08%	-14.21%	-17.08%	-17.90%	-19.49%	-20.14%	-21.37%
Correlation with QQQ	1.00	0.05	0.31	0.37	0.46	0.52	0.57
Min Monthly Return	-26.20%	-8.15%	-9.29%	-9.95%	-10.10%	-10.67%	-10.73%
Max Monthly Return	23.48%	12.81%	14.09%	15.06%	15.48%	15.37%	15.64%
Number of Months	122	122	122	122	122	122	122
% Up Months	52%	67%	63%	65%	67%	62%	60%
% Down Months	48%	33%	37%	35%	33%	38%	40%

The effectiveness of the collar strategy in the April 1999 to September 2002 is evident in the results provided in Exhibit 4b and 5b. In the early bubble run-up and collapse, the QQQ experienced an annualized return of -23.3% with a 42% volatility. In this volatile market, the 2% OTM passive collar strategy generated an annualized return of 21.2% at a volatility of only 13.7%. Thus the collar was able to turn a sizeable loss into a significant gain, while cutting risk (as measured by standard deviation) by more than 2/3. Other measures confirm the risk reduction including the minimum monthly return, the percentage of up months, and the Leland beta. The capital protection ability of the collar strategy can be illustrated by the maximum drawdown. The maximum drawdown of the QQQ is reduced significantly from -81.1% to -7.5% over the most severe market move that the QQQ has ever experienced.

Exhibit 4b Passive Collars with 2% OTM Puts – April 1999 to September 2002

Monthly Data: Apr. 1999-Sept, 2002	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 0% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 1% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 3% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 4% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 5% OTM, 1 Mo Call.2% OTM. 6 Mo Put.
Annualized Return	-23.31%	26.02%	21.66%	21.16%	19.43%	17.85%	15.85%
Annualized Std Dev	42.44%	12.94%	13.27%	13.69%	14.33%	14.50%	14.91%
Sharpe Ratio	-0.65	1.69	1.32	1.24	1.07	0.95	0.79
Annual Stutzer Index	-0.51	1.58	1.27	1.21	1.06	0.96	0.81
CAPM Beta	1.00	0.00	0.06	0.08	0.11	0.14	0.16
Leland Beta	1.00	0.00	0.06	0.08	0.12	0.14	0.16
Monthly Leland Alpha	0.00%	1.67%	1.50%	1.50%	1.44%	1.37%	1.28%
Information Ratio	0.00	1.11	1.08	1.08	1.07	1.06	1.04
Skew	0.14	0.17	0.26	0.39	0.43	0.41	0.40
Kurtosis	-0.70	0.87	2.00	2.47	2.78	2.51	2.80
Maximum Drawdown	-81.08%	-5.28%	-7.54%	-7.54%	-9.16%	-9.16%	-10.39%
Correlation with QQQ	1.00	0.00	0.21	0.27	0.34	0.41	0.47
Min Monthly Return	-26.20%	-5.28%	-7.54%	-7.54%	-9.16%	-9.16%	-10.39%
Max Monthly Return	23.48%	12.81%	14.09%	15.06%	15.48%	15.37%	15.64%
Number of Months	42	42	42	42	42	42	42
% Up Months	40%	74%	71%	74%	74%	67%	64%
% Down Months	60%	26%	29%	26%	26%	33%	36%

Exhibit 4c Passive Collars with 2% OTM Puts – October 2002 to September 2007

Monthly Data: Sept, 2002 to Sept. 2007	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 0% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 1% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 3% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 4% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 5% OTM, 1 Mo Call.2% OTM. 6 Mo Put.
Annualized Return	20.37%	3.73%	4.57%	5.19%	6.88%	7.42%	6.14%
Annualized Std Dev	17.54%	5.58%	7.08%	7.93%	8.55%	9.14%	9.75%
Sharpe Ratio	1.00	0.15	0.24	0.29	0.47	0.50	0.33
Annual Stutzer Index	1.01	0.17	0.26	0.32	0.49	0.52	0.37
CAPM Beta	1.00	0.07	0.26	0.30	0.38	0.43	0.48
Leland Beta	1.00	0.09	0.28	0.33	0.40	0.44	0.50
Monthly Leland Alpha	0.00%	-0.04%	-0.24%	-0.26%	-0.23%	-0.24%	-0.42%
Information Ratio	0.00	-0.96	-1.11	-1.12	-1.10	-1.15	-1.36
Skew	0.33	-0.13	-0.21	-0.22	-0.25	-0.02	-0.20
Kurtosis	1.63	0.24	0.03	0.04	-0.05	-0.07	0.37
Maximum Drawdown	-12.36%	-6.62%	-11.83%	-14.02%	-12.12%	-14.33%	-16.45%
Correlation with QQQ	1.00	0.20	0.63	0.67	0.77	0.82	0.86
Min Monthly Return	-12.09%	-3.67%	-4.67%	-5.49%	-5.49%	-5.50%	-6.90%
Max Monthly Return	18.47%	4.46%	4.88%	5.59%	5.91%	6.86%	6.86%
Number of Months	60	60	60	60	60	60	60
% Up Months	62%	65%	57%	57%	62%	60%	58%
% Down Months	38%	35%	43%	43%	38%	40%	42%

Exhibit 4d Passive Collars with 2% OTM Puts – October 2007 to May 2009

Monthly Data: Sept, 2007 to May. 2009	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 0% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 1% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 3% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 4% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 5% OTM, 1 Mo Call.2% OTM. 6 Mo Put.
Annualized Return	-19.78%	2.44%	-1.33%	-1.44%	-3.35%	-4.20%	-3.93%
Annualized Std Dev	29.23%	10.46%	11.00%	11.56%	12.15%	12.92%	13.29%
Sharpe Ratio	-0.73	0.10	-0.25	-0.25	-0.39	-0.44	-0.40
Annual Stutzer Index	-0.67	0.15	-0.20	-0.20	-0.35	-0.40	-0.36
CAPM Beta	1.00	0.13	0.21	0.25	0.27	0.32	0.34
Leland Beta	1.00	0.12	0.20	0.24	0.27	0.31	0.34
Monthly Leland Alpha	0.00%	0.31%	0.14%	0.20%	0.08%	0.09%	0.16%
Information Ratio	0.00	0.81	0.74	0.77	0.71	0.71	0.75
Skew	-0.16	-0.95	-1.53	-1.64	-1.47	-1.34	-1.36
Kurtosis	-0.88	2.18	2.74	3.08	2.43	2.12	2.00
Maximum Drawdown	-49.74%	-14.21%	-17.08%	-17.90%	-19.49%	-20.14%	-21.37%
Correlation with QQQ	1.00	0.35	0.56	0.62	0.65	0.71	0.76
Min Monthly Return	-15.57%	-8.15%	-9.29%	-9.95%	-10.10%	-10.67%	-10.73%
Max Monthly Return	13.06%	5.64%	3.84%	3.84%	4.65%	5.26%	5.39%
Number of Months	20	20	20	20	20	20	20
% Up Months	50%	60%	65%	70%	70%	60%	55%
% Down Months	50%	40%	35%	30%	30%	40%	45%

To consider these results in a different light, the collar could have earned an investor 21.2% per year over the period with a maximum loss of capital of 7.5% regardless of how poorly

the investor timed their entry into the strategy. Clearly in this case, the collar was an effective way of capturing a significant return from the bubble run-up without experiencing the magnitude of losses that came with the collapse.

