LUND UNIVERSITY
School of Economics and Management

Master Thesis
Autumn 2009

FOREIGN EXCHANGE RATE EXPOSURE OF AUTOMOTIVE MAKERS: CASE STUDY

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Abstract

Title: Foreign Exchange Rate Exposure of Automotive Makers: Case Study

Seminar Data: 2010-01-15

Course: FEKP01, Master Thesis in Finance, 10 Swedish Credit (15 ECTS)

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Key words: Stock price, exchange rate, Stock market index, Spillover model, GARCH Model

Purpose: The aim of our paper is to find out the relationship between exchange rate and corporate value. We are going to study the impact of volatility of exchange rate on automakers' value.

Theoretical perspective: The theoretical framework mainly involves prior research in the area of exchange rate exposure and corporate value. Further, the relationship between corporate performance and market performance is studied.

Methodology: Colleting data for four largest automakers in the world as well as exchange rate and stock market index to run regression to study their relation ship. Unconditional Spillover model is used.

Results: Five out of nine exchange rates we selected are significant for corporate stock price but weakly impact on corporate stock price.

Conclusion: The impact of foreign exchange rate on corporate stock price is weak or insignificant.

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1. INTRODUCTION

In the first chapter of this paper, we introduce the whole picture of this subject to readers. Background, problem specification, purpose and research delimitation are presented. This chapter is ended by a disposition of the thesis.

1.1 BACKGROUND

After the collapse of Bretton Woods System[1] in 1970's, many countries have implemented floating exchange rates. Simultaneously, uncertainties of the exchange rates have become one of the major risks for enterprises, especially for those multinational corporations. Exchange rate risk has been firstly paid attention by financial industry, because many financial institutes, which are involved in trading and loaning of foreign currencies, have been affected by the floating of exchange rate. With the expansion of global business, researchers realized that non-financial firms would be affected by the uncertainty of foreign exchange rate as well. People found out that the value of firm, which was involved in foreign currencies and based on activities such as selling or producing abroad, is influenced by the foreign exchange rate. In the real world, the impacts of floating exchange rate have been clearly illustrated. In the late of 1990s, Asian Financial Crisis[2] started from the collapse of Thai baht which was caused by freely floating of Thai baht against US dollar. Those mostly affected countries had suffered from the worst slumping of GNPs and the highest depreciation of domestic currencies. The issue of exchange rate has become the focus of economists and researchers. As long as globalization has been intensified, the influence of exchange rate among various economies has been gradually

[1] The system was built by most of the world's leading nations at Bretton Woods, New Hampshire, in 1944. It agreed that US dollar can be convertible into gold at $35 per ounce and other currencies should fixed exchange rates against US dollar.

[2] Asian Financial Crisis was a regional financial crisis beginning in July 1997 and gripped much countries of Asia. Indonesia, South Korea and Thailand were the countries most affected.

strengthened. Thus, some economists reached a conclusion that all companies, no matter local or international, are directly or indirectly affected by uncertainty of macroeconomic variables, of which the exchange rate is a very important one. (Oxelheim 1999)

Recently, the exchange rate exposure has once again become the focus of studies. Since 2007, a financial crisis has become the most serious financial crisis since Great Depression has expended globally (Roubini, Rogoff and Behravesh, 2009). This crisis was caused by the bursting of housing bubble in United States. Among 1997-2006, according to the S&P/Case-Shiller national home-price index, the price of houses in the US rose by 124%[3]. The housing bubble caused a significant increasing of the sub-prim lending. Correspondingly, U.S. householders became indebted, and financial institutes became overleveraged. High default rates of Sub-prime which was caused by the bursting of housing bubble raised a chain reaction of financial institutes. A number of banks which had influence in the global financial market went bankrupt or got badly hit. As one of the results, the world's currency markets became chaotic. The exchange rates of world's main currencies, such as US Dollar, Euro and British Pound, changed significantly.

During the period of financial crisis, a large number of countries have been hit seriously. The financial crisis began from the United States and extended globally rapidly. The GDP of the UK, Japan and other areas of Europe have serious declined as well. The recession of the world's economy was from industries' slump, and automotive industry is one of them. The crisis of automotive industry began from the second half of 2008, which was a part of the global financial crisis. Similar to the financial crisis, the crisis of automotive industry also started from the USA and spread globally.

The biggest automaker has been hit the worst. General Motors which had led in sales for 77 consecutive years until the year of 2007 in the world suffered from significant

[3] "CSI: credit crunch". 2008.. Retrieved 2008-05-19

decline in sales and it had to face a hedge problem. Compared to the year of 2007, GM's total sales went down 11 percent in 2008. Especially during the third and the fourth quarters, the sales went down 11.4% and 26% respectively, compared with the same quarter a year ago[4]. On July 10, 2009, General Motors Corporation was reorganized to be General Motors Company with brands, workforces and plants spanned-off. The other two of "big three"[5] automakers in the United States were also suffered from the crisis, and they were force to seek fund aiming to get out of the dilemma. As the second largest automaker in the U.S. and the fourth largest in the world, Ford Motor also had to face a difficult situation. From 2005 to 2008, its revenue went down 17.4% and profit was even down 78.09%[6]. In order to tide over the difficulties, Ford is spinning-off brands to obtain a better finance situation. (See Table 1)

After the reorganization of General Motors, Toyota which is based in Japan has placed the first in sales among automotive manufactures in the world. However, it has not escaped from the impact of the crisis. On December 22, 2008, Toyota announced their expected loss for the first time in the latest 70 years in its core vehicle-making business. A $1.7 billion loss, which is related to group operating revenue, has been its first time since 1938.

The situation in Europe is not so bad as the United States and Japan. Although Saab (Sweden), Volvo Cars (Sweden) and Opel (Germany) have been spinning-off from General Motors and Ford, they were not influenced significantly. Let us take Volkswagen which is the largest automaker in Europe and the third largest in the world as an example. From Year 2005 to 2008, when other leader auto manufactures were suffering from significant decline, the annual sales of Volkswagen had increased 10.08%, 3.8% and 4.5% and the corresponding profit increased 74.46%, 3.8% and

[4] Data comes from the official website of GM.
[5] General Motors, Ford and Chrysler are called "big three" automakers in the United States.
[6] Data comes from "DataStream".

4.5%, respectively[7].(see Table 2)

Year	Annual Sales ('000) (in USDs)	Increasing in Annual sales (%)	Corresponding Profits (%)
2005	177,089	-	-
2006	160,123	-9.58	-32.83
2007	172,455	7.70	-616.80
2008	146,277	-17.4	-78.09

Table 1: Sales of Ford in the period 2005-2008

Year	Annual Sales (‘000) (in EURs)	Increasing in Annual Sales (%)	Corresponding Profits (%)
2005	95,268	-	-
2006	104,875	10.8	74.46
2007	108,897	3.8	3.8
2008	113,808	4.5	4.5

Table 2 Annual sales of Volkswagen from 2005 to 2008

1.2 DISCUSSION OF PROBLEM

The process of assessing the affect of foreign exchange rate on corporate value is rarely easy. Previous researches showed that the affect of return of foreign exchange rate as the only one factor on corporate value is insignificant (Bartram 2007; Domingnez and Tesar 2001). In addition, accepted by efficient-market hypothesis (EMH), it is impossible to consistently outperform the market by using any information that the market already knows.

In fact, as growing of global business, the links between different countries are more closely. Different currencies’ cash flows flow in and out of the companies. Changes of foreign exchange rate definitely will impact on corporate value, particularly international companies. Oxelheim and Wihlborg (1995) studied the affect of foreign

[7] Data comes from “DataStream”.

exchange rate on corporate value with other macroeconomic factors. And, they concluded that foreign exchange rate is affecting corporate value.

The problem we want to solve in this paper is how to measure the exposure of foreign exchange rate on corporate value. Since study the return of exchange rate as the only factor affecting on corporate is insignificant, why do not we try the volatility? In addition, reference to the research of Oxelheim and Wihlborg, exchange rates of different corporate operational aspects could also be significant variables for corporate value.

1.3 PURPOSE

Through the financial crisis, we notice that the exchange rate changes dramatically, and it does have impact in people's daily life. Thus, we think it might as well have some kind of influence on corporate value. Thus, we are very interested in studying whether the exchange rate could influence corporate value and how much it can be. The purpose of this thesis is to empirically test the relationship between exchange rate and corporate value, mainly the exchange rate exposure on automakers' value.

1.4 DELIMITATIONS

In this paper we do not try to investigate hedging and derivative activity on risk management of foreign exchange rate. Furthermore, corporate operating strategy, product structure and market operation are not studied in this paper.

In addition, the impact of exchange rate on corporate value under financial crisis is not studied in this paper. Because during financial crisis period, both exchange rate and corporate performance are unstable. There are too many factors that would influence these two variables above, and those are too complex for us to study. The most important reason for not considering financial crisis is that, during the period of crisis, changes of corporate value and exchange rate could not be represented as the

typical relationship between them.

1.5 OUTLINE OF THE THESIS

The outline of this paper is as follow.

In Chapter 1, we introduce the whole picture of this subject to readers. Background, problem specification, purpose and research delimitation are presented. This chapter is ended by a disposition of the thesis.

In Chapter 2, we firstly present previous literatures on the subject including models and results. Furthermore, this chapter includes specific introduction of three different kinds of exchange rate exposures.

In Chapter 3, we present the way how the data are collected and the methodology used in our research. Some sample information and different empirical models related to this research are presented as well. Further, we describe data processing and reliability and validity of this study.

In Chapter 4, we present obtained result of regression to readers. Starting with description of variables and data, requirements of assumption are also presented. Specification of Empirical result and regression tests is the main content of this chapter.

In Chapter 5, we analyze different variables' effect on corporate stock price. The variables are divided to two groups as exchange rate and market index to analyze. The hypotheses are also discussed in this chapter.

In Chapter 6, a short conclusion is presented with possible improvements for the research in this field.

2. THEORY

In the chapter of theory, we firstly present previous literatures on the subject including models and results. Furthermore, this chapter includes specific introduction of three different kinds of exchange rate exposures.

