LV14042

Pair Trading with Options

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Abstract

Options are an easy concept to discuss but very are very difficult one to put into practice. In this exercise students are challenged to use different option strategies in a pair-trading framework. With market volatility high and after the stock market fallout in 2008, pair trading has gained much attention. Students have also become interested in this more complex way of trading. This exercise combines the concepts of both pair trading and options to create an experiential learning experience for students. Students will create their own pair trade and then use an option strategy to make a pair trade. Options allow the investor to eliminate the downside risks of a typical pair trade but also add complexities such as time decay of option premiums. The exercise provides students with the ability to explore option strategies in a real-world trading scenario examining premiums over time instead of a static problem set only thinking about the valuation of options at expiration.

Finance students are both confused and excited about options and the use of options. Although the initial understanding of options is achievable through traditional lecturing and option problem sets, the real understanding of options is only understood through the use of options in different scenarios. In this exercise, students are placed in a real world-trading environment to test their knowledge of option strategies and witness how these strategies work using historical option data. In this paper we integrate the use of option strategies with the idea of pair trading.

Pair trading is not a new concept but with market volatility at all time highs, pair trading has gained attention within the trading community and has filtered its way to the retail investing public. With retail traders hearing more about pair trading students have begun to gain interest in this topic as well. Pair trading is a market neutral trading strategy, which enables traders to profit under virtually any market conditions. The direction of the market has no apparent affect on the trade. Usually most courses in Finance have limited coverage on pair trading. Pair trading typically involves pairing a long position in a stock with a short position in another stock. Of course the long position is one that an investor feels will increase and the short one is a stock the investor would feel is inferior. Pair trading typically involves two similar firms or ETFs. Since most investors and students are long only investors the idea of pair trading is sometimes a hard one to grasp. Shorting a stock is sometimes thought as a more dangerous position than being long (or owning) a stock. Theoretically this is true as a short position can lose an infinite amount of money.

We introduce the use of options within the framework of pair trading. Trading with options versus stock allows for different risk/return tradeoffs. Options can be used to

limit the downside risk of the short component of the pair trade, thus making a pair trade with options can better define the risk of downside of the pair trade, which as mentioned above is unlimited as it relates to the short position. In the exercise students come up with a hypothetical pair trade and then create an option strategy to take advantage of the pair trade. One potential selection for the option trade is a straddle pair trade. This involves the purchase of a call on the stock believed to go up and purchasing a put on the stock believed to drop. Students can explore different option strategies and then back test their trading strategy and the success of the pair trade by looking at the equity only returns versus that of options from their pair trade selected.

This exercise provides students with an experiential learning method to numerous different learning objectives. Instead of just learning about options and pair trades students learn by developing trades and testing them. Students will analyze different option strategies and examine investments in a pair-trading framework. Also, be able to examine portfolio and risk management in an option framework. Finally, it allows students to reflect on their option strategy and pair trade to measure their success in understanding the concept of options and pair trading.

This exercise would be a particular good fit for any Investment course or in a Financial Markets course. It could also used with currencies and currency options for an International Finance course. This would most likely be used in a graduate course, but could be adapted for an undergraduate course as well if simplified. This exercise would also be a perfect compliment with the Black-Scholes model. Students can se actual option premiums and how they are impacted by the variables within the Black-Scholes model. As students set up a trading strategy they can see the importance of what impacts option

premiums. This paper proceeds as follows: Section two explains the related literature. Section three explains how to conduct the exercise and provides the instructor notes for the exercise. Section four provides sample pair trades using options and tables showing the results of those trades. Section five concludes.

II. Literature Review

Preston (2011) discusses the logic of the pair trade, which is to make money on the fluctuations in price between the two stocks (or whichever instrument is used). If both stocks increase, but the long position increases faster relative to the short position, you will have losses on the short position and gains on the long position; the profits would exceed the losses here if the long position were greater than the short position. The idea he points out is that the logic of pairs trading can be quite simple, though the actual trading can become complex. An investor needs to know the logic of the trade and indicators he is looking for before he can make his trades successful.

He further argues that the correlation (relative strength) between the two stocks needs to be positive. If there is a positive correlation between the two stocks and the two stocks are correlated to the market, an increase in the market will cause a movement of the same magnitude for each stock. For highly uncorrelated stocks, a change in the market will not lead to the desired change and could lead to disastrous effects.

Preston's main focus is that the pair needs to be at a higher spread than usual. It needs to be an unusual event that an investor can take advantage of as the spread reverts to its mean. You buy the stock that is relatively cheap, sell the stock that is relatively expensive, and speculate that the long position will rise relative to the short position.

Preston states that as the spread reverts “the speculation behind the pairs trade has been met and it is wise to close it out with a profit or loss” (*Traders-Mag.com*, p.44). Though these trades take much patience and knowledge, it is an opportunity to make a profit whether the market is going up or down; just find a pair that has a spread that reverted from its mean (prices above and below the normal range) and speculate on the trade reverting to its mean over a period of time. Whether you are trading equities or derivative instruments such as options, the same principles apply and profits may be realized.

