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Estimation and Forecasting of the Dynamic Relationship between Stock Prices and Exchange Rates: A Comparative Study

Estimation and Forecasting of the Dynamic Relationship between Stock Prices and Exchange Rates: A Comparative Study

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Abstract

This thesis examines the dynamic relationship between stock prices and exchange rates. Both long-run and short-run relationships between these variables are explored. The study uses daily time series data from China, the European Union, the United Kingdom and the United States. The period of study was divided into in-sample and out-of-sample data. The in-sample data set covered the period starting from January 3, 2000 to December 31, 2010 and included 22,976 observations after adjustments, whereas the out-of-sample data extended from January 3, 2011 to March 31, 2015 and incorporated 8,848 observations after adjustments. The study uses the in-sample-data to apply cointegration tests, the Vector Auto Regression model (VAR), the Vector Error Correction Model, and Granger causality tests to examine the short and long-run relationship between stock prices and exchange rates in the countries of the sample. The results revealed a long-run relationship between stock prices and exchange rates running from the Euro Exchange Rate to the FTSE Eurotop 100 Index, which supports the Flow-Oriented Theory. Furthermore, this study showed that there is a unidirectional Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price in the short-run. This result supports the arguments of the Flow-Oriented Theory. Moreover, this study demonstrates that there is a unidirectional Granger-causality relationship running from the Dow Jones Industrial Average Index closing price to the US Exchange Rate in the short-run, which corresponds with the arguments of the Share-Oriented Theory. With regards to the United Kingdom, bi-directional causality has been found between the FTSE 100 Index closing price and the UK Exchange Rate in the short-run, which supports Flow-Oriented and Share-Oriented Theories. Furthermore, this study uses the out-of-sample data to apply a VAR Forecast for China, the United Kingdom and the United States because there is short-run relationship between stock prices and exchange rates. The out-of-sample data is also used to estimate the VECM Forecast for the European Union.

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Dedication

I dedicate this thesis to my late father Ali Marseet, who passed away on 18th of February, 2012. May Allah's mercy and forgiveness be upon his soul. Ameen!

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Chapter 1: Introduction

1.1 Introduction

This introductory chapter begins by highlighting the significance of the research, followed by laying-out the research problem, the overall aim and objectives, the research questions, and a discussion regarding what motivated the researcher to carry out this research. The contributions of this study are also highlighted, as is the way in which they support other researchers to discover the importance of the current research in both the literature and practice in the field of finance, which is then followed by details of the research's key findings. The last part of this chapter demonstrates how this thesis is organized.

1.2 Significance of the Research

The present research is significant because its results will contribute to the increase of knowledge in the field of finance. Furthermore, this study provides additional evidence for the on-going debate regarding the type and direction of the relationship between exchange rate and stock closing price in the short and/or long-run, in both developing and developed countries (China, the European Union, the United Kingdom, and the United States). Additionally, this study does not limit itself to previous contributions, but extends its application to forecasting, after estimating the short or long relationships in the aforementioned countries. To the best of the researcher's knowledge, this is the first study to employ forecasting when studying the relationship between stock prices and exchange rates, and therefore it helps to understand the relationship between stock market and a foreigner market, especially in the short-run, because a better understanding of short-run movements for these two markets enables financial managers to make more informed investments and financing decisions.

1.3 The Research Problem

Few of the published studies have explored the relationship between the stock prices and the exchange rate in developing countries, such as China, where the stock market is government-controlled, and in developed countries (the United Kingdom, the European Union and the United States), where the stock markets are free. Through a review of previous studies, therefore, it can be seen that there is paucity in the literature concerning comparative studies between developing and developed countries. This research, therefore, attempts to address the gap in this area with up-to-date evidence for China, the European Union, the United States and the United Kingdom, through examining the dynamic relationship between stock prices and exchange rates in these countries.

1.4 Research Overall Aim and Research Objectives

The overall aim of this research is to examine the dynamic relationship between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States. In order to achieve this overall aim, the following three objectives have been formulated:

1. To detect both short and long–run relationships between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States.

2. To determine the direction of the relationship between stock prices and exchange rates and discover which of them affects the other or whether both affect each other in the previously mentioned countries.

3. To examine whether or not the data of the stock prices and exchange rate in the above-mentioned countries have good predictive ability for the future.

1.5 Research Questions

In order to achieve the objectives of this study, the following three main questions were formulated:

1- Is there any long-run relationship between:

a) The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate?
b) The FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate?
c) The FTSE 100 Index closing price and the UK Exchange Rate?
d) The Dow Jones Industrial Average Index closing price and the US Exchange Rate?

2- What is the direction of the relationship between:

a) The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate?
b) The FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate?
c) The FTSE 100 Index closing price and the UK Exchange Rate?
d) The Dow Jones Industrial Average Index closing price and the US Exchange Rate?

3- Do the data of the stock prices and exchange rates in the chosen countries have good predictive ability for the future?

1.6 Motivation for the Research

The motivation for the research can be divided into personal motivation and academic research motivation as follows:

1.6.1 The Personal motivation

The researcher taught economic and issues related to stock markets for a few years at university level. Therefore, the researcher has become interested in developing her awareness of what goes in the field of stock markets and foreign markets. As such, through a review of a number of previous studies, the researcher noted the main variable effecting stock prices of any index is the exchange rate, which has stimulated her to go deep enough to have a sufficient understanding of the relationships between stock prices and exchange rates. Furthermore, the researcher is interested in understanding the difference (with regards to this relationship) between the countries whose governments control the stock market and the countries that have free stock markets. Therefore, the researcher has chosen a sample which includes mixed countries (Government controlled stock markets and free stock market).

1.6.2 The Research Motivation and the Rationales behind Selecting Each Country

The primary motivation behind conducting this research can be seen in the reality that through a review of previous studies, it is evident that there has been limited research carried out to explore the relationship between stock prices and exchange rate as a comparative study between developing countries, where the stock market is government-controlled, and in developed countries, where the stock markets are free. As such, this study attempts to fill this gap in the literature through examining this relationship between developing countries like China and developed countries such as the European Union, the United Kingdom in the short and long run.

Additionally, in this study, the researcher has selected China, the United States, the United Kingdom and the European Union for several reasons. Firstly, the European Union, which is composed of many countries, is treated as if it is one group for the aims of the analysis and discussion in this thesis. This is because the FTSE Eurotop 100 Index represents the 100 most highly capitalized Blue-Chip Companies in Europe. Secondly, although the United Kingdom is a member of the European Union, it possesses the London Stock Exchange market, which is the second largest stock market in the world. Thirdly, the New York stock market has been included because it is the world's leading market. Additionally, the three stock markets for these countries are free stock markets, whereas the stock market of China is government controlled, which is another reason for choosing China. Moreover, another key reason for selecting these four countries together is the availability of data in terms of using daily time series data, which is not accessible in all countries at the same time. Moreover, the researcher is employing specific techniques and software to carry out the analysis, which requires a large number of observations. Similarly, the researcher chose the Shanghai Stock Exchange Composite Index, the FTSE Eurotop 100 Index, the UK FTSE 100 Index and the Dow Jones Industrial Average Index because these indices include the largest companies representing the vast majority of the economies of the countries mentioned earlier.

More specifically, the main reason behind selecting the Shanghai Stock Exchange Composite Index is because it is the largest indicator in the Chinese Stock Market, and this index includes the largest companies, which are state-owned business listed on the Shanghai Stock Exchange Market. Furthermore, this index includes the firms that are relatively small joint ventures or private businesses and are mostly export-oriented as listed on the Shenzhen Stock Exchange Market (Levy & Newell, 2000; Varma, 2006).

With regards to the FTSE 100 Index for United Kingdom, such selection attributes to the fact that it includes some of the most proactive companies in the world with regards to climate change, and it also measures the performance of the largest 100 firms (in terms of market capitalization) on the London Stock Exchange (Khurshed, 2011; Nieh & Yau, 2009). Additionally, the reason behind using the Dow Jones Industrial Average Index is that it is the best-known stock index in the world, including thirty major U.S. firms. Its main goal is to represent the performance of the stock market by measuring the performance of firms with established track records, who are dominant players in their respective industries. Considering these central countries aim to achieve the overall aim of this research.

1.7 Contribution to Knowledge

The study is a contribution to the existing knowledge, since it explores the relationship between stock prices and exchange rates in the four major stock markets in the world.

This also contributes to an enrichment of the literature through the empirical investigation of the association between the nominal exchange rates and stock prices in China, where the stock market is government-controlled, and in developed countries (the United Kingdom, the United States and the European Union) where the stock markets are free. The contribution of this study lies in the fact that it provides additional empirical evidence on the on-going debate about the type and direction of the relationship between exchange rate and stock price in the short and long-run relationship in the countries mentioned above. More specifically, this research contributes to knowledge on three levels, which are as follows.

