CAMBRIDGE ASSOCIATES LLC

THE BENEFITS OF SELLING VOLATILITY

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Report Contents

The Benefits of Selling Volatility

Over the past several years, we have often discussed the possibility that future investment returns will look quite different (and potentially much weaker) than the average returns realized in the twentieth century, and that investors may be forced to choose between unpleasant options—e.g., cut spending dramatically and potentially underinvest in the institution, or continue to spend at elevated levels and risk permanent impairment of the endowment.[1] Partly for this reason, many investors have begun to seek returns in less traditional areas—for example, scaling back long-only equity exposure (market beta) and using the proceeds to fund investments in vehicles such as hedge funds (alpha and more market-neutral exposure).

With this in mind, we propose investors consider selling volatility. More specifically, investors should take a serious look at the benefits of a fully collateralized option-selling program designed to capture the historical spread between implied volatility (e.g., the VIX) and *realized* volatility (Exhibit 1). Over the past 20 years, a strategy of systematically selling out of the money puts and calls on the S&P 500 Index (a short strangle portfolio) would not only have soundly beaten equity returns with lower volatility, but also offered similar returns to the median hedge fund manager tracked by Cambridge Associates, albeit with slightly higher volatility (Exhibit 2).[2] Such a strategy would also have offered significantly better transparency and liquidity than most hedge funds.

There are, of course, some caveats. To begin with, this strategy may be a nonstarter for those uncomfortable using derivatives-based strategies. Further, while historical returns look terrific, we have yet to see a back-tested strategy that didn't! Finally, despite the similar return stream to hedge funds, investors should *not* consider this a "hedge fund substitute," as the risk/return profiles are quite different. Most notably, upside returns for a volatility-selling strategy are capped, while down-side returns are not—in essence, once markets rise past the strike price of the sold call, the portfolio becomes 100% T-bills, while when markets fall past the strike price of the put, the portfolio becomes 100% equities (Exhibit 3).

Even taking such concerns into consideration, there are underlying reasons to believe the returns realized by a volatility-selling strategy are repeatable, and that such strategies may therefore deserve a place in investor portfolios; however, as with any investment strategy, wide adoption would likely impact prices and depress future returns.

The Rationale

As noted, a volatility-selling strategy looks to capture the historical gap between implied and realized volatility by systematically selling fully collateralized[3] out of the money put *and* call options on a given index, with potential returns accruing both from appreciation of the underlying collateral and premiums from the option sales. Exhibit 4 shows a graphical representation of how such a strategy works. While this could be implemented in any number of ways, we focus on a strategy that is balanced such that the investor sells out-of-the-money puts and calls (discussed in

[1] For more details, please see our 2010 report *The Sober Future of Endowment Spending.*

[2] Results include estimated transaction costs, but not manager fees. However, they also exclude interest earned on cash balances from option sales, which should roughly offset fees.

[3] Puts are collateralized with cash or cash equivalents (e.g., T-bills), and calls with shares in the underlying index (e.g., an S&P 500 ETF).

more detail below), rolled on a monthly basis, with proceeds summed and then halved to keep the strategy in balance.

As shown in Exhibit 1, there has been a persistent historical premium for implied volatility relative to realized volatility. While there is no single accepted theory as to why this is so, the most compelling one may be the simplest. To wit, given that the majority of option buyers are looking to hedge against (or profit from) a specific event, while option sellers are essentially looking for income, sellers are likely to be more price sensitive than buyers. For example, an investor buying index puts to protect against a sharp market drawdown is unlikely to haggle over a few extra cents on the option, since the risk of not buying the option and seeing the market crater would probably outweigh the small additional cost; the option seller, on the other hand, is much more likely to care about extra pennies given the absence of upside potential. Said a slightly different way, the option seller is in effect being compensated for providing insurance to the option buyer. Whatever the reason, the premium has been remarkably persistent over time—since 1990, implied volatility has been higher than subsequently realized volatility in 86.9% of monthly observations, with a mean difference of 4.5 percentage points.

The Logistics

We would encourage investors to not be deterred by the apparent complexity of Exhibit 4; a volatility-selling strategy is actually very straightforward, and once accounts are set up and funded, it requires virtually no administrative input (assuming, as we strongly recommend, that investors use a manager[4] to handle implementation). That said, it is obviously worth understanding the nuts and bolts of the strategy.

The strategy basically consists of selling equally valued amounts of out-of-the-money puts and calls on a monthly basis, with each basket fully collateralized to eliminate the risk of margin calls/uncapped losses. Options are European-style—i.e., only exercisable at the end of the period—and allowed to expire monthly. All settlement is done in cash, with no possibility of shares being "put" to or "called" away from the investor. (Equities are used as call collateral because they will track the movement of the option that has been sold, not because they will be needed to meet intra-month calls.) At the end of each month, the collected premiums and collateral returns for both puts and calls are summed, with half allocated to each strategy for the next month. This is necessary because otherwise the portfolio could become badly out of balance. For example, during an equity bull market, the appreciation of the call collateral would swamp that of the put collateral, thus leading to a portfolio skewed to equity risk.

Our example uses so-called 20-delta options.[5] Delta is a measure of the expected price move in the option relative to the underlying index—20-delta means the option should move about 20 cents for every $1 move in the index. Delta also provides an approximation of the probability the option will end the period in the money (e.g., a 20-delta option has about a 20% probability of closing in the money). Thus, by using a delta-based strategy, an investor sells options that are further out of the money in high-volatility markets and closer to the money when implied volatility is lower.

It is worth noting that our assumptions regarding delta pricing and strategy weights are not set in

[4] Investors with the requisite staff and expertise could, of course, do this in house, but for the majority of investors, it will be far simpler to outsource this function.

