Exploring the Use of Equity Collars in Asset Allocation: A Simulation Approach

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Abstract: *The 2008 market meltdown poses fundamental questions about investor reliance on diversification as a tool to manage risk in investment strategies. This article demonstrates that the use of asset allocation schemes alone is not sufficient to reduce portfolio risk. The analysis of the effects of changing correlation and volatility regimes suggests that management of the diversification effect is necessary. In addition to asset allocation decisions, attention should be paid to the implementation of more effective hedges. This research shows that the implementation of a zero-cost equity collar shows promise in managing investment risk as well as providing better risk-to-return ratios. The collar not only outperformed across a wide range of asset mixes on a risk/return basis but also provided a predetermined downside boundary on wealth. Our findings demonstrate that the holding period and the width of the collar have an impact on the investor's overall risk/return performance.*

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The 2008 market meltdown poses fundamental questions about the dependency on diversification to manage risk in investment strategies. Diversification is the foundation of modern portfolio theory and enjoys an unquestioned commitment, under current regulation, on the part of fiduciaries managing asset allocation strategies. Ironically however, just at the time that diversification is most needed, its risk reduction benefits have faltered. There has been a rise in the level of the cross-correlation structure of returns in the capital markets across the world. The globalization of economic markets has increased the dependence across asset class returns, and shocks to specific economies have rippled across markets at the same time.

The diminishing diversification effect underscores the need for alternatives to control investment risk. This research indicates that the application of zero-cost equity collars provides an attractive alternative solution.[1] A collar is an option strategy that uses both puts and calls simultaneously. The strategy utilizes buying a put option, which gives the investor the right to sell the underlying equity shares at a stated or exercise price. This provides the investor with known downside protection. To offset the cost of the put, a call option is sold. With the call option, one must sell the underlying shares at a predetermined or exercise price. Hence, the term "collar" refers to the stated range set by the put and call options in which the return on the underlying stock investment can travel. While the option literature is robust in its description of how various option strategies can be formulated, it is

void of any comparison to the results one would achieve relative to asset allocation. The effectiveness of this type of hedge to control downside risk in asset allocation presents an unexplored topic in risk management.

The Advantages of a Zero-Cost Equity Collar to Control Investment Risk

There are several advantages to using a collar strategy. First, the overall cost of the collar strategy is consistent with the asset allocated portfolio. Using zero-cost collars does not require an additional investment on the part of the investor, because the cost of the put that provides downside protection is offset by the income from the sale of the call.

Second, the collar provides deterministic limits to the investment outcome. Using the S&P 500 as a benchmark and assuming a 15% limit on return movement as an example, in each period the resulting return on the collar has three potential outcomes. If the S&P 500 index return (including dividends) is up by 15% or more, the call will be exercised and the investor will receive the positive 15% return. That outcome is possible since the collar is set to have a strike price at a 15% appreciation level above the current S&P 500 index. Should the index decline and the put be exercised, then the loss to the investor would be a maximum of 10% regardless of the actual decline in the index. For example, if the stock index fell 50%, the loss would be limited by the put to only 10%, thereby protecting the investor from serious deterioration in the value of the investment.

In the case where neither the put nor the call is exercised, the return to the investor would be equal to the return the index actually provided. Therefore, once the collar is positioned the investor knows the potential maximum and minimum return that the collar strategy will provide. Unlike the asset-allocated portfolio, consisting of a mix of stocks and bonds, the collar provides deterministic limits to the investment outcome and volatility. The limits are set by the exercise prices of the put and call options. With the asset-allocated portfolio, the outcome is totally probabilistic. The investor must determine what meaning the historic mean and standard deviation provide relative to some future outcome.

Research Questions

The key research question examined in this study was whether or not the use of an equity collar can provide the investor with better overall returns on a risk-adjusted basis. A secondary research question asked about the effect of varying correlation structure across the two asset classes. The second question examined was whether the equity collar will outperform the long-only asset allocation approach when changing correlations and varying volatilities are included in the analysis.

The key research methodology was simulation analysis. By running simulations on the return distributions, one can demonstrate the impact various asset mixes have on an investor's risk/return outcome. Using the simulation approach, multiple outcomes can be established over varying time intervals. For example, what would be the risk/return trade-off if the allocation was held for 5, 10, 15, or 20 years? By looking at 10,000 possible future outcomes, the investor is better able to judge the asset mix that is appropriate.