In this paper, we select the stock prices of Toyota, General Motors, Volkswagen and Ford as dependent variables and make regression for each one with the corresponding foreign exchange rates and stock market index as independent variables. We raised four hypotheses which are described in chapter 3 in this paper to test the influence of market index and exchange rates of main market, the areas where main competitors and main suppliers are based in and the area of main production on corporate value.

For study the value of corporation, cash flow is the best indicator (Koller, Goedhart and Wessels, 1990). Based on the corporate finance theory, the corporate value is calculated by the future cash flow. Therefore, the study of the relationship between corporate cash flow and foreign exchange rate will well indicate the exchange rate exposure on corporate value. However, the data of cash flow is not readily available. In some extent, operation cash flow is confidential and the data are rarely published in the annual report. Since the yearly data is not frequent enough, we use stock price as the proxy of corporate value in this paper. Accurately, stock price is the measure of equity value which is a part of corporate value. As many articles did, we use stock price to indicate corporate value in this paper.

2.1. LITERATURE REVIEW

A large number of articles are written for the analysis of exchange rate exposure on non-financial corporate value. There are two main types of approach. One is making

regression to study the relationship between basis stock prices and foreign exchange rate. Adler and Dumas (1984) were the first fining exchange rate exposure as the impact of unanticipated changes in exchange rates on stock prices, and raised the theory that exchange risk can be quantified by the regression coefficients which regressed from stock price returns against foreign exchange rate changes. The other is measuring currencies' exposure on individual corporate cash flow. Most empirical literatures focus on equity prices primarily, since cash flow data is not readily available. Instead, stock prices are used as a proxy for cash flows (Bartram 2006).

The research of stock prices is usually to analysis the response of a big group of companies in different economies and industries to shocks of foreign exchange rate. The cross economies and industries studies of a big group of samples generally choose trade weighted index[8] as the indicator of exchange rate. Jorion (1990) was the first using a regression of stock returns of 287 US multinational firms on changes in foreign exchange rate index to get a result where only few firms have significant exchange rate exposure. Ki-ho Kim (2002) analyzed monthly data of the S&P's 500 composite stock price index for the 1970-1998 and found that the index is related to the industrial production positively, whereas it is negatively to the real exchange rate. Griffin and Stulz (2001) studied weekly stock return data on 320 industry pairs in six countries from 1975 to 1997. They found that common shocks to industries across countries are more important than competitive shocks. Correspondingly, Blenman, Lee and Walker (2006) used three models of foreign exchange rate exposure to investigate the significance of exposure for US multinationals during the period of 1985-1997. They found that exchange exposure is related to firm size negatively, whereas it is positively related to the degree of foreign operation.

Some literatures study on the relationship between the changes of stock price returns and the foreign exchange rate changes of particular economy or industry. In these articles, authors usually choose one or several specific foreign exchange rates which

[8] Trade weighted index is a weighted average of exchange rates of home and foreign currencies, with the weight for each foreign country equal to its share in trade.

are closely related to the studied economy and industry. Yaqiong Pan (2009) chose iron and steel industry's panel data of the period 2005-2008 of the companies listed on the Shanghai and Shenzhen Stock Exchange. He built the augmented Jorion Model to analyze the sensitivity of stock price returns to exchange rate changes and found that Chinese iron and steel industry has significant exposure to USD and JPY and insignificant exposure to EUR and HKD. Hieh, Lin and Wang (2008) studied the effect of exchange rate of NT dollar against US dollar on the corporate values of food, glass, electricity, paper, rubber and steel industries. They found that if the discount rate is large enough, the exchange rate uncertainty is positively related to the corporate value. Bahmani-Oskooee and Hegerty (2007) analyzed disaggregated export and import data for 117 Japanese industries of the period 1973-2006. They found that the trade shares of most industries are relatively unaffected by uncertainty of Yen-Dollar exchange rate in the long run while some industries are influenced by exchange-rate volatility in the short run, but this effect is often ambiguous. Bahamani-Oskooee and Wang (2009) disaggregated the annual trade data between Australia and the USA for 108 commodities over the period of 1962-2005, and got the result that in the long run both the export and import industries are sensitive to the real exchange rate of Australia Dollar-US Dollar.

In contrast, the studies of foreign exchange rate exposure on corporate cash flow always focus on individual companies. In this way, researchers can consider more factors such as sales, production and competition than simply study exchange rate of home currency against one foreign currency. Choi (1986) introduced a model to study the effect of exchange rate uncertainty on corporate value, which considers the input and output elasticity of foreign exchange rate. From management's point of view, considering the factors of sales, production and competition, Oxelheim and Wihlborg (1995) used quarterly data to measure Volvo car's cash flow exposure to exchange rates and other macroeconomic variables.

2.2. Change of foreign exchange rate

Foreign exchange rates started to float freely since 1971 after the collapse of Bretton Woods System. When Bretton Woods system held, members of the system were required to establish a parity of their national currencies in terms of gold and to maintain exchange rates within plus or minus 1% of the parity by intervening in their foreign exchange markets. In the other word, the change of exchange rates among the members' currencies was limited in 1% under Bretton Woods System. From 60's to 70's, there were several breakouts of U.S. Dollar crisis. In Dec 1971, "Smithsonian Agreement" was signed for the marked depreciation of dollar against gold, while the U.S. Federal Reserve Bank refused to sell gold to foreign central banks, bringing the U.S. dollar and gold linked system in name only. In Feb 1973, associated with further depreciation of U.S. Dollar, the world's major currencies were forced to implement a floating exchange rate system due to the impact of speculators. In addition, "Jamaica Agreement" was signed in 1976, which provides the legalization of the floating exchange rate and non-monetary of gold, bringing the total collapse of the Bretton Woods system. From that time on, the world has entered a period of floating exchange rates.

However, the research of exchange rate changes is worthless if the global market is perfect[9]. In the perfect market, there are no custom duty cost and transaction cost. When the exchange rate causes a different price of a product between two regions or two countries, goods and money can move freely between regions and countries and finally get equilibrium. We pick the changes of exchange rate between China and the USA as an example and set S_C as exchange rate of Chinese Yuan and S_A as exchange rate of US dollar. We chose a product which exists in both China and the USA, and its price is P_C and P_A in China and the USA respectively. At the equilibrium condition, the ratio of exchange rates S_C/S_A is equal to 5 and the ration of prices P_C/P_A is equal to 0.2. In case Chinese Yuan depreciates and S_C/S_A become to 10, the real price of this

[9] In this paper, the perfect market means that there is no transfer cost of goods and money between countries, such as customs duty, transportation cost and agency cost.

product will be doubled in the USA compared with China. Without any transfer cost, the product will be rushed into the USA form China. The increased supply of the product in the USA will decrease the price and the increased demand of the product in China will increase the price until the real prices between China and the USA become equal again.

In the other case, the price index I_A of the USA increased, which means that the consumption in the USA is higher than it in China. The fund will be rushed into China from the USA to consume and invest. As the result, the demand of Chinese Yuan will increase and lead S_C increases until the real price index I_C of China become as high as I_A. We can find that under the perfect market, the condition will keep in equilibrium of $\frac{S_A}{S_B}=\frac{P_B}{P_A}=\frac{I_A}{I_C}$ in the long term. While the real world is imperfect and we will discuss the impact of exchange rate in the real world below.

At the macro level, changes of exchange rate do not work so much on firms' value if the market is perfect. While, at micro level, the changes of exchange rate will not affect firms' value if it could totally "Pass through" to customers. These cases are particularly in monopoly market or the market of low price elastic products. In these markets, increase of price will not impact the dem and of products. Firms which suffer from increased price of input due to changes of exchange rate could increase the products price to compensate the higher cost and do not need to be worried about demand decreasing. In perfect competition market, increased input price can not totally "pass through" to customers because the demand of products decreases as price increases. Meanwhile, decreased demand of products causes decrease of input and decreased demand of input causes price input decreasing. This process leads to a new equilibrium point where firms could maintain the net cash flow level with proper cost of input and proper price of products.

2.3. MOTIVATIONS OF STUDY ON FOREIGN EXCHANGE RATE EXPOSURE

In the real world, the market is not perfect. The volatility of exchange rates could not get an equilibrium point from free transaction of funds and products (Oxelheim, 1999). The imperfect of the market, such as customs duty, transportation cost and agency cost, leads to value[10] gaps among countries. And, the value gaps always impact international trade. Two opposing views were proposed by economists. De Grauwe (1988) believes that since the beginning of floating exchange rates the international trade has declined by more than a half. Hooper and Kohlhagen (1978) found a negative relationship between the volatility of exchange rate and international trade volume. While, other economists argued that the volatility of exchange rate could stimulate the growth of international trade. (Gotur, 1985)

It is believed that foreign exchange rates are strongly linked to the profitability and financial decision of firms (Oxelheim, 1999). One of the central motivations for the creation of the euro was to eliminate exchange rate risk to enable European firms to operate free from the uncertainties of changes in relative prices resulting from exchange rate movements (Domingnez and Tesar, 2004). The volatility of foreign exchange rates could impact corporate cash flows. Particularly for the firms with foreign-currency based activities, such as exporters and importers (Bartram, 2007). Importing firms can benefit from the appreciation of local currency since they could afford more products from foreign market. Vice versa, local products subsequently become more affordable to foreign consumers since depreciation of local currency and thus exporting firms can benefit from it.

Recently, there is a new theory that any firms no matter domestic or international can be affected by changes of exchange rate (Oxelheim, 1999). For example, there is an automaker which only produces and sells cars in the USA. Although it does not have

[10] The “value” here refers to the value of products, contracts, bonds, futures and so on.

any overseas business, it is still affected by exchange rate changes of US dollar. We assume that this automaker is called Localcars. Localcars's cash flow can not be affected by changes of exchange rate directly because of Localized procurement and sales. However, there are several situations in that exchange rate changes of US dollar will also impact Localcars's cash flow indirectly. First, the supplier of Localcars may be a foreign-related company which is affected by the change of US dollar's exchange rate and thus localcars's cost would be affected because of the change of inputs' price. Second, the competitor of Localcars may be a foreign-related company such as Toyota. Products' price of Toyota decreases in the USA when US dollar appreciates and thus products' competitiveness and demand of Localars would be decreased. Third, price of gasoline in the USA will definitely be affected by changes of US dollar's exchange rate, and cost of driving (cost of gasoline) is an important factor of vehicle demand. Depreciation of US dollar leads appreciation of gasoline price and thus the demand of Localcars's products would be decreased. Sometimes, these three situations exist and to play a role together. In the first situation Localcars's inflow of cash is affected and in the second and third situation its outflow of cash is affected. The volatility of cash flow leads unstable corporate value and thus the volatility of exchange rate can affect every firm's value.