[5] From January 1990 through third quarter 2010, 20-delta calls have ranged from 2.0% to 11.7% out-of-the-money, with a median of 4.0%, and puts ranged from 2.0% to 13.4%, with a median of 4.4%.

stone. An investor could, for example, choose to sell closer to the money options (i.e., higher delta), which would net more premium income, but increase the size and frequency of losses (Exhibit 5). Changing the put/call and related collateral weights, meanwhile, would not only allow investors to dial expected returns and volatility up or down (Exhibit 6), but also to more closely match their total portfolio exposures (e.g., an investor with a total portfolio equity beta of 60% might prefer a 60/40 split to better match this exposure rather than a 50/50 split, which would, depending on where the cash was drawn from, potentially de-risk the portfolio). Specified exposures could be handled either through an overlay or a separate account product.

Along similar lines, an obvious question is why investors would choose to implement this type of strategy through a product format, when investors with index (or index-like) exposure could achieve much the same result with an overlay. The simple answer is behavioral—any strategy that requires monthly rolling of options will inevitably tempt investors to make tactical decisions about when and how to roll such options, as opposed to simply letting the program run. While it is, of course, possible that investors would add value through such decisions, to engage in this type of process would in effect undermine the point of the program, which is to maintain a persistent exposure to the volatility gap. As such, a product format makes more sense for *most* investors.

It is also worth noting that we analyzed several different time periods for options (e.g., three-month or one-year options), and found little benefit to using longer-dated options; our preference for one-month options, therefore, is driven mainly by their superior liquidity, although it is also true that by rolling options more frequently, costs—in the form of bid/ask spreads—will be consequently higher.

In sum, while there are many valid approaches to this strategy, the central point is to capture the historical premium of implied versus realized volatility by using a fully collateralized strategy that takes the prospect of uncapped losses off the table. For the remainder of this paper, we focus on the balanced 50/50 portfolio in which puts and calls are rolled monthly.

The Results

As noted, a volatility-selling strategy has performed remarkably well over time, with annual risk-adjusted returns similar to those of the median hedge fund manager tracked by Cambridge Associates, and of course hedge fund managers have themselves posted returns significantly better than those of equity indices since 1990. While such a strategy will, of course, never deliver returns comparable to a top-notch individual money manager—or arguably to a well-designed hedge fund program—its strong performance during such a diverse period speaks well of its durability.

The benefits of the strategy, as well as its limitations, are perhaps best illustrated during crisis periods (Exhibit 7), when the strategy has consistently posted better returns than equities, but has been less successful relative to hedge funds. For example, from November 30, 2007, through the end of February 2009, the strategy returned -24.9% versus -51.0% for the S&P 500, -21.4% for the HFRI Fund Weighted Composite Index, and -14.5% for the median manager tracked by Cambridge Associates. During the tech bust, meanwhile, the strategy returned -13.8%, which compared quite favorably to the -43.8% return for the S&P, but lagged the HFRI Fund Weighted Composite Index (-2.1%) and the CA manager median (14.1%) by wide margins.

The most significant drawback of the strategy is that it has market exposure due to its fully

collateralized nature, and will thus track the overall market to some degree. While this is likely to be mitigated during crisis periods as volatility spikes, thus driving up premium income, the experience during the tech bust should not be dismissed—while a volatility-selling strategy cushioned losses during this period, it badly lagged hedge funds, many of which saw the bust coming and adjusted portfolios accordingly. Further, and perhaps a bigger worry, is that after a certain percentage decline, the strategy offers *no* cushion against additional losses, and will basically track the market. (Said differently, it offers a fixed monthly cushion on a variable liability.) This is because once the market value falls below the put strike price, further declines will be consistent with losses in the market, as the liability associated with the sale of puts increases dollar for dollar with the market decline. Although losses would be offset by gains from the put and call premiums and income from the T-bills, those return sources are fixed, while the downside depends on market action. Conversely, the strategy also caps gains, as once the market appreciates past the call strike price, further gains in the equity portion of the portfolio are needed to cover the appreciating cost of the call.[6] As noted earlier, should the market decline below the strike price of the sold put, the portfolio effectively becomes the 100% equities (until options are rolled, of course), while if the market rises above the strike price of the call, the portfolio becomes 100% T-bills.

Such issues provide context for understanding why this strategy can vary significantly from hedge funds in some periods, but perform similarly in others. A short strangle strategy emphatically should *not* be expected to behave like a hedge fund during outlier periods. The strategy not only has *zero* chance of ever putting up huge return numbers, but is also exposed to significant losses in the case of a sustained market downturn; hedge funds, by contrast, have historically provided better protection on the downside, while also participating (albeit to a lesser degree) in market rallies (Exhibit 8). The bottom line is that while long-term returns have been broadly comparable to those of hedge funds, investors should take this with a large grain of salt—selling volatility should by no means be considered akin to a hedge fund program.

Finally, investors that decide to pursue a volatility-selling strategy must also figure out how to fit it into their portfolios. In our opinion, the best slot for these strategies is in the same spot as hedge funds—either in an "alternatives," "volatility-dampening," or "diversifiers" bucket, depending on how one defines such buckets. While risk and return exposures are clearly different, the *objective* for this strategy—an investment that should, over the long term, provide equity-like returns but with lower volatility—is analogous to that of hedge funds.

Non-U.S. Investors

While much of our analysis focused on U.S. markets, this strategy is appropriate for investors in any market with sufficient liquidity and options coverage. As shown in Exhibit 9, returns for comparable strategies in U.K. and continental European markets have been similar to those of a U.S.-based strategy, and such markets obviously have ample liquidity. Unfortunately, the same cannot be said for most emerging markets, and thus the strategy will likely not make sense for investors based in such markets. While it is, of course, theoretically possible to invest in such a strategy in another country/currency, in our opinion the complexity—e.g., how should one size a position, should currency be hedged—outweighs the potential benefits.

[6] For the period studied, equity prices rose above the call strike price 20.6% of the time, and fell below the put strike price 10.7% of the time.

