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2010

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## Recommended Citation

Doyle, Barry; Mefford, Robert; and Tay, Nicholas, "Black Swans and Retirement Strategies: Is “Buy and Hold Best”?" (2010). *Finance*. Paper 1.

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# **BLACK SWANS AND RETIREMENT STRATEGIES: IS “BUY AND HOLD BEST”?**

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## **ABSTRACT**

The recent market crash which has led to as much as a 47% drop in the value of the S&P500 index has made some of us wonder if there is a cost effective way for us to hedge our retirement portfolios against such a drastic loss. Our objective is to investigate empirically the tradeoffs that will arise from using a protective put strategy for hedging retirement portfolios over an investment horizon that is long enough to be comparable to the average holding period for retirement portfolios

Keywords: risk management, VaR, Black Swan event, portfolio design

## **INTRODUCTION**

The recent market crash which has led to as much as a 47% drop in the value of the S&P500 index has made some of us wonder if there is a cost effective way for us to hedge our retirement portfolios against such a drastic loss. In the case of a portfolio that tracks the S&P500 index, a straight forward approach to hedge against such downside risk is to simply long a put (protective put) on the S&P 500 index. Would the losses that could be averted with the protective put strategy justify the hedging costs for a long term investment strategy? From an efficient market view point, if the put option is correctly priced, we should not expect the protective strategy to produce excess returns. However, recent studies [12] [13] have suggested that market participants tend to underestimate the likelihood of black swan events. If this is true, options could be underpriced and this may make it worthwhile to pursue the protective put strategy described above.

Our objective is to investigate empirically the tradeoffs that will arise from using a protective put strategy for hedging retirement portfolios over an investment horizon that is long enough to be comparable to the average holding period for retirement portfolios. Since the modern day option markets were not developed until the 70s, we have a relatively short period of time series of actual option price data. In a later section we describe how further extensions of this work will provide more robust justification for our strategy. Our results favor the use of a protective put strategy for hedging retirement portfolios. Results are presented in Section III.

The conventional wisdom for retirement planning and, indeed, any long-term investment strategy, has been buy and hold for the equity portion of the portfolio. Numerous people in the academic and practitioner fields have advocated this, beginning with Burton Malkiel’s academic classic “A Random Walk down Wall Street”, to the advocacy of Vanguard’s John Bogle, to the recent advice of popular advisors such as Suze Orman. However, the recent drastic plunge in

equity value is making some of us wonder if the buy and hold strategy is in fact the best approach to retirement planning.

Clearly there are good reasons for advocating the buy-and-hold strategy. One well known piece of evidence from the Vanguard Group shows that on average actively managed equity mutual funds underperforms the Wilshire 5000 index by about 1.09% annually for the period from 1972 to 2001. Further, Malkiel [11] and others find the performance of most professional money managers to be inconsistent from one period to the next which suggest that these managers are not skillful investors and therefore it is useless to invest in actively managed mutual funds.

Most of the advocates of buy and hold have made the implicit assumption of “semi-strong” market efficiency; that is, current market prices reflect all available public information. Absent access to inside information, attempts to time the market will ultimately prove fruitless. There is ample empirical evidence in the literature that show that on average active professional money managers are unable to outperform a passive index (see [10], for example) . Fund managers that have superior performance over one time period do not , on average, exhibit superior performance over subsequent time periods

Portfolio theory has generally focused on achieving an efficient portfolio: one that achieves the minimum amount of risk for a given level of expected return. In the popular business press, attacks on the value of portfolio theory often center on comments such as “...Or you could have just bought the gold ETF and made 17%. That’s the difference figuring out which way the wind is blowing can make” [4]. Of course, generating superior returns is easy if one knows how the market will move next month or next year, or even tomorrow.

The value of market timing should not be underestimated, though. In the period from 1978 until 2005 the S&P500 earned a mean annual return of 9.6%. If you could avoid the worst fifty days, your mean annual return would have been 18.7%. Conversely, if you missed the best 50 days, your mean annual return would have been a mere 2.2%. Analyses of other time periods yield similar results; in the period from January 1960 through December 2008, a buy and hold strategy will generate ending wealth of \$15.07 from an initial \$1 investment. However, missing the ten best days over this time period would have reduced your ending wealth to \$8.90. This result emphasizes the danger of attempting to time the market (and “missing”). Conversely, avoiding the ten worst days would generate ending wealth of \$28.25 [6] [8]. From a practical perspective, the question arises: absent market timing skills, can an investor avoid some of the losses associated with the worst performing days without sacrificing the gains associated with the best days? Does one need a crystal ball to achieve superior performance?