Chang and Chang (2011) discuss the biases in the different methods of calculating prices, so with a superior pricing formula, some biases should be removed. They conclude that the information-time formula outperforms Merton’s diffusion-jump formula in explaining Black-Scholes biases, but is less satisfactory in the case of stock options. They suggest that transaction counts or trading volume should affect asset prices and that information-time pricing should be a valuable alternative to the traditional calendar-time pricing.

Gatev et al (2006) discusses the performance of pairs trading and the arbitrage opportunities presented to investors who trade pairs. They begin by stating that the excess returns of pairs trading are a result of temporary mispricing. In their study, they found that the profits from the pairs they chose were uncorrelated with the S&P 500, but were slightly sensitive to the spreads between small and large stocks and between value and growth stocks. Their claim is that excess returns are related to the mispricing of stocks. They showed in their research that the profits were not due simply to mean reversion alone. In that case, one would expect the returns of both the short and the long positions

to be equal. Thus, there are more factors than mere mean reversion to consider in a successful pairs trade.

III. Instructor Notes / Student Exercise

Lectures of both pair trading and of options would precede this exercise. Some extra readings can be assigned including the references in this paper to increase student understanding. The idea of pair trading will be explained to students including explaining how to setup a pair trade and how it works. A typical pair trade is buying one stock you think will increase while at the same time selling a stock in a similar industry, sector, or market direction. The design of most pair trades is to take advantage of some mispricing or fundamental swing in prices of stocks. Students will also need to understand how options work to make a pair trade using options.

First, students must be aware of option leverage. Each stock call option contract purchased gives the investor the right to purchase 100 shares of stock at the given exercise price, while a put gives the investor the right to sell 100 shares of stock at the given exercise price. The "greeks" of options also need to be explained to students so they understand how options are trading in a portfolio setting. First, delta or how a $1 change in stock price impacts option premiums must be explained to students. A delta of 0.50 signifies that a dollar increase in stock price leads to an increase of 50 cents in the option premium. When picking the options to use students can use delta to determine the ratio of calls and puts to use if a delta strategy is desired, similar to a Beta neutral strategy for an all equity pair trade. Gamma (first derivative of delta) or the rate at which delta

increases or decreases can be used as well for the students to further develop their option strategy.

Next, students should examine theta or time premium decay. This shows how fast the time premium of the option reduces or decays over time. This is important because when purchasing calls and puts as time passes the option time premium approaches zero. Thus, options with longer time periods have higher premiums and those premiums decay as you approach expiration. Next, vega or the how volatility impacts option prices. As volatility of the underlining stock increases so does option premiums on that stock. With all else equal, the option premium increases in value when the implied volatility of the underlying stock increases. So, even with no price movement in the underlining stock the option will move down with time and can move up and down with changes in volatility. The option strategy summary is shown in figure 1, which can be provided to students.

OPTION GREEKS SUMMARY – Figure 1

Delta	How stock price changes impact option premiums
Gamma	First derivative of delta (the rate at which delta increases or decreases)
Theta	Time premium decay (how fast the time premium decays over time)
Vega	How the option premium will change with changes in implied volatility of the stock

Exercise Explained

After explaining about pair trading and options, students will be instructed to think of an interesting pair trade with stocks. Next, the students will have to create an option strategy to take advantage of the pair trade such as a spread or straddle. Students should motivate the option strategy used by explaining how the strategy works and how it will be used to maximize returns or limit downside risks. For example a straddle limits the investors potential loss if the trade goes down but also is expensive in terms of time

period decay (the theta discussed earlier). Third, students will set a time period for their trade in terms of how long they will have the trade for. Fourth, students are given the raw data to calculate the profit or loss of trade(s) over the selected time period. The dates of this data (annual or two years) can be given beforehand or hidden so students do not know the results before picking a strategy. Either way is interesting as either students think they have a good or bad strategy based on stock returns and will see the impact of an option trade or will be surprised both by the equity only pair trade and the option pair trade. Students will see how their option strategy traded over the time period. The time period for the pair trade can be months or years depending on the preference of the instructor and the purpose of the trade.

Discussion Questions

1. Explain theoretically when your option strategy should do well and when it would do poorly. Discuss other option strategies that could be used.
2. Gather the stock returns for both stocks over a three-year time period. Analyze the pair trade based solely on equity returns. Base gains and losses on a hypothetical $500,000 portfolio.
3. Discuss why the leverage, VIX (proxy for vega), time premium (or theta), and stock price movement in comparison to the stock (delta) is important to the premiums of options. How do these affect whether you pick in-the-money, out-of-the-money, or at-the-money options?
4. Gather and calculate your option performance and measure it against that of the equity holdings, VIX, and S&P 500.

5. Discuss how the option strategy worked and how it is different for an all equity pair trade.
6. In this particular exercise, we already know the performance of stocks and options beforehand. Based on the results what type of trade (stock or option) would you use in the future if you were going to make a pair trade?

