

**The Flash Crash: Effects on S&P 500 Index versus non-Index stocks**

Aaron Carlton

The Leonard N. Stern School of Business  
Glucksman Institute for Research in Securities Markets

Faculty Advisor: Jeffrey Wurgler

April 1, 2011

## **I. INTRODUCTION**

On the afternoon of May 6, 2010, the US stock markets experienced a sudden crash and an almost equally sudden recovery. This “Flash Crash” occurred without any obvious external news, and while some firms experienced a complete drop in market capitalization, other firms experienced equally impressive gains during the same time period. In many ways, this 2010 crash is reminiscent of the crash that began on October 19, 1987 when the market declined 20% also without any obvious villains to blame.

This paper focuses on two findings from the October 1987 and investigates whether the same anomalies were present, and to what degree, in the Flash Crash. The two findings in question are whether the S&P 500 was more adversely affected by the crash than the broader market, and if ‘beta’ was the best predictor of stock vulnerability during a sudden crash.

Preliminary findings indicate that the S&P 500 was more adversely impacted during the Flash Crash, although to a much smaller degree than the 7% difference seen in 1987. Additionally, the significance of beta appears to be consistent with the findings from 1987.

## **II. BACKGROUND AND HYPOTHESIS**

### **II.1 1987 October Crash**

On October 19, 1987, commonly referred to as Black Monday, the stock market dropped more than 20%, resulting in a loss of close to \$1 trillion in market capitalization in the US markets. The decline

spanned of four trading days, with the Black Monday representing the largest single day adjustment. Despite the enormous scale of the crash, the United States' markets actually performed better than its international peers, placing 5<sup>th</sup> in terms of market performance among the 23 major markets (Roll, 1988).

There has been much debate over whether Black Monday is evidence of market efficiency or inefficiency. The latter argument is perhaps most widespread due to an article in the *New York Times* that stated the plunge was largely the result of computerized trading (Kamphuis, 1989). The former argues that there was no single cause for the crash and the sharp decline is a great example of how quickly a paradigm shift can occur.

The most frequently blamed suspects of the 1987 crash are index arbitrage, program trading, and portfolio insurance, but the debate still continues to this day (Fama, 1988). Regardless of the reason for this crash or any other, crashes provide us with unique opportunities to examine how the market behaves in times of extreme volatility.

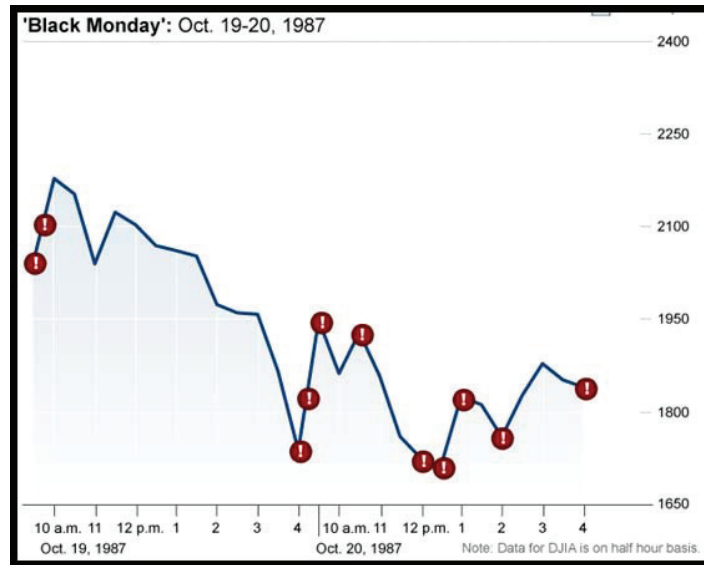


Figure 1 – October 1987 crash in 30 minute intervals<sup>1</sup>

### II.1.A S&P 500 underperformance

Blume, MacKinley, and Terker studied the impact of the 1987 crash on the S&P 500 index stocks in their paper *ORDER IMBALANCES AND STOCK PRICE MOVEMENTS ON OCTOBER 19 AND 20, 1987*. Their analysis contained several findings, including an observation that the S&P 500 index stocks underperformed the broader market by a significant percentage. Specifically, they state that “the S&P stocks declined roughly seven percentage points more than non-S&P stocks on October 19 and, in the opening hours of trading on October 20, recovered almost all of this loss.”

They performed the analysis by creating two portfolios, one consisting of S&P 500 stocks and one consisting of non-S&P 500 stocks, and found that the S&P portfolio fell 20.5% while the non-S&P portfolio fell 13.1%. By the following morning the gap between the two portfolios had narrowed greatly, as the S&P portfolio also had a faster recovery.

<sup>1</sup> Image as appeared in the Wall Street Journal:  
<http://online.wsj.com/article/SB10001424052748704314904575250602626326346.html#articleTabs%3Dinteractive>

As the paper states, “These results are consistent with, but do not prove, the hypothesis that S&P stocks fell more than warranted on October 19 because the market was unable to absorb the extreme selling pressure on those stocks.” The authors also note that this data does not prove market inefficiency, but it supports the conjecture that the magnitude of trading volume had more to do with the additional decline than underlying economic factors.

### ***II.1.B Beta as a Predictor***

Richard Roll took a different approach when examining the October 1987 crash. His research focused more on the international impact of Black Monday and the factors that contributed to varied declines among nations. In his paper *The International Crash of October 1987*, Roll performed a cross-sectional multiple regression on local currency returns and market characteristics. He found no indication that market characteristics had any marginal significance. However, there was one variable with high significance, beta. Beta was not only the most statistically significant predictor of price movement across countries, but it also represented “more than three times the magnitude of any other estimated coefficient in the regression.”

## **II.2 2010 Flash Crash**

The Flash Crash reached its low at 2:47pm on May 6, 2010. Within 10 minutes, the market dropped nearly 600 points, and within a half hour had largely recovered. By the end of the day, the markets had recovered and the S&P 500 returned to its pre-crash levels.

The SEC/CFTC chronicles the events of May 6, 2010 in their report *FINDINGS REGARDING THE MARKET EVENTS OF MAY 6, 2010*. According to the report, the market was turbulent from the start and by 1:00pm there was broad negative sentiment. By 2:30pm, the S&P 500 volatility index (“VIX”) increased 22.5% from its opening levels, and the E-mini S&P 500 futures and the S&P 500 SPDR had fallen 55% and 20%, respectively.

The event that many believe ultimately triggered the crash was a large sell order at 2:32pm. A mutual fund wanting to sell 75,000 E-Mini contracts ran an automated execution algorithm. This algorithm sold the entire lot in just 20 minutes, resulting in the largest year-to-date net change in the E-Minis. Between 2:41pm and 2:44pm an additional 140,000 E-Mini contracts were sold by other high frequency traders wishing to reduce their exposure (Commodity Futures Trading Commission and SEC, 2010). This, in turn, accelerated the rate the automated execution algorithm operated, resulting in a liquidity crisis at both the E-Mini index and individual stock level.

The Chicago Mercantile Exchange paused trading on the E-Mini at 2:45:28 for five seconds. This action stabilized prices for the E-Mini as well as the S&P 500 SPDR, even though the automated algorithm continued to sell contracts until 2:51pm (Commodity Futures Trading Commission and SEC, 2010). Around this same time, the over-the-counter market makers routed almost all orders to public exchanges, which decreased the liquidity for individual stocks.



Figure 2 – ‘Flash Crash’ from 2:00pm – 3:00pm<sup>2</sup>

<sup>2</sup> Image as appeared in the Wall Street Journal:  
<http://online.wsj.com/article/SB10001424052748704314904575250602626326346.html#articleTabs%3Dinteractive>

### **III.3 Hypothesis**

This hypothesis tests whether the stocks in the S&P 500 were more adversely impacted during the Flash Crash relative to an alternative non-S&P 500 portfolio. The initial belief is that a difference will be found, but that the S&P portfolio will not differ from the alternative portfolio by more than 1%, compared to the 7% difference seen in the October crash.

The second hypothesis is that the beta is not a good predictor of how a stock will behave during this market crash. Betas are a moving average of a stock's idiosyncratic risk relative to the broader market, and change over time. Given the extremely short duration of the Flash Crash, and the fact that the crash is widely believed to be the result of a liquidity crisis rather than an adjustment to underlying fundamental data, I predict that the beta will not have a statistically significant impact on the performance of the stocks.

## **III. DATA**

### **Portfolio Sources**

This report uses data from a variety of sources. The list of index components, for both the S&P 500 and the Russell 3000, was gathered using CapitalIQ. The S&P portfolio used in this report is made up of the components of the S&P 500 index, while a subset of Russell 3000 stocks were used to create two separate non-S&P 500 portfolios. The Russell 3000 index was selected because it represents a broad range of US stocks and an accurate list of components was readily available.

### **SIC Codes, Beta, and Market Cap**



The Standard Industrial Classification (“SIC”) code for each stock was pulled from the Center for Research in Security Prices (“CRSP”) database provided by Wharton Research Data Services (“WRDS”). Similarly, this database also provided the market capitalization, capitalization assignment decile, beta, and beta assignment decile for individual stocks using 2009 year-end data.

### **Stock Prices**

Individual stock prices and volumes were pulled from the Trade and Quote (“TAQ”) database, also available on WRDS. This database provided “Actual trade Price per Share” and the volume of shares traded from 2:00pm – 4:00pm on May 6, 2010. This window was used because it is roughly plus and minus one hour from the time of the Flash Crash.

The data from TAQ often contained multiple trades per second, but this data was consolidated into 1-minute and 5-minute intervals using a weighted average of all trades occurring within the interval. The 1-minute interval was created because it is not uncommon for a stock in the non-S&P 500 portfolio to trade only a handful of times per minute, as opposed to every second. The 5-minute interval further reduced noise. A 15-minute interval was used in Blume, MacKinley, and Terker’s *ORDER IMBALANCES AND STOCK PRICE MOVEMENTS ON OCTOBER 19 AND 20, 1987*, but that length of time is not useful for analyzing a crash that occurred and reversed within roughly thirty minutes.

### **III.1 Matching Procedure**

In addition to gathering the data, the portfolios themselves needed to be created. In total, three portfolios were generated; one S&P portfolio and two non-S&P portfolios. The S&P portfolios consisted

of the list of companies in the S&P 500 index<sup>3</sup>. The second two portfolios are named “Pair: Beta” and “Pair: Market Cap.” These non-S&P portfolios are ‘paired’ in the sense that every stock in the S&P portfolio was matched to a similar stock not in the S&P portfolio. The non-S&P portfolios are a collection of these matched stocks.

The “Beta” and “Market Cap” designation describes the two different methods used for creating the non-S&P portfolio. Below is the process for creating both non-S&P portfolios:

**Step 1:** Sort Russell 3000 components (omitting those also in the S&P 500 index) by SIC code descending and then by beta descending for Pair: Beta. Alternatively, sort by SIC code descending, and then by market cap descending for Pair: Market Cap. Sort S&P 500 by just the SIC code descending.

**Step 2:** Match each S&P 500 stock with a Russell 3000 stock with the same 4-digit SIC code. In the case when sorting by beta, the two companies with the largest beta (one S&P portfolio, one non-S&P portfolio) among those with same SIC code are paired. The next two companies with the next largest beta are also paired, etc. Similarly, in the Pair: Market Cap portfolio, the two companies with the greatest market capitalization and same SIC code are paired.

No stock is repeated in the same portfolio. For example, if two S&P stocks have SIC 1234, and only one non-S&P stock has SIC 1234, then only the S&P stock with the larger beta or market cap will be paired and the other S&P stock will remain unpaired. This is also

---

<sup>3</sup> The S&P 500 portfolio in this report does not use all 500 firms, but rather 470 firms. The 30 firms were removed due to data issues as explained in the Appendix.

when differences occur between the two non-S&P portfolios, since the company with the largest beta might not be the same company with the largest market cap.

**Step 3:** For remaining unpaired S&P 500 stocks, match with Russell 3000 stock with same 3-digit SIC code. This is the case where an S&P stock with SIC 1234 could be paired with a non-S&P stock with SIC 1239, because they match on the left three. This match is not as strong as the 4-digit match since the 3-digit code is more general. Again, no stock is paired twice in the same portfolio.

**Step 4:** The remaining unpaired S&P 500 stocks were then matched with Russell 3000 stock with same 2-digit SIC code. This is the case where an S&P stock with SIC 1234 could be paired with a non-S&P stock with SIC 1299. The 2-digit code is more general than the 3- or 4-digit codes, but still has meaning.

**Step 5:** The remaining unpaired S&P stocks are removed from the analysis. This is because 2-digit code SIC code is the highest level industry classification.

There are a limitless number of ways to generate the alternative portfolio. Two non-S&P portfolios were generated because it a way to double check to see if the pairing methodology greatly impacts the results.

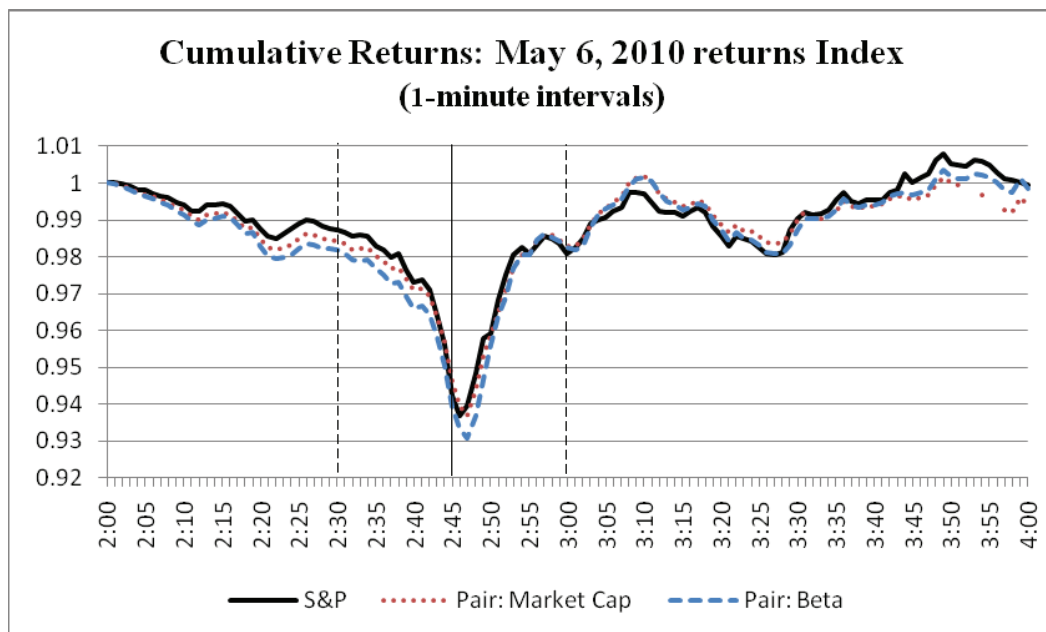
## **III.2 Stock Level Data**

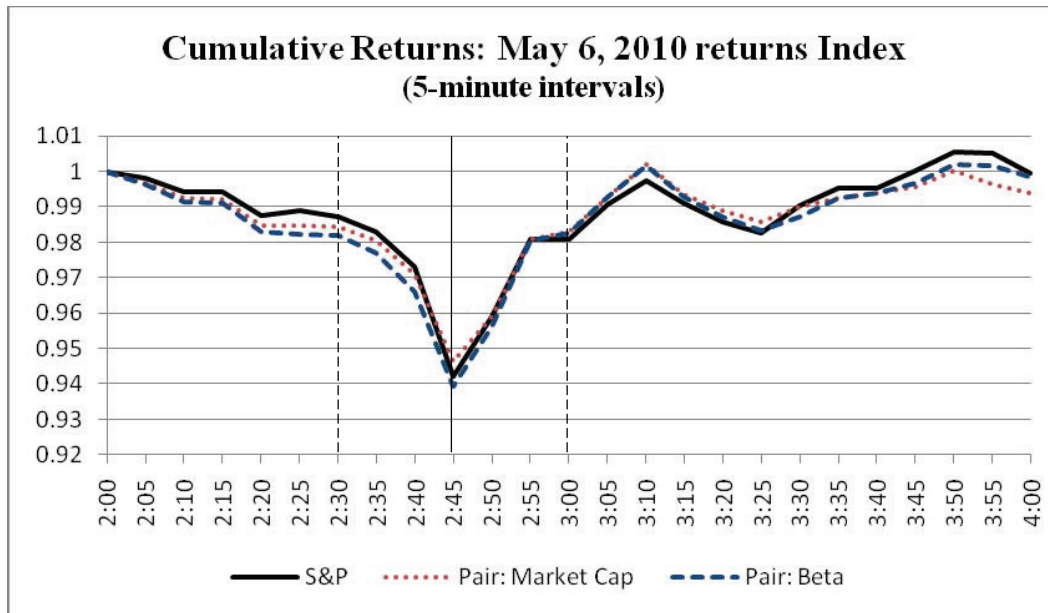
### ***III.2.a Returns***

All the charts below show the data in 1-minute intervals and 5-minute intervals. The solid vertical lines are located at 2:45pm, with dashed vertical lines at 2:30pm and 3:00pm.

