# Portfolio Management Applications for the Classroom: Illustrating spot-futures parity and bear/bull strategies with ETFs and mutual funds

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**ABSTRACT**

Classroom treatment of course material which incorporates market-traded investment assets helps students relate to the material and internalize it more effectively by seeing its linkage with the real world. Two such treatments of portfolio management applications are presented that use actual levels of the S&P 500 index, market prices of the CME futures contract and SPiDeRs, SPY dividend yields, Treasury bill quotes, and the stated investment objectives of two mutual funds. Spot-futures parity is illustrated within the context of a well-known equity hedge application, while a fund's index-multiple return enhancement goal is modeled pedagogically by combining long equity and futures positions.

## I. INTRODUCTION

Derivatives in general, and futures contracts in particular, provide an abundance of material to cover either in a specialized course or in an investments/portfolio management class which devotes part of its syllabus to these topics. The workings of margin accounts and the mark-to-market process, offsetting contract positions, and institutional features of the marketplace including the clearinghouse, the exchange, the pit, and the oft-asked "what happens if I fail to offset before the contract expires" question all generally need to be understood and grasped before students are ready to consider the more advanced applications and pricing of futures contracts. Market simulations are a growing part of the pedagogy in economics and finance because they engage students and provide hands-on practice, and examples of their application to the futures subject matter have been presented by Alonzi, Lange, and Simkins [2000] and Holt [1996]. The former discusses the benefits of a computer-based trading game with Treasury bond futures while the latter simulates pit trading. More recently, Root and Lien [2005] construct a clever exercise in which they basically create a futures contract on the average grade received by a derivatives class and let the students trade it with an eye towards an eventual impact on their grades. Once students understand the features, properties, and trading mechanics of these contracts, they can be shown extensions and applications. The goal of this paper is to illustrate two such applications – one a familiar risk-reduction example, the other a return-enhancement strategy – and do it in such a way as to demonstrate important finance concepts using actual market instruments so that students are better able to relate to what they see and internalize it more effectively.

The familiar application is that of an equity portfolio hedge. Within the framework

of the spot-futures parity relationship, $F_o = S_o(1+r_f-d)^T$, I use market values and prices of the S&P 500 index, its CME futures contract, the SPiDeRs ETF (Ticker: SPY), and U.S. Treasury Bills to demonstrate the hedge and confirm that the theoretical parity condition can be shown to hold in practice as well as in a textbook. In the process, I address the implications for the parity condition of the institutional detail that the ex-dividend dates for SPY coincide with the expiration dates of the S&P 500 index futures contracts.

The second application is an advanced example best targeted for an elective undergraduate portfolio management class. I use futures contracts properties to illustrate cases of the way in which two retail mutual funds (in the ProFunds family) might pursue their stated investment objectives to produce "twice the return on the S&P 500" or "twice the inverse of the S&P 500".

The remainder of this paper is organized as follows. The equity hedge is presented in section II. The outline of how a manager might use futures positions combined with long positions in the underlying stocks to configure a mutual fund to produce a return which is a multiple of the S&P 500 is in Section III. The article concludes in Section IV.

## II. EQUITY HEDGE AND DEMONSTRATION OF PARITY

I frame the hedging example as if the students are managers of a portfolio of stocks which looks very much like the S&P 500 in terms of sector exposure and that its $\beta$ relative to that index is 1.0. On January 17th 2006, the spot level of the index was 1282.93, so a portfolio whose value was $1,282,930 on that day can be described as 1,282,930/1282.93 = 1000 shares of the index. After establishing these facts, I ask the students how they might hedge the risk to which this portfolio is exposed. In addressing this issue, we walk through a simple outline whose goal is to help them to identify risk factors and then figure out what position to take in the hedging instrument to hedge this risk. One version of this outline consists of 3 relatively simple questions:

- First, identify the risk factor. That is, what is the key variable to which the portfolio or asset or company is susceptible?
- Second, in what direction does the price of the risk factor have to move for the portfolio or asset or company to be harmed?
- Third, using this price direction, what position in the hedging instrument gains if the risk exposure is realized?

While these questions belabor the process for those experienced with risk management, students who have never been exposed to hedging issues use this outline as a roadmap to organize their thoughts until they become more comfortable with the subject matter. In this example, an interactive discussion helps them to see that the answers to the questions are, respectively, stock prices, declines, and a short position. If short positions had not been previously covered earlier in the semester, this example provides a context within which to introduce the strategy and discuss in detail its motives and implications.

