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Terrorist Attacks on September 11, 2001: A Test of Market Efficiency in the Insurance and Airline Industries

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ABSTRACT
How will the market react to an unforeseen event? How efficiently will it react to the terrorist attacks on September 11, 2001? This event study tests the semi-strong market efficiency theory by looking at the stock price returns of two samples of totaling 29 firms that were greatly affected by this event using the risk adjusted event study methodology. The evidence shows that both the insurance airline industries were greatly negatively affected on and after the event. However, it is clear to see that the firms in the airline industry were hurt a lot worse overall and their stock price returns took a longer time to recover. Regardless of the differentiation, both industries confirm the semi-strong market efficiency theory.

INTRODUCTION

"A market is efficient with respect to an information system if and only if security prices act as if everyone knows that information system. If this condition holds, prices are said to "fully reflect" the information system" (Beaver). Market efficiency has two implications. First, in any given time period, a securities' abnormal return depends on information or news received by the market in that period. And second, an investor who uses the same information as the market cannot expect to earn abnormal returns (Ross). For this to hold, one of the following conditions must be true: investors react rationally, investors have offsetting irrationalities in the marketplace, or arbitrage of professionals dominates the speculation of amateurs in the market.. Unforeseen catastrophes like terrorist attacks have a major effect on the overall stock market. These attacks can cause uncertainty and panic and affect all companies in the market. This study tests the semi-strong efficiency theory by analyzing the impact the attacks on September 11, 2001 had on the risk adjusted stock price returns of insurance and airline firms. The biggest attack on American

soil was the attack on September 11, 2001 when terrorists hijacked commercial airlines and flew the planes into the World Trade Center and the Pentagon causing mass casualties and destruction. This event hurt over 400 businesses with the destruction of buildings and the loss of major resources. It closed the NYSE for four days until it was re-opened on September 17, 2001. Thus, insurance companies were hit hard after the event by damages to buildings and infrastructure, as well as deaths. In addition, the airline industry suffered damages from the event, but most importantly the attacks significantly reduced air travel with people fearful of another attack. This study looks at the airline and insurance industries since research suggests that they were the most negatively affected by the terrorist attacks.

PROBLEM AND PURPOSE

How does the market respond to an unforeseen crisis? Is the market efficient enough to react to events right as they happen or does it take time for them to adjust? Also, do all of the industries in the market react and behave the same way? What types of industries are most negatively affected by an unforeseen crisis?

The purpose of this study is to test market efficiency by analyzing the effect of the unforeseen September 11, 2001 terrorist attacks on risk adjusted stock returns of 2 samples of different firms each that are expected to have been the most negatively impacted. The study will analyze 20 firms from the life insurance, property and casualty, and insurance brokers industry within the financial sector, as well as 9 firms within the regional and major airlines industry of the service sector. This study will randomly select the sample of firms within the two sectors resulting in a total of 29 different companies. The study hypothesizes that both selected industries reacted negatively to attacks on September 11, 2001 according to semi-strong form efficient market hypothesis. This research analyzes the risk-adjusted rate of return of the stock prices for the insurance and airline sample firms thirty trading days before and thirty trading days after the date of the event in order to test the semi-strong efficient market hypothesis.

LITERATURE REVIEW

Market Efficiency and Investment Analysis Fees

This study tests the semi-strong market efficiency theory by using the standard event study methodology in the finance literature. If the market is semi-strong form efficient, then two popular methods of stock valuation are rendered useless resulting in a most significant implication of this study. Investors pay analysts who use these valuation models billions of dollars annually for investment advice and guidance. Thus, if the market is efficient, these investors are wasting billions of dollars on useless investment advice. Efforts to determine the "right" value of stock are useless since in an efficient market the "right" price is the market price that almost instantly impounds all available and relevant information.