A similar approach was also used for the collar. While the range of the collar was set, the overall return depends on the distribution of returns that occur over the holding period. Applying the simulation approach to the collar again allowed for an estimate of the possible future returns that fall within the boundaries of the collar. The collar allows the investor to express the risk nature of the investment in a concrete fashion. That is, "Can you deal with a possible 10% loss?" and "Will you be satisfied with a maximum gain of 15%?" There are no surprises beyond those parameters. However, the overall return and therefore the investor's risk/return outcome are affected by the stochastic nature of the return distribution that falls within those parameters.

Model Development and Results

Although the objective of asset allocation was to obtain the optimal expected return-to-risk profile, it was useful for our purposes to distinguish between two types of asset allocation. Strategic asset allocation is an approach that is long term with at least a five-year investment horizon. Investors hold positions across asset classes consistent with their long-term views of asset class return performance. The objective of the strategic weights is to

provide a rate of return while diversifying investment risk across various asset classes.

In contrast, tactical asset allocation is an approach with an investment horizon that may be as short as one month to one quarter. Short-term "bets" are taken consistent with shorter-term views of asset class return performance, with holdings that deviate within a specified range from the strategic weights.[2] This paper is concerned with the first approach to asset allocation whereby a long-term view of the capital markets is taken, and strategic weights are constructed across the asset classes of stocks and bonds.

Impact of Correlations on Diversification

The diversification benefits of asset allocation strategies are wholly dependent on the low correlations that can characterize the return behavior across asset classes. The fact that stock and bond returns are uncorrelated in a long-only context makes those two asset classes potential candidates for inclusion in an asset allocation scheme. Asset allocation strategies further assume that correlations across asset classes remain constant over any one investment horizon. Casual observations of the return performance of the stock and bond markets reveal that in turbulent times, such as the recent market crisis, the low correlations between asset classes can rise to unacceptably high levels.[3] Table 1 provides an historical perspective on the frequency of changes in correlation regimes in U.S. equity and bond markets over the period 1926-2008. We examined the annual returns to the S&P 500 index and the five-year U.S. Treasury note as proxies for returns available to investors in the capital markets during up and down markets. Rolling correlations over 5, 10, 15, and 20-year windows were calculated and compared to the values obtained over the entire time period. It was interesting to note that the average values of the correlations were similar for the 15 and 20-year windows for the analysis that includes only positive equity market returns as compared to the entire time frame. However, when equity market returns were segmented into "down" or negative return periods, the correlations were significantly higher (or less negative) and were especially notable for the 20-year window. The assumption of a zero or close to zero correlation between asset classes is likely to be unwarranted during periods of time when the equity markets exhibit negative returns. The maximum and minimum rolling correlation for up and down markets indicated an extremely wide range. For example, using a 20-year window the correlations range from .53 to -.48. The power of diversification across asset classes to hedge risk during "down" equity markets was significantly weakened. An alternative to diversification as the only approach used to hedge risk, especially shortfall risk, was apparent (Table 1).

TABLE 1

Rolling "Window" Correlations

Period 1926–2008

Window	Average	Maximum	Minimum
5 year	.07	.98	–.89
10 year	.06	.64	–.77
15 year	.05	.56	–.59
20 year	.03	.44	–.60

Positive Equity Market Returns over the Period 1926–2008

Window	Average	Maximum	Minimum
5 year	.16	.98	–.87
10 year	.12	.75	–.79
15 year	.08	.61	–.51
20 year	.04	.53	–.48

Negative Equity Market Returns over the Period 1926–2008

Window	Average	Maximum	Minimum
5 year	.14	.94	–.71
10 year	.12	.62	–.35
15 year	.15	.46	–.33
20 year	.25	.45	–.09

To determine how well the collar approach would perform relative to traditional asset allocation, simulation analysis was performed using Crystal Ball.[4] The purpose of the simulation was to examine the impact of changes in asset class correlations and volatility on the risk/return profile over a range of investment horizons. For example, for the investor who makes plans for retirement, the horizon date could be on the order of several years, within a range of 5 to 20 years. Therefore, we examined the performance of the collar-protected portfolio versus the long-only asset allocated portfolio over the same time periods.

