THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF FINANCE

HOW THE FINANCIAL MARKETS REACTED TO THE FUKUSHIMA DAIICHI NUCLEAR CRISIS

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A thesis
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of the requirements
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in Finance
with honors in Finance

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Abstract

This thesis aims to acquaint readers with how financial markets react to nuclear crises. It is a topic of considerable interest because nuclear crises, such as the Fukushima Daiichi Nuclear Disaster, tend to make big headlines and appeal to the general public. I have chosen to first give a brief overall background of the crisis so that I may delve into the financial aspects of the crisis in the following section of the paper. The introduction of the crisis background will be written mainly based off of secondary research. However, the financial analysis, which comprises the majority of the paper, will be primary research, as I am conducting the analysis myself rather than obtaining the information from other papers.

The focus of this paper is the analysis of what happened in the financial markets. I have used daily data to make tables and graphs as well as do certain calculations to see how relevant stocks and indices reacted to the unexpected news that was the Japanese Nuclear Crisis. I took two main approaches to analyze the financial realm of the crisis. First, I looked at what happened to the stock for several days immediately following the crisis to analyze price levels and percent changes. The other analysis approach that I took was conducting an event study. I observed how the stocks performed on average before the crisis struck and then examined their performance after the disaster.

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Literature Review

The implications on the financial markets from the Fukushima Daiichi Nuclear Disaster are what I seek to uncover through the analysis of data and the writing of my thesis. The Japanese Nuclear Crisis began in March 2011 when the Tohoku earthquake and tsunami caused a chain reaction of issues at the Fukushima Daiichi Nuclear Power Plant. Due to the damage from the earthquake and flooding from the tsunami, a meltdown resulted in the nuclear reactors, significant explosions occurred at the plant, and radiation exposure continues to remain an issue to this day. This recent disaster is the worst nuclear crisis to take place in decades and still remains a popular topic that continues to be written on.

The majority of the articles that I have found online tend to be a summary of the Fukushima Daiichi Nuclear Disaster. They follow a similar chronological pattern explaining how the earthquake and tsunami caused the damage to the power plant and then detailing the events that ensued since then. The Japanese initially tried to downplay the incident to make it appear less severe than it really was, but the crisis has since been increased to level 7 on the International Nuclear Event Scale, which is the most extreme level of disaster.

The papers that I viewed gave very detailed accounts of the crisis from the inception of the incident to the present time, some providing timelines as a helpful visual aid. The focus of these papers is on the specifics of what happened at the plant, while my paper aims to focus on the economics of what happened around the crisis. I do plan on having a section of my thesis briefly detailing what occurred with regard to the earthquake, tsunami, and plant damage because I think these are key elements to the overall theme of my paper and will help readers have a sufficient prologue. Only once having comprehended the events of the crisis can the reader

follow along with the financial aspects of my paper. Therefore, this introduction detailing the events of the crisis is similar to other papers that have been written. However, the main focus of my paper, the financial market reaction to the Fukushima Daiichi Nuclear Disaster, is a much less documented topic, which is how my paper will be differentiated from previous works.

The papers already written that most similarly match my topic are referring to the economic implications that the crisis has on Japan. For example, one of the papers talked about the massive infrastructure damage, the loss of homes, and the shortage of electricity that Japan has had to deal with in the aftermath of the crisis. Although the paper focuses on a business-related aspect of the crisis, my thesis will still be significantly different because I want to focus more on financial markets (i.e. stocks, indices).

The Fukushima Daiichi Nuclear Disaster is a popular topic that has been highly publicized and has had many papers written on it, and that is why I find it especially pleasing that I get to view the topic from a different perspective. I want to tie in what others have written in this area into my thesis while adding in fresh information from another viewpoint. My objective and final goal from writing my thesis is to add insightful new evidence to this subject matter. After having done thorough research, I shall be able to conclude how the financial markets reacted to the Japanese Nuclear Crisis. My hypothesis is that the Fukushima Daiichi Nuclear Disaster had a negative impact on the financial markets, as most crises do, because of the high levels of uncertainty that arise after such a disaster.

Introduction

Japan is a strong nation and is a major superpower in the world. They have one of the strongest economies and their currency, the Yen, is viewed by investors as a safe haven to flock to in times of uncertainty. However, even a nation as strong as Japan can face harsh times when in the midst of having to deal with a catastrophic nuclear crisis. The Fukushima Daiichi Nuclear Disaster began on March 11, 2011. Japan was struck with both an earthquake and tsunami which caused severe damage to the country's infrastructure and resulted in over 15,000 fatalities. Perhaps the most substantial blow to the country of Japan, though, was when the 9.0 magnitude Tohoku earthquake and tsunami irreparably ravaged the Fukushima Daiichi Nuclear Power Plant. The plant flooded with water from the colossal tsunami and immense damage had been done to the plant and its equipment. The tsunami had taken out the power, which resulted in the reactors overheating and three of the reactors to suffer a full meltdown. Radiation exposure is probably the most severe and lasting consequence of the nuclear disaster. The surrounding area of a 12-mile radius was evacuated to attempt to prevent radiation poisoning. Many months have passed and the crisis is ongoing. It is a constant effort to contain and clean up the disaster while the people of Japan are suffering and still feeling the effects of the nuclear energy crisis.