Technical Stock Analysis

The first method called into question by the efficient market hypothesis is technical stock analysis. Technical analysis is, in essence, the recording of the actual history of trading for one stock or a group of equities and deducing the future trend from this historical analysis. Technical analysts identify buy and sell points by analyzing past price movement with charts. Often called chartists, they closely examine the effect on stock price of supply and demand, popular opinions, moods, guesses, and blind necessities. Using these factors continually and automatically, technical analysis disregards the minor fluctuation in the market and identifies how stock prices tend to move in trends in the long run. Finally changes in trends are determined by shifts in supply and demand relationships and can be detected sooner or later in the market (Levy). With

regards to technical analysis, critics contend that the behavior of the stock market in the past may not be indicative of behavior in the years to come and that multiple interpretations could be made by looking at the chart of stock price movements. These critics also argue that if technical analysis were continually successful, an influx of technical traders will neutralize whatever profit potential exists (Levy).

Fundamental Stock Analysis

The other stock valuation model used by analysts to determine market value is fundamental stock analysis. According to the underlying assumption of fundamental stock analysis, each security has an intrinsic value, which is the present value of expected future cash flows of the firm. Therefore, value and future cash flow depend upon the firm's earning potential, economic variables, and financial factors that cause actual market prices to move toward intrinsic values (Levy). If the fundamental intrinsic value is below the market value, the analyst recommends a sell signal and the opposite or a buy signal when the intrinsic value is above the market value. Critics of fundamental analysis contend that the market reacts so quickly that it is impossible to maximize profit from the market because the investor is forced to wait for information to be publicly available. This information comprises statistics on sales, orders, earnings, and dividend announcements. Not only is this information hard to collect but it is also costly and not always reliable. A fundamental analyst may find himself heavily invested in a security for a considerable length of time before the market support develops (Levy).

Market Efficiency

If the market is semi-strong form efficient, investors are wasting billions of dollars on technical and fundamental analyst fees for worthless advice. There are three different forms of market efficiency as defined by the efficient market hypothesis. These include strong-form efficiency, semi-strong form efficiency, and weak form efficiency. Strong form efficiency states that the market reacts to all forms of information including past, public, and private. This makes it impossible for someone to earn an above normal return because the stock price reflects all information whether known or not. An above normal return would be a return greater than the expected risk adjusted return of the stock price. Accordingly, an investor can't earn an above normal return by acting on inside information. Research suggests that the market is not strong form efficient because insiders outperform the market with information regarding both profitable and non-profitable situations. This finding provides enough evidence to refute the strong-form of the efficient market hypothesis (Finnerty). Next, the weak form efficient market hypothesis states that all past information is imbedded in stock price. This means that the stock price would not reflect other information, such as earnings forecasts, merger announcements, or money supply figures (Ross). This means that no investor can earn an above normal return by acting on past information rendering technical analysis useless since its basic assumption rests on the ability to use the past stock price movement identified in charts to predict future stock prices. Weak-form efficiency is about the weakest type of efficiency that we would expect a financial market to display because historical price information is the easiest kind of information about a stock to acquire (Ross). No investor can earn an above normal return by acting on past information.

Semi-Strong Form Efficiency

Finally, the form of market efficiency tested in this study is the semi-strong form efficient market hypothesis. This states that all stock prices reflect public information making it impossible to earn an abnormal return by acting or investing on public information, thus rendering fundamental

stock analysis useless. This information includes historical stock prices and published accounting statements of a firm (Ross). This study tested the semi-strong form efficient market hypothesis by examining the risk-adjusted returns of 9 airline and 20 insurance firms' stock prices from thirty trading days before the event to thirty days after. Ross defines an efficient market response as the stock price instantaneously adjusts to and fully reflects new information. There is no tendency for subsequent increases and decreases (Ross).

September 11 Terrorist Attacks and Effect on Insurance and Airline Stock Returns

Previous research shows the market as a whole was significantly negatively affected by the terrorist attacks on September 11th. Marc Davis reported that, "Not only has this attack affected the market but other notable attacks have caused harm as well. On the first day of NYSE trading after 9/11, the market fell 684 points, a 7.1% decline, setting a record for the biggest loss in exchange history for one trading day. At the close of trading that Friday, ending a week that saw the biggest losses in NYSE history, the Dow Jones was down almost 1,370 points, representing a loss of over 14%"(Davis, 2017). The attack on September 11th is the second most costly catastrophic event, right behind Hurricane Katrina (Jasen, 2011). This terrorist attack put our economy through a six-month recession and required government intervention in order to recover from the slump (Jasen, 2011).