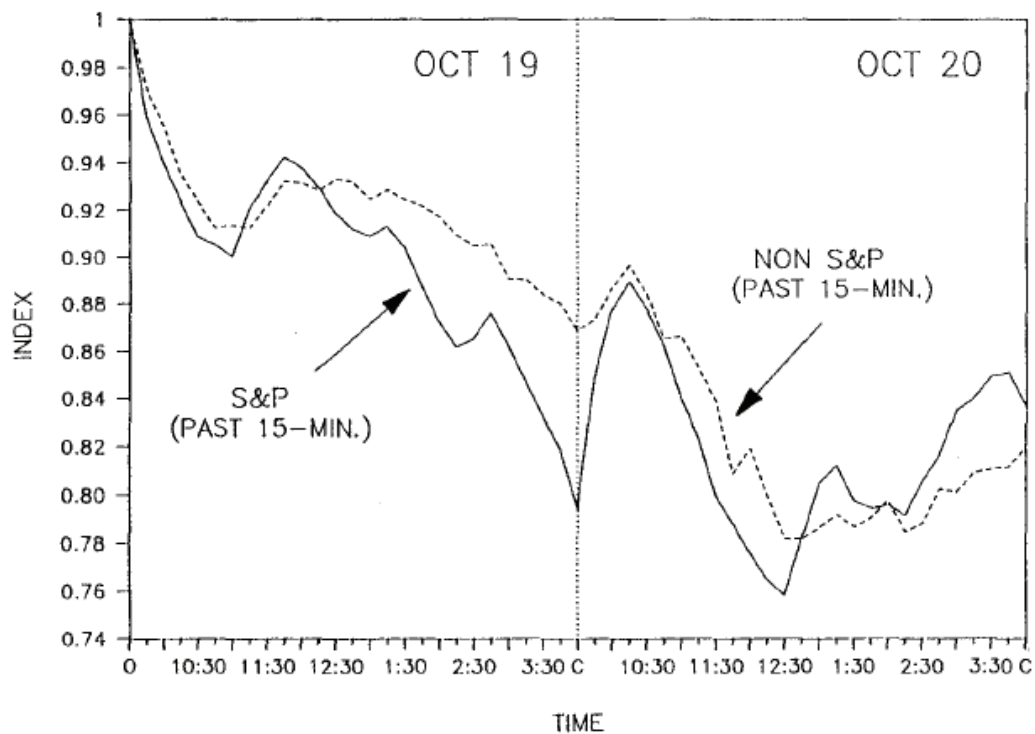
## Cumulative Returns

The first set of charts is an index of all three portfolios, the one S&P portfolio and the two non-S&P portfolios. The index starts at 1, and shows the cumulative returns over the two hour window from 2:00pm – 4:00pm. As we will see, the S&P portfolio hits it low for the day of -6.31% at 2:46pm, while the Pair: Market Cap and Pair: Beta portfolios hit their lows of -6.33% and -6.93% at 2:47pm, respectively.





Below is a copy of the similar index graph appearing in Blume, MacKinley, and Terker' *ORDER IMBALANCES AND STOCK PRICE MOVEMENTS ON OCTOBER 19 AND 20, 1987*:



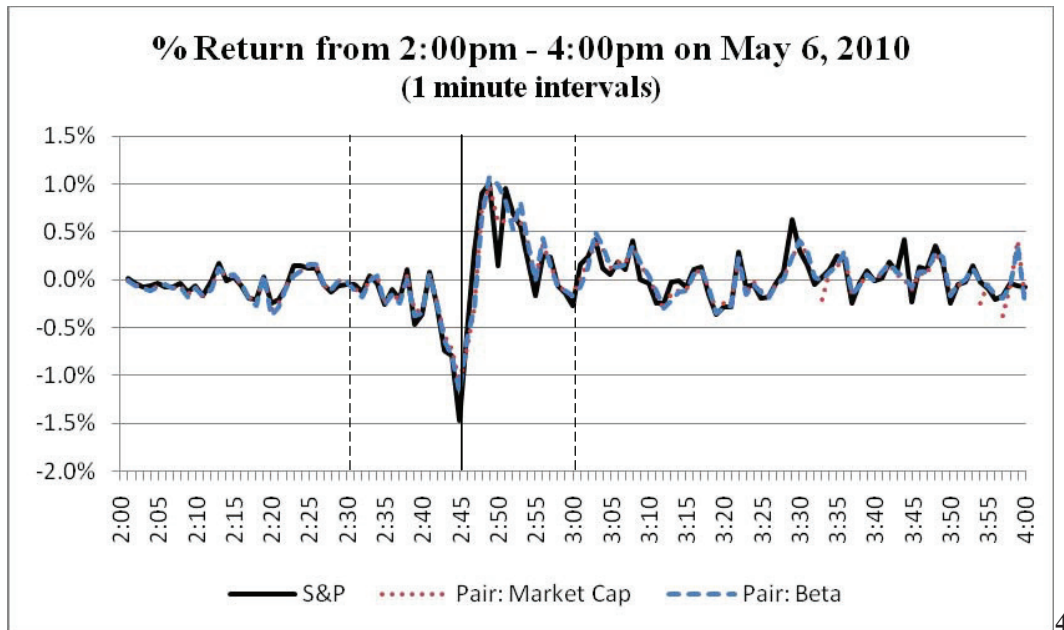
Perhaps the most notable difference between the two sets of charts is the scale. The Flash Crash chart approaches a 10% dip over the course of minutes, while the Black Monday experienced a 20-25% decline over the course of two days.

Another notable characteristic when comparing these graphs is that the S&P consistently underperformed the market for most of October 19, 1987. However, with the Flash Crash, we see that for most of the two hour time horizon, the two non-S&P portfolios underperformed the S&P portfolio.

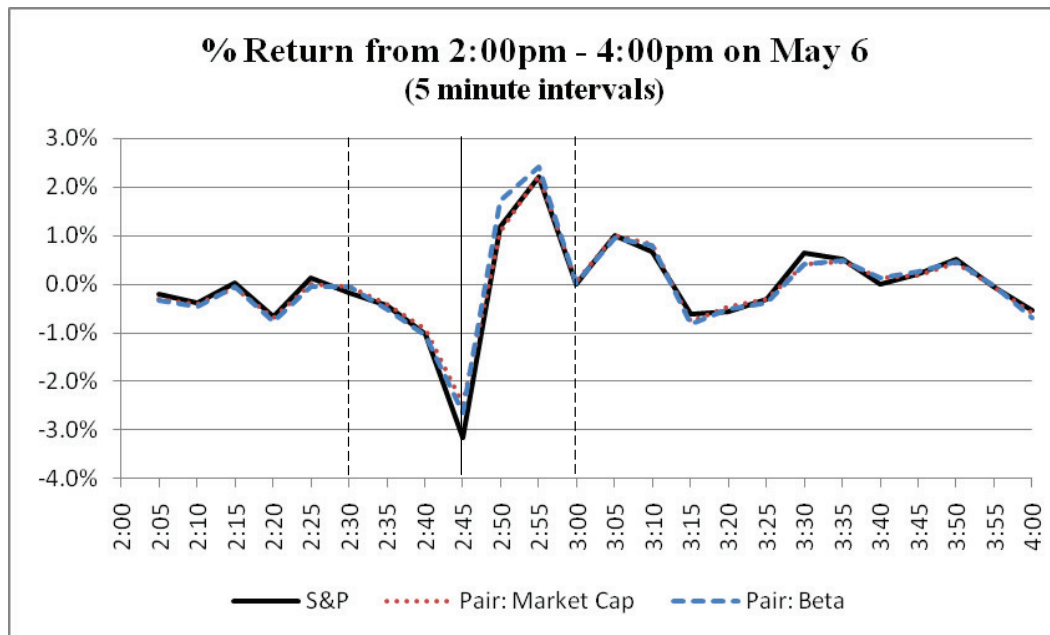
### **Percentage Returns**

The next set of charts show the percentage returns of the three portfolios from 2:00pm – 4:00pm on May 6, 2010. For each portfolio, an average price for each minute was determined by using a weighted average of the number of shares changed and trade price. The percentage movement was the calculated using the following formula:

$$[(P_t / P_{t-1}) - 1] * 100\%$$



4

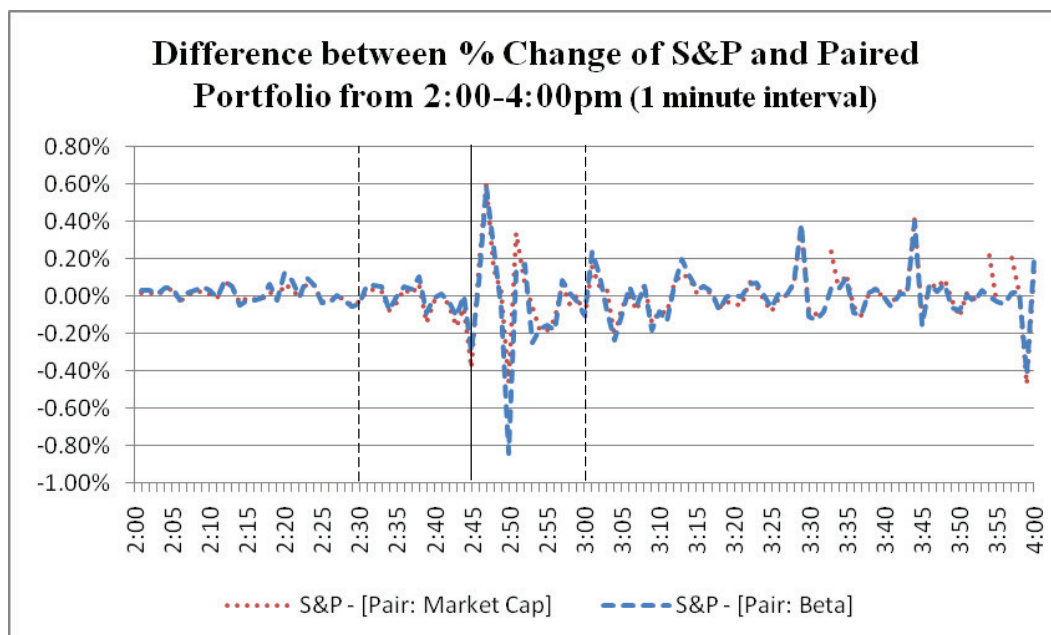


4 Three data points were removed from all remaining graphs as outliers. All three points were in the Pair – Market Cap portfolio and occurred at 3:32pm, 3:53pm, and 3:56pm. The average percent change was -0.005%, with a deviation of 0.27% and a range of [-1.08%, 0.98%] without the outliers. The percentage change for the outliers were 76.66%, 30.95%, and 9.91%, respectively, and were the result of enormous percentage gains from one company, AMSC.

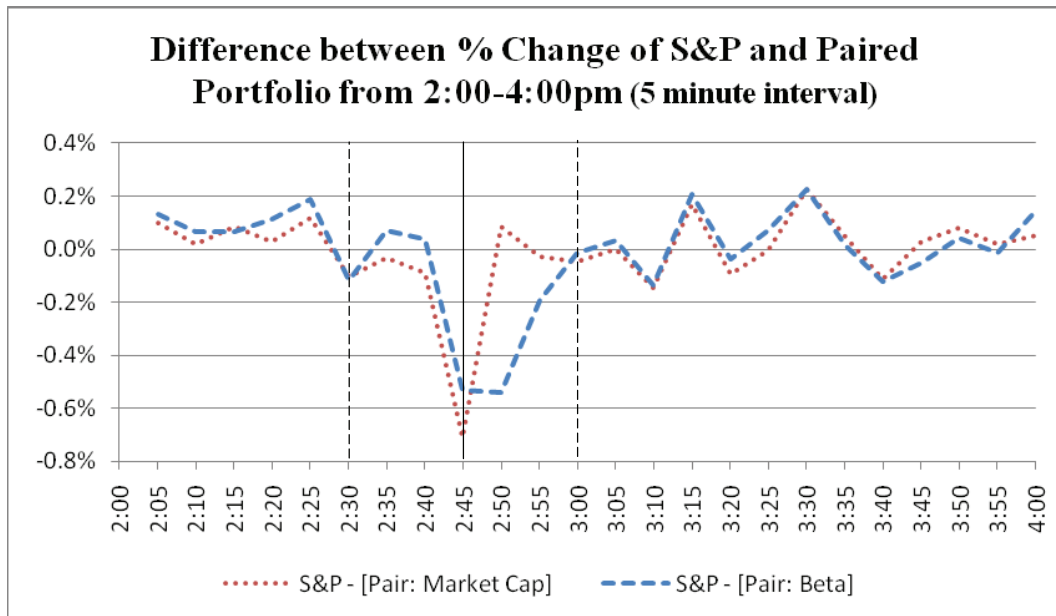
The 1-minute interval chart shows that the three portfolios behaved in a very similar manner. In fact, of the 120 observations, the S&P portfolio and the Pair: Market Cap portfolio moved in the same direction, either both positively or both negatively, 110 times. The S&P portfolio moved in the same direction of the Pair: Beta portfolio 109 out of 120 observations.

A second important feature of the 1-minute interval chart is that the decline at 2:45pm for the S&P portfolio is greater than either of the non-S&P portfolios. The S&P fell -1.47% between 2:45 and 2:46, while the Pair: Market Cap and Pair: Beta portfolios fell -1.08% and -1.17%, respectively. This preliminary finding indicates that the S&P 500 portfolio was more adversely affected during the peak of the crash than non-S&P stocks.

The next set of charts shows the difference between the S&P portfolio and the non-S&P portfolio, which is simply % change S&P minus the % change non-S&P. All negative points on the graph represent the times when the S&P portfolio underperformed the non-S&P portfolios.





