

# The Impact of Natural Disasters on Global Stock Market: the Case of the Japanese 2011 Earthquake

by

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Abstract

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In this study, we investigate the impact of the Japanese earthquake 2011 on six most representative stock markets all over the world. An event study procedure is employed to analyze the data from all of these markets. Daily average abnormal return, cumulative abnormal return and average cumulative abnormal return are calculated to perform the test and analyze the reaction of the stock markets. Consistent with the literature, this paper finds that a negative shock brought by this catastrophic natural disaster exists in all of the six stock markets. But this impact is surprisingly small. Under the statistic t-test, the shock on all of the six stock markets is statistically insignificant. But for some individual stocks, this earthquake shows a significantly impact. The impact is either positive or negative. The direction of impact will depend on the industries that the company is involved in.

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# **Chapter 1**

## **Introduction**

### **1.1 Background of Study**

Natural disasters are unpredictable and uncontrollable by humans and result in huge damage to personal property. Natural disasters have an impact in many areas of the economy, including financial markets. On March 11<sup>th</sup> 2011, a massive earthquake hit the east coast of northern Honshu Island, Japan. Although Japan frequently is hit with earthquakes, this magnitude 9.0 earthquake was the biggest on record and made it the most catastrophic earthquake Japan has ever suffered. The center of this earthquake was located about 100 kilometers off the coast, which generated a large and extremely damaging tsunami with 10-meter-high waves that reached as far as the U.S. west coast.

The earthquake and resulting tsunami led to a malfunction of a cooling system of nuclear generators, which was caused by this large earthquake, and as a result, there was a nuclear hazard in the Fukushima Daiichi nuclear power station. Although the power station shut down itself after the earthquake, the core temperature of the generator did not drop due to the malfunction of the cooling system. So there was possibility that the core could melt down the protective shell and expose into the air, which could result in a nuclear leak.

Japan declared a state of emergency following the failure of the cooling system, resulting in the evacuation of nearby residents. Officials from the Japanese Nuclear and Industrial Safety Agency reported that radiation levels inside the plant were up to 1,000 times normal levels, and that radiation levels outside the plant were up to 8 times normal levels. This was considered to be the most catastrophic consequence which was brought on by this earthquake.



A stock market is a public entity for the trading of company stock (shares) and derivatives at an agreed price. It is a loose network of economic transactions, not necessarily a physical facility or discrete entity. Back in the middle of the 13th century, Venetian bankers were the first to trade in government securities. The Dutch East India Company (founded in 1602) was the first joint-stock company to get a fixed capital stock and as a result, continuous trade in company stock emerged on the Amsterdam Exchange. Soon thereafter, a lively trade in various derivatives, among which options and repos, emerged on the Amsterdam market.

There are now stock markets in virtually every developed and most developing economies, with the world's largest markets being in the United States, United Kingdom, Japan, India, China, Canada, Germany (Frankfurt Stock Exchange), France, South Korea and the Netherlands. In 2008, an estimation of the world's stock market was a size of 36.6 trillion US dollars. Most stock markets in developed countries are considered to be mature markets, meaning these markets will be more efficient and well-regulated than those in developing countries.

## **1.2 Rationale of the Study**

Japan is the third largest economy in the world and the second largest developed economy. It has the second largest automobile manufacturing industry and the largest electronics goods industry, and is often ranked among the world's most innovative countries leading several measures of global patent filings. If we take automobiles as an example, they are a common transport tool in the world. Events such as earthquakes that happen in any manufacturing country will have impact on production. For example, when a natural

disaster leads to the destruction or shut-down of the factory, the delivery of the goods will be delayed or canceled. Also, if the disaster hits the ports or traffic, transportation system, material or parts of the product cannot be delivered on time to finish the manufacturing process. Or, end products are destroyed in the warehouse by an earthquake. Japan exports cars to all over the world. If any of the situations above happened, it will cause the overseas partners to adjust their strategies. This procedure may have the impact on the stock price of these overseas partners and on their own domestic stock market.

Nowadays, due to the economic globalization process, many corporations list their stocks on overseas markets. As one of the most advanced economy in the world, Japan from 1995 has already had 121 Japanese corporations listing their stocks on overseas stock exchanges, including Frankfurt, London and New York. This number is growing rapidly since the fast development of economic globalization. The formation of the global industrial chain will link the world's economy more closely. One product will be made in an overseas factory and parts of this product will come from all over the world. If one or some of the links has a problem, then the whole chain will be affected. Under this condition, this catastrophic earthquake might have an impact on global stock markets, instead of just one single country's stock market, such as Japan's.

In the Japanese 2011 earthquake, the nuclear hazard became the focus of attention from the world. After this event, people are more focusing on the negative factors of nuclear power, and even this way of generating power is considered dangerous in some points of views. What happened at the Fukushima Daiichi nuclear power plant was an accident with limited control by mankind. But the potential danger of nuclear power is gradually known by the public now. Governments of those countries which have nuclear power

plants have announced more safety inspections to show the people this kind of power plant is safe or needs to improve. All of these decisions from government can have an impact on the energy related corporation's stock. Additionally, people's fear will also have an impact on stock markets. After the natural disasters, panic buying and panic selling can happen. This kind of behavior can cause a shock to a stock market.

### **1.3 Objective of the Study**

This study aims to determine whether global stock markets react to the happening of a significant event such as natural disasters and what the effects of these reactions will be. As mentioned above, ten largest stock markets are spread all over the world, including North America, Asia, and Europe. The world's economy has been globalized, but in the case of the Japanese earthquake, the stock markets may show different reactions to the natural disaster, depending on how closely linked to industries directly affected, such as automobile manufacturing, nuclear power plants and so on.

The earthquake happened in Japan, and although its consequences were catastrophic to the country, its impact on global stock market is a matter of much interest. After all these years of development of stock markets, a sound legal system has been built, and all mature stock market should be efficient. So we will use statistical methods to find out the relationship between the reactions of global stock markets to the Japanese earthquake, and also determine the size of the reaction.

### **1.4 The limitations of this Paper**

There are ten large developed stock markets in the world, but this paper only selects 6 of them to study; two from Asia, two from North America and two from Europe. Many

different kinds of companies are listed on stock market. Some are medical related and others are energy related or material and construction corporations. For this kind of stock, a positive impact may appear due to the need for reconstruction after the disaster. But it cannot represent the overall situation of stock markets. This paper will choose the six largest stock markets in the six countries mentioned above. Together the countries and stock markets are the most representative of both the global economy and financial markets. However, there are still lots of other representative economies in the world, some of them are developing countries. Another limitation is that for each stock market the sample size is of only 30 stocks from each of the major indices.

### **1.5 Chapter Organization**

This major research project relates to the impact of the Japanese earthquake 2011 on global stock markets. It will be made up of five chapters. While this chapter has set the context for the study, Chapter 2 explores the theoretical issues of this study including literature review. Chapter 3 introduces the data sources and methodology of the study and Chapter 4 provides the output and presents an analysis of the results. Chapter 5 provides conclusions.

## **Chapter 2**

### **Literature Review**

There are five parts in this chapter. The first part introduces the economic loss caused by the natural disaster. The second describes the shock on global stock markets brought about by the Japanese earthquake. The following part introduces the six stock markets in this study. The fourth part describes the efficient market hypothesis and the last part provides examples of event studies related to non-economic events.

#### **2.1 Economic Loss Caused by Natural Disasters**

Natural disasters often strike without warning, and the death and destruction often leads to a significant financial devastation. The impact of some of the worst natural disasters in the history will be introduced below.

Hurricane Andrew in 1992 cost nearly \$41 billion lost and led to the bankruptcy of 11 insurance agencies. The Kobe earthquake occurred in Japan 1995 caused nearly \$102 billion economic loss. Roads and highways and seventy percent of the Osaka-Kobe railways were destroyed. Only three percent of the property in the Kobe area was covered by insurance. It also caused major Japanese markets to plunge after the disaster. The Indian Ocean earthquake happened on Boxing Day in 2004 and caused a serious tsunami affecting people of 14 countries. The local coastal fishing industry was devastated and also the shipping industry was affected due to the changes on the seabed. Around \$13 billion of loss was recorded. Hurricane Katrina struck the U.S. in 2005 and made an economic cost of approximately \$125 billion. It caused damage to the oil and forest industry. There were 30 oil platforms destroyed or damaged and 1.3 million acres of

forest destroyed. Most of the residents of New Orleans were unemployed after that. The Wenchuan earthquake occurred in China 2008 and cost nearly \$200 billion economic loss and the Haiti earthquake in 2010 cost nearly \$14 billion (businesspundit.com).

The Japanese earthquake of 2011 caused an economic loss nearly of \$300 billion. More specifically, forty-one percent of the loss came from earthquake, thirty-six percent was from tsunami and the rest of the loss was from nuclear power plant itself. 16273 people were recorded dead, 3061 were reported missing and 27074 people were injured, with numbers still being counted. 129530 buildings were destroyed and nearly 1000000 other buildings were partially destroyed or damaged (earthquake-report.com).

## **2.2 Stock Markets All Over the World Were Shocked by the Japanese Earthquake**

The Japan's Nikkei index ended down 6.18 percent on the first trading day after the quake. Carmaker company Nissan was down by 9.5 percent after shutting its factories. Toshiba which makes semiconductors and nuclear reactors fell 16 percent. Shares in Tokyo Electric Power Company fell by 24 percent. Benchmark crude oil price fell to less than \$99 due to the weaker demand of Japan the world's third largest economy. On the other hand, industrial and materials companies gained some profit due to the need for reconstruction. Kajima and Nishimatsu Construction are both construction companies in Japan rose around 20 percent after the earthquake (BBC.co.uk).

The Hang Seng Index of Hong Kong declined by 1.6 percent after the earthquake, but was expected to recover due to the resources counters and steelmakers on demand from Japanese reconstruction activities (Reuters.com).

The U.S. stock market dropped about 6 percent after the quake and the Dow Jones Industrial Average fell by approximately 2.3 percent. Gas prices rose up by 4.7 percent then, and as the U.S. imports everything from cars to consumer electronics to semiconductors, were all affected by this quake (abcnews.go.com). The impact on Canadian stock markets appears to be minimal. The maximum decline on the stock market was only 1.3 percent after one week and 2.3 percent after one month. The energy sector performed well after the earthquake, while the insurance sector was not as bad as one might have expected. The TSX insurance sector declined 2.1 percent after an average 1.9 percent gain in one month (theglobeandmail.com).

In the UK, the FTSE index of 100 shares fell nearly 1 percent. The companies which were nuclear related were hit hardest, but solar energy companies went up. Another concern in UK was that luxury goods firms were expected to lose sales. Although few insurance companies from UK were related to Japan, investors' concern also made shares of insurance companies fall (guardian.co.uk). German shares were hit hardest in European stocks and the main DAX index fell by 1.3 percent. Companies related to power and insurance firms were the source of dragging down the market (Data from bbc.co.uk).

### **2.3 Six Stock Markets in the Study of this Paper**

The Tokyo Stock Exchange (TSE) of Japan is the third largest stock exchange in the world by aggregate market capitalization of its listed companies. It had 2292 listed companies with a combined capitalization of US\$3.3 trillion as of Dec 2011. Hong Kong Stock Exchange (SEHK) from Hong Kong, Asian's third largest and world's sixth largest stock exchange in terms of market capitalization. It had 1477 listed companies with a

combined market capitalization of HK\$16.985 trillion as of the end of 2011. China's stock market is still not entirely open to foreign investors, so this paper chooses not to use this market to analyze this impact of Japanese earthquake.

The New York Stock Exchange (NYSE) from the U.S. is the largest stock exchange in the world by market capitalization of US\$14.242 trillion as of Dec 2011. It had 3893 companies from 40 countries listed with 77% from North America, 21% from Europe, and 2% from other area of the world. The Toronto Stock Exchange (TSX) from Canada is the world's seventh largest by market capitalization of CAD\$2.106 trillion as the end of 2010. It had 1587 listed companies with 94% from North America and 6% from other areas of the world.

London Stock Exchange (LSE) is the world's fourth largest and the Europe's largest stock market. It had 2938 listed companies with a market capitalization of US\$3.266 trillion at the end of 2011. The Frankfurt Stock Market (FWB) from Germany is the world's tenth largest stock market. As of November of 2010, companies from more than 80 countries were listed on the Frankfurt stock exchange with 49% from North America, 31% from Europe (including Russia), 14% from Asia and 6% from Australia and Africa. It had a combined market capitalization of US\$1.185 trillion as of the end of 2011.

## **2.4 Efficient Market Hypothesis**

Before the 1960s, economists always thought a stock market was not a proper subject for serious study, until Eugene Fama introduce the term "efficient market" in his 1965 paper, "The Behavior of Stock Market Prices". This is the origin of the efficient-market



hypothesis (EMH). Under this theory, financial markets are "informationally efficient", that means competition will drive all information into the market price.

Fama(1970) introduced the semi-strong-form of market efficiency. Stock prices will adjust rapidly to the new public available information and in an unbiased fashion. That means the prices will reflect the information in a very fast speed that nobody can make a positive return by trading on that information. This kind of public information includes the announcement of a firm, changes in economic policy, breaking through of a new technology, regime change, and also, natural disasters.

Samaratunga (2012) looked into the stock market efficiency of Japan and other 7 Asia-Pacific regions. The paper used Unit root test, Ljung-Box Q-statistic test and VR test to analyse the data of stock price indices from 11 July 1997 to 16 May 2008 on a weekly basis. The results showed that the Japanese stock market is weak-form efficient.

Liu (2011) investigated the market efficiency of the Hong Kong stock market. The paper studied the data from 2002 to 2009, using methods that included unit root tests and nonparametric VR tests to indicate the market efficiency. The conclusion was that under both unit root test and nonparametric VR test, weak-form efficiency of Hang Seng index daily and weekly series was indicated.

Wong (2002) investigated the degree of market efficiency in the Hong Kong stock exchange. The paper used an event study analysis with the data of 542 corporate news announcements through the beginning of 1994 to the end of 2000. It came with the conclusion that the Hong Kong stock market is semi-strong form efficient.

Nisar and Hanif (2012) tested the market efficiency of the NYSE in the USA and other stock markets of developed countries in Europe and North America. They used a run test and VR test analysed the data which was based on weekly and daily series from 1997 to 2011. The conclusion of weak form efficiency in NYSE was clearly stated.

Gersdorf and Bacon (2009) tested the market efficiency of U.S. stock market with respect to merge and acquisition announcements. They used a standard event study to analyse twenty acquiring firms from April 2007 to August 2007. Due to the small size of the sample, semi-strong form efficiency showed the signs in the 30 days after the announcement. But the New York stock exchange was definitely semi-strong form efficient.

Radikoko (2009) used a variety of statistical tests to investigate for weak form efficiency on the Canadian TSX equity exchange. The paper qualitatively compared the efficiency on the TSX against that of the NYSE and other stock exchanges in the world and analysed the data of seven daily Canadian index price series up to March 2008, including S&P/TSX Composite index from 1980 and S&P/TSX 60 Index begin from 1982 and more. Over all, the conclusion showed that the Canadian TSX is weak form efficient.

Worthington and Higgs (2003) tested the weak form efficiency in European developed and emerging stock market including the UK and other countries. The paper analysed the data of market value-weighted equity on a daily basis from December 1987 to May 2003. The test methods included a run test, Unit root test and multiple variance ratio test. They all indicated that the UK stock market is weak form efficient.

Gillette (2005) tested the market efficiency of the German stock market. CAN SLIM™, which was developed by William O'Neil who is a well-known American investment analyst, was used in this paper to analyse the data of Frankfurt Stock Exchange from 1970 to 2005. The conclusion was that the German stock market is weak-form efficient.

Griffin et al. (2007) compared the profitability and market efficiency between emerging markets and developed markets all over the world. The paper used data from 56 markets from 1994 to 2005, including 28 emerging markets and 28 developed markets to analyse the profitability. In conclusion, developed markets, including Japan, Hong Kong, U.S., Canada, and UK, and German markets were indicated to have strong signs of both weak and semi-strong form market efficiency.

Fama et al. (1969) introduced the event study methodology. This methodology was used to analyse the data of 940 criteria-meeting stock splits from 1927 to 1959. The conclusion was that these splits are efficient in a sense that stock prices adjust rapidly to new information. This method was widely used in the academic field to investigate the relationship between stock price and new information such as announcements of firms or natural disasters and so on.

Schweitzer(1989) implied that through event studies, statistical techniques can be used to analyse the stock prices and returns to a specific event including firm announcements, bank regulatory changes and other kinds of events. The results showed that stock market reacted to new information.

Aiuppa et al. (1993) examined the reaction of insurance stock prices to the 1989 Loma Prieta Earthquake. A two-index market model was used to analyse the data. The

conclusion was that the market perceived that an earthquake can make additional earnings for earthquake insurers.

Liargovas (2010) studied the impact of terrorism on Greek banks' stocks. In the paper, an event study method was used to analyse these non-economic events' impact on stock prices. Three attacks, including the 9/11 attack in New York, the Madrid train bombing in 2004 and the London train bombing in 2007 were used in study. The conclusion was that all three attacks caused negative return on the stock prices of Greek Banks.

## **2.5 Impact of Natural Disasters on Stock Market**

Worthington and Valadkhani(2004) investigated the impact of natural disasters on the Australian stock market. The paper used the daily price and accumulation returns from 1982 to 2002 with the record of 42 natural disasters to examine the impact. The conclusion was that in different kinds of natural disasters, an earthquake had a mixed impact on market returns.

Wang (2011) studied the Japanese natural disasters on stock market. 84 natural disasters from 1982 to 2011 were used to analyse the impact on the Japanese Nikkei 225 and U.S. S&P500 index. The conclusion was that natural disasters have an indirect impact of changing the volatility of stock returns. It also showed that an inefficient market response might be caused by the delayed information due to the death and loss of the disasters.

D.R. Barton, Jr.(2005) observed the U.S. stock market performance after the Hurricane Katrina and finds out stock markets moved up after the storm. The same situation also happened after hurricanes Andrew, Hugo and Camille.

Maierhofer (2011) observed the stock market reaction after the 5 worst natural disasters. It appeared that after every disaster, the stock market would have a small decline in a very short period and then the whole market would go up. Panic selling was considered to be the reason. Cutler et al. (1988) studied the impact of the non-economic news on stock market. They used monthly stock returns from 1926 to 1985 to analyse the impact. The conclusion was that non-economic events have “surprisingly small effect” on stock markets.

## **Chapter 3**

### **Data Sources and Methodology**

This chapter will be divided in two parts. The first part is to introduce where the data come from and the reason why choose these data. The second part is to describe the process of an event study in this paper and also introduce the model used in study.