Answers to Discussion Questions

1. Explain theoretically when your option strategy should do well and when it would do poorly.

   Students should answer this question by discussing their option strategy and how it should work theoretically work in different scenarios. For example if the student selected a straddle (buying both a call and put), they should comment on the cost of the straddle and how no movement in the stock would be bad for this strategy even outside of the normal pair trade. Also, if each stock moved up a lot or down a lot than the straddle would be a good trade even if the pair trade part of the trade did work well. This is a good point of the exercise for the students to first think about what might happen and then see what happens with the data.

2. Discuss why the leverage, VIX (proxy for vega), time premium (or theta), and option price movement in comparison to the underlining stock (delta) is important to the premiums of options. How do these affect whether you pick in-the-money, out-of-the-money, or at-the-money options?

   Students should define all items listed in question 2, similar to what was written under the instructor notes. Students should also discuss the concept of in-the-money, out-of-the-money, and at-the-money. Students should link together the

fact that out-of-the money options have the smallest deltas but can have the largest percentage moves, and the opposite with in-the-money options.

3. Analyze the pair trade based solely on equity returns. Base gains and losses on a hypothetical $500,000 portfolio. Gather and calculate your option performance and measure it against that of the equity holdings, VIX, and S&P 500.

   An example of pair trades that could be selected is included in the section titled sample pair trades and in the tables below. These trades are three year in duration, which may be much longer than the duration chosen by students, but provide an example of a potential trade.

4. Discuss how the option strategy worked and how it is different for an equity pair trade.

   Students should analyze the returns of the equity portfolio versus that of the option portfolio and provide some analysis between the two. An example of this is shown in the sample pair trades section and tables below. Students should also discuss how the option strategy selected worked and how it was different from an equity pair trade.

5. Based on the results what type of trade (stock or option) would you use in the future if you were going to make a pair trade? How could the information from the exercise impact your future trading? How did this exercise increase your understanding of pair trading and options?

   Students should respond with a reflection type answer for this question. After the completion of the exercise students should discuss how their understanding has increased and list of couple of things they learned through the exercise. For

example students could discuss how pair trading with options using a straddle strategy makes volatility almost more important than the quality of the pair trade. Students may also address how time decay of options and how it is important to trade options before they expire, discussing the rolling of shorter term options to capture the pair trade over several months or years.

IV. Sample Pair Trades

The tables show four pair trades pair trades created by students: long AAPL, short RIMM; long HD, short LOW; long QQQ, short SPY; and long DIA, short SPY. Call options were purchased for AAPL, HD, QQQ, and DIA; put options were purchased for RIMM, LOW, and SPY. From 2008 through 2010, Apple experienced a phenomenal increase in price, while Research in Motion experienced a phenomenal decline in price; as one might expect, this would lead to great profits with this pair trade, as will be shown later. Home Depot experienced a high growth rate, being priced around 63% higher at the end of 2010 versus the beginning of 2008; Lowe's experienced growth, but much lower around 3% higher over the three-year period. For consistency, both indexes were paired against the S&P 500 index; the NASDAQ trade fared much better than the Dow Jones trade.

Data Used For Sample Pair Trades

Data was collected from a pool of options data from 2008 through 2010. This was the time period of data used but this can be adjusted to fit the duration selected by both the instructor and the students. Among the collected information was the underlying stock price, the strike price, bid and ask beginning price, bid and ask ending price, and

the delta of each option. For the month of January 2008, the purchase would be options expiring in February 2008; the options would be purchased at the beginning of the month and exercised at the end of the month. For February 2008, it would be options expiring in March 2008; the options would be purchased at the end of January and exercised at the end of February. An amount of $50,000 was allocated to each pair trade; each month $50,000 was reinvested into each pair trade. This was compared to holding only stock the entire time. Options pair trades were adjusted for delta, as it tracks the change in the option price with the change in the underlying stock. For trades holding stock only, adjustments for beta were made. The options-only strategy was then compared to the stock-only strategy.

V. Conclusion

Experiential learning is on the rise and it has been shown that students will retain things longer after putting them into practice. Options are traditional an easy concept to discuss but students never seem to fully understand the idea of options and how they are traded. This exercise gives students the opportunity to use options in practice and formulate a trading strategy. The exercise increase students understanding and retention of options and pair trading while at the same time provides them with a real-world trading experience.