2.4. EXCHANG RATE EXPOSURES

The quantitative influence of exchange rate is called as exchange rate exposure. There are three exposures of exchange rate, accounting exposure, transaction exposure and economic exposure.

2.4.1. Accounting exposure

Translation exposure is the possibility of foreign currencies' fund changes in firm's balance sheet due to the changes of foreign exchange rate. It is not actual loss (or gain) but a loss (or gain) of book, and will influence the result of financial report. It is illustrated by the example below that this description is too abstract to understand.

There is a company based in China needs to import equipments from the USA. We assume the total cost of the equipments is 500 thousand US dollar. At the time when import contract was singed the exchange rate of Chinese Yuan against US dollar is 8/1. The equipments cost 4 million Chinese Yuan and the liability was recorded in the company's balance sheet. In the end of accounting period, the exchange rate of Chinese Yuan against US dollar changed from 8/1 to 7/1, at the time the total cost of the equipments is 3.5 million Chinese Yuan. The gain of 0.5 million Yuan in the companies balance sheet caused by exchange rate change is translation exposure.

2.4.2. Transaction exposure

Transaction exposure is actual loss (or gain) for companies whose payables and receivables are denominated in foreign currencies due to change of foreign exchange rate. The same as accounting exposure, we use an example to illustrate the abstract description.

The same Chinese company we used in the previous section's example needs import some other equipments from Europe. We assume the total cost of the equipment is 1 million Euros. In this transaction, the company signed a contract with a European company first and pay for the equipments three months later. The exchange rate of Chinese Yuan against Euro was 9/1 when the contract was signed. The equipments cost 9 million Chinese Yuan at that time. Three months later, the exchange rate of Chinese Yuan against Euro changed to 10/1 at the time of the Chinese company paid for the equipments. In this exchange rate, the Chinese company has to pay the European company 10 million Yuan. The lost of 1 million Yuan of the Chinese company is transaction exposure.

2.4.3. Economic exposure

Economic exposure is a possibility of benefit change in a specific future period due to the change of foreign exchange rates. In the other word, it is net value change of

company’s future cash flow. We also give an example make this description easier to understand.

The Chinese company which imported equipments from the USA and Europe respectively has a branch in Japan. The branch can create a net cash flow of 100 million Yen each year. We assume risk free rate in Japanese market is 10% and the exchange rate of Japanese Yen against Chinese Yuan is 7/1 in the beginning of accounting period. At present, the net value of future two years’ cash flow of the Chinese company in Chinese Yuan is $\frac{100/7}{1+10\%}+\frac{100/7}{(1+10\%)^2}=24.8$ million. If the exchange rate of Japanese Yen against Chinese Yuan changes to 8/1, the net value of the Chinese company’s cash flow in Chinese Yuan will change to $\frac{100/7}{1+10\%}+\frac{100/8}{(1+10\%)^2}=23.3$ million. The difference of 1.5 million Yuan is economic exposure.

3. METHODOLOGY AND DATA

In this chapter we present the way how the data are collected and the methodology used in our research. Some sample information and different empirical models related to this research are presented as well. Further, we describe data processing and reliability and validity of this study.

3.1. RESEARCH APPROACH

The purpose of this thesis is to test the relationship between exchange rate and corporate value empirically, mainly the exchange rate exposure on automakers' value. We investigate the corporate value changes of three different automakers which are affected by foreign exchange rate changes. Four multinational automakers in the USA, Japan and Europe are chosen in this research to perform a quantitative study. Data are collected during 2000-2006. The main reference of this paper is based on previous studies performed by Oxelheim and Wihlborg (1995) concerning microeconomic shocks on General Motor, and Bartram (2007) concerning foreign exchange rate risk on corporate cash flow and stock price. The model employed in this study is in some extent based on the previous study by Christiansen (2003).

3.2. Data Collection

3.2.1. Sources of information

In this paper, the financial data is obtained from one source, "DataStream". The reason of collecting data from unified data source is to ensure reliability of the data. Collecting financial data from different sources is not good for the accuracy of the data, because different database may use different methods to calculate financial

figures. All financial information including financial statements of the companies, stock prices of companies, performance of stock markets and foreign exchange rates in this paper are extracted from this source of information.

The data collected from "DataStream" are in the raw-data form, while, for the statistical reason the data used in regression analysis are usually returns of raw-data. In this paper, all data used in the model are converted to return from raw-data. Meanwhile, "ELIN" and "LIBRIS" are used to search relevant articles and previous literatures. The website of Wikipedia is used to search explanation of definitions and general information of companies and industry.

3.2.2. Sample

Four largest automakers in the world are selected in this paper. They are General Motor, Toyota, Volkswagen and Ford from the USA, Japan and Germany11. In 2008, the output of these four companies accounted for 42% of world vehicle production (See Figure 1). In addition, Japan, China, United States and Germany are the four largest automotive producing counties in the world. In 2008, these four countries contributed more than 50% of the vehicle production in the world (see Figure 2). The stock price of Ford, Toyota and Volkswagen has significant change during the period over 2000-2006. The general trend of the stock price of Ford is downward. The stock price is 252.75 US dollar in the beginning of 2001 while 51.39 US dollar in the end of 2006. The curve of stock price of Toyota is a "U" shape. At the two ends of the period, Toyota's stock price kept around 450 Japanese Yen. The lowest price is close to 180 Japanese showed in May, 2003. The change of VW's stock price is the most erratic one. Its price's fluctuation is very severe in the period and the highest value is showed in the end of the period. (See Figure 3)

[11] In this paper, we treat Europe as a united market but not separated countries.

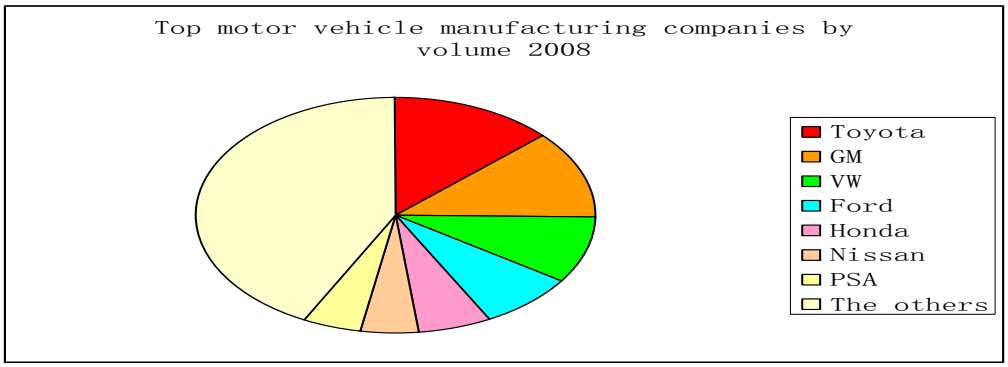

Figure 1: Top motor vehicle manufacturing companies by volume 2008

(Data come from Production Statistics", OICA. 2009)

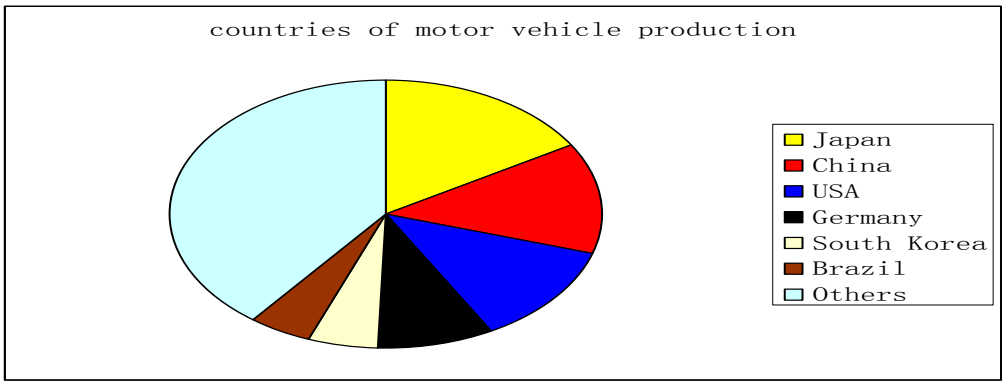

Figure 2 Countries of motor vehicle production

(Data come from World motor vehicle production by manufacturer: World ranking of manufacturers 2008", OICA. 2009.)

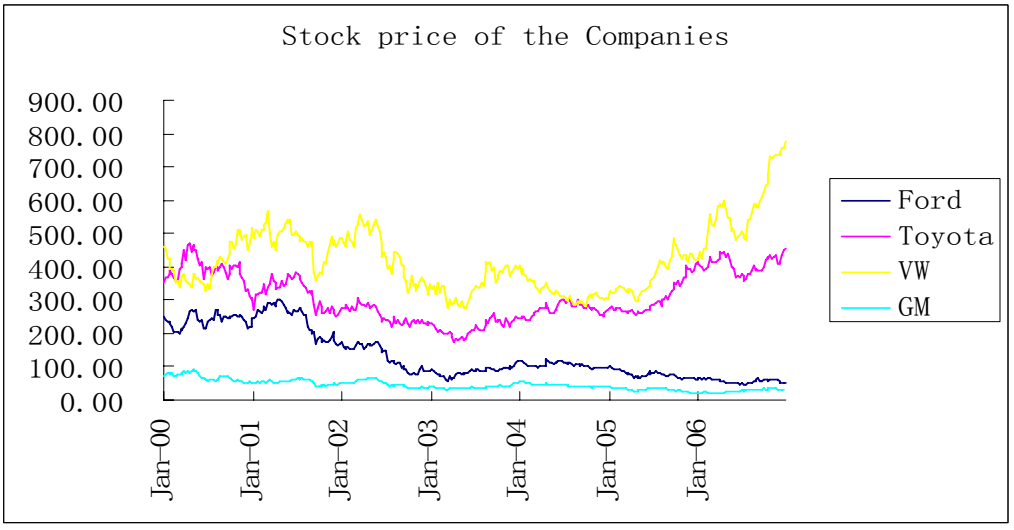

Figure 3: Stock price of companies

(The currency used to show shock price is local currency where the company based in.)