We expected the collar to perform poorly in the next sub-period due to the low volatility and steady positive returns with very few sharp down moves. The results confirm this expectation. Exhibits 4c and 5c provide the evidence. In this steadily climbing, near ideal market for the QQQ and poor market for the collar, the collar exhibits a far lower return. The annualized return of the QQQ over the period is 20.4% at relatively moderate volatility of 17.5%. The 2% OTM collar only provides a 5.2% return over this period. It does, however, do so at a far lower volatility. In this period, the collar provides about ¼ of the returns of the QQQ at less than ½ the volatility. By most measures, the collar underperforms the QQQ on a risk-adjusted basis in this period. It has a slightly higher maximum drawdown, fewer up-months, a lower Stutzer index, a negative information ratio and a -0.26% monthly Leland alpha. It is interesting to note that this underperformance is not nearly as significant as the QQQ's underperformance in the early period.

The results pertaining to the final sub-period are provided in Exhibits 4d and 5d. This is the credit crisis period from October 2007 to May 2009. Once again, the collar provides significant capital protection. The -19.8% annualized loss of the QQQ is reduced to only -1.4%, while the standard deviation is cut from 29.2% to 11.6%. Therefore, the collar cuts a significant loss to less than 1/10 its size while cutting volatility by almost 2/3. Other results confirm the collar's outperformance in this period. The monthly Leland beta is 0.2%, the information ratio is 0.77, while the maximum drawdown is reduced from 49.7% to 17.9%.

Exhibit 5a Passive Collars with 2% OTM Calls – April 1999 to May 2009

Monthly Data: April, 1999-May, 2009	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.0% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.1% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.3% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.4% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.5% OTM. 6 Mo Put.
Annualized Return	-3.57%	8.91%	9.35%	9.26%	9.74%	9.85%	9.89%
Annualized Std Dev	30.40%	10.27%	10.87%	10.98%	11.10%	11.26%	11.35%
Sharpe Ratio	-0.22	0.57	0.58	0.56	0.60	0.60	0.60
Annual Stutzer Index	-0.07	0.60	0.60	0.59	0.63	0.63	0.62
CAPM Beta	1.00	0.09	0.13	0.13	0.15	0.15	0.16
Leland Beta	1.00	0.08	0.12	0.13	0.14	0.15	0.16
Monthly Leland Alpha	0.00%	0.52%	0.56%	0.56%	0.60%	0.61%	0.62%
Information Ratio	0.00	0.42	0.46	0.45	0.48	0.48	0.49
Skew	-0.21	0.47	0.20	0.16	0.14	0.06	0.05
Kurtosis	0.55	4.20	3.68	3.52	3.35	3.24	3.12
Maximum Drawdown	-81.08%	-18.83%	-17.91%	-17.90%	-17.90%	-18.81%	-18.81%
Correlation with QQQ	1.00	0.26	0.36	0.37	0.40	0.42	0.44
Min Monthly Return	-26.20%	-7.70%	-9.90%	-9.95%	-9.95%	-10.30%	-10.30%
Max Monthly Return	23.48%	15.02%	15.06%	15.06%	15.11%	15.11%	15.15%
Number of Months	122	122	122	122	122	122	122
% Up Months	52%	63%	63%	65%	64%	63%	61%
% Down Months	48%	37%	37%	35%	36%	37%	39%

Exhibit 5b Passive Collars with 2% OTM Calls – April 1999 to September 2002

Monthly Data: Apr. 1999-Sept, 2002	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.0% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.1% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.3% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.4% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.5% OTM. 6 Mo Put.
Annualized Return	-23.31%	22.67%	21.48%	21.16%	21.38%	21.43%	20.84%
Annualized Std Dev	42.44%	13.27%	13.58%	13.69%	13.75%	13.72%	13.86%
Sharpe Ratio	-0.65	1.40	1.28	1.24	1.25	1.26	1.21
Annual Stutzer Index	-0.51	1.34	1.24	1.21	1.22	1.23	1.18
CAPM Beta	1.00	0.05	0.08	0.08	0.09	0.09	0.10
Leland Beta	1.00	0.05	0.08	0.08	0.09	0.10	0.10
Monthly Leland Alpha	0.00%	1.55%	1.51%	1.50%	1.53%	1.54%	1.51%
Information Ratio	0.00	1.09	1.09	1.08	1.10	1.10	1.10
Skew	0.14	0.39	0.40	0.39	0.37	0.36	0.38
Kurtosis	-0.70	2.93	2.60	2.47	2.44	2.51	2.41
Maximum Drawdown	-81.08%	-7.47%	-7.54%	-7.54%	-7.48%	-7.48%	-7.48%
Correlation with QQQ	1.00	0.18	0.25	0.27	0.29	0.30	0.32
Min Monthly Return	-26.20%	-7.47%	-7.54%	-7.54%	-7.48%	-7.48%	-7.48%
Max Monthly Return	23.48%	15.02%	15.06%	15.06%	15.11%	15.11%	15.15%
Number of Months	42	42	42	42	42	42	42
% Up Months	40%	74%	71%	74%	74%	74%	69%
% Down Months	60%	26%	29%	26%	26%	26%	31%