#### **3.1 Data Source**

Japan's biggest stock market is the Tokyo Stock Exchange (TSE), and Tokyo stock Price Index(TOPIX) is an important stock market index for the TSE. It tracks all domestic companies listed on the TSE which calculates and distributes TOPIX every second. Using this index as the benchmark of Japanese stock market will obtain the best reflection of the impact of the event. The Hong Kong Stock Exchange is the second largest stock market in China, and Hang Seng Index is the main indicator of the overall market performance in Hong Kong. It is used to record and monitor the largest companies listed on the Hong Kong Stock Exchange. Its use as benchmark to analyse the impact of the event in Hong Kong stock market will be appropriate. The reason why this paper dose not choose an index from the Shanghai Stock Exchange, which is the biggest stock exchange in China, has been discussed in previous chapter.

North America, Europe and Asia are the three most developed areas in economy all over the world. Data from six different stock markets of six different countries in these three areas will be used to analyse the impact of this event. For the U.S.A., the NYSE composite index(NYA) is chosen to be the benchmark of the market return. It covers all

common stocks listed on the New York Stock Exchange which is the largest stock exchange in U.S. and it can reflect the general trend of the U.S. stock market. In Canada, the Toronto Stock Exchange is the biggest stock exchange in the country, and the S&P/TSX Composite Index includes the largest companies listed on the exchange as measured by market capitalization. This index will be used in this paper as the benchmark to analyse the impact on the Canadian stock market. The FTSE 100 index is a share index of 100 companies listed on the London stock market with the highest market capitalization. It is one of the most widely used stock indices and is seen as a gauge of business prosperity. It will be used as the benchmark of market return for the UK market. In Germany, the Frankfurt Stock Exchange is the biggest stock exchange, and the HDAX Index includes 110 largest companies listed on the Frankfurt market as measured by market capitalization. It can reflect the general trend of the German stock market.

For each stock market, a sample of thirty listed companies will be made up. Every sample of thirty companies are listed on the corresponding index. They are ranked by market capitalization from the highest as in December 2010. There are slight differences in trading dates in the six countries, given holidays or other reasons. Each company in every sample is still listed on the corresponding index over the whole period of the study. All of the data used in this paper are provided by Bloomberg<sup>TM</sup>. The list of names and codes of these public companies are in Appendix A.

### **3.2 Methodology**

In the case of an event study, choosing the event day is the key point. In that period, market reaction may come from many different reasons, such as earning announcement,

stock splits, changes in fiscal or monetary policies, unemployment rate, inflation rate and other important public information released. Normally, to analyse the impact of one of the factors, a specific period will be chosen to exclude the influence of the other important information. Due to the properties of nonrepeatable and unpredictability of a natural disaster, to analyse the “shock” of natural disaster is the point of this paper. An unexpected event suddenly strikes when everything else is in their normal schedule.

### 3.2.1 Event Period

The Japanese earthquake, which is used in this paper, happened on Friday, 11 March 2011. In an event study, event day ( $T=0$ ) is the first trading day after the actual date of event occurring. So the event day will be 14 March 2011. The whole event period should start before the event has an effect on the stock market. In this study, the event window is chosen as ten trading days before and after event day, which is from  $T=-10$  to  $T=10$ .

An estimation period should be employed to estimate the expected return of the sample stocks in an event study. Typically, forty trading days( $T=-50$ ) before the event window will be chosen. Table 3.1 below shows the entire event period of six different markets. Because of the difference in trading dates, date of beginning and ending of event period is not the same.

Table 3.1 **Study Period**

Market(Country)	Estimation Period	Pre-event	Event day	Post-event
TSE(Japan)	2010/12/28-2011/2/25	02/28-03/11	03/14	03/15-03/29
SEHK(China)	2010/12/30-2011/2/25	02/28-03/11	03/14	03/15-03/28
NYSE(US)	2010/12/30-2011/2/25	02/28-03/11	03/14	03/15-03/28
TSX(Canada)	2010/12/30-2011/2/25	02/28-03/11	03/14	03/15-03/28
LSE(UK)	2010/12/31-2011/2/25	02/28-03/11	03/14	03/15-03/28
FWB(Germany)	2011/01/3-2011/02/25	02/28-03/11	03/14	03/15-03/28



### 3.2.2 Models of Event Study

After identifying the study period, the next step is to use a proper model to analyse the data for the estimation period, so that expected returns can be calculated over the period window. Normally, two categories of models will be considered. They are statistical models and economic models. The most common used economic models are the Capital Asset Pricing Model (CAPM), the Arbitrage Pricing Theory (APT).

CAPM is an equilibrium model that explains the risk and return related to the stock. It is used to determine a theoretically appropriate required rate of return of an asset. The equation of CAPM can be described as:

$$R_{it} = R_{ft} + b_i (R_{mt} - R_{ft}) \dots\dots\dots 3.1$$

$R_{it}$  is the return of stock  $i$  at time  $t$ .  $R_{ft}$  represents the risk-free rate at time  $t$ , usually use the T-bill rate.  $R_{mt}$  is the return of market portfolio at time  $t$ .  $b_i$  is the risk parameter of the stock  $i$ .  $b_i$  is determined by regression analysis of historical data.

The Arbitrage Pricing Model (APT) is a general theory that explains the expected return of an asset can be modeled as a linear function of various macro-economic factors.

$$R_j = a_j + b_{ji} F_i + e_j \dots\dots\dots 3.2$$

$R_j$  is the return of asset  $j$ .  $a_j$  is a constant for asset  $j$ .  $F_i$  is a systematic factor.  $b_{ji}$  is the sensitivity of the  $j^{\text{th}}$  asset to factor  $i$ .  $e_j$  is the error term with mean zero.

Basically, APT is just an extension of CAPM, and with many factors which makes it relatively complicated. Both models require economic theory to support, which do not suited for the study in this paper.

Statistical models are more commonly used in event studies, because under these models, expected returns are derived purely from statistical assumptions about the behavior of returns. Two popular models such as the Constant Mean Return Model and Market Model will be considered. Due to the simplicity, market model is chosen to be the model to analyse the data from estimation period.

### 3.2.3 Market Model

The equation of the Market Model can expressed as below:

$$R_{it} = a_i + b_i R_{mt} + e_{it} \dots \dots \dots 3.3$$

where:

$R_{it}$  : is the return of the stock i in period t

$R_{mt}$  : is the return of the market portfolio in period t

$a_i$  : is the interception of this regression line for the stock i

$b_i$  : is the slope of this regression line for the stock i

$e_{it}$  : is the error term

and:

$$R_{it} = P_{it}/P_{i(t-1)} - 1 \dots \dots \dots 3.4$$

where:

$P_{it}$  : is the price of stock i at time t

$P_{i(t-1)}$  : is the price of stock i at time t-1

The  $(a_i + b_i R_{mt})$  in the Market Model represent the systematic component of return. The error term  $(e_{it})$  is the unsystematic component of the return. If we analyse the data from estimation period using this model, we can calculate  $a_i$  and  $b_i$ .

### 3.2.4 Abnormal Return (AR) and Average Abnormal Return (AAR)

This step is to calculate the abnormal return and its average value. In the previous step, estimates  $(a_i$  and  $b_i)$  have been calculated. With them, the difference between actual return of stocks and expected or normal return of stocks in the event period can be calculated by the formula below:

$$AR_{it} = R_{it} - (a_i + b_i R_{mt}) \dots\dots\dots 3.5$$

where:

$AR_{it}$  : is the abnormal return of stock i at time t

$R_{it}$  : is the actual return of stock i at time t

$(a_i + b_i R_{mt})$  : is the expected or normal return of stock i at time t

Average abnormal return(AAR) is simply the sum of abnormal returns(ARs). It can be calculated by the equation below:

$$AAR_t = (1/N)\sum AR_{it} \dots\dots\dots 3.6$$

where:

$AAR_t$  : is the average abnormal return at time t

$N$  : is the number of stocks

$AR_{it}$  : is the abnormal return of stock  $i$  at time  $t$

From this step, the daily abnormal returns of the whole sample will be calculated. There are two ways to investigate the impact of Japanese earthquake on the stock market. The first one is to plot the graph and examine the pattern. Along with it, a statistical test will be performed to examine the significance of daily abnormal return. This paper will use a hypothesis test.

that is:

$$H_0 : AAR_t = 0$$

$$H_1 : AAR_t \neq 0$$

which means to test if the AAR at time  $t$  is significantly different from zero. For a small sample, the t-test is usually used. Equation 3.7 below will show how to calculate the test statistic  $t$ :

$$t = N^{0.5} AAR_t / SD_t \dots \dots \dots 3.7$$

where:

$SD_t$  : is the standard deviation of abnormal return at time  $t$

Normally, a significance level of five percent will be chosen, and the degrees of freedom  $n$  is  $N-1$ . In this step,  $n$  equals thirty minus one, which is twenty-nine. After looking up in the t-table, the corresponding value of  $t_{0.05, 29}$  is  $\pm 2.045$ . This means if  $|t| \geq t_{0.05, 29}$ , we

reject the null hypothesis. Then the daily average abnormal return of each trading day in the sample is significantly different from zero.

### **3.2.5 Cumulative Abnormal Return (CAR) and Average Cumulative Abnormal Return (ACAR)**

In this step, each company's cumulative abnormal return will be calculated. The method is very straight-forward. Simply sum each company's abnormal return across the event period. It can be described as the formula below:

$$CAR_i = \sum AR_{it} \dots \dots \dots 3.8$$

where:

$CAR_i$  : is the cumulative return of stock i over the event period

Using this value, we can perform a hypothesis test to identify the significance of cumulative return of each stock. That is:

$H_0$  : mean of  $CAR_i$  is zero

$H_1$  : mean of  $CAR_i$  is not zero

To perform this test, we need to calculate the test statistic t:

$$t = CAR_i / (SD_i T^{0.5}) \dots \dots \dots 3.9$$

where:

T : is the number of trading days in event period

$SD_i$  : is the standard deviation of abnormal return of stock i

In this t-test, the significance level is five percent, and degrees of freedom, twenty. From the t table, the corresponding value of  $t_{0.05, 20}$  is  $\pm 2.086$ . This means if  $|t| \geq t_{0.05, 20}$ , we reject the null hypothesis. Then the mean of cumulative abnormal return of stock  $i$  in the sample is significantly different from zero.

There are two ways to calculate average cumulative abnormal return (ACAR). The first one is described as Equation 3.10 below:

$$ACAR = (1/N)\sum CAR_i \dots \dots \dots 3.10$$

where:

$N$  : the number of stocks

The other one is simply sum the  $AAR_t$ s over the event period, as Equation 3.11 below shows:

$$ACAR = \sum AAR_t \dots \dots \dots 3.11$$

Then we perform a hypothesis test to see if ACAR over all is significantly different from zero,

that is:

$$H_0 : ACAR = 0$$

$$H_1 : ACAR \neq 0$$

the test statistic  $t$  is calculated by the formula below:

$$t = N^{0.5} ACAR / SD \dots \dots \dots 3.12$$

where:

N : is the number of stocks

SD : is the standard deviation of cumulative abnormal return

A significance level of five percent will be chosen, and the degrees of freedom n is twenty-nine. After looking up in the t-table, the corresponding value of  $t_{0.05, 29}$  is  $\pm 2.045$ . This means if  $|t| \geq t_{0.05, 29}$ , we reject the null hypothesis. Then overall average cumulative abnormal return of this sample is significantly different from zero.

## **Chapter 4**

### **Analysis of the Results**

This chapter will analyse the results from the event study procedure performed in the previous chapter. All data of six different stock markets will be presented in the Appendices B-G.

Three parts will be presented in this chapter. The first part will introduce the method to obtain the results using MS Excel in this paper. The second part is to analyse the results with statistic value and charts. This part is also the most important part of the whole study. It will show the existence of the impact of Japanese earthquake on different stock markets and also show if the impact is positive or negative. The last part will be the summary of this study.

#### **4.1 To Obtain Results in MS Excel**

In following the procedure of an event study, the first step is to calculate for the estimation period and event period the daily return of each company in the sample. Then we use the data from estimation period with LINEST function in Excel to calculate the interception and slope of the Market Model.

The next step is to use the estimated  $a$  and  $b$  to calculate the abnormal return of stock in the event period. According to the formula provided in the previous chapter along with SUM function in Excel, we can easily calculate the average abnormal return, cumulative abnormal return and average cumulative abnormal return. For the test statistic  $t$ , first we



need to use the STDEVA formula in Excel to calculate the corresponding standard deviation for each t. Then we can get the t value.

At last, all of the statistic t values and graphs will be presented to analyse the final conclusion.

## **4.2 Result Analysis**

This section will be divided into six parts due to the number of stock markets commencing with the Japanese stock market, followed by Hong Kong, US, Canada, UK and following, the German market.

For daily abnormal return of the sample,  $|t| \geq t_{0.05, 29}$ , so if t is greater than 2.045 or less than -2.045, there is a significant impact on daily abnormal return brought by the earthquake. For cumulative return of each company over the event period in the sample,  $|t| \geq t_{0.05, 20}$ , which means if t is greater than 2.086 or less than -2.086, a significant impact on a specific stock brought by the earthquake exist. For the overall average cumulative abnormal return, the condition of t value is as the same as the daily abnormal return. At last, after the significance test, we will conclude if the impact is positive or negative by watching the sign of daily abnormal return, cumulative abnormal return and average cumulative abnormal return.

### **4.2.1 Japanese Stock Market**

Figure 4.1 shows the daily average abnormal return of thirty companies listed on the TOPIX Index. The event day is day eleven in the figure. We can see that daily AAR is smoothly fluctuating around zero. On the event day and the trading day after, AAR has a

sharp rise but the following day, AAR declined with nearly twice the rate and reached the rate around 0.015 below zero. After that, AAR stayed below zero generally until the end of the event period. From the figure, we can say the earthquake had a shock on the Japanese stock market and a negative impact on the return of stock market. The possible reason of the inefficient reaction of the stock market after the event day might be the delay of information caused by the earthquake. Subsequently, lots of death and loss have occurred. From Appendix B, we can see the t-value of daily AAR. It is surprisingly that no t-value exceeds 2.045 thus we do not reject the null hypothesis. From the statistical view, the earthquake has had no significant impact on the Japanese stock market for the period in this study.

Figure 4.1 AAR of the Japanese stock market

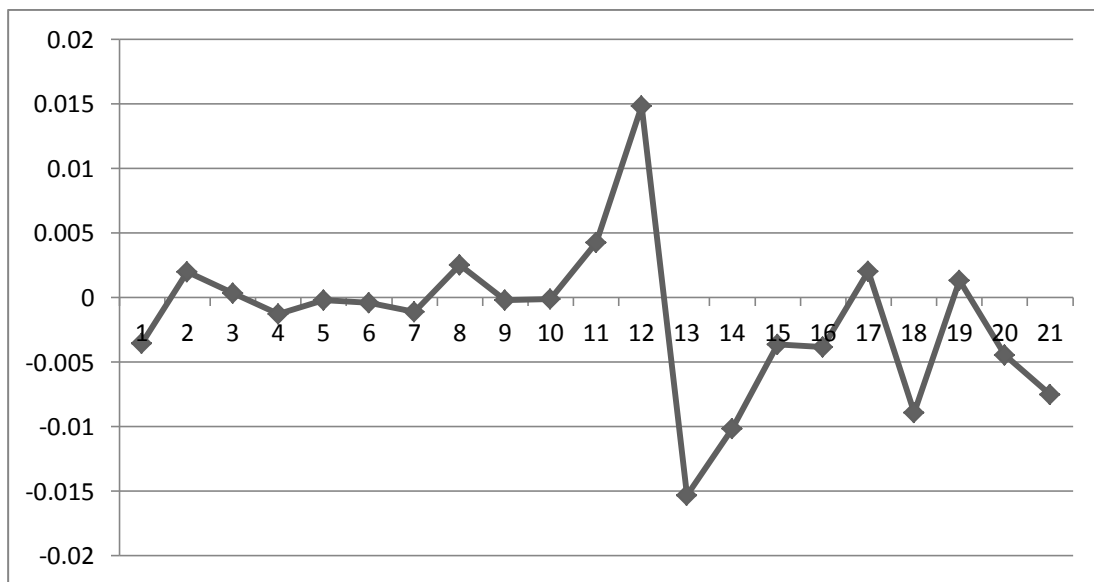
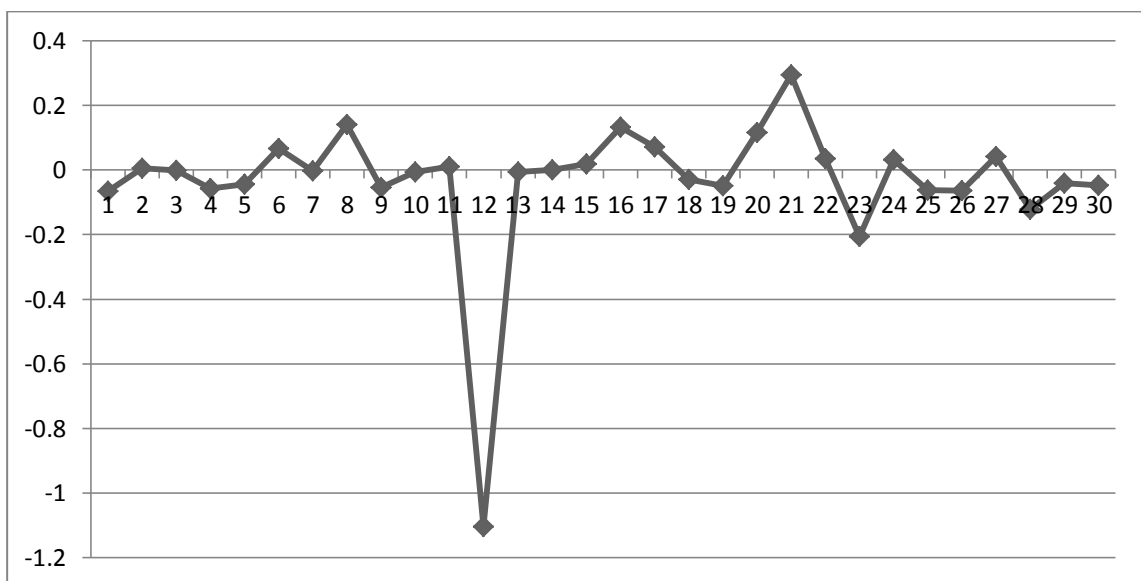


Figure 4.2 shows the CAR of each company over the event period. We can see CAR of most of the companies is near zero. From Appendix A, number twelve is the Tokyo electric power company (TEPCO). The possible reason of this huge negative CAR might

be the nuclear hazard of Fukushima Daiichi Nuclear Power Plant in the earthquake. Considering TEPCO is running the power plant, its stock price will be affected by this catastrophic disaster.

