A Study Of U.S. Stock Market Volatility, Fall 2008

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ABSTRACT

This is a market volatility study utilizing three measures of assessing volatility in the U.S stock markets prior to and after the month of September 2008 using three proxies. The first is the VIX index, the CBOE options volatility measure. The next two are bearish, or short position strategy, ETF's based on stock indexes but designed to reflect and benefit from stock market movements in the downward direction. They are the Power Shares index, symbol SDS, and the Rydex Index, symbol RMS. This research evaluates and analyzes weekly movements in the three volatility variables mentioned above for a period of the last eight months of 2008. This includes the four months prior to and the four months after the beginning of September 2008. Specifically, the relative magnitude, volatility and degree of correlation between the three variables will be examined and compared to the movements in NYSE, NASDAQ and S & P stock indexes. The life span and volume of trading, one measure of liquidity, in each of the three variables will also be evaluated. Part of the analysis, and conclusions, will involve analyzing how similar or dissimilar the three behave and whether one may be a better indicator of current or future volatility in the stock market, or financial markets in general and how effective the bear market ETF's might be as hedging vehicles in a down market.

Keywords: Stock market, volatility, ETF, Fear Index, bear market, financial crisis

INTRODUCTION

he unprecedented financial upheaval concentrated largely, so far, in the fall of 2008 has coincided with market fluctuations comparable only to October 19, 1987, March 2000-2003, and 1929-1933 in recent and not so recent history. The fallout from things like questionable values of financial institutions assets such as Credit Default swaps and sub-prime mortgage backed bonds coinciding with significant defaults on home mortgages as well as large decreases in housing prices have contributed to significant numbers of failures, and forced mergers, among financial institutions.

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In some sense these two ETF's are equity related investor fear indicators. Because we have seen a flight to quality followed sometimes by a dramatic recovery in financial markets in the space of a few days we could have also included gold prices and volume of treasury bill trading as well as short term interest rate movements among others. However, we will wait for a later study to incorporate those variables.

This research evaluates and analyzes weekly movements in the three volatility variables mentioned above for a period of the last eight months of 2008. This includes the four months prior to and the four months after the beginning of September 2008. For some perspective, at one point in the middle of September 2008 the major equity indexes were off approximately 25% from their 2007 highs. It may be recalled that from August 1987 through the

middle of October 1987 the major indexes were off approximately 25 % from their previous highs followed by an approximate 23% decline on October 19, 1987.

Specifically, the relative magnitude, volatility and degree of correlation between the three variables will be examined and compared to the movements in NYSE and NASDAQ stock indexes. The life span and volume of trading, one measure of liquidity, in each of the three variables will also be evaluated.

Part of the analysis, and conclusions, will involve analyzing how similar or dissimilar the three behave and whether one may be a better indicator of current or future volatility in the stock market, or financial markets in general.

A potential criticism of the study might relate to its relatively short time period and the lack of direct comparisons to periods like the 1987 October crash, the significant decline in 1973-74, and of course the 1929 stock market crash and its following repercussions. Also, the failure to compare global indexes over the study period could also be noted.

There are two possible answers to those critiques. First, it would be desirable to incorporate, and compare, those periods to the present circumstances and future studies by myself may do just that. Secondly, however, the recent events and related actions taken by the U.S. and foreign governments during September and October 2008 and subsequently are to a large degree without historical precedent. The failure to survive independently of 3 out of 5 of the largest U.S. investment banks, along with the largest insurance company, and the largest brokerage firm, and the largest mortgage originator in the U.S. is without precedent. Similarly the takeover of the two largest mortgage buyers, FNMA, and FMAC also occurred in the same early short time interval in 2008, all within weeks or even days of each other. (See a more detailed summary of the sequence of recent events later in the paper.)

Tables and graphs are available from the author on request.

So, the argument for this study, although not as comprehensive as it could be in terms of indicators and time periods is as follows. To a large degree this is unprecedented and so a more historical perspective may not add much insight. Also, these three indicators are representative of widespread fear, if not panic, in the financial markets. Thus adding to them may not provide significant additional information or rigor.

DATA

Weekly data is plotted, correlated and compared to evaluate whether the VIX or one of two prominent BEAR ETF's are the better measure, or are reflective or predictive indicators, of market volatility. The NYSE indicator is the S&P500. The NASDAQ 100 is the OTC market indicator. The two bear market ETF's are the Rydex RMS mid cap 400% and the Pro Shares SDS. Descriptions of the VIX, RMS, and SDS are included in the appendix.