Exhibit 5c Passive Collars with 2% OTM Calls – October 2002 to September 2007

Monthly Data: Sept, 2002 to Sept. 2007	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.0% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.1% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.3% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.4% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.5% OTM. 6 Mo Put.
Annualized Return	20.37%	2.91%	5.02%	5.19%	5.79%	6.39%	6.83%
Annualized Std Dev	17.54%	7.11%	7.91%	7.93%	8.18%	8.32%	8.47%
Sharpe Ratio	1.00	0.00	0.27	0.29	0.35	0.42	0.46
Annual Stutzer Index	1.01	0.04	0.30	0.32	0.38	0.44	0.48
CAPM Beta	1.00	0.23	0.30	0.30	0.33	0.34	0.36
Leland Beta	1.00	0.26	0.33	0.33	0.36	0.37	0.38
Monthly Leland Alpha	0.00%	-0.35%	-0.27%	-0.26%	-0.26%	-0.22%	-0.21%
Information Ratio	0.00	-1.19	-1.13	-1.12	-1.11	-1.08	-1.06
Skew	0.33	-0.24	-0.21	-0.22	-0.16	-0.18	-0.24
Kurtosis	1.63	0.14	0.06	0.04	0.16	0.02	-0.08
Maximum Drawdown	-12.36%	-16.37%	-14.02%	-14.02%	-13.04%	-11.74%	-11.74%
Correlation with QQQ	1.00	0.57	0.67	0.67	0.71	0.71	0.73
Min Monthly Return	-12.09%	-5.23%	-5.49%	-5.49%	-5.56%	-5.56%	-5.56%
Max Monthly Return	18.47%	4.75%	5.59%	5.59%	6.24%	6.24%	6.24%
Number of Months	60	60	60	60	60	60	60
% Up Months	62%	58%	57%	57%	55%	55%	55%
% Down Months	38%	42%	43%	43%	45%	45%	45%

Exhibit 5d Passive Collars with 2% OTM Calls – October 2007 to May 2009

Monthly Data: Sept, 2007 to May. 2009	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.0% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.1% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.3% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.4% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.5% OTM. 6 Mo Put.
Annualized Return	-19.78%	0.54%	-1.03%	-1.44%	-0.84%	-2.02%	-2.02%
Annualized Std Dev	29.23%	9.54%	11.16%	11.56%	11.64%	12.32%	12.32%
Sharpe Ratio	-0.73	-0.09	-0.22	-0.25	-0.19	-0.28	-0.28
Annual Stutzer Index	-0.67	-0.05	-0.17	-0.20	-0.14	-0.23	-0.23
CAPM Beta	1.00	0.17	0.23	0.25	0.26	0.29	0.29
Leland Beta	1.00	0.17	0.22	0.24	0.25	0.28	0.28
Monthly Leland Alpha	0.00%	0.23%	0.20%	0.20%	0.26%	0.22%	0.22%
Information Ratio	0.00	0.79	0.77	0.77	0.81	0.78	0.78
Skew	-0.16	-1.41	-1.72	-1.64	-1.64	-1.55	-1.55
Kurtosis	-0.88	2.32	3.70	3.08	3.04	2.47	2.47
Maximum Drawdown	-49.74%	-15.49%	-17.91%	-17.90%	-17.90%	-18.81%	-18.81%
Correlation with QQQ	1.00	0.52	0.60	0.62	0.64	0.68	0.68
Min Monthly Return	-15.57%	-7.70%	-9.90%	-9.95%	-9.95%	-10.30%	-10.30%
Max Monthly Return	13.06%	3.75%	3.84%	3.84%	3.84%	3.95%	3.95%
Number of Months	20	20	20	20	20	20	20
% Up Months	50%	55%	65%	70%	70%	65%	65%
% Down Months	50%	45%	35%	30%	30%	35%	35%

Active Collars: The next set of exhibits provides results relating to active implementations of the collar strategies. Exhibits 6a, 6b, 6c and 6d provide summary statistics for the short, medium and long horizon active collar strategies for each of the periods discussed earlier as well as providing corresponding statistics for the 2% OTM passive collar and the QQQ.

Exhibit 6a Active Collar Strategies April 1999 to May 2009

Monthly Data: April, 1999-May, 2009	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR Short ACTIVE COLLAR - 1Mo Call.6 Mo Put.	QQQQ TR Medium ACTIVE COLLAR - 1Mo Call.6 Mo Put.	QQQQ TR Long ACTIVE COLLAR - 1Mo Call.6 Mo Put.
Annualized Return	-3.57%	9.26%	11.55%	10.94%	10.67%
Annualized Std Dev	30.40%	10.98%	11.44%	11.54%	11.34%
Sharpe Ratio	-0.22	0.56	0.74	0.68	0.67
Annual Stutzer Index	-0.07	0.59	0.75	0.70	0.69
CAPM Beta	1.00	0.13	0.15	0.15	0.16
Leland Beta	1.00	0.13	0.14	0.15	0.15
Monthly Leland Alpha	0.00%	0.56%	0.74%	0.70%	0.67%
Information Ratio	0.00	0.45	0.54	0.52	0.52
Skew	-0.21	0.16	0.01	0.07	-0.07
Kurtosis	0.55	3.52	3.28	3.26	2.80
Maximum Drawdown	-81.08%	-17.90%	-21.73%	-23.57%	-23.91%
Correlation with QQQ	1.00	0.37	0.39	0.41	0.42
Min Monthly Return	-26.20%	-9.95%	-10.38%	-10.38%	-10.38%
Max Monthly Return	23.48%	15.06%	15.41%	15.41%	14.57%
Number of Months	122	122	122	122	122
% Up Months	52%	65%	66%	64%	66%
% Down Months	48%	35%	34%	36%	34%

Exhibit 6a provides statistics covering the overall period. As we mentioned earlier, the passive collar clearly outperformed the QQQ in the overall period. The active collar adjustment strategy outperformed both the QQQ and the passive collar. All three active collars performed similarly, with the short active collar performing the best. While the volatility is slightly higher for the short active collar than the passive collar, returns are more than 2% higher annually. This is also reflected in the Stutzer index, at 0.75 versus 0.59 for the passive collar. Similarly, the monthly Leland alphas are 0.74% and 0.56%, respectively. Therefore, the short active implementation of the collar increases the Stutzer index and the Leland alpha both by a factor of about ½. The information ratio is also increased, suggesting that an active implementation does provide a benefit to collar performance. On the other hand, maximum drawdown and minimum monthly return are both slightly increased in magnitude.

In the bubble sub-period, the short active collar significantly outperforms the passive collar. The active collar generates almost a 1/3 higher annualized return at essentially the same standard deviation. Similarly, Exhibit 6b provides evidence that the Stutzer index, Leland alpha and information ratio are all significantly higher for the active collar. In fact, in this period, the active collar generates almost 2% *per month* of Leland's alpha.