Conclusion

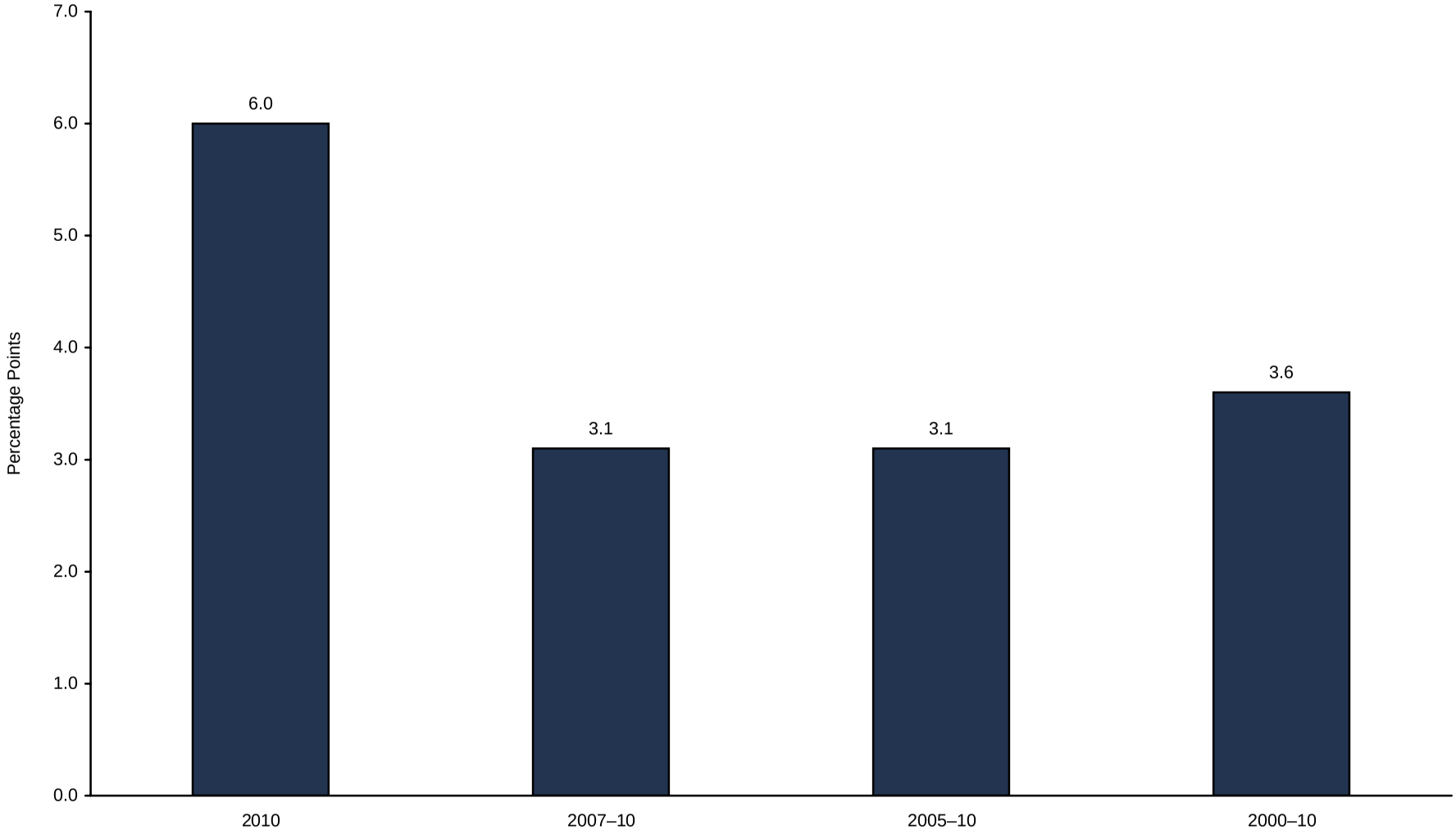
Given the paucity of attractive investment options at the moment, investors must increasingly be willing to look outside their comfort zone if they wish to meet annual spending needs, or, for investors without such needs, to grow assets in real terms over time. For investors willing to adopt a derivatives-based strategy, we believe a fully collateralized volatility-selling program may be worth considering, as long-term risk-adjusted returns have been very strong, and there are sound reasons for believing the historical disparity between implied and realized volatility will persist. We would consider such a strategy best suited to a volatility-dampening, alternatives, or diversifiers bucket, but given the very different risk/return structures, investors should view the strategy as a more liquid complement to an existing hedge fund program, not a substitute. ■

EXHIBITS

Exhibit 1

There Has Been a Consistent Premium for Implied Volatility Relative to Realized Volatility

VIX Less Realized Volatility (Annualized)