We chose representative companies in each “big four” countries except China in order to investigate if there is a relationship of foreign exchange rate exposures among the three countries. Although China is the second largest country of automotive manufacturing, we do not select automakers in China because that the largest automakers based in China are joint ventures and related to the four companies we selected. Meanwhile, the purely Chinese-fund companies lack the power of international influence. Chinese based automakers are not typical samples we are studying. However, we do not ignore China’s influence as the second largest market of vehicles. In this paper, we take into account the factor of production, marketing and competition for the studying exchange rates choosing. China is an important market for all four companies we selected, so the impact of exchange rate changes of Chinese Yuan will be considered.

3.2.3. Data description

We collect weekly stock return of the four selected companies to investigate the impact of exchange rate changes on corporate value. The data of exchange rates are collected from Datastream in three groups. To analyze the relationship between exchange rates changes and value of the companies of General Motor and Ford, we collect weekly exchange rate returns of US dollar against to Chinese Yuan, Japanese Yen and Euro respectively. The respective three countries which the selected currencies belong to have significant meaning for the two US automakers. China is the biggest market for both of the two US automakers, Japan and Euro are the economy which their main competitors are based on. Similar to the US case, we collected weekly exchange rate returns of Japanese Yen against to US dollar, Chinese Yuan and Euro, as well as Euro against to US dollar, Chinese Yuan and Japanese Yen respectively, in order to investigate the relationship between exchange rate changes and the corporate value of Toyota and Volkswagen. The same as General Motor and Ford, China is the biggest market of Toyota and Volkswagen and the four companies are competitors for each other. In addition, in order to investigate the relationship

between stock prices of individual companies and market performance, we collected the weekly return of stock market index of three countries.

3.2.4. Excluded Observations

Our data is collected in the period over 2000-2006, which is between two financial crises. The one before our data's period is Asian financial crisis, which started in July 1997 and began to recover in 1999. The other after our data's period is the financial crisis we are suffering from now. This financial crisis is widely considered that started in July 2007 and still on at present. During financial crisis, the return of corporate stock prices and the changes of exchange rates are not normal and representative. A model with data collected in the period of financial crisis would not represent appropriate relationship between corporate value and exchange rate. In this paper, we avoid the data in the periods of the two financial crises on purpose.

3.3. Methodology

We set up a model which combined three previously presented models in researches of exchange rate exposure. The three models are used in previous studies of exchange rate exposure from different aspects. We extract the usefulness of them to compose our model. And, we rise four hypotheses to been argument.

3.3.1. Related Models

The classical method of exposure measurement generally employs regression analysis of relationship between the changes of foreign exchange rate and corporate value. The most applied one is the following two factors model:

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \delta_j R_{st} + \varepsilon_{jt}$$

Where R_{jt} refers to stock return of company j in the period of t. R_{mt} refers to

index return of the whole capital market m in the period of t. And R_{st} refers to exchange rate return of currency s in the period of t. A lot of literatures use this model to measure the exposure of exchange rate on corporate value. Generally, samples used in this model are large. Economists usually choose a large number of companies in a market (for example the world's top 500 companies in a country or an area) or an industry (for example all public steel companies in the world). The exchange rate which is studied here is not the exchange rate of currency s against to a specific currency but the trade weighted index of currency s.

Although most empirical literatures on foreign exchange rate exposure use the model above, the literatures of risk management of exchange rate risk usually focus on corporate cash flow. As an alternative approach of exposure measurement, the model below is used to investigate the relationship between changes of exchange rate and corporate cash flow changes:

$$R_{CFjt} = \alpha_j + \delta_j R_{St} + \varepsilon_{jt}$$

Where R_{CFjt} refers to corporate cash flow return of company j in the period of t. R_{st} refers to exchange rate return of currency s in the period of t. Generally, economists use this model to investigate individual companies since the data of corporate cash flow is not available publically. Collecting large group's sample of corporate cash flow is much more difficult than collecting the data of stock prices. Usually, authors work closely with one or limited number of companies to write empirical literatures of exchange rate exposure on corporate cash flow. They choose a small number of companies as sample to investigate the relationship between exchange rate changes and changes of cash flow. In this model, the studied exchange rate is the exchange rate of currency s against to a specific foreign currency but not an index used in the stock price model.

As the development of global economy, the business of multinational companies is

commonly involved in different countries. Just study the exchange rate of domestic currency against to one specific foreign currency for corporate cash flow is not enough. Competitive, supplied and produced factors of exchange rate should also be considered in the research. Oxelheim and Wihlborg provide a model of exchange rate exposure on corporate cash flow with some macroeconomics factors considered:

$$(CF_t^{DC} / P_t^{DC}) = \alpha_1 + \alpha_2 (DC / FC)_{t-i} + \alpha_3 V_{t-i} + \alpha_4 Z_{t-i} + \varepsilon_t$$

Where CF_t^{DC} refers to the nominal cash flows during the period of t in domestic currency. P_t^{DC} refers to the price level in domestic currency in the period of t. $(DC / FC)_{t-i}$ refers to the exchange rates of domestic currency against one specific foreign exchange rate in period $t-i$. V_{t-i} refers to some other macroeconomic variables in period $t-i$, such as interest rate and inflation rate. Z_{t-i} refers to firm- and industry- specific disturbances, such as new competitor entering or new rules making.

3.3.2. The employed model

According to efficient-market hypothesis (EMH), it is impossible to consistently outperform the market by using any information that the market already knows. This means that studying the relationship between the returns of exchange rates and stock prices only does not make sense. Consequently, we use empirical volatility and mean spillover model to study the impact of foreign exchange rate on stock price of the three automakers in this paper. Christiansen (2003) applied a three steps' model to investigate the spillover effects in European bond market. The first two steps of the model use a single variable GARCH model to estimate the return of the US bond market (global effect) and the aggregate European return (regional effect), respectively. The one period lagged US and European returns are used as explanatory variables. In the third step, a single variable extend GARCH model is used to estimate

the return of individual European bond market.

We use the similar model to test the influence of foreign exchange rates and stock market indexes on stock prices of the three companies we selected. First, the conditional return on the foreign return is assumed to evolve according to an AR(1) model:

$$S_{i,t} = \alpha_{0,1} + \alpha_{1,i} S_{i,t-1} + e_{i,t}$$

$S_{i,t}$ is the return of foreign exchange rate, where i represents different exchange rate returns, such as S_{useu} represents the return of the exchange rate of US dollar against to Euro. The idiosyncratic shock $e_{i,t}$, is normally distributed with mean 0 and the conditional variance follows a symmetric GARCH(1,1) specification. The GARCH model was developed independently by Engle (1982) and Bollerslev (1986):

$$\sigma_{i,t}^2 = \omega_i + \alpha_i e_{i,t-1}^2 + \beta_i \sigma_{i,t-1}^2$$

The model allows the conditional variance to be dependent upon previous own lag. $\alpha_i e_{i,t-1}^2$ is the volatility during the previous period of i. $\beta_i \sigma_{i,t-1}^2$ is the fitted variance from the model during the previous period of i. σ_t^2 is know as the conditional variance since it is a one-period ahead estimate for the variance calculated based on any past information thought relevant. Using the GARCH model it is possible to interpret the current fitted variance as a weighted function of a long-term average value. The reason why we use GARCH(1,1) model is that we think one period lag is enough to pass through the affect all cross the world (we use weekly data). Since the development of information system, the financial information could be spread globally in the very short time.

The return of stock price of company j, $R_{j,t}$, is described by the following extended

AR(1) specification:

$$R_{j,t} = \beta_{0,j} + \beta_{1,j} R_{j,t-1} + \beta_{2,j} S_{i,t-1} + \beta_{3,j} e_{i,t} + e_{j,t}$$

The return of stock price of company j depends on its own lagged return and the lagged return of foreign exchange rate as well as the contemporary exchange rate residual. The mean spillover effects are introduced by the lagged exchange rate return $S_{i,t}$. The volatility spillover from the exchange rate to selected companies' stock price takes place via the exchange rate's idiosyncratic shock, $e_{i,t}$. The idiosyncratic shock $e_{j,t}$ has mean 0 and the conditional variance $\sigma_{j,t}^2$ which evolves according to the GARCH (1, 1):

$$\sigma_{j,t}^2 = \omega_j + \alpha_j e_{j,t-1}^2 + \beta_j \sigma_{j,t-1}^2$$

In addition, individual company's stock price is affacted by the performance of whole of the stock market. Meanwhile, as automotive giants, each one the three companies must influence the local stock market in some extent. In this paper, we also study the mutual influence between market index and corporate stock price employing the same processes as above. First, the conditional return on the foreign return is assumed to evolve according to an AR(1) model:

$$I_{k,t} = \alpha_{0,1} + \alpha_{1,k} I_{k,t-1} + e_{k,t}$$

$I_{k,t}$ is the return of market index of market k, where k represents different exchange rate returns, such as I_{us} represents the return of stock market index of the USA. The idiosyncratic shock $e_{k,t}$, is Also normally distributed with mean 0 and the conditional variance follows a symmetric GARCH(1,1) specification:

$$\sigma_{k,t}^2 = \omega_k + \alpha_k e_{k,t-1}^2 + \beta_k \sigma_{k,t-1}^2$$

$\sigma_{k,t-1}^2$ is the shock of the exchange rate return k. The return of stock price of company j, $R_{j,t}$, is described by the following extended AR(1) specification:

$$R_{j,t} = \beta_{0,j} + \beta_{1,j} R_{j,t-1} + \beta_{2,j} I_{k,t-1} + \beta_{3,j} e_{k,t} + e_{j,t}$$

The one period lagged variables in the model can play the role of avoiding autocorrelation.