The financial sector was one of the industries greatly affected. Over 200 insurers shared losses of around $33 billion after the attacks and this led the insurance industry to re-evaluate its risk. The Fiscal Times reports, "Of the $33 billion in insured losses, about a third were property claims, a third were for business interruption, and the remainder were liability (including aviation), workers' compensation, event cancellation, and life insurance"(Jasen, 2011). Even though insurance companies have taken a hit they have been able to rebound from this crisis and in the long run able to be profitable. They also have been able to learn from this crisis and how to prevent more losses (Woehr, 2006). Today, there is even terrorism insurance to prepare for the worst to come. Next as far as the airline industry is concerned, it was significantly affected by these attacks and possibly made worse off than insurance firms. Marc Davis reported that, American Airlines stock dropped from a $29.70 per share on September 11 to $18.00 per share on September 17, a 39% decline. United Airlines stock dropped from $30.82 per share to $17.50 per share on September 17, a 42% decline. (Davis, 2017) Both of these airlines had their planes hijacked and destroyed on the day of the attack. Not only did airline companies struggle from the wreckage of the aftermath, but they also were affected afterwards by the lack of travel out of fear and increased security procedures by TSA. An economic study performed by Cornell University proved that federal baggage screenings brought about a 6 percent reduction overall in passenger volume, with a 9 percent reduction in the nation's busiest airports, this totaling a nearly $1 billion loss for the airline industry (Blalock). In terms of government intervention both of the industries were treated differently. On September 23, 2001 that President Busch signed on a Airline Bail Out Package worth $15 billion in federal aid to help the struggling industry in order for airline travel to continue (Bush Signs Airline Bailout Package). It wasn't until November 26,2002 that President Busch signed the Terrorism Risk Insurance Act of 2002 (Terrorism Risk Insurance Program). This Act allowed the government to bail out the insurance companies as a last resort in the future. The insurance industry's premiums following the incident rose drastically to account for the possibility of another event occurring.

METHODOLOGY

This study used the standard risk adjusted event study methodology from the finance literature to test the stock market's response to the attacks on September 11, 2001. All required historical data of all firms' stock prices and the corresponding S&P 500 index for the event study period, 181 trading days before the event and 30 trading days after, were obtained from Yahoo! Finance. Only trading days when the market was open are analyzed. Weekends, holidays, and the four days the market was closed following the September 11 attack are ignored. The analysis was conducted as follows:

- Historical stock prices for all companies and the S&P 500 were obtained for the event study duration of -180 trading day to +30 trading days, where -30 to +30 is the event period and day 0 is the event day (September 11, 2001).

- The holding period returns (HPR) for the sample firms (R) and the S&P 500 (Rm) were calculated using the following formula:

  $$\text{Current daily stock return} = \frac{\text{(Current Day Close Price – Previous Day Close Price)}}{\text{Previous Day Close Price}}$$

- A regression analysis was performed using the actual daily returns of each company (dependent variable) and the corresponding S&P 500 daily returns (independent variable) over the course of the pre-event period (day -181 to -31).