From Appendix B we can find three t-values are in the rejection zone. Two of them show the significant positive impact on CAR of individual stock. One is for Komatsu Ltd. which is a mining and construction equipment manufacture. The positive CAR of this company might be caused by the need of reconstruction after the earthquake. Another t-value is for Mitsubishi Corporation which has business across lots of industries, including energy. The reason for the positive return might be caused by the shift of demand in energy after the nuclear hazard brought by the earthquake. The t-value of TEPCO shows the negative significant impact. The t-value of ACAR is not in the rejection zone, so we can say that earthquake has significant impact on some individual stocks, and overall, it has had a negative but not significant impact on the Japanese stock market.

Figure 4.2 CAR of the Japanese market

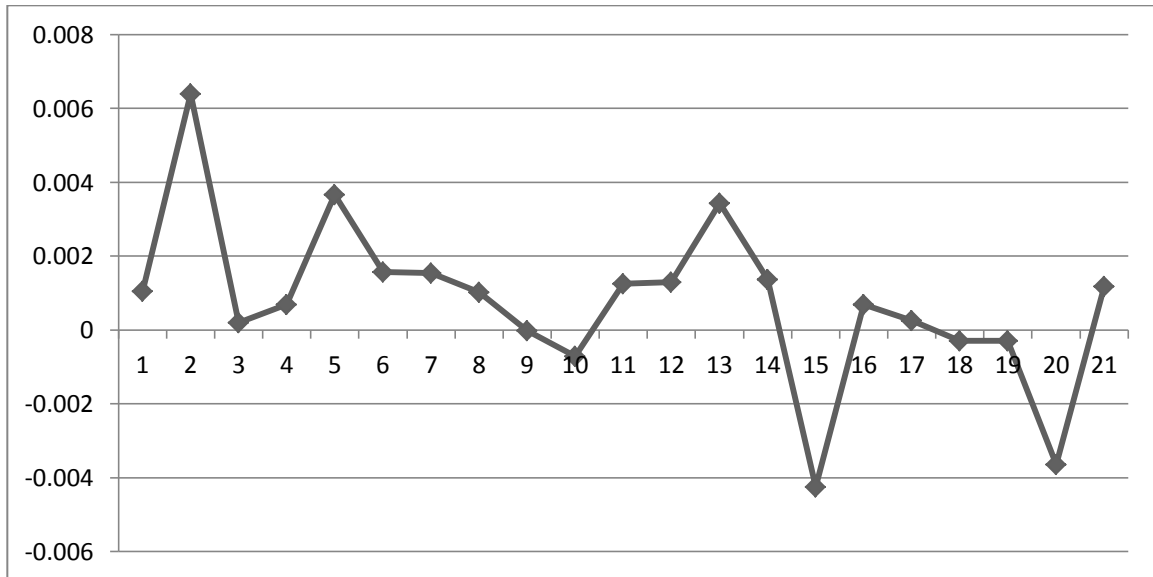


#### **4.2.2 Hong Kong Stock Market**

Figure 4.3 shows that the daily AAR of the Hong Kong stock market is slightly above zero before the event day. At the calendar day of earthquake occurring, a slight drop of AAR shows in the figure but in the following days AAR come back to positive until the fourth day after the event day. A relatively sharp drop shows in the figure and AAR stayed negative during the rest of the days in the event period. From the figure we can say that Japanese earthquake has generally a negative impact on the Hong Kong stock market. The delayed responds from daily AAR might be caused by the delay of information about the nuclear hazard. Geographically, Hong Kong is closer to Japan than any other area in this study, so the leak of the nuclear radiation may affect Hong Kong area.

From Appendix C, we can see that one t-value falls in the rejection zone. It is just the trading day when the AAR has a sharp drop. Form a statistical viewpoint, we can say that the Japanese earthquake had a significant negative shock on Hong Kong stock market. But this shock has been delayed due to the information delay.

Figure 4.3 AAR of the Hong Kong stock market

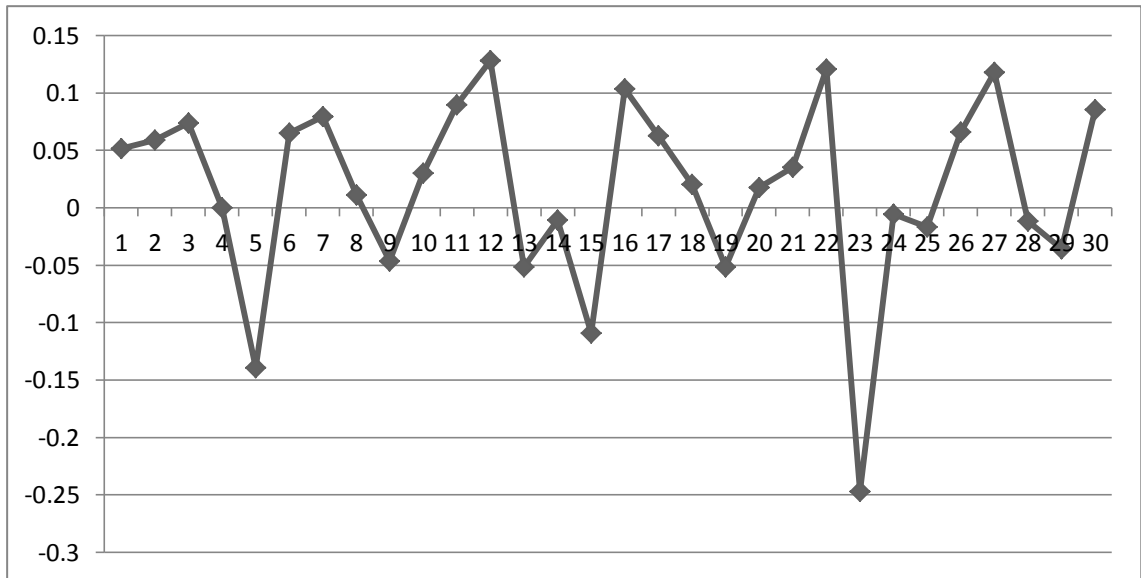


In Figure 4.4, the CAR of each company on Hong Kong stock market is presented. Thirty CARs shows the inconsistency over the event period and in general they represent a view of volatility. From Appendix A we know the number twenty-three is the Li&Fung Ltd. which has a noticeable negative CAR that reached minus twenty-five percent. Li&Fung Ltd. is a company that has business on trading, logistics and distribution internationally. The possible reason of this negative AAR is the negative impact on the global supply chain. During the earthquake, many Japanese factories were destroyed or shut down. The shipments of raw material and products from or to Japan were influenced.

From Appendix C, we can see there are six t-values that fall in the rejection zone. Four of them are showing that CAR is significantly positive during the event period, and two of them are significantly negative, including the t-value of Li&Fung Ltd.. The t-value of ACAR is not in the rejection zone, so from a statistical view, Japanese earthquake has

only significant impact on some individual stocks of the Hong Kong market. Overall, the earthquake has negative, but insignificant impact on the Hong Kong stock market.

Figure 4.4 CAR of the Hong Kong stock market

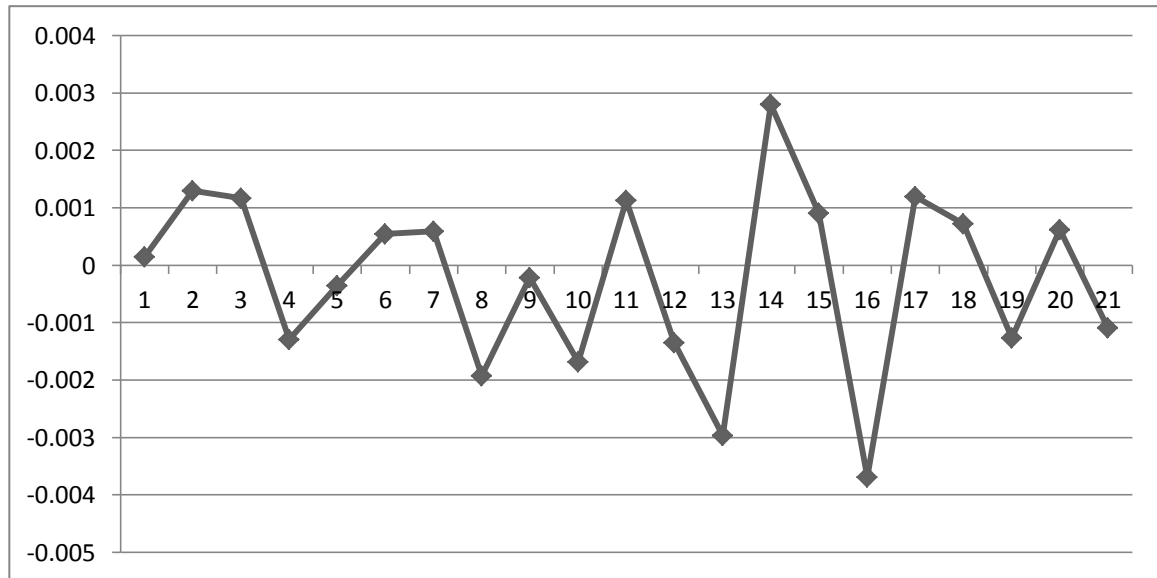


#### 4.2.3 the US Stock Market

In the Figure 4.5 we can see that the daily AAR of US stock market is gently moving around zero before the event day. After the event day, a drop occurred, but in the following day there was a rise. And then a rise following another drop made the AAR go back to the similar status as it was before the event day. From the figure, we can say that AAR of US stock market was affected negatively by Japanese earthquake, but in a few days, the market self-adjusted and went back to the status before the event. Due to the efficiency of US stock market, this kind of self-adjustment is reasonable. In Appendix D, we can see the t-value of daily AAR of US stock market, none of them fall in the

rejection zone. So that we conclude that Japanese earthquake has had a negative shock, but insignificant impact on daily AAR of the US stock market.

Figure 4.5 AAR of the US stock market



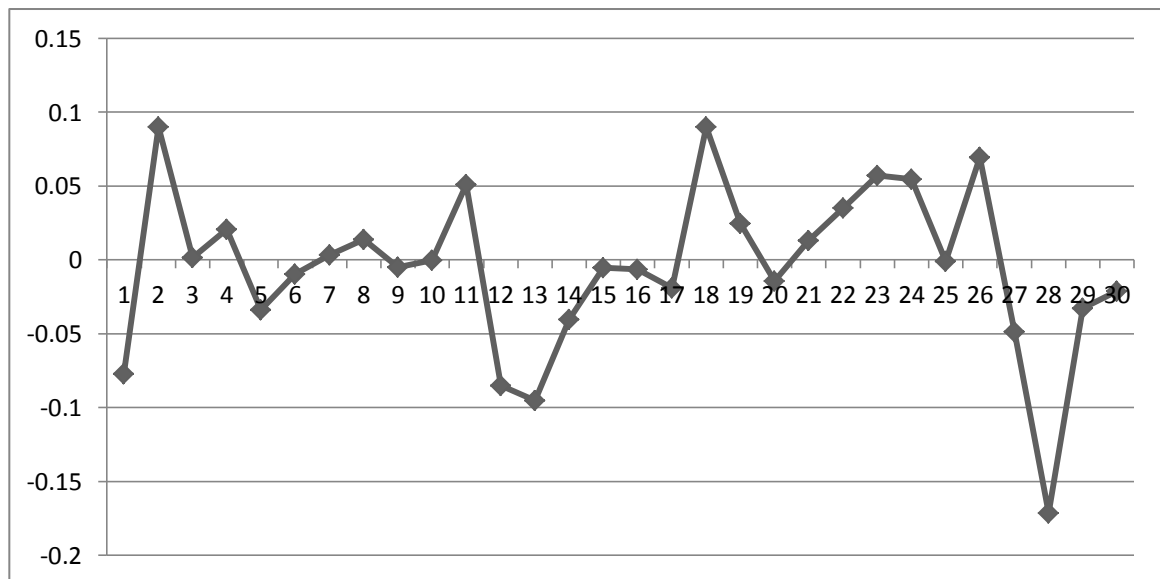
In Figure 4.6 we can see the most of the CARs are located around zero within a range from negative point five percent to positive point five percent. In general they show a disorderly pattern. We notice that an apparent negative CAR is showing in the figure. According to Appendix A, it is the Toyota Corporation. The possible reason of this negative CAR is the disruption of Toyota's output brought about by the earthquake. Some of the factories were destroyed or shut down. We noticed that Toyota Corporation is also listed on the Japanese TOPIX Index. But in that index, Toyota's CAR is not significantly negative. The earthquake might just interfere with the whole supply chain from Japan to the US of Toyota Corporation.

In Appendix D, four t-values are in the rejection area. Three of them show significantly negative CAR over the event period. Besides Toyota, the other two are Exxon Mobil

Corporation and General Electric Company. The former is the world's largest publicly traded international oil and gas company. The earthquake caused a rise of gas prices in US. So this is the possible reason of Exxon Mobil Corporation having a significantly negative CAR. General Electric Company is interconnected with the company operating the Fukushima Daiichi Nuclear Power Plant which experienced a nuclear hazard in the earthquake. So the reason for its significant negative CAR is obvious. The t-value of ACAR in the US stock market is not in the rejection zone.

So that we know Japanese earthquake has significant impact on some individual stocks, but overall, only an insignificant shock was revealed on the US stock market.

Figure 4.6 CAR of the US stock market



#### 4.2.4 Canadian stock market

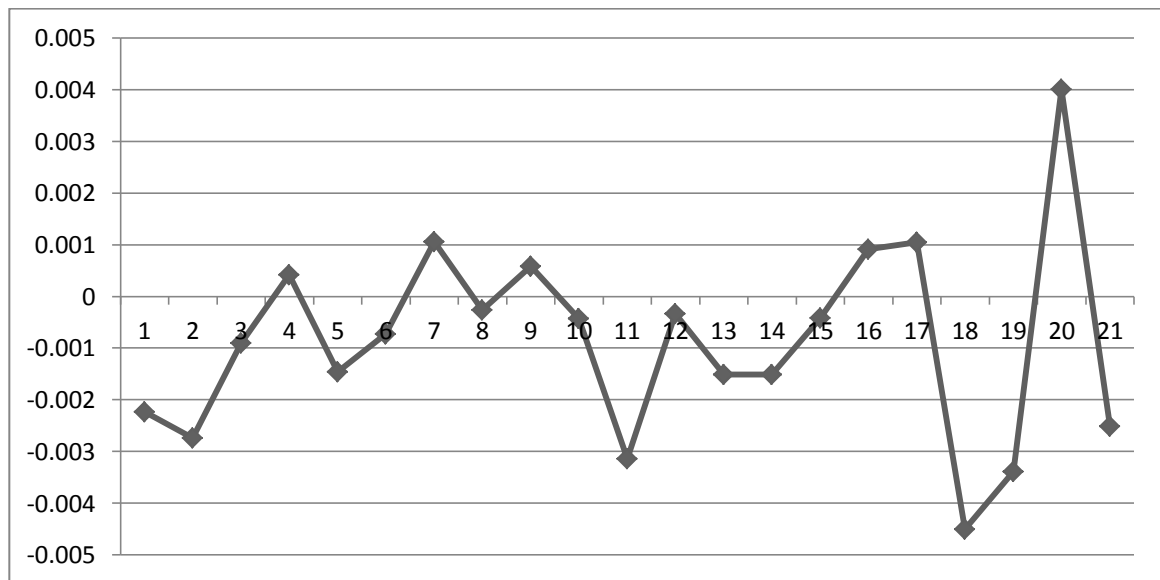
In Figure 4.7, the daily AAR of Canadian stock market is close to zero before the event day. On the event day, a slight drop shows up in the figure, and then it returns to the



similar status as it before the event day. In the last few days of the event window, the AAR seems more volatile than the other days in the event period. But it is still fluctuating around zero.

From the figure, we can say that Japanese earthquake has had a negative impact on daily AAR of Canadian stock market. From Appendix E, we can see only one t-value of AAR lands in the rejection zone. It is the ninth day after the event day and in the time frame it is relatively far from the event day. The possible reason is that the market may over adjust from the previous loss. So statistically speaking, the Japanese earthquake had only a negative shock in terms of the statistical insignificance of the daily AAR of the Canadian stock market.

Figure 4.7 AAR of the Canadian stock market



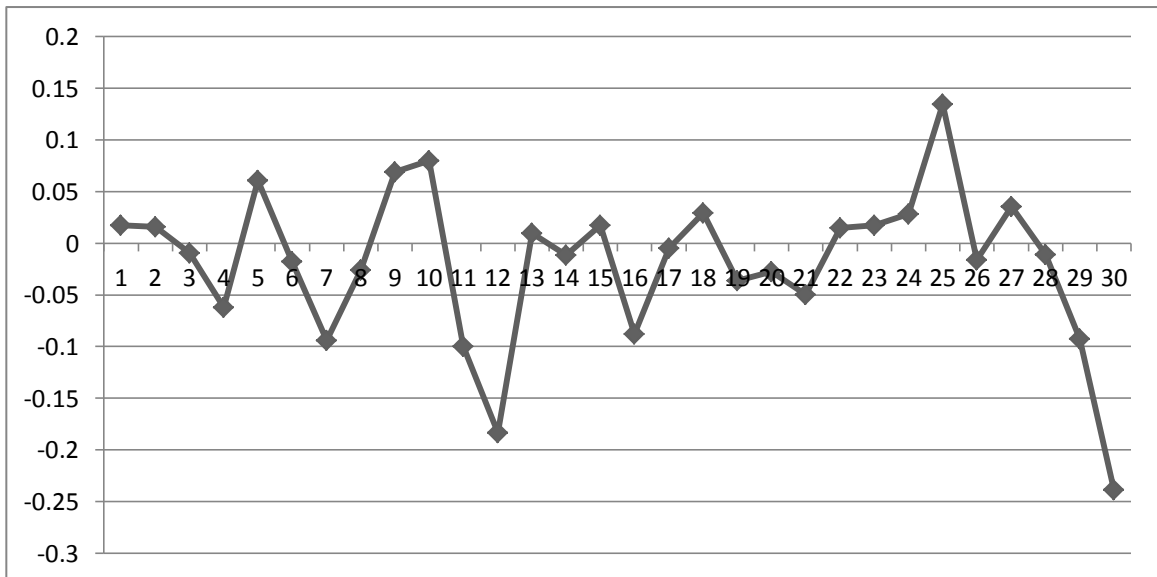
In Figure 4.8, CARs of the Canadian market show inconsistency. Two noticeable negative CARs are number twelve and number thirty. One is RIM Company which is a Canadian telecommunication and wireless equipment company with its well-known

product the BlackBerry smartphone. The other is Cameco Corporation, which is one of the world's largest publicly traded uranium companies. The possible reason of the apparent negative CAR of RIM company is the earthquake and tsunami caused the smartphone parts shortage. And for Cameco Corporation, the reason is obvious. Uranium is the core material used for a nuclear power plant to generate power. Due to the nuclear hazard in earthquake, CAR of such company will be affected.