3.3.3. Tests

ARCH model is standing on the heteroscedastic variances. If the variance of errors is constant is known as homoscedasticity. If the variance of the errors is not constant, this would be known as heteroscedasticity. If the errors are heteroscedastic the estimators will still give unbiased coefficient estimates, but they are no longer BLUE. That is, they no longer have the minimum variance among the class of unbiased estimators. The heteroscedasticity of variance for foreign exchange rates will be tested in chapter 4.

In addition, if an important variable is omitted from the equation, the consequence of estimated coefficients on all other variables will be biased and inconsistent unless the excluded variable is uncorrelated with all the included variables. Even if this condition is satisfied the estimate of the coefficient on the constant term will be biased. Consequently, all forecasts made from the model would be biased and the standard errors will also be biased. As a result, hypothesis tests could yield inappropriate inferences. In this paper, we use Chow test to detect if the model includes sufficient variables or not.

Meanwhile, if the model includes an irrelevant variable, the consequence is that the coefficient estimators would still be consistent and unbiased, but the estimators would

be inefficient. This would imply that the standard errors for the coefficients are likely to be inflated relative to the values which they would have taken if the irrelevant variable had not been included. Variables which would otherwise have been marginally significant may no longer are so in the presence of irrelevant variables. In this paper, we use Wald test to find out if there are irrelevant variables or not. The tests will be present and null hypotheses will be raised in the chapter 4 for each automaker.

3.3.4. Hypotheses

There are four hypotheses in this paper. The first one is that the appreciation of currency in the main foreign market of the company has a positive relation with firm's stock price. The appreciation of the main foreign market's currency has two aspects to impact on corporate cash flow. First, turn over in foreign market will increased when it is counted by local currency where the company is based in with appreciated foreign market's currency. Second, compared to the appreciated currency in foreign market, local cost of the company's products is decreased and thus the company's competition will be increased.

The second hypothesis is that the appreciation of currency in the main foreign produce area of the company has a negative relation with firm's stock price. The appreciation of the main foreign produce area's currency also has two aspects to impact on corporate cash flow. First, the cost, such as labor and property cost will be increased as the appreciation of produce area's currency and thus corporate net cash flow will be decreased. Second, when the increased cost is added on price, the turn over in foreign market will decrease because of decreased competition.

The third hypothesis is that the appreciation of currency where main supplier of the company is based in has a negative relation with firm's stock price. It is the same as the above two situations. Appreciation of supplier's currency increases input price and thus it decreases company's net cash flow and competition in foreign market.

The forth hypothesis is that the stock price of an individual company is related to the performance of the whole market where the company is based in. Stock price is a mirror of a company's performance, and any individual company's performance could not be independent from the whole market's situation. There must be a relation between the trend of the whole stock market and the individual corporate stock price.

3.4. Validity and Reliability

We chose to just investigate the relationship between exchange rate and corporate stock price in the period over 2000-2006. Usually, corporate cash flow is the direct indicator of corporate value. If we chose corporate cash flow as dependent variable we will face a major problem as observations are not sufficient. The information of corporate cash flow is not available daily in public. The most frequent declaration of cash flow by company is quarterly data. Obviously, 7 years quarterly data is not sufficient to make an empirical study. Meanwhile, we do not study data beyond the period. As we mentioned before, there are two financial crises beyond the two ends of the period. During financial crisis, the return of corporate stock prices and the changes of exchange rates are not normal and representative. A model with data collected in the period of financial crisis would not represent appropriate relationship between corporate value and exchange rate. In this paper, we avoid the data in the periods of the two financial crises on purpose.

3.4.1. Validity

As globalization intensifies, a company's performance is usually not impacted by only one exchange rate. The factors of production, competition and marketing dominate the companies' performance. According to operation of these companies, the factors come from different countries. As a result, we chose different exchange rates as variables to test their impact on corporate value.

The model employed in this paper is applied in previous related research and well

commented in previous literature. It is proved that the model can study volatility efficiently. This paper only involves data collection and data processing.

3.4.2. Reliability

To ensure reliability we apply unified process of data and use only one database to collect data. All regressions used in this paper are run using OLS in the econometrics software EViews. It is well used software for statistical research. According to efficient-market hypothesis (EMH), it is impossible to consistently outperform the market by using any information that the market already knows. This means that only studying the relationship between the returns of exchange rates and stock prices does not make sense. Consequently, we use empirical volatility and mean spillover model to study the impact of foreign exchange rate on stock price of the three automakers in this paper.

4. EMPIRICAL FINDINGS

In this chapter, we present obtained result of regression to readers. Starting with description of variables and data, requirements of assumption are also presented. Specification of Empirical results and regression tests are the main contents of this chapter.

4.1. DESCRIPTIVE STATISTICS

The weekly returns of these four companies, General Motors, Ford, Toyota and Volkswagen, are selected as dependent variables of the model. We use R_G, R_F, R_T and R_V to represent them. To study the impact of different exchange rate returns on the four companies, we select exchange rate of local currency of the country where each company is based in against three different foreign currencies. These three foreign currencies are from countries where the company's market, suppliers and competitors belong to. We use S_{USEU}, S_{USYE} and S_{USYU} to represent three foreign exchange rate variables which are US dollar against to Euro, Japanese Yen and Chinese Yuan respectively of Ford. Similarly, we use S_{YEEU}, S_{YEUS}, S_{YEYU}, S_{EUUS}, S_{EUYE} and S_{EUYU} to represent foreign exchange variables which are Japanese Yen against to Euro, US dollar and Chinese Yuan as well as Euro against to US dollar, Japanese Yen and Chinese Yuan of Toyota and Volkswagen, respectively. Exchange rates regarding to General Motors are the same as Ford's. We use two-way exchange rate in this paper, such as the exchange rate of EUR against to US dollar, S_{EUUS}, and the exchange rate of US dollar against to EUR, S_{USEU}. It is because of the exchange rate of two currencies is different in different exchange markets. In addition, stock market index of three countries where the three companies are based in are variables in the model. We use I_{US}, I_{EU} and I_{JA} to represent them.

Variable	*Min*	*Max*	*Mean*	*Median*	*Std.dev*
S_{USEU}	-0.04038	0.039024	0.000681	0.000965	0.013659
S_{USYE}	-0.03488	0.041882	-0.00034	-0.00047	0.012868
S_{USYU}	-0.00152	0.020187	0.000161	0	0.001159
S_{YEEU}	-0.05863	0.039001	0.001005	0.001429	0.014345
S_{YEUS}	-0.04404	0.038187	0.000336	0.00085	0.012398
S_{YEYU}	-0.04463	0.034581	0.000502	0.000759	0.013082
S_{EUUS}	-0.03877	0.040922	-0.00068	-0.00116	0.013755
S_{EUYE}	-0.05214	0.058693	-0.00102	-0.00168	0.014463
S_{EUYU}	-0.03867	0.040924	-0.00052	-0.00097	0.013716
I_{US}	-0.13261	0.088102	-0.0005	0.000988	0.026556
I_{EU}	-0.15819	0.105236	0.000101	0.003376	0.026126
I_{JA}	-0.10338	0.103081	-0.00081	-0.000066	0.030310

Table 3: Descriptive Statistics over the Variables

(Table over min, max, mean, median and standard deviation for all variables.)

Variable		Coefficient	Std. Error	t-Statistic
S_{USEU}	C	0.000709	0.000719	0.986162
	USEU(-1)	-0.001041	0.052591	-0.019785
S_{USYE}	C	-0.00032	0.000677	-0.472415
	USYE(-1)	0.015231	0.052618	0.289468
S_{USYU}	C	0.000157	6.15E-05	2.55281
	USYU(-1)	0.030299	0.052676	0.575184
S_{YEEU}	C	0.000964	0.000756	1.274232
	YEEU(-1)	0.037784	0.052594	0.71841
S_{YEUS}	C	0.000301	0.000652	0.461842
	YEUS(-1)	0.038549	0.052574	0.733227
S_{YEYU}	C	0.000473	0.000689	0.686333
	YEYU(-1)	0.024627	0.052602	0.468177
S_{EUUS}	C	-0.000734	0.000723	-1.014155
	EUUS(-1)	-0.008083	0.052522	-0.153898
S_{EUYE}	C	-0.001041	0.000762	-1.365069
	EUYE(-1)	0.00931	0.052587	0.177046
S_{EUYU}	C	-0.000569	0.000721	-0.789652
	EUYU(-1)	-0.007158	0.052522	-0.136282

Table 4

In the first step, we use univariate model to estimate different returns of exchange rates (see Table 4). The AR(1) parameter is small, negative and insignificant, which implies no

or weak negative first-order autocorrelation. Variances of the foreign exchange returns are stationary. This will be test in the next section. And, we use the same way to estimate the returns of market indexes of the USA, Japan and Germany (see Table 5). From the coefficients we can say market index has weak negative first-order autocorrelation.

Variable		Coefficient	Std. Error	t-Statistic
I_{US}	C	-0.000614	0.001393	-0.440904
	IUS(-1)	-0.066024	0.052436	-1.259145
I_{EU}	C	3.23E-05	0.001369	0.023579
	IEU(-1)	-0.076253	0.052428	-1.45443
I_{JA}	C	-0.000959	0.001589	-0.603729
	IJA(-1)	-0.072155	0.052416	-1.376578

Table 5

In the second step, we use ARCH-LM test to test residuals of foreign exchange rates (see Table 6) and market indexes (see Table 7).