Firstly, on the empirical level, although previous studies (Amarasinghe & Dharmaratne, 2014; Bahmani-Oskooee & Domac, 1997; Caporale, Pittis, & Spagnolo, 2002; Fowowe, 2015; Kim, 2003; Li & Huang, 2008; Nieh & Yau, 2010) have examined the relationship between exchange rates and stock prices, this study is the first of the very few studies (Nydahl & Friberg, 1999; Stavarek, 2005; Zhang, Panagiotidis, & Alagidede, 2011) which provide an up to date empirical examination of the relationship between the nominal exchange rates and stock prices in developing countries, namely China, where the stock market is government-controlled, and in developed countries, namely the United Kingdom, the United States and the European Union, where the stock markets are free.

Secondly, on a practical level, this study provides additional empirical evidence on the ongoing debate about the type and direction of the relationship between exchange rate and stock price in the short or long-run in the sample countries. Thirdly, on the methodological level, to the best of the researcher's knowledge, this is the first study to employ forecasting techniques in the sample, using the VAR Forecasts in case there is short-run relationship between stock prices and exchange rates, and using the VEC Forecasts in the case there is long-run relationship between stock prices and exchange rates. This can be considered another contribution of this research.

1.8 The key findings

The aim of this section is to briefly highlight the key findings of this research. As such, the first key finding of this research is that there is unidirectional Granger-causality relationship running from the Exchange Rate to stock prices in the short-run for China, which supports the Flow-Oriented Theory. The second key finding of this research is that there is unidirectional Granger-causality relationship running Rate from stock prices to the Exchange in the short run for United States, which supports the share-Oriented Theory. The third key finding of this research is that there is the bi-directional Granger-causality relationship between stock price and exchange rate in the short-run, which supports the Flow-Oriented and the Share-Oriented Theories. The fourth key finding of this study is that there is unidirectional Granger-causality relationship running from the Exchange Rate to stock prices in the long run for the European Union, which supports the Flow-Oriented Theory. Finally, an analysis of this data further showed that the data of the stock market and exchange rate in the four countries examined have a good predictive ability for the future.

1.9 Structure of the Thesis

The thesis is divided into seven chapters. Following this introductory chapter, chapter two covers the theoretical and empirical background of the research regarding the relationship between stock prices and exchange rate in the short and long-run. In addition, the relevance of this study to current research is discussed in this chapter.

Chapter three presents the reasons why the researcher used the chosen variables and data sources. Moreover, this chapter discusses the different econometric and statistical methodologies that are applied throughout the thesis, including the Augmented Dickey-Fuller and Phillip Peron unit root tests and the Engle–Granger and the Johansen's cointegration test. Furthermore, this chapter explains the Granger causality tests and provides a detailed explanation of how it can estimate the Granger causality tests under the Vector Auto Regression model (VAR) and under the Vector Error Correction (VECM) Model in case the variables are Co-integrated. This chapter also includes how it can estimate the regression model by the Ordinary Least Squares (OLS) method and estimate the regression model by the Weighted Least Squares (WLS) method, in case the time series data is at a stationary at level. The last part of this chapter presents how it can estimate forecasting with Autocorrelated Errors (Dynamic forecasting) and the test of the Predictive Capability.

Chapter four discusses in detail the empirical results obtained by analyzing the time series of in-sample data. This chapter presents the descriptive statistics of stock prices, exchange rate growth and the determination of the Optimal Lag Lengths of the VAR Model for all the sample countries. In addition, the chapter deals with the results of the Augmented Dickey-Fuller and Phillip Peron tests for each variable individually. Moreover, it provides the results of the Engle-Granger and Johansen's cointegration test and the results of short-run causality relationship under the Vector Auto Regression model (VAR). Likewise, the results of the long–run causality relationship under the VECM will be dealt with. The results of the Pairwise Granger causality tests in both the short- run and the long-run will be shown in this chapter.

Chapter five presents how to estimate the VAR Forecast and the VECM Forecast father descriptive statistics and applied the Augmented Dickey-Fuller and Phillips-Perron unit root tests of the out-of- sample time series data.

Chapter six discusses the research results that have been obtained by applying the different tests referred to in the methodology chapter, in order to achieve the research aims and answer the research questions. It also refers to the previous studies that investigated the relationship between stock prices and exchange rate in China, the European Union, the United Kingdom and the United States. Furthermore, this chapter discusses the results with regards to employing the VAR Forecast and the VECM.

The final chapter discusses the results obtained from the current study with respect to the research questions and objectives. a discussion of the achievements of the research is provided. Some ideas for further research are presented, with the hope that other researchers in this field benefit from the theoretical and practical implications of the findings of this study.

Chapter 2: Theoretical Framework and Literature Review

2.1 Introduction

This study attempts to disclose the relationship between stock price and exchange rates, in both the short and long-run, in China, the European Union, the United Kingdom and the United States. The relationship between stock price and exchange rates has been tested in the countries mentioned above. Therefore, this chapter consists of six parts, including the introduction. The second part covers the theoretical framework and literature review. The third part surveys the empirical studies of the short-run relationship between stock prices and exchange rates, based on causality tests. The fourth part deals with the empirical studies of the long-run relationships between stock prices and exchange rates based on cointegration techniques. The fifth part introduced the relevance of the current research with the previous studies, while the final part is a chapter summary.

Then, the chapter deals with what other researchers have achieved in studying the relationship between stock prices and exchange rates. It will deal with the theories that tackle these relationships in detail. Highlighting the different views of these theories enables the researcher to locate his research within the proper context. What the researcher will also discuss the issues of both theories, which are of great relevance to the current research.

2.2 Theoretical Framework

There are many theories sharing views concerning stock markets and foreign exchange markets, for example the Efficient Capital Market, the Capital Asset Pricing, the Arbitrage Pricing, the Random Walk, the Power Parity, the Flow-Oriented, the Stock-Oriented, and Monetary Theories. All of these theories are within the research area of the current study, but only the Flow-Oriented and the Stock-Oriented theories are of direct relevance to it. Both theories study the direction of the relationship between the stock price and exchange rate, and the impact of each one on the other. As mentioned earlier, the Flow-Oriented and the Stock-Oriented theories will be discussed in detail, since they are the focus of the current research in explaining the relationship between stock prices and exchange rate. The next section will deal with the dynamic linkage between stock prices and exchange rates.

2.2.1 The Flow-Oriented Theory or Traditional Theory

The first theory studying the linkage between stock market prices and exchange rate movements is the Flow-Oriented Theory (Dornbusch & Fischer, 1980, p. 39), also known as the Traditional Theory, it suggests that exchange rate movements should lead to stock price movements. It is based on a macroeconomic view and the efficient market hypothesis, because the stock prices represent the discounted present value of expected future cash flows of the company, and any phenomenon that affects the cash flow of the firm will be reflected in the firm's stock price. “In terms of Granger's causality; it is causal "unidirectional" runs from exchange rates to stock prices or that exchange rates are 'Granger - cause' of stock prices” (Biao, 2009, p. 9).

To clarify, this theory assumes that the competitiveness of a firm is affected by the change or exchange rate fluctuation that in turn will affect the company’s earnings and value-added, then the stock prices in general. In particular, the Flow-Oriented Theory assumes that the exchange rate is determined largely by the current account of the country or the trade balance performance. On the other hand, the stock price is usually defined as the present value of the company's future cash flows (Bodnar & Gentry, 1993, pp. 29-45). According to this theory, international competitiveness and the balance of trade position are affected by currency movement, and any change in an exchange rate, which in turn affects the real economic variables such as output and real income of the country (ibid). In the case of multi-national companies, exchange rate movements have an impact on their competitiveness, and thus, their earnings and stock prices; exchange rate movements affect the competitiveness of companies through its impact on the price of inputs and outputs (Biao, 2009, pp. 9-31).

As a result of the improvement of the local currency status, it will make exported goods relatively expensive, which in turn will lead to a decrease in external demand and sales, and therefore, the company's profits will decline and so will the stock price. On the other hand, when the local currency appreciates, the imported goods become relatively cheaper. Therefore, for importing companies, the relationship between the value of the company and exchange rate movements are just the opposite (Biao, 2009, pp. 9-31). Bodnar and Gentry (1993, pp. 29-45) also explained that fluctuation in stock prices might affect the company's prices and assets denominated in foreign currencies. Furthermore, the movement of exchange rate also has an impact on the future of the company in terms of the receivables or payables denominated in foreign currency. For those who import goods, the appreciation in the value of the local currency leads to profits increasing, while the devaluation of the local currency will reduce profits. The conclusion drawn from this review is that stock prices are affected by the exchange rate movements (Biao, 2009, pp. 9-31).

Other studies, which use the exchange rate models, also reach the same conclusion. For instance, Hekman (1985) suggests a value based financial valuation model for multinational companies, where exchange rate is the leading indicator of stock prices. Through exploring the effects of the exchange rate volatility on the firm value, Sercu and Vanhulle (1992, pp. 155-182) answered this equation in which the increase in the exchange rate volatility has a positive impact on the market value of companies. Granger, Huangb, and Yang (2000, pp. 337-354) also reached the result that the change in exchange rates leads to change the market value of all companies that conduct international trade. In addition, Granger et al. (2000, pp. 337-354) consider the impact of exchange rates on the firm's stock prices depending on the firm's status in terms of net importers or exporters. In other words, currency devaluation would benefit from the firm profit, and therefore their stock market values when the firms are exporters.