From Appendix E, we found that only one t-value is in the rejection area, and that belongs to Sun Life Financial Inc. which is an international financial services company known primarily as a life insurance company. The reason why the CAR of this company is significantly negative might be the insurance business, which is related to Japan.

The t-value of ACAR of Canadian stock market is not in the rejection area. So overall, Japanese earthquake only had a small negative shock on the Canadian stock market and it is statistically insignificant.

Figure 4.8 CAR of Canadian stock market

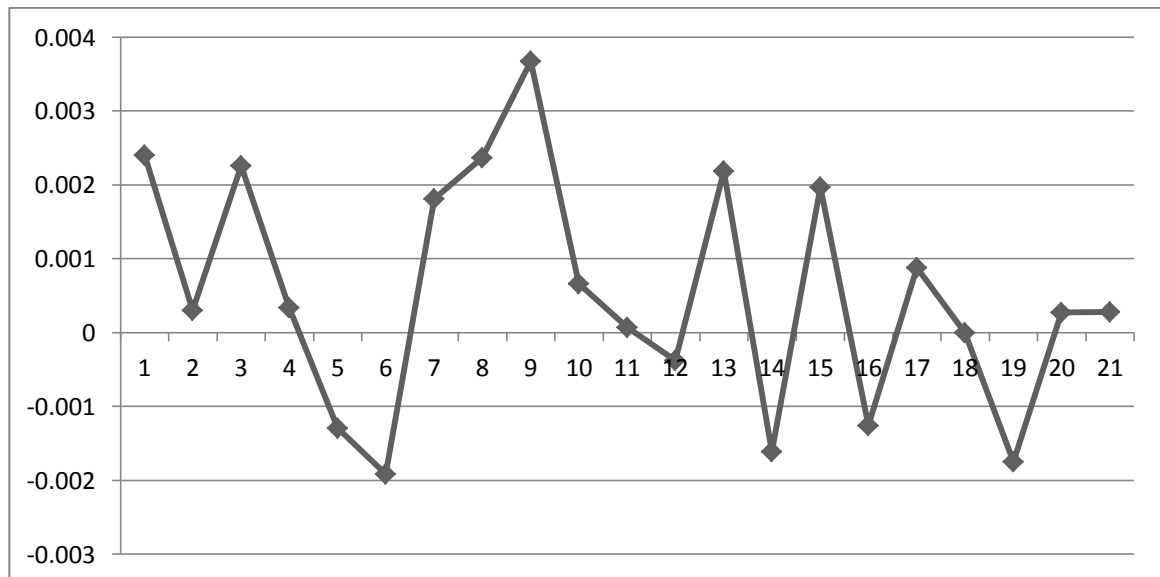


#### 4.2.5 UK stock market

In Figure 4.9, the daily AAR of UK stock market moves around zero with a small magnitude before the event day. On the event day, ARR was dragged down to somewhere close to zero from a positive position. After that, the AAR turned up like the way it performance in the period before event day, but more volatile. So a small negative impact can be observed from the figure.

In Appendix F, we find that only one t-value is in the rejection zone. The t-value is from day nine which is two days before the event day. Whatever the reason is for this significant positive AAR, the earthquake brought it down to zero. So from the figure, we can tell that the Japanese earthquake had a small negative shock on the UK stock market but this shock is statistically insignificant.

Figure 4.9 AAR of the UK stock market

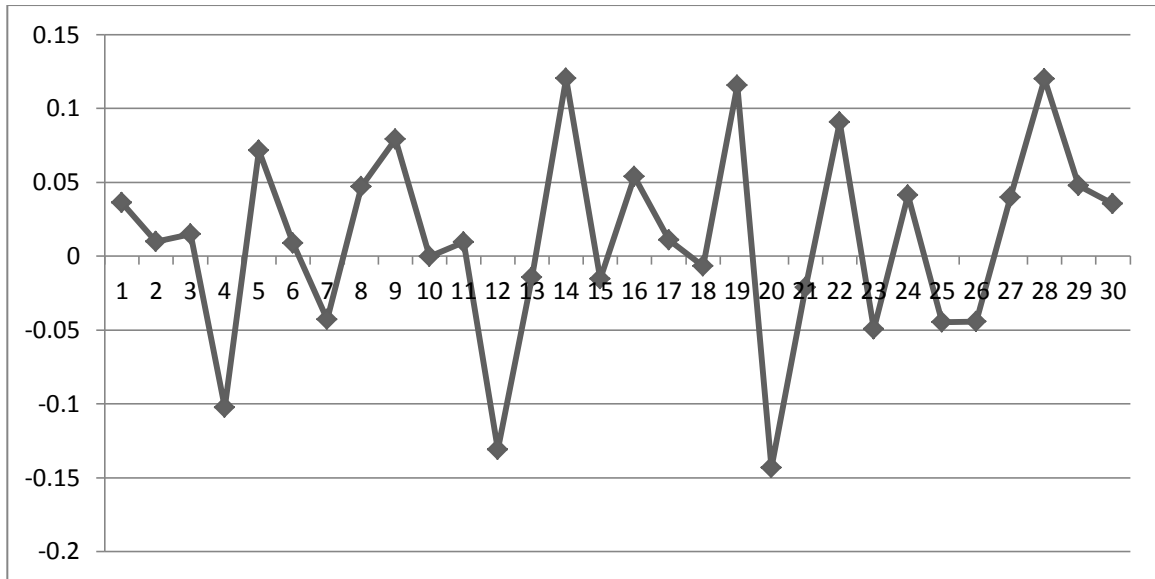


In Figure 4.10, we can see that a big part of companies' CARs are located around zero with a relatively larger range than other companies show in the figure. CARs of five companies are obviously different from zero. From Appendix A, we can find them as Royal Bank Scotland, Xetrata Plc, SABMiller Plc, Barclays Plc and Antofagasta Plc. Worth noticing is that Xetrata Plc and Antofagasta Plc both have business in the mining area. So the positive CARs of these two companies can be explained as a shift of demand in energy away from nuclear.

In Appendix F, we find that five t-values are in the rejection area, and these t-values belong to the five companies of Unilever Plc, Royal Bank Scotland, Xetrata Plc, SABMiller Plc, and Barclays Plc. Worth noticing is that Unilever Plc is a multinational consumer goods company with products of foods, cleaning agent and personal care products. The possible reason for the significant positive CAR of this company is that foods and cleaning necessities will be needed by people in the disaster area.

The t-value of ACAR of UK stock market is not in the rejection zone, so that we can say that overall the effect of a negative small shock brought by Japanese earthquake existed on the UK stock market, but statistically, it is insignificant.

Figure 4.10 CAR of the UK stock market



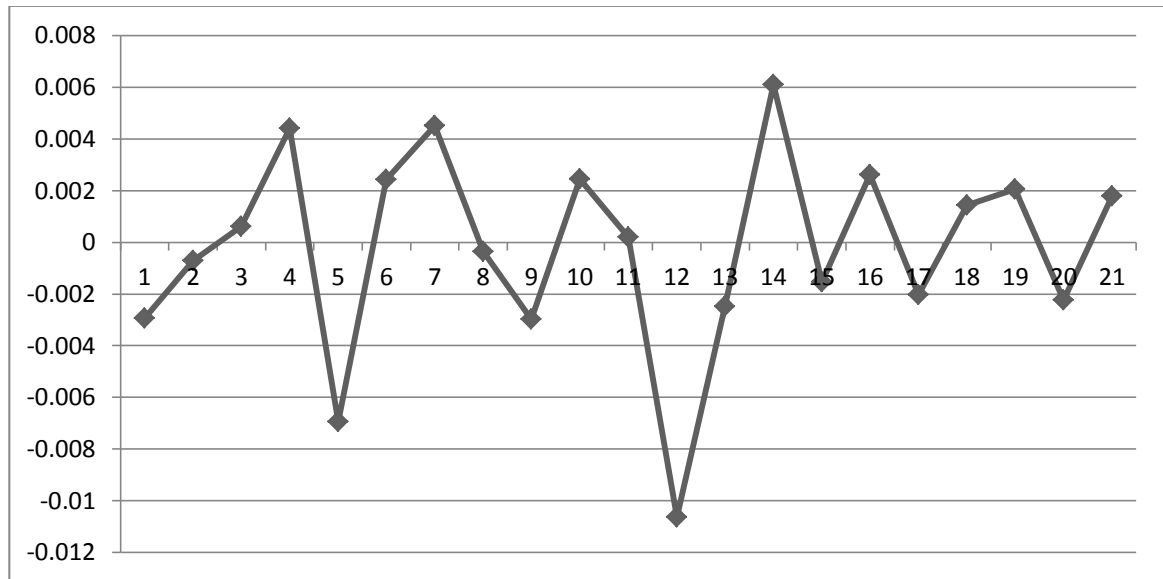
#### 4.2.6 German stock market

In Figure 4.11, we find that the daily AAR of the German stock market move around zero with a small magnitude before event day. The day after the event day, a sharp drop brought down the AAR to somewhere below zero, which shows up in the figure. And it seems the market self-adjusted the AAR to the place above zero in the following two days. Then it went back to the status of fluctuating around zero. From the figure, we can see that a negative shock happened on the day after the event day, but soon the daily AAR bounce back to a similar status as it was before the event day.

From Appendix G, we can find that five t-values are in the rejection area. Three of them are in the period before the event day. Worth noticing is that on the day after the event day, t-value shows that daily AAR is significantly negative, and after two days of that, t-value shows AAR is significantly positive. So we can say that a statistically significant negative effect on AAR was brought on by Japanese earthquake exists on the German stock market, and a statistically significant rise of AAR happened three days after the

event day. Market efficiency is a reasonable explanation of this movement of self-adjustment.

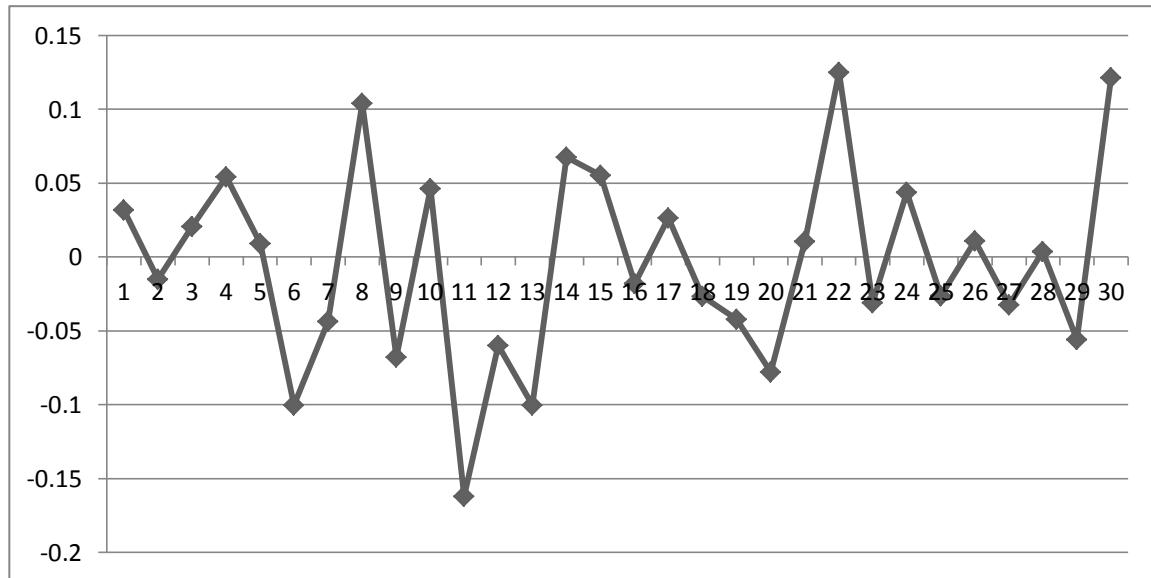
Figure 4.11 AAR of the German stock market



In Figure 4.12, most of the CARs are located around zero within a small range. CARs of four companies are obviously different from zero than other companies over the event period. From Appendix A we know these companies are Deutsche Telekom AG, Deutsche Bank AG, Continental AG and Deutsche Lufthansa AG. Worth noticing is that Continental AG is a worldwide leading German auto and truck parts manufacturing company. Since auto manufacturing in Japan was hit hard due to the earthquake, the demand for automobiles from other areas in the world could be expected to rise. So does the parts sector for automobile. That might be the reason why this company has a positive CAR over the event period. From Appendix G, we can see that only one t-value is in the rejection zone, and that t-value belongs to the Deutsche Bank AG. It shows that CAR of this company is significantly negative over the event period. The t-value of ACAR of the German market is not in the rejection zone. So, overall there is negative but statistically

insignificantly shock on the German stock market brought about by the Japanese earthquake.

Figure 4.12 CAR of German stock market



### 4.3 Summary

According to the figures of average abnormal returns and cumulative abnormal returns of six different stock markets all over the world, a negative impact in the form of a shock brought by Japanese earthquake can be observed. From the figures of average abnormal returns, every stock market performs a self-adjustment which brought back the daily average abnormal return to its former status, except Japan. Considering the earthquake strike happened in Japan with huge destruction and losses this is not surprising. With a long period of reconstruction, the stock market needed more time to adjust back to the previous level.

For the t-values of daily average abnormal return and cumulative abnormal return and average cumulative abnormal return in these stock markets, almost every t-value of daily

AARs in six stock markets is not in the rejection area. Except for Germany, a significant negative daily AAR shows after the earthquake and followed by a significantly positive daily AAR which brought the daily AAR of German stock market to its status before the earthquake.

The t-values of CARs for each stock in six stock markets show that the earthquake has a different impact on individual stocks, and this is the result of them being in different industries. A positive impact may appear on the companies that are involved in construction, foods, and in this specific event of a Japanese earthquake, due to the nuclear hazard in the earthquake, mining and non-nuclear energy are related. Due to this particular event, negative impacts will appear on oil, automobile, consumer electronic goods and nuclear energy related companies.

Based on these results and those non-rejected t-values of ACARs of six stock markets, we can conclude that the Japanese earthquake that happened on March 11 2011 has had a negative but statistically insignificant impact on global stock markets.



## **Chapter 5**

### **Conclusion**

This paper employed an event study methodology to investigate the impact of Japanese earthquake happened on March 11 2011 on global stock markets.

This paper chose six different stock markets from the three most developed areas all over the world to analyse. As such they are the most representative stock markets and included Japan, Hong Kong, US, Canada, UK and Germany. In order to measure the effect of this earthquake on stock markets, this paper chose ten days before the calendar day that earthquake happened and ten days after to create an event window. Forty days before the event window was chosen to be the estimation period.

Because there is no support of economic theory for this natural disaster event, this paper chose the statistical model, which is the Market Model to estimate the proper parameters for the analysis. The sample size of each stock market was set to be thirty companies. Due to the properties of small samples, the statistic t-test was chosen to perform a test on the results.

The results show that there was no significant impact on each of these markets overall. But in daily average abnormal return, each stock market experienced a negative shock brought by the earthquake. Except for the Japanese stock market, every other stock market self-adjusted the daily average abnormal return back to the former status. The earthquake is considered the reasonable cause of these results.

In referring to the cumulative abnormal return of each stock in the markets, the impact was felt differently across industries and companies. Some companies showed a positive effect due to this earthquake and some of them it was negative. Otherwise the earthquake had no significant impact on the rest of the companies. This can be considered the reason why overall the earthquake had no significant impact on global stock markets.

Furthermore, different natural disasters have various other properties so the effects will vary by industries and companies. So our prediction is that it is difficult to be sure what impact a natural disaster will have on a specific stock market or global markets in general.

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## Appendix A : The Tickers and Names of All Companies

Japanese Stock Market		
No.	Ticker	Short Name
1	7203 JP Equity	TOYOTA MOTOR
2	9437 JP Equity	NTT DOCOMO INC
3	8306 JP Equity	MITSUBISHI UFJ F
4	7267 JP Equity	HONDA MOTOR CO
5	9432 JP Equity	NIPPON TELEGRAPH
6	7751 JP Equity	CANON INC
7	8316 JP Equity	SMFG
8	8058 JP Equity	MITSUBISHI CORP
9	7201 JP Equity	NISSAN MOTOR CO
10	7974 JP Equity	NINTENDO CO LTD
11	9984 JP Equity	SOFTBANK CORP
12	9501 JP Equity	TOKYO ELECTRIC P
13	4502 JP Equity	TAKEDA PHARMACEU
14	8411 JP Equity	MIZUHO FINANCIAL
15	6758 JP Equity	SONY CORP
16	6954 JP Equity	FANUC CORP
17	6752 JP Equity	PANASONIC CORP
18	2914 JP Equity	JAPAN TOBACCO
19	6902 JP Equity	DENSO CORP
20	8031 JP Equity	mitsui & co
21	6301 JP Equity	KOMATSU LTD
22	9433 JP Equity	KDDI CORP
23	9020 JP Equity	EAST JAPAN RAIL
24	5401 JP Equity	NIPPON STEEL
25	8802 JP Equity	MITSUBISHI ESTAT
26	8766 JP Equity	TOKIO MARINE HD
27	8604 JP Equity	NOMURA HOLDINGS
28	9503 JP Equity	KANSAI ELEC PWR
29	3382 JP Equity	SEVEN & I HOLDIN
30	4063 JP Equity	SHIN-ETSU CHEM

## Appendix A : The Tickers and Names of All Companies

Hong Kong Stock Market		
No.	Ticker	Short Name
1	857 HK Equity	PETROCHINA CO-H
2	1398 HK Equity	IND & COMM BK-H
3	939 HK Equity	CHINA CONST BA-H
4	941 HK Equity	CHINA MOBILE
5	5 HK Equity	HSBC HLDGS PLC
6	3988 HK Equity	BANK OF CHINA-H
7	883 HK Equity	CNOOC LTD
8	2628 HK Equity	CHINA LIFE INS-H
9	386 HK Equity	CHINA PETROLEU-H
10	2318 HK Equity	PING AN INSURA-H
11	1088 HK Equity	CHINA SHENHUA-H
12	3328 HK Equity	BANK OF COMMUN-H
13	13 HK Equity	HUTCHISON WHAMPO
14	16 HK Equity	SUN HUNG KAI PRO
15	700 HK Equity	TENCENT HOLDINGS
16	2388 HK Equity	BOC HONG KONG HO
17	1299 HK Equity	AIA GROUP LTD
18	1 HK Equity	CHEUNG KONG
19	762 HK Equity	CHINA UNICOM HON
20	11 HK Equity	HANG SENG BK
21	388 HK Equity	HONG KONG EXCHNG
22	19 HK Equity	SWIRE PACIFIC-A
23	494 HK Equity	LI & FUNG LTD
24	66 HK Equity	MTR CORP
25	1898 HK Equity	CHINA COAL ENE-H
26	101 HK Equity	HANG LUNG PROPER
27	4 HK Equity	WHARF HLDG
28	2 HK Equity	CLP HLDGS LTD
29	2600 HK Equity	ALUMINUM CORP-H
30	3 HK Equity	HONG KG CHINA GS