Financial Analysis

	11-Mar	14-Mar	15-Mar	16-Mar	17-Mar
General Electric Company	1.29%	-2.16%	-1.56%	-3.37%	1.42%
Tokyo Electric Power Company	-1.49%	-23.57%	-24.68%	-24.57%	-13.36%
S&P 500	0.71%	-0.60%	-1.12%	-1.95%	1.34%
Nikkei 225	-1.72%	-6.18%	-10.55%	5.68%	-1.44%

Table 1 depicts the returns of several stocks/indices related to the Japanese Nuclear Crisis over a five-day period surrounding the beginning of the crisis

Above is Table 1 which I have created showing the returns of the S&P 500, Nikkei 225, Tokyo Electric Company, and General Electric Company over a five-day period, March 11th being the day the Fukushima Daiichi Nuclear Disaster began. The S&P 500 and the Nikkei 225 are indexes that portray the health of the economy by tracking stocks for the U.S. and Japan, respectively. I was surprised to see that the U.S. economy was not harshly affected by the Fukushima Daiichi Nuclear Disaster.

Being such a large crisis that represents risk and uncertainty to a global economy, I believed that the Fukushima Daiichi Nuclear Disaster would have a more negative effect on the markets. The S&P 500 does not give the indication that a global disaster had occurred. This is a sign that investors did not believe the United States economy would be pained by this crisis abroad.

The market index for Japan, the Nikkei 225, did suffer the effects of the nuclear crisis more so than the American index but not as severely as I would have predicted. The markets did not realize the severity of the disaster immediately, which seems to be true of all the stocks/indices I tracked. After the weekend passed, investors had time to gather new information, determine the effects of the crisis, and make predictions about what lied ahead for

Japan. This can be seen in the table above which exhibits how the level of the Japanese index began to fall and continued in that downward direction. Over the five-day period, the Nikkei 225 fell over 12%.

I chose to track the stock returns of GE because the boiling water reactors of the plant were designed by GE, and markets being efficient, tend to blame the stocks of the companies they believe responsible for such crises. However, GE also did not take too significant of a hit from the nuclear energy crisis.

TEPCO, the Tokyo Electric Power Company, maintained the Fukushima Daiichi Nuclear Power Plant, and their stock price did reflect the crisis in the manner I predicted. Although the crisis began on March 11th, it appears that the markets did not understand the severity of the disaster until the next market open. TEPCO stock suffered severe losses, dropping 62.38% over the five days I tracked.

GE

General Electric Company (GE) is one of the players at fault for the Fukushima Daiichi Nuclear Disaster because they are the company that originally designed the Mark 1 Boiling Water Reactors that failed at the nuclear power plant. GE designed this type of reactor back in the 1960's and marketed it to potential buyers as being less expensive and cheaper. However, the cost savings came from building the reactor with a smaller containment structure that wasn't as strong as perhaps a more costly substitute. The insufficiency of these boiling water reactors has been warned against for over 40 years now, but the nuclear power industry never followed through with prohibiting the use of such reactors. March 11, 2011, proved the destructive consequences of using the inadequate design, as one of the worst nuclear disasters unfolded. In a world of efficient markets, I presumed that GE's stock price would take a hit for developing the faulty reactors and for having ignored all the previous warnings of its shortfalls. On the Friday of the incident, the stock price did not drop but subsequently did the following week, as can be seen in Figure 1 below. Over the five-day period, the stock fell 4.38%. I was surprised by the measly 4% decrease as I believed the stock would have plummeted. I also conducted an event study to attempt to reveal the effects the nuclear disaster had on GE's stock over time. To do this, I took the average monthly prices for six months prior to the incident and six months after the incident, took the percent changes from month to month, and took the average of the percent changes to get a handle on GE's performance. Before the incident, GE averaged a 5.48% appreciation in the value of their stock, and after the incident, GE averaged 4.53% depreciation. These results can be seen in Figure 2 below.