S_{USEU}	F-statistic	0.010214	Prob. F(1,360)	0.919554
	Obs*R-squared	0.010271	Prob. Chi-Square(1)	0.919276
S_{USYE}	F-statistic	1.794625	Prob. F(1,360)	0.181209
	Obs*R-squared	1.795644	Prob. Chi-Square(1)	0.18024
S_{USYU}	F-statistic	0.003648	Prob. F(1,360)	0.951872
	Obs*R-squared	0.003668	Prob. Chi-Square(1)	0.951706
S_{YEEU}	F-statistic	0.895845	Prob. F(1,360)	0.344533
	Obs*R-squared	0.898586	Prob. Chi-Square(1)	0.343161
S_{YEUS}	F-statistic	0.007298	Prob. F(1,360)	0.931968
	Obs*R-squared	0.007338	Prob. Chi-Square(1)	0.931733
S_{YEYU}	F-statistic	4.828299	Prob. F(1,360)	0.028633
	Obs*R-squared	4.790869	Prob. Chi-Square(1)	0.028611
S_{EUUS}	F-statistic	0.092042	Prob. F(1,360)	0.761772
	Obs*R-squared	0.09253	Prob. Chi-Square(1)	0.760985
S_{EUYE}	F-statistic	5.659576	Prob. F(1,360)	0.017881
	Obs*R-squared	5.602934	Prob. Chi-Square(1)	0.01793
S_{EUYU}	F-statistic	0.083585	Prob. F(1,360)	0.772663
	Obs*R-squared	0.08403	Prob. Chi-Square(1)	0.771909

Table 6

I_{US}	F-statistic	5.3739	Prob. F(1,360)	0.021
	Obs*R-squared	5.324277	Prob. Chi-Square(1)	0.02103
I_{JA}	F-statistic	1.101022	Prob. F(1,360)	0.294746
	Obs*R-squared	1.103763	Prob. Chi-Square(1)	0.293442
I_{EU}	F-statistic	14.15306	Prob. F(1,360)	0.000197
	Obs*R-squared	13.69335	Prob. Chi-Square(1)	0.000215

Table 7

In the third step, we use multi-variable regression equation to estimate relationship between corporate stock price and exchange rate. We use corporate stock price as dependent variable as well as its own lagged price, one period lagged exchange rate and residual of exchange rate as independent variables

4.1.1. Toyota

From the figures (see Table 8) we can see Toyota's own lagged return of stock price has weakly negative effect on its return of stock price. One period lagged exchange rate return of Japanese Yen against to Euro has negative impact on Toyota's stock price. One lagged return of exchange rates of Japanese Yen against to US dollar and Chinese Yuan are positively related to Toyota's stock price.

Variable		Coefficient	Std. Error	t-Statistic
S_{YEEU}	C	0.000897	0.002045	0.438646
	ST(-1)	-0.155864	0.05289	-2.946918
	YEEU(-1)	-0.213954	0.144809	-1.477485
	EYEEU	-0.595723	0.144612	-4.119457
S_{YEUS}	C	0.000628	0.002086	0.300833
	ST(-1)	-0.099472	0.052595	-1.891303
	YEUS(-1)	0.056059	0.168843	0.332019
	EYEUS	0.236668	0.168927	1.401007
S_{YEYU}	C	0.00044	0.002063	0.213434
	ST(-1)	-0.092255	0.051912	-1.777139
	YEYU(-1)	0.405853	0.158335	2.56326
	EYEYU	-0.313081	0.157702	-1.985278

Table 8: Estimated coefficients of Toyota with the whole sample period (from 2000 to Dec 2006)

We run joint Wald tests to see if exchange rate related variables are necessary for the model (see Table 9).

Test Statistic		Value	df
S_{YEEU}	F-statistic	9.378207	(2, 359)
	Chi-square	18.75641	2
S_{YEUS}	F-statistic	1.039479	(2, 359)
	Chi-square	2.078958	2
S_{YEYU}	F-statistic	5.263204	(2, 359)
	Chi-square	10.52641	2

Table 9

$H_0^1 : \beta_{2,YEUS} = \beta_{3,EYEUS} = 0$ (No US dollar spillover effect)

$H_0^2 : \beta_{2,YEEU} = \beta_{3,EYEEU} = 0$ (No Euro spillover effect)

$H_0^3 : \beta_{2,YEYU} = \beta_{3,EYEYU} = 0$ (No Chinese Yuan spillover effect)

From the figures in Table 9, we can reject H_0^1 and H_0^3 but not H_0^2 in 5% significant level. It means that the impact of the exchange rate of Japanese Yen against to US dollar on Toyota's stock price is insignificant.

Meanwhile, we estimate the relationship between market index of Japan and stock price of Toyota (see Table 10). The return of Japan's market index has no significant impact on Toyota's stock price.

Variable	Coefficient	Std. Error	t-Statistic
C	0.000642	0.001551	0.414095
ST(-1)	-0.095851	0.052519	-1.825062
IJA(-1)	-0.001480	0.069140	-0.021406
EIJA	0.882716	0.051301	17.20675

Table 10

For the same purpose as above, we run joint Wald test to find out if the market index of Japan is a necessary factor of Toyota's stock price (see Table 11).

Test Statistic	Value	df	Probability
F-statistic	148.0462	(2, 359)	0.0000
Chi-square	296.0924	2	0.0000

Table 11

$H_0^4 : \beta_{2,IJA} = \beta_{3,EIJA} = 0$ (No market Index spillover effect)

From the figure in Table 11, we can see the null hypothesis is strongly rejected in 5% level. We can conclude that market index and Toyota's stock price is related.

4.1.2. General Motors

From the figures (see Table 12), we can see that GM's own lagged return of stock price has no significant or weakly positive effect on its return of stock price. One period lagged exchange rate return of US dollar against to Euro has negative impact on GM's stock price. One lagged return of exchange rates of US dollar against to Japanese Yen and Chinese Yuan are positively related to GM's stock price.

Variable		Coefficient	Std. Error	t-Statistic
S_{USEU}	C	-0.002487	0.002641	-0.941706
	SG(-1)	0.001664	0.052786	0.031517
	USEU(-1)	-0.130276	0.19344	-0.673471
	EUSEU	-0.31972	0.192886	-1.657559
S_{USYE}	C	-0.002568	0.002651	-0.968793
	SG(-1)	0.003372	0.052934	0.063705
	USYE(-1)	0.006174	0.205492	0.030045
	EUSYE	-0.05377	0.206006	-0.261014
S_{USYU}	C	-0.002679	0.002674	-1.001982
	SG(-1)	0.003179	0.052844	0.060153
	USYU(-1)	0.674689	2.284371	0.29535
	EUSYU	-0.579806	2.287881	-0.253425

Table 12: Estimated coefficients of GM with the whole sample period (from 2000 to Dec 2006)

Test Statistic		Value	df
S_{USEU}	F-statistic	1.603375	(2, 358)
	Chi-square	3.206751	2
S_{USYE}	F-statistic	0.034507	(2, 358)
	Chi-square	0.069014	2
S_{USYU}	F-statistic	0.075643	(2, 358)
	Chi-square	0.151287	2

Table 13

We run joint Wald tests to see if exchange rate related variables are necessary for the model (see Table 13).

$H_0^1 : \beta_{2,USEU} = \beta_{3,EUSEU} = 0$ (No Euro spillover effect)

$H_0^2 : \beta_{2,USYE} = \beta_{3,EUSYE} = 0$ (No Japanese Yen spillover effect)

$H_0^3 : \beta_{2,USYU} = \beta_{3,EUSYU} = 0$ (No Chinese Yuan spillover effect)

From the figures in Table 13, we can reject H_0^1 and H_0^3 but not H_0^2 in 5% significant level. It means that the impact of the exchange rate of US dollar against to Japanese Yen on GM's stock price is insignificant.

Meanwhile, we estimate the relationship between market index of The USA and stock price of General Motors (see Table 14). The return of US market index has significant positive impact on GM's stock price.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002538	0.002510	-1.011115	0.3126
SG(-1)	-0.041335	0.052020	-0.794599	0.4274
IUS(-1)	0.293373	0.098177	2.988198	0.0030
EIUS	0.535885	0.094647	5.661947	0.0000

Table 14

For the same purpose as above, we run joint Wald test to find out is the market index of the USA is a necessary factor of GM's stock price (see Table 15).

Test Statistic	Value	df	Probability
F-statistic	74.47598	(2, 359)	0.0000
Chi-square	148.9520	2	0.0000

Table 15

$H_0^4 : \beta_{2,IUS} = \beta_{3,EIUS} = 0$ (No market Index spillover effect)

From the figure in Table 15 we can see the null hypothesis is strongly rejected in 5%

level. We can conclude that market index and GM's stock price is related.

4.1.3. Volkswagen

From the figures (see Table 16) we can see VW's own lagged return of stock price has no significant or weakly negative effect on its return of stock price. One period lagged exchange rate return of Euro against to Japanese Yen has negative impact on VW's stock price. One lagged return of exchange rates of Euro against to US dollar and Chinese Yuan are positively related to VW's stock price.

Variable		Coefficient	Std. Error	t-Statistic
S_{EUUS}	C	0.001557	0.002354	0.661691
	SV(-1)	-0.041416	0.052723	-0.785543
	EUUS(-1)	0.031446	0.174098	0.180625
	EEUUS	0.64911	0.171129	3.793112
S_{EUYE}	C	0.001417	0.002395	0.591841
	SV(-1)	-0.037937	0.052706	-0.719791
	EUYE(-1)	-0.113465	0.165538	-0.685432
	EEUYE	0.232209	0.165242	1.405266
S_{EUYU}	C	0.00157	0.002348	0.66847
	SV(-1)	-0.044138	0.05271	-0.837383
	EUYU(-1)	0.057808	0.17455	0.331183
	EEUYU	0.67639	0.171307	3.948405

Table 16: Estimated coefficients of VW with the whole sample period (from 2000 to Dec 2006)

We run joint Wald tests to see if exchange rate related variables are necessary for the model (see Table 17).

Test Statistic		Value	df	Probability
S_{EUUS}	F-statistic	7.21146	(2, 359)	0.0008
	Chi-square	14.42292	2	0.0007
S_{EUYE}	F-statistic	1.221519	(2, 359)	0.296
	Chi-square	2.443037	2	0.2948
S_{EUYU}	F-statistic	7.850832	(2, 359)	0.0005
	Chi-square	15.70166	2	0.0004

Table 17

$H_0^1 : \beta_{2,EUUS} = \beta_{3,EEUUS} = 0$ (No US Dollar spillover effect)

$H_0^2 : \beta_{2,euYE} = \beta_{3,EEUYE} = 0$ (No Japanese Yen spillover effect)

$H_0^3 : \beta_{2,EUYU} = \beta_{3,EEUYU} = 0$ (No Chinese Yuan spillover effect)

From the figures in Table 17, we can not reject all three null hypotheses. It means that the impact of foreign exchange rates on VW's stock price is insignificant.