The futures listing in the *Wall Street Journal* for the S&P 500 contract appeared as follows on January 17rd, 2006:

| | Open | High | Low | Settle |
|---|---|---|---|---|
| **S&P 500 Index (CME)-$250 x index** | | | | |
| Mar | 1292.60 | 1295.20 | 1283.70 | 1289.50 |
| Jun | 1297.20 | 1297.80 | 1294.50 | 1299.30 |

The T-bill listing for that same day included these bills:

| Maturity | Days to Mat | Bid | Asked | Chg | Ask Yld |
|---|---|---|---|---|---|
| Mar 16 06 | 57 | 4.13 | 4.12 | … | 4.20 |
| . | | | | | |
| . | | | | | |
| . | | | | | |
| Jun 15 06 | 148 | 4.27 | 4.26 | 0.01 | 4.40 |

The first step in demonstrating the mechanics of the hedge is to determine how many short positions to take in the index futures contracts. Since the value of the portfolio is $1,282,930, and a review of the details of the newspaper listing leads students to identify $250 as the contract multiplier, the class and I use (spot value of portfolio/(contract multiplier*spot level of index)) to conclude that 4 contracts are needed to completely hedge the risk exposure.

For purposes of this exposition, I analyze the hedge using the June contract but tabulate results using both the March and June contracts. To illustrate the effectiveness of the hedge, several contract-expiration values of the S&P 500 index are modeled as reported in Table 1a. Instruction on the convergence property alerts students that these values of the S&P 500 are also the closing prices of the futures contract on expiration day. Not insignificantly, expiration day is the 3rd Friday of the month, which will be June 16th for the June contract in this example (and March 17th for the March contract). At hypothetical June values of 1280 and 1290, the index is lower than the June futures price of 1299.30 in January and so the margin account on the futures positions produces a gain, calculated on a per contract basis as $(1299.30 - F_T)*250$. At 1300, 1310, and 1320, prices have risen and the short futures position suffers a loss which reduces the overall value of the portfolio. Not unexpectedly, Table 1a shows that the total value of the portfolio combining the equity holdings and margin account is the same $1,299,300 regardless of the eventual index value
on June 16th.

Once the class members digest this result, I extend it to invoke a critical finance and capital markets concept by challenging them to consider what rate of return the hedged equity portfolio should expect to earn if all of the assets and rates involved are at their fair levels on January 17th. I prod them with the hint that the answer to this question is an idea, rather than a specific number (at least initially). Having seen an exhibit akin to Table 1a, some students declare that since the outcome is certain, the lack of uncertainty calls for the portfolio to earn a risk-free rate. Other students reason that since the portfolio gains both when stock prices rise -- via the portfolio holdings – as well as when they fall – via the futures contracts – there is no risk and so, again, the portfolio should earn a risk-free rate.

The Treasury bill listings serve to explore and confirm this intuition. This offers a further contextual opportunity to revisit the discussion of Treasury securities which may have occurred

earlier in the semester to elaborate on their different types along with the concepts of nominal and real risklessness. The one-day differential between the maturity of the June T-bill and the expiration of the June futures contract is noted for now and revisited later, though setting it aside does not qualitatively impact the result.

The T-bill pricing relationship included in Investments textbooks shows that the price of the June T-bill on January 17th can be calculated with the information displayed in the *Wall Street Journal* listing, using the midpoint of the bid and ask discount rates[1]:

$$.04265 = \frac{1000 - \text{Price}}{1000} * \frac{360}{148}$$

The price of this T-bill on January 17th is $982.466. Since T-bills pay no coupons and are guaranteed to return $1000 face value to the holder at maturity, this bill earns $17.534 over the 148-day holding period ending one-day before the June futures contract expires. This represents a no-risk holding period rate of return (HPR) of:

$$\frac{(1000 - 982.466)}{982.466} = 1.785\%$$

The information in Table 1a, however, documents that the return earned by the hedged equity portfolio between January 17th and June 15th is lower than 1.785%:

$$\frac{(1{,}299{,}300 - 1{,}282{,}930)}{1{,}282{,}930} = 1.276\%$$

This varies by 0.509% from the T-bill HPR which is positioned to represent the appropriate risk-free rate.

So, the class and I are left with a puzzle. If their intuition is correct (and, more to the larger point, if spot-futures parity holds), then we must figure out why the gap between these returns is so large. In resolving this puzzle interactively with the class, I am able to invoke exchange-traded funds (ETFs), dividend yields, and market expectations, as well as to connect the dots between this example and spot-futures parity. The only variable in that parity condition which has not been used in the example to this point is the dividend yield, d% ($D in some formulations). In addition to the change in the value of the portfolio and the futures margin account, the equity portfolio earns dividends over the holding period during which the hedge is in place. Since the portfolio is posited to mirror the S&P 500 and is hedged by a contract written on that index, these dividends -- in yield terms -- can be estimated by looking at www.amex.com and inspecting the distribution history for SpiDeRs, the ETF which trades as a regular company stock on AMEX (Ticker: SPY) but which is tied to an underlying portfolio of the S&P 500 stocks. Results reported by Ackert and Tian [2000] that SpiDeRs are correctly priced relative to the underlying stock index portfolio, offering little arbitrage opportunity, validate this substitution.