In an efficient long-term investment market, the answer to the preceding question should be “no”. In such a market, the cost of any type of portfolio insurance should offset any gains associated with avoiding the impact of the worst performing days. If this condition did not exist, portfolio managers would exploit any existing inefficiencies and drive insurance prices into equilibrium.

However, we show evidence that a strategy exists that will outperform basic buy and hold investing over the long term by taking advantage of potential inefficiencies in the pricing of

S&P 500 index put options. We show that a strategy of consistently “rolling over” a long position in one year put options yielded a long-term return that exceeds the return associated with a simple buy and hold strategy. We further demonstrate that the value of our strategy arises from the existence of “Black Swan” events: rare events that have a large impact on outcomes.

## STRATEGY DESCRIPTION AND MOTIVATION

### Motivation

For our strategy to provide superior performance, consistent long-term mispricing of long put options must exist. Why might one expect to observe systematic mispricing of a widely traded financial instrument? Estimated option prices derived via the Black-Scholes (B-S) model are highly sensitive to volatility; other model inputs are generally known with a fair degree of certainty. Since the model volatility input is forward-looking--- the volatility that will occur over the time to expiration--- it is implicitly unknown. Of course, one may estimate volatility from historical data. Whenever historical data is used to predict future events, though, two major factors influence the reliability of the estimate: first, this process assumes that the future distribution of events will approximate past distributions. Second, one must choose an appropriate historical time period over which to make estimates.

Both of the factors influencing model reliability form the core of our motivation to develop the theory, as well as providing a possible explanation for our observed results. First, the B-S model assumes that volatility has a normal distribution. Several articles [1] [7] have questioned the reliability of underlying distributional assumption of B-S. We observe large price swings, both positive and negative, in the markets than are inconsistent with underlying distributional assumptions of B-S. Research has shown that large daily returns occur more frequently than are consistent with a normal distribution; this return characteristic is often described as being “fat-tailed” relative to the normal. Casual observation, as noted in the introduction, suggests that a substantial portion of returns to the S&P 500 (as well as any well-diversified equity portfolio) are contained in a relatively few number of days, confirming the fat-tailed nature of observed return distributions. We characterize these influential events as “Black Swans” (henceforth “swans”).

The existence of swans by itself should not provide an adequate explanation for the availability of a strategy to generate long term returns in excess of a buy-and-hold strategy. The impact of a few days of unusual returns on long term returns, discussed earlier, is well known. The existence of this apparent opportunity for excess long term returns must have another motivation. The motivation is likely to be found by examining the time horizon over which the strategy operates.

Our strategy requires the annual purchase of put options on the S&P 500. As a consequence, substantial monthly cash outflows are required to follow it. The value comes from the *long-term* application of this strategy. The very nature of it takes advantage of the large gain associated with the swan events against the relatively small outflows required to maintain the position. As swans are, by definition, rare, this implies that returns to this strategy will *underperform* a buy-and-hold for most periods, and *substantially outperform* it on an infrequent basis. As such, following the strategy requires considerable discipline, as it will underperform the benchmark

during most time periods. The implications of this will be explored further in the Results section following.

## **Description**

To implement our strategy, a portfolio consisting of the S&P 500 index is formed. During each year that the portfolio is in existence, we purchase at-the-money put options (or, more precisely, the put option that is closest to at the money); the number of index put options is equal to the value of the portfolio. As the option expires in the following year, new options are purchased in the same fashion, thus generating the “roll-over” strategy.

These “near-the-money” options are used for this strategy to take advantage of the relatively well known characteristic of the put option “smile”. In practice, the implied volatility of put options is lowest for at the money options. Implied volatility is the volatility consistent with the current market price of the option according to the B-S pricing model. Further, at-the-money options are generally more liquid than other options, thus reducing the spread associated with the transaction. These long near-the-money puts provide a form of portfolio insurance; specifically, the option position pays off in the event of a drop in the underlying portfolio. As noted in the Introduction, one would expect, a priori, this strategy to not provide higher ending wealth than a basic buy-and-hold, as the option premiums should offset any gains associated with the insurance payoff.