Meanwhile, we estimate the relationship between market index of The USA and stock price of Volkswagen (see table 18). The return of EU market index has significant positive impact on VW's stock price.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001632	0.002015	0.809884	0.4185
SV(-1)	-0.119756	0.052165	-2.295716	0.0223
IEU(-1)	0.174559	0.090632	1.926034	0.0549
EIEU	0.938512	0.077542	12.10324	0.0000

Table 18

For the same purpose as above, we run joint Wald test to find out is the market index of Europe is a necessary factor of VW's stock price (see Table 19).

Test Statistic	Value	df	Probability
F-statistic	20.48637	(2, 358)	0.0000
Chi-square	40.97273	2	0.0000

Table 19

$H_0^4 : \beta_{2,IEU} = \beta_{3,EIEU} = 0$ (No market Index spillover effect)

From the figure in Table 19 we can see the null hypothesis is strongly rejected in 5% level. We can conclude that market index and VW's stock price is related.

4.1.4. Ford

From the figures (see Table 20) we can see GM's own lagged return of stock price has

no significant or weakly negative effect on its return of stock price. One period lagged exchange rate return of US dollar against to Chinese Yuan has positive impact on GM's stock price. One lagged return of exchange rates of US dollar against to Japanese Yen and Euro are negatively related to GM's stock price.

Variable		Coefficient	Std. Error	t-Statistic
S_{USEU}	C	-0.004363	0.002654	-1.643798
	SF(-1)	-0.042043	0.052648	-0.798574
	USEU(-1)	-0.117944	0.199536	-0.591091
	EUSEU	-0.93068	0.193685	-4.805123
S_{USYE}	C	-0.004513	0.002701	-1.670922
	SF(-1)	-0.038431	0.052639	-0.730087
	USYE(-1)	-0.255742	0.211635	-1.208409
	EUSYE	-0.628516	0.209168	-3.00484
S_{USYU}	C	-0.00448	0.002758	-1.624393
	SF(-1)	-0.031295	0.052741	-0.593372
	USYU(-1)	0.535521	2.358131	0.227095
	EUSYU	-2.299513	2.354448	-0.976668

Table 20: Estimated coefficients of Ford with the whole sample period (from 2000 to Dec 2006)

We run joint Wald tests to see if exchange rate related variables are necessary for the model (see Table 21).

Test Statistic		Value	df	Probability
S_{USEU}	F-statistic	11.71743	(2, 359)	0
	Chi-square	23.43485	2	0
S_{USYE}	F-statistic	5.264923	(2, 359)	0.0056
	Chi-square	10.52985	2	0.0052
S_{USYU}	F-statistic	0.502296	(2, 359)	0.6056
	Chi-square	1.004592	2	0.6051

Table 21

$H_0^1 : \beta_{2,USEU} = \beta_{3,EUSEU} = 0$ (No Euro spillover effect)

$H_0^2 : \beta_{2,USYE} = \beta_{3,EUSYE} = 0$ (No Japanese Yen spillover effect)

$H_0^3 : \beta_{2,USYU} = \beta_{3,EUSYU} = 0$ (No Chinese Yuan spillover effect)

From the figures in Table 21 we can reject H_0^1 and H_0^2 but not H_0^3 in 5% significant level. It means that the impact of the exchange rate of US dollar against to Chinese Yuan on Ford's stock price is insignificant.

Meanwhile, we estimate the relationship between market index of The USA and stock price of Ford (see Table 22). The return of US market index has weak negative impact on Ford's stock price.

Variable	Coefficient	Std. Error	t-Statistic
C	-0.004262	0.002368	-1.799503
SF(-1)	0.002656	0.052699	0.050392
IUS(-1)	-0.031050	0.102569	-0.302725
EIUS	0.984189	0.089349	11.01510

Table 22

For the same purpose as above, we run joint Wald test to find out if the market index of the USA is a necessary factor of Ford's stock price (see Table 23).

Test Statistic	Value	df	Probability
F-statistic	60.66786	(2, 359)	0.0000
Chi-square	121.3357	2	0.0000

Table 23

$H_0^4 : \beta_{2,IUS} = \beta_{3,EIUS} = 0$ (No market Index spillover effect)

From the figure in Table 23 we can see the null hypothesis is strongly rejected in 5% level. We can conclude that market index and Ford's stock price is related.

4.2. RESULTS OF TESTS

4.2.1. Heteroscedasticity

We run white test for each exchange rate used in this paper to see if the residuals of exchange rate variables are heteroscedasticity or not.

White Test				
S_{USEU}	F-statistic	0.02936	Prob. F(2,360)	0.971069
	Obs*R-squared	0.059199	Prob. Chi-Square(2)	0.970834
S_{USYE}	F-statistic	0.907453	Prob. F(2,360)	0.404472
	Obs*R-squared	1.820851	Prob. Chi-Square(2)	0.402353
S_{USYU}	F-statistic	0.007767	Prob. F(2,360)	0.992263
	Obs*R-squared	0.015664	Prob. Chi-Square(2)	0.992199
S_{YEEU}	F-statistic	0.581713	Prob. F(2,360)	0.559465
	Obs*R-squared	1.169342	Prob. Chi-Square(2)	0.557289
S_{YEUS}	F-statistic	0.314079	Prob. F(2,360)	0.730661
	Obs*R-squared	0.632289	Prob. Chi-Square(2)	0.728954
S_{YEYU}	F-statistic	2.915409	Prob. F(2,360)	0.055462
	Obs*R-squared	5.785698	Prob. Chi-Square(2)	0.055418
S_{EUUS}	F-statistic	0.055616	Prob. F(2,360)	0.94591
	Obs*R-squared	0.112124	Prob. Chi-Square(2)	0.94548
S_{EUYE}	F-statistic	2.918002	Prob. F(2,360)	0.055321
	Obs*R-squared	5.790763	Prob. Chi-Square(2)	0.055278
S_{EUYU}	F-statistic	0.044512	Prob. F(2,360)	0.956469
	Obs*R-squared	0.089743	Prob. Chi-Square(2)	0.95612

Table 24

From the figures (see Table 24) we can see most of the residuals of exchange rates are heteroscedastic. We dealt with it before we run the regressions.

4.2.2. Variables omitting

In previous chapter we mentioned a risk of the model that is the omission of important variables. In this paper we use Chow test to test parameters' stability. From the figures in the tables below, all null hypotheses for the four companies in both two studies of foreign exchange rate and market index can not be rejected. It means there must be some variables ate omitted. As the reasons of the limited time and resource, we can not find all relevant variables for this study. The authors who want to research this object further can work with the target companies more closely.

Chow Breakpoint Test: 6/27/2003				
S_{YEEU}	F-statistic	1.164606	Prob. F(4,355)	0.32614
	Log likelihood ratio	4.732443	Prob. Chi-Square(4)	0.315868
S_{YEUS}	F-statistic	1.865973	Prob. F(4,355)	0.115869
	Log likelihood ratio	7.55299	Prob. Chi-Square(4)	0.109395
S_{YEYU}	F-statistic	1.754505	Prob. F(4,355)	0.137532
	Log likelihood ratio	7.106184	Prob. Chi-Square(4)	0.130382
I_{JA}	F-statistic	0.347875	Prob. F(4,355)	0.845465
	Log likelihood ratio	1.420101	Prob. Chi-Square(4)	0.840694

Table 25 Toyota

Chow Breakpoint Test: 6/27/2003				
S_{USEU}	F-statistic	3.625221	Prob. F(4,354)	0.006534
	Log likelihood ratio	14.53295	Prob. Chi-Square(4)	0.005775
S_{USYE}	F-statistic	1.040582	Prob. F(4,354)	0.386124
	Log likelihood ratio	4.231587	Prob. Chi-Square(4)	0.37557
S_{USYU}	F-statistic	0.973285	Prob. F(4,354)	0.422099
	Log likelihood ratio	3.959412	Prob. Chi-Square(4)	0.411527
I_{US}	F-statistic	1.739595	Prob. F(4,354)	0.140706
	Log likelihood ratio	7.046624	Prob. Chi-Square(4)	0.133445

Table 26 General Motors

Chow Breakpoint Test: 6/27/2003				
S_{EUUS}	F-statistic	1.159051	Prob. F(4,355)	0.328654
	Log likelihood ratio	4.710015	Prob. Chi-Square(4)	0.318366
S_{EUYE}	F-statistic	1.925398	Prob. F(4,355)	0.105665
	Log likelihood ratio	7.790964	Prob. Chi-Square(4)	0.099543
S_{EUYU}	F-statistic	1.197892	Prob. F(4,355)	0.311404
	Log likelihood ratio	4.866798	Prob. Chi-Square(4)	0.30124
I_{EU}	F-statistic	2.430487	Prob. F(4,355)	0.047376
	Log likelihood ratio	9.807373	Prob. Chi-Square(4)	0.043801

Table 27 Volkswagen

Chow Breakpoint Test: 6/27/2003				
S_{USEU}	F-statistic	0.311915	Prob. F(4,355)	0.869971
	Log likelihood ratio	1.273564	Prob. Chi-Square(4)	0.865844
S_{USYE}	F-statistic	0.403606	Prob. F(4,355)	0.806041
	Log likelihood ratio	1.647085	Prob. Chi-Square(4)	0.800306
S_{USYU}	F-statistic	0.758458	Prob. F(4,355)	0.552912
	Log likelihood ratio	3.089045	Prob. Chi-Square(4)	0.543036
I_{US}	F-statistic	1.01242	Prob. F(4,355)	0.400878
	Log likelihood ratio	4.117522	Prob. Chi-Square(4)	0.390335

Table 28 Ford

5. Analysis

In this chapter, we analyze different variables' impact on corporate stock price. The variables are divided into two groups for analysis, as exchange rate and market index. The hypotheses are also discussed in this chapter.

In this paper, we chose stock prices of four multinational automakers, Toyota, General Motors, Volkswagen and Ford as independent variables, nine exchange rates (US dollar against Euro, US dollar against Japanese Yen and US dollar against Chinese in US exchange market; Euro against US dollar, Euro against Japanese Yen and Euro against Chinese Yuan in European exchange market as well as Japanese Yen against US dollar, Japanese Yen against Euro and Japanese Yen against Chinese Yuan in Japanese exchange market) and three market indexes of the USA, Japan and Europe as independent variables, making regression to study the relationship among them.