Table 2 shows the recent history of SPY as of mid-January 2006. With the exception of the double dividend at the end of 2004, SPY declares dividends in March, June, September, and December of each year, and these dividends tend to get larger with each successive quarter within a year. These four months coincide with the S&P 500 index futures contracts, and routinely the contract expiration dates fall on the ex-date for that month's SPY dividend. Though the contracts expire on Friday, their last trading date is the prior day Thursday, which is the last day that exploiters of parity violations would unwind their arbitrage portfolios. Any traders who constructed arbitrage portfolios to exploit parity violations involving the June contract, therefore, either sell stocks on that last Thursday, June 15th (if they had a short futures positions), surrendering claim to the June SPY dividend, or buy-to-cover stocks on that last Thursday (fulfilling a long futures position), relieving themselves of the obligation to pay the June dividend on their short stock positions. Both situations indicate that the June index dividend is not priced into the June contract, and so only a March SPY dividend yield -- and not a June yield – is credited to the equity portfolio over the January 17th to June 16th holding period.

An inspection of Table 2 suggests that one possible expectation market participants could have of the future March 2006 SPY dividend, prior to its announcement (which had not occurred as of January 17th), is the 67.167 cents per share that was declared for December 2005. On January 17th, the market price of SPY was $128.33 per share, for an expected future dividend yield on that day of .523%. This yield matches almost exactly the missing piece between the T-bill holding period return and the return we expect to earn on the hedged equity portfolio without the dividends! Expressed in dollars, if the equity portfolio expects to earn .523%*1,282,930 = $6709.72 in dividends over the holding period, its total expected June dollar value is $1,306,009.72. This reflects an expected holding period return of

$$\frac{(1{,}306{,}009.72 - 1{,}282{,}930)}{1{,}282{,}930} = 1.799\%$$

which differs from the 1.785% T-bill HPR by only 1.4 basis points. If the 148-day HPR for the T-bill is extrapolated out one more day to coincide with the expiration of the futures contract, this adds another .01785/148 = .00012 to the risk-free HPR, pushing it to 1.797% and a mere 0.2 basis point deviation from the hedged portfolio expected HPR.

The resolution of this example serves to reinforce financial intuition for students with actual financial instruments as a complement to textbook examples. In the process, they come to understand that they have also seen spot-futures parity demonstrated in practice, and as part of the exercise were exposed to ETFs, dividend yields, Treasury securities, and the functioning of market expectations. Even the imperfections in the example provide educational opportunities to discuss features of the financial markets. I remind those who are uncomfortable that the HPRs do not match exactly that not only have we not fully reflected the impact of bid-ask spreads, but error is also introduced due to the fact that the settlement futures price is not an individual contract price quote but rather an average of the last transactions of the trading day. Market efficiency issues can be injected as well, as an attentive class member could legitimately wonder why the market is apparently pricing the most recent December dividend into the parity condition rather than recognize the fact, so clearly seen in Table 2, that the following year's March dividend is always significantly lower than the prior December payout, and that the subsequent June dividend is slightly higher than the March dividend.

Table 3 reveals that the principles illustrated here are not unique to the January 17th date I used with this example. Of the 19 trading days in January 2006, the HPR on the hedged equity portfolio using $0.67167 as the expected cash dividend compares favorably to the T-bill HPR for roughly half of those days.[2] Indeed, a demonstration much like the one shown here using a day where the HPRs are *not* close is equally useful as a second example. It can be used to draw out market imperfections, the idea of the settlement futures price as an average, and the reality that mispricings within the spot-futures relationship still occur even though the introduction of the SPY ETF has reduced the occurrence of arbitrage opportunities and the duration over which those opportunities remain profitably exploitable [Switzer, Varson, and Zghidi, 2000 and Chu and Hsieh, 2002]. The appendix describes some excel spreadsheet templates that can accompany this example and support its presentation in the classroom.

## III. A MUTUAL FUND IMPLEMENTION OF A BULL OR BEAR STRATEGY

One of the benefits of running a dartboard competition as part of teaching investments and portfolio management classes is exposure to the variety of stocks and mutual or closed-end funds that students select for their dartboard-challenging portfolios. Two funds which came to my attention in this way are the ProFunds UltraBull (Ticker: ULPIX) and UltraBear Investors (Ticker: URPIX) funds. According to their prospectuses, the former "seeks daily investment results, before fees and expenses, that correspond to twice (200%) the daily performance of the S&P 500 Index", while the latter "seeks daily investment results, before fees and expenses, that correspond to twice (200%) the inverse (opposite) of the daily performance of the S&P 500 Index". Not only are these unusual strategies for a mutual fund to pursue, but when their peers introduce them in class, students ask how a fund goes about achieving these objectives. According to Morningstar.com analyst reports, the Bull fund does so by investing "70% to 80% of the fund's assets in equities to replicate the index and the remainder in derivative securities (swaps, futures, and options on futures) to create an equivalent notional position" [Geenty, 2005]. The Bear fund "owns no individual stocks, but uses short total-return swaps, short index futures contracts, and options on exchange-traded futures contracts" [Kathman, 2003]. Inspired by my students' inquisitiveness, I now include a session on this topic in an undergraduate portfolio management class after derivatives – specifically futures contracts – have been covered. It is not intended to be 100% faithful to the strategies these two funds pursue, but to use what the students have seen in our coverage of futures contracts to pique their curiosity and give them an idea of how it might be done.