METHODOLOGY

This study, over a short time interval encompassing very volatile markets, and economic uncertainty will evaluate whether either of two well known bear market ETF's or the VIX are appropriate proxies, or predictors, of NYSE or NASDAQ volatility and how beneficial each of the ETF's would have been as hedging vehicles.

EXPECTED RESULTS

Preliminary conclusions would involve concluding whether one or more of these three variables tend to lead, or lag, major market downturns. Also the degree to which they reflect financial concern, or even panic as well as whether they could or should influence subsequent government, and thus taxpayer, provided reassurance will be evaluated.

Also, if one of the three volatility indicators matches up, or reacts more, or most, quickly with the movements in the NASDAQ or NYSE proxies then there is a potential to utilize positions in the best indicator to hedge, or protect, against future volatility.

HISTORICAL STUDIES of MARKET VOLATILITY

There have been a large number of studies examining stock market volatility. One explanation of market volatility relates liquidity risk to the current financial upheaval. We can define liquidity in at least two different ways. The first relates to how easy it is to trade the security, which is related to trading volume and small bid-ask spreads as described by (Pedersen, 2008). The second is funding liquidity related to the funds available to a prospective buyer or seller. For example if an investor cannot meet a margin call or a related source of funding for trading due to tightening of credit standards for bank related loans or lines of credit. This current situation, related to the unwinding of highly leveraged bank asset positions and shrinking capital adequacy, has likely led to larger bid-ask spreads and less liquid trading in securities markets according to (Pedersen, 2008). This, of course, has spillover effects on global market liquidity and for the average investor as well as institutional investors. For instance when many hedge funds were asked by their customers to redeem their shares after they incurred major market losses in 2008, some were not liquid enough to meet the requests. In earlier research, (Haim Mendelson, 1987), studied how liquidity affects stock market prices, and thus volatility. He says "that there is a strong correlation between the loss of liquidity across stocks and declines in price. He found that "when the loss in liquidity is dramatic, the decline in prices is dramatic." Another approach relating to the causes of world wide stock market volatility is a working paper by (Diebold, 2007). He relates macroeconomic volatility to stock market volatility. A slightly different approach is related to why stock market volatility changes over time, (Schwert, 1990). In evaluating the influence of variables such as trading activity, default risk, and firm profitability and financial leverage, he found that the degree of financial leverage utilized had a relatively small effect on stock volatility. Similarly, (Jones, Mulherin, and Titman, 1990) in their study of whether speculative activity has an effect on stock market volatility they used the share turnover rate and growth in margin credit as indicators of speculative activity. They found no relation between speculation and market volatility in the period prior to the 1929 crash. However, they did find a relationship between the two for the 1934-36 period, where previous research had found significant mean reversion in stock returns for that period.

In a different vein, (Balaban and Bayar, 2002) utilized the market forecasting accuracy of eleven different forecasting models across fourteen stock markets for the ten year period, 1988 through 1997.

(Jones, Walker and Wilson, 2004) analyzed and developed a measure of stock market volatility using measurements relating to large percentage changes in daily stock prices, i.e., extreme days, in the market for the period 1885-2002. They concluded that large negative changes appeared to influence investor behavior more than large positive changes as measured by equity mutual fund flows.

Stock market volatility in emerging economies was studied in the Fiji market by (Mala and Reddy, 2007). They relate stock market volatility to its effect on consumer spending. as documented by a number of previous studies including (Campbell, 1996, Ludvigson and Steindel, 1998, and Poterba, 2000). They also relate stock market volatility to a decline in consumer confidence and business investment. They conclude that for their small sample of 15-16 firms in the Fiji market that volatility is related to low trading volume, or trading liquidity, and in some cases where their IPO's were determined to be underpriced.

THE SEQUENCE OF EVENTS (IN ROUGHLY CHRONOLOGICAL ORDER)

As has been widely noted the primal causes of the financial crisis in September 2008 were the sub-prime mortgage market abuses, and subsequent packaging, sales and purchases, of sub-prime mortgage backed securities, their low default risk ratings, and associated backing or insurance against default utilizing unregulated credit default swaps (CDO's) by financial institutions world wide. Leading up to the crisis in September there were a series of multi-billion dollar write downs by major financial institution of their assets reflecting the severe deterioration of the value of the sub-prime mortgages and related securities they held. These events led to a series of unprecedented actions First, the U.S. government stepped in to take over the two major mortgage buying Agencies FNMA and FMAC to stabilize the mortgage market.