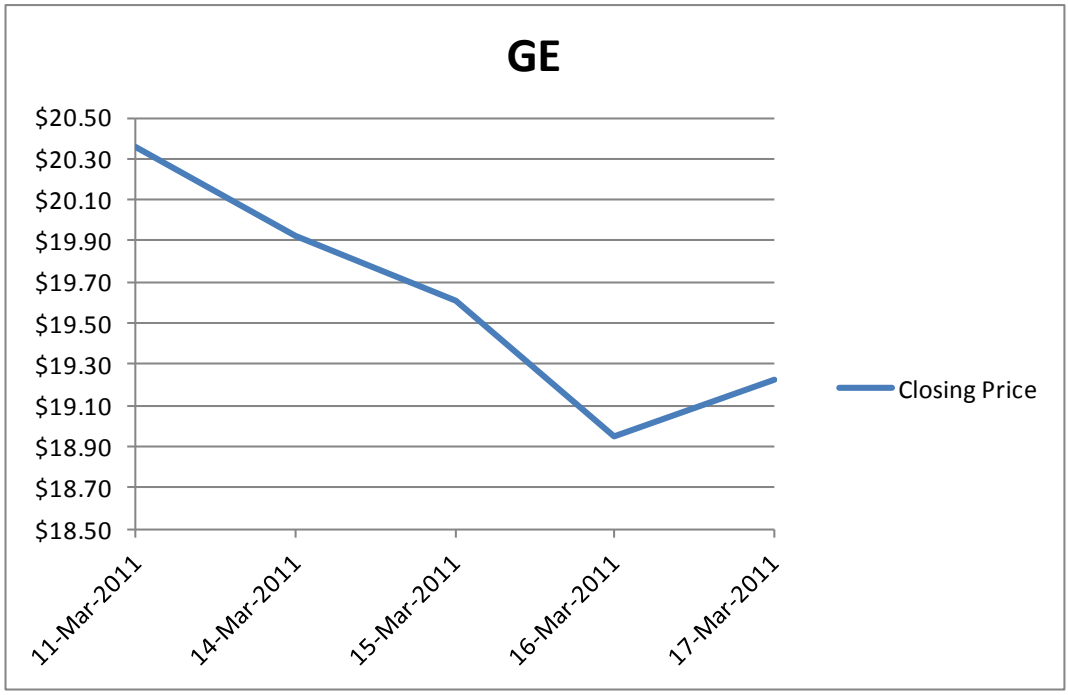

Figure 1 shows GE's stock price reaction to the Japanese Nuclear Crisis over a five-day period surrounding the beginning of the crisis

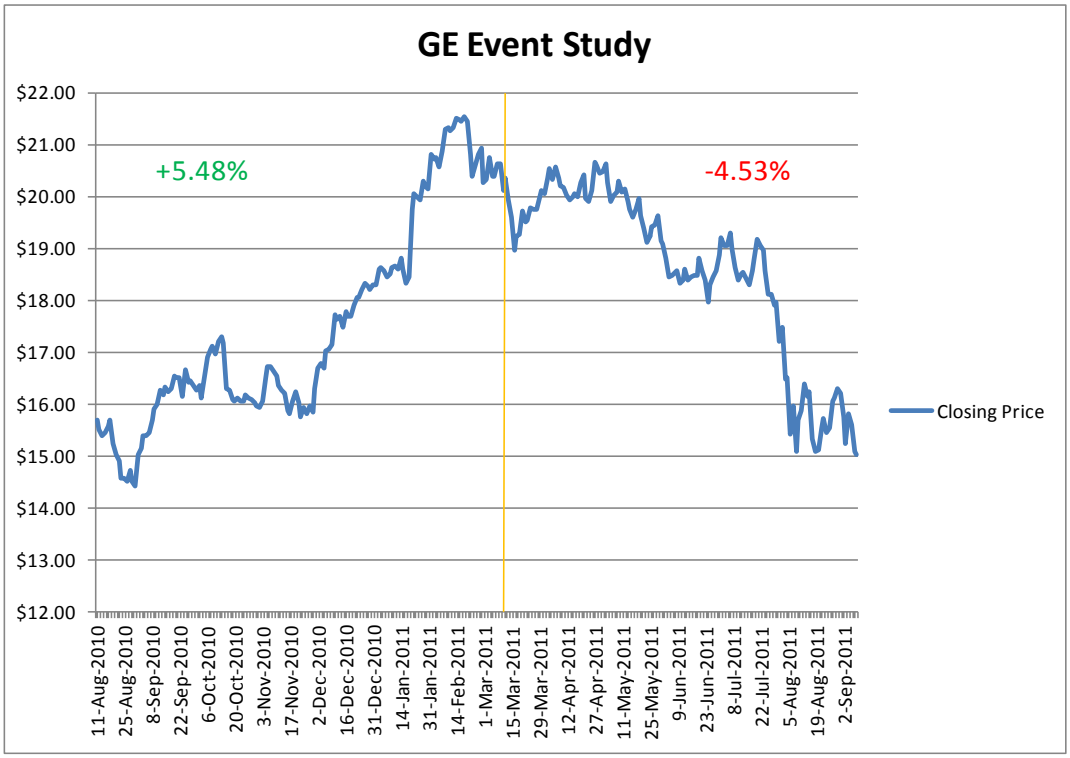

Figure 2 is the event study conducted for GE which displays GE's stock performance six months before the Japanese Nuclear Crisis and six months after the crisis

TEPCO

The Tokyo Electric Power Company (TEPCO) maintained the Fukushima Daiichi Nuclear Power Plant. It was at this plant that the nuclear reactors failed and caused the largest nuclear disaster since the 1980's. It is fair to reason that the market will hold TEPCO most responsible for this disaster as it was their main responsibility to prevent such catastrophes from occurring. Once again, it appears that the market was not able to grasp the severe ramifications from the crisis on March 11th; the stock only dropped 1.49%. The following week, however, TEPCO's stock price was brutally punished, dropping in double digit percentages Monday through Thursday. Just over the five days observed, the stock plummeted 62.94% in value. Figure 3 below displays the stock price's descent from March 11th to the 17th, and Figure 4 shows the drastic percent change decreases over the same time period. The event study produced very interesting results. Before the event, TEPCO was only suffering an average price depreciation of 2.00%, but after the event, TEPCO stock price, on average, was dropping 17.55%. Since the March 11th disaster, the lowest the stock price fell to was ¥190 on June 10th; compared to the stock price on March 11th of ¥2,121, the stock had fallen an astonishing 91.04%. These results can be seen in Figure 5 below. A final interesting observation can be made from Figure 6, which shows the percent change in TEPCO price. Before the incident, the stock price did not have large deviations from the average price, and the stock price remained relatively constant. After the incident, it is remarkable how much the volatility increased in the percent change in price. The stock went from a very steady fluctuation and stable pricing to wild swings in both directions.

