FINANCIAL SERVICES REVIEW

Financial Services Review 22 (2013) 291–310

Individual investors: Asset allocation vs. portfolio insurance (puts or calls)

Ken Johnston[a,]*, John Hatem[b], Elton Scott[a]

[a]*Berry College, Campbell School of Business, Department of Accounting and Finance, 2277 Martha Berry Hwy NW, Mount Berry, GA 30149, USA*

[b]*Georgia Southern University, College of Business, Department of Finance and Quantitative Analysis, Statesboro, GA 30460, USA*

Abstract

The purpose of this study is to test if an individual can successfully use index options to partially replace fixed income securities in an individual's retirement portfolio. Two types of option insurance portfolios are examined. Put option insurance portfolios are created by selling fixed percentages of a stock index portfolio and using the proceeds to purchase index put options. Call option insurance portfolios are created by writing index options worth fixed percentages of a stock index portfolio and using the proceeds to purchase more of the stock index (covered call option insurance is also examined). The use of put options in the portfolio should allow the investor to reduce downside risk, as they age, similar to increasing the bond allocation, while also allowing the investor to participate in increased upside potential by having a higher percentage of the portfolio invested in stocks. Along with increased potential for returns with a larger percentage of the portfolio invested in stocks, the income the investor receives by writing call options and investing them in more of the stock index may also provide the investor some protection against losses in exchange for limiting potential gains. Results indicate that shifting asset allocation appears to be the better strategy when compared with the put option insurance portfolios. Overall the call option insurance portfolios returns are superior to the asset allocation portfolios. On a risk adjusted basis, an argument can be made that the fixed percentage call option insurance portfolios outperform the asset allocation portfolios, when the asset allocation favors stocks.

Keywords: Asset allocation; Portfolio insurance; Options

* Corresponding author. Tel.: +1-706-290-2687; fax: +1-706-802-6728.
E-mail address: kjohnston@berry.edu (K. Johnston)

1057-0810/13/$ – see front matter

1. Introduction

As individuals progress through their work life, typically their asset mix shifts towards a higher allocation of fixed income securities and less equity. Arguments have been made for and against higher allocations (see Asness, 1996; Brennan & Xia, 2002; Campbell & Viceira, 2002; Campbell, Chan, & Viceira, 2003; Chai, Horneff, Maurer, & Mitchell, 2011; Gomes & Michaelides, 2005; Ibbotson, Milevsky, Chen, & Zhu, 2007; Leibowitz & Koegleman, 1991; Pfau, 2010; Samuelson, 1994; Siegel, 1994; & Van Hemert, 2010). The basis of these arguments are a combination of risk (individual risk aversion, risk of shortfall, real interest rate risk, and uninsurable income risk), terminal wealth, diminishing human capital, and investment horizon. The purpose of the increased fixed income allocation is to reduce risk. This risk reduction comes at a cost, reduction in the amount of upside capture. As discussed in Leland (1980), if an investor wants to maximize their expected return given the constraint of insuring against any losses they may want to purchase portfolio insurance.

The purpose of portfolio insurance is to reduce or eliminate downside risk while allowing you to participate in any potential gains from a market upturn. In its most basic form portfolio insurance requires one to purchase protective puts (Pozen (1978)). Put options can be created synthetically using the underlying stock and stock index futures. A synthetic put option on a portfolio can also be created by dynamically varying the stock-bond composition of the option-replicating portfolio (Fortune, 1995). However as discussed in Tian (1996) and Fortune (1993), in reality these synthetic strategies do not function well when the stock market crashes. They found that investors were unable to protect their positions because of several reason, one being suspended trading. Therefore, this study will not examine the use of synthetic put options as a source of portfolio insurance.

Empirical evidence indicates that the majority of options expire out of the money. This is consistent with the efficient market hypothesis. Information on expected volatility and market conditions are used when the option writer chooses which exercise price to offer, and is a factor in determining the premiums of the available index put options.[1] It is unlikely that that the use of large amounts of index put options in an investor's stock portfolio would be a successful strategy. The cost of the insurance would be greater than the option payoff and increase in upside potential.

Although market expectations are incorporated into the options market, market expectations are often incorrect especially in periods with large market declines. It may be possible to use small amounts of index put options in a stock portfolio that gives you significant payoffs in these periods. The increased upside potential from a higher proportion of stock in the investor's portfolio, along with the occasional options payout, may overcome the cost of the majority of periods where the options expire out of the money. This may result in a portfolio consisting of shares of a stock index and index put options outperforming the typical asset allocation portfolio of stocks and bonds.

Given that most options expire out of the money, it may be the case that a strategy of writing index call options may be superior to the purchase of index put options. The investor receives current income, in the form of the premiums, which they can invest in the stock index. This current income will also provide the investor some protection against losses (insurance) in exchange for limiting potential gains.

Superior return performance is not the only characteristic of importance. As discussed earlier, many arguments to shift the asset mix towards a higher allocation of fixed income securities and less equity deal with reducing risk. Risk characteristics of the asset allocation portfolios and the insurance portfolios will also be examined.

Previous studies examining portfolio insurance, whether using historical data or using theoretic or stochastic modeling have focused on the investment tradeoffs involved, costs versus potential benefits of the insurance exclusively. This articles contribution to the literature is examining how portfolio insurance compares to asset allocation changes. In addition, this article examines two approaches when writing index call options. First, a buy/write approach is used, where all the call options are completely covered.[2] The second approach assumes that the individual investor is applying portfolio insurance to only part of their portfolio. The remainder of their portfolio is invested in an asset allocation portfolio consisting of shares in a mutual fund that matches the stock index and the bond index. The overall stock component is such that any written options are completely covered hence there would be no margin requirements.

Specifically, the purpose of this study is to examine the use of small percentages of index put options (buy), small percentages of index call options (write), and completely covered calls (write), in place of bonds.[3] Using historical data, are the downside risk reduction adequate and is the potential for higher valuations realized? This strategy will not attempt to time the market, that is, buy index put options or write index call options when market downturns are predicted to be more likely. Overall the literature on market timing finds little evidence of timing ability[4] (see Blake, Lehmann, & Timmermann, 1999; Bollen & Busse, 2001; Brinson, Hood, & Beebower, 1986; Cuthbertson, Nitzsche, & O'Sullivan, 2010; Daniel, Grinblatt, Titman, & Wermers, 1997; Dellva, Demaskey, & Smith, 2001; Goetzmann, Ingersoll, & Ivkovic, 2000; Friesen & Sapp, 2007; Graham & Harvey, 1997; Jiang, Yao, & Yu (2007)).

2. Index put option portfolio insurance

The "put option insurance" portfolio includes shares in a stock index and put options on that index. Here the assumption is that the index options purchased can only be exercised at maturity. The value of the put option insurance portfolio (V_{PIT}) at time T (when the set of options purchased expires) is given by:

$$V_{PIT} = n_t S_0(1 + r_s) - n_p M P_{p0}(1 + r_s) + n_p M \max[X_p - S_0(1 + r_s), 0] \quad (1)$$

Where: n_t is the number of shares of the stock index owned before purchasing any put options, S_0 is the value of the stock market index at the beginning of the period,[5] r_s is the return on the index over the life of the options, n_P is the number of index put options purchased, M is the multiplier for the index options,[6] P_{p0} is the price of the index put options at the beginning of the period and X_p is the exercise price of the index put options, $M\max[X_p - S_0(1 + r_s), 0]$ is the value of each put option at expiration. $n_t S_0(1 + r_s)$ is the value of the stock portfolio with no insurance, $n_p M P_0(1 + r_s)$ is the cost of the insurance, $n_p M\max[X_p - S_0(1 + r_s), 0]$ is what you make on the insurance.