Then institutions including investment banks, Merrill Lynch, Bear Stearns, Lehman Brothers, Morgan Stanley, Goldman Sachs and other investment banks and commercial banks like CityGroup became vulnerable to

failure or takeover. Similarly major savings institutions like Wachovia Bank, and Washington Mutual, the largest Savings and loan organization in the country, had similar massive mortgage holdings and related asset value mark downs. Countrywide Mortgage, the largest U.S. originator of mortgages fired their chairman related to massive mortgage related losses. Outside of the U.S. Barclay's of England and UBS, the largest Swiss bank among other very large foreign based banks had similar major markdowns of asset values related to mortgages.

During this 6-8 month period beginning at the start of 2008 the chairman of the board of Citygroup and Merrill Lynch were also fired, or forced to resign.

Bear Stearns was forced into a takeover by J.P. Morgan bank. Subsequently in September Lehman brothers was allowed to fail and declared bankruptcy. Many of Lehman's assets were subsequently bought by Barclay's Bank who had been negotiating with them for a buyout until just before the bankruptcy filing. Wachovia Bank was later sold to, or taken over, by Wells Fargo after a contest with J.P. Morgan Merrill Lynch also agreed to sell out to Bank of America.

The major remaining traditional investment banking firms, Morgan Stanley and Goldman Sachs, after the failure or merger of the major investment banking firms Lehman Brothers, Bear Stearns, and Merrill Lynch, applied and were approved on a fast track basis by the federal reserve to be bank holding companies. This allowed them to thus stabilize their business operations by adding the commercial banking side while being able to attract deposits and rebuild their capital position through debt and equity offerings as a partially lower risk commercial bank. AIG, the largest insurance company in the U.S. also has received massive infusions of funds twice exceeding \$100 billion in total, from the U.S. government.

Since all these unprecedented events, which included bailouts or forced mergers of the largest brokerage firm and investment bank, the largest Savings and loan and the largest mortgage originator in the U.S. there have been a number of U.S. bank failures and also a large number of bank infusions of government funds used to bolster the capital positions of financial institutions in the U.S along with similar measures around the world.

After spending trillions of dollars spent of U.S. government, and by proxy taxpayers, money in propping up or recapitalizing financial institutions in the U.S. the current situation in February 2009 is primarily focused on a massive economic stimulus plan that is rapidly approaching another trillion dollars in cost and a separate plan to isolate toxic bank assets in so called bad banks. Although there is uncertainty regarding the valuation, and thus purchase price, of these largely sub prime related and devalued mortgage assets the cost of such purchases by the U.S. government will certainly not be adequately covered by the remaining bailout funds currently authorized by the original bailout plan authorized by the U.S. congress. The formation of one or more bad banks would relieve the financial institutions of the toxic mortgage related assets and thus improve their capital position and potentially their willingness to expand lending. The bad assets would be held by the government after purchase and eventually sold off at hopefully a value which would not result in large losses to the U.S. government and taxpayers

There are also some proposals that suggest that the government should get warrants to buy the common stock of the institutions who sell them the bad assets. This would provide the potential for the government and taxpayer to recoup part or all of their investment when the financial institutions recover.

THE DATA

Table 1 shows the correlation matrix between the VIX, RMS, and SDS vs. the S&P 500 the NASDAQ and the S&P 400 midcap index for the four months, prior to the Fall financial crisis May-August 2008, and then the first four months of the financial crisis, September-December 2008 and the entire 8 period May-December 2008. The consistently highest correlations for the two four month periods and the entire 8 month period are between the two stock indexes other than the S&P 400 and the SDS. The lowest correlations are with the VIX. The differences are significant enough that choosing one of the three bear market proxies, to hedge, or speculate, would have been clearly superior. The correlations are, of course, negative because the bear ETF's are designed to move inversely to the stock indexes

Examining the data for the four most volatile weeks for the S&P 500 Index during the 8 month period in 2008 we see that for: (1) the week of September 29, when the S&P dropped 9.4%, the RMS went up 24.62%, and the SDS went up 15.6%. The change in the VIX was 29.94% (2) The following week of October 6th the S&P went down 18.2 %, the RMS went up 41.21% and the SDS went up 43.79%. The change in the VIX was 54.96% (3) Conversely when the S&P went up 10.49 % during the week ending October 27^{th} , the RMS went down 25.5% and the SDS went down 22.08%. The change in the VIX was 24.31%. (4). Similarly, when the S&P went up 12.03 % in the week ending November 24^{th} , the RMS went down 30.32% and the SDS went down 21.9% The change in the VIX was 23.93%. For the four least volatile weeks in the study the ranking results and comparisons are different.