Figure 1. Alphas and Betas for 20 Insurance Firms

Firm Name	Ticker	Alpha y	Beta x slp
MetLife Inc.	MET	-0.0002594	0.747
Berkshire Hathaway Inc.	BRK-B	0.0007433	0.341
Sun Life Financial Inc.	SLF	0.00013988	0.649
American International Group	AIG	-0.00005445	0.677
Chubb Limited	CB	0.0012155	0.961
The Hartford Financial Services Group, Inc.	HIG	-0.00012638	0.775
Lincoln National Corporation	LNC	0.00050683	0.795
Loews Corporation	L	0.0008058	0.366
Markel Corporation	MKL	0.0013297	0.609
Cincinnati Financial Corporation	CINF	0.00044996	0.487
CNA Financial Corporation	CNA	-0.0011395	0.523
Arch Capital Group Ltd.	ACGL	0.0028423	0.117
Arthur J. Gallagher & Co.	AJG	0.00145575	0.297
Torchmark Corporation	TMK	0.00058824	0.551
American Financial Group, Inc.	AFG	0.00073507	0.582
Everest Re Group, Ltd.	RE	0.00107754	0.661
Marsh & McLennan Companies Inc.	MMC	0.0005532	1.0235
Prudential plc	PUK	-0.0007304	0.725
XL Group Ltd	XL	0.0013526	0.581
Brown & Brown, Inc.	BRO	0.0030592	0.352

Figure 2. Alphas and Betas for 9 Airline Firms

Firm Name	Ticker	Alpha	Beta
Southwest Airlines Co.	LUV	0.0000676	0.917
China Eastern Airlines Corporation, Ltd.	CEA	-0.0004294	0.868
China Southern Airlines Company, Ltd.	ZNH	0.0009451	1.18902
Grupo de Aeroportuario del Sureste	ASR	-0.0000879	0.6048
SkyWest Inc.	SKYW	0.0018102	2.0223
Hawaiian Holdings Inc.	HA	0.00184153	0.4126
PHI Inc.	PHII	0.0032029	0.18018
Ryanair Holdings plc	RYAAY	0.0005542	0.829
Alaska Air Group, Inc.	ALK	0.00115912	1.162

- For this study, in order to get the normal expected returns, the risk-adjusted method (market model) was used. The expected return for each day of the event period from day -30 to day +30, was calculated as: E(R)= alpha + Beta (Rm)

Where Rm is the return on the market (S&P 500 index)

- Then, the Excess return (ER) will be calculated as:

ER= the Actual Return (R) – Expected Return E(R)

- Average Excess Returns (AER) will be calculated (for each day from -30 to +30) by averaging the excess returns for all the firms for a given day.
  AER = Sum of Excess Return for given day / n,
  Where n = number of firms in sample
- Cumulative AER (CAER) will be calculated by adding the AERs for each day from -30 to +30.
- Graphs of AER and Cumulative AER will be plotted for the event period i.e. day -30 to day +30.

In order to test semi-strong market efficiency with after the attacks on September 11, 2001, this study proposed the following hypotheses:

$H1_0$: The risk adjusted return of the stock price of the sample of 20 insurance companies is not significantly affected by this type of information on the event date.

$H1_1$: The risk adjusted return of the stock price of the sample of 20 insurance companies is significantly negatively affected by this type of information on the event date.

$H2_0$: The risk adjusted return of the stock price of the sample of 20 insurance companies is not significantly affected by this type of information around the event date as defined by the event period.

$H2_1$: The risk adjusted return of the stock price of the sample of 20 insurance companies is significantly negatively affected around the event date as defined by the event period.

$H3_0$: The risk adjusted return of the stock price of the sample of 9 airline companies is not significantly affected by this type of information on the event date.

$H3_1$: The risk adjusted return of the stock price of the sample of 9 airline companies is significantly negatively affected by this type of information on the event date.

$H4_0$: The risk adjusted return of the stock price of the sample of 9 airline companies is not significantly affected by this type of information around the event date as defined by the event period.

$H4_1$: The risk adjusted return of the stock price of the sample of 9 airline companies is significantly negatively affected around the event date as defined by the event period.

$H5_0$: The risk adjusted return of the stock price of the global sample of 20 insurance and 9 airline companies is not significantly affected by this type of information on the event date.

$H5_1$: The risk adjusted return of the stock price of the global sample of 20 insurance and 9 airline companies is significantly negatively affected by this type of information on the event date.

$H6_0$: The risk adjusted return of the stock price of the global sample of 20 insurance and 9 airline companies is not significantly affected by this type of information around the event date as defined by the event period.