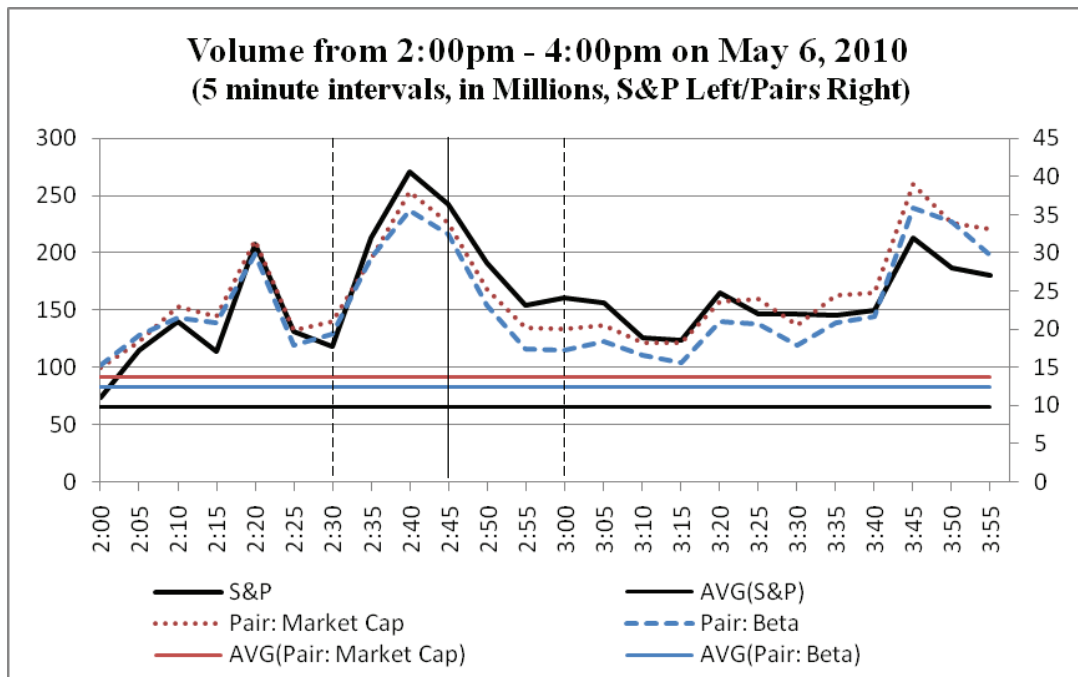
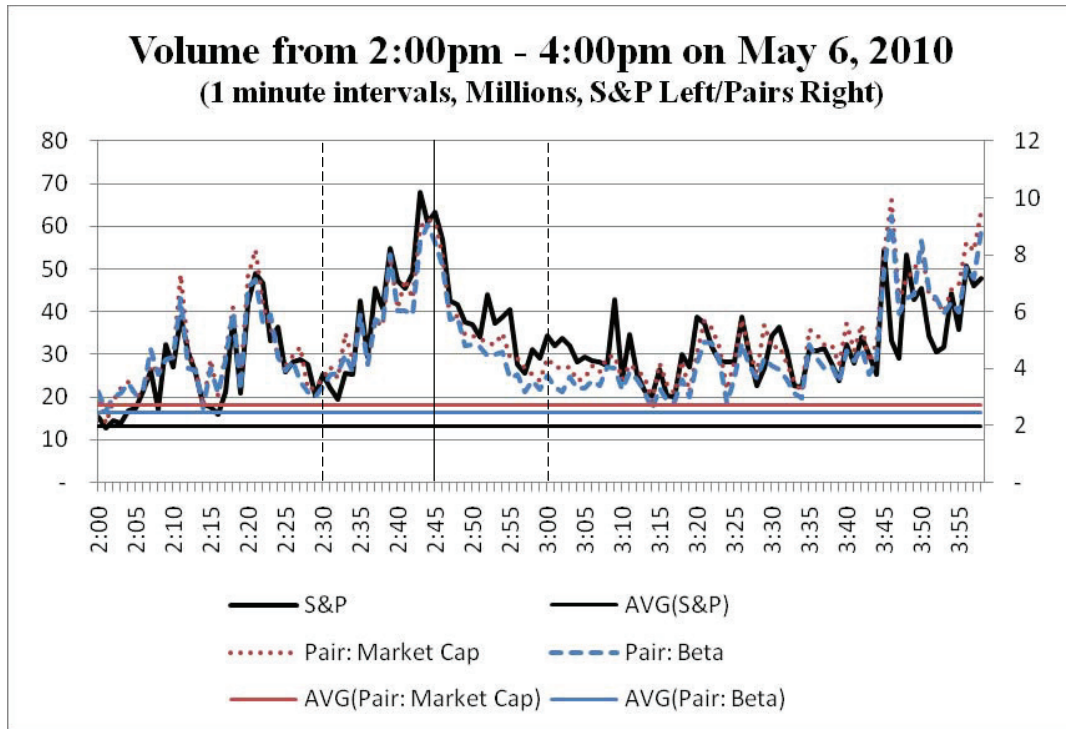


On the 1-minute interval chart above we see that the S&P portfolio fell first, at 2:45, followed by a larger fall in the non-S&P stocks, subsequently followed by an even larger fall in the S&P portfolio. These charts indicate that the S&P 500 portfolio fell by a greater amount during the peak of the crash, although the difference between the portfolios is much less than the 7% seen during the October 1987 crash.

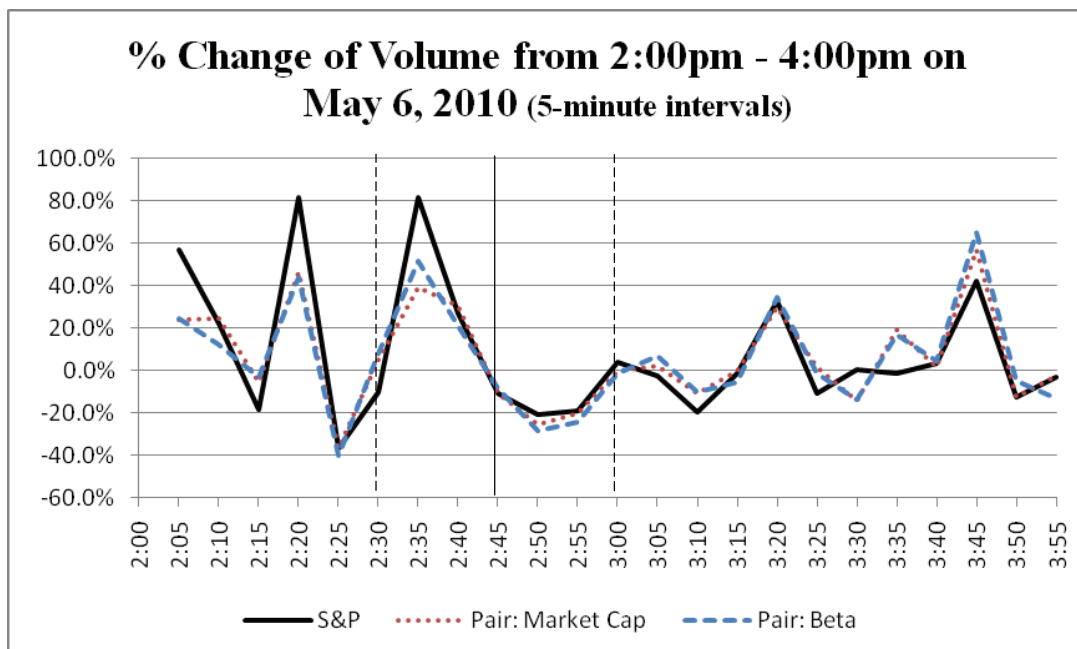
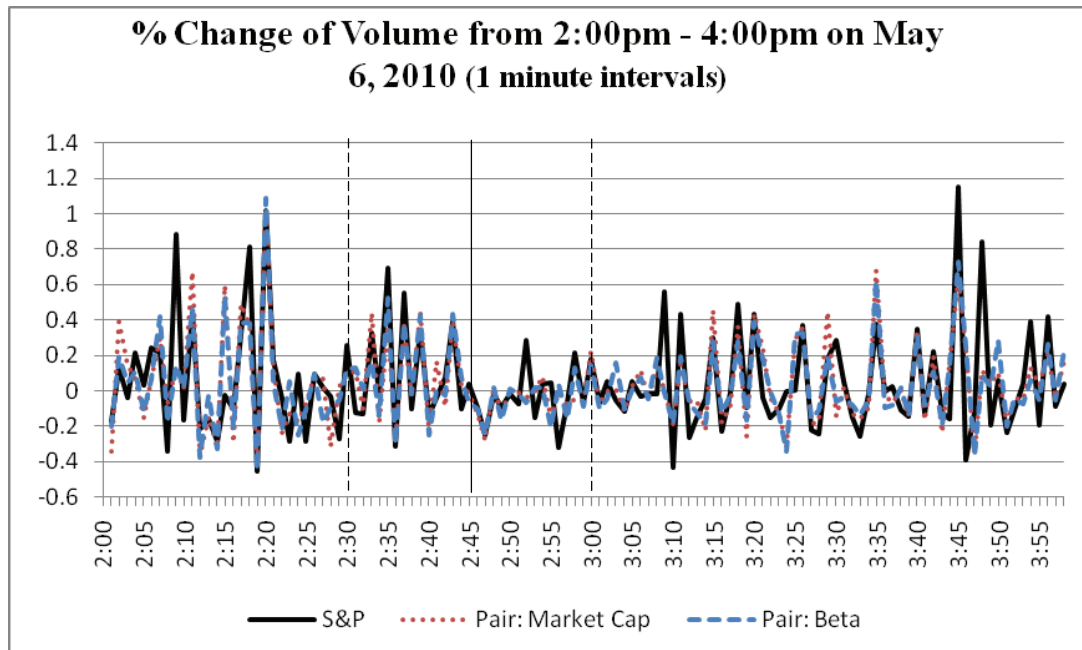
### III.2.b Volume

Below are the trading volumes of the three portfolios during the same two hour window. The axis on the left represents the number of shares traded in the S&P portfolio during each interval, while the axis on the right represents the number of shares traded in the non-S&P portfolio during the same intervals. The averages displayed in these charts show the average number of trades per interval from

2:00pm – 4:00pm on the previous day, May 5, 2010. It is worth noting that the average volume on May 6, 2010 was more than twice that of the previous day.



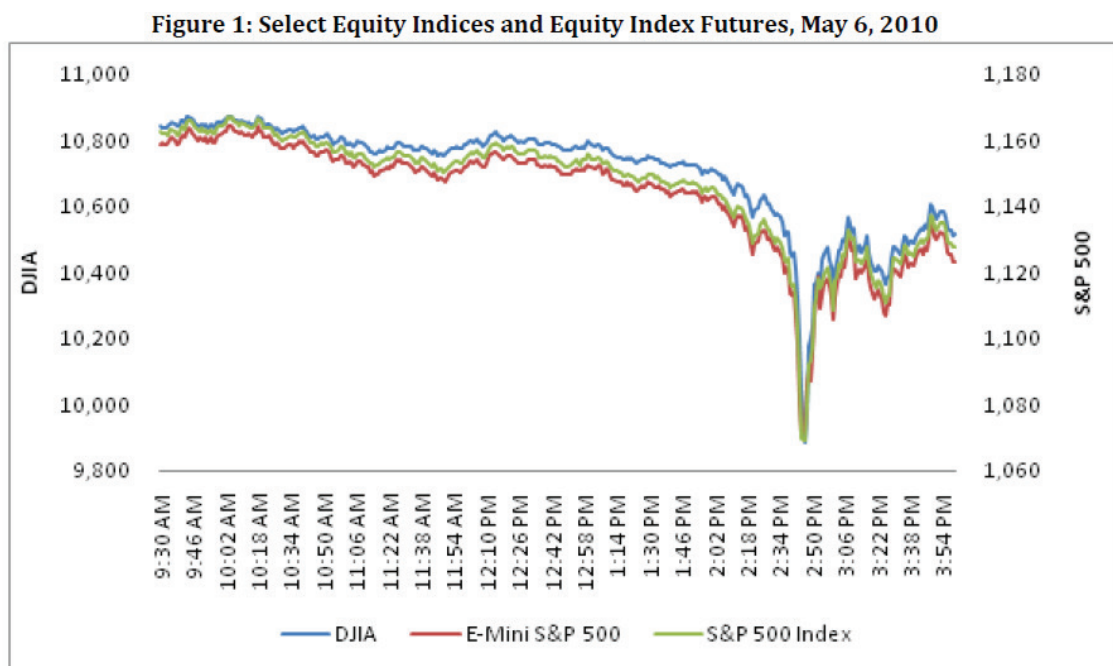
The charts below show the percentage change in volume during the same time period:



Interestingly, the volume appears to be most calm during the period of the crash, which is consistent with prices decreasing due to a lack of buyers. The portfolios had the greatest volatility between 2:40pm and 3:10pm, but the graphs above show of the smallest number of orders, relative to the already inflated volume, during that same time period.

#### IV. Market-level Analysis

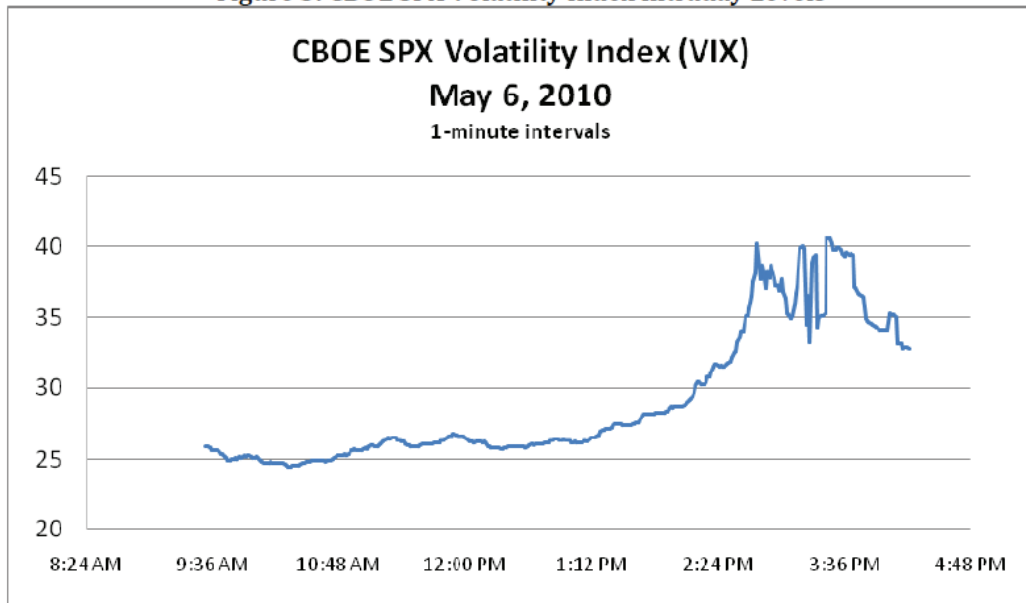
To give some insight into the events of May 6, 2010, we need to examine how the market behaved throughout the day, not just between 2:00pm – 4:00pm. All the charts in this section are as they appear in the SEC’s report on the *Preliminary Findings Regarding the Market Events of May 6, 2010*.