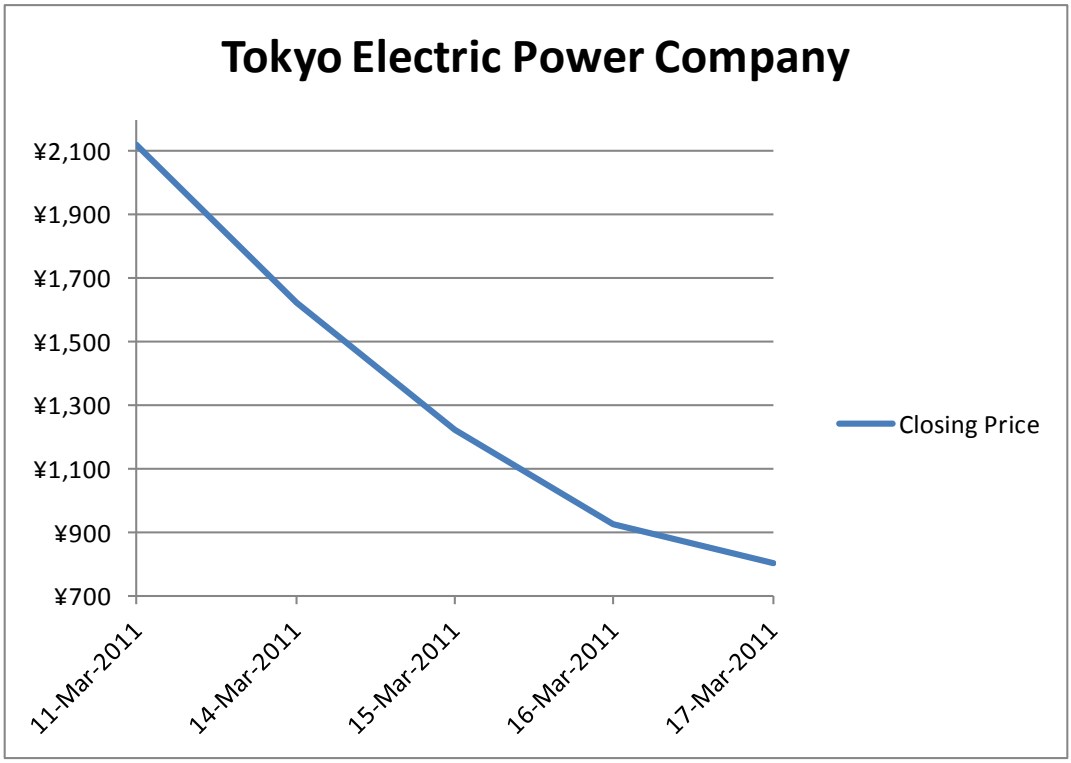

Figure 3 shows TEPCO's stock price reaction to the Japanese Nuclear Crisis over a five-day period surrounding the beginning of the crisis

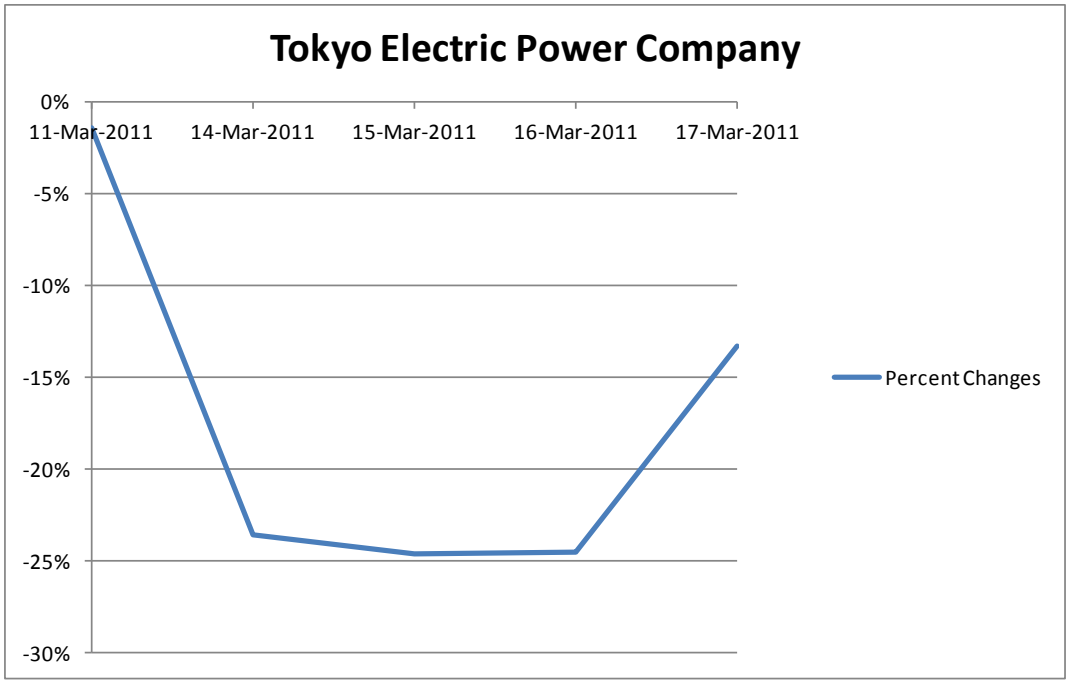

Figure 4 depicts the percent changes in TEPCO's stock price in relation to the Japanese Nuclear Crisis over a five-day period surrounding the beginning of the crisis