5.1. EFFECT OF EXCHANGE RATE ON CORPORATE STOCK PRICE

Variables	Expected Sign	Obtained Sign	Inferencee
S_{YEEU}	+	-	Unexpected
S_{YEUS}	+	+	Insignificant
S_{YEYU}	+	+	Expected
S_{USEU}(GM)	-	-	Insignificant
S_{USYE}(GM)	-	+	Insignificant
S_{USYU}(GM)	+	+	Insignificant
S_{EUUS}	+	+	Expected
S_{EUYE}	+	-	Insignificant
S_{EUYU}	+	+	Expected
S_{USEU}(Ford)	-	-	Expected
S_{USYE}(Ford)	-	-	Expected
S_{USYU}(Ford)	+	+	Insignificant

Table 29

S_{YEEU} - exchange rate of Japanese Yen against to Euro. The increase of S_{YEEU} means unexpected depreciation of Japanese Yen against to Euro. We assume that Europe is the area where Toyota's competitors are based in. According to our hypothesis, unexpected appreciation of currency in competitors' area will cause stock price to increase of local company. While from the empirical result in this paper, 1 unit increase of S_{YEEU} leads to 21% decrease of the return of Toyota's stock price. Since the result is unexpected for us, we give the explanation that Europe is a market for Toyota rather than as a competitor.

S_{YEYU} - exchange rate of Japanese Yen against to Chinese Yuan. The increase of S_{YEYU} means unexpected depreciation of Japanese Yen against to Chinese Yuan. We assume that China is a very important market for Toyota. So, according to our hypothesis, unexpected appreciation of currency in foreign market could increase the return of corporate stock price. The result of empirical study proved the hypothesis. Every 1 unit increase of S_{YEEU} leads to 40% increase of the return of Toyota's stock price. The result is in line with our expectation.

S_{EUUS} - exchange rate of Euro against to US dollar. The increase of S_{EUUS} means unexpected depreciation of Euro against to US dollar. US automakers are very important competitors of Volkswagen. Appreciation of US dollar against Euro, according to our hypothesis, will increase the competition of VW's products and thus increase the value of VW. The result of empirical study proved our expectation. One unit increase of S_{EUUS} could increase 3% return of VW's stock price.

S_{EUYU} - exchange rate of Euro against to Chinese Yuan. The increase of S_{EUYU} means unexpected depreciation of Euro against to Chinese Yuan. China is the second biggest market of automobile. Appreciation of currency in foreign market could increase the company's stock price. Although China is a world factory, it is more a market than a produce area for VW. According to our hypothesis, appreciation of Chinese Yuan could increase VW's stock price. The empirical result is in line with our hypothesis. One unit in crease of S_{EUYU} leads to 5% increase of the stock price return.

S_{USEU}(Ford) - exchange rate of US dollar against to Euro. The increase of S_{USEU} means unexpected depreciation of US dollar against to Euro. In Europe, there are both of own factories and competitors of Ford. Meanwhile, Europe is also an important market of Ford. Three factors impact on Ford's stock price at the same time and we assume that the produce factor is impacted mostly by unexpected exchange rate change. According to our hypothesis, the appreciation of Euro against to US dollar could decrease Ford's stock price. The empirical result shows that one unit increase of S_{USEU} will leads to 12% increase of Ford's stock price return.

S_{USYE}(Ford) - exchange rate of US dollar against to Euro. The increase of S_{USYE} means unexpected depreciation of US dollar against to Japanese. Similar as Europe, Ford owns subsidiaries and competitors in Japan. As a produce area, appreciation of Japanese Yen could lead to decrease of Ford's Stock price. While, as an area of competitors, appreciation of Japanese Yen could lead to increase of Ford's Stock price. We assume that Japan is a produce area rather than an area of competitors. So according to our hypothesis, it is proved by the empirical result that S_{USYE} has negative effect on ford's stock price. One unit increase of S_{USYE} could decrease 25% return of stock price.

Studied by previous literature (Oxelheim and Wihlborg, 2008), appreciation of currencies in foreign markets will positively affect corporate value, such as appreciation of Chinese Yuan against US dollar, Euro and Japanese Yen; appreciation of currencies in foreign produce area will negatively affect corporate value, such as Euro against to US dollar and Japanese Yen.

5.2. EFFECT OF MARKET INDEX ON CORPORATE STOCK PRICE

As the empirical result indicated, individual company's stock price is related to market index significantly.

The stock market index of Japan has weakly negative effect on Toyota's stock price.

We think there are two reasons causing this result. First, Japan is not the biggest market of Toyota. Most cash flow is obtained from foreign markets as the USA, China and Europe. When the stock market of Japan has unexpected increase, the whole economic situation of Japan must be posited in a high level and thus cause appreciation Japanese Yen against other main currencies. Depreciation of foreign markets' currency will cause decrease of return of company's stock price. Second, Toyota owns many oversea factories which located in all over the world. The situation weakens the impact of the index of Japanese stock market.

The cases of General Motors and Volkswagen reflect a general rule. The return of stock prices of individual companies is impacted by the whole market performance. One unit index of US stock market increase could lead to 29% increase of GM's stock price. One unit index of European stock market increase could lead to 17% increase of VW's stock price.

Similar to Toyota, Ford is impacted by US market negatively and weakly. The explanation that we believe is similar as Toyota. Ford's cash flow is also mainly from foreign market. The high level local market reflects appreciation of US dollar. This causes depreciation of stock price. On the other side, global production weakens the impact of US market.

We can not find previous literatures study exactly on the relationship between market index volatility and individual corporate value. Christiansen (2003) studied how the volatility in a number of European bond markets are affected by the volatility in the US and European bond markets. He distinguished between global, regional and local volatility effects and applied GARCH model. The conclusion he got is that For the EMU countries (plus Denmark) regional effects have been shown to be most important followed by local effects. Global effects have been shown to be almost inconsequential. For non-EMU countries own country effects have been found to be stronger, European effects smaller and US effects larger. The EMU countries have been shown to be less affected by the US bond market after the introduction of the

Euro.

5.3. HYPOTHESES

There are four hypotheses in this paper. The first one is that the appreciation of currency in the main foreign market of the company has a positive relation with firm's stock price. This hypothesis is proved by the empirical study of the variable of S_{YEYU}. Since China is the second market in the world of Toyota, the appreciation of Chinese Yuan could increase the cash flow to Toyota from China and thus increase the performance of Toyota. This hypothesis is proved by previous study (Oxelheim and Wihlborg, 2008).

The second hypothesis is that the appreciation of currency in the main foreign produce area of the company has a negative relation with firm's stock price. This hypothesis is proved by the empirical study of the variable of S_{USEU}(Ford). Europe is a very important produce area of Ford, as Ford owns many subsidiaries in Europe. Therefore, the appreciation of Euro could decrease the cash flow to Ford from Europe and thus decrease the performance of Ford. This hypothesis is also proved by Oxelheim and Wihlborg (2008).

The third hypothesis is that the appreciation of currency where the main supplier of company is based in has a negative relation with firm's stock price. This hypothesis is proved by the empirical study of the variable of S_{USYE}(Ford). Ford owns subsidiaries in Japan. In this way, Japan is a supplier of Ford. As a consequence, the appreciation of Japanese Yen could increase the cash flow of Ford to its suppliers in Japan and thus decrease the performance of Ford. Oxelheim and Wihlborg (2008) concluded that appreciation of supplier's currency increases input price and thus it decreases company's net cash flow and competition in foreign market.

The forth hypothesis is that the stock price of an individual company is related to the performance of the whole market where the company is based in. All of the four

companies that we selected are influenced by the stock market in their local country and the variables of market index are proved significantly. As mentioned before, we can not find previous literatures on the relationship between volatility of stock market index and individual corporate value. Christiansen (2003) find out the effect between countries is significant and Oxelheim and Wihlborg (2008) find out that the index of consumption is significantly affect on corporate value.

6. Conclusion

In the last chapter of this paper, a short conclusion is presented with possible improvements for the research in this field.

The purpose of the thesis is trying to find out the relationship between exchange rate and corporate value. Meanwhile, it is to study whether or not there is a relationship between individual company's stock price and performance of the whole stock market.

We chose four biggest automakers, Toyota, General Motors, Volkswagen and Ford in the world as our samples to study the impact of foreign exchange rate on their stock price. Incidentally, the relationship between market performance and individual company's performance is empirically estimated. We collected weekly data of nine exchange rates and three stock market indexes during the period 2000-2006 as independent variables to run regressions with the four companies' stock prices.

Five variables out of nine exchange rates are proved insignificant for corporate stock price. Appreciation of Chinese Yuan against to Japanese Yen and Euro is showed by empirical result to have positive effect on Toyota and Volkswagen's stock price, whereas the appreciation of Euro against to Japanese Yen and US dollar causes Toyota and Ford's stock price to decrease. The empirical result also shows that Japanese Yen's appreciation has a negative effect on Ford's stock price. All three variables of stock price indexes are proved to be significantly related with corporate stock price. However, the impact of significant variables on corporate stock price is weak. Considering four out of nine variables are insignificant, we conclude that the impact of exchange rate on automakers is weak.

The results of empirical study verified the hypotheses raised in the beginning of this

paper. Although the impact of exchange rate between Japanese Yen and Euro is unexpected from our assumption, we get reasonable explanation for it. All four hypotheses are supported by the empirical results in this paper: the appreciation of currency in the main foreign market of the company has a positive relation with firm's stock price; the appreciation of currency in the main foreign produce area of the company has a negative relation with firm's stock price; the appreciation of currency where main supplier of the company is based in has a negative relation with firm's stock price; the stock price of an individual company is related to the performance of the whole market where the company is based in.

This paper could be used to study the impact of exchange rate on public companies' performance. Further research in this area could do more in-depth study on the analysis of the company's operation in order to get sufficient information of the company's production, competition and marketing. More variables could be chosen to study the sufficient and correct factor impacting on corporate stock price

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