Impact on Investment Horizons

To judge the impact the two investment strategies had on overall risk/return performance, it was

assumed that the investor would invest $10,000 a year for a period of 5, 10, 15, and 20 years. These four specific periods were chosen to provide insight on the superiority of either of the strategies during shorter or longer investment horizons. The asset allocation method was examined across all time periods and asset mixes ranged from a 10% equity exposure and 90% debt to 100% equity. The equity collar that was used was a zero cost 1.5:1 (+15%, –10%) collar. Previous research had examined a 2:1 (+20%, –10%) collar.[5] However, given the current environment and the higher cost of puts, a 1.5:1 collar was considered more realistic. In addition, two 1.5:1 collars were considered. In the first case, a +15% and –10% collar was examined. In the second case, a +20% and a –13.3% collar was examined. By evaluating two cases—one with a narrow band and the second with a wider band—two perspectives to the 1.5:1 collar could be viewed.

To establish the parameters for the distribution of returns used in the simulation, the annual returns for the S&P 500 index and the returns for the five-year Treasury note were analyzed back to 1926. The descriptive statistics for these return distributions appear in Table 2. The results were converted to wealth relatives, and the respective means and standard deviations were used as parameters for the simulations.

TABLE 2

Descriptive Statistics for the S&P 500 Index and Five-Year Treasury Notes for the Period 1926-2009

	S&P 500 Index	Five-Year Treasury
Average annual return	11.7%	5.2%
Median annual return	12.5%	4.1%
Standard deviation	20.6%	7.2%
Maximum annual return	54.0%	29.1%
Minimum annual return	–43.4%	–37.0%
Correlation	.04	

Using Crystal Ball, 10,000 runs were performed forecasting future results for each asset mix and the collar. The coefficient of variation (the ratio of mean wealth to standard deviation of wealth outcomes) was

TABLE 3

**The Narrow Band Zero Cost Collar:
Results of Simulation under Historic Volatility (.20) and Low Asset Class Correlation (.00)**

Coefficients of Variability for Year 20 Wealth

Stock percent plus bond percent	**S10% + B90%**	**S20% + B80%**	**S30% to 100% + B70% to 0%**
Portfolio	.21	.28	.36 to .69
Collar	.26	.26	.26

Coefficients of Variability for Year 15 Wealth

Stock percent plus bond percent	**S10% to 20% + B90% to 80%**	**S30% + B70%**	**S40% to 100% + B60% to 0%**
Portfolio	.17 to .21	.26	.31 to .55
Collar	.24	.24	.24

Coefficients of Variability for Year 10 Wealth

Stock percent plus bond percent	**S10% to 30% + B90% to 70%**	**S40% + B60%**	**S50% to 100% + B50% to 0%**
Portfolio	.14 to .18	.22	.26 to .42
Collar	.19	.19	.19

Coefficients of Variability for Year 5 Wealth

Stock percent plus bond percent	**S10% to 30% + B90% to 70%**	**S40% + B60%**	**S50% to 100% + B50% to 0%**
Portfolio	.10 to .12	.14	.17 to .30
Collar	.14	.14	.14

calculated from the simulation outputs and used as the performance metric to establish the superiority of the collar relative to each of the asset mixes. Four scenarios that varied asset class, correlation, volatility estimates, and assumptions regarding the boundaries of the collar were simulated.

Simulation Results

Scenario 1:
The Narrow Band Zero Cost Collar with Historic Equity Market Volatility and Low Asset Class Correlations

The results of the simulation under conditions of low correlation between the two asset classes and typical or historic volatility are presented in Table 3. Under historical volatility conditions and low asset correlations, the equity collar outperformed the traditional portfolio mix of stocks and bonds at equity exposures of at least 20% when the investment horizon was 20 years. This indicated that the collar outperformed all asset mixes where equity exceeded 20% of the portfolio. At the five-year horizon, the collar-protected portfolio outperformed at the equity exposure of 40% and higher. These results not only indicated the viability of the collar as an efficient means of risk control but also showed that the desired time horizon was also a critical factor.

Scenario 2:
The Narrow Band Zero Cost Collar with High Equity Market Volatility and High Asset Class Correlations

In addition to the impact of changing correlations in the market, the simulation analysis also examined the impact of the high level of current volatility. To measure the current volatility, we extracted the implied volatility from the S&P 500 at the money option, dated January 2008. The implied standard deviation of .35, from the Black-Scholes model was then used as the parameter for the simulations. Crystal Ball was used again, and 10,000 runs were made with the new risk parameter. This was also performed on the collar, and once again the two investment strategies were compared across each asset mix. The results of simulations conducted under high asset class correlations and high volatility are presented in Table 4. Under high equity volatility and historic asset class correlation, the equity collar outperformed the traditional portfolio mix of stocks and bonds at equity exposures of 10% and higher for the 20-year horizon. At the 5-year horizon, the collar-protected portfolio outperformed the 20% long-only equity exposure. In this case, as correlations increased along with volatility, the collar provided a broader range of risk control. In the scenario of current volatility and high correlations, the collar provided a superior risk/return trade-off across almost the entire spectrum of asset mixes.