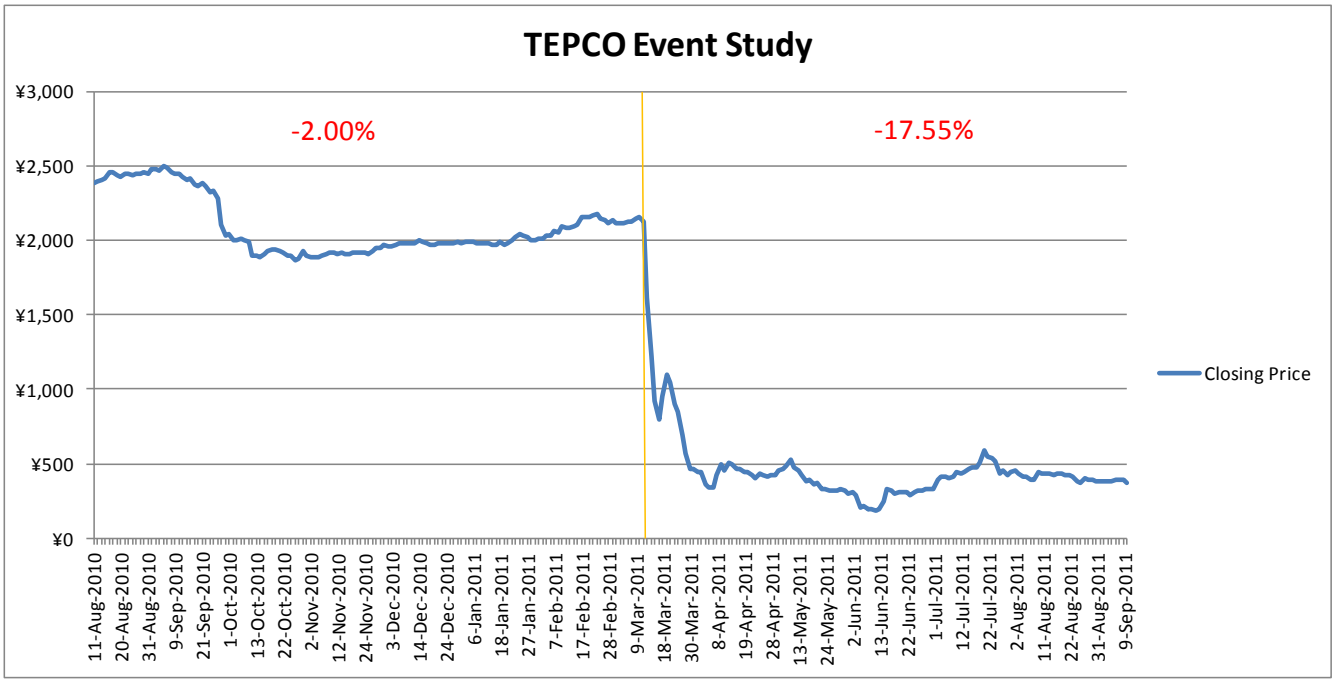

Figure 5 is the event study conducted for TEPCO which displays TEPCO's stock performance six months before the Japanese Nuclear Crisis and six months after the crisis