Moreover, changes in exchange rates affect the firm's transactions. In fact, the change of exchange rate has its effect on the firm's future concerning the receivable or payable denominated in foreign currency (Biao, 2009, pp. 9-31). Despite the fact that the growing use of derivatives, such as currency options and forward contracts, may work to limit the way in which currency changes affect the profits of the company, most companies tend to be influenced in some way by changes in exchange rates (ibid). As Adler and Dumas (1984, pp. 41-50) have already reported, local companies and companies that have limited international business may encounter exchange rate risks because that exchange rate movement will affect their input, output prices, or demand of products. Therefore, on a macroeconomic basis, a country's international trades and the degree of the trade imbalance have an influence on the movements of exchange rates on stock prices (ibid). This change is confirmed by Bodnar and Gentry (1993), who stated that the firms that get involved in international trade activities could be exposed to foreign exchange rate risk at any time (Biao, 2009, pp. 9-31).

To sum up, the Flow-Oriented Theory suggests that any changes in exchange rates can cause changes in stock prices. However, a company can be either the importer or the exporter, and the net impact of the stock market values cannot be clearly determined. The sign of the correlation between stock prices and exchange rates is thereby irrational, to some extent. The reduction of local currency value will make local firms who are exporters more competitive, and thus it raises the prices of its shares. Thus, the Flow Oriented Theory indicates that there is "a positive relationship between stock prices and exchanges rates with direction of causation running from exchange rates to stock prices" (Stavarek, 2005b, p. 141). According to Granger's causality; this positive relationship is known as the causal "unidirectional" runs from exchanges rates to stock prices or exchange rates is Granger - cause of stock price (Biao, 2009, pp. 9-13). Under these conditions, one may expect a positive causal relationship running from exchange rates to stock prices (Liu, 2009, pp. 196-204).

2.2.2 The Stock-Oriented or Portfolio Balance Theory

The second theory is the Stock-Oriented Theory (Branson, Aghevli, & Komiya, 1983; Frankel, 1987; Rosenberg, 2003), which is also known as the portfolio balance theory. It was founded by Branson, Halttunen, and Masson (1977). It studies the linkage between the stock market prices and the exchange rate movements.

There is a difference between the "Stock-Oriented" theory and "Flow-Oriented" theory concerning the explanation of the exchange movement and how it affects the movement of the stock price. The Flow-Oriented Theory assumes that exchange rate movements should lead toward stock price movements, while the Stock-Oriented Theory suggests that the fluctuations of the stock prices can influence the exchange rate movements. The Stock-Oriented Theory claims that stock prices have a negative correlation impact on the exchange rate, which is due to a decline in stock prices that leads to a contraction of domestic wealth, which is expected to influence money demand and interest rates. In addition, the demand of foreign investors for domestic currency and domestic assets will decrease, because of the decline in the domestic stock prices. Thus, the shifts that occur in the supply and demand of currencies lead to capital outflows and the devaluation of domestic currency. In an opposite case, when the value of stock prices increase, foreign investors become more interested in investing in a country's equity securities, because of their belief that it is possible to benefit from international diversification. This situation in turn causes capital inflows and raises the value of the currency (Caporale, Pittis, & Spagnolo, 2002; Granger et al., 2000; Pan, Fok, & Liu, 2007; Stavarek, 2005a)

In summary, the rising of the stock market would attract capital inflows from foreign investors, which leads to an increase in demand of currency of the country, and vice versa. Therefore, because of a decline or rise in stock prices, they have the relationship with an appreciation (depreciation) in exchange rates. Furthermore, the benefits of international diversification are considered another essential reason for investors to invest in a foreign country's equity securities. Moreover, an improvement in an investment climate of a country (e.g., a stable political system, a fair legal system, financial openness and liberalization, etc.) will cause capital inflows and improvement in the status of currency (Biao, 2009, pp. 9-31). Furthermore, Gavin (1989, pp. 181- 200) argues that the performance of the stock market has a significant role in determining the wealth of investors and money demand. Naturally, at the time of the financial crisis, the behaviour of investor’s changes; this is a result of loss of confidence in economic and political stability, which causes sudden disintegration of the assets demands. This disintegration often leads to changes in portfolio preference from domestic assets to foreign-currency assets (for example, the U.S. dollar) (Biao, 2009, pp. 9-31). That leads to depreciating of the local currency has a negative impact on the stock market returns (Adjasi & Biekpe, 2005). Tabak (2006, pp. 1-37) showed that stock prices lead to exchange rates with a negative relationship. This leads to a rise in the demand for money, and thus a rise in interest rates, which leads to higher inflows of foreign capital, and in turn leads to a currency appreciation. Therefore, the currency appreciation was a result of raising the inflows of foreign capital (Biao, 2009, pp. 9-31).

Kutty (2010a) mentioned another theoretical argument in the dynamic relationship between stock price and exchange rate. The Stock-Oriented Theory can be deemed another channel by which movements in stock prices have effect on change of exchange rates. This theory assumes that "the portfolio adjustments [movements in the foreign capital- inflows and outflows of foreign capital] occur whenever there is a change in the stock prices" (Kutty, 2010a, p. 9). Therefore, rising in stock price will attract more foreign capital, which leads to an increase in the domestic investor's wealth. This means raising the demand for money, and thus increasing interest rates, which leads to higher inflows of foreign capital, and in turn leads to a currency appreciation which resulted from raising the inflows of foreign capital. On the contrary, a decline in the stock prices will cause a diminished corporate wealth, which reduces the country's wealth. This may cause a reduction in the demand for money and the monetary authorities decreasing interest rates to alleviate this situation. The capital may flow out of a country when the interest rates are lower (relatively speaking) to take advantage of rising interest rates in another country, which leads to the devaluation of the currency. Thus, this theory suggests that lower stock prices may cause currency depreciation (Agyapong, 2012, pp. 7-19).

Yu (1997, pp. 47-56) also argues that capital outflows have effects on exchange rate when movements in stock prices are stable enough to build or break the confidence of investors in the stock market. In general, the Stock-Oriented Theory assumes Granger causes a negative association between stock prices and exchange rates; an increase in stock prices leads to improvement in the value of domestic currency because of an increase in the domestic currency's demand. Likewise, the decline in stock prices leads to a reduction of the exchange rate, due to an increase in the supply of foreign currency (Liu, 2009, pp. 196-204).

The economic analysis suggests that the value of the company is related to exchange rate movements. This is confirmed by Shapiro (1975, pp. 485-502), who predicted an increase in the value of domestic companies with the depreciation of domestic currency. Adler and Dumas (1984, pp. 41-50) also believe that the effect is not limited to domestic companies only, but it also extends to foreign companies that operate in local markets. Moreover, developments occurring in the stock market lead to the development of an asset market model. This is how the asset market model visualizes currencies as an asset in financial market. As a result, currencies are increasingly demonstrating a strong relationship with other markets, especially the equities like stock exchange in that money can be lost or made on the foreign exchange market by investors and speculators buying and selling at the correct times. In general, currencies can be traded at spot (current exchange rates) and foreign exchange options markets (derivatives of exchange rates) (Agyapong, 2012, pp. 9-17).

Sharpe (1970) explained that the Capital Asset Pricing Model introduced by the Stock-Oriented Theory and Capital Markets. Moreover, he has identified two different risks (systematic and unsystematic risks) to be associated with the investment (Agyapong, 2012, pp. 9-17). The systematic risk is encountered by virtue of being in the market and the unsystematic one emerges from the firm's operations, and how they should be assessed in terms of portfolios and individual securities. Because of the existing risks, the strategies of investors are creating the diversified portfolio made of securities or financial assets from various areas, including capital, real assets, money, and foreign exchange markets (using the currency as a commodity) (ibid). In times and places of domestic currency dropping against a major trading currency, investing in currency commodity would be a proper alternative to investing in stocks. Likewise, currency commodity could be a suitable alternative of investment in money market (Adjasi, Harvey, & Agyapong, 2008, pp. 7-28).

Solnik (2000) believes that there is another important issue in the theory when studying the relationship between the exchange rate and returns. Solnik believes that the impact of the risks and crises are the basics of the financial crisis. It has been observed that in many emerging markets, financial periodical crises shook the interest rate, exchange rate, and stock prices. Such disintegration is also recorded in the developed markets respectively, but it is less frequent and in a smaller amount, and the recovery is quicker than in emerging markets (Patel & Sarkar, 1998, pp. 50-61). In emerging markets, the crash is usually triggered through a currency crisis. Therefore, the economies in the emerging countries are less diversified than developed countries, because they depend on a few activities to produce exports and are strongly dependent on imports. Thus, the exchange rate is a crucial variable (Agyapong, 2012, pp. 9-17).