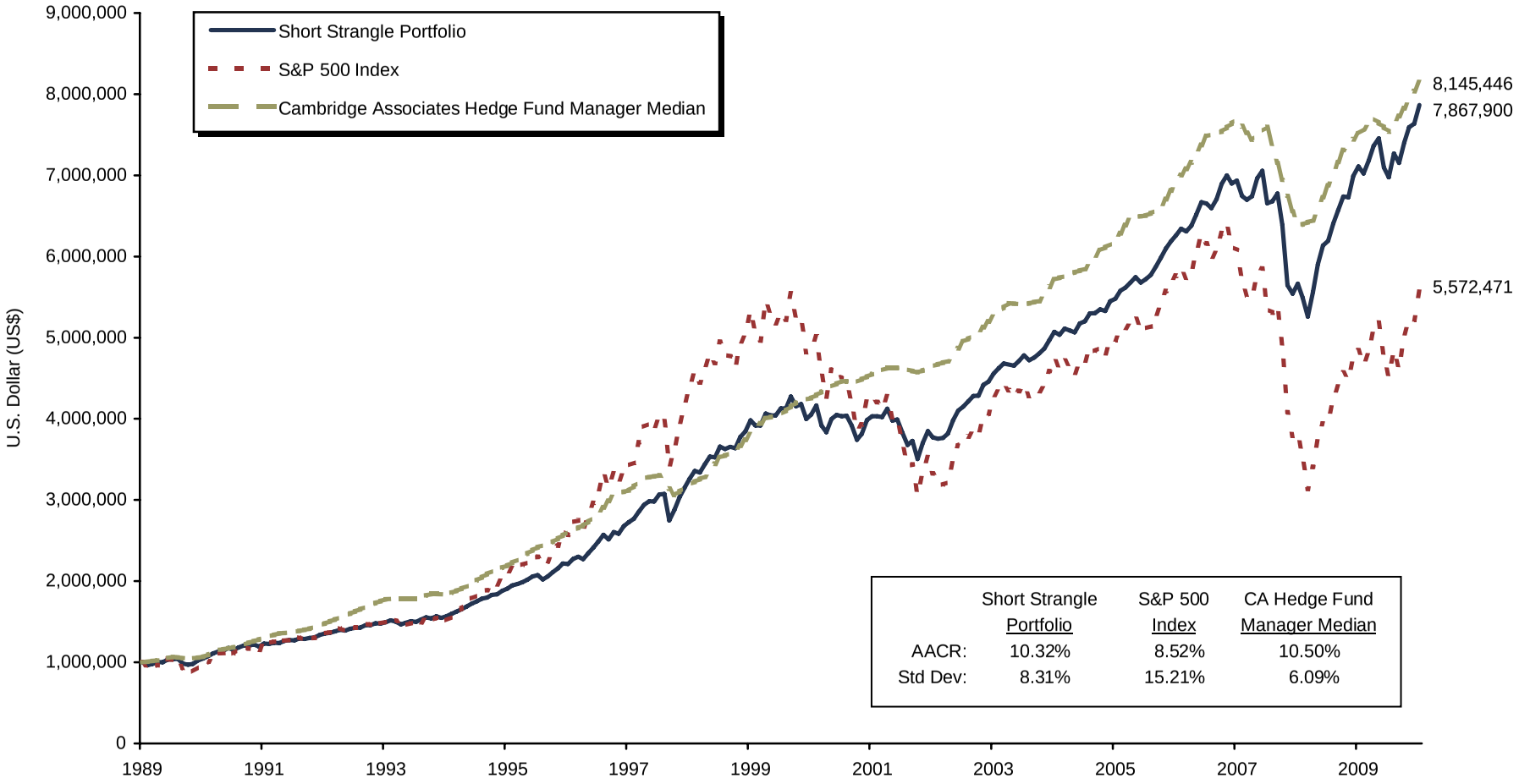


Source: The Clifton Group.
Note: Data provided by Bloomberg L.P. and BofA Merrill Lynch.

Exhibit 2

Cumulative Wealth of a Fully Collateralized Short Strangle Portfolio Against Various Indices

December 31, 1989 – December 31, 2010 • December 31, 1989 = $1,000,000

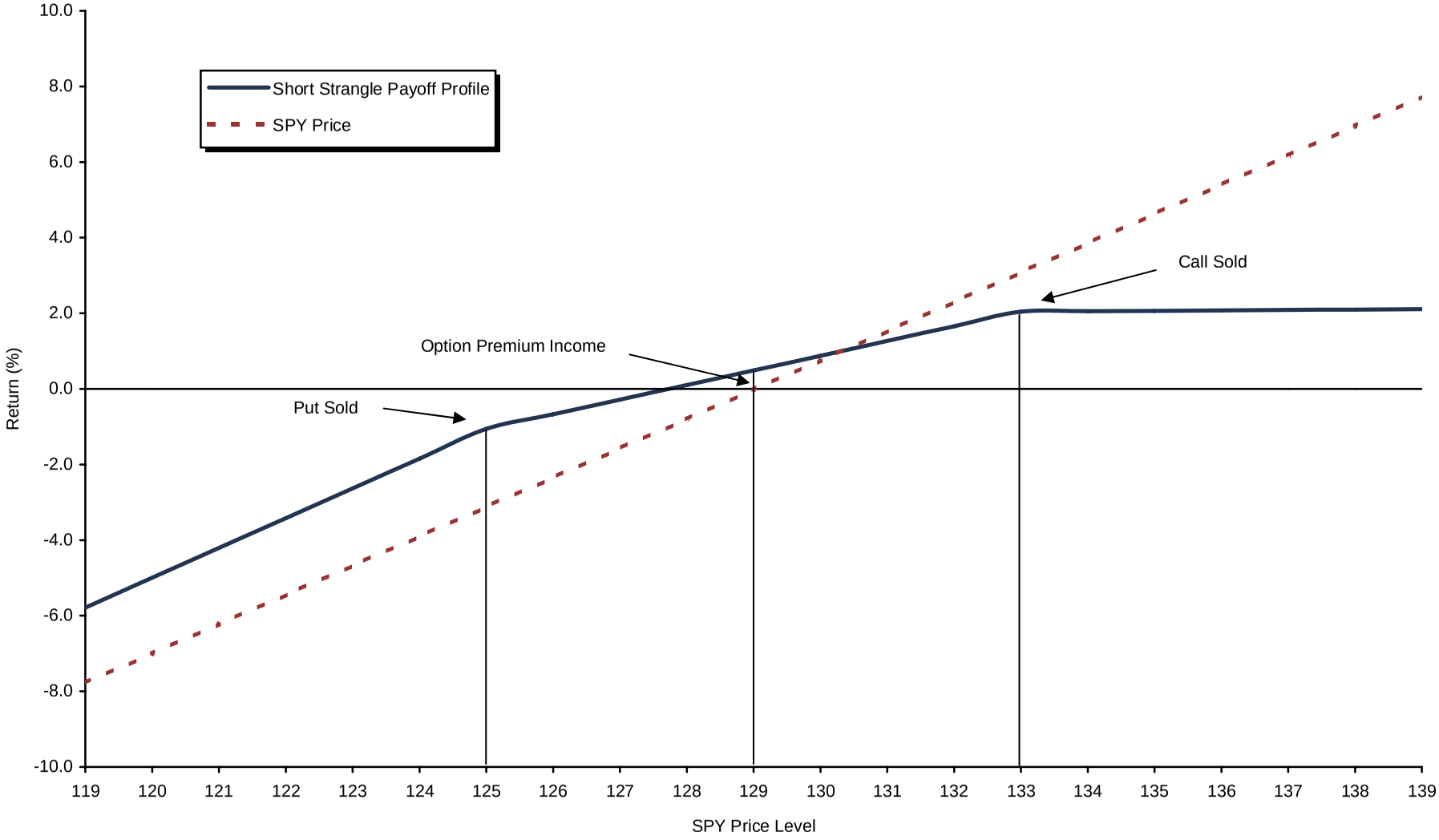


Sources: Cambridge Associates LLC Investment Manager Database, The Clifton Group, Standard & Poor's, and Thomson Datastream.