Table 1: Long AAPL, Short RIMM								
Date	**Options**	**Returns**	**Stock Returns**	**Difference**	**S&P**	**Absolute Δ**	**VIX**	**VIX Δ**
Jan '08	$ 14,798.00	29.60%	-14.45%	44.05%	-6.12%	6.12%	17.75	16.44%
Feb '08	$ (39,418.00)	-78.84%	-18.21%	-60.63%	-3.48%	3.48%	23.54	1.30%
Mar '08	$ 23,864.00	47.73%	6.66%	41.07%	-0.60%	0.60%	21.20	-3.50%
Apr '08	$ 77,395.00	154.79%	12.84%	141.95%	4.75%	4.75%	23.70	-18.82%
May '08	$ (19,054.00)	-38.11%	-5.67%	-32.44%	1.07%	1.07%	26.05	-14.24%
June '08	$ (3,560.00)	-7.12%	4.53%	-11.65%	-8.60%	8.60%	23.50	34.32%
July '08	$ (29,020.00)	-58.04%	-10.13%	-47.91%	-0.99%	0.99%	34.54	-4.22%
Aug '08	$ (2,235.00)	-4.47%	7.65%	-12.12%	1.22%	1.22%	32.07	-9.98%
Sept '08	$ 89,037.00	178.07%	10.88%	167.20%	-9.08%	9.08%	22.05	90.75%
Oct '08	$ 7,415.00	14.83%	20.82%	-5.99%	-16.94%	16.94%	17.59	52.04%
Nov '08	$ 8,315.00	16.63%	1.92%	14.71%	-7.48%	7.48%	19.50	-7.70%
Dec '08	$ (34,752.00)	-69.50%	-3.45%	-66.06%	0.78%	0.78%	24.62	-27.64%
Jan '09	$ (38,400.00)	-76.80%	-30.92%	-45.88%	-8.57%	8.57%	21.68	12.10%
Feb '09	$ 76,860.00	153.72%	27.00%	126.72%	-10.99%	10.99%	24.51	3.37%
Mar '09	$ 21,340.00	42.68%	9.77%	32.91%	8.54%	8.54%	30.69	-4.77%
Apr '09	$ 5,800.00	11.60%	-41.51%	53.11%	9.39%	9.39%	25.61	-17.31%
May '09	$ (6,996.00)	-13.99%	-5.22%	-8.77%	5.31%	5.31%	26.01	-20.77%
June '09	$ 13,540.00	27.08%	14.48%	12.60%	0.02%	0.02%	25.92	-8.89%
July '09	$ 29,895.00	59.79%	7.82%	51.97%	7.41%	7.41%	26.35	-1.63%
Aug '09	$ (11,740.00)	-23.48%	6.81%	-30.29%	3.36%	3.36%	28.92	0.35%
Sept '09	$ 31,040.00	62.08%	17.62%	44.46%	3.57%	3.57%	36.50	-1.54%
Oct '09	$ 54,840.00	109.68%	14.86%	94.82%	-1.98%	1.98%	44.14	19.84%
Nov '09	$ (16,712.00)	-33.42%	7.48%	-40.91%	5.74%	5.74%	46.35	-20.14%
Dec '09	$ (6,045.00)	-12.09%	-11.26%	-0.83%	1.78%	1.78%	44.84	-11.55%
Jan '10	$ (25,073.00)	-50.15%	-2.00%	-48.14%	-3.70%	3.70%	40.00	13.56%
Feb '10	$ (8,331.00)	-16.66%	-6.13%	-10.53%	2.85%	2.85%	55.28	-20.80%
Mar '10	$ 45,066.00	90.13%	10.49%	79.64%	5.88%	5.88%	59.89	-9.79%
Apr '10	$ 36,958.00	73.92%	14.86%	59.06%	1.48%	1.48%	39.39	25.36%
May '10	$ 67,554.00	135.11%	13.14%	121.97%	-8.20%	8.20%	20.65	45.44%
June '10	$ 17,550.00	35.10%	16.75%	18.35%	-5.39%	5.39%	22.94	7.70%
July '10	$ (26,103.00)	-52.21%	-14.51%	-37.69%	6.88%	6.88%	23.95	-31.96%
Aug '10	$ 36,520.00	73.04%	20.03%	53.01%	-4.74%	4.74%	17.83	10.85%
Sept '10	$ 30,915.00	61.83%	3.07%	58.76%	8.76%	8.76%	20.79	-9.02%
Oct '10	$ (9,808.00)	-19.62%	-10.83%	-8.79%	3.69%	3.69%	25.61	-10.55%
Nov '10	$ (17,870.00)	-35.74%	-5.25%	-30.49%	-0.23%	0.23%	26.54	11.04%
Dec '10	$ 3,595.00	7.19%	9.65%	-2.46%	6.53%	6.53%	26.20	-24.60%
Sum	$ 397,180.00	794.36%	79.58%	714.78%	-8.07%	186.06%	1046.7	65.06%
Average	$ 11,032.78	22.07%	2.21%	19.86%	-0.22%	5.17%	29.08	1.81%