The "call option insurance" portfolio includes shares in a stock index where the proceeds from writing call options on the index are reinvested in the stock index. The value of the call option insurance portfolio (V_{CIT}) at time T is given by:

$$V_{CIT} = n_t S_0(1 + r_s) + n_c M P_{c0}(1 + r_S) - n_c M \max[S_0(1 + r_s) - X_c, 0] \quad (2)$$

Where: n_c is the number of call options written, P_{c0} is the price of the index call options at the beginning of the period and X_c is the exercise price of the index call options.

$M\max[S_0(1 + r_s) - X_c, 0]$ is the value of each call option at expiration. In the context of insurance, $n_t S_0(1 + r_s)$ is the value of the stock portfolio with no insurance, $n_c M P_{c0}(1 + r_S)$ is what you make on the insurance, $n_c M\max[S_0(1 + r_s) - X_c, 0]$ is the cost of the insurance.

The "asset allocation" portfolio includes shares in a stock index and shares in a bond index. The value of the asset allocation portfolio at time zero is the weighted average of the value of the stock and bond indexes: The value of the asset allocation portfolio at time T is given by:

$$V_{AT} = n_{s2} S_0(1 + r_s) + n_b B_0(1 + r_b) \quad (3)$$

n_{s2} is the number of shares of the index owned, B_0 is the value of the bond portfolio at time zero, and n_b is the number of shares of the bond index owned. r_b is equal the return on the bond portfolio over the life of the options. At the end of each period the portfolio returns are calculated. A period is defined as the time to maturity for the index options purchased. This study is trying to determine if the insurance portfolios can have higher returns than the asset allocation portfolios while having less risk or comparable risk to the asset allocation portfolios. For any insurance portfolio to have higher returns, what the investor makes on the insurance and allowing the investor to participate in any potential market upturn to a greater degree, must be greater than the cost of the insurance. For any insurance portfolio to have less risk or comparable risk to the asset allocation portfolio, the insurance payoff must substantially reduce the downside volatility of the portfolio.

3. Empirical analysis

To form the put and call option insurance portfolios, at the beginning of each quarter, index call (put) options are written (purchased). The time to maturity on these options when purchased is three months.[7]

Put option insurance portfolios are created by selling 1% and 3% of a stock index portfolio and using the proceeds to purchase index put options.[8] When purchasing put options, since the investor is putting fixed amounts in options each period, regardless of the options price the dollar amount spent each period will be the same. The tradeoff here is the farther the investor's put options are out of the money, the lower the option premium, and the more options the investor can purchase thus increasing their potential payoff. However, the farther out of the money the investor's put options are the lower the probability that they will end up in the money.

To determine where the optimal exercise price is for the put options, in Table 1, the historical quarterly return performance of the S&P 500 for the period March 17, 1950 until

Table 1 Historical three month return performance S&P 500 (March 17, 1950–June 15, 1990)

	Percentage of total	Average return	Standard deviation	Median return	Minimum return	Maximum return
Panel A						
Overall (161 returns)	100.00%	2.17%	7.26%	2.08%	−21.22%	24.63%
Panel B						
Negative Periods (57 returns)	35.40%	−5.34%	4.86%	−3.86%	−21.22%	−0.01%
Returns		<−10%	<−5%		<−2%	
Percent of overall returns		4.97%	13.04%		26.09%	
Percent of negative returns		14.04%	36.84%		73.68%	
Panel C						
Positive periods (104 returns)	64.60%	6.28%	4.58%	6.14%	0.089%	24.63%
Returns		>15%	>13%		>10%	>8%
Percent of overall returns		1.88%	4.97%		13.04%	21.11%
Percent of positive returns		2.89%	7.69%		20.19%	32.69%

Notes: S&P 500 returns are three month returns (not annualized).

June 15, 1990 is examined. This period is chosen since it is before the option data test period, eliminating issues related to data mining. The quarterly return cycles (March, June, September, and December) are the same as in the test period data. Given this strategy buys put options, investors are concerned with the number of negative periods. Table 1, Panel B, shows that overall 35.40% of the quarterly returns are negative. Given these historical quarterly returns, clearly the investor would want put options close to the exercise price. If the investor chooses out of the money put options, say for example 5%, the investor would have to take a 5% hit in the quarter before the put options kick in. Table 1 Panel B shows the quarterly returns are less than −5% only 13.04% of the time and less than −10% only 4.97% of the time. Clearly this would not be a successful strategy, the cost of the options would be greater than the potential option payoff. If the investor chooses deep in the money put options, they would be paying a lot for these options. If the market increases the investor loses the premiums. Given that the market increases about two-thirds of the time, again it is unlikely this would be a successful strategy. Therefore for the put option insurance portfolios the closest to the current stock market index value, in the money options are chosen.[9]

Call option insurance portfolios are created by writing index call options worth 1% and 3% of a stock index portfolio and investing the proceeds back into the stock market index (covered calls are also examined). When writing index call options, it is not clear how far out of money you should write your options. The farthest out of the money option has a lower probability of being called but the premium is much smaller. Furthermore, when the investor is writing fixed dollar amounts of options (1% and 3% cases), any time the premium is low the investor's potential option exposure is higher because they will write more options. A significant market upturn may result in a writer of options having to payout a significant portion of their portfolio to the purchasers of the calls.

To determine how far out of the money to write the options, again the historical quarterly return performance of the S&P 500 in Table 1 is examined. Given this strategy writes options, investors are concerned with the number of positive periods. Table 1, Panel C, shows that overall 64.60% of the quarterly returns are positive. Writing call options with exercise prices 13% higher than the market price would have ended up in the money less than 5% of the time. Therefore, we feel that the potential tradeoff between size of premium and potential option exposure is maximized if the exercise price of the call options written is as close as possible to 13% greater than the current index value.

The number of options used in all strategies will be rounded to whole numbers (round up at 0.5 unless otherwise specified). Additional restrictions are placed on the amount of options used. First, all options will be limited to a maximum of 0.5% of the open interest to limit the affect investors trading will have on the premium. Second a minimum of at least one option must be used in each period (puts and calls). Thirdly, when the call option strategy used in this study assumes that the investor is writing call options for only a portion of the stock component held, the investor wants to limit the risk exposure to the remainder of their retirement portfolio. Equating what is made on the call option insurance portfolio to what is paid out if it ends up in the money is:

$$n_tS_0(1 + r_s) + n_cMP_{c0}(1 + r_S) = n_cM[S_0(1 + r_s) - X_c] \tag{4}$$

solving for r_s:

$$r_s = \frac{n_cM[S_0 - X_c - P_{c0}] - n_tS_0}{n_tS_0 + n_cMP_{c0} - n_cMN_0} \tag{5}$$

Eq. (5) gives the future return were the call option insurance portfolio is wiped out. Examination of Table 1 indicates that in the period before our test period the largest positive three month return is 24.63%. To limit risk to the remainder of the investor's portfolio the number of options written are restricted such that Eq. (5) is as close as possible, but not lower than 75%.