Notes: Data are monthly. The fully collateralized short strangle portfolio consists of 50% S&P 500 ETF (SPY) and 50% Treasury bills. Each month, 20-delta puts and calls are sold and rolled over. Performance reflects the gains on collateral and option premium income received each month and is meant to reflect expected transaction costs associated with options trades, but not expected investment management fees. Short strangle data are simulated and provided by The Clifton Group. Data for Cambridge Associates Hedge Fund Manager Median are quarterly and monthly returns are extrapolated for cumulative wealth.

Exhibit 3

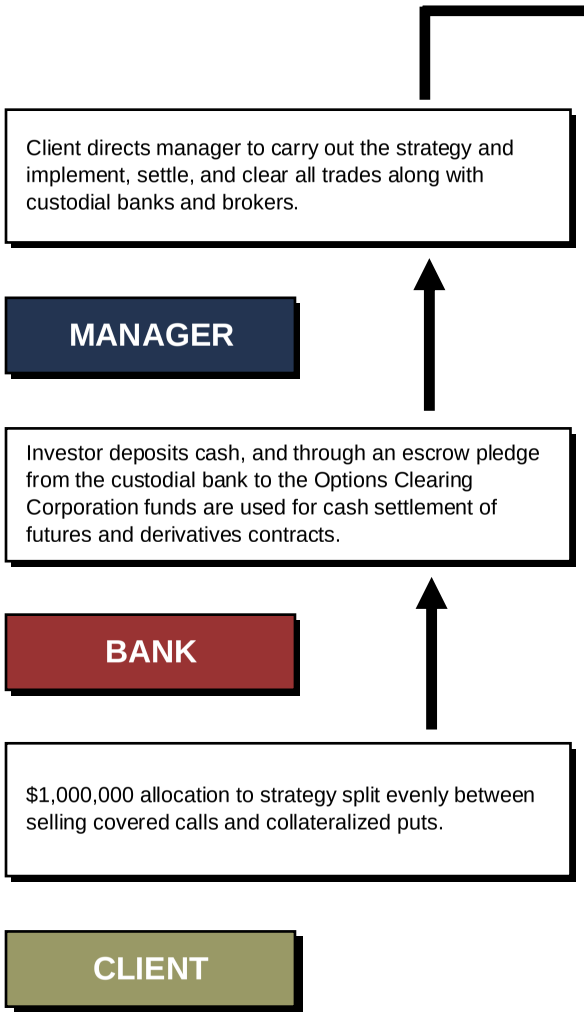
Strategy Payoff Diagram



Source: Morningstar.
Notes: As of January 24, 2011, the price level of the SPY (S&P 500 ETF) was 129. Option prices are for 20-delta calls and puts as of that day. For illustration only.

Exhibit 4

How It Works



$1,000,000

$500,000 Dedicated to Call Selling

- **Purchase** $500,000 of S&P 500 ETF **(SPY)**.
- **Sell** one-month 20-delta calls and receive **Yc** in premium.
- On exercise day, pay the difference between the underlying price **X** and the strike **St** if option is in the money and zero if not.
- **Total return** = Return from **(SPY)** + premium received (**Yc**) **less** any payment if option is exercised **(X - St)**.

$500,000 Dedicated to Put Selling

- **Deposit** $500,000 to be held at custodial bank in T-bills.
- **Sell** one-month 20-delta puts and receive **Yp** in premium
- On exercise day, pay the difference between the strike **St** and the underlying price **X** if in the money and nothing if not.
- **Total Return** = T-bill's collateral return + premium received (**Yp**) **less** any payment if option is exercised (**St - X**).