Table 2: Long HD, Short LOW								
Date	**Options**	**Returns**	**Stock Returns**	**Difference**	**S&P**	**Absolute Δ**	**VIX**	**VIX Δ**
Jan '08	$ 7,285.00	14.57%	-3.59%	18.16%	-6.12%	6.12%	17.75	16.44%
Feb '08	$ (25,800.00)	-51.60%	-4.00%	-47.60%	-3.48%	3.48%	23.54	1.30%
Mar '08	$ 17,196.00	34.39%	10.56%	23.83%	-0.60%	0.60%	21.20	-3.50%
Apr '08	$ (32,605.00)	-65.21%	-7.18%	-58.03%	4.75%	4.75%	23.70	-18.82%
May '08	$ (11,536.00)	-23.07%	-0.27%	-22.80%	1.07%	1.07%	26.05	-14.24%
June '08	$ 9,022.00	18.04%	-0.16%	18.21%	-8.60%	8.60%	23.50	34.32%
July '08	$ (16,635.00)	-33.27%	3.38%	-36.65%	-0.99%	0.99%	34.54	-4.22%
Aug '08	$ 28,118.00	56.24%	-7.48%	63.71%	1.22%	1.22%	32.07	-9.98%
Sept '08	$ 10,412.00	20.82%	0.13%	20.70%	-9.08%	9.08%	22.05	90.75%
Oct '08	$ (4,884.00)	-9.77%	-0.89%	-8.88%	-16.94%	16.94%	17.59	52.04%
Nov '08	$ (11,570.00)	-23.14%	2.77%	-25.91%	-7.48%	7.48%	19.50	-7.70%
Dec '08	$ (16,245.00)	-32.49%	-3.50%	-28.99%	0.78%	0.78%	24.62	-27.64%
Jan '09	$ 7,428.00	14.86%	8.31%	6.54%	-8.57%	8.57%	21.68	12.10%
Feb '09	$ 16,876.00	33.75%	10.31%	23.44%	-10.99%	10.99%	24.51	3.37%
Mar '09	$ 16,576.00	33.15%	-1.10%	34.25%	8.54%	8.54%	30.69	-4.77%
Apr '09	$ (14,566.00)	-29.13%	-6.53%	-22.60%	9.39%	9.39%	25.61	-17.31%
May '09	$ (27,802.00)	-55.60%	-0.42%	-55.18%	5.31%	5.31%	26.01	-20.77%
June '09	$ (23,317.00)	-46.63%	0.85%	-47.49%	0.02%	0.02%	25.92	-8.89%
July '09	$ 9,081.00	18.16%	-6.47%	24.64%	7.41%	7.41%	26.35	-1.63%
Aug '09	$ 12,285.00	24.57%	9.50%	15.07%	3.36%	3.36%	28.92	0.35%
Sept '09	$ (23,730.00)	-47.46%	1.01%	-48.47%	3.57%	3.57%	36.50	-1.54%
Oct '09	$ (19,586.00)	-39.17%	0.29%	-39.46%	-1.98%	1.98%	44.14	19.84%
Nov '09	$ 11,522.00	23.04%	-2.38%	25.43%	5.74%	5.74%	46.35	-20.14%
Dec '09	$ (22,981.00)	-45.96%	-0.62%	-45.34%	1.78%	1.78%	44.84	-11.55%
Jan '10	$ (10,570.00)	-21.14%	3.91%	-25.05%	-3.70%	3.70%	40.00	13.56%
Feb '10	$ 15,897.00	31.79%	1.90%	29.90%	2.85%	2.85%	55.28	-20.80%
Mar '10	$ (13,162.00)	-26.32%	2.22%	-28.54%	5.88%	5.88%	59.89	-9.79%
Apr '10	$ 36,082.00	72.16%	-3.40%	75.56%	1.48%	1.48%	39.39	25.36%
May '10	$ 19,869.00	39.74%	4.87%	34.86%	-8.20%	8.20%	20.65	45.44%
June '10	$ 33,835.00	67.67%	0.99%	66.68%	-5.39%	5.39%	22.94	7.70%
July '10	$ (22,245.00)	-44.49%	-0.57%	-43.92%	6.88%	6.88%	23.95	-31.96%
Aug '10	$ (29,063.00)	-58.13%	0.62%	-58.75%	-4.74%	4.74%	17.83	10.85%
Sept '10	$ 32,177.00	64.35%	3.95%	60.40%	8.76%	8.76%	20.79	-9.02%
Oct '10	$ (12,592.00)	-25.18%	1.29%	-26.48%	3.69%	3.69%	25.61	-10.55%
Nov '10	$ (21,693.00)	-43.39%	-7.83%	-35.56%	-0.23%	0.23%	26.54	11.04%
Dec '10	$ (39,272.00)	-78.54%	5.56%	-84.10%	6.53%	6.53%	26.20	-24.60%
Sum	$ (116,193.00)	-232.39%	16.04%	-248.43%	-8.07%	186.06%	1046.70	65.06%
Average	$ (3,227.58)	-6.46%	0.45%	-6.90%	-0.22%	5.17%	29.08	1.81%