It is clear from this theoretical review that there are different ways for the stock and currency markets interaction. This makes the empirical analysis of the degree and direction of the causal relationship between exchange rates and stock prices, of particular interest and provided the motivation to conduct several studies in order to evaluate the relationship between exchange rates and stock prices. Although theories such as the Stock-Oriented and Flow–Oriented Theories showed that the relationship should exist among exchange rates and stock prices, the evidence provided through the literature concerning this issue has been mixed (Richards, Simpson, & Evans, 2009, pp. 3-23).

2.2.3 Summary of the Theories

Some of the previous empirical studies provide mixed conclusions; they found the causality relationship from exchange rate to stock prices which corresponds with the Flow-Oriented Theory, for example, (Asaolu & Ogunmuyiwa, 2011; Inci & Lee, 2014; Maswere & Kaberuka, 2013). Other studies found the causality relationship running from stock prices to exchange rate supporting the Stock-Oriented Theory for instance, (Bhunia, 2012; Kutty, 2010a; Nieh & Yau, 2010; Tsai, 2012). Some comparative studies that examined the relationship between stock prices and exchange rate in more than one country often support both theories. That depends on the results for each country on its own such as the study of (Lean, Narayan, & Smyth, 2011; Rutledge, Karim, & Li, 2014; Zhang, Panagiotidis, & Alagidede, 2011). There are some studies for one country or more supporting both theories in case the direction of the relationship between stock prices and exchange rate is bi-directional, such as the studies of (Abdullah, Parvez, Tooheen, & Saha, 2014; Andreou, Matsi, & Savvides, 2013; Caporale, Hunter, & Ali, 2013; Kumar, 2013) .There are some other studies which explore the relationship between stock prices and exchange rate and they found no relationship and these two variable are independent and they do not affect each other (Franck & Young, 1972; Ibrahim & Aziz, 2003; Kaliyamoorthy & Parithi, 2012; Kumar, 2009; Srinivasan, 2014).

The next part will tackle the short-run relationship between stock prices and exchange rates starting from a historical view and including discussion of relevant views.

2.3 Short-Run Relationships between Stock Prices and Exchange Rate

Studying the linkage between stock prices and exchange rate has started since 1970s. The study of Franck and Young (1972) was the first study that examined this relationship using the change of six exchange rates to employ a regression analysis. They found no relationship between stock prices and exchange rate. Other earlier studies were by Ang and Ghallab (1976). They examined the behaviour of stock price during US dollar devaluation of fifteen US MNC's stock returns to US dollar fluctuation during the period from August 1971 to March 1973. Their results are consistent with previous observational studies, which found no significant relationships between the variables.

The empirical evidence of the relationships between stock prices and exchange rates started with Aggarwal (1981), who was among the first to study the effects of exchange rates on stock prices using monthly data of the United States Economy during the period from 1974 to 1978. The study employed the Ordinary least Squares method to investigate the relationships between stock prices and exchange rates. His study shows that there is a positive correlation between the trade-weighted exchange rates and the US stock market indices. Given that there a positive correlation consequently his study supports the Flow-Oriented Theory. His findings are in contrast with the results of Soenen and Hennigar (1988). They provided evidence of negative correlations, although they used the same variables, and the period of their study included a period study of Aggarwal's study, which extended from 1973 to 1988 for each month, they employed the Correlation analysis. The difference in the period and the method may give those different results. Moreover, their study provides evidence in support of the Stock-Oriented Theory. In the 1990s, quick developments in econometrics including unit root tests and cointegration tests encouraged many researchers to study this issue using newly developed methods. Ma and Kao (1990) examined the degree of stock price reaction to exchange rate changes in six industrialised economies, including Japan, Italy, France, West Germany, Canada, and the United Kingdom. They used monthly data from January 1973 to December 1983 and employed the asset-pricing model. Their study did not only examine a relationship between stock markets and financial markets, it also added an important dimension (the relationships between stock prices at the macro and micro levels) to the discussion of the relationship between these markets. Therefore, the study was useful in establishing a foundation for further studies on the interaction between stock prices and exchange rates. Ma and Kao’s findings supported The Flow-Oriented Theory where they found exporting firms’ stock values sensitive to changes in foreign exchange rates. In other words, “exchange rates driving stock prices” (Richards et al., 2009, pp. 5-11). In spite of all these advantages, their study was limited because they only used simple regression analysis to establish a correlation between the variables or only examined the reaction of one variable to changes in the other (ibid).

Bahmani-Oskooee and Sohrabian (1992) were the first researchers who used the cointegration method to test the correlation between stock prices and exchange rates, which was considered as the contribution of their study. To find the long and short-run relationships between stock prices and exchange rates, they applied both the Granger-causality and the cointegration tests. The data used consisted of monthly data for the Poor's Composite Index of 500 stocks the price of the Poor's Composite Index of 500 Index and the exchange rates of the United States from July 1973 to December 1988. Their study supported the arguments of the Flow-Oriented Theories, because there is a bi-directional causality relationship running from the exchange rate to the price of the Poor's Composite Index of 500 Index in the short-run and while they did not find any relationships between the variables in the long run. Although the study used a new method of that time, however, it used also monthly data, which might not capture the changes in stock prices. After Bahmani-Oskooee and Sohrabian’s study the cointegration technique became the second model applied when examining the relationships between stock prices and exchange rates in the short or long term after employing the unit root test (Bahmani-Oskooee & Sohrabian, 1992, pp. 459-464). Some researchers preferred to use different specific techniques to examine the relationship between stock prices and exchange rate. For example, Rittenberg (1993) explored the relationship between changes of exchange rate and changes of price level in Turkish Stock Market during the 1980s. The study employed three different specific techniques for optimal lag selection i.e. the subset model, auto regression method of Kunst and Marin (1989) and an arbitrarily selected Hsiao method (1979). His empirical work shows in all the cases that the Granger-causality relation runs from price level changes to exchange rate changes. Reviewing previous studies about the relationships between stock prices and exchange rates, these tests were rarely used (Rittenberg, 1993, pp. 245-259).

There are some studies published after the Asian crises, but their analysis did not include the crisis period. Therefore, the results of these studies cannot be compared to other studies that include the crisis period. Some of these studies, for example, included (Abdalla & Murinde, 1997; Ibrahim, 2000; Nydahl & Friberg, 1999; Yu, 1997).Yu's (1997) study supported both the Flow-Oriented and Stock-Oriented Theories. The study employed the Granger-causality test and the Vector Auto Regression model (VAR) on stock prices and spotted exchange rates of the Hong Kong, Singaporean, and the Tokyo stock markets from January 3, 1983 to June 15, 1994. The study showed mixed results, in the short-run there is a bi-directional causality between stock return and changes in exchange rates of the Tokyo stock market and any changes in stock prices are caused by changes in exchange rates in the Hong-Kong market. However, no such causation relationship was found for the Singaporean Stock Market. The Vector Auto Regression model displayed that there is a strongly short-run relationship between these two variables for all three markets. These mixed results are consistent with Abdalla and Murinde's (1997) study of four Asian markets. They used the Engle-Granger cointegration test, VAR model and the error correction model (ECM) to investigate the relationships between exchange rates and stock prices in the Indian, Pakistani, the Philippines and the Korean stock markets. They analysed monthly data for the period from 1985 to 1994. They found the unidirectional causality relationship from exchange rates to stock prices in the Indian stock market and a unidirectional causality relationship running from stock prices to exchange rates in the Philippines. On the other hand, they did not find any causality relationships between stock prices and exchange rates in the Pakistani and the Korean context.

Ajayi, Friedman, and Mehdian (1998) used daily and weekly closing prices and exchange rates data for two groups; the first group included seven advanced markets (Canada, France, Italy, Germany, Japan, the United States and the United kingdom) from April 1985 to August 1991. The second group included eight Asian emerging markets in Taiwan, The Philippines, Indonesia, Korea, Hong Kong, Thailand, Singapore and Malaysia from December 1987 to September 1991 employing the Granger-causality (1969) test. They found a unidirectional causality relationship running from stock prices to exchange rates in all the six advanced markets; therefore, their results supported the Stock-Oriented Theory (Ajayi et al., 1998, pp. 241-251). Moreover, the study showed mixed results in respect to Asian emerging markets. There was a bi-directional causality relationship in Taiwan meanwhile there was unidirectional causality relationship running from stock prices to the exchange rate in the Philippines and Indonesia. Furthermore, there was unidirectional causality relationship running from exchange rates to stock prices in the Korean stock market. In addition, there is no significant causal relationship in the Hong Kong, Thai, Singaporean and the Malaysian stock markets in a long or short-run relationship.