The critical concept in presenting this case study is the leverage aspect of investing in futures contracts. The students need to understand the multiplicative relationship between movements in the price of the contract and the return on a margin account -- when the margin requirement is 10% (5%), a 1% move in the contract price moves the margin account by 10% (20%), etc. The "UltraBull" fund holds stocks replicating the index along with derivatives, which I assume are solely futures contracts for purposes of this example. The mix of these two investments in the portfolio is set to achieve the fund's objective. When one of the fund's assets, the S&P 500, moves by 1% (up or down), its other asset moves by 10% (up or down), and some mix of these two holdings produces the target objective of a 2% move (up or down). Framing it this way allows students to see a parallel between this problem and the routine portfolio return calculations they do with portfolios holding multiple assets in non-equal proportions. The

"UltraBull" problem can be expressed mathematically in a form that resembles those calculations when the margin requirement is 10% or 5%, respectively:

$$2\% = \text{weight}_{S\&P}*1\% + (1-\text{weight}_{S\&P})*10\% \quad (1)$$
$$2\% = \text{weight}_{S\&P}*1\% + (1-\text{weight}_{S\&P})*20\% \quad (2)$$

The solution to (1) to allocate 8/9 (88.889%) of the portfolio's assets to long positions of the S&P 500 stocks and the other 1/9 (11.111%) of assets to futures contracts produces a two-times amplified effect of S&P 500 changes on the value of the fund. Table 4a illustrates this result, starting with a portfolio valued at $290,087.50 -- $257,850 for stock holdings, the remaining $32,237.50 for the futures margin account -- and using the spot index and March futures contract price on January 17th, 2006. Table 4b is similar, except that the margin requirement is 5%, the starting portfolio is valued at $306,269, and the weights necessary to achieve the bull objective are 18/19 (94.737%, or $290,150.25) in stocks and 1/19 (5.263%, or $16,118.75) in the futures contracts, found by solving equation (2). Both scenarios employ one futures contract for simplicity. In both tables, scenarios of potential spot index (and futures price, assuming parity holds) increases and decreases of 1%, 2%, and 5% all produce the desired result of a fund HPR two times the rate of change in the index. A 1% increase (decrease) in the index results in a 2% increase (decrease) in the total value of the portfolio, a 2% increase (decrease) in the index results in a 4% increase (decrease) in the total value of the portfolio, and a 5% increase (decrease) in the index results in the expected 10% increase (decrease) in the total value of the portfolio. This is accomplished by virtue of the return on the margin account, which is shown to be 10 or 20 times each projected spot and futures price change in Tables 4a and 4b, respectively. In the appendix, the spreadsheet templates underlying these tables are displayed and described.

The objective of the "UltraBear" fund offers the opportunity to inject a wrinkle into the illustrative case for a class, but it can also be used to stimulate provocative discussion about investment structures. Since this fund is effectively "one big short position" in the index, discussion can be ignited when an instructor reminds students of two seemingly contradictory facts which they know well: first, that short positions involve *selling* assets; second, that investors send money to mutual funds to invest by *buying* assets. The ensuing conversation serves to promote a deeper appreciation for the opportunities and possibilities which the investment landscape offers.

Despite the fact that the dated Morningstar.com analysis indicates that the "UltraBear" fund does not own stocks in the index as it pursues its objective to deliver twice the inverse of the S&P 500, the ensuing example assumes that it does to be consistent with students' understanding that the fund receives investor money with which to buy assets. It can be tweaked to demonstrate the case of no stock holdings. The problem for the fund manager to combine long positions in the stocks with short positions in the futures contract is expressed mathematically as:

$$2\% = \text{weight}_{S\&P}*-1\% + (1-\text{weight}_{S\&P})*10\% \quad (3)$$
$$2\% = \text{weight}_{S\&P}*-1\% + (1-\text{weight}_{S\&P})*20\% \quad (4)$$

Equation (3) assumes that the requirement on the margin account for the futures positions is 10%; equation (4) assumes the requirement to be 5%. Both capture the need to produce a return equal to positive 2% when the index declines by 1% by combining a long position in the index

stocks – which also decline by 1% -- and short positions in the futures contracts that generate margin account returns of 10% or 20%, respectively. When the margin requirement is 10%, solving equation (3) reveals that an 8/11 (72.727%) position in the index stocks and a 3/11 (27.273%) position in futures contracts is needed to produce the desired 2% return when the index declines by 1%. These positions are 18/21 (85.714%) and 3/21 (14.286%) with a margin requirement of 5%.