On exercise day…

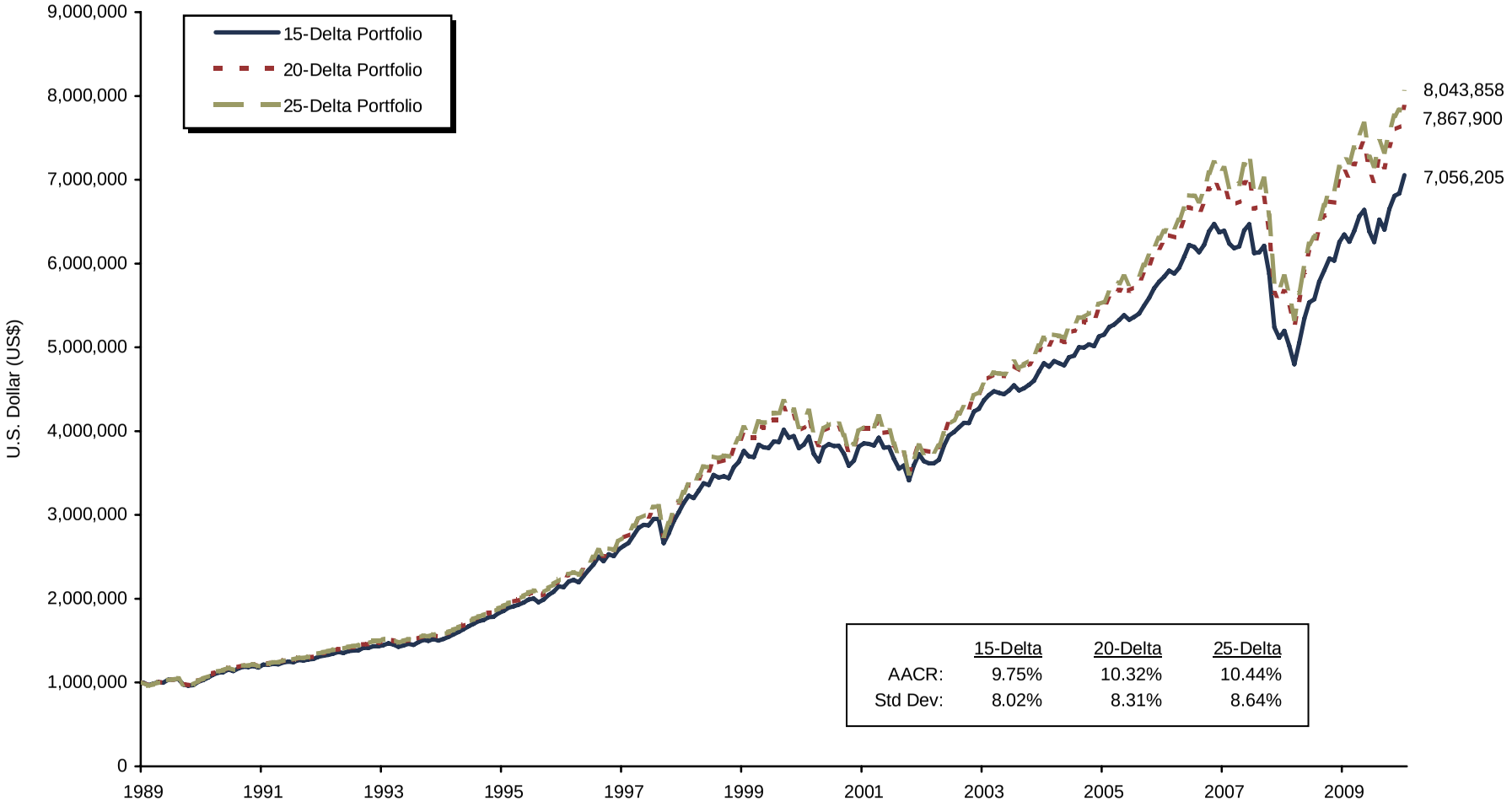
- Take the balance from each strategy and rebalance total portfolio.
- **Example:** Total portfolio is equal to $575,000 in call-selling strategy and $525,000 in put-selling strategy after options are exercised and cash settled. Total portfolio = $1,100,000.
- Rebalance portfolio once options have been cash settled and cleared so that $550,000 is now dedicated to each strategy.
- Sell one-month 20-delta calls and one-month 20-delta puts, and repeat the process.
- Puts and calls are sold based on constant deltas. Further out-of-the-money strikes are sold in higher-volatility markets and less out-of-the-money strikes are sold in lower-volatility markets. Strikes are determined by a target delta of 20 (representing a general probability of exercise; 20-delta = 20% chance of exercise).

Sources: Cambridge Associates LLC, based on information from The Clifton Group and the CBOE.
Notes: Options are European style and generally only exercised on the last business day before expiration. The expiration day for equity index options is the Saturday immediately following the third Friday of the expiration month.

Exhibit 5

Cumulative Wealth of Fully Collateralized Short Strangle Portfolios with Options Sold at Various Target Deltas

December 31, 1989 – December 31, 2010 • December 31, 1989 = $1,000,000



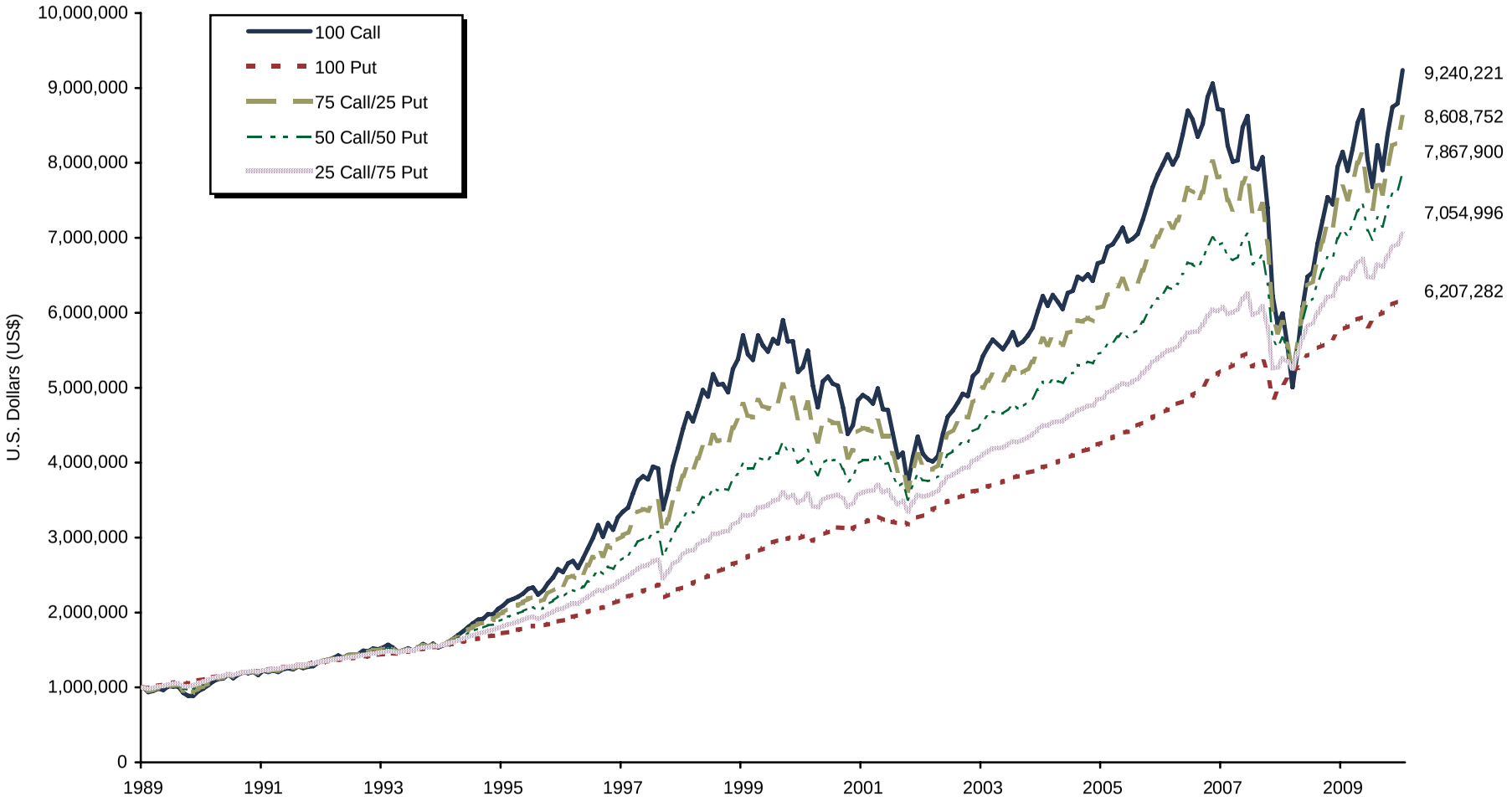
Source: The Clifton Group.