Because the investor is writing calls on a stock index, which settles in cash, there is no feasible way to explicitly write a covered call. If the investor uses a buy/write strategy it can easily be determined the dollar amount of a stock index mutual fund to hold to be in essence completely covered. What the investor makes on the call option portfolio is:

$$n_tS_0(1 + r_s) + n_cMP_{c0}(1 + r_S) \tag{6}$$

Rearranging:

$$(n_tS_0 + n_cMP_{c0})(1 + r_S) \tag{7}$$

The potential payout by the investor for any in the money r_s is:

$$n_cM[S_0(1 + r_s) - X_c] \tag{8}$$

Rearranging:

$$n_cMS_0(1 + r_s) - n_cMX_c \tag{9}$$

In all intensive purposes this portfolio would be covered if:

$$(n_tS_0 + n_cMP_{c0})(1 + r_S) \geq n_cMS_0(1 + r_s) - n_cMX_c \tag{10}$$

for any in the money r_s.

Rearranging:

$$(n_tS_0 + n_cMP_{c0})(1 + r_S) + n_cMX_c \geq n_cMS_0(1 + r_s) \quad (11)$$

If $(n_tS_0 + n_cMP_{c0}) \geq n_cMS_0$ Eq. (11) will be true for all positive values of r_s and therefore the call option insurance portfolio is in essence completely covered.

The performance of these insurance portfolios will be compared with portfolios comprised of the same stock index used in the insurance portfolio and a bond portfolio (asset allocation portfolios). Seven different asset allocations will be examined: 80/20, 70/30, 60/40, 50/50, 40/60, 30/70, and 20/80 stocks/bonds. The asset allocation portfolios are rebalanced each period.[10] The options will not be exercised early, at maturity they will expire worthless or be exercised. It is assumed that the investor has $100,000 to invest in an insurance portfolio and no additional amounts will be added. The stock index used in this study is the S&P 500. These options are European in exercise style with a multiplier of 100. The S&P 500 option data set, used in this study, runs from June 15, 1990 through December 17, 2010.

In each period, beginning June 15, 1990, the closest to 13% out of the money call option, along with the slightly in the money put option on the S&P 500 index are chosen. These options have to have traded that day so there is a premium price available and have enough open interest to meet our restriction of being a price taker. The closing option price that day is used to match the option data up with the closing prices of the stocks and bond index values taken from Yahoo finance. All options will have the same expiration date. On the Friday before the expiration date of this first set of options, September 20, 1990, again the closest to 13% out of the money call options, along with the slightly in the money put options on the S&P 500 index are chosen. This process is followed, with the last option recorded on December 17, 2010. The time to maturity on these options when purchased is three months, giving us 82 periods. The index option data are obtained from the Chicago Board Options Exchange data website (Market Data express).

Vanguard's Total Bond Market Index Fund (VBMFX) is used to calculate the returns on the bond portfolio. It was chosen since it was the only bond index that the authors where able to obtain data that would match up with the early option data. Vanguard's Total Bond Market Index Fund utilizes a passive management investment approach designed to track the performance of the Barclays Capital U.S. Aggregate Float Adjusted Index. The Bond index return data are obtained from the Yahoo finance Web site.

4. Results

Table 2 provides summary statistics on the actual option strike prices used in the portfolio insurance strategies. The put option insurance portfolio uses the closest to the market price slightly in the money options. The mean and median in the money levels of the put options used are 0.66% and 0.49%, respectively, with a standard deviation of 0.79%. The call option insurance portfolio writes options that are as close as possible to 13% greater than the market value of the index at the time of purchase. For the overall period the mean and median out of the money levels of the call options were 11.21% and 11.86%, respectively. The minimum value was only 1.98% and the standard deviation is 2.63%. Early on in this sample, far out

Table 2 Summary statistics of options employed in insurance portfolios

	Mean	Minimum	Maximum	Median	Standard deviation
SIM puts (in the money levels)	0.66%	0.02%	6.40%	0.49%	0.79%
Far calls (in the money levels)	11.21%	1.98%	15.19%	11.86%	2.63%
Far calls First half data (in the money levels)	9.58%	1.98%	14.79%	9.41%	3.16%
Far calls Second half data (in the money levels)	12.19%	8.61%	15.19%	12.56%	1.63%

Notes: SIM puts are slightly in the money options put options. Far Calls are options written where the exercise price is as close as possible to 13% greater than the market value at the time.

of the money options are thinly traded and along with other restrictions limits choice. When the call option data are broken into two subsamples you can see that the second period results are much closer to what is desired. The mean and median are now 12.19% and 12.56%, respectively, out of the money, the minimum is now 8.61% and standard deviation is reduced to 1.63%. The lack of liquidity in the far out of the money call option market in the early periods results in the call option insurance portfolio using options that are less out of the money than what is considered optimal. When fixed dollar amounts of call options are written in each period, by writing call options closer to the current market price the premium is higher, and therefore, less options are written. These options have a higher probability of being in the money, but given that the options are closer to being in the money when written, the exposure is less because fewer options are written. The call option insurance portfolio returns could be positively biased if there are many instances where the options ended up in the money substantially greater than 13% when the actual options written where much closer to the market price at the time. This never occurs in any early periods, in fact in the first half of the data the written call options end up in the money only three times (call option in the money levels written are 1.98%, 13.54%, and 12.74%. The corresponding quarterly stock returns are 2.02%, 16.10%, and 16.46%). Thus, early illiquidity issues in the market will not substantially affect results.

Table 3 shows the individual portfolios return statistics. The average returns are the average quarterly (three month) returns over the entire 82 period sample. The average returns of the put option insurance portfolios, for all asset allocations, indicate the use of small amounts of options is not a successful strategy. The lowest average (median) quarterly return of the asset allocation portfolios is 1.83% (1.71%) for 20/80 stocks/bonds asset allocation portfolio. These values are greater than the average (median) returns for the 3% put option insurance portfolio 1.28% (0.38%). The 1% put option insurance portfolio has an average (median) quarterly return of 1.91% (1.90%). These returns are greater than the asset allocation portfolios only when the asset allocation significantly favors bonds (30/70 and 20/80 stocks/bonds). Given that decreasing put options increases the returns, it is the increase in upside potential that results in any put option insurance portfolio superior performance and

Table 3 Portfolio's summary quarterly return statistics (June 15, 1990–December 17, 2010)

	Average return	Standard deviation	Return minimum	Return maximum	Return median	Percent positive
All stock	2.38%	8.36%	−28.75%	20.64%	3.08%	71.95
Asset allocation portfolios						
80/20 stocks/bonds	2.25%	6.67%	−22.30%	16.72%	2.73%	73.17
70/30 stocks/bonds	2.18%	5.82%	−19.07%	14.76%	2.56%	76.83
60/40 stocks/bonds	2.11%	5.00%	−15.85%	12.81%	2.30%	76.83
50/50 stocks/bonds	2.04%	4.20%	−12.63%	10.85%	2.02%	76.83
40/60 stocks/bonds	1.97%	3.44%	−9.40%	9.09%	2.05%	76.83
30/70 stocks/bonds	1.90%	2.75%	−6.17%	7.84%	1.98%	79.27
20/80 stocks/bonds	1.83%	2.19%	−2.95%	6.70%	1.71%	81.71
Put options insurance portfolios						
3%	1.28%	5.36%	−13.21%	16.05%	0.38%	52.44
1%	1.91%	6.58%	−19.58%	17.68%	1.90%	62.20
Far call options insurance portfolios						
3%	2.90%	7.79%	−27.47%	17.69%	3.84%	76.83
1%	2.78%	8.00%	−27.99%	19.67%	3.50%	76.83
Covered	2.56%	8.07%	−28.35%	18.37%	3.51%	75.61