Exhibit 6b Active Collar Strategies April 1999 to Sept 2002

Monthly Data: Apr. 1999-Sept, 2002	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR Short ACTIVE COLLAR - 1Mo Call.6 Mo Put.	QQQQ TR Medium ACTIVE COLLAR - 1Mo Call.6 Mo Put.	QQQQ TR Long ACTIVE COLLAR - 1Mo Call.6 Mo Put.
Annualized Return	-23.31%	21.16%	27.02%	24.27%	25.90%
Annualized Std Dev	42.44%	13.69%	13.71%	14.13%	13.25%
Sharpe Ratio	-0.65	1.24	1.67	1.43	1.64
Annual Stutzer Index	-0.51	1.21	1.54	1.35	1.52
CAPM Beta	1.00	0.08	0.11	0.12	0.11
Leland Beta	1.00	0.08	0.11	0.12	0.11
Monthly Leland Alpha	0.00%	1.50%	1.94%	1.78%	1.87%
Information Ratio	0.00	1.08	1.26	1.20	1.24
Skew	0.14	0.39	0.13	0.23	0.12
Kurtosis	-0.70	2.47	2.82	2.55	2.57
Maximum Drawdown	-81.08%	-7.54%	-7.48%	-8.70%	-7.54%
Correlation with QQQ	1.00	0.27	0.33	0.36	0.37
Min Monthly Return	-26.20%	-7.54%	-7.48%	-8.39%	-7.54%
Max Monthly Return	23.48%	15.06%	15.41%	15.41%	14.57%
Number of Months	42	42	42	42	42
% Up Months	40%	74%	74%	74%	76%
% Down Months	60%	26%	26%	26%	24%

Exhibit 6c provides statistics for the second, unfavorable to the collar, sub-period. In this sub-period, the short active strategy significantly mitigates the underperformance of the passive strategy. While it still underperforms the QQQ, the monthly Leland beta is improved from a -26 basis point loss to an -8 basis point loss per month. Similarly, annualized returns are improved from 5.2% to 6.7%, while volatility is slightly reduced. The active implementation also improves maximum drawdown and minimum monthly return. The improvements of the medium horizon active strategy are even more significant in this period.

The credit crisis sub-period is the only period in which the active strategy underperforms the passive strategy (albeit only slightly) and it still significantly outperforms the QQQ. These results suggest that a dynamic collar adjustment approach that is actively managed may have been able to overcome the small performance deficit between our passive and active strategies. However, “may” is the operative word. These results are only for the reported time frame and might not represent results for future time frames. In addition, there may be alternative approaches which provide superior results. Exhibit 6d provides the Leland alpha, which is reduced from 20 basis points per month to 13 basis points. Annualized losses are increased from

-1.4% to -3.0% and standard deviations are increased slightly from 11.6% to 13.7%. Similarly, the information ratio drops from 0.77 to 0.70.

Exhibit 6c Active Collar Strategies October 2002 to Sept 2007

Monthly Data: Sept, 2002 to Sept. 2007	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR Short ACTIVE COLLAR - 1Mo Call.6 Mo Put.	QQQQ TR Medium ACTIVE COLLAR - 1Mo Call.6 Mo Put.	QQQQ TR Long ACTIVE COLLAR - 1Mo Call.6 Mo Put.
Annualized Return	20.37%	5.19%	6.72%	7.91%	6.59%
Annualized Std Dev	17.54%	7.93%	7.68%	7.87%	7.99%
Sharpe Ratio	1.00	0.29	0.50	0.64	0.46
Annual Stutzer Index	1.01	0.32	0.52	0.64	0.48
CAPM Beta	1.00	0.30	0.26	0.28	0.31
Leland Beta	1.00	0.33	0.29	0.30	0.35
Monthly Leland Alpha	0.00%	-0.26%	-0.08%	-0.01%	-0.18%
Information Ratio	0.00	-1.12	-0.95	-0.88	-1.03
Skew	0.33	-0.22	-0.08	-0.22	-0.23
Kurtosis	1.63	0.04	0.80	0.41	0.30
Maximum Drawdown	-12.36%	-14.02%	-9.39%	-10.79%	-11.85%
Correlation with QQQ	1.00	0.67	0.59	0.62	0.68
Min Monthly Return	-12.09%	-5.49%	-5.42%	-5.39%	-5.39%
Max Monthly Return	18.47%	5.59%	6.18%	6.18%	6.18%
Number of Months	60	60	60	60	60
% Up Months	62%	57%	63%	60%	62%
% Down Months	38%	43%	37%	40%	38%

Exhibit 6d Active Collar Strategies October 2007 to May 2009

Monthly Data: Sept, 2007 to May. 2009	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR Short ACTIVE COLLAR - 1Mo Call.6 Mo Put.	QQQQ TR Medium ACTIVE COLLAR - 1Mo Call.6 Mo Put.	QQQQ TR Long ACTIVE COLLAR - 1Mo Call.6 Mo Put.
Annualized Return	-19.78%	-1.44%	-3.01%	-5.02%	-5.51%
Annualized Std Dev	29.23%	11.56%	13.72%	13.27%	13.56%
Sharpe Ratio	-0.73	-0.25	-0.32	-0.49	-0.51
Annual Stutzer Index	-0.67	-0.20	-0.27	-0.45	-0.47
CAPM Beta	1.00	0.25	0.28	0.24	0.26
Leland Beta	1.00	0.24	0.27	0.23	0.25
Monthly Leland Alpha	0.00%	0.20%	0.13%	-0.10%	-0.12%
Information Ratio	0.00	0.77	0.70	0.60	0.58
Skew	-0.16	-1.64	-0.98	-0.89	-0.91
Kurtosis	-0.88	3.08	0.98	1.26	0.95
Maximum Drawdown	-49.74%	-17.90%	-21.73%	-23.57%	-23.91%
Correlation with QQQ	1.00	0.62	0.59	0.54	0.56
Min Monthly Return	-15.57%	-9.95%	-10.38%	-10.38%	-10.38%
Max Monthly Return	13.06%	3.84%	5.64%	5.64%	5.64%
Number of Months	20	20	20	20	20
% Up Months	50%	70%	60%	55%	60%
% Down Months	50%	30%	40%	45%	40%

Exhibit 7 summarizes many of these results graphically. The exhibit provides an illustration of the growth of a $100 investment in the active QQQ collar and the 2% OTM passive QQQ collar against the growth of a QQQ investment over the entire period. The

difference in the performance of the QQQ and the collar strategies is clearly evident as is the added performance gained by implementing the active collar rather than the passive collar.