$H6_1$: The risk adjusted return of the stock price of the global sample of 20 insurance and 9 airline companies is significantly negatively affected around the event date as defined by the event period.

The sample firms were randomly selected from the life Insurance, property and casualty, and insurance brokers industries within the financial services sector. Also, firms were randomly selected from the regional and major airline industry within the services sector. The reason for choosing these industries is based on the expectation that these two industries should suffer the greatest damage in the overall market from the September 11 terrorist attacks.

QUANTITATIVE TESTS AND RESULTS

Did the market react to the terrorist attacks on September 11, 2001? Were the risk-adjusted stock price returns for the two industries significantly negatively affected? If there were a significant reaction regarding the event, it would be expected that the difference in Actual Daily Returns and Expected Daily Returns (from day -30 to day +30) would differ significantly. If a significant risk adjusted difference is detected, then we can support our alternative hypotheses that the unforeseen event of the attacks would cause decreased returns on stock prices. To statistically test for a difference in the risk adjusted average excess returns and the cumulative average excess returns (for the firms over the time period day -30 to day +30), a paired sample t-test was performed and found a significant difference at a 5% level between actual and expected risk adjusted returns of the two samples of firms as well as all both samples together. Average Excess Return (AER) graphs are displayed for each group of firms in Figure 3 and 5, as well as collectively in Figure 7. Looking at the figures, we see that both samples and the samples combined show significant variation in the AERs after the event (day 0). Results here support my alternate hypotheses that the risk adjusted return of the stock price of the both samples of firms and the samples combined around the event period of the terrorist attacks are significantly affected around the event. Another purpose of this analysis was to test the semi-strong efficiency of the market in reacting to these unforeseen attacks. The key in determining this is if the AER and CAER are significantly different from zero or if there is a visible graphical or statistical relationship between time and either AER or CAER. Like the AERs, the CAER charts (seen in Figures 4,6 and 8) show

significant negative reactions of the risk adjusted returns for the two samples of firms and the samples combined following event day 0. The two samples of the firms and the samples combined recover after the event providing evidence that the market is semi-strong efficient. Although we see that the firms are able to recover, the recovery period between the two samples we observed are different. The insurance firms were able to recover twenty market days quicker compared to the airline firms.