Similarly, the most extreme weekly percentage changes also varied substantially for the three bear market indicators. The VIX was the most volatile over the entire 8 month period as measured by the standard deviation of weekly returns. However, for the second four month period, September through December the RMS was slightly more volatile than the VIX and considerably more volatile than SDS. However, any volatility comparison between SDS and RMS needs to take into account the much greater trading volume, and therefore liquidity differences between the two as discussed later. Because the RMS is based on the S&P MIDCAP 400 the weekly changes, standard deviation and correlations with the ETF's for the 8 month study period are also shown in table.

LIQUIDITY MEASURED BY TRADING VOLUME AND BID ASK SPREADS

Comparing the weekly trading volume in table of the SDS and RMS ETF'S we note that the RMS trades at a much lower level of trading volume than the SDS. Choosing one of these two for speculative or hedging purposes based on ease of entry and exit and probably the narrowness of the bid/ask spread would clearly favor SDS.

RELATIVE VOLATILITY

RMS is also clearly more volatile for the study period with a standard. deviation of returns of 14.94 as compared to the SDS at 11.19 and the Std. and Poors 500 at 5.24 and the S&P 400 at 6.25 and the NASDAQ at 5.32 for the entire 8 month study period. Thus the RMS appears to be almost three times as volatile on average as the S&P 500 while the SDS appears to be a little more than twice as volatile. Because the SDS is designed to track two times the mid-cap 400 Index, considered to be more volatile than the large caps included in the 500 Index, this might be a reasonable result. The Standard deviation of weekly returns the S&P 400 for the study period was 6.25. Thus the S&P400 was somewhat more volatile than the S&P500 at 5.24. Although the RMS is supposed to be designed to be twice as volatile as the S&P400 it appears that it was almost 2.5 times as volatile as indicated in Table 2.

RESULTS and PRELIMINARY CONCLUSIONS

The RMS seems to be more than twice as volatile, negatively than the S&P500, and more volatile than it was designed to be in this very volatile period. The SDS, designed to move twice as much negatively with the S&P 500 seems to have tracked relatively well and better than the RMS. This may be due to the much smaller trading volume of the RMS, thus leading to greater volatility. Also, end of the day bid ask spreads were observed to be consistently and substantially greater for RMS than SDS, which is consistent with the markedly lower trading volume of the RMS. See table

The correlations between the VIX, RMS, and SDS against the S&P 500 and NASDAQ indexes are instructive (Table 1). Even though the RMS is based on the S&P400 and the SDS is based on the S&P 500 the correlations between each of the three bear market indicators, including the VIX, against the NASDAQ are as relatively as strong, especially for the four most volatile months from September through December 2008. Thus using the RMS or SDS, based on correlation coefficients or r squared coefficient of determination, to hedge a NASDAQ like portfolio would likely have been roughly as effective as with a portfolio more closely aligned with the S&P400 or S&P 500. However, as noted earlier, the trading volume, and bid ask spread comparisons would suggest that the SDS would have been the preferred hedging vehicle.

LEADS and LAGS

Using weekly and daily closing price data, (Tables 1-5) no discernible, or significant, leads or lags were detected which would aid in the prediction of future stock market price volatility. However, leads and lags were tested for both price and volume data relationships between the indices and ETF's.

LAG ORDER SELECTION RESULTS

Lag order selection statistics for the endogenous variables: daily close to close returns of the S&P 500 index (deltasp) and natural log of the daily volume of traded SDS ETF shares (Involume_sds); indicate that two lags are significant. The calculation had 4 degrees of freedom and both lags had p-values of 0.000.

VECTOR AUTOREGRESSION RESULTS

A subsequent vector autoregression of the variables above the relevant lags indicates the following. Lnvolume_sds does not have any statistically significant effect on deltsp. The regression constant was also not a significant factor on deltasp. The lags of deltasp did have significant impacts, as would be expected with any degree of sticky price effects.