Exhibit 7: Growth of $100 in Active and Passive Collar Strategies

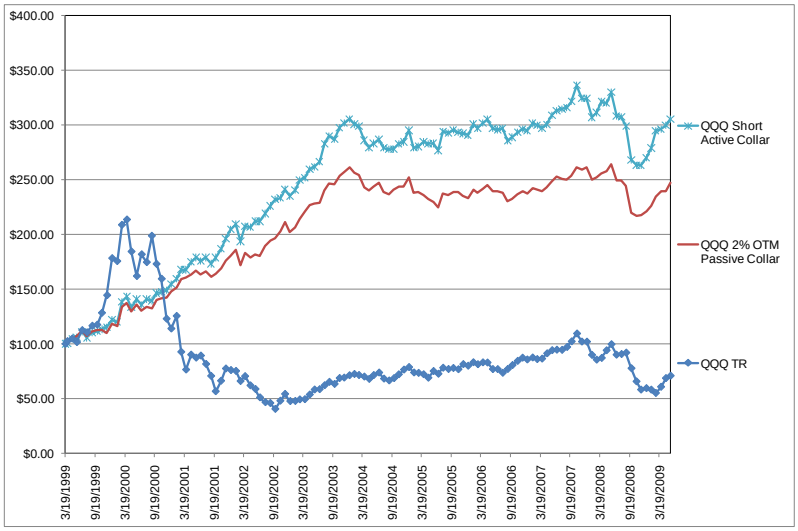
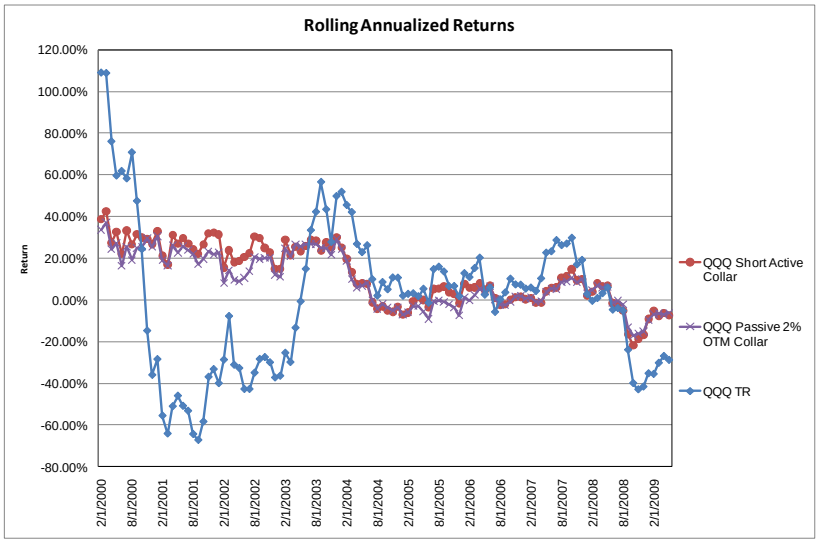


Exhibit 8: Rolling 12-Month Annualized Returns Active and Passive Collars

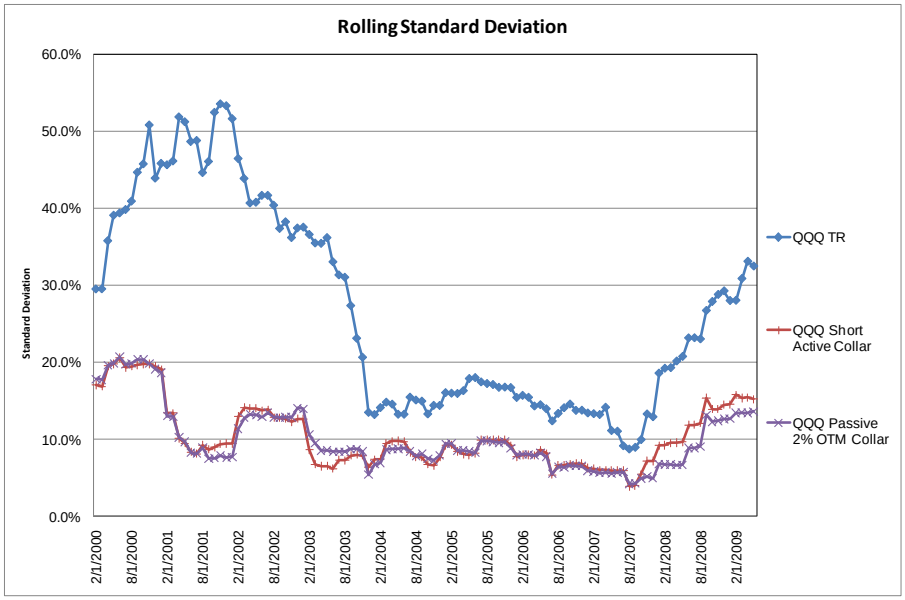


Exhibits 8 and 9 provide rolling 12-month annualized returns and standard deviations, respectively. In Exhibit 8 it is clear that the returns to the collar strategies are much more stable

than those of the QQQ. In addition, the collars clearly avoid the worst of the negative returns near the beginning and at the end of the period.

The rolling standard deviations provided in Exhibit 9 are evidence of the potential risk reduction benefits of the collar strategy. The collar strategies exhibit lower standard deviations throughout the entire period, with the difference ranging from about 5% to about 45%. It is also worth noting that both exhibits indicate that the benefits of the active collar strategy over the passive collar tend to be relatively subtle, particularly when compared to the difference between the collars and the QQQ.

Exhibit 9: Rolling 12-Month Annualized Standard Deviation Active and Passive Collars



Collaring a Mutual Fund

We also consider applying a collar strategy to a well known small cap equity mutual fund. For the analysis, we chose a fund which used the QQQ as a potential passive benchmark

and is assumed to track reasonably well with the QQQ. The fund we utilize is from a well-known platform, is found in the Morningstar Category "Small Growth", and carries a 10-year risk rating of "Above Average" and return rating of "Average" relative to its peers. Our intention is to simulate the practice of applying a collar strategy to a standard equity portfolio on which there are no available options written. In such a case, the investor would choose options based on liquidity considerations and how well the underlying tracks the investor's portfolio.

Exhibits 10a, 10b, 10c and 10d provide summary statistics for the mutual fund with and without the passive and active collar strategies. Before discussing the results, it should be noted that the strategies represented are not true collar overlays. The methodology does assume daily rebalancing of the option and mutual fund positions to maintain the proper exposure and is thus simply a first approximation at the performance of a true collar overlay. In the case of a true overlay, far less rebalancing would be required to maintain the collar overlay. In order to easily apply these strategies as overlays, the investor could allocate a portion of their portfolio to cash, and use this cash reserve to manage the cash flows resulting from the option positions.