## Appendix A : The Tickers and Names of All Companies

US Stock Market		
No.	Ticker	Short Name
1	XOM US Equity	EXXON MOBIL CORP
2	PTR US Equity	PETROCHINA -ADR
3	BHP US Equity	BHP BILLITON-ADR
4	BBL US Equity	BHP BILLITON-ADR
5	PBR US Equity	PETROBRAS SA-ADR
6	RDS/A US Equity	ROYAL DUTCH-ADR
7	RDS/B US Equity	ROYAL DUTCH-ADR
8	CHL US Equity	CHINA MOBILE-ADR
9	BRK/A US Equity	BERKSHIRE HATH-A
10	BRK/B US Equity	BERKSHIRE HATH-B
11	WMT US Equity	WAL-MART STORES
12	GE US Equity	GENERAL ELECTRIC
13	HBC US Equity	HSBC HOLDING-ADR
14	IBM US Equity	IBM
15	CVX US Equity	CHEVRON CORP
16	VALE US Equity	VALE SA-SP ADR
17	PG US Equity	PROCTER & GAMBLE
18	T US Equity	AT&T INC
19	JNJ US Equity	JOHNSON&JOHNSON
20	JPM US Equity	JPMORGAN CHASE
21	WFC US Equity	WELLS FARGO & CO
22	KO US Equity	COCA-COLA CO/THE
23	RIO US Equity	RIO TINTO-ADR
24	NVS US Equity	NOVARTIS AG-ADR
25	C US Equity	CITIGROUP INC
26	PFE US Equity	PFIZER INC
27	BP US Equity	BP PLC-ADR
28	TM US Equity	TOYOTA MOTOR-ADR
29	BAC US Equity	BANK OF AMERICA
30	TOT US Equity	TOTAL SA-SP ADR



## Appendix A : The Tickers and Names of All Companies

Canadian Stock Market		
No.	Ticker	Short Name
1	RY CN Equity	ROYAL BANK OF CA
2	TD CN Equity	TORONTO-DOM BANK
3	BNS CN Equity	BANK OF NOVA SCO
4	SU CN Equity	SUNCOR ENERGY
5	ABX CN Equity	BARRICK GOLD CRP
6	CNQ CN Equity	CAN NATURAL RES
7	POT CN Equity	POTASH CORP SAS
8	BMO CN Equity	BANK OF MONTREAL
9	G CN Equity	GOLDCORP INC
10	TCK/B CN Equity	TECK RESOURCES-B
11	IMO CN Equity	IMPERIAL OIL
12	RIM CN Equity	RESEARCH IN MOTI
13	CNR CN Equity	CAN NATL RAILWAY
14	TRI CN Equity	THOMSON REUTERS
15	CM CN Equity	CAN IMPL BK COMM
16	MFC CN Equity	MANULIFE FIN
17	BCE CN Equity	BCE INC
18	TRP CN Equity	TRANSCANADA CORP
19	GWO CN Equity	GREAT-WEST LIFEC
20	CVE CN Equity	CENOVUS ENERGY
21	HSE CN Equity	HUSKY ENERGY INC
22	PWF CN Equity	POWER FINANCIAL
23	ENB CN Equity	ENBRIDGE INC
24	ECA CN Equity	ENCANA CORP
25	K CN Equity	KINROSS GOLD
26	TLM CN Equity	TALISMAN ENERGY
27	RCI/B CN Equity	ROGERS COMMUNI-B
28	BAM/A CN Equity	BROOKFIELD ASS-A
29	SLF CN Equity	SUN LIFE FINANCI
30	CCO CN Equity	CAMECO CORP

## Appendix A : The Tickers and Names of All Companies

UK Stock Market		
No.	Ticker	Short Name
1	BLT LN Equity	BHP BILLITON PLC
2	RDSA LN Equity	ROYAL DUTCH SH-A
3	RDSB LN Equity	ROYAL DUTCH SH-B
4	HSBA LN Equity	HSBC HLDGS PLC
5	RIO LN Equity	RIO TINTO PLC
6	VOD LN Equity	VODAFONE GROUP
7	BP/ LN Equity	BP PLC
8	GSK LN Equity	GLAXOSMITHKLINE
9	ULVR LN Equity	UNILEVER PLC
10	BATS LN Equity	BRIT AMER TOBACC
11	LLOY LN Equity	LLOYDS BANKING
12	RBS LN Equity	ROYAL BK SCOTLAN
13	BG/ LN Equity	BG GROUP PLC
14	XTA LN Equity	XSTRATA PLC
15	AZN LN Equity	ASTRAZENECA PLC
16	STAN LN Equity	STANDARD CHARTER
17	AAL LN Equity	ANGLO AMER PLC
18	TSCO LN Equity	TESCO PLC
19	SAB LN Equity	SABMILLER PLC
20	BARC LN Equity	BARCLAYS PLC
21	DGE LN Equity	DIAGEO PLC
22	RB/ LN Equity	RECKITT BENCKISE
23	CCL LN Equity	CARNIVAL PLC
24	NG/ LN Equity	NATIONAL GRID PL
25	IMT LN Equity	IMPERIAL TOBACCO
26	CNA LN Equity	CENTRICA PLC
27	PRU LN Equity	PRUDENTIAL PLC
28	ANTO LN Equity	ANTOFAGASTA PLC
29	BT/A LN Equity	BT GROUP PLC
30	BSY LN Equity	BRITISH SKY BROA

## Appendix A : The Tickers and Names of All Companies

German Stock Market		
No.	Ticker	Short Name
1	SIE GR Equity	SIEMENS AG-REG
2	DAI GR Equity	DAIMLER AG
3	VOW3 GR Equity	VOLKSWAGEN-PREF
4	BAS GR Equity	BASF SE
5	BAYN GR Equity	BAYER AG-REG
6	EOAN GR Equity	E.ON AG
7	SAP GR Equity	SAP AG
8	DTE GR Equity	DEUTSCHE TELEKOM
9	ALV GR Equity	ALLIANZ SE-REG
10	BMW GR Equity	BAYER MOTOREN WK
11	DBK GR Equity	DEUTSCHE BANK-RG
12	RWE GR Equity	RWE AG
13	MUV2 GR Equity	MUENCHENER RUE-R
14	LIN GR Equity	LINDE AG
15	HEN3 GR Equity	HENKEL AG -PFD
16	MEO GR Equity	METRO AG
17	TKA GR Equity	THYSSENKRUPP AG
18	DPW GR Equity	DEUTSCHE POST-RG
19	FME GR Equity	FRESENIUS MEDICA
20	MRK GR Equity	MERCK KGAA
21	MAN GR Equity	MAN SE
22	CON GR Equity	CONTINENTAL AG
23	BEI GR Equity	BEIERSDORF AG
24	ADS GR Equity	ADIDAS AG
25	FRE GR Equity	FRESENIUS SE & C
26	SDF GR Equity	K+S AG-REG
27	DB1 GR Equity	DEUTSCHE BOERSE
28	HEI GR Equity	HEIDELBERGCEMENT
29	IFX GR Equity	INFINEON TECH
30	LHA GR Equity	DEUTSCHE LUFT-RG

## Appendix B : AR AAR CAR ACAR and t-values of Japanese Stock Market

10	11	12	13	14	15	16	17	18	19	20	21	22
-0.0526	-0.00012	-0.01229	0.009917	0.001246	-0.00203	0.027645	-0.00206	-0.01322	0.003297	0.001281	0.019604	-0.01489
-0.00603	-0.01332	0.00367	0.001542	0.001592	-0.00889	0.002859	-0.00477	0.018033	0.001749	-0.00457	0.013186	-0.00662
-0.01051	-0.01045	-0.00756	-0.00268	0.012662	0.005415	0.008456	0.003106	-0.02398	-0.00242	0.013654	0.024143	0.015538
-0.01332	0.037161	-0.00181	0.002167	-0.00471	-0.00664	0.006261	-0.00067	0.010365	0.000208	0.001403	0.012161	-0.00564
-0.00691	-0.00014	-0.00152	-0.0006	-0.01251	0.003929	0.005609	0.00114	7.9E-05	0.002391	0.005128	0.012008	-0.00108
0.00658	-0.00126	0.006816	0.001556	0.01234	0.00115	0.006492	0.012482	-0.01781	-0.01251	-0.00353	0.002329	0.006939
0.005934	0.005223	-0.00131	-0.00042	-0.00191	-0.00191	0.005526	-0.00049	0.006005	-0.00999	0.001197	0.013574	0.010327
0.031017	-0.00368	0.004405	0.004818	-0.00947	-0.00923	0.000703	-0.00466	0.0201	-0.0128	-0.00169	-0.00574	0.022849
-0.00028	-0.00477	0.005275	0.003915	0.011514	0.008853	-0.00877	0.012156	-0.00061	0.002243	-0.00374	-0.00365	-0.01485
0.005076	-0.00086	-0.01389	-0.00775	0.015097	-0.00146	0.006659	-0.0053	-0.00093	-0.00228	-0.01555	-0.00026	0.032838
0.020217	0.040069	-0.22512	-0.00967	0.020261	-0.00037	0.05488	-0.01525	0.037647	-0.00482	0.035214	0.101305	0.043389
0.079494	0.023639	-0.23287	-0.03853	0.055026	0.026028	0.07277	-0.03003	0.009318	0.04046	0.082551	0.069633	-0.02982
-0.01804	-0.01444	-0.2584	-0.00122	-0.05775	0.009296	-0.04143	0.019097	0.056172	-0.03487	-0.04729	-0.00948	0.021444
-0.02542	-0.02294	-0.135	0.003686	-0.00091	0.00597	-0.02821	0.020797	-0.0186	0.006327	0.028534	-0.00374	-0.00913
-0.0035	-0.01744	0.173693	0.016478	-0.01119	-0.02628	-0.01619	-0.00071	-0.03699	-0.0201	-0.00836	-0.01165	-0.03876
-0.01458	-0.04494	0.158841	0.011596	0.002638	-0.02123	0.005665	0.012121	-0.05348	-0.01459	-0.03562	-0.02796	-0.01925
0.006808	0.002845	-0.04503	0.000992	0.006593	0.009268	-0.01516	-0.00418	-0.00729	-0.02575	0.029086	0.037796	0.011997
-0.00768	0.004745	-0.1405	0.004896	0.006893	-0.00667	0.024949	-0.00619	-0.01243	-0.01427	0.043609	0.001462	0.010311
0.007091	0.032301	-0.0268	0.011843	-0.00705	0.029225	0.012785	0.016838	0.025354	0.002405	0.002296	0.011809	0.033094
0.000368	-0.02089	-0.20638	-3.5E-05	-0.00123	-0.01247	-0.00801	0.026499	-0.00839	0.02969	-0.00909	0.031047	-0.02065
-0.01067	0.020258	-0.14884	-0.019	-0.03944	0.016775	0.009647	0.022186	-0.01815	0.016801	0.000964	0.006151	-0.02133
0.024897	0.021061	0.117249	0.011699	0.021855	0.013579	0.025052	0.013706	0.024886	0.017193	0.027527	0.028518	0.022504
-0.00694	0.011008	-1.10462	-0.00651	-0.00029	0.018746	0.133134	0.072114	-0.0288	-0.04883	0.115471	0.29373	0.034669
-0.06085	0.114056	-2.05587	-0.12133	-0.00294	0.301258	1.159697	1.148148	-0.25255	-0.6197	0.915371	2.247609	0.33618

Time	t-value	AAR	SDt	AR	1	2	3	4	5	6	7	8	9
-10	-1.47096	-0.00353	0.013142549	0.001909	-0.00622	-0.00742	-0.00993	-0.00435	0.000332	-0.00687	-0.00829	-0.01636	
-9	1.200758	0.001996	0.009106268	-0.01032	0.011024	0.014249	0.003632	0.013035	-0.00395	0.012558	0.002737	0.009592	
-8	0.182096	0.000353	0.010612905	-0.00306	-0.00503	0.001673	-0.00265	0.008536	0.007292	0.004879	0.00387	0.010712	
-7	-0.65549	-0.00127	0.010642109	-0.01188	-0.00425	-0.00841	0.001172	0.010819	-0.01022	-0.0174	0.003511	-0.01161	
-6	-0.15205	-0.0002	0.007300676	5.68E-05	0.004909	-0.00787	-0.00993	-0.01289	0.014552	-0.00612	0.003051	0.003657	
-5	-0.2623	-0.00038	0.008008713	-0.00738	0.004709	0.007683	-0.01622	-0.00315	-0.00705	0.004603	0.006801	-0.00765	
-4	-0.99405	-0.00112	0.006167432	0.002209	-0.0106	-0.00402	-0.00088	-0.0086	0.004479	-0.00578	-0.00115	-0.009	
-3	1.23381	0.002533	0.011243446	-0.00557	0.020874	0.006211	-0.00659	0.006333	-0.00576	-0.00924	-0.00767	-0.01326	
-2	-0.0983	-0.00018	0.009928213	-0.00157	-0.01453	0.006957	0.007123	-0.00707	0.019367	-0.00248	-0.00355	0.020196	
-1	-0.06718	-0.00013	0.010342227	0.003739	-0.01382	0.001035	-0.00968	-0.00373	0.011017	0.00749	-0.00281	-0.00151	
0	0.385971	0.00427	0.060595097	0.015257	-0.01021	0.042561	0.01413	-0.0179	0.014767	0.050452	0.013741	-0.00092	
1	1.157952	0.014825	0.070123574	0.046252	-0.03435	0.057087	0.061159	-0.04875	0.08572	0.07305	0.042631	0.086151	
2	-1.36911	-0.0153	0.061193706	0.002738	0.097264	-0.05588	-0.03256	0.065147	-0.04809	-0.06926	0.025848	-0.02249	
3	-1.82972	-0.01014	0.03035919	-0.01414	-0.04765	-0.03363	-0.00319	-0.03858	-0.02224	-0.01198	-0.00631	-0.0005	
4	-0.50123	-0.00364	0.039829963	-0.05069	-0.0052	-0.00538	-0.01835	-0.01891	-0.00365	-0.02247	0.020194	-0.04168	
5	-0.51199	-0.00383	0.04100952	-0.02104	0.007417	0.014922	-0.02813	0.032859	-0.00839	-0.00338	-0.01447	-0.05903	
6	0.599871	0.002022	0.018465964	-0.004	0.005943	0.005821	-0.00962	-0.0134	0.032957	0.018744	0.024878	-0.01903	
7	-1.5964	-0.00893	0.030626306	-0.01901	-0.01022	-0.01134	-0.0178	-0.00953	-0.0225	0.00511	0.024889	-0.03528	
8	0.37329	0.001321	0.019380821	0.010909	0.020227	-0.01024	-0.01568	0.018812	-0.0172	-0.01931	0.015141	0.009578	
9	-0.59657	-0.00447	0.041046683	0.002851	-0.00265	0.012939	0.019467	-0.0054	0.005621	0.008617	0.000532	0.034298	
10	-1.29981	-0.00752	0.031677988	-0.00314	-0.0024	-0.02858	0.016953	-0.00786	0.020186	-0.0148	-0.00348	0.009579	
SD		0.221509	Sdi	0.017701	0.027255	0.023857	0.019966	0.023685	0.026032	0.027526	0.014347	0.029432	
ACAR		-0.03332	CAR	-0.06589	0.005243	-0.00164	-0.05758	-0.04457	0.067245	-0.0036	0.140095	-0.05455	
t-value		-0.82401	t-value	-0.81229	0.041976	-0.01496	-0.62933	-0.41061	0.563699	-0.0285	2.130904	-0.40449	

## Appendix B : AR AAR CAR ACAR and t-values of Japanese Stock Market

23	24	25	26	27	28	29	30
-0.0059	0.005165	-0.00412	-0.00613	0.004939	-0.00323	-0.00687	0.001658
0.017741	-0.00493	0.003049	-0.00481	-0.01049	0.001306	0.014017	-0.00698
-0.01343	0.006211	-0.0107	-0.00611	0.010526	-0.00792	-0.00416	-0.01542
0.011007	-0.00138	-0.0028	0.000129	-0.00834	-0.0029	-0.01287	-0.00972
0.000115	-0.00929	0.003	0.016715	-0.00432	-0.00374	0.003132	-0.00863
-0.00872	-0.00108	0.003928	-0.00845	-0.00214	0.003137	0.006514	-0.00863
-0.00903	-0.00641	0.000785	-0.00558	0.002677	-0.00089	-0.00922	-0.00432
0.000728	0.006445	0.019411	0.006037	0.007044	0.00485	0.003845	0.005674
-0.01955	0.005203	-0.01417	-0.01519	0.008629	0.003018	-0.0012	-0.00382
-0.0194	0.000301	0.011555	-0.00131	0.012109	-0.00369	-0.00347	-0.00305
-0.16178	0.022667	0.029259	-0.02481	0.041317	-0.0128	0.005846	0.008764
-0.03516	-0.01335	0.007883	0.112307	0.043857	-0.08798	-0.06093	-0.01851
0.028994	-0.02685	0.002897	-0.06054	-0.01318	0.048321	0.01459	-0.03892
0.007133	0.001568	0.016978	-0.02363	0.007103	0.030402	-0.0007	0.013731
0.028968	0.018377	0.006422	-0.02938	0.003633	-0.00439	-0.03094	0.045104
0.050665	0.027089	-0.06492	-0.00752	-0.02088	-0.01705	0.026216	0.011426
-0.00276	0.002096	-0.0298	0.014447	-0.0012	0.005914	0.015425	-0.00168
-0.03364	-0.01634	0.029275	-0.00013	-0.01654	-0.01342	-0.02031	-0.01011
-0.02051	-0.01027	-0.04921	-0.01231	-0.01602	-0.00769	0.002656	-0.01045
-0.00238	0.016217	-0.02338	0.00826	-0.00791	-0.01365	0.007725	0.004256
-0.0191	0.010284	0.002194	-0.01522	0.001219	-0.03886	0.00958	0.002575
0.040732	0.013179	0.023333	0.031297	0.016479	0.025395	0.018608	0.015857
-0.20599	0.031717	-0.06247	-0.06321	0.042047	-0.12127	-0.04113	-0.04707
-1.10358	0.525173	-0.58428	-0.44073	0.556809	-1.04205	-0.4823	-0.64771