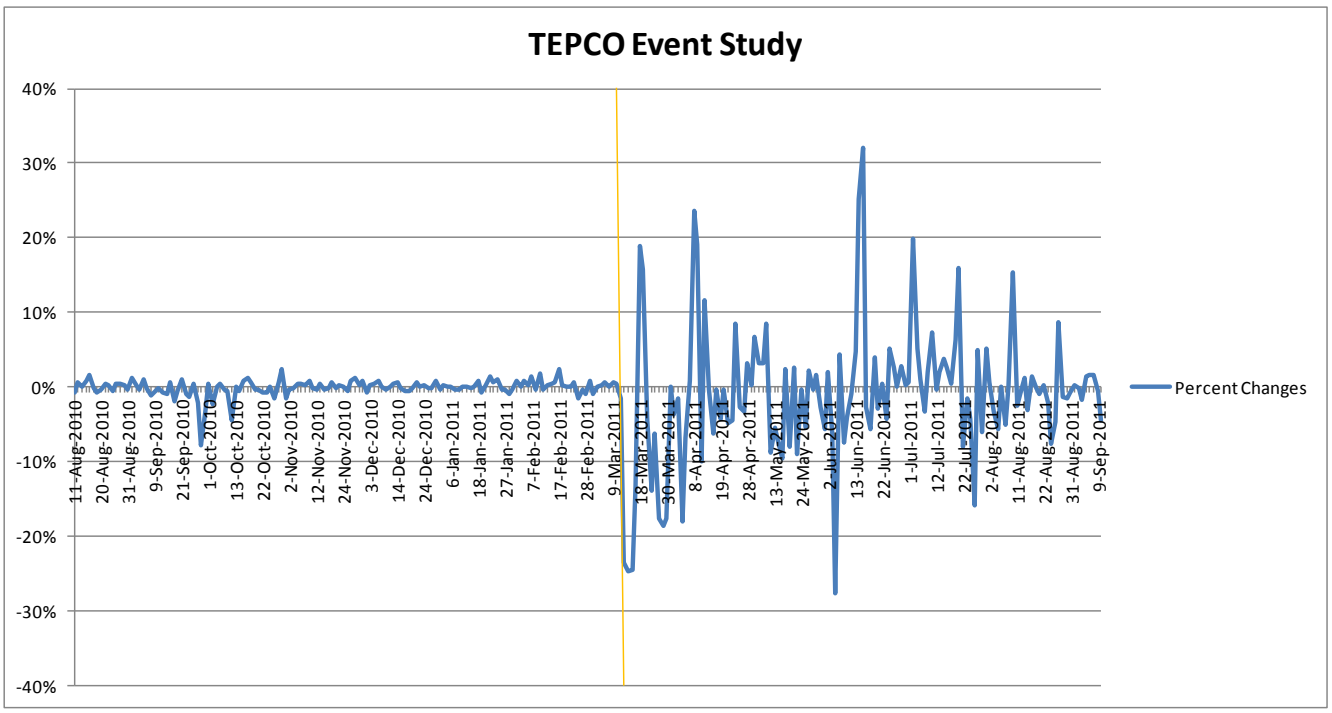

Figure 6 is the event study conducted for TEPCO which displays the percent changes in TEPCO's stock price six months before the Japanese Nuclear Crisis and six months after the crisis

S&P 500

The S&P 500 did not initially experience any significant decline in value related to the Fukushima Daiichi Nuclear Disaster. The day the crisis began, the S&P increased a meager 0.71%. The following week, it had minor decreases in value followed by a subsequent gain, as can be seen in Figure 7 below. Over the five-day period, the S&P only dropped 1.65% in value. The event study has shown that the S&P 500 performed better before the crisis, producing an average appreciation in value of 3.45%, while decreasing in value after the crisis by 1.86% on average, as can be seen in Figure 8 below.

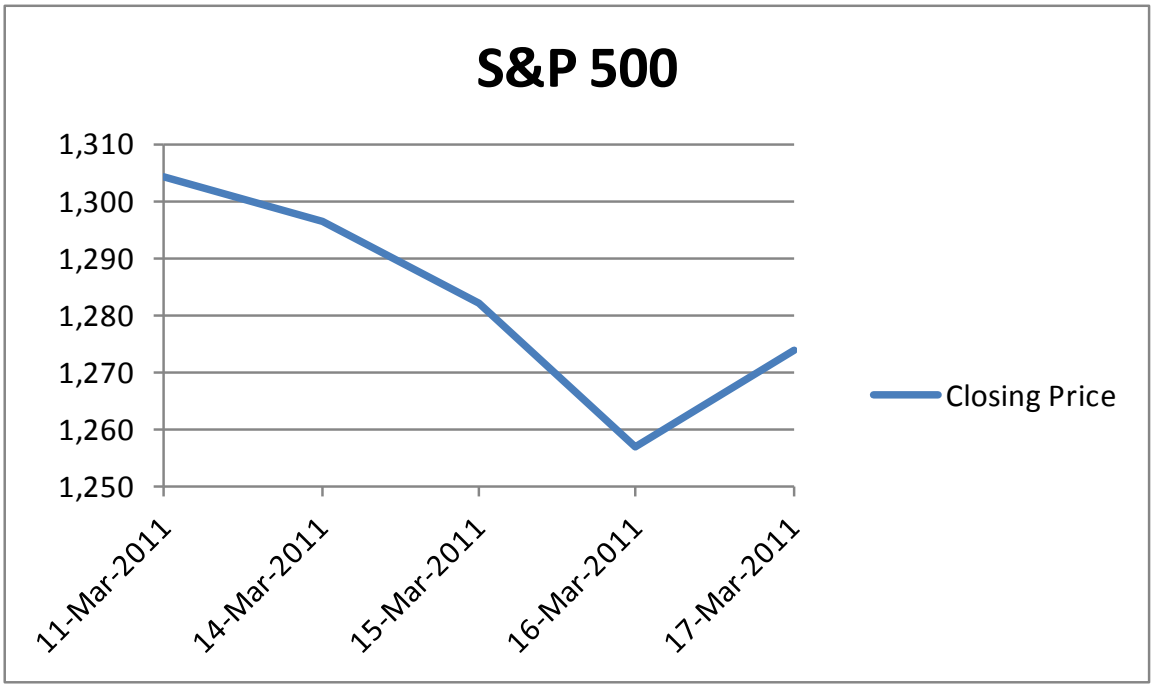

Figure 7 shows the S&P 500's reaction to the Japanese Nuclear Crisis over a five-day period surrounding the beginning of the crisis