TABLE 4

The Narrow Band Zero Cost Collar:
Results of Simulation under High Volatility (.35) and High Asset Class Correlation (.40)

Coefficients of Variability for Year 20 Wealth

Stock percent plus bond percent	**S10% + B90%**	**S20% to 100% + B80% to 0%**
Portfolio	.37	.56 to 1.52
Collar	.32	.32

Coefficients of Variability for Year 15 Wealth

Stock percent plus bond percent	**S10% + B90%**	**S20% to 100% + B80% to 0%**
Portfolio	.27	.38 to 1.07
Collar	.27	.27

Coefficients of Variability for Year 10 Wealth

Stock percent plus bond percent	**S10% + B90%**	**S20% + B80%**	**S30% to 100% + B70% to 0%**
Portfolio	.19	.26	.35 to .78
Collar	.22	.22	.22

Coefficients of Variability for Year 5 Wealth

Stock percent plus bond percent	**S10% + B90%**	**S20% + B80%**	**S30% to 100% + B70% to 0%**
Portfolio	.13	.17	.21 to .52
Collar	.16	.16	.16

Scenario 3:
The Wider Band Zero Cost Collar with Historic Equity Market Volatility and Low Asset Class Correlations

The results of the simulation under conditions of low correlation between the two asset classes and typical or historic volatility are presented in Table 5. Here, a wider (20%, –13.33%) collar was examined. Under typical volatility conditions and low asset correlation, the equity collar outperformed the traditional portfolio of stocks and bonds at equity exposures of at least 40% when the investment horizon was 20 years. At the 5-year horizon, the collar-protected portfolio outperformed at the equity exposure of 50%. While the collar performed well, the results indicated that the boundaries used to establish the 1.5 to 1 collar had an impact on the relative performance. The results showed that the narrower band (15%, –10%) outperformed the wider band (+20%, –13.33%) zero cost collar.

Scenario 4:
The Wider Band Zero Cost Collar with High Equity Market Volatility and High Asset Class Correlations

In addition to the impact of changing correlations in the market, the simulation analysis also examined the impact of the current high level of volatility. The results of simulations conducted under high asset class correlation and high volatility are presented in Table 6. Under high equity volatility and high asset class correlation, the equity collar outperformed the traditional portfolio of stocks and bonds at equity exposures of at least 10% for the 20-year horizon. At the 5-year horizon, the collar-protected portfolio outperformed the 30% long-only equity exposure. These results were consistent with the previous finding. Under conditions of high volatility and high correlation, the narrower band (+15%, –10%) collar was superior (Table 6).

Conclusions

The message of the research presented here is to investors and financial advisors alike: asset allocation alone will not maximize returns while reducing portfolio risk. The analysis of the effects of changing correlation and volatility regimes suggests that management of the diversification effect is a requirement. As a complement to

TABLE 5

**The Wide Band Zero Cost Collar:
Results of Simulation under Historic Volatility (.20) and Low Asset Class Correlation (.00)**

Coefficients of Variability for Year 20 Wealth			
Stock percent plus bond percent	**S10% to 30% + B90% to 70%**	**S40% + B60%**	**S50% to 100% + B50% to 0%**
Portfolio	.21 to .35	.40	.48 to .66
Collar	.36	.36	.36
Coefficients of Variability for Year 15 Wealth			
Stock percent plus bond percent	**S10% to 30% + B90% to 70%**	**S40% + B60%**	**S50% to 100% + B50% to 0%**
Portfolio	.17 to .26	.31	.35 to .55
Collar	.30	.30	.30
Coefficients of Variability for Year 10 Wealth			
Stock percent plus bond percent	**S10% to 40% + B90% to 60%**	**S50% + B50%**	**S60% to 100% + B40% to 0%**
Portfolio	.14 to .22	.26	.29 to .43
Collar	.24	.24	.24
Coefficients of Variability for Year 5 Wealth			
Stock percent plus bond percent	**S10% to 40% + B90% to 60%**	**S50% + B50%**	**S60% to 100% + B40% to 0%**
Portfolio	.10 to .14	.17	.19 to .29
Collar	.17	.17	.17

determining the best combinations of asset classes, attention should be paid to the specification and implementation of more effective hedges. This research found that the implementation of a zero-cost equity collar showed promise in controlling shortfall risk as well as providing better risk to return ratios. The collar not only outperformed across a wide range of asset mixes on a risk/return basis but also provided a predetermined downside boundary on wealth. The findings also demonstrated that the holding period and the width of the collar have an impact on the investor's overall risk/return performance.