## Appendix C : AR AAR CAR ACAR and t-values of Hong Kong Stock Market

Time	t-value	AAR	SDt	AR	1	2	3	4	5	6	7	8	9
-10	0.59258	0.00105	0.00975	0.00428	0.00443	0.00099	-0.0073	0.00076	0.00837	-0.0111	0.01421	-0.0031	
-9	1.69958	0.0064	0.02061	0.00374	0.01187	0.008	0.0227	-0.0562	0.00024	0.01659	9E-05	0.00965	
-8	0.10382	0.0002	0.01045	0.01762	0.00352	0.0086	-0.0008	-0.012	0.01058	0.00726	0.00328	-0.018	
-7	0.38997	0.00069	0.00962	0.00289	0.00614	0.00719	-0.0018	-0.0018	0.00441	-0.0157	0.0029	-0.004	
-6	1.78023	0.00367	0.01128	-0.0075	0.00385	-0.0018	0.00414	-0.0165	-0.0001	0.00095	0.01706	-0.0184	
-5	0.74041	0.00157	0.01158	0.0073	-0.0017	0.00229	0.00175	-0.0089	0.0021	0.02427	0.00246	-0.0041	
-4	0.9119	0.00155	0.00929	-0.0019	-0.009	-0.0029	0.0018	0.00603	-0.0098	-0.0042	0.00246	0.00799	
-3	0.67222	0.00103	0.00836	-0.0165	0.00978	0.01286	-0.0012	-0.0079	0.00565	-0.0064	0.00522	-0.0131	
-2	-0.0167	-2E-05	0.0076	0.0046	0.00067	0.0098	-0.0004	-0.0095	0.00631	-0.0037	0.00119	0.0113	
-1	-0.4461	-0.0007	0.00867	0.00179	-0.0085	-0.0001	0.00905	-7E-05	-0.0029	-0.0065	0.00083	3.7E-05	
0	0.7219	0.00126	0.00955	-0.0019	0.01001	0.00297	-0.0052	-0.0043	0.00097	0.01043	0.00035	0.01386	
1	0.55469	0.00129	0.01275	-0.0039	-0.0026	0.01451	-0.0046	-0.0025	0.00779	-0.0056	-0.0063	0.02059	
2	1.43315	0.00343	0.0131	0.00747	0.01323	0.00229	-0.016	-0.0122	-0.0007	0.00234	0.00139	-0.0018	
3	0.36275	0.00137	0.02063	0.01207	0.00198	0.01266	-0.0108	-0.005	0.00671	0.01737	0.01121	0.01819	
4	<b>-2.34892</b>	-0.0043	0.00991	-0.0152	-0.0115	0.00263	0.01018	0.00305	0.00955	-0.0008	-0.014	-0.0325	
5	0.36784	0.00069	0.01032	0.01252	-0.0005	-0.0089	0.00326	-0.005	-0.0098	0.01945	0.00671	-0.0112	
6	0.11697	0.00026	0.01206	0.01671	0.00186	-0.0024	-0.003	-0.0059	-7E-05	0.02354	0.00431	-0.0056	
7	-0.0802	-0.0003	0.02032	0.01707	0.00548	0.00781	-0.0096	-0.0077	0.00179	0.00466	-0.0171	0.00068	
8	-0.1541	-0.0003	0.0102	-0.0018	0.01336	0.00737	-0.0024	-0.0053	0.00361	0.01547	-0.0204	0.00404	
9	-0.9073	-0.0036	0.02202	-0.0022	0.00826	0.00805	-0.001	0.01345	0.016	0.00089	-0.0123	-0.0053	
10	0.4928	0.00117	0.01305	-0.0055	-0.0018	-0.0183	0.01138	-0.0019	0.00431	-0.0097	0.00742	-0.0158	
	<b>SD</b>	<b>0.08261</b>	<b>Sdi</b>	0.00961	0.00711	0.00775	0.00852	0.01316	0.00619	0.01191	0.00971	0.01325	
	<b>ACAR</b>	<b>0.016395</b>	<b>CAR</b>	0.0517	0.05902	0.07364	0.00023	-0.1393	0.065	0.07937	0.0111	-0.0465	
	<b>t-value</b>	<b>1.087006</b>	<b>t-value</b>	1.17358	1.81099	<b>2.07391</b>	0.00592	<b>-2.3114</b>	<b>2.29135</b>	1.45358	0.24931	-0.7657	

10	11	12	13	14	15	16	17	18	19	20	21	22
0.01715	-0.0087	-0.0018	-0.0031	-0.0009	0.00728	0.00895	0.01057	-0.0083	0.00033	-0.013	0.00699	0.00213
0.01557	0.00779	0.0111	0.0026	0.01682	0.01777	0.0265	-0.0038	0.03647	0.02517	0.02921	0.00621	0.02547
0.00385	-0.0036	0.01035	-0.0031	-0.0077	0.01076	0.01835	-0.0018	-0.0031	-0.015	-0.0091	0.00269	0.0053
0.00974	0.0133	0.01955	-0.0126	0.00584	0.00103	-0.0033	0.01366	-0.0049	-0.0199	-0.0066	-0.0041	0.01817
0.01174	-0.0004	0.01123	-0.0062	-0.0057	0.02226	-0.0042	-0.0043	0.00118	0.01253	0.00404	0.00571	0.00341
0.01254	0.03733	0.00094	-0.0048	-0.0076	-0.0176	0.00546	0.00826	-0.0069	-0.0107	-0.0015	-0.0038	-0.006
-0.0035	-0.0145	0.00034	-0.0094	0.00089	-0.0033	-0.0058	0.0303	-0.0038	0.00211	0.01556	0.00463	0.00685
0.01513	0.00067	0.01021	-0.0089	0.00398	-0.0009	0.00954	-0.0108	-0.0102	0.0065	-0.0008	-0.0085	0.014
-0.009	0.00351	-0.0002	0.01601	0.00287	-0.0183	-0.0112	0.00374	0.00837	-0.0085	0.00026	0.00019	-0.0087
-0.008	-0.0018	0.00226	0.00102	-0.0065	0.01189	0.02108	-0.018	0.00793	-0.0086	-0.0182	0.00859	0.00872
-0.0026	0.02176	-0.0023	-0.0105	-0.0167	0.02427	-0.0064	-0.0089	-0.0119	0.00066	-0.0031	-0.0063	0.00354
-0.0251	0.01672	0.01358	0.00808	-0.0049	-0.0059	0.02064	0.00298	0.01018	0.0082	0.00077	0.01495	0.00738
-0.0022	0.0093	0.01197	0.00327	0.0152	0.00785	-0.0068	0.01679	0.00482	-0.0181	0.00112	0.00379	0.00124
-0.0041	0.02533	0.01479	-0.0255	0.00252	-0.0854	0.00176	-0.0064	0.00123	-0.0146	0.01002	-0.0026	0.01121
-0.008	-0.0051	0.00317	-0.0031	0.00284	-0.0121	-0.0025	-0.0073	-0.0015	-0.0216	-0.002	0.00042	0.00149
0.00221	0.00888	-0.0125	0.00741	0.0008	-0.0273	-0.0096	0.00878	-0.0037	0.00157	-0.0043	0.00741	0.00366
0.01323	-0.0096	0.0098	-0.0068	-0.0156	-0.0218	0.01457	0.00023	-0.0102	0.02831	-0.0068	0.01246	0.01203
0.00786	-0.0094	0.00622	0.02527	-9E-05	-0.0116	-0.0143	0.01768	0.02245	-0.0161	0.00419	-0.005	0.00816
-0.003	-0.002	0.00289	0.00462	-0.0037	0.01897	0.00418	0.01473	-0.0101	0.01961	-0.0047	-0.0097	-0.0043
-0.0103	-0.0092	0.01294	-0.0242	0.0031	-0.0077	0.01079	-0.0014	0.00063	-0.0139	0.01272	0.00607	0.00345
-0.0029	0.00954	0.00349	-0.0013	0.00404	-0.0193	0.0257	-0.0026	0.00158	-0.0094	0.00964	-0.0047	0.00346
0.01089	0.01325	0.00746	0.01172	0.00826	0.02396	0.01262	0.01154	0.01164	0.01483	0.01049	0.00686	0.00783
0.03027	0.0897	0.12803	-0.0513	-0.0105	-0.1091	0.1035	0.06256	0.02046	-0.0514	0.01743	0.03539	0.12061
0.60671	1.4774	<b>3.74429</b>	-0.9559	-0.2788	-0.994	1.78919	1.18245	0.38365	-0.7568	0.36243	1.12649	<b>3.36357</b>

## Appendix C : AR AAR CAR ACAR and t-values of Hong Kong Stock Market

23	24	25	26	27	28	29	30
-0.015	-0.0033	-0.004	0.00518	0.02626	-0.0031	0.01221	-0.0156
-0.0372	0.01248	0.00491	0.00918	-0.0049	0.00012	-0.0449	0.01859
-0.0276	0.00049	0.00396	0.00284	-0.0146	-0.0018	0.00614	0.00857
-0.0098	-0.0071	0.01329	-0.0081	0.00645	-0.0001	-0.0042	-0.0001
0.03024	0.00646	0.00314	0.01302	0.02888	-0.0041	-0.004	0.00328
-0.0045	-0.0026	0.02607	-0.0021	0.01132	0.0016	-0.0094	-0.0044
0.00415	0.00521	0.00277	-0.0011	0.01407	0.00384	-0.0102	0.01682
-0.0007	0.00092	-0.0006	0.00591	0.00131	0.00583	0.00807	0.00161
-0.0111	-6E-05	0.0026	0.00363	-0.0065	0.00379	0.00553	0.00204
-0.0119	0.00092	0.00011	-0.0084	0.0098	-0.0023	0.00174	-0.0055
-0.0062	0.00269	0.01344	-0.003	0.00429	0.0129	3.2E-05	0.00503
-0.0018	0.00033	0.00911	-0.031	-0.0074	-0.021	0.01486	-0.0093
-0.0147	-0.018	0.01169	0.02941	-0.0045	-0.0057	0.03328	0.02718
0.0044	-0.0047	0.02904	0.02447	-0.004	-0.012	-0.0024	0.01353
0.01149	-0.004	-0.0037	-0.0059	0.01002	-0.0189	-0.0105	-0.0022
-0.0052	0.00038	0.01309	0.00591	0.01244	0.01762	-0.0131	-0.0003
0.00078	-0.01	-0.0077	-0.0144	0.00209	0.00573	-0.0168	-0.0012
-0.0076	0.0063	-0.0876	0.01359	0.02678	-0.0001	-0.0063	0.00763
-0.0072	-0.0006	-0.0207	0.00026	-0.017	-0.0028	0.00177	-0.0038
-0.1023	0.00429	-0.0396	0.00439	0.00406	-0.0002	0.00383	0.00733
-0.0355	0.00419	0.01427	0.02206	0.01903	0.0088	-0.0015	0.01631
0.02554	0.00647	0.02479	0.01356	0.01297	0.00911	0.01488	0.01024
-0.2472	-0.0057	-0.0165	0.06573	0.11782	-0.0118	-0.0358	0.08555
<b>-2.1123</b>	-0.1915	-0.1454	1.05816	1.98281	-0.2817	-0.5252	1.82305

## Appendix D : AR AAR CAR ACAR and t-values of the US Stock Market

Time	t-value	AAR	SDt	AR	1	2	3	4	5	6	7	8	9
-10	0.053099	0.000145	0.014959	-0.0056	0.006133	-0.00013	-0.00211	-0.02113	0.002294	0.001477	0.004026	0.022062	
-9	0.666886	0.001298	0.010663	-0.00175	0.012502	0.004474	0.011134	-0.00519	-0.0068	-0.00771	0.011807	-0.01113	
-8	0.593114	0.001172	0.010819	-0.00153	0.018143	0.010301	0.012979	0.039071	0.002374	-0.00665	0.002699	-0.00811	
-7	-0.96461	-0.0013	0.007361	-0.00448	-0.00269	-0.00016	-0.00083	-0.01268	-0.00028	-0.00293	0.000141	0.005512	
-6	-0.23031	-0.00035	0.008359	-0.00745	0.000292	0.005846	0.009961	0.016859	0.003242	0.009266	0.009827	-0.00838	
-5	0.388478	0.000544	0.007676	-0.00114	0.00577	-0.00151	0.001533	0.008211	-0.00024	0.000474	8.61E-05	0.003874	
-4	0.213714	0.00059	0.015123	-0.00899	0.01924	-0.00839	-0.01705	-0.03173	-0.01707	-0.01669	0.01531	0.00798	
-3	-1.17547	-0.00192	0.008961	-0.00441	-0.0098	-0.01924	-0.01706	-0.003	-0.00747	-0.00783	0.005396	-0.00229	
-2	-0.09937	-0.00022	0.011876	-0.02416	0.018798	-0.01566	-0.01032	-0.01432	-0.00619	-0.00554	-0.0007	0.009509	
-1	-1.35876	-0.00168	0.006779	0.002147	-0.00214	0.008588	0.006375	-0.00029	-0.00455	-0.00182	0.001792	-0.00365	
0	0.499059	0.001132	0.012429	0.004628	0.001955	0.0027	0.003786	0.013407	0.00819	0.009554	0.004441	-0.00651	
1	-0.81391	-0.00135	0.009095	-0.00665	0.000543	-0.00724	-0.00064	-0.00596	-0.00486	-0.00584	-0.00914	-0.01056	
2	-1.37586	-0.00297	0.01182	-0.01508	0.008781	0.00131	0.001125	0.000682	-0.00791	-0.00398	-0.02763	0.002744	
3	1.304545	0.002806	0.011782	0.008921	-0.00502	0.010265	0.016634	-0.00377	0.021105	0.023203	-0.0117	0.003166	
4	0.560532	0.000907	0.008864	-0.01109	-0.02296	0.007023	0.011672	-0.0127	0.007681	0.012293	0.002386	-0.00109	
5	-1.44113	-0.00369	0.014028	0.01006	0.014385	-0.00782	-0.01327	0.001376	-0.00069	0.004981	0.000833	0.007678	
6	1.065261	0.001191	0.006124	-0.00409	0.010319	-0.00462	-0.00556	0.00816	0.013623	0.015166	0.003912	5.19E-05	
7	0.410351	0.00072	0.00961	-0.00416	0.021197	0.012958	0.017795	0.009504	-0.00332	-0.00549	-0.001	-0.0048	
8	-0.69179	-0.00127	0.010037	-0.00651	0.000423	0.005835	-0.00137	-0.01254	0.00085	-0.0034	-0.0015	-0.00305	
9	0.473706	0.000615	0.007108	0.006958	-0.00285	-0.00677	-0.01197	0.009448	0.004501	0.007451	0.001311	-0.00063	
10	-0.73626	-0.00109	0.008127	-0.00274	-0.00293	0.003791	0.008022	-0.01742	-0.01419	-0.01258	0.001496	-0.00715	
	<b>SD</b>	<b>0.056024</b>	<b>Sdi</b>	0.0079	0.010988	0.008611	0.010652	0.015457	0.008794	0.009785	0.008803	0.007998	
	<b>ACAR</b>	<b>-0.00472</b>	<b>CAR</b>	-0.07712	0.090085	0.001539	0.020839	-0.03402	-0.00971	0.003388	0.013808	-0.00478	
	<b>t-value</b>	<b>-0.46132</b>	<b>t-value</b>	<b>-2.13012</b>	1.78911	0.039004	0.426905	-0.48029	-0.24086	0.07555	0.342291	-0.13054	

10	11	12	13	14	15	16	17	18	19	20	21	22
0.020846	0.002144	-0.00452	-0.0498	-0.008	0.011053	-0.01224	0.003345	0.005667	0.029612	-0.01094	-0.01563	-0.00794
-0.00879	0.011741	-0.01952	-0.01258	-0.00654	-0.00486	0.013962	-0.00279	0.00165	-0.00684	-0.00281	0.006848	0.022048
-0.00573	-0.00169	-0.00139	0.005278	-0.00213	0.002164	0.013471	-0.00482	0.003154	0.002428	-0.0132	-0.00686	-0.00754
0.004144	-0.00604	0.003838	-0.01399	0.011241	-0.00124	-0.00925	0.001469	-0.0103	0.001264	-0.00352	0.002381	0.012724
-0.00782	0.006439	-0.01419	-0.00769	-0.00898	-0.00413	0.002207	-0.007	-0.00126	0.003151	-0.00378	-0.00389	-0.00217
0.003524	0.005936	0.007473	0.008657	-0.00921	-0.00594	-0.01892	-0.00357	0.007689	-0.00707	0.005272	0.010431	0.00458
0.008242	0.00599	0.003201	0.006685	0.009348	0.002419	-0.00859	0.00555	0.016765	0.004665	0.016176	0.014254	0.004709
-0.0023	0.007154	-0.00022	-0.00017	0.020969	-0.01734	-0.00743	7.11E-05	0.015089	-0.0033	0.005342	0.012878	0.001292
0.00933	0.013513	-0.0063	0.012783	-0.01449	-0.02397	0.010422	-0.00543	0.01084	-0.00606	0.008413	0.014888	0.004194
-0.00246	-0.0027	0.004924	-0.00751	-0.00235	0.003981	-0.00059	0.000131	-0.00753	0.001121	-0.00463	0.000913	-0.00872
-0.00632	0.000393	-0.01706	0.004831	-0.00508	0.008964	0.021969	-0.00092	-0.00289	-0.00628	-0.00062	0.003614	-0.00994
-0.00773	0.003846	-0.00518	0.008227	-0.01047	0.006778	0.007596	-0.00933	-0.00276	-0.00635	0.002231	0.027459	-0.00849
0.001022	6.37E-05	-0.01563	-0.01856	-0.02987	-0.01152	0.010242	-0.01267	-0.00113	-0.00736	0.010626	0.00291	-0.01399
0.004521	-0.00804	-0.00491	-0.01459	-0.00268	0.018527	-0.01339	0.010767	0.004827	0.004983	-0.00831	-0.02383	0.00536
0.002357	0.00109	-0.00693	-0.01069	0.005968	0.000693	0.010401	0.002897	0.004579	0.007221	0.016535	0.005099	0.005187
0.002553	-0.00021	0.005035	-0.00675	0.000977	0.014256	-0.02022	0.010577	0.001122	0.001213	-0.02816	-0.0268	0.008111
0.000954	0.00524	-0.01035	-0.00091	0.001755	-0.00061	0.002578	-0.005	-0.00136	0.001564	0.000784	-0.00485	0.001291
-0.00558	-0.00654	-0.00252	-0.0025	0.006499	-0.00089	0.011324	0.000137	0.001567	-0.0005	-0.00139	-0.00514	0.011926
-0.00299	0.015876	0.003083	-6.5E-05	-0.00253	-0.00621	-0.02216	0.003741	0.010719	0.004607	-0.00887	-0.0091	0.004506
-0.00054	-0.00347	-0.00483	-0.00334	0.010811	0.010504	-0.00101	-0.00366	0.011898	0.000175	0.000422	0.011594	0.00864
-0.00738	0.000445	0.000962	0.007453	-0.00544	-0.00806	0.003179	-0.00261	0.021735	0.006559	0.005962	-0.00417	-0.00081
0.007178	0.006427	0.007785	0.013621	0.010813	0.010298	0.012628	0.005886	0.008075	0.008099	0.010246	0.013083	0.00889
-0.00013	0.05118	-0.08503	-0.09522	-0.04022	-0.00543	-0.00644	-0.01913	0.090085	0.024801	-0.01449	0.013011	0.034962
-0.00404	1.737776	<b>-2.38346</b>	-1.52555	-0.8116	-0.11514	-0.11126	-0.7091	<b>2.434598</b>	0.668279	-0.30852	0.217019	0.858229