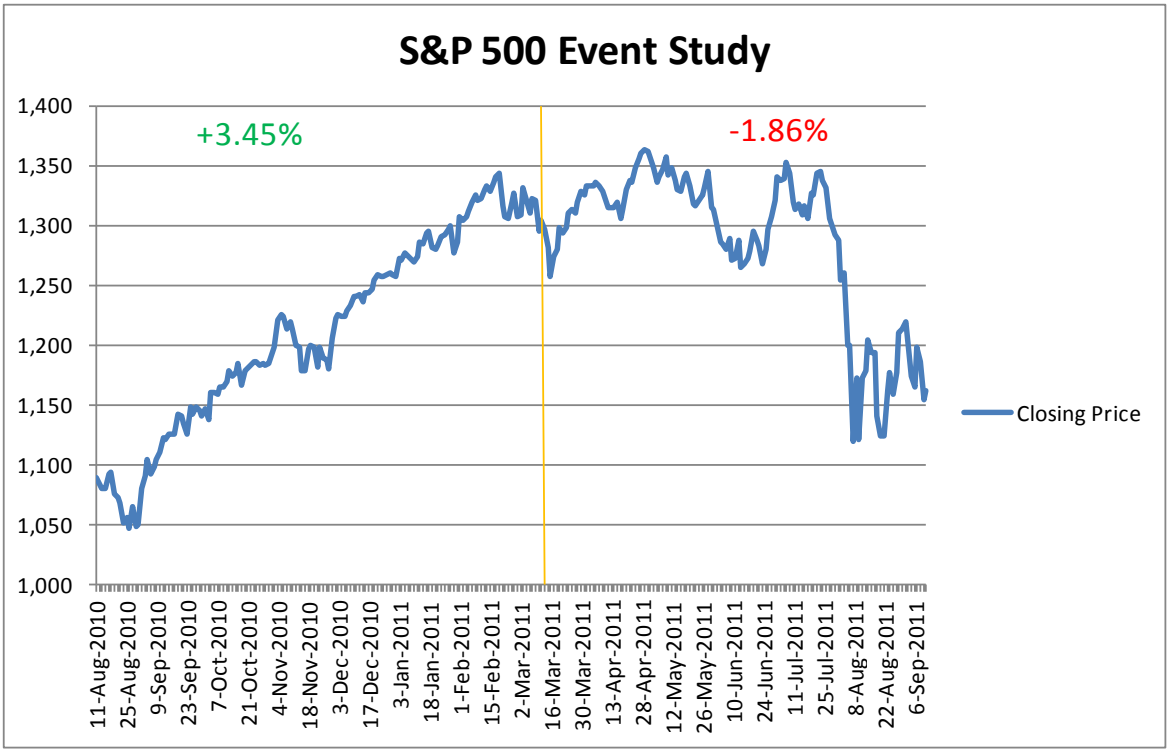

Figure 8 is the event study conducted for the S&P 500 which displays the S&P 500's performance six months before the Japanese Nuclear Crisis and six months after the crisis

Nikkei 225

The Nikkei 225, an index representative of Japan's economy, reflected that a crisis detrimental to the country had taken place. As can be seen in Figure 9 below, the index moderately fell 1.72% when the crisis began, but as details were released and more distressing news came to light, the markets reacted by falling 6.18% Monday and 10.55% Tuesday. The index had fallen 12.60% over the five-day period observed surrounding the inception of the Japanese Nuclear Crisis. The event study proved results similar to those found in the previous analyses – the period after the event proved harder on the financial markets than the period before the event. The Nikkei 225 appreciated in value 2.64% on average before the incident and decreased 2.92% after the incident, which can be seen in Figure 10 below.