5

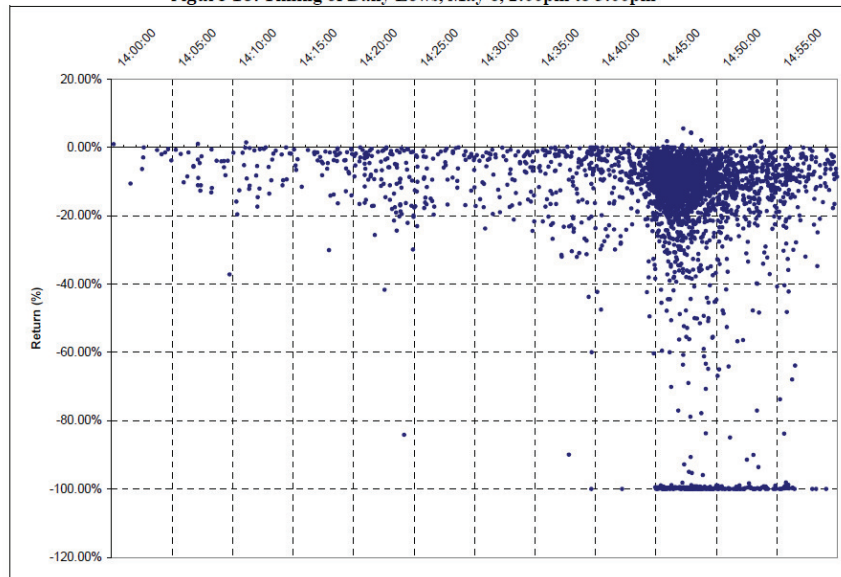
5 Source: Preliminary Findings Regarding the Market Events of May 6, 2010, SEC

Figure 3: CBOE SPX Volatility Index Intraday Levels

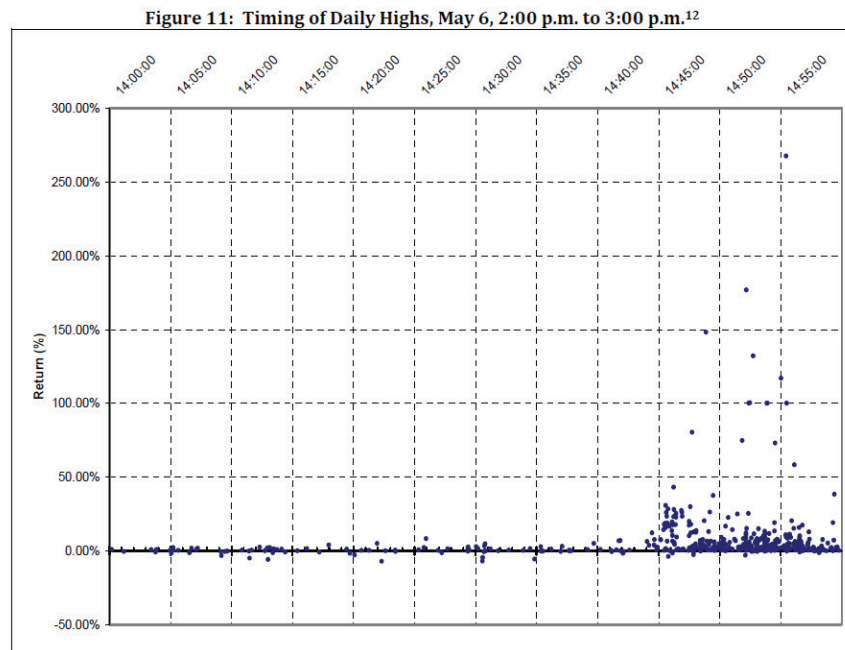


The majority of intra-day lows occurred during the peak of the crash and in its subsequent wake, as the chart below shows:

Figure 10: Timing of Daily Lows, May 6, 2:00pm to 3:00pm<sup>11</sup>



However, while some stocks lost nearly all their value, a group of stocks also increased drastically, doubling, or even tripling in value during the same time period:



## V. Regression Analysis

The first regression analysis was done to determine if the S&P 500 portfolio performed differently than the non-S&P stocks, using dummy variable to represent the S&P firms<sup>6</sup>. The regressions below were performed on the 2:45pm cross-section, using a 5-minute interval. Therefore, it captures the changes from 2:45pm – 2:50pm. This time was chosen because it was the minute that had the most significant declines in the data.

---

<sup>6</sup> Dummy Variable “S&P?” = 1 if stock is on the S&P500, 0 otherwise

Each table contains two sets of regressions because the S&P portfolio was compared to each of the non-S&P portfolios separately.

**Table 1: % change versus S&P?**

2:45-2:50	Pair: Beta (R-Sq = 2.2%)				Pair: Market Cap (R-Sq = 4.9%)			
		Coef	T	P		Coef	T	P
	Constant	-0.0263	-32.34	0.000	Constant	-0.0245	-33.87	0.000
	S&P?	-0.0053	-4.61	0.000	S&P?	-0.0071	-6.95	0.000

Depending on the alternative portfolio used, the S&P portfolio dropped -0.5 to -0.7% more than the non-S&P portfolio. This coefficient is statistically significant, indicating that the S&P stocks were hurt more during the peak of the crash.

The second regression looks at several more variables, including beta, market capitalization, and abnormal volume. The beta and market cap were pulled from the CRSP database, as previously mentioned, and a 2009 end-of-year numbers. The ‘abnormal return’ variable is a ratio consisting of the volume traded between 2:45pm and 2:50pm, divided by the average 2-hour volume of the previous day.

**Table 2: % Change versus S&P?, Beta, MarkCap(M), AbVolume**

2:45-2:50	Pair: Beta (R-Sq = 6.3%)				Pair: Market Cap (R-Sq = 7.4%)			
		Coef	T	P		Coef	T	P
	Constant	-0.01754	-8.65	0.000	Constant	-0.0201	-11.68	0.000
	S&P?	-0.00595	-4.71	0.000	S&P?	-0.0060	-5.56	0.000
	Beta	-0.00418	-5.48	0.000	Beta	-0.0027	-3.56	0.000
	MarkCap(M)	-0.00008	-3.59	0.000	MarkCap(M)	-0.0001	-3.76	0.000
	AbVolume	-0.00106	-1.22	0.224	AbVolume	-0.0005	-0.64	0.524

Of the four variables in the regression, only the abnormal volume ratio is not statistically significant. There is not enough data at this point to claim that beta is the best predictor of how the stocks behaved, but it does appear to have a significant predictive quality. It is also worth noting that the R-squared values are 6.3% and 7.4%, which is much greater than originally predicted.

Table 3 below contains a series of regressions for five time periods, ranging from 2:35pm through 3:00pm. The purpose of this regression is to examine the predictive qualities of the variables in the minutes leading up to the crash, as well as in the recovery of the crash. The three variables used in the regression below are the S&P dummy variable, beta, and market cap.



**Table 3: % Change versus S&P?, Beta, MarkCap(M) Series**

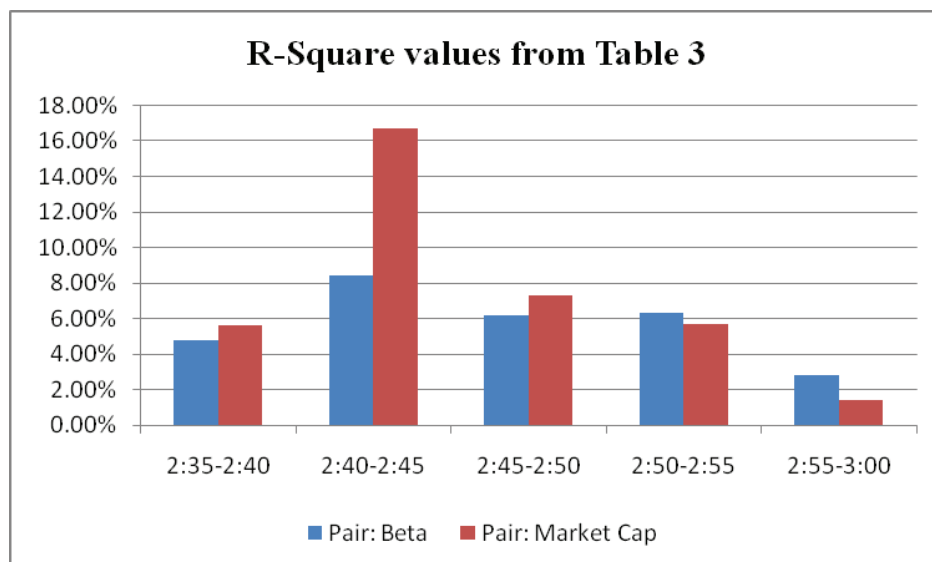
2:35-2:40	Pair: Beta (R-Sq = 4.8%)				Pair: Market Cap (R-Sq = 5.6%)			
		<b>Coef</b>	<b>T</b>	<b>P</b>		<b>Coef</b>	<b>T</b>	<b>P</b>
	Constant	-0.00313	-8.43	0.000	Constant	-0.0024	-8.90	0.000
	S&P?	-0.00034	1.12	0.263	S&P?	-0.0003	-1.04	0.299
	Beta	-0.00111	-6.06	0.000	Beta	-0.0012	-7.02	0.000
2:40-2:45	MarkCap(M)	-0.00001	-2.15	0.032	MarkCap(M)	-0.0000	-2.55	0.011
	Pair: Beta (R-Sq = 8.4%)				Pair: Market Cap (R-Sq = 16.7%)			
		<b>Coef</b>	<b>T</b>	<b>P</b>		<b>Coef</b>	<b>T</b>	<b>P</b>
	Constant	-0.0058	-9.62	0.000	Constant	-0.0056	-16.45	0.000
	S&P?	-0.0012	-2.39	0.017	S&P?	-0.0013	-4.29	0.000
2:45-2:50	Beta	-0.0027	-9.08	0.000	Beta	-0.0028	-13.11	0.000
	MarkCap(M)	0.0000	0.70	0.485	MarkCap(M)	0.0000	1.04	0.298
	Pair: Beta (R-Sq = 6.2%)				Pair: Market Cap (R-Sq = 7.3%)			
		<b>Coef</b>	<b>T</b>	<b>P</b>		<b>Coef</b>	<b>T</b>	<b>P</b>
	Constant	-0.0192	-12.49	0.000	Constant	-0.0201	-17.09	0.000
2:55-2:55	S&P?	-0.0059	-4.69	0.000	S&P?	-0.0060	-5.58	0.000
	Beta	-0.0041	-5.42	0.000	Beta	-0.0027	-3.53	0.000
	MarkCap(M)	-0.0001	-3.56	0.000	MarkCap(M)	-0.0001	-3.75	0.000
	Pair: Beta (R-Sq = 6.3%)				Pair: Market Cap (R-Sq = 5.7%)			
		<b>Coef</b>	<b>T</b>	<b>P</b>		<b>Coef</b>	<b>T</b>	<b>P</b>
2:55-3:00	Constant	0.0035	1.52	0.130	Constant	0.0003	0.17	0.867
	S&P?	-0.0031	-1.62	0.105	S&P?	0.0000	0.00	0.999
	Beta	0.0079	6.89	0.000	Beta	0.0080	7.09	0.000
	MarkCap(M)	0.0001	2.78	0.006	MarkCap(M)	0.0001	3.11	0.002
	Pair: Beta (R-Sq = 2.8%)				Pair: Market Cap (R-Sq = 1.4%)			
		<b>Coef</b>	<b>T</b>	<b>P</b>		<b>Coef</b>	<b>T</b>	<b>P</b>
	Constant	0.0148	6.60	0.000	Constant	0.0173	9.14	0.000
	S&P?	0.0014	0.75	0.454	S&P?	0.0006	0.35	0.723
	Beta	0.0054	4.88	0.000	Beta	0.0040	3.43	0.000
	MarkCap(M)	-0.0000	-0.64	0.522	MarkCap(M)	-0.0000	-0.80	0.426

There are a number of observations from the results above. First, the only variable that is statistically significant in every regression is beta, and it always falls within the 99% confidence interval. Additionally, the beta coefficient consistently matches the same sign as the constant coefficient.

Regardless of whether the market is increasing or decreasing, the stocks with the higher betas appear to follow in the same direction to a greater degree. This is beta's purpose, but it is interesting that beta remains valuable even during short time durations in potentially irrational markets. More analysis would need to determine if beta is in fact the best predictor, but these results are consistent with that belief.

Much like beta, the S&P dummy variable's coefficient also consistently has the same sign as the constant's coefficient. This further supports the claim that the S&P 500 fell faster and recovered faster than an alternative portfolio.

There is also an unexpected finding with regards to the r-squared values. These values vary greatly across tests, ranging from 1.4% through 16.7%. However, there seems to be a pattern. The r-squared value increases during volatile periods and decreases thereafter. Five time periods is not enough draw any conclusion, but this data at least indicates that beta and market cap may become better predictors in times of extreme volatility.



## **VI. Conclusion**

In October 1987, the S&P 500 performed 7% worse than the broader market during the Black Monday crash. This report analyzed whether the same was true during the May 6, 2010 Flash Crash. The methodology used was to create an S&P portfolio and compare it to two different alternative portfolios. Both non-S&P portfolios consisted of companies in the same industries as the S&P portfolio, and a secondary characteristic of having the best match with regards to beta or market capitalization.

The analysis indicated that stocks in the S&P 500 underperform its peers, but to a much lesser extent than in 1987. The S&P stocks were within 1% of the non-S&P portfolios at the peak of the crash, compared to 7% on Black Monday. The fact that the 2010 crash occurred quicker and the imbalance between the portfolios was smaller may be the result of a more efficient market. Technological improvements may be one of the factors that enable markets to digest larger corrections faster than twenty years ago. I would expect this trend to continue, and when the next sudden crash occurs for no obvious reason, there will be even less of a difference between the S&P and non-S&P portfolios.

This study also found that beta is still one of the best predictors of how a stock will behave during a crash. Despite the fact the regression was performed on returns over 5-minute windows, the beta still predicted stock price movement more consistently and to an overall higher degree than the other predictors.

## APPENDIX: S&P 500 Index Firms Removed from S&P Portfolio

Company Removed	Reason for Omission
Berkshire Hathaway Inc.	No SIC code associated with stock ticker in CRSP
Brown-Forman Corporation	No SIC code associated with stock ticker in CRSP
Comcast Corporation	No SIC code associated with stock ticker in CRSP
Discovery Communications, Inc.	No SIC code associated with stock ticker in CRSP
E*TRADE Financial Corporation	No SIC code associated with stock ticker in CRSP
Motorola Mobility Holdings, Inc.	No SIC code associated with stock ticker in CRSP
Motorola Solutions, Inc.	No SIC code associated with stock ticker in CRSP
NextEra Energy, Inc.	No SIC code associated with stock ticker in CRSP
Noble Corp.	No SIC code associated with stock ticker in CRSP
QEP Resources, Inc.	No SIC code associated with stock ticker in CRSP
Viacom, Inc.	No SIC code associated with stock ticker in CRSP
Moody's Corp.	Bad beta associated with stock ('0') in CRSP
CareFusion Corporation	No beta associated with stock in CRSP
CBS Corporation	No beta associated with stock in CRSP
CME Group Inc.	No beta associated with stock in CRSP
Coach Inc.	No beta associated with stock in CRSP
ConocoPhillips	No beta associated with stock in CRSP
Constellation Brands Inc.	No beta associated with stock in CRSP
Coventry Health Care Inc.	No beta associated with stock in CRSP
Dun & Bradstreet Corp.	No beta associated with stock in CRSP
Fluor Corporation	No beta associated with stock in CRSP
Lennar Corp.	No beta associated with stock in CRSP
McCormick & Co. Inc.	No beta associated with stock in CRSP
Loews Corporation	No SIC pair found – Pair: Market Cap method
Lorillard, Inc.	No SIC pair found – Pair: Market Cap method
Altria Group Inc.	No SIC pair found – Pair: Market Cap method
Norfolk Southern Corp.	No SIC pair found – Pair: Market Cap method
The Sherwin-Williams Company	No SIC pair found – Pair: Market Cap method
The Home Depot, Inc.	No SIC pair found – Pair: Market Cap method
Big Lots Inc.	No SIC pair found – Pair: Market Cap method
Reynolds American Inc.	No SIC pair found – Pair: Beta method
Lorillard, Inc.	No SIC pair found – Pair: Beta method
Altria Group Inc.	No SIC pair found – Pair: Beta method
Norfolk Southern Corp.	No SIC pair found – Pair: Beta method
The Sherwin-Williams Company	No SIC pair found – Pair: Beta method
The Home Depot, Inc.	No SIC pair found – Pair: Beta method
Family Dollar Stores Inc.	No SIC pair found – Pair: Beta method
Molson Coors Brewing Company	No Market Cap in CRSP