## **DATA AND RESULTS**

We use data from VFINX (Vanguard Index Trust 500 Index), a tradable index security, as the base equity portfolio. We construct the protective put portfolio by purchasing long positions on 365 day index put options such that there are just enough puts to cover the amount invested in the portfolio at the beginning of the time period. Consequently, the number of puts purchased will rise as the portfolio accumulates value. We also use two treasury investments as a benchmark. In one, we simulate a 1-year constant maturity treasury portfolio that invests/rollovers the entire contribution annually in treasury bonds with one year remaining to maturity. In the other we simulate an investment in one year treasury strips.

We provide results only for the rather simple strategy of buying one year put options on the S&P 500 index for a very pragmatic reason. The intended market for this strategy is not sophisticated investors; rather, this is appropriate for the average investor with a 401-k type retirement asset that wishes to provide some insurance against a dramatic decline in asset values. Certainly, other forms of insurance may well provide better results, and are a potentially fruitful avenue for future research.

The results of our analysis are shown in Figure 1. We have made the following assumptions in constructing the graphs:

- Contribute \$10,000 annually in each of the portfolios from Dec 96 to Dec 2008

- The buy and hold portfolio invests the entire contribution in SP500 index or VFINX
- The protective put portfolio invests the entire contribution in a mixture of SP500 shares and long positions in put in such a manner that there are just enough puts to cover the investment in the SP500 (VFINX) shares that are held in the protective put portfolio; the puts purchased are at-the-money or nearest to the money 365-day puts.
- The 1-year constant maturity treasury portfolio invests/rollovers the entire contribution annually in treasury bonds with one year remaining to maturity
- The 365-day zero coupon portfolio invests the entire contribution in 365-day zero coupon STRIPS.

The results over the specified time period of 1996 to 2008 show that the protective put portfolio is superior to the buy and hold strategy. The results are, of course, specific to this particular time period, but are suggestive of the value of such a strategy in a volatile market.

## **IMPLICATIONS/FUTURE RESEARCH POTENTIAL**

The current results obtain only from late 1996 as index options were not widely available prior to that time. The results presented here, while showing the superiority of the protective put versus a buy and hold strategy, do not provide compelling evidence of such a strategy providing superior performance in future. A more robust argument may be made by estimating option prices in earlier years based upon historical volatility. In effect, one can argue that *if* index options existed in the earlier parts of the twentieth century, then the prices of such options would be consistent with the inputs of current options pricing models, notably B-S. However, such an analysis, while providing more evidence than the restricted sample that we provide, would still not provide a rigorous justification for following this retirement strategy.

A proposed approach to providing a more robust justification is to use a bootstrapping technique to evaluate our proposed strategy. In brief, as applied to this paper, the bootstrapping methodology would assume that observed market returns over the past decades represent samples from a larger underlying population. By analyzing multiple simulations, using samples from the observed returns distribution, one may make robust inferences of the value of the proposed strategy versus a buy and hold one. Chernick, [3], and Davison & Hinkley [5] provide a comprehensive overview of bootstrapping technique.

Our results indicate that the protective put strategy may well be superior to a buy and hold, which begs a rather obvious question: since this strategy, by design, is uncomplicated, why isn't it widely used? A possible explanation lies with the manner in which portfolios are measured. Virtually all portfolios, retirement or not, provide quarter, 1-year, 5-year, and perhaps 10-year performance measures. During "normal" return years, the protective put portfolio will underperform a buy and hold one. The business literature, both academic and popular, is filled with stories about how managers focus on short term performance. Investors look at these returns as well, and often base investment decisions based upon them. A challenge for managers of a portfolio based upon these results would be as follows: how to convince investors that underperformance for substantial periods of time (a likely occurrence) is in their best interests.

## CONCLUSION

We have proposed an alternative equity investment strategy: purchase one year index put options to provide protection against sharp downturns in the market (black swans). Such a portfolio will often underperform a similar buy and hold strategy over many shorter holding periods. We argue that this strategy is particularly well suited for retirement portfolios. This type of portfolio is designed to be held long term, and we have purposely constructed it to be simple and easily replicated by a typical investor with a 401-k type of retirement holding. Results suggest that such a strategy may be superior to a buy and hold strategy.

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