Notes: Portfolio returns are three month returns (not annualized). 80/20, 70/30, 60/40, 50/50, 40/60, 30/70, and 80/20 stocks/bonds: Allocation of stocks and bonds in the asset allocation portfolio, 3% and 1% is the option %: percentage of index put options in the insurance portfolio (the remainder is invested in the S&P 500) or percentage of index call options written in the insurance portfolio (the remainder and the proceeds from the written calls are invested in the S&P 500), Covered: covered call option insurance portfolio, Average return difference: The return of the insurance portfolio—the return of the asset allocation portfolio is calculated on the expiration date of each set of options. The average of these values is the average position. Standard deviation: is the standard of the average return difference. Return minimum: is the smallest value of all option periods (the return of the insurance portfolio—the return of the asset allocation portfolio). Return maximum: is the largest value of all option periods (the return of the insurance portfolio—the return of the asset allocation portfolio) percent positive: is percentage of periods where the return of the insurance portfolio > the return of the asset allocation portfolio.

not the options payoff. On the whole, the put option insurance portfolio return results indicate that overall, the cost of the insurance dominates the options payoff.

The average and median quarterly returns, for all the call option insurance portfolios, are all much larger than the asset allocation portfolios.[11] The quarterly average (median) returns for the 3%, 1%, and covered call option insurance portfolios are 2.90% (3.84%), 2.78% (3.50%), and 2.56% (3.51%), respectively. These results indicate that return from the reinvested premiums far outweigh the potential cost of writing these options. These options rarely end up in the money. In the 82 periods these far out of the money calls end up in the money only six times (7.32%). Even in the periods when the call options ended up in the money, the dollar value of the call option insurance portfolio increased. Thus, the restriction on writing 1% and 3% calls such that the investor must be able to withstand a positive return of 75% in a quarter is successful as it protected the remainder of the investor's retirement portfolio.

Examination of the quarterly returns in Table 3 clearly show support for the call option insurance portfolios compared with all asset allocations. Superior return performance is not the only characteristic of importance. As discussed earlier the most important reason to shift asset allocation towards bonds is to reduce risk. Therefore, risk characteristics of the asset allocation portfolios and the insurance portfolio must be examined.[12]

To initially examine the risk characteristics of the asset allocation and insurance portfolios, the standard deviations of the quarterly returns are provided in Table 3 along with the percentages of positive return periods, the minimum and the maximum quarterly returns. Overall these results indicate that the asset allocation portfolios are superior in terms of risk reduction. The asset allocation portfolios all have lower standard deviations and minimum returns, than the call option insurance portfolios. Only the 80/20 and 70/30 stock/bond asset allocation have higher standard deviations and minimums than any of the put option insurance portfolios. The 80/20 stock/bond asset allocations standard deviation and minimum (6.67% and −22.30%) is higher than both the 3% and 1% put option insurance portfolios whereas the 70/30 stock/bond asset allocations standard deviation and minimum (5.82% and −19.07%) is higher than the 3% put option insurance portfolio. Overall, the percentage of positive quarterly returns are about the same for the call option insurance portfolios versus the asset allocation portfolios. The put option insurance portfolios percentage of positive returns are below that of the asset allocation portfolios.

Looking at the return distributions of the various portfolios in isolation does not give the investor an accurate assessment of the risk profiles. These distributions are not independent of each other because of composition of the portfolios and economic forces. Both the asset allocation portfolios and the insurance portfolios contain some percentage of the stock market index. This will result in some positive correlation regardless of the correlation between stocks and bonds over the test period. Because of the lack of independent data a better way to assess the riskiness of the insurance portfolios is to examine the distribution of the quarterly return differences. For example, assume an insurance portfolio has a higher standard deviation, in isolation, than an asset allocation portfolio but the return difference is positive 100% of the time. Clearly an argument could be made that this insurance portfolio dominates the asset allocation portfolio and is not riskier. Therefore, by examining the distributions of return differences, this information will provide additional usable information about the return and risk of these strategies.

Tables 4 and 5 show the averages and standard deviations of the distributions of the quarterly returns of the insurance portfolios minus the quarterly returns of the asset allocation portfolios. Also shown are the percentages of positive return difference periods along with the minimum, maximum, and median return difference. Examining the skewness and kurtosis (not shown) indicates non-normality in all cases; the values are not near zero or three, respectively. A formal test is used to test for normality and the Bowman-Shelton test, in Tables 4 and 5, rejects normality for all distributions at the 1% level of significance. Therefore it is inappropriate to use a paired t test to determine significant positive or negative distributions since this test is much too vulnerable to deviations from the normal distribution. The distribution examined here is the difference of two paired groups. The pairs being each quarterly return of the asset allocation portfolio and the insurance portfolios. The Wilcoxon signed ranks test is a nonparametric analog of the paired samples t test and is therefore appropriate for our analysis.[13] Given our sample size is greater than 50 the normal approximation of the Wilcoxon signed rank test is used. The null hypothesis is that the quarterly return populations are identical. The alternative hypothesis is that the insurance portfolio

Table 4 Quarterly return differences statistics put insurance portfolios vs. asset allocation portfolios (June 15, 1990–December 17, 2010)

Put options insurance portfolios	Average return difference	Standard deviation	Return difference minimum	Return difference maximum	Return difference median	Difference percent positive	Bowman Shelton test	Wilcoxon sign rank test
80/20 stocks/bonds								
3%	−0.97%	2.85%	−3.84%	10.78%	−1.92%	19.51	130.38*	−4.67
1%	−0.39%	0.94%	−1.89%	2.72%	−0.42%	30.49	25.55*	−3.44
70/30 stocks/bonds								
3%	−0.90%	2.43%	−3.93%	9.40%	−1.67%	26.83	79.86*	−4.58
1%	−0.27%	1.21%	−2.18%	2.91%	−0.37%	37.80	35.73*	−2.40
60/40 stocks/bonds								
3%	−0.83%	2.29%	−4.35%	8.01%	−1.41%	26.83	28.75*	−3.81
1%	−0.20%	1.90%	−3.73%	4.87%	−0.31%	43.90	34.29*	−1.38
50/50 stocks/bonds								
3%	−0.76%	2.48%	−4.77%	6.63%	−1.31%	26.83	34.72*	−3.21
1%	−0.13%	2.70%	−6.95%	6.83%	−0.36%	47.56	26.51*	−0.72
40/60 stocks/bonds								
3%	−0.69%	2.93%	−5.19%	7.16%	−1.19%	32.93	37.12*	−2.61
1%	−0.06%	3.53%	−10.18%	8.79%	−0.27%	47.56	20.53*	−0.25
30/70 stocks/bonds								
3%	−0.63%	3.54%	−7.04%	9.12%	−1.05%	40.24	30.44*	−2.11
1%	0.00%	4.39%	−13.40%	10.75%	−0.20%	47.56	16.89*	0.07
20/80 stocks/bonds								
3%	−0.56%	4.25%	−10.27%	11.08%	−0.82%	39.02	23.56*	−1.68
1%	0.07%	5.25%	−16.63%	12.70%	−0.08%	47.56	14.74*	0.22

*Significant at the 1% level. Portfolio returns are three month returns (not annualized). 80/20, 70/30, 60/40, 50/50, 40/60, 30/70, and 80/20 stocks/bonds: Allocation of stocks and bonds in the asset allocation portfolio, 3% and 1% is the option %: percentage of index put options in the insurance portfolio (the remainder is invested in the S&P 500), Average return difference: The return of the insurance portfolio—the return of the asset allocation portfolio is calculated on the expiration date of each set of options. The average of these values is the average position. Standard deviation: is the standard of the average return difference. Return difference minimum: is the smallest value of all option periods (the return of the insurance portfolio—the return of the asset allocation portfolio). Return difference maximum: is the largest value of all option periods (the return of the insurance portfolio—the return of the asset allocation portfolio) percent positive: is percentage of periods where the return of the insurance portfolio > the return of the asset allocation portfolio.