Table 3: Long QQQ, Short SPY								
Date	**Options**	**Returns**	**Stock Returns**	**Difference**	**S&P**	**Absolute Δ**	**VIX**	**VIX Δ**
Jan '08	$ (13,447.00)	-26.89%	-5.83%	-21.06%	-6.12%	6.12%	17.75	16.44%
Feb '08	$ 41,083.00	82.17%	-2.26%	84.42%	-3.48%	3.48%	23.54	1.30%
Mar '08	$ (23,226.00)	-46.45%	2.78%	-49.23%	-0.60%	0.60%	21.20	-3.50%
Apr '08	$ 2,652.00	5.30%	3.21%	2.10%	4.75%	4.75%	23.70	-18.82%
May '08	$ (5,828.00)	-11.66%	4.42%	-16.08%	1.07%	1.07%	26.05	-14.24%
June '08	$ 24,703.00	49.41%	-1.26%	50.67%	-8.60%	8.60%	23.50	34.32%
July '08	$ (23,125.00)	-46.25%	1.53%	-47.78%	-0.99%	0.99%	34.54	-4.22%
Aug '08	$ (20,782.00)	-41.56%	-0.08%	-41.49%	1.22%	1.22%	32.07	-9.98%
Sept '08	$ 25,767.00	51.53%	-6.16%	57.70%	-9.08%	9.08%	22.05	90.75%
Oct '08	$ 31,820.00	63.64%	1.05%	62.59%	-16.94%	16.94%	17.59	52.04%
Nov '08	$ 16,890.00	33.78%	-4.50%	38.28%	-7.48%	7.48%	19.50	-7.70%
Dec '08	$ (10,143.00)	-20.29%	1.28%	-21.56%	0.78%	0.78%	24.62	-27.64%
Jan '09	$ 13,288.00	26.58%	5.94%	20.64%	-8.57%	8.57%	21.68	12.10%
Feb '09	$ 20,748.00	41.50%	5.47%	36.03%	-10.99%	10.99%	24.51	3.37%
Mar '09	$ 11,187.00	22.37%	2.01%	20.37%	8.54%	8.54%	30.69	-4.77%
Apr '09	$ 7,837.00	15.67%	3.13%	12.54%	9.39%	9.39%	25.61	-17.31%
May '09	$ (16,374.00)	-32.75%	-2.63%	-30.12%	5.31%	5.31%	26.01	-20.77%
June '09	$ (14,678.00)	-29.36%	3.00%	-32.36%	0.02%	0.02%	25.92	-8.89%
July '09	$ 9,100.00	18.20%	0.98%	17.22%	7.41%	7.41%	26.35	-1.63%
Aug '09	$ (22,652.00)	-45.30%	-2.22%	-43.09%	3.36%	3.36%	28.92	0.35%
Sept '09	$ (9,301.00)	-18.60%	2.11%	-20.71%	3.57%	3.57%	36.50	-1.54%
Oct '09	$ (20,400.00)	-40.80%	-1.14%	-39.66%	-1.98%	1.98%	44.14	19.84%
Nov '09	$ (1,366.00)	-2.73%	0.18%	-2.91%	5.74%	5.74%	46.35	-20.14%
Dec '09	$ (970.00)	-1.94%	3.30%	-5.24%	1.78%	1.78%	44.84	-11.55%
Jan '10	$ (6,248.00)	-12.50%	-2.83%	-9.67%	-3.70%	3.70%	40.00	13.56%
Feb '10	$ (4,579.00)	-9.16%	1.49%	-10.65%	2.85%	2.85%	55.28	-20.80%
Mar '10	$ 6,388.00	12.78%	2.05%	10.73%	5.88%	5.88%	59.89	-9.79%
Apr '10	$ 1,030.00	2.06%	0.71%	1.35%	1.48%	1.48%	39.39	25.36%
May '10	$ 60,969.00	121.94%	0.54%	121.39%	-8.20%	8.20%	20.65	45.44%
June '10	$ (17,282.00)	-34.56%	-0.97%	-33.59%	-5.39%	5.39%	22.94	7.70%
July '10	$ 3,270.00	6.54%	0.43%	6.11%	6.88%	6.88%	23.95	-31.96%
Aug '10	$ (12,464.00)	-24.93%	-0.63%	-24.29%	-4.74%	4.74%	17.83	10.85%
Sept '10	$ 27,218.00	54.44%	4.22%	50.21%	8.76%	8.76%	20.79	-9.02%
Oct '10	$ 8,820.00	17.64%	2.51%	15.13%	3.69%	3.69%	25.61	-10.55%
Nov '10	$ (17,492.00)	-34.98%	-0.17%	-34.81%	-0.23%	0.23%	26.54	11.04%
Dec '10	$ (12,460.00)	-24.92%	-1.93%	-22.99%	6.53%	6.53%	26.20	-24.60%
Sum	$ 59,953.00	119.91%	19.70%	100.20%	-8.07%	186.06%	1046.70	65.06%
Average	$ 1,665.36	3.33%	0.55%	25.35%	-0.44%	10.06%	29.08	1.81%