## APPENDIX: Pair: Market Cap Portfolio

S&P	Matched Pair	SIC Match	S&P	Matched Pair	SIC Match
3M Co.	Insulet Corporation	3841	Laboratory Corp. of America Holdings	Genoptix, Inc.	8071
Abbott Laboratories	NeurogesX, Inc.	2834	Legg Mason Inc.	Calamos Asset Management Inc.	6211
Abercrombie & Fitch Co.	Buckle Inc.	5651	Leggett & Platt, Incorporated	Sealy Corporation	2515
ACE Limited	Old Republic International Corp.	6331	Leucadia National Corp.	Louisiana-Pacific Corp.	242
Adobe Systems Inc.	Parametric Technology Corporation	7370	Lexmark International Inc.	Aruba Networks, Inc.	3577
Advanced Micro Devices, Inc.	Diodes Incorporated	3674	Life Technologies Corporation	Novavax, Inc.	2836
Aetna Inc.	CorVel Corporation	6324	Limited Brands, Inc.	Charming Shoppes Inc.	5621
AFLAC Inc.	Triple-S Management Corporation	6321	Lincoln National Corp.	Protective Life Corp.	6311
Agilent Technologies Inc.	Ixia	3825	Linear Technology Corp.	Rambus Inc.	3670
Air Products & Chemicals Inc.	Sensient Technologies Corporation	2813	Lockheed Martin Corporation	Federal Signal Corp.	37
Airgas Inc.	Innophos Holdings Inc	5169	Loews Corporation	Star Scientific, Inc.	2111
AK Steel Holding Corporation	Texas Industries Inc.	3312	Lowe's Companies Inc.	Builders FirstSource, Inc.	5211
Akamai Technologies Inc.	BGC Partners, Inc.	7372	LSI Corporation	ON Semiconductor Corp.	3674
Alcoa, Inc.	Kaiser Aluminum Corporation	3334	M&T Bank Corp.	Western Alliance Bancorporation	6022
Allegheny Energy Inc.	Dynegy Inc.	4911	Macy's, Inc.	Stein Mart Inc.	5311
Allegheny Technologies Inc.	Carpenter Technology Corp.	3312	Marathon Oil Corporation	Walter Energy, Inc.	1321
Allergan Inc.	Durect Corp.	2834	Marriott International, Inc.	Vail Resorts Inc.	7011
Altera Corp.	SMART Modular Technologies (WWH) Inc.	3670	Marsh & McLennan Companies, Inc.	MGIC Investment Corp.	6351
Amazon.com Inc.	United Online, Inc.	7370	Marshall & Ilsley Corporation	Synovus Financial Corp.	6021
Ameren Corporation	Northwestern Corp.	4931	Masco Corporation	American Woodmark Corp.	243
American Electric Power Co., Inc.	ITC Holdings Corp.	4911	Massey Energy Co.	James River Coal Co.	1221
American Express Company	City National Corp.	6712	Mastercard Incorporated	EnerNOC, Inc.	7389
American International Group, Inc.	Unitrin Inc.	6331	Mattel Inc.	Kid Brands, Inc.	3942
American Tower Corp.	Hughes Communications, Inc.	4899	McAfee, Inc.	Magma Design Automation Inc.	7372
Ameriprise Financial Inc.	Advance America, Cash Advance Centers Inc.	6141	McDonald's Corp.	Ruby Tuesday, Inc.	5812
AmerisourceBergen Corporation	BMP Sunstone Corporation	5122	McKesson Corporation	Herbalife Ltd.	5122
Amgen Inc.	BioCryst Pharmaceuticals, Inc.	2830	Mead Johnson Nutrition Company	Caraco Pharmaceutical Laboratories Ltd.	2834
Amphenol Corporation	Thomas & Betts Corp.	3678	MeadWestvaco Corporation	Domtar Corporation	2621
Anadarko Petroleum Corporation	Quicksilver Resources Inc.	1311	MedcoHealth Solutions Inc.	Drugstore.com Inc.	591
Analog Devices Inc.	IXYS Corp.	3674	Medtronic, Inc.	Nalco Holding Co.	3841
Aon Corporation	PartnerRe Ltd.	6321	MEMC Electronic Materials Inc.	Entropic Communications, Inc.	3674
Apache Corp.	McMoRan Exploration Co.	1311	Merck & Co. Inc.	Acacia Research Corporation	2834
Apartment Investment & Management Co.	iStar Financial Inc.	6798	MetLife, Inc.	National Financial Partners Corp.	6411
Apollo Group Inc.	Career Education Corp.	8200	MetroPCS Communications, Inc.	NII Holdings Inc.	4812
Apple Inc.	Omniceil Inc.	3571	Microchip Technology Inc.	TriQuint Semiconductor, Inc.	3670
Applied Materials Inc.	Brooks Automation Inc.	3550	Micon Technology Inc.	Conexant Systems Inc.	3674
Archer Daniels Midland Company	Darling International Inc.	207	Microsoft Corporation	Interactive Intelligence, Inc.	7370
Assurant Inc.	Employers Holdings, Inc.	6331	Molex Inc.	Anadigics, Inc.	3670
AT&T, Inc.	Virgin Media, Inc.	4813	Molson Coors Brewing Company	Coca-Cola Bottling Co. Consolidated	208
Autodesk, Inc.	Smith Micro Software Inc.	7370	Monsanto Co.	The Scotts Miracle-Gro Co.	2879
Automatic Data Processing, Inc.	DST Systems Inc.	7374	Monster Worldwide, Inc.	Lamar Advertising Co.	731

AutoNation Inc.	Sonic Automotive Inc.	5511	Morgan Stanley	Wilmington Trust Corporation	6712
AutoZone Inc.	Pep Boys - Manny, Moe & Jack	5531	Murphy Oil Corporation	Holly Corporation	2911
Avalonbay Communities Inc.	Duke Realty Corp.	6798	Mylan, Inc.	Jazz Pharmaceuticals, Inc.	2834
Avery Dennison Corporation	Vistaprint N.V.	275	Nabors Industries Ltd.	Hercules Offshore, Inc.	1381
Avon Products Inc.	Tupperware Brands Corporation	2844	Nasdaq OMX Group Inc.	GFI Group Inc.	6200
Baker Hughes Incorporated	Oil States International Inc.	3533	National Oilwell Varco, Inc.	Gulfmark Offshore, Inc.	3533
Ball Corporation	Crown Holdings Inc.	3411	National Semiconductor Corporation	OmniVision Technologies Inc.	3674
Bank of America Corporation	Webster Financial Corp.	6021	NetApp, Inc.	Brocade Communications Systems, Inc.	3572
Baxter International Inc.	Delcath Systems Inc.	3841	Netflix, Inc.	World Wrestling Entertainment Inc.	78
BB & T Corp.	Financial Institutions Inc.	602	Newell Rubbermaid Inc.	Entegris, Inc.	3089
Becton, Dickinson and Company	Symmetry Medical, Inc.	3841	Newfield Exploration Co.	Swift Energy Co.	1311
Bed Bath & Beyond, Inc.	Tuesday Morning Corp.	57	Newmont Mining Corp.	Golden Star Resources, Ltd.	1041
Bemis Company, Inc.	Clearwater Paper Corporation	26	News Corp.	The E. W. Scripps Company	2711
Best Buy Co. Inc.	Pier 1 Imports, Inc.	57	Nicor Inc.	Atmos Energy Corporation	4924
Big Lots Inc.	BJ's Wholesale Club Inc.	5331	Nike Inc.	CROCS Inc.	3021
Biogen Idec Inc.	VIVUS Inc.	2830	NiSource Inc.	CH Energy Group Inc.	4931
BMC Software Inc.	RealNetworks Inc.	7372	Noble Energy, Inc.	NV Energy, Inc.	4931
Boeing Co.	AAR Corp.	3721	Nordstrom Inc.	J. Crew Group, Inc.	5651
Boston Properties Inc.	CBL & Associates Properties Inc.	6798	Northeast Utilities	El Paso Electric Co.	4911
Boston Scientific Corporation	W.R. Grace & Co.	3841	Northern Trust Corporation	Boston Private Financial Holdings Inc.	6020
Bristol-Myers Squibb Company	Medicines Co.	2834	Northrop Grumman Corporation	Garmin Ltd.	3812
Broadcom Corp.	Photronics Inc.	3670	Novell Inc.	Syntel, Inc.	7370
CA Technologies	Rightnow Technologies Inc.	7372	Novellus Systems, Inc.	Century Aluminum Co.	3350
Cablevision Systems Corporation	LodgeNet Interactive Corporation	4841	NRG Energy, Inc.	Calpine Corp.	4911
Cabot Oil & Gas Corporation	Rex Energy Corporation	1311	Nucor Corporation	Universal Stainless & Alloy Products Inc.	3312
Cameron International Corporation	Dynamic Materials Corp.	349	NVIDIA Corporation	Power-One Inc.	3670
Campbell Soup Co.	Lancaster Colony Corporation	203	NYSE Euronext, Inc.	TD AMERITRADE Holding Corporation	62
Capital One Financial Corp.	CapitalSource Inc.	6141	Occidental Petroleum Corporation	Continental Resources Inc.	1311
Cardinal Health, Inc.	Elizabeth Arden, Inc.	5122	Omnicom Group Inc.	Valassis Communications Inc.	731
CarMax Inc.	McGrath Rentcorp	55	ONEOK Inc.	Southwest Gas Corporation	4923
Carnival Corporation	Royal Caribbean Cruises Ltd.	4481	Oracle Corp.	Ansys, Inc.	7370
Caterpillar Inc.	Manitowoc Co. Inc.	3531	O'Reilly Automotive Inc.	U.S. Auto Parts Network, Inc.	553
CB Richard Ellis Group, Inc.	RAIT Financial Trust	6798	Owens-Illinois, Inc.	Apogee Enterprises, Inc.	32
Celgene Corporation	HB Fuller Co.	289	PACCAR Inc.	Oshkosh Corporation	3711
CenterPoint Energy, Inc.	UIL Holdings Corporation	4911	Pall Corp.	Twin Disc Inc.	356
CenturyLink, Inc.	Atlantic Tele-Network, Inc.	4813	Parker Hannifin Corporation	Sun Hydraulics Corp.	349
Cephalon Inc.	ArQule Inc.	2830	Patterson Companies Inc.	1-800-Flowers.com Inc.	5990
Cerner Corp.	Sonic Solutions	7373	Paychex Inc.	DSP Group Inc.	87
CF Industries Holdings, Inc.	LSB Industries Inc.	2873	Peabody Energy Corp.	Alpha Natural Resources, Inc.	1221
CH Robinson Worldwide Inc.	Pacer International Inc.	4731	People's United Financial Inc.	Univest Corp. of Pennsylvania	6036
Charles Schwab Corp.	Raymond James Financial Inc.	6211	Pepco Holdings, Inc.	ALLETE, Inc.	4931
Chesapeake Energy Corporation	Crosstex Energy Inc.	1311	Pepsico, Inc.	National Beverage Corp.	2086
Chevron Corp.	Ameron International Corporation	29	PerkinElmer Inc.	Cepheid	3826
CIGNA Corporation	WellCare Health Plans, Inc.	6324	Pfizer Inc.	Akorn, Inc.	2834
Cincinnati Financial Corp.	Selective Insurance Group Inc.	6330	PG & E Corp.	UniSource Energy Corporation	4911
Cintas Corporation	Perry Ellis International Inc.	2320	Philip Morris International, Inc.	Vector Group Ltd.	2111
Cisco Systems, Inc.	GT Solar International, Inc.	3674	Pinnacle West Capital Corp.	Great Plains Energy Incorporated	4911
Citigroup, Inc.	Citizens Republic Bancorp, Inc	6021	Pioneer Natural Resources Co.	Energy Partners Ltd.	1311
Citrix Systems, Inc.	Take-Two Interactive Software Inc.	7370	Pitney Bowes Inc.	Immersion Corporation	357
Cliffs Natural Resources Inc.	US Gold Corporation	10	Plum Creek Timber Co. Inc.	Skyline Corp.	24

Clorox Corporation	Zep, Inc.	2842	PNC Financial Services Group Inc.	First Community Bancshares, Inc. (Bluefield)	6021
CMS Energy Corp.	Vectren Corporation	493	Polo Ralph Lauren Corp.	The Talbots Inc.	5136
Coca-Cola Enterprises Inc.	M&F Worldwide Corp.	2086	PPG Industries Inc.	Ferro Corp.	2851
Cognizant Technology Solutions Corp.	Epicor Software Corporation	7370	PPL Corporation	Alliant Energy Corporation	4911
Colgate-Palmolive Co.	AptarGroup, Inc.	2844	Praxair Inc.	Calgon Carbon Corporation	2813
Comerica Incorporated	Banco Latinoamericano de Comercio Exterior, S.A	6021	Precision Castparts Corp.	Steel Dynamics Inc.	33
Computer Sciences Corporation	Unisys Corporation	7373	priceline.com Incorporated	comScore, Inc.	7389
Compuware Corporation	Concur Technologies, Inc.	7370	Principal Financial Group Inc.	Presidential Life Corp.	63
ConAgra Foods, Inc.	Seaboard Corp.	2011	Procter & Gamble Co.	Stepan Company	2841
CONSOL Energy Inc.	Arch Coal Inc.	122	Progress Energy Inc.	Portland General Electric Company	4911
Consolidated Edison Inc.	UGI Corp.	493	Progressive Corp.	American Financial Group Inc.	6331
Constellation Energy Group, Inc.	OGE Energy Corp.	4931	ProLogis	Developers Diversified Realty Corp.	6798
Corning Inc.	Belden, Inc.	3357	Prudential Financial, Inc.	Phoenix Companies Inc.	6311
Costco Wholesale Corporation	School Specialty Inc.	53	Public Service Enterprise Group Inc.	Cleco Corporation	4931
CR Bard Inc.	CryoLife Inc.	3841	Public Storage	MPG Office Trust, Inc.	6798
CSX Corp.	Kansas City Southern	4011	PulteGroup, Inc.	Hovnanian Enterprises Inc.	1531
Cummins Inc.	Brunswick Corporation	3519	QUALCOMM Incorporated	BigBand Networks, Inc.	3663
CVS Caremark Corporation	Rite Aid Corp.	5912	Quanta Services, Inc.	EMCOR Group Inc.	1731
Danaher Corp.	Cognex Corp.	3823	Quest Diagnostics Inc.	Array BioPharma, Inc.	8071
Darden Restaurants, Inc.	Ruth's Hospitality Group Inc.	5812	Qwest Communications International Inc.	Cogent Communications Group Inc.	4813
DaVita, Inc.	Clinical Data, Inc.	809	R.R. Donnelley & Sons Company	Presstek Inc.	2750
Dean Foods Co.	Lifeway Foods Inc.	202	RadioShack Corp.	hhgregg, Inc.	5731
Deere & Company	CNH Global NV	3523	Range Resources Corporation	Forest Oil Corp.	1311
Dell Inc.	Extreme Networks Inc.	3570	Raytheon Co.	Herley Industries Inc.	3812
Denbury Resources Inc.	Stone Energy Corp.	1311	Red Hat, Inc.	Internap Network Services Corp.	7374
DENTSPLY International Inc.	Somaxon Pharmaceuticals, Inc.	3840	Regions Financial Corp.	PacWest Bancorp	6021
Devon Energy Corporation	ATP Oil & Gas Corp.	1311	Republic Services, Inc.	Covanta Holding Corporation	4953
DeVry, Inc.	Corinthian Colleges Inc.	8249	Robert Half International Inc.	Cross Country Healthcare, Inc.	7363
Diamond Offshore Drilling Inc.	Parker Drilling Co.	1381	Rockwell Automation Inc.	ION Geophysical Corporation	3829
DIRECTV	Clearwire Corporation	4899	Rockwell Collins Inc.	Ducommun Inc.	3728
Discover Financial Services	World Acceptance Corp.	6141	Roper Industries Inc.	Graco Inc.	3561
Dominion Resources, Inc.	Westar Energy, Inc.	4911	Ross Stores Inc.	Zumiez, Inc.	56
Dover Corp.	Columbus Mckinnon Corp.	353	Rowan Companies Inc.	W&T Offshore Inc.	1381
DR Horton Inc.	Beazer Homes USA Inc.	1531	Ryder System, Inc.	Standard Parking Corp.	751
Dr Pepper Snapple Group, Inc.	Wendy's/Arby's Group, Inc.	2086	Safeway Inc.	Pantry Inc.	5411
DTE Energy Co.	Ormat Technologies Inc.	4911	SAIC, Inc.	Gerber Scientific Inc.	7373
Duke Energy Corporation	IdaCorp, Inc.	4911	Salesforce.com	SFN Group, Inc.	8742
Eastman Chemical Co.	PolyOne Corporation	2821	SanDisk Corp.	Universal Display Corp.	3570
Eaton Corporation	ArvinMeritor Inc.	3714	Sara Lee Corp.	Treehouse Foods, Inc.	203
eBay Inc.	Alliance Data Systems Corporation	7389	SCANA Corp.	MDU Resources Group Inc.	493
Ecolab Inc.	Arch Chemicals Inc.	2841	Schlumberger Limited	Helix Energy Solutions Group, Inc.	1389
Edison International	Otter Tail Corporation	4911	Scripps Networks Interactive, Inc.	Crown Media Holdings Inc.	4841
EI DuPont de Nemours & Co.	Myers Industries Inc.	2821	Sealed Air Corporation	Tredegar Corp.	267
El Paso Corp.	PetroQuest Energy Inc.	1311	Sears Holdings Corporation	Casey's General Stores Inc.	5331
Electronic Arts Inc.	iGATE Corporation	7370	Sempra Energy	Clean Energy Fuels Corp.	4932
Eli Lilly & Co.	Targacept, Inc.	2834	Sigma-Aldrich Corporation	Broadwind Energy, Inc.	2836
EMC Corporation	Falconstor Software Inc.	3572	Simon Property Group Inc.	NorthStar Realty Finance Corp.	6798
Emerson Electric Co.	Capstone Turbine Corp.	3629	SLM Corporation	Asta Funding Inc.	61
Entergy Corporation	Empire District Electric Co.	4911	Snap-on Inc.	EnPro Industries, Inc.	342
EOG Resources, Inc.	GMX Resources Inc.	1311	Southern Company	DPL Inc.	4911
EQT Corporation	Energen Corp.	4923	Southwest Airlines Co.	US Airways Group, Inc.	4512