Nydahl and Friberg (1999) found positive relationships from stocks prices to exchange rates when they examined the relationship between the valuation of the stock market and an effective nominal exchange rate in the eleven industrialized countries. They used monthly data from 1973 to 1996, applying an ordinary least square (OLS) regression method. The study sample included the disparate economies of Austria, Belgium, Denmark, Germany, France, Italy, Japan, Norway, the Netherlands, Sweden, Finland, Switzerland, the United States and the United Kingdom. Therefore, it does not logically get the same results for all countries due to the size and structure of the markets. In addition, the study was limited to using the ordinary least square method. Ibrahim (2000) used bivariate, multivariate cointegration and the Granger-causality test to investigate the relationships between stock prices and exchange rates for Malaysia. He applied three exchange rates namely the nominal effective exchange rate, the ringgit via-a-vis the U.S. dollar rate and the real effective exchange rate. The study used monthly data from January 1979 to June 1996. The multivariate tests results demonstrated that there is not a long-run relationship between stock prices and exchange rates. Nonetheless, there is evidence for a bi-directional causality relationship between the variables only in of the nominal effective exchange rates. Therefore, Ibrahim study supported both the Flow-Oriented and Stock- Oriented Theories (Ibrahim, 2000, pp. 36-47).

2.3.1 During and after the Asian Crises from 1997 to 2006

In the late 1990s, the Asian financial crisis experienced interest in the interaction between currency and stock markets in developing markets. The crisis was plunged currency and stock markets in southern Asian countries. Thus, some studies were conducted to detect the impact of the stock prices and the changes in exchange rates (Biao, 2009, pp. 9-20). Granger et al. (2000) study was the first study that investigated the bivariate causality between exchange rates and stock prices in the short-run in Hong Kong, Japan, Indonesia, Malaysia, the Philippines, Singapore, Thailand South Korea, and Taiwan. They employed the Gregory and Hansen cointegration test and Granger causality tests using daily data observations from January 3, 1986 to June 16, 1998. Their results revealed that the stock prices lead exchange rates for the Philippines which were consistent with Abdalla and Murinde's (1997) study. Furthermore, they found the bi-directional causality relationship for Hong Kong, Singapore, Malaysia, Thailand and Taiwan whereas the study failed to reveal any recognizable patterns of Indonesia and Japan. Their results were inconsistent with Yu's (1997) study of Hong Kong market which showed no changes in stock prices caused by changes in exchange rates while the results of Granger et al. (2000) were inconsistent with Ibrahim (2000) for Malaysia who found evidence of a short-run causal relationship from stock prices to exchange rates.

Moreover, their study showed that only South Korea followed the Flow-Oriented Theory, which demonstrated exchange rates caused stock market changes in South Korea. Their result was consistent with the finding of Ajayi et al. (1998) and Granger et al. (2000) for South Korea where both studies found a unidirectional causal relationship from exchange rate to stock prices. Whilst the results were conflicting with the results of (Abdalla & Murinde, 1997; Doong, Yang, & Wang, 2005; Fama & Miller, 1972) for Korean stock markets. Abdalla and Murinde (1997) did not find any causality relationships between stock prices and exchange rate whereas Doong et al. (2005) found a bi-directional causality between the South Korean exchange market and the South Korean stock market when they examined the dynamic relationship between stocks prices and exchange rates. They employed the Engle and Granger test, the Granger-causality test and finally an unrestrictive bivariate GARCH-M model using daily data from January 3, 1986 to November 14, 1997. The study also examined the relationships for Indonesia, Malaysia, The Philippines, Thailand, and Taiwan. The result of the Granger-causality test revealed the existence of the bi-directional causality in Thailand, Malaysia, and Indonesia and there are no significant casual relationships were observed for the Philippines and Taiwan. Moreover, the Engle and Granger test showed that stock prices and exchange rates are not Co-integrated. This difference in results is due to the difference in the period (Doong et al., 2005, pp. 118-123).

Some studies include only the Asian crisis period, and others studies do not include it or include the period before and after the Asian session. Furthermore, the difference in results is due to the difference of the tests used. Smyth and Nandha (2003) chose Bangladesh, India, Pakistan and Sri Lanka to investigate the relationships between stock prices and exchange rates. They used monthly data over a five-year period starting from January 1994 to December 2000. The study employed both Engle–Granger two-step and Johansen's cointegration test and the Granger causality test. The Johansen cointegration results suggested that there is no long-run association between these two financial variables in any of the four countries while the Granger causality test found that there is unidirectional causality relationship running from exchange rates to stock prices in the Sri Lanka and India. For Bangladesh and the Pakistani Exchange Rates and stock prices were independent. Mishra (2004) did not agree with Smyth and Nandha (2003) in respect to India. He attempted to detect whether the stock market and foreign exchange markets are related to each other or not in India. His study used the Granger's causality and the VAR tests on monthly data of stock return and exchange rate from April 1992 to March 2002. The findings of the study showed no Granger's causality relationship between the exchange rate and stock return. Hatemi and Roca (2005) attempted to examine the link between exchange rates and stock prices in Indonesia, the Philippines, Malaysia and Thailand. They used bootstrap causality tests with leveraged adjustments before and during the Asian financial crisis of 1997. They preferred to use daily data just for the first year of the Asian financial crises, which started from 1 January until 31 December. They divided the sample period into two sub-periods. The first period comprised the duration, before the crisis from 1 January to 1 July 1997, and the second period included the crisis period from 2 July to 31 December 1997. They found that before the Asian crisis, exchange rates Granger cause changed in stock prices for all countries except the Philippines. While during the crisis period there was not any relationships in any of the countries mentioned. They claimed that "the foreign exchange and stock markets became segmented or the transmission of information between the two markets became efficient during the crisis" (Hatemi & Roca, 2005, p. 545).

Although Hatemi and Roca (2005) used daily data, which are better than the monthly ones to capture the changes in stock prices and exchange rates, but they used just one year that might make their results limited. That is what they differed from the study results of Doong et al. (2005) in which they used daily data and long period including the period before, during and after the Asian crisis. Therefore, they reported conflicting results for Malaysia, Indonesia, the Philippines and Thailand whereas both studies agree about the Philippines; both studies displayed no significant casual relationships observed for the Philippines. Phylaktis and Ravazzolo (2005) applied the Johansen's cointegration test, multivariate Granger causality and VAR tests to determine the long-run and short-run dynamics between stock prices and exchange rates. The sample of the study included six countries of the Pacific Basin; namely Malaysia, Hong Kong, Singapore, Thailand, Indonesia, and the Philippines. The researchers analysed monthly data over the period from 1980-1998 and found that there is no long-run relationship among the real exchange rates and the local stock market in each Pacific Basin country. Furthermore, in the short-run domestic stock prices were positively related to the real exchange rate. This result was not in line with the results of, Granger et al. (2000), which found bi-directional causality between stock prices and exchange rate of Hong Kong, Malaysia, Thailand and Singapore and there is no recognizable pattern for Indonesia. Whilst the finding of Phylaktis and Ravazzolo (2005) were consistent with the results of Granger et al. (2000) in that their study found unidirectional causality from stock prices to exchange rate for Philippines.

Some researchers prefer to examine the relationship between the exchange rate and stock prices within a set of the macroeconomic variables. For example, Kurihara (2006) investigated the relationship between exchange rates and stock prices during the Quantitative Easing Policy in Japan. The study used daily data of Japanese stock prices, exchange rate (yen/U.S. dollar), U.S. stock prices and the Japanese interest rate. The period under examination spanned from March 19, 2001 to September 30, 2005. The study employed the cointegration rank test, Vector Auto Regression (VAR) Model and Ordinary Least Squares (OLS) test. The empirical results showed that the exchange rate affected the Japanese stock price while this result was not in line with the studies of Nieh and Yau (2006) and Granger et al. (2000) .

In the same year, Nieh and Yau (2006), investigated the short and long-run interrelationships between the New Taiwan Dollar/ Yen exchange rates and stock prices in Taiwan and Japan. The monthly data used from January 1991 to July 2005 to employed the Granger-causality test and Johansen's cointegration test. The results revealed that there was no long-run equilibrium or movement relationship between stocks prices of Taiwan and Japan and exchange rate of NTD/Yen. Also, their study showed that stock prices of both Taiwan and Japan impacted each other (bi-directional causality) while there was no causal relationship found among the stock prices and the NTD/ Yen exchange rates for both countries in the short–run. Notably, this result was inconsistent with the study of Granger et al. (2000) for the Taiwan stock market where they found bi-directional causality relationship between stock prices and exchange rate in the short–run. However, both Granger et al. (2000) study and Nieh and Yau (2006) study failed to reveal any recognizable pattern for Japan. Therefore, both studies were not consistent with Kurihara (2006) study who found that the exchange rate affected the Japanese stock prices.