Tables 5a and 5b summarize these two scenarios, again using the spot index and March futures contract price from January 17th, 2006. When the margin requirement for the futures position is 10%, a portfolio with initial value of $118,202.50 is allocated $85,965 (72.727%) to long positions in the index stocks and $32,327.50 (27.273%) to a short position in exactly one index futures contract[3]. When the margin requirement for the futures position is 5%, a portfolio with initial value of $112,828.75 is allocated $96,710 (85.714%) to long positions in the index stocks and $16,118.75 (14.286%) to a short position in exactly one index futures contract. As before, both tables analyze a series of anticipated spot index and futures price changes, with the latter arrived at by assuming compliance with the parity condition. By virtue of the futures margin account allocation, which amplifies the 1%, 2%, and 5% declines (increases) in the futures price by a factor of 10 (Table 5a) and 20 (Table 5b), the returns of these "funds" in the last column of the tables are, indeed, twice the inverse of the corresponding S&P 500 index changes in the first column of these tables.

## IV. CONCLUSION

This paper details a classroom treatment of two portfolio management applications which combine equity positions and futures contracts to achieve different investment objectives. The first employs an equity hedge objective to illustrate a real-world spot-futures parity relationship using actual levels of the S&P 500 index, market prices of the futures contract and SpiDeRs, SPY dividend yields, and outstanding Treasury bills. The second aims to give finance students a taste of how customized portfolio objectives can be constructed by mixing derivatives with traditional equity holdings. Both examples incorporate actual market instruments which serves to help students relate to and internalize course material so that they can become conversant with the features and uses of investment assets and practices.

## ENDNOTES

[1] I use the midpoint here to be consistent with the newspaper listings for futures contracts, which do not show bid-ask spreads.

[2] HPRs on the hedged equity portfolio were calculated with the December $0.67167 dividend, with a March dividend estimate of $0.537, and with a March+June dividend estimate of $1.05. The calculated HPR using $0.67167 was closest to the T-bill HPR for 12 days and equally as close as one of the other dividend estimate HPRs for 4 additional of the 19 total days.

[3] Some students may inquire as to whether the $85,965 is enough to buy the 500 stocks in the index in their market-weighted proportions, since it is effectively 85965/(1282.93*250) = .268 "shares" of the index. The example can be scaled up as necessary to address these concerns.

[4] This scenario admits discussion of margin calls and how different investors (individuals vs. institutional) meet them, as the margin account balance would not be allowed to fall this far below the maintenance level. Regardless of margin account replenishment, the $16K loss is the important result.

[5] This scenario admits discussion of margin calls and how different investors (individuals vs. institutional) meet them, as the margin account balance cannot fall into a deficit situation. But as before, the $16K loss is the focus.

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**Table 1a.**

**Scenario analysis of a hedged equity portfolio using the June futures contract. All results are as of the expiration date of the June contract.**

| Value of S&P 500 at contract expiration in June | Value of portfolio: 1000 shares | Gain (loss) on futures margin account ($F_{FIRST} - F_{LAST}$)*250*# contracts | Total Value of Portfolio, before dividends | Total Value of Portfolio, including dividend yield of 0.523% |
|---|---|---|---|---|
| | | | | |
| 1280 | $1,280,000 | (1299.30-1280)*250*4 = 19,300 | $1,299,300 | $1,306,009.72 |
| 1290 | $1,290,000 | (1299.30-1290)*250*4 = 9,300 | $1,299,300 | $1,306,009.72 |
| 1300 | $1,300,000 | (1299.30-1300)*250*4 = (700) | $1,299,300 | $1,306,009.72 |
| 1310 | $1,310,000 | (1299.30-1310)*250*4 = (10,700) | $1,299,300 | $1,306,009.72 |
| 1320 | $1,320,000 | (1299.30-1320)*250*4 = (20,700) | $1,299,300 | $1,306,009.72 |

**Table 1b.**

**Scenario analysis of a hedged equity portfolio using the March futures contract. All results are as of the expiration date of the March contract.**

| Value of S&P 500 at contract expiration in March | Value of portfolio: 1000 shares | Gain (loss) on futures margin account ($F_{FIRST} - F_{LAST}$)*250*# contracts | Total Value of Portfolio, no dividends |
|---|---|---|---|
| | | | |
| 1270 | $1,270,000 | (1289.50-1270)*250*4 = 19,500 | $1,289,500 |
| 1280 | $1,280,000 | (1289.50-1280)*250*4 = 9,500 | $1,289,500 |
| 1290 | $1,290,000 | (1289.50-1290)*250*4 = (500) | $1,289,500 |
| 1300 | $1,300,000 | (1289.50-1300)*250*4 = (10,500) | $1,289,500 |
| 1310 | $1,310,000 | (1289.50-1310)*250*4 = (20,500) | $1,289,500 |