Given the wide range of allocation percentages where the collar surpasses the performance of the asset allocation mix, the problem of determining the appropriate asset allocation is much simplified. The use of a collar mitigates the need to relate age to asset allocation. For example, the young investor might be advised to hold 90% stocks and10% bonds initially. Then as the investor ages, it is incumbent upon the manager (and the investor) to select a new age-appropriate allocation mix. Since the adjustment of the mix is not an automatic process, it could result in an inappropriate risk exposure given the investor's new and shorter investment horizon. For the older investor, and in light of increasing age expectations, the presence of a greater equity exposure is less troublesome if a collar is implemented.

In place of traditional asset allocation, the collar provided the investor with a deterministic upper and lower limit for total portfolio performance. Therefore, the need to rely on historical statistical measures was eliminated. In reality, it is very difficult for the average investor to relate the statistical measures to his or her risk preferences. The average return, historically, was 12% for the equity market. Does the investor then expect a 12% return? Is this expectation consistent with the actual performance of the S&P 500 index? The index provided a return in the range of 11% to 13% only four times during the period examined. How does the investor know what the expected value implies in terms of future returns given that the range of outcomes was between –43% and +54% over the last eight decades?

Finally, managing shortfall risk may be at least as important as traditional long-only diversification methods. Whether the allocation is 60% stocks and 40% bonds or an equal split, those allocations may be viewed as a conservative mix. However, the 2008 experience would indi-

TABLE 6

The Wide Band Zero Cost Collar:
Results of Simulation under High Volatility (.35) and High Asset Class Correlation (.40)

Coefficients of Variability for Year 20 Wealth

Stock percent plus bond percent	**S10% + B 90%**	**S20% to 100% + B80% to 0%**
Portfolio	.41	.58 to 1.38
Collar	.41	.4

Coefficients of Variability for Year 15 Wealth

Stock percent plus bond percent	**S10% + B90%**	**S20% + B80%**	**S30% to 100% + B70% to 0%**
Portfolio	.27	.37	.51 to 1.06
Collar	.35	.35	.35

Coefficients of Variability for Year 10 Wealth

Stock percent plus bond percent	**S10% to 20% + B90% to 80%**	**S30% + B70%**	**S40% to 100% + B60% to 0%**
Portfolio	.19 to .26	.34	.42 to .78
Collar	.28	.28	.28

Coefficients of Variability for Year 5 Wealth

Stock percent plus bond percent	**S10% to 20% + B90% to 80%**	**S30% + B70%**	**S40% to 100% + B60% to 0%**
Portfolio	.13 to .17	.21	.26 to .53
Collar	.21	.21	.21

cate an exposure of 40% loss on the equity portion. It is fair to say that many investors failed to see the extent of the recent market decline given the historic data. As a result, a broad segment of the investment community suffered significant and unexpected loss of wealth regardless of the preconceived asset mix that had been deployed.

Further research related to the behavioral aspects of the investor's reaction to risk and return should prove useful. For example, would an investor be satisfied with the collar approach if the market were to experience a significant upturn? Is investor "regret" stronger relative to downside losses than to the failure to benefit beyond the upside cap of the collar? Is simply varying the width of the collar the solution, or does the investment advisor need additional tools that can accurately determine the client's "true" preference for risk/return trade-offs? ■

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(2) Attilio Meucci, *Risk and Asset Allocation* (New York: Springer-Finance, 2007).
(3) Andrew Ang and Geert Bekaert, "How Regimes Affect Asset Allocation," *Financial Analysts Journal* (March/April 2004).
(4) Crystal Ball is commercial software oriented toward forecasting and risk analysis. Through simulation methods (Latin Hypercube and Monte Carlo), it is a tool that can be used for dealing with uncertainty in financial models.
(5) D'Antonio, "Equity Collars as an Alternative to Asset Allocation."