While the active mutual fund collar underperforms the active QQQ collar in the overall period (see Exhibit 10a), the improvement on the mutual fund is very significant. The return of the active mutual fund collar is more than 4 times the return of the mutual fund, while the standard deviation is about 1/3 lower. The Stutzer index increases from 0.12 to 0.45, the information ratio (relative to the QQQ) is increased from 0.42 to 0.53, and the monthly Leland alpha increases from 0.42% to 0.72%. In addition, maximum drawdown is significantly improved from -69.7% to -24.8%. Similar results are found with the passive mutual fund collar. The passive mutual fund collar provides a return almost 3 times the return of the mutual fund at

about 2/3 the standard deviation, significantly outperforming the mutual fund while slightly underperforming the active mutual fund collar.

In the first (tech bubble) sub-period, the collar strategy significantly improves the returns of the mutual fund while reducing the standard deviation. As indicated in Exhibit 10b, the mutual fund exhibits a -7.1% annualized loss at a 42.1% standard deviation. In contrast, the passive and active mutual fund collars deliver 17.0% and 20.3% returns at 27.2% and 27.6% standard deviations, respectively. Similarly, the Stutzer index and Leland alpha are improved from -0.07 and 1.34% to 0.47 and 1.97% for the passive collar and further improved to 0.58 and 2.24% for the active collar.

Exhibit 10a Mutual Fund Collar Strategies April 1999 to May 2009

Monthly Data: April, 1999-May, 2009	QQQQ TR FUND ONLY - No Options	Small Cap Mutual Fund FUND ONLY - No Options	Small Cap Mutual Fund PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	Small Cap Mutual Fund Short ACTIVE COLLAR - 1 Mo Call.6 Mo Put.	QQQQ TR Short ACTIVE COLLAR - 1 Mo Call.6 Mo Put.
Annualized Return	-3.57%	2.35%	8.37%	9.83%	11.55%
Annualized Std Dev	30.40%	28.89%	17.90%	18.28%	11.44%
Sharpe Ratio	-0.22	-0.02	0.30	0.37	0.74
Annual Stutzer Index	-0.07	0.12	0.38	0.45	0.75
CAPM Beta	1.00	0.84	0.33	0.34	0.15
Leland Beta	1.00	0.84	0.33	0.33	0.14
Monthly Leland Alpha	0.00%	0.42%	0.60%	0.72%	0.74%
Information Ratio	0.00	0.42	0.48	0.53	0.54
Skew	-0.21	0.18	1.13	1.07	0.01
Kurtosis	0.55	1.34	4.98	4.49	3.28
Maximum Drawdown	-81.08%	-69.70%	-25.27%	-24.82%	-21.73%
Correlation with QQQ	1.00	0.89	0.57	0.57	0.39
Min Monthly Return	-26.20%	-21.66%	-12.01%	-12.51%	-10.38%
Max Monthly Return	23.48%	27.66%	25.93%	26.03%	15.41%
Number of Months	122	122	122	122	122
% Up Months	52%	57%	55%	58%	66%
% Down Months	48%	43%	45%	42%	34%

Exhibit 10b Mutual Fund Collar Strategies April 1999 to September 2002

Monthly Data: Apr. 1999-Sept, 2002	QQQQ TR FUND ONLY - No Options	Small Cap Mutual Fund FUND ONLY - No Options	Small Cap Mutual Fund PASSIVE COLLAR - 2% OTM, 1Mo Call.2% OTM. 6 Mo Put.	Small Cap Mutual Fund Short ACTIVE COLLAR - 1 Mo Call.6 Mo Put.	QQQQ TR Short ACTIVE COLLAR - 1Mo Call.6 Mo Put.
Annualized Return	-23.31%	-7.05%	16.96%	20.28%	27.02%
Annualized Std Dev	42.44%	42.14%	27.24%	27.61%	13.71%
Sharpe Ratio	-0.65	-0.27	0.47	0.58	1.67
Annual Stutzer Index	-0.51	-0.07	0.58	0.68	1.54
CAPM Beta	1.00	0.89	0.40	0.41	0.11
Leland Beta	1.00	0.89	0.40	0.41	0.11
Monthly Leland Alpha	0.00%	1.34%	1.97%	2.24%	1.94%
Information Ratio	0.00	0.84	1.21	1.32	1.26
Skew	0.14	0.41	0.71	0.64	0.13
Kurtosis	-0.70	-0.41	1.12	0.91	2.82
Maximum Drawdown	-81.08%	-69.70%	-25.27%	-24.82%	-7.48%
Correlation with QQQ	1.00	0.89	0.62	0.63	0.33
Min Monthly Return	-26.20%	-21.66%	-12.01%	-12.51%	-7.48%
Max Monthly Return	23.48%	27.66%	25.93%	26.03%	15.41%
Number of Months	42	42	42	42	42
% Up Months	40%	48%	60%	62%	74%
% Down Months	60%	52%	40%	38%	26%

Exhibit 10c Mutual Fund Collar Strategies October 2002 to September 2007

Monthly Data: Sept, 2002 to Sept. 2007	QQQQ TR FUND ONLY - No Options	Small Cap Mutual Fund FUND ONLY - No Options	Small Cap Mutual Fund PASSIVE COLLAR - 2% OTM, 1Mo Call.2% OTM. 6 Mo Put.	Small Cap Mutual Fund Short ACTIVE COLLAR - 1 Mo Call.6 Mo Put.	QQQQ TR Short ACTIVE COLLAR - 1Mo Call.6 Mo Put.
Annualized Return	20.37%	19.12%	7.83%	9.12%	6.72%
Annualized Std Dev	17.54%	14.20%	9.70%	9.77%	7.68%
Sharpe Ratio	1.00	1.14	0.51	0.64	0.50
Annual Stutzer Index	1.01	1.12	0.54	0.66	0.52
CAPM Beta	1.00	0.67	0.25	0.23	0.26
Leland Beta	1.00	0.70	0.28	0.26	0.29
Monthly Leland Alpha	0.00%	0.30%	0.03%	0.16%	-0.08%
Information Ratio	0.00	-0.13	-0.79	-0.69	-0.95
Skew	0.33	0.00	0.19	0.28	-0.08
Kurtosis	1.63	0.26	-0.20	-0.31	0.80
Maximum Drawdown	-12.36%	-13.76%	-9.66%	-9.79%	-9.39%
Correlation with QQQ	1.00	0.83	0.44	0.40	0.59
Min Monthly Return	-12.09%	-9.18%	-5.10%	-5.39%	-5.42%
Max Monthly Return	18.47%	10.97%	7.25%	7.33%	6.18%
Number of Months	60	60	60	60	60
% Up Months	62%	68%	57%	58%	63%
% Down Months	38%	32%	43%	42%	37%