**Table 2.**

**Distribution history for SPY exchange-traded fund, December 2000 to March 2006.**

| Distribution per share | Ex-Date | Record Date | Pay Date | % change from prior quarter | Dividend Yield |
|---|---|---|---|---|---|
| | | | | | |
| .41133 | 12/15/2000 | 12/19/2000 | 01/31/2001 | | |
| .31551 | 03/16/2001 | 03/20/2001 | 04/30/2001 | -23.3% | .268% |
| .34644 | 06/15/2001 | 06/19/2001 | 07/31/2001 | +9.8% | .284% |
| .36900 | 09/21/2001 | 09/25/2001 | 10/31/2001 | | |
| .39277 | 12/21/2001 | 12/26/2001 | 01/31/2002 | | |
| .33098 | 3/15/2002 | 3/19/2002 | 4/30/2002 | -15.7% | .286% |
| .35337 | 6/21/2002 | 6/25/2002 | 7/31/2002 | +6.8% | .349% |
| .37810 | 9/20/2002 | 9/24/2002 | 10/31/2002 | | |
| .43584 | 12/20/2002 | 12/24/2002 | 1/31/2003 | | |
| .35438 | 3/21/2003 | 3/25/2003 | 4/30/2003 | -18.7% | .402% |
| .36025 | 6/20/2003 | 6/24/2003 | 7/31/2003 | +1.7% | .360% |
| .40006 | 9/19/2003 | 9/23/2003 | 10/31/2003 | | |
| .51559 | 12/19/2003 | 12/23/2003 | 1/30/2004 | | |
| .39476 | 3/19/2004 | 3/23/2004 | 4/30/2004 | -23.4% | .349% |
| .41376 | 6/18/2004 | 6/22/2004 | 7/30/2004 | +4.8% | .363% |
| .46878 | 9/17/2004 | 9/21/2004 | 10/29/2004 | | |
| .35102 | 11/15/2004 | 11/17/2004 | 12/2/2004 | | |
| .56789 | 12/17/2004 | 12/21/2004 | 1/31/2005 | | |
| .46709 | 3/18/2005 | 3/22/2005 | 4/29/2005 | -17.8% | .391% |
| .48762 | 6/17/2005 | 6/21/2005 | 7/29/2005 | +4.4% | .402% |
| .52169 | 9/16/2005 | 9/20/2005 | 10/31/2005 | | |
| .67167 | 12/16/2005 | 12/20/2005 | 01/31/2005 | | |
| TBD | 3/17/2006 | 3/21/2006 | 4/28/2006 | | |
| | | | | | |
| | | | | | |

**Table 3.**

**Daily analysis of spot-futures parity compliance and an equity portfolio hedge put in place in January 2006 for the holding period ended June 16th, using June contract futures prices, S&P 500 index levels, T-bill and SPY quotes, and SPY expected dividend yields on each trading day in January 2006. Cases in which the T-bill HPR (holding period return) in column 7 and the Hedged Portfolio + Dividend Yield HPR in the rightmost column (also columns 4 + 9) approach each other indicate close compliance with spot-futures parity.**