Notes: Data are monthly. The fully collateralized short strangle portfolio consists of 50% S&P 500 ETF (SPY) and 50% Treasury bills. Each month, puts and calls are sold and rolled over. Performance reflects the gains on collateral and option premium income received each month and is meant to reflect expected transaction costs associated with options trades, but not expected investment management fees. Short strangle data are simulated and provided by The Clifton Group.

Exhibit 6

Cumulative Wealth of Portfolios with Various Put and Call Weights

December 31, 1989 – December 31, 2010 • December 31, 1989 = $1,000,000



Source: The Clifton Group.

Notes: Data are monthly. The fully collateralized short strangle portfolio consists of various ratios of S&P 500 ETF (SPY) and Treasury bills. Each month, 20-delta puts and calls are sold and rolled over. Performance reflects the gains on collateral and option premium income received each month and is meant to reflect expected transaction costs associated with options trades, but not expected investment management fees. Short strangle data are simulated and provided by The Clifton Group.

Exhibit 7

Summary Statistics for a Fully Collateralized Short Strangle Portfolio Versus Various Benchmarks During Economic "Crisis" Periods Over the Last 20 Years

Cumulative Returns

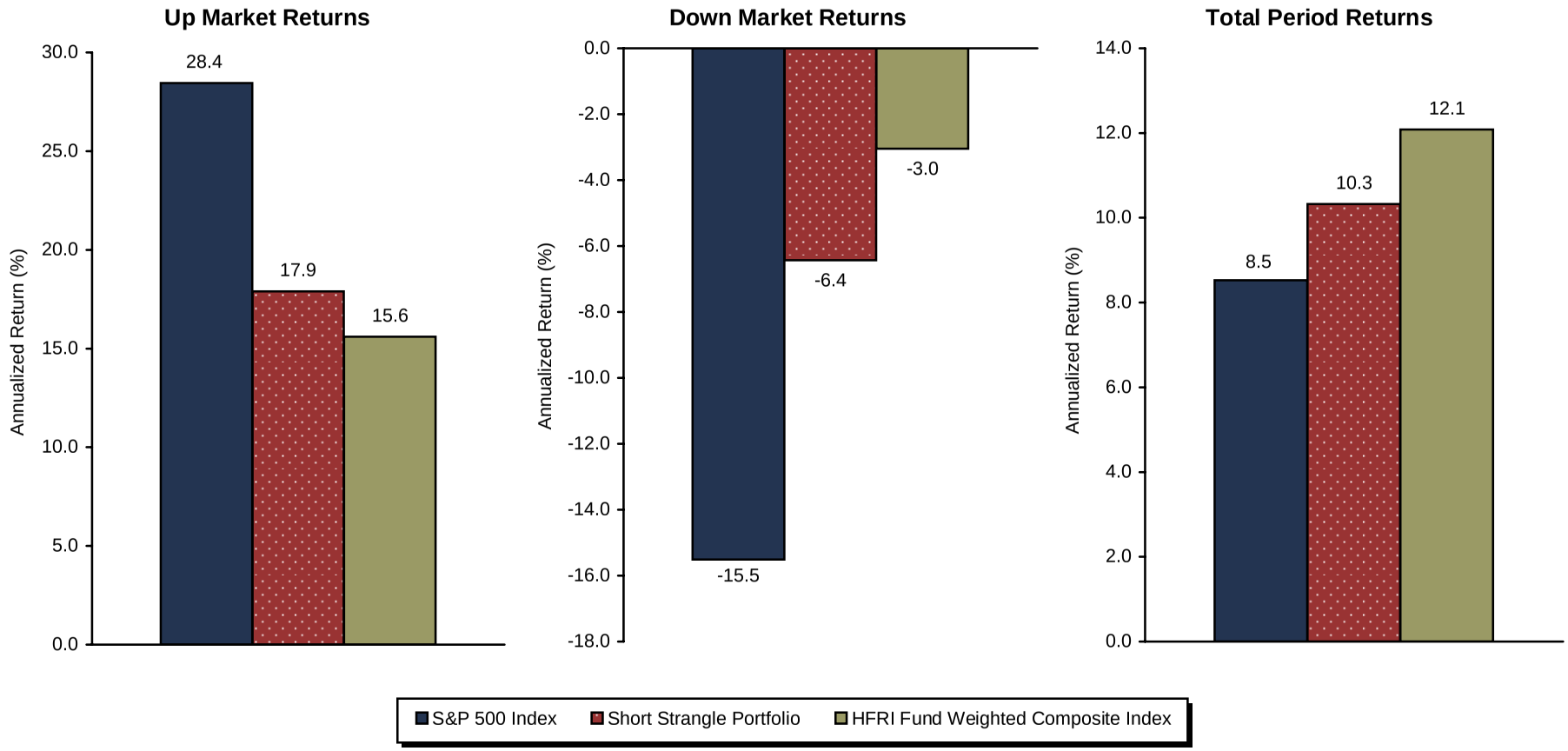
Dates	Short Strangle Portfolio	S&P 500 Index	HRFI Fund Weighted Composite Index	Cambridge Associates Hedge Fund Manager Median
Peso Crisis (Nov 30, 1994 – Jan 31, 1995)	1.81	0.32	-1.57	-0.39 (Q4 1994)
Asian Currency Crisis (Aug 31, 1997 – Nov 30,1997)	4.12	0.70	1.53	10.06 (Q3 1997 – Q4 1997)
Russia/LTCM Crisis (Apr 30, 1998 – Aug 31, 1998)	-6.63	-12.57	-10.57	-6.43 (Q2 1998 – Q3 1998)
Tech Bust (Apr 30, 2000 – Sept 30, 2002)	-13.79	-43.75	-2.06	14.14 (Q2 2000 – Q3 2002)
Credit Crisis (Nov 30, 2007 – Feb 28, 2009)	-24.86	-50.95	-21.42	-14.50 (Q4 2007 – Q1 2009)