Exhibit 10d Mutual Fund Collar Strategies October 2007 to May 2009

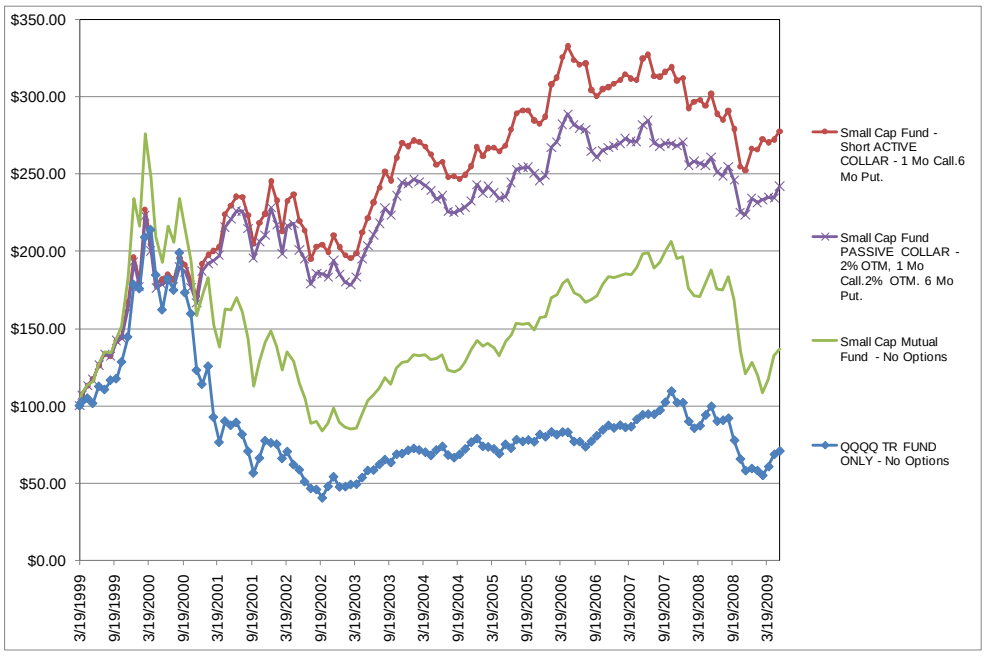
Monthly Data: Sept, 2007 to May. 2009	QQQQ TR FUND ONLY - No Options	Small Cap Mutual Fund FUND ONLY - No Options	Small Cap Mutual Fund PASSIVE COLLAR - 2% OTM, 1Mo Call.2% OTM. 6 Mo Put.	Small Cap Mutual Fund Short ACTIVE COLLAR - 1 Mo Call.6 Mo Put.	QQQQ TR Short ACTIVE COLLAR - 1Mo Call.6 Mo Put.
Annualized Return	-19.78%	-20.50%	-6.29%	-7.47%	-3.01%
Annualized Std Dev	29.23%	27.47%	10.44%	11.54%	13.72%
Sharpe Ratio	-0.73	-0.80	-0.74	-0.77	-0.32
Annual Stutzer Index	-0.67	-0.77	-0.74	-0.77	-0.27
CAPM Beta	1.00	0.87	0.23	0.25	0.28
Leland Beta	1.00	0.87	0.22	0.24	0.27
Monthly Leland Alpha	0.00%	-0.31%	-0.26%	-0.32%	0.13%
Information Ratio	0.00	-0.07	0.57	0.52	0.70
Skew	-0.16	-0.38	-0.92	-0.72	-0.98
Kurtosis	-0.88	0.00	1.57	0.80	0.98
Maximum Drawdown	-49.74%	-47.51%	-17.35%	-20.95%	-21.73%
Correlation with QQQ	1.00	0.93	0.65	0.64	0.59
Min Monthly Return	-15.57%	-19.93%	-8.41%	-8.66%	-10.38%
Max Monthly Return	13.06%	12.82%	4.76%	5.60%	5.64%
Number of Months	20	20	20	20	20
% Up Months	50%	45%	40%	50%	60%
% Down Months	50%	55%	60%	50%	40%

Exhibit 10c provides results for the unfavorable period. In the unfavorable period the passive and active mutual fund collars both underperform the mutual fund, with the active mutual fund collar generating 9.1% returns at 9.8% volatility versus 19.1% returns at 14.2% volatility for the mutual fund. The performance differential between the active mutual fund collar and the mutual fund is not as significant as the differential for the QQQ collar and the QQQ for this time period. The monthly Leland alpha for the active mutual fund collar is 0.16% versus 0.30% for the mutual fund.

The statistics for the credit crisis sub-period are provided in Exhibit 10d. In this period, the active and passive mutual fund collars provide very similar results, with the passive mutual fund collar slightly outperforming the active collar. Both mutual fund collars outperform the mutual fund in this period on a raw return basis. On a risk adjusted return basis, the passive collar outperforms the mutual fund with a Leland alpha of -0.26% versus 0.31% for the mutual fund. In contrast, the active collar provides virtually the same Leland alpha as the mutual fund in this sub-period. The passive collar improves returns by cutting losses by about 2/3 from -20.1% to -6.3%, while also cutting volatility by almost 1/3 from 27.5% to 10.4%. The maximum drawdown and minimum monthly return are cut by more than ½ for the passive collar.

Exhibit 11 provides a graphical representation of the performance of an investment in the small cap mutual fund versus the collared mutual fund. Once again, the outperformance of the collared mutual funds is clearly evident in the overall period, with the active collar quite consistently outperforming the passive collar.

Exhibit 11: Growth of $100 in Mutual Fund Strategies



Conclusions

In this paper we consider the performance of passive and active implementations of the collar strategy on the QQQ ETF as well as on a sample small cap equity mutual fund. The 10+ year time horizon since the inception of QQQ options has provided us with a variety of market conditions in which to test the performance characteristics of the collar. As expected, the results of the analysis show that a passive collar strategy (whether on the QQQ or on the mutual fund) is most effective (relative to a long underlying position) in declining markets and less effective in rising markets. For the period of analysis, the active collar adjustment strategy tends to outperform the passive collar. Judgments as to the particular benefits of the passive and active collar strategies are, of course, dependent on the risk tolerance of the individual investor.