| | June Settle Futures Price | S&P 500 Index Close | Hedged Portfolio HPR | June 15, 2006 T-bill Bid and Ask midpoint | T-bill Days to Maturity | T-bill HPR | SPY Price | SPY Dividend Yield assuming $0.67167 | Hedged Portfolio + Dividend Yield Total HPR |
|---|---|---|---|---|---|---|---|---|---|
| 4-Jan | 1290.0 | 1273.46 | 1.289% | 0.04175 | 161 | 1.903% | 127.30 | 0.528% | 1.817% |
| 5-Jan | 1290.9 | 1273.48 | 1.358% | 0.04165 | 160 | **1.886%** | 127.38 | 0.527% | **1.885%** |
| 6-Jan | 1301.5 | 1285.45 | 1.251% | 0.04185 | 159 | 1.883% | 128.44 | 0.523% | 1.774% |
| 9-Jan | 1304.8 | 1290.15 | 1.142% | 0.04195 | 156 | 1.851% | 128.77 | 0.522% | 1.664% |
| 10-Jan | 1306.0 | 1289.69 | 1.271% | 0.04225 | 155 | **1.853%** | 128.90 | 0.521% | **1.792%** |
| 11-Jan | 1309.7 | 1294.18 | 1.210% | 0.04255 | 154 | 1.854% | 129.31 | 0.519% | 1.729% |
| 12-Jan | 1303.4 | 1286.06 | 1.352% | 0.04245 | 153 | **1.837%** | 128.80 | 0.521% | **1.873%** |
| 13-Jan | 1302.5 | 1287.61 | 1.161% | 0.04245 | 152 | 1.825% | 128.68 | 0.522% | 1.683% |
| ***16-Jan*** | ***Martin Luther King, Jr. Holiday*** | | | | | | | | |
| **17-Jan** | **1299.3** | **1282.93** | **1.276%** | **0.04265** | **148** | **1.785%** | **128.33** | **0.523%** | **1.799%** |
| 18-Jan | 1293.4 | 1277.93 | 1.206% | 0.04275 | 147 | **1.777%** | 127.82 | 0.525% | **1.731%** |
| 19-Jan | 1298.0 | 1285.04 | 1.010% | 0.04265 | 146 | 1.760% | 128.31 | 0.523% | 1.534% |
| 20-Jan | 1274.3 | 1261.49 | 0.998% | 0.04265 | 145 | 1.748% | 125.97 | 0.533% | 1.532% |
| 23-Jan | 1278.7 | 1263.82 | 1.160% | 0.04275 | 142 | **1.715%** | 126.42 | 0.531% | **1.691%** |
| 24-Jan | 1279.9 | 1266.86 | 1.016% | 0.04285 | 141 | 1.707% | 126.55 | 0.531% | 1.547% |
| 25-Jan | 1280.6 | 1264.68 | 1.241% | 0.04325 | 140 | **1.711%** | 126.66 | 0.530% | **1.771%** |
| 26-Jan | 1287.5 | 1273.83 | 1.066% | 0.04355 | 139 | 1.710% | 127.36 | 0.527% | 1.593% |
| 27-Jan | 1299.0 | 1283.72 | 1.191% | 0.04365 | 138 | **1.702%** | 128.54 | 0.523% | **1.714%** |
| 30-Jan | 1298.3 | 1285.19 | 1.022% | 0.04395 | 135 | 1.676% | 128.44 | 0.523% | 1.545% |
| 31-Jan | 1293.4 | 1280.08 | 1.038% | 0.04395 | 134 | **1.663%** | 127.50 | 0.527% | **1.565%** |

**Table 4a.**

**Analysis of "Bull" portfolio designed to achieve twice the return of the S&P 500 index. The spot level of the index is 1282.93 and the price of the March futures contract is 1289.50 on January 17th, 2006. Each contract requires 10% margin of $32,237.50. A portfolio of $290,087.50 is allocated 88.887% ($257,850) to stock holdings and 11.113% ($32,237.50) to 1 futures contract. Futures prices are assumed to obey parity when spot index changes.**

| Percentage Change in Spot and Futures Prices | New Spot Index Value | New Futures Price | New Value of Portfolio Stock Holdings: $257,850* (1+change) | Change in Value of Margin Account ($F_t$ – 1289.50)*250 | Rate of Return: Margin Account | Total Value of Margin Account | Total Value of Fund Holdings | Rate of Return (Starting Value of $290,087.50) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| +5% | 1347.08 | 1353.98 | $270,742.50 | $16,120.00 | +50.00% | $48,357.50 | $319,100.00 | 10.00% |
| +2% | 1308.59 | 1315.29 | $263,007.00 | $6,447.50 | +20.00% | $38,685.00 | $301,692.00 | 4.00% |
| +1% | 1295.76 | 1302.40 | $260,428.50 | $3,225.00 | +10.00% | $35,462.50 | $295,891.00 | 2.00% |
| 0 | 1282.93 | 1289.50 | $257,850.00 | $0.00 | 0% | $32,237.50 | $290,087.50 | 0.00% |
| -1% | 1270.10 | 1276.61 | $255,271.50 | -$3,222.50 | -9.996% | $29,015.00 | $284,286.50 | -2.00% |
| -2% | 1257.27 | 1263.71 | $252,693.00 | -$6,447.50 | -20.00% | $25,790.00 | $278,483.00 | -4.00% |
| -5% | 1218.78 | 1225.03 | $244,957.50 | -$16,117.50 | -49.996% | $16,120.00 | $261,077.50 | -10.00% |

**Table 4b.**

**Analysis of "Bull" portfolio designed to achieve twice the return of the S&P 500 index. The spot level of the index is 1282.93 and the price of the March futures contract is 1289.50 on January 17th, 2006. Each contract requires 5% margin of $16,118.75. A portfolio worth $306,269 is allocated 18/19 ($290,150.25) to stock holdings and 1/19 ($16,118.75) to 1 futures contract. Futures prices are assumed to obey parity when spot index changes.**