Equifax Inc.	Valassis Communications Inc.	73	Southwestern Energy Co.	Berry Petroleum Co.	1311
Equity Residential	LaSalle Hotel Properties	6798	Spectra Energy Corp.	National Fuel Gas Co.	4923
Estee Lauder Companies Inc.	Revlon, Inc.	2844	Sprint Nextel Corp.	Terremark Worldwide, Inc.	4813
Exelon Corp.	MGE Energy Inc.	4931	St. Jude Medical Inc.	Stereotaxis Inc.	3845
Expedia Inc.	Gaylord Entertainment Co.	4833	Stanley Black & Decker, Inc.	Gulf Island Fabrication Inc.	34
Expeditors International of Washington Inc.	Forward Air Corp.	4730	Staples, Inc.	Books-A-Million Inc.	5940
Express Scripts Inc.	HEALTHSOUTH Corp.	8093	Starbucks Corporation	The Cheesecake Factory Incorporated	5810
Exxon Mobil Corporation	WD-40 Company	29	Starwood Hotels & Resorts Worldwide Inc.	Orient-Express Hotels Ltd.	7011
F5 Networks, Inc.	Nuance Communications, Inc.	7372	State Street Corp.	Oriental Financial Group Inc.	6022
Fastenal Co.	Lumber Liquidators Holdings, Inc.	52	Stericycle, Inc.	Casella Waste Systems Inc.	4950
Federated Investors, Inc.	Cohen & Steers Inc.	6282	Stryker Corp.	NewMarket Corp.	3841
FedEx Corporation	Air Transport Services Group, Inc.	4513	Sunoco, Inc.	Owens Corning	29
Fidelity National Information Services, Inc.	Gaiam Inc.	7389	SunTrust Banks, Inc.	Nara Bancorp Inc.	6021
Fifth Third Bancorp	Associated Banc-Corp	6711	SUPERVALU Inc.	Nash Finch Co.	5141
First Horizon National Corp.	TCF Financial Corporation	6021	Symantec Corporation	Sapient Corp.	7370
First Solar, Inc.	Amkor Technology, Inc.	3674	Sysco Corp.	United Natural Foods, Inc.	514
FirstEnergy Corp.	Hawaiian Electric Industries Inc.	4911	T. Rowe Price Group, Inc.	Penson Worldwide Inc	6211
Fiserv, Inc.	Ultimate Software Group, Inc.	7370	Target Corp.	99¢ Only Stores	5331
FLIR Systems, Inc.	Trimble Navigation Limited	3810	TECO Energy, Inc.	PNM Resources, Inc.	4911
Flowserve Corp.	Ampco-Pittsburgh Corp.	3561	Tellabs Inc.	Brush Engineered Materials Inc.	3661
FMC Corp.	Dril-Quip, Inc.	3533	Tenet Healthcare Corp.	Health Management Associates Inc.	8062
FMC Technologies, Inc.	Tesco Corporation	3533	Teradata Corporation	Cray Inc.	3571
Ford Motor Co.	Spartan Motors Inc.	3711	Teradyne Inc.	Consolidated Tomoka Land Co.	3825
Forest Laboratories Inc.	Dynavax Technologies Corporation	2834	Tesoro Corporation	CVR Energy, Inc.	2911
Fortune Brands Inc.	OmegaFlex, Inc.	343	Texas Instruments Inc.	RadiSys Corporation	3674
Franklin Resources Inc.	Piper Jaffray Companies	6282	Textron Inc.	Spirit AeroSystems Holdings Inc	3728
Freeport-McMoRan Copper & Gold Inc.	Coeur d'Alene Mines Corporation	1041	The AES Corporation	Headwaters Inc.	4911
Frontier Communications Corporation	Equinix, Inc.	4813	The Allstate Corporation	Horace Mann Educators Corp.	6331
GameStop Corp.	Williams-Sonoma Inc.	57	The Bank of New York Mellon Corporation	Heartland Financial USA Inc.	6022
Gannett Co., Inc.	Journal Communications Inc.	2711	The Chubb Corporation	National Interstate Corporation	6331
Gap Inc.	Stage Stores Inc.	5651	The Coca-Cola Company	MGP Ingredients Inc.	208
General Dynamics Corp.	TAL International Group, Inc.	3731	The Dow Chemical Company	Hexcel Corp.	2821
General Electric Co.	Dresser-Rand Group Inc.	3511	The Goldman Sachs Group, Inc.	Astoria Financial Corporation	6712
General Mills, Inc.	Smart Balance, Inc	20	The Interpublic Group of Companies, Inc.	Clear Channel Outdoor Holdings Inc.	731
Genuine Parts Company	American Axle & Manufacturing Holdings Inc.	5013	The J. M. Smucker Company	Del Monte Foods Co.	2033
Genworth Financial Inc.	CNO Financial Group, Inc.	6311	The Kroger Co.	Winn-Dixie Stores Inc.	5411
Genzyme Corp.	ViroPharma Inc.	2830	The McGraw-Hill Companies, Inc.	The Knot, Inc.	2731
Gilead Sciences Inc.	Human Genome Sciences Inc.	2830	The TJX Companies, Inc.	Citi Trends	56
Goodrich Corp.	Orbital Sciences Corp.	3761	The Travelers Companies, Inc.	PICO Holdings Inc.	6331
Goodyear Tire & Rubber Co.	Cooper Tire & Rubber Co.	3011	The Washington Post Company	The McClatchy Company	2711
Google Inc.	Sourcefire, Inc.	7375	Thermo Fisher Scientific, Inc.	Measurement Specialties Inc.	3829
H&R Block, Inc.	American Capital, Ltd.	6159	Tiffany & Co.	Blue Nile Inc.	5944
Halliburton Company	Complete Production Services, Inc.	1389	Time Warner Cable Inc.	Dish Network Corp.	4841
Harley-Davidson, Inc.	Gentex Corp.	37	Time Warner Inc.	DreamWorks Animation SKG Inc.	7812
Harman International Industries Inc.	DTS Inc.	3651	Titanium Metals Corporation	RTI International Metals, Inc.	3356
Harris Corp.	Arris Group Inc.	3663	Torchmark Corp.	FBL Financial Group Inc.	6311



Hartford Financial Services Group Inc.	CNA Financial Corporation	6331	Total System Services, Inc.	Marchex, Inc.	7389
Hasbro Inc.	LeapFrog Enterprises Inc.	3944	Tyco International Ltd.	Hutchinson Technology Inc.	3679
HCP, Inc.	Macerich Co.	6798	Tyson Foods Inc.	Sanderson Farms, Inc.	2015
Health Care REIT Inc.	Ashford Hospitality Trust Inc.	6798	U.S. Bancorp	Privatebancorp Inc.	602
Helmerich & Payne Inc.	Warren Resources Inc.	1311	Union Pacific Corporation	Genesee & Wyoming Inc.	4011
Hershey Co.	Ralcorp Holdings Inc.	2066	United Parcel Service, Inc.	Dynamex Inc.	4215
Hess Corporation	Frontier Oil Corp.	2911	United States Steel Corp.	Commercial Metals Company	3312
Hewlett-Packard Company	Silicon Graphics International Corp.	3571	United Technologies Corp.	Triumph Group, Inc.	372
HJ Heinz Co.	B&G Foods Inc.	2033	Unitedhealth Group, Inc.	Health Net Inc.	6324
Honeywell International Inc.	LMI Aerospace Inc.	372	Unum Group	StanCorp Financial Group Inc.	6321
Hormel Foods Corp.	Smithfield Foods Inc.	201	Urban Outfitters Inc.	Casual Male Retail Group, Inc.	5650
Hospira Inc.	Medifast Inc.	2834	V.F. Corporation	Quicksilver Inc.	232
Host Hotels & Resorts Inc.	Sunstone Hotel Investors Inc.	7011	Valero Energy Corp.	Alon USA Energy, Inc.	2911
Hudson City Bancorp, Inc.	Flushing Financial Corp.	6030	Varian Medical Systems Inc.	Cynosure, Inc.	3845
Humana Inc.	HealthSpring Inc.	6324	Ventas, Inc.	FelCor Lodging Trust Inc.	6798
Huntington Bancshares Inc.	West Coast Bancorp	6020	VeriSign Inc.	Cadence Design Systems Inc.	7372
Illinois Tool Works Inc.	Kulicke & Soffa Industries Inc.	356	Verizon Communications Inc.	Valmont Industries, Inc.	4813
Ingersoll-Rand Plc	Lydall Inc.	3564	Visa, Inc.	Asset Acceptance Capital Corp.	6153
Integrus Energy Group, Inc.	Black Hills Corporation	4931	Vornado Realty Trust	Pennsylvania Real Estate Investment Trust	6798
Intel Corporation	CTS Corporation	3679	Vulcan Materials Company	USEC Inc.	142
IntercontinentalExchange, Inc.	Harris & Harris Group, Inc.	679	W.W. Grainger, Inc.	Houston Wire & Cable Company	5063
International Business Machines Corp.	Super Micro Computer, Inc.	3571	Walgreen Co.	PetMed Express Inc.	5912
International Flavors & Fragrances Inc.	Lubrizol Corporation	2865	Wal-Mart Stores Inc.	Dollar Tree, Inc.	5331
International Game Technology	Las Vegas Sands Corp.	7999	Walt Disney Co.	Ameristar Casinos Inc.	799
International Paper Co.	Verso Paper Corp.	2621	Waste Management, Inc.	US Ecology, Inc.	4953
Intuit Inc.	Bottomline Technologies Inc.	7370	Waters Corp.	Bruker Corporation	3826
Intuitive Surgical, Inc.	Hansen Medical, Inc.	3842	Watson Pharmaceuticals Inc.	Orexigen Therapeutics, Inc.	2834
Invesco Ltd.	Eaton Vance Corp.	6282	WellPoint Inc.	LHC Group, Inc.	8082
Iron Mountain Inc.	Arkansas Best Corporation	42	Wells Fargo & Company	CenterState Banks, Inc.	6021
ITT Corporation	Colfax Corporation	3561	Western Digital Corp.	Seagate Technology PLC	3572
J. C. Penney Company, Inc.	Retail Ventures Inc.	5311	Western Union Co.	Dollar Financial Corp.	6099
Jabil Circuit Inc.	Sanmina-SCI Corp.	3672	Weyerhaeuser Co.	Deltic Timber Corp.	24
Jacobs Engineering Group Inc.	McDermott International Inc.	8711	Whirlpool Corp.	Helen of Troy Limited	363
Janus Capital Group Inc.	Pzena Investment Management, Inc.	6282	Whole Foods Market, Inc.	Ruddick Corp.	541
JDS Uniphase Corporation	Fairchild Semiconductor International Inc.	3674	Williams Companies, Inc.	ATRION Corp.	492
Johnson & Johnson	Salix Pharmaceuticals Ltd.	2834	Windstream Corporation	PAETEC Holding Corp.	4813
Johnson Controls Inc.	BE Aerospace Inc.	2531	Wisconsin Energy Corp.	Central Vermont Public Service Corp.	4911
JPMorgan Chase & Co.	NGP Capital Resources Company	6726	Wyndham Worldwide Corporation	MGM Resorts International	7011
Juniper Networks, Inc.	VMware, Inc.	7379	Wynn Resorts Ltd.	Empire Resorts Inc.	7990
Kellogg Company	Corn Products International Inc.	204	Xcel Energy Inc.	NSTAR	4911
KeyCorp	Texas Capital BancShares Inc.	6021	Xerox Corp.	3D Systems Corp.	3577
Kimberly-Clark Corporation	Buckeye Technologies Inc.	26	Xilinx Inc.	RF Micro Devices Inc.	3670
Kimco Realty Corporation	SL Green Realty Corp.	6798	XL Group plc	PMI Group Inc.	6351
KLA-Tencor Corporation	Microvision Inc.	3827	Yahoo! Inc.	WebMD Health Corp.	7375
Kohl's Corp.	Bon-Ton Stores Inc.	531	Yum! Brands, Inc.	DineEquity, Inc.	5812
Kraft Foods Inc.	J&J Snack Foods Corp.	2052	Zimmer Holdings, Inc.	Wright Medical Group Inc.	3842
L-3 Communications Holdings Inc.	Ener1, Inc.	3669	Zions Bancorp.	East West Bancorp, Inc.	6020