Figure 3. AER of 20 Insurance Firms vs. Event Period

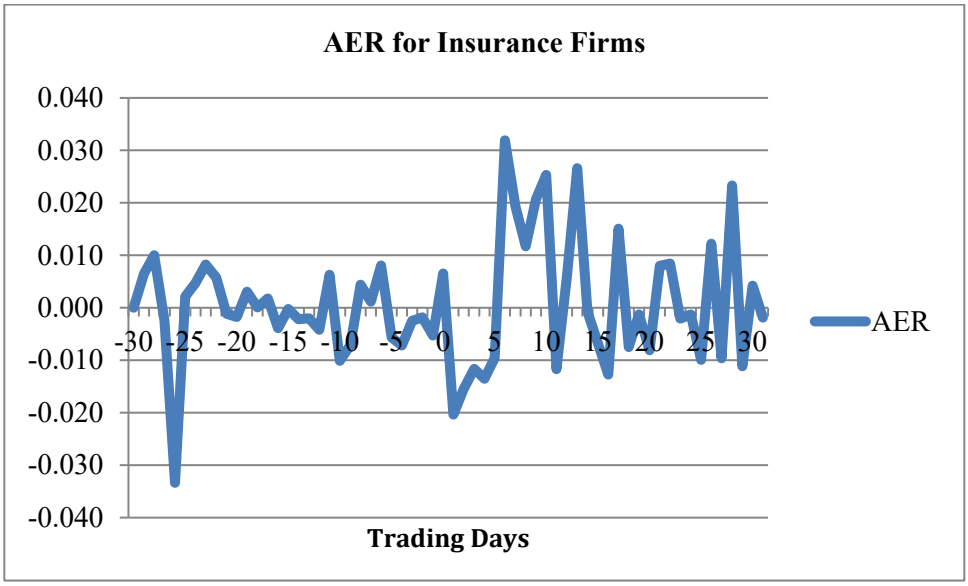
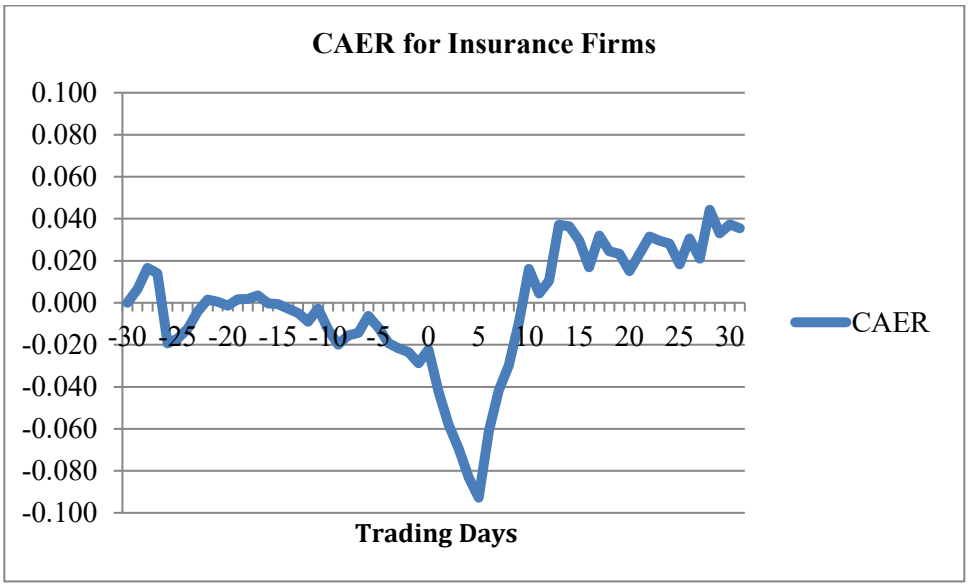


Figure 4. CAER of 20 Insurance Firms vs. Event Period



a. Note that the market was closed for four days after the attacks on September 11, 2001. The market was reopened on September 17, 2001.