## Appendix D : AR AAR CAR ACAR and t-values of the US Stock Market

23	24	25	26	27	28	29	30
0.010886	0.016416	-0.0125	0.012903	-0.00159	0.007226	-0.00576	0.00617
0.012876	0.025361	-0.00064	0.007579	-0.00175	0.006938	0.000521	-0.01078
-0.00103	0.007746	0.004704	-0.00052	-0.00111	-0.01936	-0.01152	0.003836
-0.00358	-0.01188	-0.00225	0.015646	-0.00878	-0.01034	0.005862	0.002109
0.000433	0.004378	-0.01899	-0.00047	0.013681	-0.00941	0.000692	0.008779
-0.01159	-0.00717	0.010594	0.00517	0.001312	-0.01523	0.009777	-0.00243
-0.02269	-0.01444	0.018849	-0.00332	-0.0159	0.001607	0.035605	-0.01403
-0.00487	-0.00314	0.00672	-1.7E-05	-0.00716	-0.0058	-0.00334	-0.00644
-0.00475	0.007606	0.009028	0.003834	-0.01267	-0.0039	0.015025	-0.00018
0.006896	0.001881	0.000237	-0.00036	-0.00578	-0.02974	-0.00141	-0.00322
0.024059	-0.00492	0.004973	0.022949	-0.00794	-0.04174	0.001512	0.002286
0.015508	0.000407	-0.00218	0.008311	-0.01512	0.00562	0.003072	-0.01165
0.002341	-0.00221	0.019482	-0.00543	0.010771	0.005279	0.015945	-0.00941
0.012941	0.01157	-0.00859	0.01379	0.0123	0.001153	-0.00795	0.012943
2.37E-05	-0.00339	0.004177	0.00861	0.001312	-0.01494	-0.00637	0.00016
-0.00595	0.004755	-0.03758	-0.02662	-0.00573	0.007266	-0.0288	0.002686
-0.00026	0.010807	0.004098	0.000762	0.001826	-0.00813	-0.00577	0.004335
0.01907	-0.00604	-0.00599	-0.00389	0.006978	-0.01534	-0.02044	-0.00183
0.004302	0.016112	-0.00198	0.011474	0.002805	-0.02162	-0.02523	0.006772
-0.00426	0.003133	0.007101	0.000737	-0.00098	-0.00903	-0.01206	-0.01083
0.006908	-0.00216	-0.00031	-0.00174	-0.01498	-0.00212	0.007971	-0.00048
0.010865	0.009863	0.012566	0.010104	0.008768	0.01298	0.014575	0.007327
0.057256	0.054818	-0.00105	0.069389	-0.0485	-0.17159	-0.03266	-0.02121
1.149943	1.212794	-0.0182	1.498602	-1.20716	<b>-2.88472</b>	-0.48904	-0.63163

## Appendix E : AR AAR CAR ACAR and t-values of Canadian Stock Market

Time	t-value	AAR	SDt	AR	1	2	3	4	5	6	7	8	9
-10	-1.27407	-0.00223	0.009598	-0.00331	-0.00182	-0.00518	0.003902	0.002161	0.001127	0.006308	0.001359	0.002087	
-9	-1.19064	-0.00274	0.01261	-0.00534	-0.01758	-0.01347	0.001524	0.026574	0.001251	-0.00891	-0.0045	0.038155	
-8	-0.53271	-0.0009	0.009286	0.0044	0.004535	-0.00291	0.000646	0.000858	0.013315	0.002838	-0.00372	0.003914	
-7	0.109352	0.000419	0.020988	0.04856	0.033258	0.003796	-0.02254	-0.0313	-0.0415	-0.00279	-0.0007	-0.01564	
-6	-0.66709	-0.00146	0.012013	-0.00832	-0.00349	-0.00036	0.012436	0.004125	0.027751	-0.01995	-0.00299	0.016188	
-5	-0.30483	-0.00073	0.013072	0.002993	-0.00153	0.017573	-9.5E-05	0.024819	-0.01305	-0.01862	-0.00534	0.014347	
-4	0.345674	0.001054	0.016702	0.016594	0.01452	-0.00967	-0.03408	-0.00158	-0.02473	-0.009	0.018091	-0.00646	
-3	-0.16275	-0.00026	0.008828	0.006247	0.000121	-0.00101	0.000114	0.002718	0.012906	-0.03602	-0.00105	-0.00287	
-2	0.283694	0.000582	0.011244	-0.01718	0.008037	-0.00186	-0.00345	0.016251	0.000187	-0.00776	-0.00988	0.000987	
-1	-0.22231	-0.00042	0.010445	0.003614	0.001131	-0.00475	0.008103	0.003856	-0.0003	-0.00249	-0.00573	4.42E-05	
0	-0.67655	-0.00314	0.025413	0.004499	0.003347	0.014544	-0.0002	0.014475	0.004359	-0.0142	0.007646	0.011637	
1	-0.10198	-0.00034	0.018176	-0.00715	-0.00074	0.003146	0.002513	-0.01175	0.029882	0.031876	-0.00652	-0.00504	
2	-0.49245	-0.00151	0.016848	-0.00991	-0.00742	-0.00956	0.004339	-0.00525	0.00111	0.01377	-0.00471	-0.0035	
3	-0.40884	-0.00152	0.02031	0.005341	-0.01218	-0.01148	0.013776	-0.0287	0.020961	-0.00933	0.003832	-0.0126	
4	-0.14733	-0.00041	0.015391	-0.01484	-0.00398	-0.00053	-0.02778	0.020656	-0.01464	-0.02476	-0.00486	0.01789	
5	0.354642	0.000914	0.014117	0.006243	-0.00039	-0.00137	0.004547	-0.01616	-0.00986	-0.00634	0.006067	-0.01096	
6	0.498039	0.001048	0.011528	-0.00229	0.006311	0.011112	0.001148	0.002733	-0.00427	-0.01403	-0.00352	0.001132	
7	-1.62432	-0.00451	0.0152	-0.00362	0.001977	-0.00334	-0.02729	0.029309	-0.01312	0.003456	0.003517	0.028942	
8	-1.06881	-0.00339	0.01739	-0.00648	0.002008	0.003336	-0.00327	-0.00435	-0.00549	-0.00138	-0.0059	-0.01783	
9	<b>2.079314</b>	0.004013	0.01057	-0.00115	-0.01162	-0.00325	0.005274	0.005217	-0.00125	0.026575	-0.00611	0.006043	
10	-1.87237	-0.00251	0.007354	-0.0017	0.001496	0.005637	-0.00176	0.005845	-0.00256	-0.00354	-0.0008	0.00261	
	<b>SD</b>	<b>0.075055</b>	Sdi	0.013463	0.01033	0.008035	0.013287	0.016236	0.01658	0.015777	0.006312	0.014114	
	<b>ACAR</b>	<b>-0.01806</b>	CAR	0.017212	0.016	-0.0096	-0.06214	0.06051	-0.01792	-0.09428	-0.02582	0.069078	
	<b>t-value</b>	<b>-1.31801</b>	t-value	0.278989	0.338006	-0.26085	-1.02055	0.813258	-0.23585	-1.3041	-0.89263	1.068053	

10	11	12	13	14	15	16	17	18	19	20	21	22
-0.01805	-0.00192	-0.01535	0.00434	-0.00516	-0.00331	-0.00524	0.008116	0.012014	0.001184	-0.00315	0.00552	0.010419
-0.00913	-0.00517	0.008361	-0.00913	-0.00707	-0.00534	0.00148	-0.0114	-0.0046	-0.01732	-0.00224	-0.00017	-0.00164
0.000739	0.013986	-0.01345	0.003808	-0.00261	0.0044	-0.01959	-0.00485	-0.00597	-0.01178	0.020282	-0.00277	-0.00598
0.013772	-0.01558	0.032531	0.009726	0.001394	0.04856	0.022968	0.000361	-0.00624	-0.0031	-0.01697	0.00047	-0.00065
0.001897	0.019129	-0.03563	-0.00159	0.00178	-0.00832	-0.0174	-0.00219	0.002045	0.000286	0.00141	0.001259	0.003308
0.001663	0.003807	-0.0127	0.007037	0.001319	0.002993	-0.00854	-0.00818	0.00166	-0.00642	0.003998	-0.01446	-0.00629
0.021741	-0.02305	0.004795	0.011283	0.007353	0.016594	0.008595	0.010796	0.010377	-0.00399	-0.03483	-0.02068	0.008219
-0.00913	0.000678	0.004086	-0.00144	0.005474	0.006247	-0.0044	0.00604	-0.00364	0.003023	0.004692	-0.00297	-0.00736
0.022736	-0.00847	-0.00813	0.009015	0.008818	-0.01718	0.00492	0.009976	0.002138	0.000322	-0.01934	0.005785	-0.00571
0.023865	-0.00963	0.003699	-0.00198	-0.0063	0.003614	-0.01474	-0.02051	0.018865	-0.00695	-0.01614	0.003704	-0.00504
-0.01271	-0.01007	-0.01175	-0.00432	0.023241	0.004499	-0.03158	-0.0047	-0.00559	-0.01187	0.000106	-0.00117	-0.00948
0.060547	-0.00515	-0.00617	-0.01421	-0.02317	-0.00715	-0.0381	-0.00313	-0.01182	-0.01026	0.00752	-0.01611	-0.00303
-0.00319	0.018641	-0.00987	-2.8E-05	-0.00682	-0.00991	0.008578	0.018255	-0.00287	0.006468	-0.00048	0.008203	0.010577
0.01792	0.007726	-0.00993	0.00187	-0.01237	0.005341	0.002034	0.009754	0.004792	-0.00509	0.022961	0.015304	0.004976
-0.00909	-0.03067	-0.00576	0.002503	-0.00269	-0.01484	0.021122	-0.00321	0.007056	-0.00498	-0.01089	0.0034	0.004835
-0.04245	-0.00978	-0.00373	0.000235	-0.00778	0.006243	0.004977	-0.00228	0.003323	0.011946	0.016872	-0.00527	-0.0043
-0.00805	-0.00536	0.002606	-0.01238	0.009326	-0.00229	-0.00713	0.003079	0.001042	0.007931	-0.00304	-0.01249	0.008995
-0.01298	-0.02057	-0.0124	0.001584	-0.00107	-0.00362	-0.01061	-0.01022	-0.00621	-0.00524	-0.01326	-0.00985	0.000391
0.043077	-0.01636	-0.07407	-0.00445	-0.00292	-0.00648	0.004247	0.00053	0.012696	0.007484	-0.00637	-0.01323	0.003332
-0.01054	0.014193	-0.01003	0.007435	0.010003	-0.00115	0.000983	-0.00462	-0.00275	0.00434	0.017287	0.008496	0.003935
0.007127	-0.01636	-0.01048	0.000409	-0.00254	-0.0017	-0.01077	0.00338	0.002897	0.007463	0.003788	-0.00286	0.005042
0.022627	0.013837	0.01971	0.006837	0.009572	0.013463	0.015127	0.008904	0.00764	0.007756	0.014303	0.009286	0.006238
0.079762	-0.09999	-0.18337	0.00971	-0.01178	0.017212	-0.08818	-0.00499	0.029219	-0.03654	-0.02779	-0.04991	0.014551
0.769231	-1.57686	-2.03012	0.309888	-0.26859	0.278989	-1.27206	-0.12234	0.834523	-1.02801	-0.42394	-1.17272	0.509029

## Appendix E : AR AAR CAR ACAR and t-values of Canadian Stock Market

23	24	25	26	27	28	29	30
0.00247	-0.00687	-0.02268	-0.00635	-0.00256	0.013391	-0.01344	-0.027
0.00549	-0.01629	0.010488	-0.00112	-0.00298	-0.02783	-0.00716	0.002837
-0.00035	0.007505	-0.01174	0.012986	3.35E-05	-0.00852	-0.01492	-0.0122
-0.003	-0.00473	-0.0029	-0.02533	0.002144	-0.01781	0.004927	0.000869
-0.00135	-0.0028	0.000896	0.004972	-0.01055	-0.01622	-0.01035	0.000131
-0.0028	-0.00013	0.040132	-0.01222	-0.00772	0.010331	-0.01812	-0.01828
-0.00017	-0.01928	-0.00074	-0.00085	0.016309	0.022766	0.008621	0.024082
-0.0072	0.008697	0.010979	-0.00284	0.005172	0.002969	0.00235	-0.01045
0.003915	-0.0184	0.02254	0.008655	0.001424	0.003362	-0.00794	0.013702
0.009374	-0.00709	0.02426	-0.00185	0.00086	0.004793	-0.01099	-0.00801
0.006099	0.042184	0.00504	0.005619	-0.00588	0.004015	-0.00382	-0.11813
-0.00117	0.013557	-0.00206	-0.00552	0.006345	-0.00676	-0.00355	0.023025
0.000599	0.020904	-0.00602	0.005825	-0.004	0.001666	-0.00331	-0.07753
-0.00942	0.018824	-0.0212	0.0147	0.00543	-0.00446	0.000905	-0.08516
-0.00103	0.013841	0.012477	0.009247	-0.00755	0.011853	0.004208	0.040569
0.010584	0.000316	0.012052	0.000502	0.008103	-0.00358	0.013283	0.046362
0.016193	-0.00873	0.041808	-0.01429	0.008425	-0.00101	-0.00929	0.01777
-0.01121	-0.00599	0.030138	-0.03682	0.008699	-0.00964	0.000843	-0.02703
-0.00245	-0.00794	0.012073	0.003585	0.004395	0.000272	-0.00454	-0.01533
0.014418	0.015917	-0.01275	0.024694	0.01347	0.006501	-0.01136	0.012178
-0.01152	-0.0152	-0.00818	0.000367	-0.00439	0.00286	-0.00898	-0.02101
0.007651	0.015497	0.018144	0.013567	0.007201	0.011513	0.008123	0.040537
0.017455	0.028291	0.134622	-0.01605	0.035187	-0.01105	-0.09263	-0.2386
0.4978	0.398377	1.619075	-0.25808	1.066311	-0.20935	-2.48854	-1.28441

## Appendix F : AR AAR CAR ACAR and t-values of UK Stock Market

Time	t-value	AAR	SDt	1	2	3	4	5	6	7	8	9
-10	0.984178	0.002406	0.013391	0.004078	-0.00048	-0.00155	-0.04702	0.014188	-0.00248	-1.1E-06	0.003369	-0.00453
-9	0.116904	0.000301	0.014108	0.01378	-0.00501	-0.00362	-0.02026	0.014259	0.007008	-0.00055	0.001132	0.005981
-8	1.022201	0.002258	0.012098	0.008531	-0.00621	-0.01438	0.001409	-0.00338	0.009556	-0.00872	-0.00688	0.001987
-7	0.228374	0.000334	0.008007	0.001186	0.009837	0.00446	-0.01133	0.001488	0.01543	-0.00254	-0.00347	0.00201
-6	-0.86034	-0.0013	0.008253	0.008532	0.005574	0.007729	-0.01444	-0.00258	-0.0095	0.006281	0.008153	0.002042
-5	-1.3417	-0.00191	0.007811	-0.00244	-0.00141	0.000196	0.008984	-0.01765	-0.00014	0.009025	0.004954	0.00547
-4	0.718848	0.001812	0.013808	-0.00948	-0.01043	-0.00954	0.017895	-0.01368	0.01642	-0.00875	0.006641	0.004638
-3	0.826705	0.002368	0.015691	-0.01341	-0.0111	-0.01169	-0.00125	-0.00167	-0.00549	-0.01235	0.010472	0.004375
-2	<b>2.298066</b>	0.003673	0.008755	-0.01005	-0.00311	-0.00293	0.006529	-0.01094	0.001846	-0.00267	0.015934	0.014122
-1	0.288546	0.000661	0.012554	0.01327	-0.00311	0.00091	-0.00223	0.014713	0.00243	-0.01519	0.010041	0.008188
0	0.028274	6.83E-05	0.013238	0.00356	0.002398	-6.2E-05	-0.00294	0.019853	-0.01606	-0.01105	0.001236	-0.00558
1	-0.20237	-0.00038	0.0102	0.005519	-4.9E-05	0.003751	0.007798	0.014566	-0.00935	-0.00429	-0.01056	-0.00898
2	0.977439	0.002189	0.012269	0.010615	0.001596	0.003201	-0.01878	0.014371	-0.01548	0.014453	-0.00443	0.006067
3	-0.79071	-0.00162	0.011193	0.00658	0.011351	0.014846	-0.0152	0.00535	0.011935	-0.0031	0.005109	-0.00172
4	0.802321	0.00197	0.013447	0.006494	0.003748	0.011241	-0.01184	-6.1E-05	-0.01271	0.004455	-0.01415	0.009054
5	-0.6255	-0.00126	0.011023	-0.01565	0.003764	0.005562	0.001773	-0.00727	0.025668	-0.00786	0.003462	0.006878
6	0.506551	0.000879	0.009499	-0.00494	0.005378	0.006514	-0.00938	-0.00231	-0.0066	0.000901	0.003734	-0.01189
7	-0.00176	-4.8E-06	0.014824	0.015379	0.00481	0.000243	-0.0001	0.020989	-0.0048	0.00722	-0.00213	0.012561
8	-1.0606	-0.00175	0.009025	-0.00556	0.004946	-0.00078	0.005667	0.002913	-0.00513	0.006269	-0.00344	0.014225
9	0.154053	0.000275	0.009767	-0.00734	0.007333	0.011089	-0.00369	-0.00081	0.000664	0.000852	0.011241	0.009506
10	0.22092	0.000277	0.006878	0.007567	-0.00992	-0.0101	0.00608	0.009235	0.005524	-0.01514	0.00672	0.004876
	<b>SD</b>	<b>0.066771</b>	<b>Sdi</b>	0.009307	0.006459	0.007741	0.013927	0.011075	0.011073	0.008205	0.007544	0.007081
	<b>ACAR</b>	<b>0.011259</b>	<b>CAR</b>	0.036245	0.009905	0.015091	-0.10233	0.07157	0.008737	-0.04275	0.047146	0.079282
	<b>t-value</b>	<b>0.923562</b>	<b>t-value</b>	0.849794	0.33464	0.42545	-1.60347	1.410139	0.172185	-1.13709	1.36369	<b>2.443448</b>