## APPENDIX: Pair: Market Cap Portfolio

S&P	Matched Pair	SIC Match	S&P	Matched Pair	SIC Match
3M Co.	Nalco Holding Co.	3841	L-3 Communications Holdings Inc.	Ener1, Inc.	3669
Abbott Laboratories	Endo Pharmaceuticals Holdings Inc.	2834	Laboratory Corp. of America Holdings	Genoptix, Inc.	8071
Abercrombie & Fitch Co.	Zumiez, Inc.	56	Legg Mason Inc.	Raymond James Financial Inc.	6211
ACE Limited	Axis Capital Holdings Ltd.	6331	Leggett & Platt, Incorporated	Tempur Pedic International Inc.	2515
Adobe Systems Inc.	Concur Technologies, Inc.	7370	Leucadia National Corp.	Louisiana-Pacific Corp.	242
Advanced Micro Devices, Inc.	Atheros Communications Inc.	3674	Lexmark International Inc.	Aruba Networks, Inc.	3577
Aetna Inc.	WellCare Health Plans, Inc.	6324	Life Technologies Corporation	Integra LifeSciences Holdings Corporation	2836
AFLAC Inc.	PartnerRe Ltd.	6321	Limited Brands, Inc.	Dillard's Inc.	5621
Agilent Technologies Inc.	FormFactor Inc.	3825	Lincoln National Corp.	American National Insurance Co.	6311
Air Products & Chemicals Inc.	Calgon Carbon Corporation	2813	Linear Technology Corp.	Atmel Corporation	3670
Airgas Inc.	Acuity Brands, Inc.	5169	Lockheed Martin Corporation	Lear Corp.	37
AK Steel Holding Corporation	Quanex Building Products Corporation	3312	Lowe's Companies Inc.	Lumber Liquidators Holdings, Inc.	5211
Akamai Technologies Inc.	SXC Health Solutions, Corp.	7372	LSI Corporation	Cypress Semiconductor Corporation	3674
Alcoa, Inc.	Kaiser Aluminum Corporation	3334	M&T Bank Corp.	Signature Bank	6022
Allegheny Energy Inc.	Empire District Electric Co.	4911	Macy's, Inc.	Retail Ventures Inc.	5311
Allegheny Technologies Inc.	Texas Industries Inc.	3312	Marathon Oil Corporation	Questar Corporation	1321
Allergan Inc.	Salix Pharmaceuticals Ltd.	2834	Marriott International, Inc.	MGM Resorts International	7011
Altera Corp.	Silicon Laboratories Inc.	3670	Marsh & McLennan Companies, Inc.	Assured Guaranty Ltd.	6351
Amazon.com Inc.	Synopsys Inc.	7370	Marshall & Ilsley Corporation	Texas Capital BancShares Inc.	6021
Ameren Corporation	Black Hills Corporation	4931	Masco Corporation	American Woodmark Corp.	243
American Electric Power Co., Inc.	ITC Holdings Corp.	4911	Massey Energy Co.	Arch Coal Inc.	1221
American Express Company	City National Corp.	6712	Mastercard Incorporated	IHS Inc.	7389
American International Group, Inc.	CNA Financial Corporation	6331	Mattel Inc.	JAKKS Pacific, Inc.	3942
American Tower Corp.	AboveNet, Inc.	4899	McAfee, Inc.	Blackboard Inc.	7372
Ameriprise Financial Inc.	CapitalSource Inc.	6141	McDonald's Corp.	Brinker International Inc.	5812
AmerisourceBergen Corporation	Elizabeth Arden, Inc.	5122	McKesson Corporation	Herbalife Ltd.	5122
Amgen Inc.	Vertex Pharmaceuticals Incorporated	2830	Mead Johnson Nutrition Company	MannKind Corp.	2834
Amphenol Corporation	Thomas & Betts Corp.	3678	MeadWestvaco Corporation	Domtar Corporation	2621
Anadarko Petroleum Corporation	EXCO Resources Inc.	1311	MedcoHealth Solutions Inc.	Drugstore.com Inc.	591
Analog Devices Inc.	Skyworks Solutions Inc.	3674	Medtronic, Inc.	Teleflex Incorporated	3841
Aon Corporation	StanCorp Financial Group Inc.	6321	MEMC Electronic Materials Inc.	Amkor Technology, Inc.	3674
Apache Corp.	Continental Resources Inc.	1311	Merck & Co. Inc.	King Pharmaceuticals Inc.	2834
Apartment Investment & Management Co.	Camden Property Trust	6798	MetLife, Inc.	Brown & Brown Inc.	6411
Apollo Group Inc.	Career Education Corp.	8200	MetroPCS Communications, Inc.	NII Holdings Inc.	4812
Apple Inc.	Super Micro Computer, Inc.	3571	Microchip Technology Inc.	PMC-Sierra Inc.	3670
Applied Materials Inc.	Cymer Inc.	3550	Micron Technology Inc.	AVX Corp.	3674
Archer Daniels Midland Company	Darling International Inc.	207	Microsoft Corporation	Activision Blizzard, Inc.	7370
Assurant Inc.	Markel Corp.	6331	Molex Inc.	American Superconductor Corporation	3670
AT&T, Inc.	Virgin Media, Inc.	4813	Molson Coors Brewing Company	Coca-Cola Bottling Co. Consolidated	208
Autodesk, Inc.	Syntel, Inc.	7370	Monsanto Co.	The Scotts Miracle-Gro Co.	2879

Automatic Data Processing, Inc.	Rackspace Hosting, Inc	7374	Monster Worldwide, Inc.	Valassis Communications Inc.	731
AutoNation Inc.	Penske Automotive Group, Inc.	5511	Morgan Stanley	Washington Federal Inc.	6712
AutoZone Inc.	Pep Boys - Manny, Moe & Jack	5531	Murphy Oil Corporation	Owens Corning	29
Avalonbay Communities Inc.	Macerich Co.	6798	Mylan, Inc.	Par Pharmaceutical Companies Inc.	2834
Avery Dennison Corporation	Presstek Inc.	275	Nabors Industries Ltd.	Atwood Oceanics, Inc.	1381
Avon Products Inc.	AptarGroup, Inc.	2844	Nasdaq OMX Group Inc.	GFI Group Inc.	6200
Baker Hughes Incorporated	Oil States International Inc.	3533	National Oilwell Varco, Inc.	Dril-Quip, Inc.	3533
Ball Corporation	Crown Holdings Inc.	3411	National Semiconductor Corporation	International Rectifier Corporation	3674
Bank of America Corporation	TCF Financial Corporation	6021	NetApp, Inc.	Brocade Communications Systems, Inc.	3572
Baxter International Inc.	W.R. Grace & Co.	3841	Netflix, Inc.	Lions Gate Entertainment Corp.	78
BB & T Corp.	Westamerica Bancorp.	602	Newell Rubbermaid Inc.	Jarden Corp.	3089
Becton, Dickinson and Company	Hill-Rom Holdings, Inc.	3841	Newfield Exploration Co.	Forest Oil Corp.	1311
Bed Bath & Beyond, Inc.	Williams-Sonoma Inc.	57	Newmont Mining Corp.	Allied Nevada Gold Corp.	1041
Bemis Company, Inc.	Clearwater Paper Corporation	26	News Corp.	The New York Times Company	2711
Best Buy Co. Inc.	hhgregg, Inc.	5731	Nicor Inc.	Atmos Energy Corporation	4924
Biogen Idec Inc.	Perrigo Co.	2830	Nike Inc.	GSI Commerce Inc.	3021
BMC Software Inc.	Cadence Design Systems Inc.	7372	NiSource Inc.	CH Energy Group Inc.	4931
Boeing Co.	AAR Corp.	3721	Noble Energy, Inc.	Cleco Corporation	4931
Boston Properties Inc.	Liberty Property Trust	6798	Nordstrom Inc.	Stage Stores Inc.	5651
Boston Scientific Corporation	Haemonetics Corp.	3841	Northeast Utilities	Otter Tail Corporation	4911
Bristol-Myers Squibb Company	Medicis Pharmaceutical Corp.	2834	Northern Trust Corporation	BOK Financial Corp.	6020
Broadcom Corp.	Cree Inc.	3670	Northrop Grumman Corporation	Garmin Ltd.	3812
CA Technologies	Nuance Communications, Inc.	7372	Novell Inc.	JDA Software Group Inc.	7370
Cablevision Systems Corporation	LodgeNet Interactive Corporation	4841	Novellus Systems, Inc.	Century Aluminum Co.	3350
Cabot Oil & Gas Corporation	SandRidge Energy, Inc.	1311	NRG Energy, Inc.	UIL Holdings Corporation	4911
Cameron International Corporation	Dynamic Materials Corp.	349	Nucor Corporation	Commercial Metals Company	3312
Campbell Soup Co.	Lancaster Colony Corporation	203	NVIDIA Corporation	Rambus Inc.	3670
Capital One Financial Corp.	Credit Acceptance Corp.	6141	NYSE Euronext, Inc.	TD AMERITRADE Holding Corporation	62
Cardinal Health, Inc.	Nu Skin Enterprises Inc.	5122	Occidental Petroleum Corporation	Ultra Petroleum Corp.	1311
CarMax Inc.	Group 1 Automotive Inc.	55	Omnicom Group Inc.	Lamar Advertising Co.	731
Carnival Corporation	Royal Caribbean Cruises Ltd.	4481	ONEOK Inc.	WGL Holdings Inc.	4923
Caterpillar Inc.	Martin Marietta Materials Inc.	3531	Oracle Corp.	Ansys, Inc.	7370
CB Richard Ellis Group, Inc.	Alexandria Real Estate Equities Inc.	6798	O'Reilly Automotive Inc.	U.S. Auto Parts Network, Inc.	553
Celgene Corporation	HB Fuller Co.	289	Owens-Illinois, Inc.	Apogee Enterprises, Inc.	32
CenterPoint Energy, Inc.	El Paso Electric Co.	4911	PACCAR Inc.	Federal Signal Corp.	3711
CenturyLink, Inc.	TW Telecom Inc.	4813	Pall Corp.	Kulicke & Soffa Industries Inc.	356
Cephalon Inc.	IDEXX Laboratories, Inc.	2830	Parker Hannifin Corporation	Sun Hydraulics Corp.	349
Cerner Corp.	MICROS Systems, Inc.	7373	Patterson Companies Inc.	PetSmart, Inc.	5990
CF Industries Holdings, Inc.	LSB Industries Inc.	2873	Paychex Inc.	URS Corporation	87
CH Robinson Worldwide Inc.	UTi Worldwide Inc.	4731	Peabody Energy Corp.	Alpha Natural Resources, Inc.	1221
Charles Schwab Corp.	Jefferies Group Inc.	6211	People's United Financial Inc.	New York Community Bancorp Inc.	6036
Chesapeake Energy Corporation	Plains Exploration & Production Company	1311	Pepco Holdings, Inc.	Vectren Corporation	493
Chevron Corp.	Frontier Oil Corp.	2911	Pepsico, Inc.	M&F Worldwide Corp.	2086
CIGNA Corporation	AMERIGROUP Corporation	6324	PerkinElmer Inc.	Mettler-Toledo International, Inc.	3826
Cincinnati Financial Corp.	Harleysville Group Inc.	6330	Pfizer Inc.	Dendreon Corp.	2834
Cintas Corporation	Perry Ellis International Inc.	2320	PG & E Corp.	DPL Inc.	4911
Cisco Systems, Inc.	Marvell Technology Group Ltd.	3674	Philip Morris International, Inc.	Vector Group Ltd.	2111
Citigroup, Inc.	FirstMerit Corporation	6021	Pinnacle West Capital Corp.	Headwaters Inc.	4911
Citrix Systems, Inc.	Tibco Software, Inc.	7370	Pioneer Natural Resources Co.	Quicksilver Resources Inc.	1311
Cliffs Natural Resources Inc.	Hecla Mining Co.	10	Pitney Bowes Inc.	Universal Display Corp.	357

Clorox Corporation	West Pharmaceutical Services, Inc.	2842	Plum Creek Timber Co. Inc.	Skyline Corp.	24
CMS Energy Corp.	UGI Corp.	493	PNC Financial Services Group Inc.	New Alliance Bancshares Inc.	6021
Coca-Cola Enterprises Inc.	National Beverage Corp.	2086	Polo Ralph Lauren Corp.	The Talbots Inc.	5136
Cognizant Technology Solutions Corp.	Informatica Corporation	7370	PPG Industries Inc.	RPM International Inc.	2851
Colgate-Palmolive Co.	Tupperware Brands Corporation	2844	PPL Corporation	Hawaiian Electric Industries Inc.	4911
Comerica Incorporated	Community Bank System Inc.	6021	Praxair Inc.	Sensient Technologies Corporation	2813
Computer Sciences Corporation	Broadridge Financial Solutions Inc.	7373	Precision Castparts Corp.	Steel Dynamics Inc.	33
Compuware Corporation	Axiom Corporation	7370	priceline.com Incorporated	Alliance Data Systems Corporation	7389
ConAgra Foods, Inc.	Seaboard Corp.	2011	Principal Financial Group Inc.	Delphi Financial Group, Inc.	63
CONSOL Energy Inc.	James River Coal Co.	122	Procter & Gamble Co.	Church & Dwight Co. Inc.	2841
Consolidated Edison Inc.	ALLETE, Inc.	4931	Progress Energy Inc.	Great Plains Energy Incorporated	4911
Constellation Energy Group, Inc.	Northwestern Corp.	4931	Progressive Corp.	Validus Holdings, Ltd.	6331
Corning Inc.	General Cable Corp.	3357	ProLogis	Regency Centers Corporation	6798
Costco Wholesale Corporation	Bon-Ton Stores Inc.	53	Prudential Financial, Inc.	Reinsurance Group of America Inc.	6311
CR Bard Inc.	NuVasive, Inc.	3841	Public Service Enterprise Group Inc.	NV Energy, Inc.	4931
CSX Corp.	Genesee & Wyoming Inc.	4011	Public Storage	Federal Realty Investment Trust	6798
Cummins Inc.	Brunswick Corporation	3519	PulteGroup, Inc.	Toll Brothers Inc.	1531
CVS Caremark Corporation	Rite Aid Corp.	5912	QUALCOMM Incorporated	Arris Group Inc.	3663
Danaher Corp.	Cognex Corp.	3823	Quanta Services, Inc.	EMCOR Group Inc.	1731
Darden Restaurants, Inc.	Cracker Barrel Old Country Store, Inc.	5812	Quest Diagnostics Inc.	Genomic Health Inc.	8071
DaVita, Inc.	Lincare Holdings Inc.	809	Qwest Communications International Inc.	Leap Wireless International Inc.	4813
Dean Foods Co.	Lifeway Foods Inc.	202	R.R. Donnelley & Sons Company	Vistaprint N.V.	2750
Deere & Company	CNH Global NV	3523	RadioShack Corp.	Pier 1 Imports, Inc.	57
Dell Inc.	Itron, Inc.	3570	Range Resources Corporation	SM Energy Company	1311
Denbury Resources Inc.	Atlas Energy, Inc.	1311	Raytheon Co.	Analogic Corporation	3812
DENTSPLY International Inc.	CONMED Corporation	3840	Red Hat, Inc.	DST Systems Inc.	7374
Devon Energy Corporation	Petrohawk Energy Corporation	1311	Regions Financial Corp.	Webster Financial Corp.	6021
DeVry, Inc.	Corinthian Colleges Inc.	8249	Republic Services, Inc.	Waste Connections Inc.	4953
Diamond Offshore Drilling Inc.	Patterson-UTI Energy Inc.	1381	Reynolds American Inc.	Star Scientific, Inc.	2111
DIRECTV	Crown Castle International Corp.	4899	Robert Half International Inc.	TrueBlue, Inc.	7363
Discover Financial Services	EZCORP Inc.	6141	Rockwell Automation Inc.	Cubic Corporation	3829
Dominion Resources, Inc.	NSTAR	4911	Rockwell Collins Inc.	TransDigm Group Incorporated	3728
Dover Corp.	Lufkin Industries Inc.	353	Roper Industries Inc.	Graco Inc.	3561
DR Horton Inc.	NVR Inc.	1531	Ross Stores Inc.	Casual Male Retail Group, Inc.	5650
Dr Pepper Snapple Group, Inc.	MGP Ingredients Inc.	208	Rowan Companies Inc.	W&T Offshore Inc.	1381
DTE Energy Co.	PNM Resources, Inc.	4911	Ryder System, Inc.	Standard Parking Corp.	751
Duke Energy Corporation	Alliant Energy Corporation	4911	Safeway Inc.	Weis Markets, Inc.	5411
Eastman Chemical Co.	PolyOne Corporation	2821	SAIC, Inc.	National Instruments Corporation	7373
Eaton Corporation	BorgWarner Inc.	3714	Salesforce.com	FTI Consulting, Inc.	8742
eBay Inc.	Lender Processing Services, Inc.	7389	SanDisk Corp.	Electronics for Imaging, Inc.	3570
Ecolab Inc.	Arch Chemicals Inc.	2841	Sara Lee Corp.	Treehouse Foods, Inc.	203
Edison International	Portland General Electric Company	4911	SCANA Corp.	MGE Energy Inc.	4931
El DuPont de Nemours & Co.	Huntsman Corporation	2821	Schlumberger Limited	Pride International Inc.	1389
El Paso Corp.	Whiting Petroleum Corp.	1311	Scripps Networks Interactive, Inc.	Crown Media Holdings Inc.	4841