Table 4: Long DIA, Short SPY

Date	Options	Returns	Stock Returns	Difference	S&P	Absolute Δ	VIX	VIX Δ
Jan '08	$ (12,105.00)	-24.21%	1.22%	-25.43%	-6.12%	6.12%	17.75	16.44%
Feb '08	$ 48,654.00	97.31%	0.40%	96.91%	-3.48%	3.48%	23.54	1.30%
Mar '08	$ (32,362.00)	-64.72%	0.64%	-65.36%	-0.60%	0.60%	21.20	-3.50%
Apr '08	$ (17,611.00)	-35.22%	0.09%	-35.31%	4.75%	4.75%	23.70	-18.82%
May '08	$ (24,192.00)	-48.38%	-2.86%	-45.52%	1.07%	1.07%	26.05	-14.24%
June '08	$ 21,984.00	43.97%	-1.52%	45.48%	-8.60%	8.60%	23.50	34.32%
July '08	$ (19,380.00)	-38.76%	1.29%	-40.05%	-0.99%	0.99%	34.54	-4.22%
Aug '08	$ (17,225.00)	-34.45%	0.22%	-34.67%	1.22%	1.22%	32.07	-9.98%
Sept '08	$ 36,210.00	72.42%	3.55%	68.87%	-9.08%	9.08%	22.05	90.75%
Oct '08	$ 32,220.00	64.44%	2.96%	61.48%	-16.94%	16.94%	17.59	52.04%
Nov '08	$ 16,260.00	32.52%	1.82%	30.70%	-7.48%	7.48%	19.50	-7.70%
Dec '08	$ (19,409.00)	-38.82%	-1.55%	-37.27%	0.78%	0.78%	24.62	-27.64%
Jan '09	$ 9,068.00	18.14%	-0.14%	18.27%	-8.57%	8.57%	21.68	12.10%
Feb '09	$ 16,335.00	32.67%	-0.46%	33.13%	-10.99%	10.99%	24.51	3.37%
Mar '09	$ 11,373.00	22.75%	-0.89%	23.63%	8.54%	8.54%	30.69	-4.77%
Apr '09	$ (16,029.00)	-32.06%	-2.06%	-29.99%	9.39%	9.39%	25.61	-17.31%
May '09	$ (9,745.00)	-19.49%	-0.99%	-18.50%	5.31%	5.31%	26.01	-20.77%
June '09	$ (24,475.00)	-48.95%	-0.47%	-48.48%	0.02%	0.02%	25.92	-8.89%
July '09	$ 20,506.00	41.01%	0.98%	40.03%	7.41%	7.41%	26.35	-1.63%
Aug '09	$ (14,287.00)	-28.57%	0.36%	-28.93%	3.36%	3.36%	28.92	0.35%
Sept '09	$ (18,876.00)	-37.75%	-1.22%	-36.54%	3.57%	3.57%	36.50	-1.54%
Oct '09	$ (7,940.00)	-15.88%	1.99%	-17.87%	-1.98%	1.98%	44.14	19.84%
Nov '09	$ 10,962.00	21.92%	0.91%	21.02%	5.74%	5.74%	46.35	-20.14%
Dec '09	$ (31,372.00)	-62.74%	-1.05%	-61.69%	1.78%	1.78%	44.84	-11.55%
Jan '10	$ (8,050.00)	-16.10%	0.25%	-16.35%	-3.70%	3.70%	40.00	13.56%
Feb '10	$ (15,834.00)	-31.67%	-0.12%	-31.54%	2.85%	2.85%	55.28	-20.80%
Mar '10	$ 10,302.00	20.60%	-0.51%	21.11%	5.88%	5.88%	59.89	-9.79%
Apr '10	$ (9,095.00)	-18.19%	-0.10%	-18.09%	1.48%	1.48%	39.39	25.36%
May '10	$ 56,998.00	114.00%	0.46%	113.54%	-8.20%	8.20%	20.65	45.44%
June '10	$ (14,520.00)	-29.04%	1.66%	-30.70%	-5.39%	5.39%	22.94	7.70%
July '10	$ 13,600.00	27.20%	0.40%	26.80%	6.88%	6.88%	23.95	-31.96%
Aug '10	$ (11,481.00)	-22.96%	0.56%	-23.52%	-4.74%	4.74%	17.83	10.85%
Sept '10	$ (293.00)	-0.59%	-1.07%	0.49%	8.76%	8.76%	20.79	-9.02%
Oct '10	$ (18,124.00)	-36.25%	-0.59%	-35.66%	3.69%	3.69%	25.61	-10.55%
Nov '10	$ (18,450.00)	-36.90%	-0.70%	-36.20%	-0.23%	0.23%	26.54	11.04%
Dec '10	$ (12,087.00)	-24.17%	-1.49%	-22.68%	6.53%	6.53%	26.20	-24.60%
Sum	$ (68,470.00)	-136.94%	1.96%	-138.90%	-8.07%	186.06%	1046.7	65.06%
Average	$ (1,901.94)	-3.80%	0.05%	-3.86%	-0.22%	5.17%	29.075	1.81%