The relationship between stock prices and exchange rates was also examined in a number of different economies in the world before and during the Asian crisis. For example, Nieh and Lee (2001) investigated the relationship among exchange rates and stock prices in five countries namely France, Canada, Germany, Japan, Italy, the United Kingdom and the United States. They used daily data from October 1, 1993 to February 15, 1996 and applied the Engle and Granger (1987) test, Johansen Multivariate Maximum Likelihood cointegration test and Vector error correction model. The finding obtained both the Engle-Granger (EG) two-steps (1987) and the Johansen (1988) cointegration tests indicated no existence of long-run relationship between these two variables for each G-7 country. In addition, they concluded that the short-run causality relationship was running from exchange rates to stock prices that are only significant for one day in Canada, Germany and the United Kingdom. Furthermore, their findings disclosed that there is a negative Granger-causality relationship running from stock prices to exchange rates in Italy and Japan. On the other hand, the study indicates that the United States fails to show any significant correlation between these two financial variables within the United States are exogenous and not affected by each other at all (Nieh & Lee, 2001, pp. 477-490).

In general, these results were possible to be more accurate if the study used a period more than three years as for the United Kingdom the period of their study was a good period to the London Stock Market because it had a big development that time which is called The Big Bang (BB). The Big Bang (BB) on 27 October 1986 was one of the most important developments for the history of the London Stock Exchange (Khurshed, 2011, pp. 19-21). The (BB) was a package of reforms that transformed the exchange and the city. "Liberalising the way in which banks and stock-broking firms operated and bringing in foreign investment". "The exchange ceased granting voting rights to individual members and became a private company Big Bang also saw the start of move towards fully electronic trading and the closure of the trading floor" (Whitaker's, 2012, p. 549). In another study, Hatemi and Irandoust (2002) examined a possible causal relation among exchange rates and stock prices in the Sweden economy. They used monthly nominal exchange rates in their study and stock prices covering the period 1993-1998 to apply the Granger non-causality test developed by Toda and Yamamoto (1995), the VAR model and the multivariate M-Wald statistic to examine restriction on its parameters. Their study supported the Stock-Oriented Theory, which indicated that there is unidirectional Granger-causality relationship from stock prices to exchange rates.

Studying the interaction between stock prices and exchange rates also extended to the European emerging financial market. For example, Grambovas (2003) is one of the few studies which examines the relationship between exchange rate fluctuations and equity prices in certain Eastern European countries, specifically in Greece, the Czech Republic, and Hungary used weekly data of the general stock exchange indexes of stock exchanges for Athens (CI), Budapest (BUX), Prague (PX-50), New York (Dow Jones Industrials) and Frankfurt (DAX-30) and spot foreign exchange rates for Greece in relation to the British pound (GBP), Hungary and the Czech Republic in relation to the deutsche mark (DEM)"(Morales, 2007, p. 3). The data period spanned from January 1, 1994 to February 28, 2000 and the study employed the Johansen-Juselius test to detect the cointegration between the variables .Furthermore, the study employed the Granger-causality tests to disclose the direction of the relationship in the short-run. The Johansen cointegration result showed that there is an indirect relationship in the long-run between Budapest Market General Index Exchange Rate and the Deutsche Mark of International Financial Environment is taken into consideration. While the Granger-causality tests indicated that, there is unidirectional causality relationship running from exchange rates to stock prices in Hungary and Greece (Grambovas, 2003, pp. 24-48).

The results of Grambovas (2003) are not completely consistent whith the results of Murinde and Poshakwale (2004). They reported conflicting results for Hungary and the Czech Republic during the pre-Euro period while both studies showed the same result through Euro period. They employed the bivariate Vector Auto Regression (VAR) Model. The study depended on daily observations of the nominal exchange rate and stock price index to examine the relationship between stock prices and exchange rate for Hungary, the Czech Republic and Poland. The period under examination was divided into the pre-Euro period from January 2, 1995 to December 31, 2000 and the Euro period data from January 1, 1999 to December 31, 2003. The results of the study for the pre-Euro period were the Granger-causality relationship running from exchange rates to stock prices in the Czech Republic, and Poland while the bi-detraction Granger causality is found in Hungary. As for the Euro period, the study results were there is a short-run Granger-causality relationship from exchange rates to stock prices in all the three sample economies. This difference in results may be due to the difference in the type of data, which were used in both studies. Murinde and Poshakwale (2004) used daily data whereas Grambovas (2003) used weekly data, which did not capture the stock prices changes which move every moment. Therefore, using weekly data may give inaccurate results.

Stavarek (2005b) perceives the differences between the development of real and nominal exchange rates; mainly countries in transition. Therefore, he selected eight European countries and the United States to investigate the causality between effective exchange rates and stock prices. Furthermore, he used monthly data and divided the period into two parts: the first period was from 1970-1992 and the second period was from 1993-2003 for four old EU-member countries, (Germany, France Austria, and the United Kingdom), and four new EU-member countries (Hungary, the Czech Republic, Slovakia and Poland) and the United States. The result of the study found that the causality relationship existed in the countries that have developed capital and foreign exchange markets, which represents the old EU-member countries and the United States that was much strangely than in the new–comers countries. In addition, their empirical results indicated that the unidirectional causality running from stock prices to exchange rates were more powerful than long-run as well as short-run relations during the period 1993-2003 than during 1970-1992. Although, the study used a good period of ten years to analysis the relationship between the variables, however, it used monthly data, which cannot capture the changes in stock prices.

Another interesting research was developed by Gundiiz and Hatemi (2004) who investigated the causality relationships between stock prices and exchange rates in the Middle East and North African Region before and after the Asian financial crisis. They used daily nominal observations on stock prices and exchange rates from January 1, 1996 to August 8, 2000. Furthermore, the study applied the Toda and Yamamoto Modified Wald test to detect the duration causality relationship. The study found out mixed findings, for Turkey the interactions existed from stock prices to exchange rates during the analysis period. The unidirectional Granger-causality relationship running from exchange rates to stock prices included Morocco and Israel before and after the crisis. Additionally, the unidirectional Granger causality relationship running from exchange rates to stock prices for Jordan was just after the crisis. Finally, for Egypt, no Granger-causality relationship was identified between the two variables (Gundiiz & Hatemi, 2004, pp. 85-87) .

A similar dynamic relationships between the two markets in the Brazilian economy have been the subject of Tabak (2006). The period of study started from August 1, 1994 to May 14, 2002 including daily foreign exchange rates and closing prices in the São Paulo Stock Exchange Index (IBOVESPA). The result of the Granger-causality test revealed that there were no long-run relationships between stock prices and exchange rates while the linear Granger-causality relationship running from stock prices to exchange rates was negatively correlated which supported to the Stock-Oriented. Likewise, the study showed evidence of no nonlinear Granger causality from exchange rates to stock prices.

Pan et al. (2007) used a VAR model and the Granger causality tests and chose daily data from 1988 to 1998 of seven East Asian countries namely, Hong Kong, Malaysia, Thailand, Taiwan, Korea , Japan and Singapore to analyses the relationship between exchange rates and stock markets. Both tests refer to the period before the Asian financial crisis; there was a significant Granger cause from stock prices to exchange rates for Hong Kong, Korea, and Singapore. Furthermore, both tests showed that there was a significant Granger cause from exchange rates to stock returns for Japan, Hong Kong, Thailand and Malaysia. During the Asian crisis, their study displayed that there was a unidirectional causality relation from exchange rates to stock prices in all countries except Malaysia. Therefore, the study regarding these countries during the Asian crisis supports the Flow-Oriented Theory except the Malaysian one, which showed no causal relationships during the same period. There is no relationships between the stock price and exchange rate in Malaysia which confirmed the results obtained by Ibrahim and Aziz (2003). They examined the causal relationship and dynamic linkages among the Malaysian stock market and the industrial production, the price level, the money supply and the bilateral exchange rate vis-a-vis the US dollar. The study used monthly data from January 1977 to August 1998 and they applied the cointegration method and VAR model. Ibrahim and Aziz (2003) found that there is no any interaction between stock price and exchange rate while they managed to demonstrate the presence of cointegration (long-run relationship) between stock prices and the other four macroeconomic variables (Ibrahim & Aziz, 2003, pp. 6-27) .

2.3.2 During and after Financial Crises from 2007 to 2008

There is growing empirical literature that examines the relationship between exchange rates and stock prices during and after the financial crisis for example (Aydemir & Demirhan, 2009; Hasan & Javed, 2009; Kollias, Paleologou, & Mylonidis, 2010; Kutty, 2010a; Li & Huang, 2008; Morales, 2007; Ooi, Wafa, Lajuni, & Ghazali, 2009; Rahman & Uddin, 2009a; Zhao, 2010). Morales (2007), examined the relationship between exchange rates and stock price for four Eastern European markets namely the Czech Republic, Poland, Slovakia and Hungary. Both the short and long-run causality between these variables were explored using daily data over a seven-year period from 1999 to 2006 applying the cointegration, Granger-causality and Vector Error Correction tests. The Johansen cointegration result indicated no evidence of stock prices and exchange rates moving together in the long-run of all countries with the exception of Slovakia, whereas cointegrating relationship existed. Furthermore, the results provided evidence of unidirectional causal relationship from the exchange rates to the stock prices in Hungary, Poland and the Czech Republic. Moreover, the ECM model indicated that a short-run association existed between stock prices and exchange rates for Slovakian market.