Table 5 Quarterly return differences statistics call insurance portfolios vs. asset allocation portfolios (June 5, 1990–December 17, 2010)

Far call options insurance portfolios	Average return difference	Standard deviation	Return difference minimum	Return difference maximum	Return difference median	Difference percent positive	Bowman Shelton test	Wilcoxon sign rank test
80/20 stocks/bonds								
3%	0.65%	1.73%	−5.18%	4.07%	0.77%	70.73	20.62*	3.58*
1%	0.53%	1.59%	−5.78%	3.17%	0.72%	73.17	23.65*	3.56*
Covered	0.31%	1.57%	−6.05%	2.52%	0.63%	69.51	33.58*	3.10*
70/30 stocks/bonds								
3%	0.71%	2.38%	−8.39%	4.61%	1.02%	71.95	19.91*	3.43*
1%	0.60%	2.39%	−8.92%	4.91%	1.00%	73.17	24.38*	3.24*
Covered	0.38%	2.40%	−9.28%	3.73%	0.91%	67.07	29.41*	2.65*
60/40 stocks/bonds								
3%	0.79%	3.15%	−11.63%	5.40%	1.32%	73.17	25.69*	3.23*
1%	0.67%	3.23%	−12.15%	6.87%	1.29%	71.95	23.86*	3.01*
Covered	0.45%	3.26%	−12.50%	5.50%	1.13%	65.85	25.75*	2.48*
50/50 stocks/bonds								
3%	0.84%	3.94%	−14.84%	6.80%	1.64%	71.95	28.03*	3.05*
1%	0.74%	4.08%	−15.37%	8.83%	1.60%	68.29	22.51*	2.85*
Covered	0.52%	4.13%	−15.73%	7.52%	1.30%	64.63	23.34*	2.34*
40/60 stocks/bonds								
3%	0.91%	4.77%	−18.06%	8.76%	1.92%	71.95	27.71*	2.89*
1%	0.80%	4.95%	−18.60%	10.78%	1.86%	68.29	21.44*	2.70*
Covered	0.58%	5.00%	−18.95%	9.48%	1.46%	64.63	21.71*	2.28*
30/70 stocks/bonds								
3%	0.98%	5.62%	−21.29%	10.72%	2.15%	68.29	26.70*	2.75*
1%	0.87%	5.81%	−21.82%	12.74%	2.10%	65.85	20.56*	2.56*
Covered	0.65%	5.87%	−22.18%	11.44%	1.62%	64.63	20.55*	2.21*
20/80 stocks/bonds								
3%	1.05%	6.47%	−24.51%	12.68%	2.44%	67.07	25.70*	2.63*
1%	0.94%	6.68%	−25.05%	14.70%	2.27%	64.63	19.83*	2.47*
Covered	0.72%	6.74%	−25.40%	13.39%	1.77%	63.41	19.68*	2.17*

*Significant at the 1% level. Portfolio returns are three month returns (not annualized). 80/20, 70/30, 60/40/,50/50, 40/60, 30/70, and 80/20 Stocks/Bonds: Allocation of stocks and bonds in the asset allocation portfolio, 3% and 1% is the option %: percentage of index call options written in the insurance portfolio (the remainder and the proceeds from the written calls are invested in the S&P 500), Covered: covered call option insurance portfolios, Average return difference: The return of the insurance portfolio—the return of the asset allocation portfolio is calculated on the expiration date of each set of options. The average of these values is the average position. Standard deviation: is the standard of the average return difference. Return difference minimum: is the smallest value of all option periods (the return of the insurance portfolio—the return of the asset allocation portfolio). Return difference maximum: is the largest value of all option periods (the return of the insurance portfolio—the return of the asset allocation portfolio) percent positive: is percentage of periods where the return of the insurance portfolio > the return of the asset allocation portfolio.

return population is greater than the asset allocation return population, making the test a one tailed test.

The results of the Wilcoxon tests are shown in Tables 4 and 5. In no case are the Wilcoxon test statistics comparing the 3% and 1% put option insurance portfolios versus the asset allocation portfolios significantly positive regardless of asset allocation. This indicates that the returns on the put option insurance portfolio are not significantly greater than the returns on the asset allocation portfolios.

The Wilcoxon test statistics comparing the call option insurance portfolios (Table 5) are significantly positive in all cases, at the 1% level of significance. The positive significance increases as the percentage of options increases and as the asset allocation shifts to more stocks. The Wilcoxon signed rank test indicates that the returns on the call options insurance portfolios are significantly larger than the asset allocation portfolios.

Further examination of Table 4 indicates that the higher the percentage of put options in the put option insurance portfolio, the greater the difference between the cost of the put options and options payoff plus additional upside potential realized. This results in a lower probability of the put option insurance portfolio return being greater than the asset allocation portfolio return in any given period. For a given asset allocation the more put options in the portfolio the lower the average and median return. When the asset allocation favors stocks (bonds) increasing the amount of put options in the insurance portfolio increases (lowers) the standard deviation. When the asset allocation favors stocks, as you increase the use of puts in the insurance portfolio both the return difference minimum and to a greater extent the return difference maximum increases. This indicates greater volatility and thus the standard deviation increases. For example, in Table 4, comparing the 60/40 asset allocation portfolio versus the 1% insurance portfolio, the average quarterly return difference is −0.20% with a standard deviation of 1.90%. The insurance portfolio is positive 43.90% of the time, in 36 of the 82 periods is the return of the put option insurance portfolio greater than the return of the asset allocation portfolio. The minimum return is −3.73%, the maximum return is 4.87%, the median is −0.31%. When 3% of the insurance portfolio is invested in put options and compared with the 60/40 asset allocation portfolio, the average return difference is −0.83% with a standard deviation of 2.29%. The put option insurance portfolio is only 26.83% positive; in only 22 of the 82 periods is the return of the put option insurance portfolio greater than the return of the asset allocation portfolio. The minimum return is −4.35%, the maximum return is 8.01%, the median is −1.41%.

When the asset allocation favors bonds, as you increase the use of puts in the insurance portfolio the returns difference maximum deceases and the return difference minimum becomes less negative resulting in a smaller difference between the minimum and maximum position, thus reducing the standard deviation. Based on the overall results in Table 4, asset allocation is superior to the use of fixed amounts of put options.

Table 5 provides support for the call option insurance portfolios versus the asset allocation portfolios. The call option insurance return difference statistics in Table 5 indicate that overall the higher the percentage of call options in the insurance portfolio and the higher the percentage of bonds in the asset allocation portfolio, the greater the quarterly average return and median return difference. For example comparing the 3%, 1%, and covered call option insurance portfolio with the 60/40 (20/80) asset allocation portfolios the average quarterly returns differences are 0.79%, 0.67%, and 0.45% (1.05,%, 0.94%, and 0.72%), the median returns differences are 1.32%, 1.29%, and 1.13% (2.44%, 2.27%, and 1.77%). This indicates that the additional upside potential realized by having an initial larger amount of the stock index in the portfolio and investing the premiums received in the stock index exceeds the cost of writing the options on the index (when they end up in the money).