However, all factors of the equation holding lnvolume_sds as the dependent variable were significant at a 96% confidence level. The R-squared indicates that the following equation accounts for 74.7% of error in projecting the naturalized trading volume of SDS.

dektasp = sp lnvolume_sds = sds sds = 2.09985-1.509117*sp t-1 -2.468677* sp t-2 +0.6298566*sds t-1 +0.2483385*sds t-2

GRANGER CAUSALITY-Wald Test Results

The above conclusion is lent further credence by the results of the Granger causality test. The p-value of 0.001 indicates that the coefficients of the lags of deltasp in the equation for lnvolume_sds are not zero.

THEORY

Negative returns of the S&P 500 seem to cause additional trading volume in SDS. The larger impact of the second lag could indicate the tendency to heavily trade SDS if the S&P 500 is on a multi-day slide. The greater significance of the first lag in lnvolume_sds lends support to this idea. The significance of the constant value could indicate a certain level of consistent trading in SDS. This "floor" in trading volume could indicate an insurance mentality similar to the purchase of protective puts is a matter worth of further examination.

SUMMARY of RESULTS

Because this study is for a very short, but highly unusual, time period of extreme stock market volatility the conclusions reached cannot safely be generalized. However, because there are few precedents for the events and market volatility related to the current financial crisis the results may be found to apply to the possible extreme situations and volatility that are likely to continue at least into the near future.

It is probably fair to say that the VIX, RMS, and SDS based ETF's, or derivatives, would have been effective when used as hedging vehicles as protection against the recent major market downturn.

HEDGING EFFECTIVENESS

The preferred hedging vehicle in the Fall of 2008 based on correlations, tracking of percentage movements and trading volume based liquidity measures was the SDS.

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Tracking effectiveness in 2008 the two bear market ETF proxies showed gains for the entire year in the range of 60% against an average decline in the related stock indexes in the 40% range. Specifically, RMS was up 60%, while the SDS increased 61% and the S&P 500 was down 38.5% and the S&P 400 was down 34.2% in 2008. The Dow was down 33.8% for 2008 by way of comparison. So, for the year neither the SDS or the RMS tracked as a 200% bear ETF was designed to do although both of them moved very much in tandem. However, in a volatile year in both directions the two bear market indexes did not very precisely fulfill their implied promises. They should have been down approximately 68% or 76% respectively.

AUTHOR BIOGRAPHY

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| Table 1 | | | | | |
|---------------------------|---------------------------------|---------|--|--|--|
| Correlations May-December | | | | | |
| S&P 500 | Nasdaq | S&P 400 | | | |
| VIX -0.81 | -0.79 | -0.746 | | | |
| RMS-0.88 | -0.90 | -0.90 | | | |
| SDS -0.96 | -0.91 | -0.88 | | | |
| | Correlations May -August | | | | |
| S&P 500 | Nasdaq | S&P 400 | | | |
| VIX -0.82 | -0.68 | -0.529 | | | |
| RMS-0.72 | -0.84 | -0.99 | | | |
| SDS -0.99 | -0.89 | -0.78 | | | |
| | Correlations September-December | | | | |
| S&P 500 | Nasdaq | S&P 400 | | | |
| VIX -0.85 | -0.83 | -0.814 | | | |
| RMS-0.89 | -0.92 | -0.90 | | | |
| SDS -0.96 | -0.93 | -0.90 | | | |

| Table 2 | | | | |
|-------------------------------|--|---|--|--|
| Standard Deviation for May to | Standard Deviation from May | Standard Deviation from | | |
| December | to August | September to December | | |
| 5.24 | 2.00 | 7.10 | | |
| 6.25 | 2.11 | 8.51 | | |
| 5.32 | 2.49 | 7.02 | | |
| 11.19 | 4.09 | 15.32 | | |
| 16.45 | 12.27 | 19.78 | | |
| 14.94 | 4.33 | 20.67 | | |
| | Standard Deviation for May to December 5.24 6.25 5.32 11.19 16.45 14.94 | Table 2 Standard Deviation for May to December Standard Deviation from May 5.24 2.00 6.25 2.11 5.32 2.49 11.19 4.09 16.45 12.27 14.94 4.33 | Table 2 Standard Deviation for May to December Standard Deviation from May to August Standard Deviation from September to December 5.24 2.00 7.10 6.25 2.11 8.51 5.32 2.49 7.02 11.19 4.09 15.32 16.45 12.27 19.78 14.94 4.33 20.67 | |