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Appendix A: 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:

$$B_p = \frac{cov\left[r_p, -(1+r_{mkt})^{-b}\right]}{cov\left[r_{mkt}, -(1+r_{mkt})^{-b}\right]},$$

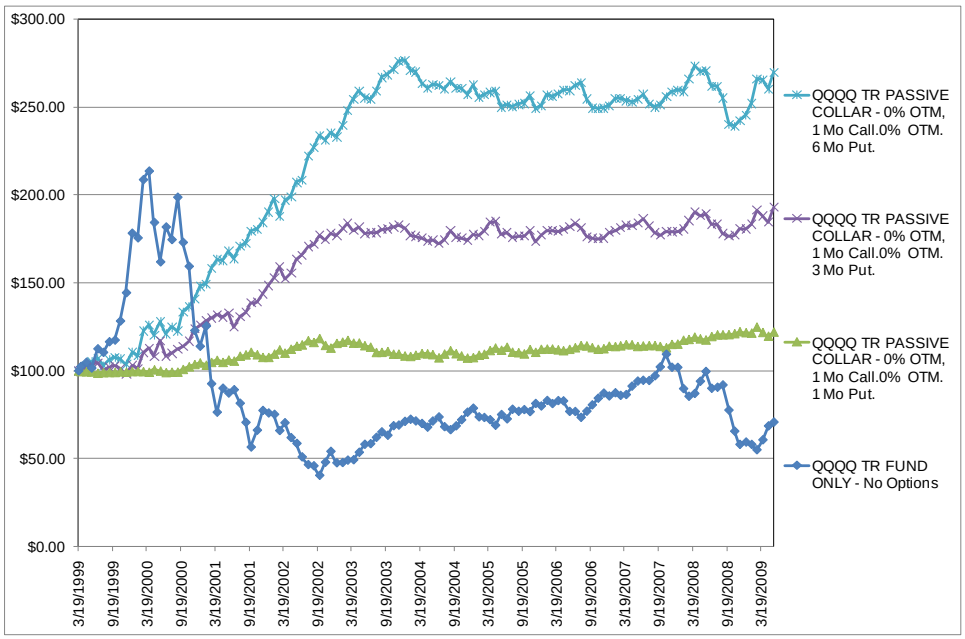
and *b* is a market price of risk. If market returns are normally distributed, *b* is given by:

$$b = \frac{\log[E(1+r_{mkt})] - \log\left(1+r_f\right)}{var[\log(1+r_{mkt})]},$$

Thus, the Leland alpha follows:

$$A_p = E[r_p] - B_p\left[E(r_{mkt}) - r_f\right] - r_f,$$

Appendix B: 1-Month Call/1-Month Put Collars



Monthly Data: April, 1999-May, 2009	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 1 Mo Put.
Annualized Return	-3.57%	9.26%	-0.30%
Annualized Std Dev	30.40%	10.98%	6.30%
Sharpe Ratio	-0.22	0.56	-0.54
Annual Stutzer Index	-0.07	0.59	-0.50
CAPM Beta	1.00	0.13	0.16
Leland Beta	1.00	0.13	0.16
Monthly Leland Alpha	0.00%	0.56%	-0.24%
Information Ratio	0.00	0.45	0.13
Skew	-0.21	0.16	0.07
Kurtosis	0.55	3.52	-0.26
Maximum Drawdown	-81.08%	-17.90%	-22.90%
Correlation with QQQ	1.00	0.37	0.76
Min Monthly Return	-26.20%	-9.95%	-3.87%
Max Monthly Return	23.48%	15.06%	5.21%
Number of Months	122	122	122
% Up Months	52%	65%	48%
% Down Months	48%	35%	52%

Monthly Data: Apr. 1999-Sept, 2002	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1Mo Call.2% OTM. 1Mo Put.
Annualized Return	-23.31%	21.16%	-3.50%
Annualized Std Dev	42.44%	13.69%	6.38%
Sharpe Ratio	-0.65	1.24	-1.20
Annual Stutzer Index	-0.51	1.21	-1.18
CAPM Beta	1.00	0.08	0.12
Leland Beta	1.00	0.08	0.12
Monthly Leland Alpha	0.00%	1.50%	-0.40%
Information Ratio	0.00	1.08	0.53
Skew	0.14	0.39	0.32
Kurtosis	-0.70	2.47	-0.33
Maximum Drawdown	-81.08%	-7.54%	-22.72%
Correlation with QQQ	1.00	0.27	0.82
Min Monthly Return	-26.20%	-7.54%	-3.87%
Max Monthly Return	23.48%	15.06%	4.11%
Number of Months	42	42	42
% Up Months	40%	74%	40%
% Down Months	60%	26%	60%

Monthly Data: Sept, 2002 to Sept. 2007	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1Mo Call.2% OTM. 1Mo Put.
Annualized Return	20.37%	5.19%	3.54%
Annualized Std Dev	17.54%	7.93%	5.84%
Sharpe Ratio	1.00	0.29	0.11
Annual Stutzer Index	1.01	0.32	0.14
CAPM Beta	1.00	0.30	0.27
Leland Beta	1.00	0.33	0.28
Monthly Leland Alpha	0.00%	-0.26%	-0.34%
Information Ratio	0.00	-1.12	-1.26
Skew	0.33	-0.22	0.18
Kurtosis	1.63	0.04	0.31
Maximum Drawdown	-12.36%	-14.02%	-6.74%
Correlation with QQQ	1.00	0.67	0.80
Min Monthly Return	-12.09%	-5.49%	-3.73%
Max Monthly Return	18.47%	5.59%	5.21%
Number of Months	60	60	60
% Up Months	62%	57%	57%
% Down Months	38%	43%	43%

Monthly Data: Sept, 2007 to May. 2009	QQQQ TR FUND ONLY - No Options	QQQQ TR PASSIVE COLLAR - 2% OTM, 1 Mo Call.2% OTM. 6 Mo Put.	QQQQ TR PASSIVE COLLAR - 2% OTM, 1Mo Call.2% OTM. 1Mo Put.
Annualized Return	-19.78%	-1.44%	-4.69%
Annualized Std Dev	29.23%	11.56%	7.20%
Sharpe Ratio	-0.73	-0.25	-0.85
Annual Stutzer Index	-0.67	-0.20	-0.85
CAPM Beta	1.00	0.25	0.19
Leland Beta	1.00	0.24	0.19
Monthly Leland Alpha	0.00%	0.20%	-0.19%
Information Ratio	0.00	0.77	0.63
Skew	-0.16	-1.64	-0.21
Kurtosis	-0.88	3.08	-1.14
Maximum Drawdown	-49.74%	-17.90%	-14.38%
Correlation with QQQ	1.00	0.62	0.77
Min Monthly Return	-15.57%	-9.95%	-3.86%
Max Monthly Return	13.06%	3.84%	2.69%
Number of Months	20	20	20
% Up Months	50%	70%	40%
% Down Months	50%	30%	60%