As expected the standard deviation of the return difference increases as the asset allocation favors bonds. Overall as anticipated as more calls are written, for a given asset allocation, both the minimum return difference decline along with the standard deviation of the quarterly return differences, thus reducing risk. There is one case where the standard deviation increases as the investor writes more calls, the 80/20 stock/bond asset allocation portfolios. Here as the investor writes more calls, from covered to 1% to 3%, the minimum difference still declines slightly from −6.05% to −5.78% to −5.18% but the maximum return increases from 2.52% to 3.17% to 4.07%. It is this return maximum difference that causes the standard deviation to increase. As anticipated, the return difference maximum declines as the asset allocation portfolio's stock component increases, however for a given asset allocation, examination of the 3% versus 1% versus covered no specific pattern is expected. The call option insurance portfolios are in essence all stock portfolios because the proceeds from issuing options are reinvested back in to the stock index. Any patterns that exists is the return difference maximums for a given asset allocation is because of the return series of the bonds and stocks and the effect of the in the money options on the returns of the insurance portfolios.

As the asset allocation increases to favor stocks the % of positive differences increases. When the asset allocation favors stocks (60/40, 70/30, and 80/20 stocks/bonds) the % of positive differences for the 1% and 3% call option insurance portfolios are greater than 70% (65% for covered call). As discussed earlier the distribution of returns differences is another way to look at risk. Given that the mean and median quarterly return differences for the call option insurance portfolios are positive and the quarterly return differences are positive over 70% of the time an argument could be made that the higher return from the call option strategy does not come with significantly more risk when compared with asset allocation portfolios that favor stocks over bonds. Potential upside return difference should be valued by investors and actively pursued. Standard deviation does not account for this when examining the asset allocation and insurance portfolios in isolation (Table 2).

Although the return differences statistics give the investor a better picture of the risk return tradeoff of these strategies, because of its common usage a reward to variability ratio is also examined. The classic Sharpe ratio is used to further examine the risk return tradeoff. Eling (2008) and Eling and Schuhmacher (2007) examine whether mutual funds and hedge funds can be adequately evaluated using the Sharpe ratio, given the nonnormal return distribution of investment funds. They compare the Sharpe ratio with other performance measures and find nearly identical rank ordering.[14] Therefore, the Sharpe ratio should be adequate for our purpose. Table 6 shows the Sharpe Ratio for the seven asset allocations, and the insurance portfolios.[15] The risk free rate used is the three month Treasury bill return. The Treasury bill returns are from the Federal Reserve Bank of Saint Louis's Web site. Quarterly Sharpe ratios are examined. It can be argued that this results in systematic biases in the Sharpe ratio calculation (Levy, 1972) since the typical investors investment horizon is not quarterly.[16] If

Table 6 Quarterly Sharpe ratios (June 15, 1990–December 17, 2010)

Asset allocation portfolios							
Stocks/bonds	80/20	70/30	60/40	50/50	40/60	30/70	20/80
Sharpe ratio	0.2025*	0.2199*	0.2426*	0.2730*	.3145*	0.3708*	0.4373*
t-stat	(1.83)	(1.99)	(2.20)	(2.47)	(2.84)	(3.36)	(3.96)
Insurance portfolios							
	Put options		Call options				
	3%	1%	3%	1%	Covered		
Sharpe Ratio	0.0703	0.1535	0.2570*	0.2348*	0.2055*		
t-stat	(0.64)	(1.39)	(2.33)	(2.13)	(1.86)		
All Stock Portfolio							
Sharpe Ratio	0.1775*						
t-statistic	(1.61)						

*Significant at the 5% level. Sharpe ratio = (mean of a portfolio's shortfall vector/standard deviation of shortfall vector). A portfolios shortfall vector is created by subtracting each three month treasury bill return from each portfolios three month return. Portfolio returns are three month returns (not annualized). 80/20, 70/30, 60/40, 50/50, 40/60, 30/70, and 80/20 stocks/bonds: Allocation of stocks and bonds in the asset allocation portfolio, 3% and 1% is the option %: percentage of index put options in the insurance portfolio (the remainder is invested in the S&P 500) or percentage of index call options written in the insurance portfolio (the remainder and the proceeds from the written calls are invested in the S&P 500), Covered: covered call option insurance portfolio.

the investors investment horizon equals the period used to calculate the Sharpe ratio there is no systematic bias. This study has only 20 years of data. Most investors saving for retirement, have investment horizons that are longer than 20 years; therefore, there would not be enough data points to calculate a Sharpe ratio. Levy's solution to the problem (he develops a multiperiod Sharpe ratio) assumes that returns are independent and identically distributed across time. Given that this assumption is false results in a different error. If returns are not serially correlated one common approach is to take the investments one period return and standard deviation and multiply it by T (investors investment horizon) and the standard deviation of T, respectively (Sharpe, 1994). Even with the assumption of no serial correlation, error is introduced because multiperiod returns and hence the standard deviation of returns should be computed taking compounding into effect.

Given these problems Sharpe (1994) states "to maximize information content, it is usually desirable to measure risks and returns using fairly short (e.g., monthly) periods." The only reason to annualize the Sharpe ratio is to standardize the results, if investments strategies are calculated using different measurement periods. Because the results in this study all have the same measurement period (quarterly) there is no reason to annualize. Multiplying the Sharpe ratio by the square root of the sample size turns the Sharpe ratio into a t statistic and it can be determined if the set of excess returns are positive and statistically significant.

The Sharpe ratio results show no support for the put option insurance portfolios. They are out performed by every asset allocation portfolio. The lowest Sharpe ratio for the asset allocation portfolio is the 80/20 stock/bonds (0.2025) and it is larger than the highest Sharpe ratio for the put options insurance portfolio (1%, 0.1535). The 3% call option portfolio outperforms the asset allocation portfolios when the allocation favors stocks (80/20, 70/30, and 60/40). The 1% call option insurance portfolio outperforms the assets allocation portfolio when the asset allocation strongly favors stocks (80/20, 70/30). Given the difference between the Sharpe ratio of the 60/40 asset allocation portfolio and the Sharpe ratios of the 1% call option portfolios is only 0.0078 (0.2426 − 0.2348) while the return difference from Table 5 is positive over 70% of the time, again an argument could be made in favor of the call option portfolio. The covered call option insurance portfolio only slightly outperforms the 80/20 asset allocation portfolio. The call option insurance portfolios all outperform an all stock portfolio.

5. Conclusion

This study examines if an individual investor can successfully use index options to partially replace fixed income securities in an individual's retirement portfolio, without trying to time the market. Using historical data, (80/20, 70/30, 60/40, 50/50, 40/60, 30/70, and 20/80) stock index/bond index asset allocation portfolios are compared with two types of insurance portfolios. Put option insurance portfolios are created by selling 1% and 3% of a stock index portfolio and using the proceeds to purchase index put options. Call option insurance portfolio are created by writing index option worth 1% and 3% of a stock index portfolio and using the proceeds to purchase more of the stock index (call option insurance portfolios using covered calls are also examined). Examining both historical returns and risk, shifting asset allocation appears to be the better strategy when compared with the put option insurance portfolios. Overall the call option insurance portfolio returns are superior to the asset allocation portfolios. Looking at return differences and the Sharpe ratio, an argument can be made that even on a risk adjusted basis the 1% and 3% call option insurance portfolios are superior to the asset allocation portfolios when the asset allocation favors stocks. This argument cannot be made for the covered call option insurance portfolio.