Although, the study used daily data to capture the changes in stock prices, however, the analysis period was somewhat short; it did not exceed seven years. Li and Huang (2008) chose a distinctive period for China, when it started revaluing the Renminbi and officially modified the exchange rate regime on July 21, 2005 to examine the relationships between the Shanghai Stock Exchange A-share Index prices and exchange rate in China stock market. They examined the causality issue in the long and short-run using the Engle–Granger cointegration test and the pairwise Granger causality test. The study used daily data for the period from July 21, 2005 to January 18, 2008. The data from the Shanghai Stock Exchange A-share Index and exchange rate suggests that there was no long-run relationship between the variables. However, there was strong evidence to support the Flow-Oriented Theory, which suggested that there was a unidirectional causation from the nominal exchange rates to the Shanghai stock returns in the short-run. Rahman and Uddin (2009a) examined the long-run and short-run relationships between stock prices and exchange rates of the pound sterling, the Japanese yen, the US dollar and the Euro and monthly values of Dhaka Stock Exchange General Index for the period in the emerging economy of Bangladesh. The study used monthly data from June 2003 to March 2008 applying cointegration, error correction model and finally the standard Granger causality tests. The result of Johansen's cointegration test proved no long-run relationships between stock prices and exchange rates for Bangladesh. Granger causality's results showed that stock prices Granger caused exchange rates of the Japanese yen and the US dollar, but there were no causal relationships between stock prices and exchange rates of the Pound Sterling and the Euro.

They constricted themselves with respect to the situation of Bangladesh when Rahman and Uddin (2009a) investigated the interactions among stock prices and exchange rates in three emerging countries of South Asia including Bangladesh, Pakistan and India. The study analysed the period of monthly data from January 2003 to June 2008 via applying the Johansen and the Granger causality tests. The findings of Johansen's cointegration test indicated that there is no cointegrating relationship among stock prices and exchange rates. The results also were consistent with the results of their first study with respect to Bangladesh. However, the results of the Granger-causality test pointed out that there was no way of causal relationships between stock prices and exchange rates in three countries. This result was not consistent with the results of their first study with respect to Bangladesh where they found the stock prices Granger cause exchange rates of the US dollar. Although they used the Granger causality test, and the same index and exchange rate and the same analysis period in both study, they achieved different results.

Kumar (2009) reported consistent results with the Rahman and Uddin (2009a) for India. He used the Granger-causality test and Johansen cointegration method to investigate the causality between stock prices and nominal exchange rate in India. Moreover, the study employed monthly average of daily data for the Period starting from 1994 to 2008. The Engle–Granger cointegration tests refer to no existence of long-run relationship between stock prices and nominal exchange rate at 5% significance level. Furthermore, there is no causality relationship running from the nominal exchange rate to the stock returns. Hasan and Javed (2009) explored the relationships between stock returns and exchange rates in Pakistan for the period from June 1998 to June 2008 using multivariate cointegration analysis and the Granger causality test. Moreover, the study included the period of Pakistani stock market before and during the financial crisis. The results indicated that unidirectional Granger cause from the exchange rates to the Pakistani stock returns existed in the short-run. Nevertheless, Rahman and Uddin (2009a) did not find any relationship between stock returns and exchange rates in Pakistan.

Ooi, Wafa, Lajuni, and Ghazali (2009) focused on pre and post financial crisis to analyze the causal relationships between exchange rates and stock prices for Thailand and Malaysia. The analysis was made from the daily data from November 1, 1993 to August 31, 2003 to examine the relationships between the variables. Moreover, they tried to investigate the long-run relationship between the variables using the Johansen's cointegration test. Also, they employed the Toda-Yamamoto (1995) test to measure the short-run dynamic causal relationships. The results found that any change in stock prices caused changes in exchange rates in both pre-crisis and post-crisis periods for Thailand. Therefore, the data of Thailand showed that the results support the Stock-Oriented Theory in both pre-crisis and post-crisis periods; however, the Malaysian findings supported the Stock-Oriented Theory just in the post-crisis period.

Aydemir and Demirhan (2009) found the bi-directional relationship when they used the daily data starting from 23 February 2001 to 11 January 2008 to investigate the Granger Causal relationship between stock prices, including the services, financial, national 100, technology and industrial indices and exchange rates in the Turkish market. They used different indices in order to see the effect of the exchange rates in different sectors, or vice versa. The results showed evidence of the bi-directional causality relationship between exchange rates and all stock market indices. Furthermore, the results offered evidence of the negative unidirectional causality existed from the services, industrial, national 100, and the financial indices to exchange rates while there is a positive unidirectional causality relationship from technology indices to exchange rates (Aydemir & Demirhan, 2009, pp. 207-215).

Kutty (2010b) was one of the few studies that used weekly data to examine both short and long-run causality between stock prices and exchange rates in Mexico. He employed the Granger-causality test and the Johansen's cointegration test. The analysis of data covered the period from the first week of January 1989 to the last week of December 2006. The result of Granger-causality test showed only unidirectional causality relationship running from stock prices to exchange rates in the short-run which support the Stock–Oriented Theory. Moreover, the Johansen's cointegration test showed no long-run relationship between these two variables. The study used weekly data, which could not capture the changes in stock prices.

The dynamic relationship between the two markets is also studied in the European market by Kollias, Paleologou, and Mylonidis (2010). Their study used daily observations of the Euro-Dollar exchange rates and two composite stock market indices the FTSE Eurotop 300 and FTSE eTX All-Share Index started from January 2, 2002 to December 31, 2008. Moreover, it employed rolling unit root, cointegration and Granger-causality tests. This methodological technique allowed for the emergence of a clearer picture of the possible dynamic linkages between stock prices and exchange rates, which indicated under normal conditions; the direction is causal from exchange rates to stock prices whereas under immoral conditions they held the reverse direction. These results were in line with the results of Pan et al. (2007) who claimed that the outlined theories cannot correctly explain the relationships between stock prices and exchange rates (Tsagkanos, Athanasios, & Costas, 2013, pp. 107-108). Zhao (2010) investigated the real effective exchange rate on the Chinese stock price before and during the financial crises. The data used consisted of monthly data real exchange rates and Shanghai Composite Stock Price Index from January 1991 to June 2009 applying the VAR and GARCH models. The finding of the study revealed the existence of the bi-directional causality relationship volatility spillovers effect between the real exchange rate and Shanghai Composite Stock Price Index. In the long-term, the study showed that no existence of stable long-run equilibrium relationships between Shanghai Composite Stock Price Index and real exchange rates.

2.3.3 Recent Research

There have been a great many studies investigating the interaction between stock prices and exchange rates published over the last five years. Zhang et al. (2011) studied the causal relationship between stock prices and exchange rates in five industrial countries within econometric methods including both the Johansen (1995) and the Saikkonen and Lutkepohl (2000) cointegration tests, and three variations of Granger causality tests. Additionally, the study displayed the non-parametric causality approach proposed through Hiemstra and Jones (1994) that allowed for non-linear causality. They used monthly data from January 1992 to December 2005 for Australia, Canada, Japan, Switzerland, and the United Kingdom. The result of the study revealed no evidence of any long-run relationship between the stock prices and exchange rates. In addition, there is unidirectional causal from exchange rates to stock prices (Flow-Oriented Theory) for Canada, Switzerland, and the United Kingdom while there is a unidirectional causal relationship from stock prices to exchange rates (Stock-Oriented Theory) only for Japan. Although, the study used more than models to determine the cointegration and the causality direction however, it is possible that the study would obtain the best results if it used daily data.

Narayan and Lean (2011) focused on major Asian markets to examine the relationships between stock prices and exchange rates in countries including Indonesia, Hong Kong, Korea, Japan, Malaysia, Thailand, Singapore and the Philippine. The study used the weekly data on the stock market indices and nominal exchange for the period from January 1, 1991 to June 30, 2005. For examining both short and long-run relationships among stock prices and exchange rates, they applied the cointegration and the Granger-causality test. Their results indicated that there was no interaction between stock price and exchange rate in the long run. On the contrary, in the short-run, there is unidirectional Granger-causality relationship running from stock prices to exchange rates for the Philippines which support Stock-Oriented Theory. However, there was unidirectional Granger-causality relationship running from exchange rates to stock prices in Korea, Indonesia, and Thailand which support Flow-Oriented Theory. As for Japan, the relationship was neutral.

In order to completely observe the relationship;Tsai (2012) used the quantile regression model to estimate the relationship between stock price and exchange rate in six Asian countries. Moreover, the study employed the Ordinary Least Squares method on the monthly data from January 1992 to December 2009. A negative short–run relationship between stock prices and exchange rate was more obvious when exchange rates were extremely high or low. That meant the increase (decrease) of stock price would decrease (increase) the exchange rate in all the seven sample economies. The study did not use the Granger-causality test and therefore, it was limited to determine the type that is not in the direction of the relationship. Bhunia (2012) studied a Granger Causal relationship between stock indices and exchange rates-in India using daily data started from April 2, 2001 to March 31, 2011. The Wald test was applied in order to detect the causality relationship. The study found that bi-directional causal relationship among exchange rates and all stock market indices. Whereas, the negative causality relationship existed from the industrials, financials, services and the national indices to exchange rate, there was also a positive causal relationship from technology indices to exchange rates. The negative causal relationship also existed from exchange rate to all stock market indices.