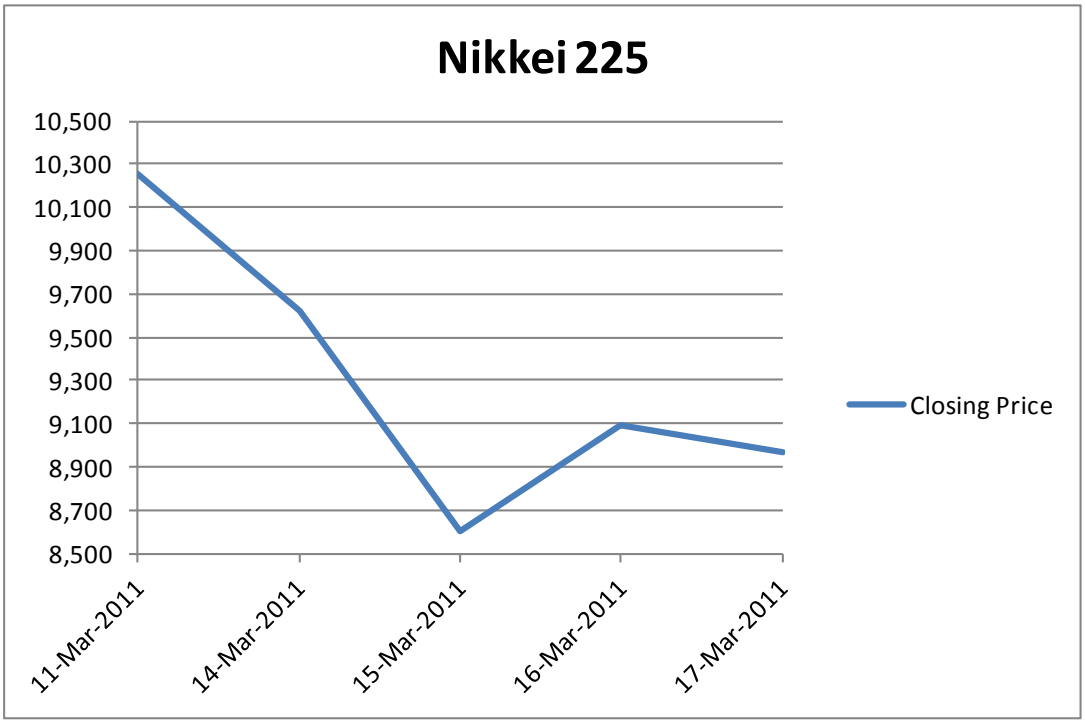

Figure 9 shows the Nikkei 225's reaction to the Japanese Nuclear Crisis over a five-day period surrounding the beginning of the crisis

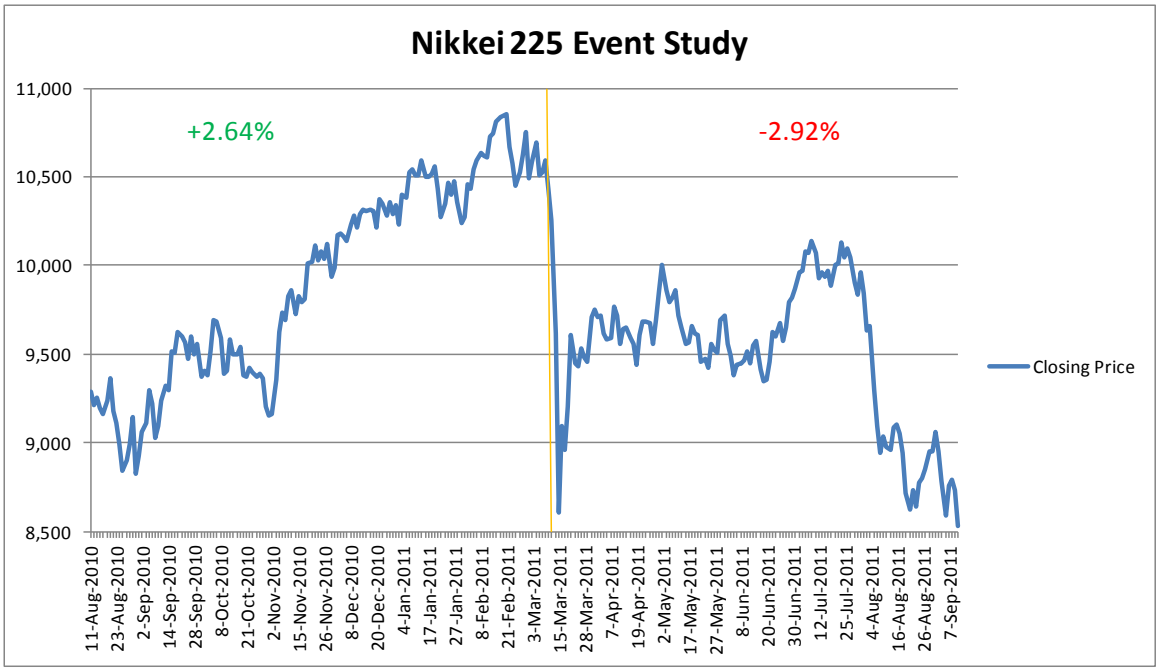

Figure 10 is the event study conducted for the Nikkei 225 which displays the Nikkei 225's performance six months before the Japanese Nuclear Crisis and six months after the crisis

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Academic Vita

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EDUCATION

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Smeal College of Business — Expected Graduation: 2012
Bachelor of Science – Finance
Schreyer Honors College

Relevant Courses

Macroeconomic Analysis
Business Information Systems
Financial/Managerial Accounting
Finance
Management & Organization
Investments
Microeconomic Analysis
Elementary Statistics
International Economics
Intermediate Microeconomics
Money and Banking
Advanced Corporate Finance

EXPERIENCE

PNC Capital Markets, LLC-Asset Backed Securities — **Pittsburgh, PA**
Investment Banking Analyst Intern — May, 2011 - Present

- Compile pitch books for prospective/renewal clients showcasing securitization structure, mechanics, and recommendations
- Conduct research on various companies/industries to keep abreast of possible issues or opportunities
- Prepare transaction memorandums detailing the entire securitization process
- Analyze financial statements to assess capital structure and financing needs
- Formulate and deliver individual/team presentations

HONORS/ACTIVITIES

The Evan Pugh Scholar Award
- Awarded to juniors earning a 3.99 and above cumulative GPA

The President Sparks Award
- Awarded to sophomores earning a 4.0 cumulative GPA

The President's Freshman Award
- Awarded to freshmen earning a 4.0 cumulative GPA

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- Member of Utilities Sector
- Member of Consumer Discretionary Sector
- Attend weekly educational presentations
- Attend weekly meetings to analyze the overall economy, specific sectors, and specific companies
- Assist fund managers in creating and presenting stock pitches

Penn State Finance Society
- Attend meetings and corporate presentations
- Managerial Public Relations Committee