The analysis conducted for this article is based on historical information and is therefore time dependent.[17] It still provides important information on the ability of the various strategies to reduce downside risk and earn additional return. Although future return distributions are unknown, the available set of index options and premiums are based on expectations at the time and it is reasonable to assume that expectations will be incorporated into the options market in a similar manner as in the past.

Given that the premium received when writing the options drives the findings, future research should examine if picking up the premium more frequently by writing call options with shorter time to maturity, for example monthly or weekly strengthens the results. This approach may not be appropriate for the typical investor as it increases the frequency and attention the investor spends adjusting their retirement portfolio.

Notes

1 Exercise prices are set mechanically by the exchange.

2 Buy/write research using stock market indexes find superior risk adjusted returns

compared with holding just an index (see Feldman & Roy, 2004; Hill & Gregory, 2003; Hill, Balasubramanian, & Tierens, 2006; Kapadia & Szado, 2007; Whaley, 2002).

3 Collar strategies where the proceeds from options written are used to purchase the puts are not examined because of the options exercise prices used in this study (discussed later in the article). Given the cases where fixed amounts are being invested in options, using far out of the money calls and slightly in the money puts would result in many more calls being written than puts purchased. Thus, the collar strategy returns to be very similar to just writing the call options.

4 Although two of the more recent study Bollen and Busse (2001), and Jiang, Yao, and Yu (2007) show that mutual funds may possess more timing ability that previously thought, Friesen and Sapp (2007) find that the magnitude of investor underperformance because of poor timing largely offsets any risk-adjusted alpha gains offered by good performing funds.

5 In reality an individual does not hold the stock index but invests the amount n_tS_0 in a mutual fund that tracks the stock market index.

6 Index options differ from individual equity options in one important way, index options can only be settled in cash since it would be costly to duplicate. Therefore, instead of each contract demanding a number of shares to be transferred, index put options have a multiplier.

7 Although the choice of options maturity is arbitrary to some degree, this study examines if individual investors can use options to partially replace the fixed income component of their retirement portfolio. Using shorter duration options is feasible but increases the trading frequency and attention the investor spends on their retirement portfolio. We feel that quarterly adjustments are reasonable. Longer duration options are not examined because some of the option strategies would not benefit by increasing option maturity. For example writing call options potentially reduces risk from receiving the premium. With longer term options premiums are received less often.

8 Larger percentages are not examined because of restrictions, discussed later, placed on amount of options used dominate such that higher percentages of options (i.e. 5%) do not result in more options used.

9 Using slightly out of the money put options did not improve results.

10 Rebalancing costs, option trading costs and all other commissions are ignored in this study.

11 These returns are also larger than an all stock index portfolio.

12 In the appendix we provide examples of the performance of each portfolio for a quarter when stocks did well and when stocks did poorly.

13 The Wilcoxon test is preferred over the sign test since it takes into account not only the signs but also the magnitudes of the differences between the matched pairs.

14 Eling and Schuhmacher (2007) examine measuring performance in additional ways: on the basis of lower partial moments, on the basis of drawdown and on the basis of value at risk.

15 We are unable to use an information ratio with the benchmark being the S&P 500. The asset allocation portfolios (80/20, 70/30, 60/40, 50/50, 40/60, 30/70, and 20/80

stock/bonds) are linear combinations of each other. When this is the case the arithmetic average of the excess returns changes in the exact same proportion as the standard deviation of the excess returns (or tracking error) thus keep the information ratio constant. If you use regression to calculate the information ratio, you get the same constant result for the asset allocation portfolios.

16 The options strategies employed in the insurance portfolios are adjusted every quarter because the options expire at that time. Therefore, although the investor's time horizon is long it could be argued that their investment horizon is short.

17 Similar results are found when the analysis is repeated with the data ending in 2006.

References

Asness, C. (1996). Why not 100% equities. *Journal of Portfolio Management, Winter*, 29–34.

Blake, D., Hood, G., & Timmermann, A. (1999). Asset allocation dynamics and pension fund performance. *Journal of Business*, *72*, 429–461.

Bollen, N., & Busse, J. (2001). On the timing ability of mutual fund managers. *Journal of Finance*, *56*, 1075–1094.

Brennan, M., & Xia, Y. (2002). Dynamic asset allocation under inflation. *Journal of Finance*, *57*, 1201–1237.

Brinson, G., Hood, R., & Beebower, G. (1986). Determinants of portfolio performance. *Financial Analysts Journal, July–August*, 39–44.

Cambell, J., & Viceira, L. (2002). *Stategic Asset Allocation: Portfolio Choice for the Long-Term Investor*. Oxford University Press: U.S.A.

Cambell, J., Lewis Chan, Y., & Viceira, L. (2003). A multivariate model of strategic asset allocation. *Journal of Financial Economics*, *67*, 41–80.

Chai, J., Horneff, W., Maurer, R., & Mitchell, O. (2011). Optimal Portfolio Choice over the Life Cycle with Flexible Work. Endogenous Retirement, and Lifetime Payouts. *Review of Finance*, *15*, 875–907.

Cuthbertson, K., Nitzsche, D., & O'Sullivan, N. (2010). The market timing ability of UK Mutual Funds. *Journal of Business Finance & Accounting*, *37*, 270–289.

Daniel, K., Grinblatt, M., Titman, S., & Wermers, R. (1997). Measuring mutual fund performance with characteristic-based benchmarks. *Journal of Finance*, *52*, 1035–1058.

Dellva, W., DeMaskey, A., & Smith, C. (2001). Selectivity and market timing performance of Fidelity sector mutual funds. *The Financial Review*, *36*, 39–53.

Eling, M. (2008). Does the measure matter in the mutual fund industry. *Financial Analysts Journal*, *64*, 54–66.

Eling, M., & Schuhmacher, F. (2007). Does the choice of performance measure influence the evaluation of hedge funds. *Journal of Banking and Finance*, *31*, 2632–2647.

Feldman, B., & Roy, D. (2004). Passive options-based investment strategies: The case of the CBOE S&P 500 buy write index. *ETF and Indexing*, *38*, 72–89.

Fortune, P. (1993). Stock market crashes: What have we learned from October 1987. *New England Economic Review, March/April*, 3–24.

Fortune, P. (1995). Stocks, bonds, options, futures, and portfolio insurance: A rose by any other name. *New England Economic Review, July/August*, 25–46.

Friesen, G., & Sapp, T. (2007). An empirical examination of fund investor timing ability. *Journal of Banking and Finance*, *31*, 2796–2816.

Goetzmann, W., Ingersoll, J., & Ivkovic, Z. (2000). Monthly measures of daily timers. *Journal of Financial and Quantitative Analysis, September*, 257–290.

Gomes, F., & Michaelides, A. (2005). Optimal life-cycle asset allocation: understanding the empirical evidence. *The Journal of Finance*, *60*, 869–904.

Graham, J., & Harvey, C. (1997). Grading the performance of market-timing news letters. *Financial Analysts Journal*, *53*, 393–416.

Hill, J., Balasubramanian, V., & Tierens, I. (2006). Finding alpha via covered index writing. *Financial Analysts Journal*, *62*, 29–46.

Hill, J., & Gregory, C. K. B. (2003). *Covered Call Strategies on S&P 500 Index Funds: Potential Alpha and Properties of Risk-Adjusted Returns*. Goldman Sachs: U.S.A.