| Percentage Change in Spot and Futures Prices | New Spot Index Value | New Futures Price | New Value of Portfolio Stock Holdings: $290,150.25* (1+change) | Change in Value of Margin Account ($F_t$ – 1289.50)*250 | Rate of Return: Margin Account | Total Value of Margin Account | Total Value of Fund Holdings | Rate of Return (Starting Value of $306,269) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| +5% | 1347.08 | 1353.98 | $304,657.76 | $16,120.00 | 100.01% | $32,238.75 | $336,896.51 | 10.00% |
| +2% | 1308.59 | 1315.29 | $295,953.26 | $6,447.50 | 40.00% | $22,566.25 | $318,519.51 | 4.00% |
| +1% | 1295.76 | 1302.40 | $293,051.75 | $3,225.00 | 20.01% | $19,343.75 | $312,395.50 | 2.00% |
| 0 | 1282.93 | 1289.50 | $290,150.25 | $0.00 | 0% | $16,118.75 | $306,269.00 | 0.00% |
| -1% | 1270.10 | 1276.61 | $287,248.75 | -$3,222.50 | -19.992% | $12,896.25 | $300,145.00 | -2.00% |
| -2% | 1257.27 | 1263.71 | $284,347.25 | -$6,447.50 | -40.00% | $9,671.25 | $294,018.50 | -4.00% |
| -5% | 1218.78 | 1225.03 | $275,642.74 | -$16,117.50 | -99.992% | $1.25[4] | $275,643.99 | -10.00% |

**Table 5a.**

**Analysis of "Bear" portfolio designed to achieve twice the inverse of the return of the S&P 500 index. The spot level of the index is 1282.93 and the price of the March futures contract is 1289.50 on January 17th, 2006. Each contract requires 10% margin of $32,237.50. A portfolio of $118,202.50 is allocated 72.727% ($85,965) to stock holdings and 27.273% ($32,237.50) to 1 short futures position. Futures prices are assumed to obey parity when spot index changes.**

| Percentage Change in Spot and Futures Prices | New Spot Index Value | New Futures Price | New Value of Portfolio Stock Holdings: $85,965* (1+change) | Change in Value of Margin Account (1289.50 - $F_t$)*250 | Rate of Return: Margin Account | Total Value of Margin Account | Total Value of Fund Holdings | Rate of Return (Starting Value of $118,202.50) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| +5% | 1347.08 | 1353.98 | $90,263.25 | -$16,120.00 | -50.00% | $16,117.50 | $106,380.75 | -10.00% |
| +2% | 1308.59 | 1315.29 | $87,684.30 | -$6,447.50 | -20.00% | $25,790.00 | $113,474.30 | -4.00% |
| +1% | 1295.76 | 1302.40 | $86,824.65 | -$3,225.00 | -10.00% | $29,012.50 | $115,837.15 | -2.00% |
| 0 | 1282.93 | 1289.50 | $85,965.00 | $0.00 | 0% | $32,237.50 | $118,202.50 | 0.00% |
| -1% | 1270.10 | 1276.61 | $85,105.35 | $3,222.50 | 9.996% | $35,460.00 | $120,565.35 | 2.00% |
| -2% | 1257.27 | 1263.71 | $84,245.70 | $6,447.50 | 20.00% | $38,685.00 | $122,930.70 | 4.00% |
| -5% | 1218.78 | 1225.03 | $81,666.75 | $16,117.50 | 49.996% | $48,355.00 | $130,021.75 | 10.00% |

**Table 5b.**

**Analysis of "Bear" portfolio designed to achieve twice the inverse of the return of the S&P 500 index. The spot level of the index is 1282.93 and the price of the March futures contract is 1289.50 on January 17th, 2006. Each contract requires 5% margin of $16,118.75. A portfolio of $112,828.75 is allocated 85.714% ($96,710) to stock holdings and 14.286% ($16,118.75) to 1 short futures position. Futures prices are assumed to obey parity when spot index changes.**

| Percentage Change in Spot and Futures Prices | New Spot Index Value | New Futures Price | New Value of Portfolio Stock Holdings: $96,710* (1+change) | Change in Value of Margin Account (1289.50 - $F_t$)*250 | Rate of Return: Margin Account | Total Value of Margin Account | Total Value of Fund Holdings | Rate of Return (Starting Value of $112,828.75) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| +5% | 1347.08 | 1353.98 | $101,545.50 | -$16,120.00 | -100.01% | -$1.25[5] | $101,544.25 | -10.00% |
| +2% | 1308.59 | 1315.29 | $98,644.20 | -$6,447.50 | -40.00% | $9,671.25 | $108,315.45 | -4.00% |
| +1% | 1295.76 | 1302.40 | $97,677.10 | -$3,225.00 | -20.01% | $12,893.75 | $110,570.85 | -2.00% |
| 0 | 1282.93 | 1289.50 | $96,710.00 | $0.00 | 0% | $16,118.75 | $112,828.75 | 0.00% |
| -1% | 1270.10 | 1276.61 | $95,742.90 | $3,222.50 | 19.992% | $19,341.25 | $115,084.15 | 2.00% |
| -2% | 1257.27 | 1263.71 | $94,775.80 | $6,447.50 | 40.00% | $22,566.25 | $117,342.05 | 4.00% |
| -5% | 1218.78 | 1225.03 | $91,874.50 | $16,117.50 | 99.992% | $32,236.25 | $124,110.75 | 10.00% |

**Appendix exhibits are available upon request.**