Table 5: Summary of Trades								
Date	**Options**	**%**	**Stocks**	**Difference**	**S&P**	**Absolute Δ**	**VIX**	**VIX Δ**
Jan '08	$ (3,469.00)	-1.73%	-22.65%	20.92%	-6.12%	6.12%	17.75	16.44%
Feb '08	$ 24,519.00	12.26%	-24.06%	36.32%	-3.48%	3.48%	23.54	1.30%
Mar '08	$ (14,528.00)	-7.26%	20.64%	-27.91%	-0.60%	0.60%	21.20	-3.50%
Apr '08	$ 29,831.00	14.92%	8.96%	5.96%	4.75%	4.75%	23.70	-18.82%
May '08	$ (60,610.00)	-30.31%	-4.38%	-25.93%	1.07%	1.07%	26.05	-14.24%
June '08	$ 52,149.00	26.07%	1.59%	24.48%	-8.60%	8.60%	23.50	34.32%
July '08	$ (88,160.00)	-44.08%	-3.93%	-40.15%	-0.99%	0.99%	34.54	-4.22%
Aug '08	$ (12,124.00)	-6.06%	0.31%	-6.37%	1.22%	1.22%	32.07	-9.98%
Sept '08	$ 161,426.00	80.71%	8.39%	72.32%	-9.08%	9.08%	22.05	90.75%
Oct '08	$ 66,571.00	33.29%	23.94%	9.34%	-16.94%	16.94%	17.59	52.04%
Nov '08	$ 29,895.00	14.95%	2.01%	12.94%	-7.48%	7.48%	19.50	-7.70%
Dec '08	$ (80,549.00)	-40.27%	-7.22%	-33.06%	0.78%	0.78%	24.62	-27.64%
Jan '09	$ (8,616.00)	-4.31%	-16.81%	12.50%	-8.57%	8.57%	21.68	12.10%
Feb '09	$ 130,819.00	65.41%	42.31%	23.10%	-10.99%	10.99%	24.51	3.37%
Mar '09	$ 60,476.00	30.24%	9.78%	20.45%	8.54%	8.54%	30.69	-4.77%
Apr '09	$ (16,958.00)	-8.48%	-46.98%	38.50%	9.39%	9.39%	25.61	-17.31%
May '09	$ (60,917.00)	-30.46%	-9.26%	-21.20%	5.31%	5.31%	26.01	-20.77%
June '09	$ (48,930.00)	-24.47%	17.86%	-42.33%	0.02%	0.02%	25.92	-8.89%
July '09	$ 68,582.00	34.29%	3.31%	30.98%	7.41%	7.41%	26.35	-1.63%
Aug '09	$ (36,394.00)	-18.20%	14.45%	-32.65%	3.36%	3.36%	28.92	0.35%
Sept '09	$ (20,867.00)	-10.43%	19.52%	-29.95%	3.57%	3.57%	36.50	-1.54%
Oct '09	$ 6,914.00	3.46%	16.00%	-12.55%	-1.98%	1.98%	44.14	19.84%
Nov '09	$ 4,406.00	2.20%	6.19%	-3.99%	5.74%	5.74%	46.35	-20.14%
Dec '09	$ (61,368.00)	-30.68%	-9.63%	-21.05%	1.78%	1.78%	44.84	-11.55%
Jan '10	$ (49,941.00)	-24.97%	-0.68%	-24.29%	-3.70%	3.70%	40.00	13.56%
Feb '10	$ (12,847.00)	-6.42%	-2.86%	-3.56%	2.85%	2.85%	55.28	-20.80%
Mar '10	$ 48,594.00	24.30%	14.24%	10.05%	5.88%	5.88%	59.89	-9.79%
Apr '10	$ 64,975.00	32.49%	12.08%	20.41%	1.48%	1.48%	39.39	25.36%
May '10	$ 205,390.00	102.70%	19.01%	83.68%	-8.20%	8.20%	20.65	45.44%
June '10	$ 19,583.00	9.79%	18.43%	-8.64%	-5.39%	5.39%	22.94	7.70%
July '10	$ (31,478.00)	-15.74%	-14.26%	-1.48%	6.88%	6.88%	23.95	-31.96%
Aug '10	$ (16,488.00)	-8.24%	20.59%	-28.83%	-4.74%	4.74%	17.83	10.85%
Sept '10	$ 90,017.00	45.01%	10.17%	34.84%	8.76%	8.76%	20.79	-9.02%
Oct '10	$ (31,704.00)	-15.85%	-7.62%	-8.24%	3.69%	3.69%	25.61	-10.55%
Nov '10	$ (75,505.00)	-37.75%	-13.96%	-23.80%	-0.23%	0.23%	26.54	11.04%
Dec '10	$ (60,224.00)	-30.11%	11.79%	-41.90%	6.53%	6.53%	26.20	-24.60%
Sum	$ 272,470.00	136.24%	117.28%	18.95%	-8.07%	186.06%	1046.70	65.06%
Average	$ 7,568.61	3.78%	3.26%	0.53%	-0.22%	5.17%	29.08	1.81%

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