Ibbotson, R., Milevsky, M., Chen, P., & Zhu, K. (2007). *Lifetime Financial Advice: Human Capital, Asset Allocation, and Insurance*. The Research Foundation of the CFA Institute: Charlottesville, VA.

Jiang, G., Yao, T., & Yu, T. (2007). Do mutual funds time the market? Evidence from portfolio holdings. *Journal of Financial Economics*, *86*, 724–758.

Kapadia, N., & Szado, E. (2007). The risk and return characteristics of the buy-write strategy on the Russell 2000 Index. *Journal of Alternative Investments*, *9*, 39–56.

Leibowitz, M., & Kogelman, S. (1991). Asset allocation under shortfall constraints. *Journal of Portfolio Management*, *Winter*, 18–23.

Leland, H. (1980). Who should buy portfolio insurance? *Journal of Finance*, *35*, 581–594.

Levy, H. (1972). Portfolio performance and investment horizon. *Management Science*, *18*, 645–653.

Pfau, W. (2010). Lifecycle funds and wealth accumulation for retirement: Evidence for a more conservative asset allocation as retirement approaches. *Financial Services Review*, *19*, 59–74.

Pozen, R. C. (1978). When to purchase protective puts. *Financial Analysts Journal*, *34*, 47–60.

Samuelson, P. (1994). The long-term case for equities. *The Journal of Portfolio Management*, *Fall*, 15–24.

Sharpe, W. (1994). Sharpe ratio. *The Journal of Portfolio Management*, *Fall*, 74–82.

Siegel, J. (1994). *Stocks for the Long Run*. Irwin Professional Publishing, U.S.A.

Stivers, C., Sun, L., & Connolly, R. (2002). *Stock Implied Volatility, Stock Turnover, and the Stock-Bond Return Relation*. Federal Reserve Bank of Atlanta, Working Paper 2002-3a.

Tian, Y. (1996). A reexamination of portfolio insurance: The use of index put options. *The Journal of Futures Market*, *12*, 163–188.

Van Hemert, O. (2010). Household interest rate risk management. *Real Estate Economics*, *38*, 467–505.

Whaley, R. (2002). Return and risk of CBOE buy write monthly index. *Journal of Derivatives*, *10*, 35–42.

Appendix

We provide examples of how the strategies performed for two specific quarters, the fourth quarter of 1998, when stocks did well, and the fourth quarter of 2008 when stocks did poorly. The examples demonstrate the amount of the ending values that can be attributed to each component.

1998Q4	Stocks did well					
Stock/bond	Beginning VAT	ns2S0(1+rs)	nbB0(1+rb)	Ending stock %	Ending VAT	Return
80/20	312,710.00	292495.7811	63223.67879	82.2	355,719.46	13.75%
70/30	297,489.31	243476.6432	90219.58244	73.0	333,696.23	12.17%
60/40	282,695.15	198316.1729	114310.5889	63.4	312,626.76	10.59%
50/50	268,337.69	156870.1963	135631.2709	53.6	292,501.47	9.01%
40/60	254,425.08	118989.1664	154318.9859	43.5	273,308.15	7.42%
30/70	240,963.55	84519.95459	170513.0412	33.1	255,033.00	5.84%
20/80	227,957.51	53305.8499	184353.8023	22.4	237,659.65	4.26%
	Beginning VPIT	ntS0(1+rs)	npMPp0(1+rs)	npMmax[Xp−S0(1+rs),0]	Ending VPIT	Return
3%	191,698.48	224133.1577	7599.8	0	216,533.36	12.96%
1%	274,778.60	321270.5703	7599.8	0	313,670.77	14.16%
	Beginning VCIT	ntS0(1+rs)	ncMPc0(1+rs)	ncMmax[S0(1+rs)−Xc,o]	Ending VCIT	Return
3%	408,134.42	477190.6514	13562.72	30397.4512	460,355.92	12.79%
1%	384,569.13	449638.2065	5086.02	11399.0442	443,325.18	15.28%
Covered	365,870.61	427775.7068	5086.02	11399.0442	421,462.68	15.20%

20084Q	Stock did poorly					
Stock/Bond	Beginning VAT	ns2S0(1+rs)	nbB0(1+rb)	Ending stock %	Ending VAT	Return
80/20	475,224.14	270877.7612	98371.42192	73.4	369,249.18	−22.30%
70/30	462,206.14	230525.5269	143515.0406	61.6	374,040.57	−19.07%
60/40	447,544.43	191325.2488	185283.3746	50.8	376,608.62	−15.85%
50/50	431,446.99	153703.3157	223273.7784	40.8	376,977.09	−12.63%
40/60	414,127.46	118026.4376	257173.1886	31.5	375,199.63	−9.40%
30/70	395,801.47	84602.43098	286758.1232	22.8	371,360.55	−6.17%
20/80	376,683.18	53677.07791	311893.6427	14.7	365,570.72	−2.95%
	Beginning VPIT	ntS0(1+rs)	npMPp0(1+rs)	npMmax[Xp−S0(1+rs),0]	Ending VPIT	Return
3%	210,655.31	150091.9682	4488.75	37215.6408	182,818.86	−13.21%
1%	356,832.10	254243.1046	4488.75	37215.6408	286,970.00	−19.58%
	Beginning VCIT	ntS0(1+rs)	ncMPc0(1+rs)	ncMmax[S0(1+rs)−Xc,o]	Ending VCIT	Return
3%	762,923.62	543582.7903	9690	0	553,272.79	−27.47%
1%	685,356.03	488316.374	5130	0	493,446.37	−27.99%
Covered	568,796.95	405267.9454	2280	0	407,547.95	−28.35%

Notes: $V_{PIT} = n_tS_0(1 + r_s) - n_pMP_{p0}(1 + r_s) + n_pM\max[X_p - S_0(1 + r_s),0]$, $V_{CIT} = n_tS_0(1 + r_s) + n_cMP_{c0}(1 + r_S) - n_cM\max[S_0(1 + r_s) - X_c, 0]$, $V_{AT} = ns2S_0(1 + rs) + nbB_0(1 + rb)$. V_{PIT}: value of the put option insurance portfolio, n_t: number of shares of the stock index owned before purchasing any put options, S_0: value of the stock market index at the beginning of the period, r_s: return on the index over the life of the options, n_P: number of index put options purchased, M: multiplier for the index options, P_{p0}: price of the index put options at the beginning of the period, X_p: exercise price of the index put options, $M\max[X_p - S_0(1 + r_s),0]$: value of each put option at expiration, $n_tS_0(1 + r_s)$: value of the stock portfolio with no insurance, $n_pMP_0(1 + r_s)$: cost of the insurance, $n_pM\max[X_p - S_0(1 + r_s),0]$: what you make on the insurance. V_{CIT}: value of the call option insurance portfolio at time T, n_c: number of call options written, P_{c0}: price of the index call options at the beginning of the period, X_c: exercise price of the index call options, $M\max[S_0(1 + r_s) - X_c, 0]$: value of each call option at expiration, $n_tS_0(1 + r_s)$: value of the stock portfolio with no insurance, $n_cMP_{c0}(1 + r_S)$: what you make on the insurance, $n_cM\max[S_0(1 + r_s) - X_c, 0]$: cost of the insurance. V_{AT}: value of the asset allocation portfolio at time T, n_{s2}: number of shares of the index owned, B_0: value of the bond portfolio at time zero, n_b: number of shares of the bond index owned. r_b: return on the bond portfolio over the life of the options.