Electronic Arts Inc.	Sapient Corp.	7370	Sealed Air Corporation	Tredegar Corp.	267
Eli Lilly & Co.	Auxilium Pharmaceuticals Inc.	2834	Sears Holdings Corporation	Casey's General Stores Inc.	5331
EMC Corporation	Seagate Technology PLC	3572	Semptra Energy	MDU Resources Group Inc.	4932
Emerson Electric Co.	FuelCell Energy Inc.	3629	Sigma-Aldrich Corporation	Seattle Genetics Inc.	2836
Entergy Corporation	Westar Energy, Inc.	4911	Simon Property Group Inc.	Annaly Capital Management, Inc.	6798
EOG Resources, Inc.	Cimarex Energy Co.	1311	SLM Corporation	First Cash Financial Services Inc.	61
EQT Corporation	Energen Corp.	4923	Snap-on Inc.	Harsco Corporation	34
Equifax Inc.	ValueClick, Inc.	73	Southern Company	Calpine Corp.	4911
Equity Residential	SL Green Realty Corp.	6798	Southwest Airlines Co.	Delta Air Lines Inc.	4512
Estee Lauder Companies Inc.	Alberto-Culver Company	2844	Southwestern Energy Co.	Concho Resources, Inc.	1311
Exelon Corp.	OGE Energy Corp.	4931	Spectra Energy Corp.	National Fuel Gas Co.	4923
Expedia Inc.	IAC/InterActiveCorp.	4833	Sprint Nextel Corp.	Valmont Industries, Inc.	4813
Expeditors International of Washington Inc.	Hub Group Inc.	4730	St. Jude Medical Inc.	Masimo Corporation	3845
Express Scripts Inc.	HEALTHSOUTH Corp.	8093	Stanley Black & Decker, Inc.	EnPro Industries, Inc.	342
Exxon Mobil Corporation	Holly Corporation	2911	Staples, Inc.	Books-A-Million Inc.	5940
F5 Networks, Inc.	Quality Systems Inc.	7372	Starbucks Corporation	Panera Bread Co.	5810
Family Dollar Stores Inc.	99¢ Only Stores	5331	Starwood Hotels & Resorts Worldwide Inc.	Vail Resorts Inc.	7011
Fastenal Co.	Builders FirstSource, Inc.	52	State Street Corp.	BancorpSouth, Inc.	6022
Federated Investors, Inc.	Piper Jaffray Companies	6282	Stericycle, Inc.	Casella Waste Systems Inc.	4950
FedEx Corporation	Air Transport Services Group, Inc.	4513	Stryker Corp.	NewMarket Corp.	3841
Fidelity National Information Services, Inc.	FactSet Research Systems Inc.	7389	Sunoco, Inc.	Ameron International Corporation	29
Fifth Third Bancorp	Commerce Bancshares Inc.	6711	SunTrust Banks, Inc.	Synovus Financial Corp.	6021
First Horizon National Corp.	Pinnacle Financial Partners Inc.	6021	SUPERVALU Inc.	United Natural Foods, Inc.	514
First Solar, Inc.	ON Semiconductor Corp.	3674	Symantec Corporation	Quest Software Inc.	7370
FirstEnergy Corp.	Ormat Technologies Inc.	4911	Sysco Corp.	Nash Finch Co.	5141
Fiserv, Inc.	Ariba Inc.	7370	T. Rowe Price Group, Inc.	Lazard Ltd.	6211
FLIR Systems, Inc.	Trimble Navigation Limited	3810	Target Corp.	BJ's Wholesale Club Inc.	5331
Flowserve Corp.	Robbins & Myers Inc.	3561	TECO Energy, Inc.	Unitil Corp.	4911
FMC Corp.	Tesco Corporation	3533	Tellabs Inc.	Riverbed Technology, Inc.	3661
FMC Technologies, Inc.	Gulfmark Offshore, Inc.	3533	Tenet Healthcare Corp.	Community Health Systems, Inc.	8062
Ford Motor Co.	Oshkosh Corporation	3711	Teradata Corporation	Silicon Graphics International Corp.	3571
Forest Laboratories Inc.	Impax Laboratories Inc.	2834	Teradyne Inc.	Ixia	3825
Fortune Brands Inc.	OmegaFlex, Inc.	343	Tesoro Corporation	WD-40 Company	29
Franklin Resources Inc.	Eaton Vance Corp.	6282	Texas Instruments Inc.	Maxim Integrated Products Inc.	3674
Freeport-McMoRan Copper & Gold Inc.	Coeur d'Alene Mines Corporation	1041	Textron Inc.	Spirit AeroSystems Holdings Inc	3728
Frontier Communications Corporation	Global Crossing Ltd.	4813	The AES Corporation	UniSource Energy Corporation	4911
GameStop Corp.	Tuesday Morning Corp.	57	The Allstate Corporation	W.R. Berkley Corporation	6331
Gannett Co., Inc.	Belo Corp.	2711	The Bank of New York Mellon Corporation	Bank of Hawaii Corporation	6022
Gap Inc.	Buckle Inc.	5651	The Chubb Corporation	Arch Capital Group Ltd.	6331
General Dynamics Corp.	TAL International Group, Inc.	3731	The Coca-Cola Company	Wendy's/Arby's Group, Inc.	2086
General Electric Co.	Dresser-Rand Group Inc.	3511	The Dow Chemical Company	Hexcel Corp.	2821
General Mills, Inc.	Corn Products International Inc.	204	The Goldman Sachs Group, Inc.	TFS Financial Corp	6712
Genuine Parts Company	Advance Auto Parts Inc.	5013	The Interpublic Group of Companies, Inc.	Clear Channel Outdoor Holdings Inc.	731
Genworth Financial Inc.	Protective Life Corp.	6311	The J. M. Smucker Company	B&G Foods Inc.	2033
Genzyme Corp.	Alexion Pharmaceuticals, Inc.	2830	The Kroger Co.	Ruddick Corp.	5411
Gilead Sciences Inc.	Human Genome Sciences Inc.	2830	The McGraw-Hill Companies, Inc.	The Knot, Inc.	2731
Goodrich Corp.	Orbital Sciences Corp.	3761	The TJX Companies, Inc.	J. Crew Group, Inc.	5651
Goodyear Tire & Rubber Co.	Cooper Tire & Rubber Co.	3011	The Travelers Companies, Inc.	Everest Re Group Ltd.	6331
Google Inc.	WebMD Health Corp.	7375	The Washington Post Company	The Dolan Company	2711
H&R Block, Inc.	CIT Group Inc.	6159	Thermo Fisher Scientific, Inc.	Beckman Coulter Inc.	3829
Halliburton Company	Oceaneering International, Inc.	1389	Tiffany & Co.	Blue Nile Inc.	5944
Harley-Davidson, Inc.	Autoliv, Inc.	37	Time Warner Cable Inc.	Dish Network Corp.	4841



Harman International Industries Inc.	Dolby Laboratories Inc.	3651	Time Warner Inc.	DreamWorks Animation SKG Inc.	7812
Harris Corp.	InterDigital, Inc.	3663	Titanium Metals Corporation	RTI International Metals, Inc.	3356
Hartford Financial Services Group Inc.	Transatlantic Holdings Inc.	6331	Torchmark Corp.	CNO Financial Group, Inc.	6311
Hasbro Inc.	LeapFrog Enterprises Inc.	3944	Total System Services, Inc.	NeuStar, Inc.	7389
HCP, Inc.	Digital Realty Trust Inc.	6798	Tyco International Ltd.	Supertex Inc.	3679
Health Care REIT Inc.	Duke Realty Corp.	6798	Tyson Foods Inc.	Sanderson Farms, Inc.	2015
Helmerich & Payne Inc.	Unit Corp.	1311	U.S. Bancorp	SVB Financial Group	602
Hershey Co.	Ralcorp Holdings Inc.	2066	Union Pacific Corporation	Kansas City Southern	4011
Hess Corporation	CVR Energy, Inc.	2911	United Parcel Service, Inc.	Dynamex Inc.	4215
Hewlett-Packard Company	Cray Inc.	3571	United States Steel Corp.	Carpenter Technology Corp.	3312
HJ Heinz Co.	Del Monte Foods Co.	2033	United Technologies Corp.	LMI Aerospace Inc.	372
Honeywell International Inc.	Triumph Group, Inc.	372	Unitedhealth Group, Inc.	Health Net Inc.	6324
Hormel Foods Corp.	Smithfield Foods Inc.	201	Unum Group	Triple-S Management Corporation	6321
Hospira Inc.	Alnylam Pharmaceuticals, Inc.	2834	Urban Outfitters Inc.	Citi Trends	56
Host Hotels & Resorts Inc.	Choice Hotels International Inc.	7011	V.F. Corporation	Phillips-Van Heusen Corp.	232
Hudson City Bancorp, Inc.	Capitol Federal Financial, Inc.	6030	Valero Energy Corp.	Alon USA Energy, Inc.	2911
Humana Inc.	HealthSpring Inc.	6324	Varian Medical Systems Inc.	Thoratec Corp.	3845
Huntington Bancshares Inc.	Prosperity Bancshares Inc.	6020	Ventas, Inc.	Rayonier Inc.	6798
Illinois Tool Works Inc.	Nordson Corporation	356	VeriSign Inc.	Pegasystems Inc.	7372
Ingersoll-Rand Plc	Donaldson Company, Inc.	3564	Verizon Communications Inc.	Equinix, Inc.	4813
Integrus Energy Group, Inc.	Clean Energy Fuels Corp.	493	Visa, Inc.	Portfolio Recovery Associates Inc.	6153
Intel Corporation	Synaptics Inc.	3679	Vornado Realty Trust	Nationwide Health Properties Inc.	6798
IntercontinentalExchange, Inc.	Harris & Harris Group, Inc.	679	Vulcan Materials Company	USEC Inc.	142
International Business Machines Corp.	Omniceil Inc.	3571	W.W. Grainger, Inc.	Anixter International Inc.	5063
International Flavors & Fragrances Inc.	Lubrizol Corporation	2865	Walgreen Co.	PetMed Express Inc.	5912
International Game Technology	Las Vegas Sands Corp.	7999	Wal-Mart Stores Inc.	Dollar Tree, Inc.	5331
International Paper Co.	Sonoco Products Co.	2621	Walt Disney Co.	Empire Resorts Inc.	799
Intuit Inc.	Parametric Technology Corporation	7370	Waste Management, Inc.	Covanta Holding Corporation	4953
Intuitive Surgical, Inc.	Edwards Lifesciences Corp.	3842	Waters Corp.	Illumina Inc.	3826
Invesco Ltd.	Morningstar Inc.	6282	Watson Pharmaceuticals Inc.	AMAG Pharmaceuticals, Inc.	2834
Iron Mountain Inc.	JB Hunt Transport Services Inc.	42	WellPoint Inc.	LHC Group, Inc.	8082
ITT Corporation	IDEX Corporation	3561	Wells Fargo & Company	Cullen/Frost Bankers, Inc.	6021
J. C. Penney Company, Inc.	School Specialty Inc.	531	Western Digital Corp.	STEC, Inc.	3572
Jabil Circuit Inc.	Benchmark Electronics Inc.	3672	Western Union Co.	Euronet Worldwide Inc.	6099
Jacobs Engineering Group Inc.	McDermott International Inc.	8711	Weyerhaeuser Co.	Deltic Timber Corp.	24
Janus Capital Group Inc.	Cohen & Steers Inc.	6282	Whirlpool Corp.	National Presto Industries Inc.	363
JDS Uniphase Corporation	Intersil Corporation	3674	Whole Foods Market, Inc.	Winn-Dixie Stores Inc.	541
Johnson & Johnson	Warner Chilcott plc	2834	Williams Companies, Inc.	ATRION Corp.	492
Johnson Controls Inc.	BE Aerospace Inc.	2531	Windstream Corporation	Atlantic Tele-Network, Inc.	4813
JPMorgan Chase & Co.	BlackRock Kelso Capital Corporation	6726	Wisconsin Energy Corp.	Dynegy Inc.	4911
Juniper Networks, Inc.	Accenture plc	7379	Wyndham Worldwide Corporation	Sunstone Hotel Investors Inc.	7011
Kellogg Company	Smart Balance, Inc	20	Wynn Resorts Ltd.	Ameristar Casinos Inc.	7990
KeyCorp	PacWest Bancorp	6021	Xcel Energy Inc.	IdaCorp, Inc.	4911
Kimberly-Clark Corporation	Buckeye Technologies Inc.	26	Xerox Corp.	Zebra Technologies Corp.	3577
Kimco Realty Corporation	Senior Housing Properties Trust	6798	Xilinx Inc.	QLogic Corp.	3670
KLA-Tencor Corporation	Microvision Inc.	3827	XL Group plc	ProAssurance Corporation	6351
Kohl's Corp.	Stein Mart Inc.	5311	Yahoo! Inc.	Sourcefire, Inc.	7375
Kraft Foods Inc.	Snyder's-Lance, Inc.	2052	Yum! Brands, Inc.	Jack in the Box Inc.	5812

## Works Cited

R.J. Barro, E.F. Fama, D.R. Fischel, A.H. Meltzer, R. Roll and L.G. Telser, edited by R.W. Kamphuis, Jr., R.C. Kormendi and J.W.H. Watson (1989). *Black Monday and the Future Financial Markets*. Homewood: Mid America Institute for Public Policy Research, Inc.,.

Blume, Marshall E., A. C. MacKinley, B. Terker (1989). Order Imbalances and Stock Price Movements on October 19 and 20, 1987. *Journal of Finance Volume: 44 Issue: 4* , 827 - 848.

Commodity Futures Trading Commission and SEC. (2010, September). *Findings regarding the market events of May 6, 2010*. Retrieved from [www.sec.gov/news/studies/2010/marketevents-report.pdf](http://www.sec.gov/news/studies/2010/marketevents-report.pdf)

Fama, E. (1988). Perspectives on October 1987, or, What Did We Learn from the Crash? *Center for Research in Security Prices Working paper series no. 232.*; Chicago: Graduate School of Business University of Chicago .

Patterson, S. (2010, May 17). *How the 'Flash Crash' Echoed Black Monday*. Retrieved from The Wall Street Journal:  
[http://online.wsj.com/article/SB10001424052748704314904575250602626326346.html#articleTabs\\_interactive](http://online.wsj.com/article/SB10001424052748704314904575250602626326346.html#articleTabs_interactive)

Roll, R. (1988). The International Crash of October 1987. *Financial Analysts Journal* , Vol. 44, No. 5: 19-35.