Sources: Cambridge Associates LLC Investment Manager Database, The Clifton Group, Hedge Fund Research, Inc., Standard & Poor's, and Thomson Datastream.
Notes: Data are monthly. The fully collateralized short strangle portfolio consists of 50% S&P 500 ETF (SPY) and 50% Treasury bills. Each month, 20-delta puts and calls are sold and rolled over. Performance reflects the gains on collateral and option premium income received each month and is meant to reflect expected transaction costs associated with options trades, but not expected investment management fees. Short strangle data are simulated and provided by The Clifton Group. Data for Cambridge Associates Hedge Fund Manager Median are quarterly.

Exhibit 8

Performance of a Fully Collateralized Short Strangle Portfolio and the HFRI Fund Weighted Composite Index in Up and Down Equity Markets

January 31, 1990 – December 31, 2010



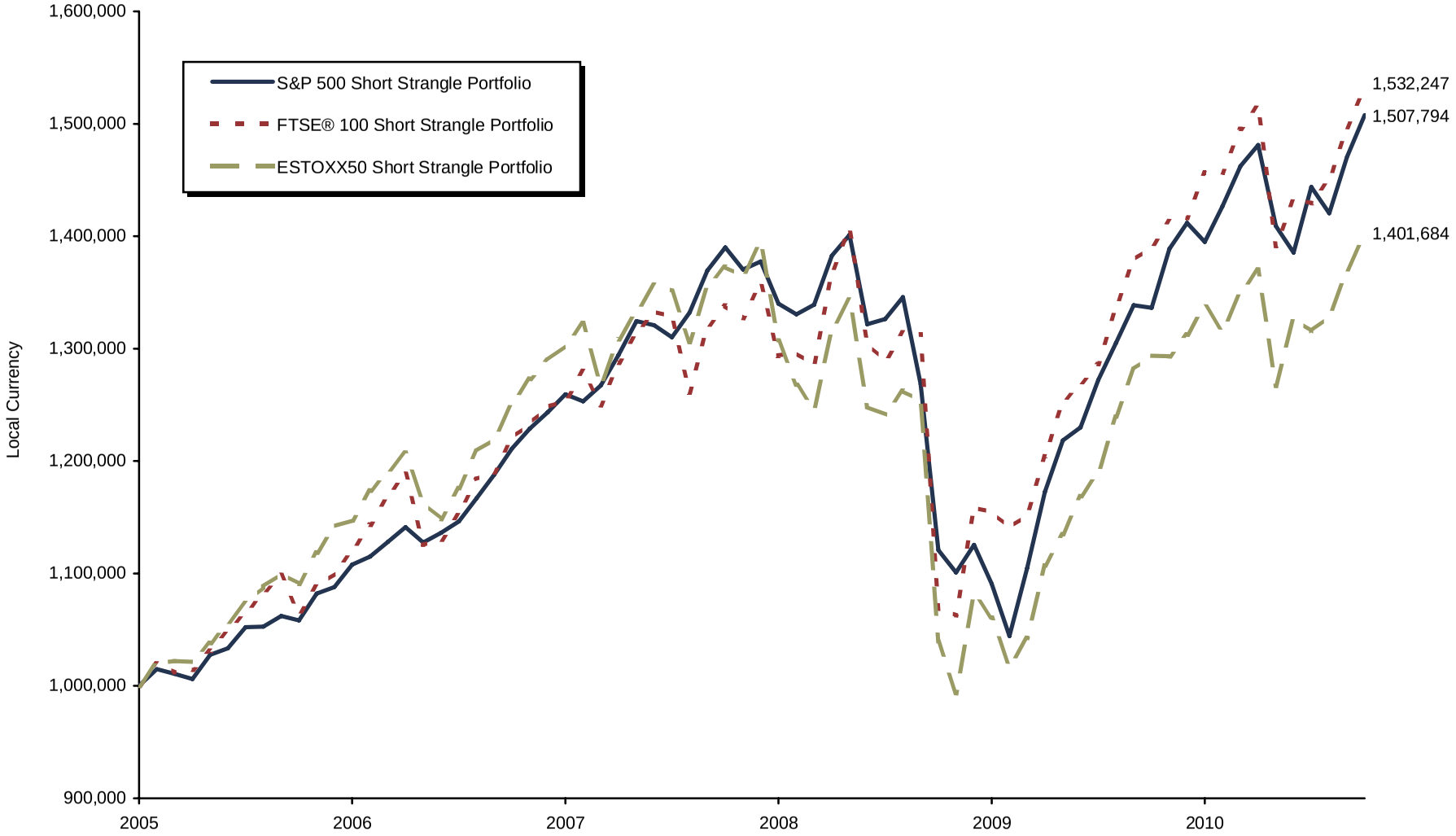
Sources: The Clifton Group, Hedge Fund Research, Inc., Standard & Poor's, and Thomson Datastream.

Notes: Up and down markets are defined by the monthly total return of the S&P 500 Index. The fully collateralized short strangle portfolio consists of 50% S&P 500 ETF (SPY) and 50% Treasury bills. Each month, 20-delta puts and calls are sold and rolled over. Performance reflects the gains on collateral and option premium income received each month and is meant to reflect expected transaction costs associated with options trades, but not expected investment management fees. Short strangle data are simulated and provided by The Clifton Group.

Exhibit 9

Cumulative Wealth of Fully Collateralized Short Strangle Portfolios

January 31, 2005 – October 31, 2010 • January 31, 2005 = 1,000,000 in Local Currency



Source: The Clifton Group.
Notes: Data provided by Objective Completion and BofA Merrill Lynch. Data are monthly.