Figure 5. AER of 9 Airline Firms vs. Event Period

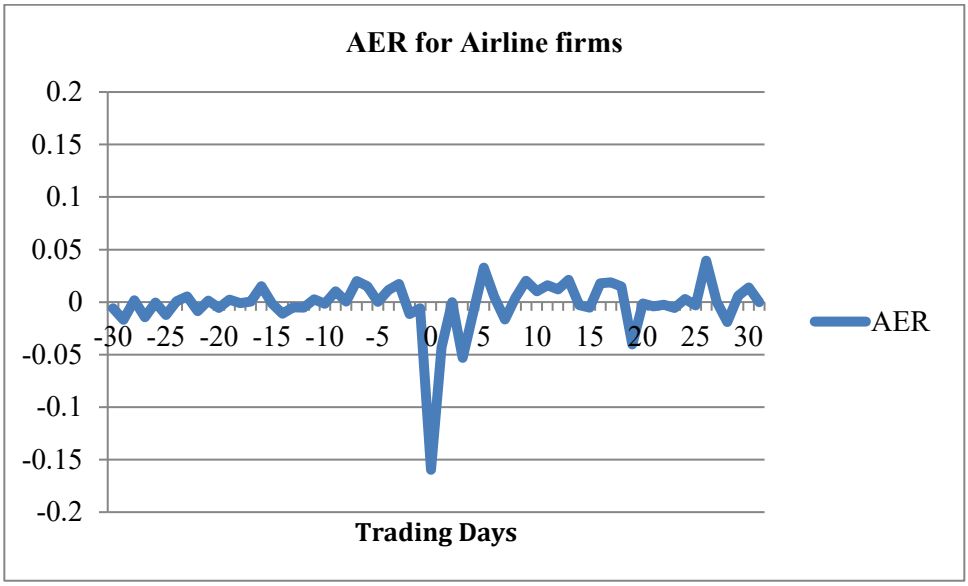
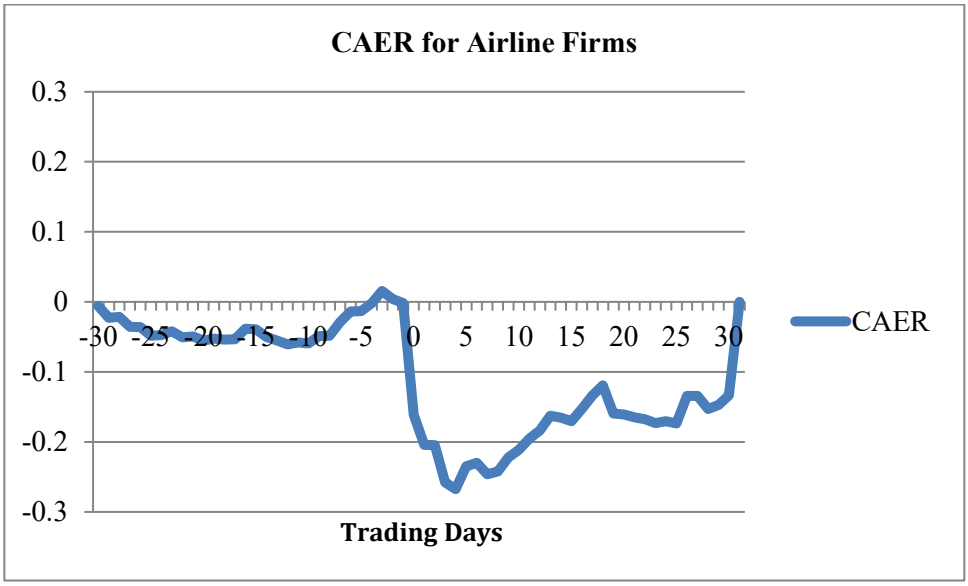


Figure 6. CAER of 9 Airline Firms vs. Event Period



a. Note that the market was closed for four days after the attacks on September 11, 2001. The market was reopened on September 17, 2001.