10	11	12	13	14	15	16	17	18	19	20	21	22
-0.00027	-0.01165	-0.01301	-0.00183	0.020571	0.013159	0.00294	0.011204	-0.00259	0.013456	0.017716	-0.00157	0.006613
0.01372	0.006057	-0.01097	-0.01947	0.011943	0.002112	0.004948	0.012861	-0.00312	0.010393	-0.01589	0.016266	0.004536
-0.00397	0.020267	-0.00196	0.000577	0.01135	-0.00702	0.048255	-0.00343	-0.00046	-0.0012	0.002639	-0.02109	0.013842
0.005334	-0.00849	-0.01105	-0.00358	0.003995	-0.0086	0.002898	-0.0031	0.001506	0.006101	-0.01659	-0.0025	-0.00185
-0.00456	-0.00856	-0.01432	-0.00253	-0.00128	0.011213	-0.0053	-0.00474	0.001924	-0.00315	-0.00806	0.001115	-0.0046
-0.00268	-0.01408	-0.00711	0.003323	0.000241	-1.8E-05	-0.00421	-0.00523	-0.0039	0.008924	-0.01817	0.003057	-0.00563
0.015757	0.00976	0.010146	-0.01954	-0.01313	-0.00303	0.000545	-0.01033	0.001088	0.009071	-0.00235	0.007329	-0.00151
-0.02138	0.004526	-0.00498	0.002558	0.002612	0.00474	-0.01936	0.003861	0.001931	0.00335	-0.00851	-0.00237	0.014233
0.00797	0.000632	-0.00935	-0.00504	0.00574	0.013234	0.000915	0.000176	-0.00034	-0.00153	-0.0033	0.006018	0.011142
-0.00525	0.014087	-0.00394	0.029601	0.00923	-0.00686	-0.00802	0.011953	-0.00424	0.007825	-0.01045	-0.00362	0.009355
-0.00282	8.04E-06	-0.01676	0.046178	0.018907	-0.00753	0.011249	0.007485	-0.00864	0.007851	-0.00983	-0.00183	-0.00135
-0.00136	0.008684	0.001017	0.012167	0.022917	-0.00773	-0.00219	0.011019	-0.0019	-0.00929	-7.4E-05	-0.01431	0.0125
0.005518	6.31E-06	-0.00159	0.006835	0.016677	-0.0057	-0.00984	0.011112	-0.00209	0.020465	-0.02269	-0.0027	0.00863
-0.00582	-0.01405	-0.01934	-0.00609	0.010744	0.00077	0.015914	-0.02307	0.009204	-0.01643	-0.01508	0.002479	-0.01361
-0.00363	0.004787	-0.00937	-0.02211	-0.00042	-0.00679	0.013108	0.007241	-0.00246	0.00616	-0.01302	0.000257	0.001388
-0.0071	0.008594	-0.0021	-0.03073	-0.00894	0.00071	0.009566	-0.01626	-0.00121	-0.00325	0.010863	-0.00374	0.003183
0.007883	0.011573	0.010544	0.018514	-0.00429	0.000993	-0.00564	0.007536	-0.01064	0.012805	-0.004	-0.00804	-0.00207
0.011278	-0.01819	-0.01886	-0.03109	0.028124	-0.00923	-0.00914	0.008358	0.001788	0.026389	-0.014	0.003982	0.004986
-0.00817	-0.00858	-0.00879	0.019928	-0.00566	-0.00524	0.002072	-0.00852	0.017917	0.005968	-0.00525	-0.00518	-0.01099
-7.8E-06	-0.00553	-0.00068	-0.0109	-0.00946	0.006213	-0.00204	0.001878	-0.00156	0.012794	-0.01055	0.010131	0.030911
-0.00073	0.009507	0.001619	-0.00102	0.000602	-0.00088	0.007206	-0.00907	0.000865	-0.00115	0.003382	-0.00486	0.011018
0.008518	0.010645	0.00832	0.019128	0.011415	0.007136	0.013488	0.010139	0.005805	0.009707	0.009884	0.008017	0.009983
-0.00028	0.009362	-0.13086	-0.01426	0.120475	-0.0155	0.053879	0.010943	-0.00692	0.115557	-0.14322	-0.02119	0.090738
-0.00727	0.191913	<b>-3.43214</b>	-0.16266	<b>2.303089</b>	-0.47398	0.871716	0.23552	-0.26021	<b>2.597804</b>	<b>-3.1619</b>	-0.57665	1.983482

## Appendix F : AR AAR CAR ACAR and t-values of UK Stock Market

23	24	25	26	27	28	29	30
-0.00058	0.001229	-0.00992	0.003081	0.023883	0.013393	0.021399	-0.00061
-0.04023	-0.00579	-0.00622	-0.01365	-0.01366	0.031271	0.002008	0.009189
0.00806	0.005966	0.008017	-0.00262	0.000159	0.004572	-0.00323	0.007087
0.004089	-0.00103	-0.00484	0.002185	-0.00376	-3.6E-05	0.008889	0.023375
-0.02196	0.001869	-0.01288	0.003293	0.012701	0.00185	0.005694	0.001599
-0.0026	0.003783	-0.01691	-7.2E-05	-0.01246	-0.00241	0.002183	0.009579
0.024107	-0.00122	0.003965	0.00255	0.018137	-0.02328	0.040271	-0.00769
0.023978	0.012552	0.040614	0.004787	0.053915	-0.00378	0.00127	-0.00138
0.027682	0.010277	0.014669	0.008782	-0.00515	0.007806	0.00767	0.003469
-0.02095	-0.01777	0.001711	-0.01603	-0.01736	0.026265	-0.00037	-0.00433
-0.00504	-0.01929	-0.00979	-0.01359	0.00345	0.016365	-0.00571	0.001383
-0.00104	-0.01476	-0.00967	-0.00088	-0.02004	0.015265	-0.00809	-0.00193
0.019651	0.009396	0.00877	-0.00425	-0.01594	0.025265	-0.01499	0.001539
-0.01394	0.006399	-0.00823	-0.00843	0.00713	0.011049	0.000493	-0.00373
-0.00912	0.0421	0.004036	0.02898	0.024381	0.008622	-0.0096	-0.00169
0.004928	-0.00462	-0.00863	-0.00989	0.006189	-0.01801	0.013996	0.002353
-0.02321	0.014786	-0.00393	-0.00328	0.017329	0.001738	0.006647	-0.00031
0.000845	-0.00407	0.005307	-0.02969	-0.01251	0.020267	-0.01232	-0.00655
-0.00845	-8.8E-05	-0.02075	0.007506	-0.01061	-0.00785	-0.00676	-0.00405
-0.00647	-0.002	-0.01073	-0.00615	-0.02123	-0.00232	0.001986	0.005098
-0.0092	0.003655	-0.00914	0.003012	0.005375	-0.00593	-0.00372	0.002947
0.017155	0.01295	0.013347	0.01161	0.018675	0.014112	0.012315	0.006828
-0.04945	0.041382	-0.04454	-0.04436	0.039933	0.120124	0.047711	0.03535
-0.62907	0.697344	-0.72814	-0.8338	0.466604	1.857533	0.845439	1.129745

## Appendix G : AR AAR CAR ACAR and t-values of German Stock Market

Time	t-value	AAR	SDt	1	2	3	4	5	6	7	8	9
-10	-1.36501	-0.00294	0.011814	0.022215	-0.02019	0.004342	0.007298	0.009784	-0.00538	-0.00444	-0.00223	-0.00158
-9	-0.39382	-0.00071	0.009812	-0.01261	0.00507	-0.0063	-0.00386	-5.1E-05	-0.01171	0.000742	-0.00401	-0.01061
-8	0.337992	0.000617	0.01	0.001214	-0.01925	0.004153	0.017123	0.006013	-0.00263	0.002574	0.006098	-0.00531
-7	<b>2.197666</b>	0.004401	0.010969	0.009583	-0.00349	-0.00218	0.011328	0.025251	-0.00168	0.006112	-0.00242	0.014601
-6	<b>-3.59745</b>	-0.00694	0.010572	-0.01066	-0.02553	-0.01086	-0.00546	-0.00841	-0.00829	-0.0102	-0.00453	0.001574
-5	1.961128	0.002423	0.006768	-0.00251	0.010414	-0.00379	0.014053	-0.00391	0.005452	-0.0009	-0.00399	0.001319
-4	<b>2.08175</b>	0.004514	0.011876	-0.00309	0.022804	0.023694	-0.01627	-0.00693	-0.00119	-0.00994	0.041111	-0.0033
-3	-0.13856	-0.00036	0.01429	0.001302	0.013426	0.006145	-0.00379	-0.00537	-0.01536	-0.01067	0.009173	-0.00179
-2	-1.23767	-0.00299	0.01322	-0.00899	-0.01779	-0.01533	-0.00311	-0.00977	0.006389	0.01386	0.006174	-0.01737
-1	0.923788	0.002455	0.014553	0.002268	0.001139	0.020267	0.009939	0.008552	0.012989	-0.01405	-0.00141	-0.01488
0	0.064403	0.000203	0.017259	-0.00073	0.003612	0.014946	0.007432	0.01312	-0.05168	-0.00479	-0.00601	-0.01365
1	<b>-3.25887</b>	-0.01064	0.01789	0.0159	-0.0083	0.007905	-0.01093	-0.01903	-0.02911	-0.01548	-0.02446	-0.00287
2	-1.00872	-0.00249	0.01351	-0.00989	-1.5E-05	0.003273	-0.01281	-0.01145	0.01253	-0.01333	-0.004	-0.01276
3	<b>2.49013</b>	0.00611	0.013439	0.017683	-0.00358	-0.00801	0.011529	0.009265	0.007823	-0.00653	0.003012	0.021606
4	-0.6298	-0.00153	0.013337	0.005602	0.015914	0.004559	0.00841	-0.00765	-0.01471	0.014621	-0.0099	-0.02024
5	0.666898	0.002623	0.021542	0.007724	0.002828	-0.00466	0.003532	0.015201	0.000259	-0.00548	0.096234	0.019976
6	-1.06254	-0.00203	0.010475	-0.0068	-0.00658	-0.00081	-0.00427	-0.00057	0.000611	-0.0045	0.019091	-0.00725
7	1.107605	0.00143	0.007071	-0.00031	0.018153	-0.00524	0.001537	-0.00574	0.004299	-0.00313	0.00291	0.001683
8	1.175825	0.002047	0.009536	-0.00686	0.013593	0.00051	0.009644	-0.00068	-0.00244	0.013048	-0.00366	-0.00615
9	-1.66439	-0.00223	0.007338	0.008718	-0.00542	-0.00806	0.009849	-0.00752	-0.00153	0.01506	-0.00839	-0.01201
10	0.979523	0.001782	0.009962	0.002066	-0.01202	-0.00397	0.002999	-0.00483	-0.00495	-0.0062	-0.00464	0.001166
	<b>SD</b>	<b>0.06676</b>	Sdi	0.009601	0.013549	0.009874	0.009325	0.010609	0.014572	0.009677	0.024387	0.011292
	<b>ACAR</b>	<b>-0.00427</b>	CAR	0.031817	-0.01522	0.020594	0.054175	0.009144	-0.10032	-0.04363	0.104162	-0.06784
	<b>t-value</b>	<b>-0.35</b>	t-value	0.723182	-0.24516	0.455111	1.26772	0.188074	-1.50232	-0.98391	0.932041	-1.31103

10	11	12	13	14	15	16	17	18	19	20	21	22
-0.01261	-0.01935	-0.0114	-0.00467	0.011447	-0.01387	-0.01314	0.012122	-0.0048	0.001958	0.005898	0.019008	0.010915
0.015878	-0.01286	-0.01542	-0.00027	0.013561	0.026293	-0.00678	-0.00197	-0.00991	0.002199	-0.01278	-0.00934	0.006181
-0.01063	0.004351	0.002999	-0.01796	0.003551	0.001776	0.004717	-0.00527	-0.00807	0.009599	-0.00232	-0.01138	0.013019
-0.00348	-0.001	0.002542	-0.00142	0.011015	0.027374	-0.0042	0.010316	0.000673	-0.00248	0.001216	-0.01198	-0.02509
-0.00129	-0.03002	-0.00404	0.00521	0.004012	0.014128	-0.0069	-0.00067	-0.01557	0.011604	0.005677	-0.02017	0.005207
0.000802	-0.00906	-0.0029	-0.0073	0.006033	0.000465	0.004074	-0.00275	0.007582	-0.0051	-0.00114	0.009328	0.010803
0.009705	0.003589	0.007503	0.003847	-0.00889	0.017306	0.006814	-0.0122	0.00189	-0.01007	0.005166	0.001306	0.016478
0.009817	-0.01829	-0.00507	-0.00034	0.01682	-0.01677	0.012764	-0.01511	0.010072	0.007127	-0.00679	0.004468	0.019009
-0.00268	-0.01341	0.009856	-0.01488	0.001248	0.002653	-0.00652	-0.00542	0.009423	-0.0094	4.07E-05	0.024237	-0.01023
0.008707	0.000871	0.012671	-0.03435	-0.00409	0.004346	0.005817	0.006402	0.009867	-0.00649	0.000149	0.003374	0.023497
0.017501	0.007249	-0.04923	-0.02704	0.009463	0.002981	0.00153	0.011858	0.008583	-0.00067	-0.00954	0.004854	0.002754
0.007939	-0.01197	-0.02241	-0.00667	-0.0179	-0.0014	-0.01254	-0.02704	-0.02112	-0.03575	-0.04604	-0.00198	0.029611
0.00233	-0.00975	-0.00311	0.013057	-0.00067	0.000739	0.008509	0.013362	-0.00941	-0.00136	-0.02213	-0.01421	-0.00908
0.001072	-0.01114	0.015621	0.041485	0.0095	-0.00864	0.003774	0.0175	-0.00171	-0.00788	0.012233	0.009608	0.01213
0.015738	-0.00932	-0.00941	-0.02596	0.018881	-0.00366	0.015193	-0.01162	-0.00336	-0.01719	-0.02466	0.006986	0.011441
-0.02413	-0.00364	0.002306	0.005767	-0.01375	-0.00757	-0.01086	0.008526	-0.00454	-0.00023	0.015359	0.009603	-0.03387
-0.00631	-0.00512	0.001942	-0.01428	0.004608	-0.00119	-0.03835	0.016665	-0.0048	0.014166	-0.00538	0.000196	0.003914
0.009658	-0.00654	-0.00066	0.004543	0.012439	0.003165	-0.00012	0.009404	0.002912	0.006044	-0.00697	-0.00301	0.012311
0.010952	-0.00593	-0.00073	-0.00046	-0.00951	0.00114	0.018244	-2.2E-05	-0.00653	0.005912	0.015709	-0.00416	-0.01596
-0.00629	-0.01291	0.00385	-0.01185	-0.00483	0.003474	-0.00704	-0.00102	0.001804	0.00181	0.008157	0.00063	-0.00222
0.003691	0.002241	0.005135	-0.00261	0.004829	0.002624	0.007093	0.003456	0.010379	-0.00598	-0.00969	-0.00686	0.044363
0.01054	0.008979	0.013956	0.016017	0.010055	0.011146	0.012433	0.011511	0.008866	0.010989	0.014495	0.010879	0.017931
0.046369	-0.16201	-0.05995	-0.10028	0.067765	0.055375	-0.01793	0.026543	-0.02663	-0.04218	-0.07783	0.010515	0.125184
0.960024	<b>-3.93745</b>	-0.93736	-1.36616	1.470627	1.084107	-0.31464	0.503184	-0.65537	-0.83772	-1.17167	0.210908	1.523509

## Appendix G : AR AAR CAR ACAR and t-values of German Stock Market

23	24	25	26	27	28	29	30
-0.00065	-0.00808	-0.00155	-0.00445	-0.02587	-0.01827	-0.00879	-0.01198
0.003072	0.012035	0.008237	0.008264	-0.00541	-0.00201	0.001389	0.001813
-0.00915	0.016127	-0.01063	0.021464	0.009889	0.007072	-0.00605	-0.00456
0.003	0.012437	0.012582	-0.00239	0.005812	0.00509	0.009005	0.025896
-0.01406	-0.01511	-0.00762	-0.00173	-0.00121	-0.01988	-0.01889	-0.01463
0.003756	0.006403	-0.00736	0.003244	0.003692	0.017536	0.011444	0.007008
0.005674	0.009795	-0.00289	-0.00187	0.005862	0.006193	-0.00169	0.011128
-0.00143	0.001996	0.012881	-0.00935	-0.01656	-0.01885	-0.02906	0.038741
0.000881	0.015943	0.003814	-0.03551	0.006066	-0.01438	-0.02248	0.017062
0.005054	-0.00682	-0.02476	-0.00393	-0.00054	-0.00843	0.044402	0.013065
-0.00322	0.009303	-0.00305	0.00939	-0.0042	0.018545	0.012228	0.024538
-0.02819	-9.5E-06	-0.04312	-0.00455	0.007848	0.022289	-0.0106	-0.00934
-0.00611	-0.00281	0.003174	0.023435	-0.00569	-0.03041	0.037623	-0.01368
-0.00739	-0.00143	0.011132	-0.00017	0.022354	0.033886	-0.01707	-0.00435
-0.00243	-0.0135	0.012885	0.001865	-0.00228	0.011268	-0.01994	0.00646
0.004026	0.002079	-0.01071	0.011834	-0.01509	-0.01638	0.010274	0.014057
0.000355	0.005694	0.005225	-0.01477	-0.00413	-0.01035	-0.00361	0.005634
0.00342	-0.00375	0.007631	0.007265	-0.00748	-0.00343	-0.01388	-0.00424
0.009062	0.005654	0.00473	0.011306	0.008246	0.013148	-0.02082	0.00858
-0.00608	-0.01043	0.002583	-0.00684	-0.01288	0.005428	-0.00449	0.001546
0.009377	0.008414	0.000389	-0.00152	-0.00076	0.005752	-0.00506	0.008558
0.008564	0.009337	0.013454	0.012608	0.010707	0.016509	0.018729	0.013822
-0.03103	0.04395	-0.02643	0.010977	-0.03235	0.003816	-0.05606	0.121302
-0.79053	1.027137	-0.4286	0.189999	-0.65923	0.050444	-0.65314	1.915135