Figure 7. AER of 29 Insurance and Airline Firms vs. Event Period

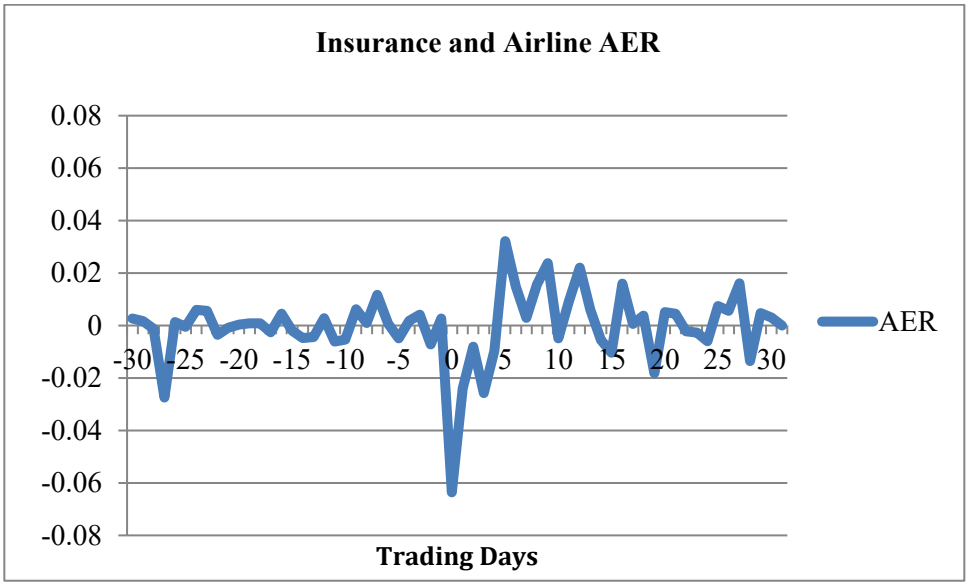
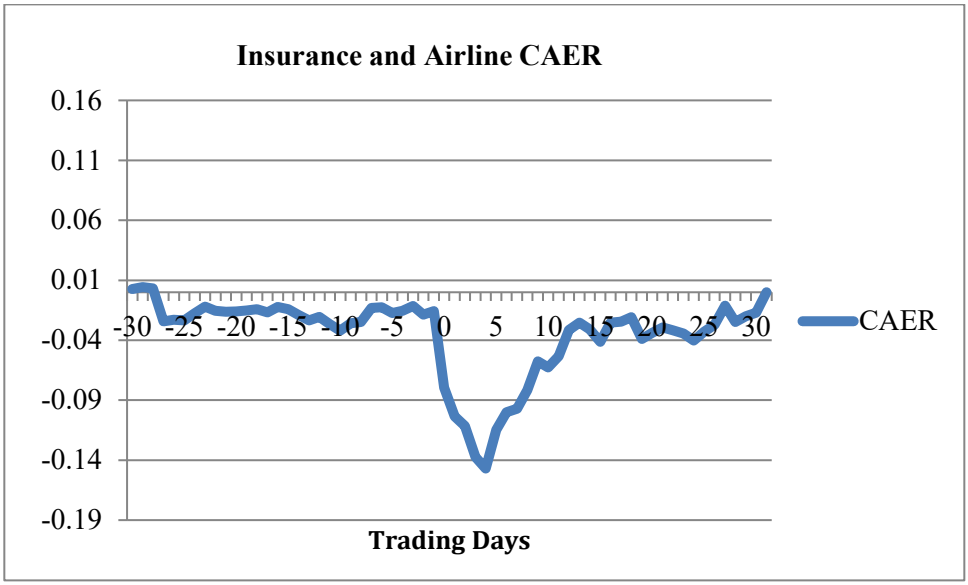


Figure 8. AER of 29 Insurance and Airline Firms vs. Event Period



a. Note that the market was closed for four days after the attacks on September 11, 2001. The market was reopened on September 17, 2001.

CONCLUSION

The purpose of this event study was to test market efficiency theory by analyzing the impact of an unforeseen terrorist attacks on two samples totaling 29 firms. This research uses the unforeseen event on September 11, 2001 to test the weak or semi-strong market efficiency theory. The study tested a random sample of 29 firms – 20 insurance firms and 9 airline firms using the risk adjusted event study methodology discussed earlier in the literature review. This finding supports the significance of information around the event since the market's negative reaction was observed. Evidence shows, in the CAER graphs (Figures 4,6,and 8), a decrease in risk-adjusted

returns for both samples and the samples together after the terrorist attacks on September 11, 2001. However, both of the graphs for the different samples are very different in the time it took the firms to recover compared to the market. . The significance tests conducted in this study help show that the attacks had a significant negative impact on these firms' stock prices over the event period. The results of the CAER of insurance firms show that the market was relatively stable until the day of the event where price returns plummeted drastically and recovered quickly in about ten market days after the event. After the tenth day the returns had reached equilibrium and remained relatively stable. The results of the CAER of airline firms show that the market was relatively stable until the day of the event where price returns plummeted drastically and didn't recover until 30 days after the event. It is obvious that the airline industry was more negatively affected compared to the insurance firms and that it had a greater impact in the long run on these firms. When the samples are put together and look at the CAER of the firms we see that the market was relatively stable until the day of the event where price returns plummeted drastically and recovered in around ten to fifteen days after the event. Following the fifteenth day the airline and insurance firms remained relatively stable with the rest of the market. These results are consistent with a semi-strong efficient market because the market reacted very negatively after the unforeseen terrorist attacks but was able to adjust back to equilibrium in the days following. Even though the terrorist attacks on September 11, 2001 negatively affected insurance and airline firms' stock returns in the short run, these companies and the financial industry as a whole were able to bounce back and remain stable.

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