These results were moving on the same wavelength with Malarvizhi and Jaya (2012), who used monthly date rather than daily ones collected from April 2001 to March 2011 and applied a different method; the Multivariate cointegration test and the Pairwise Granger causality test, to investigate the dynamic relationship between the stock price and exchange rate in India. The study found that both financial variables were not cointegrated and there was bi-directional causal relationship between exchange rates and stock prices. Therefore, both studies supported the Flow-Oriented and the Stock-Oriented Theories. Whilst, Srinivasan (2014) was conflicting for India. He found no existence of a causality relationship running from stock price to stock price or vice versa in the short-run when he examined the relationship between these variables during the period from June 1990 to April 2014. This result is consistent with Kaliyamoorthy and Parithi (2012) where they found the exchange rate and stock price are independent of each other.

Chen and Chen (2012) investigated the relationship between stock prices and exchange rates in 12 OECD countries, comprising the developed countries (the G-7) and some emerging economies, namely Poland, South Korea, Turkey, Hungary and the Czech Republic. The study used monthly data for each country employing the Bound test, the Gregory and Hansen cointegration tests and the linear Granger-causality test. The study used different periods for each country; for Canada, the United States, Japan, Germany, Italy, France and the United States the sample period started from January 1993 to September 2007. For Poland, the period started from January 1993 to September 2007 while the sample period for Turkey started January1981 to September 2007. The findings indicate that there are non-linear bi-directional relationship between stock prices and exchange rates for Canada, Japan, Italy, France, the United Kingdom, the United States, South Korea and Hungary.

Another interesting research project was conducted by Caporale et al. (2013). They chose the banking crisis period from 2007 to 2010 to examine the nature of the relationship between stock prices and exchange rates in six developed countries. They used the weekly data on stock prices and exchange rates of Canada, the Euro area, Switzerland, Japan, the United States and the United Kingdom. In addition, they applied a Bivariate GARCH-BEKK model that showed different results. The first result was a unidirectional relationship from stock price to exchange rate changes in the United Kingdom and the United States. The second result was the unidirectional relationship from exchange rate to stock price in Canada. The third result was bi-directional in the Euro area and Switzerland. These three results could be different if the study used daily data rather than weekly ones. In addition, the study analysis period was longer, since it did not exceed three years (Caporale et al., 2013, pp. 1-31).

In recent years, some researchers focused on the study of the spillovers between stock and foreign exchange markets, as Andreou et al. (2013) and Kumar (2013) found a significant bi-directional spillover between foreign exchange markets and stock prices for two groups. The first one consisted of some Asian emerging economies, namely the Korean, Malaysian, Indian, Thai, Pakistani and the Philippines whilst the second group included the Latin American countries such as Argentina, Brazil, Colombia, Mexico Chile, and Venezuela. The study used daily data from 06,01,1989 to

15,08,2008 including 1024 observations after adjustments and employing a quarto-variate VAR-GARCH test with the BEKK representation of Engle and Kroner (1995). The results of the Kumar (2013) study also were consistent with the previous studies. The study investigated the nature of returns and volatility spillovers between stock price and exchange rates. Moreover, the study investigated the direction of the relationship between two variables for India, Brazil, and South Africa, what is referred to as the IBSA countries. Therefore, the study used a set of tests to investigate the volatility spillovers between the two variables. The study applied the VAR model to determine the direction of the relationships between the variables. Moreover, he used daily closing price for three stock indices and exchange rates data series from January 1, 2000 to January 17, 2011. The study indicated that the bi-directional volatility spillover relationship between stock and foreign exchange markets existed in all IBSA countries.

One recent studies in this area was conducted by Liang, Lin, and Hsu (2013) and Amarasinghe and Dharmaratne (2014). Liang et al. (2013) re-examined the relationship between exchange rates and stock prices in five Asian countries. They considered average monthly data on the series of stock prices and exchange rates for Indonesia, Singapore, Malaysia, Philippines and Thailand, covering the period from August 2008 to June 2011. The study used a set of economic tests, which included the panel unit-root test, the panel cointegration (Engle and Granger) test and the panel causality test. It also estimated the Panel Dynamic Ordinary Least Squares (DOLS). The empirical results revealed that there are both short and long-run unidirectional causalities from exchange rates to stock prices when exchange rates influenced stock prices negatively. In addition, their empirical results showed that the dynamic association has been more significant and stronger in recent years than in early periods and expansion periods.

Amarasinghe and Dharmaratne (2014) studied the dynamic relationship between exchange rates and stock returns in the Colombo Stock Exchange using monthly data beginning from January 2003 to December 2012 to stock prices and exchange rates. A regression model and the Granger causality tests were used to check if there was any causal relationship between stocks returns and exchange rates. The study showed that there was a one way causal relationship from stock returns to exchange rates, whereas the result of the regression demonstrated that stock returns were not a significant factor for exchange rate changes.

The result of Amarasinghe and Dharmaratne (2014) was inconsistent with the findings reported by Andreou et al. (2013), who found the bi-directional spillovers between foreign exchange markets and stock prices for the Colombo Stock Exchange. One of the studies that has been published recently was by Inci and Lee (2014). They re-examined the dynamic relationship between stock prices and exchange rate by including lagged effects and causal relations. To examine this relationship they chose five major European countries; France, Italy, Switzerland, Germany, the UK and some other non-European countries such as Canada, Japan and the United States. Moreover, they used annual data over a long period from 1984 to 2009 to examine the regression models and Granger causal test. Their study showed that there is bi-directional relationship between these two stock prices and exchange rates in France, Switzerland, Canada, Germany, the UK, the US, and Japan. These results were different from what was achieved by Fowowe (2015). He used monthly data for the period starting from January 2003 to December 2013 to examine the relationship between stock prices and exchange rates for the two largest stock markets in Sub-Saharan Africa–South Africa and Nigeria. His study showed that a long-run equilibrium relationship did not exist between stock prices and exchange rates in South Africa, but existed in Nigeria. Furthermore, in the short-run, his study demonstrated that no Granger causality existed between domestic stock prices and exchange rate in South Africa, whereas the Granger-causality relationship running from exchange rates to domestic stock prices in Nigeria in the short- run. These results were based on the Gregory and Hansen structural breaks cointegration tests and the Multivariate causality tests.

Different variables such as exchange rate, reserves, interest rate, money supply, and inflation were used when Masood and Sarwar (2015) examined the links between stock price and exchange rate in the Pakistan's economy. They used the monthly data to employ the cointegration test and the Granger-causality test. Their study concluded that the long-run relationship between stock price and exchange rate did not exist whereas they found the bi-directional causality relationship between stock prices and exchange rate. Therefore, their research supported the Flow-Oriented and Share-Oriented Theories. Liang, Chen, and Yang (2015) used monthly data for five Asian countries from January 2000 to August 2013 to study the interactions of stock prices and exchange rates. Their empirical results provided evidence that supported the Share-Oriented Theory, which assumes a unidirectional Granger-causality relationship running from stock prices to exchange rates in the Philippines, Malaysia, and Thailand. Moreover, their results support the Flow-Oriented Theory that suggests that there was a unidirectional Granger-causality relationship running from exchange rates to stock prices in Indonesia. On the other hand, they found no significant relationship between the two variables in Singapore. Also their study indicated that "important implications for policy-makers and institutional investors who should rigidly monitor the dynamic linkages between stock price and exchange rate movements across the ASEAN-5 financial markets when making policy decisions and investing in these countries"(Liang et al., 2015, p. 1).

2.4 Long- Run Relationship between Stock Prices and Exchange Rate

Several studies have used the cointegration technique including the Engle and Granger (EG) two-step and the Johansen-Juselius (JJ) cointegration tests to test if there were long–run relationships between stock prices and exchange rates. Then they employed the Vector Error Correction (VECM) Model and the Granger-causality test to determine the direction and significance of the relationship between the variables.

Bahmani-Oskooee and Sohrabian (1992) was the first study that used the cointegration analysis for testing the direction of the relations between stock prices and exchange rates. They concluded that there was no any long-run relationship between two variables although they found bi-directional causality among them in the short-run. The significance of the long-run relationship between stock prices and exchange rate was confirmed by many studies before the Asian crises. Some studies have investigated the relationship between stock prices and exchange rates, while others studies investigated the relationship between stock prices and macroeconomic variables. Mukherjee and Naka (1995) used monthly data for the period beginning on

January 1971 to December 1990 to examine the relationship between the Japanese Stock Market Returns and a set of six macroeconomic variables namely exchange rate, money supply, the long-term government bond rates, industrial production index, inflation, and all money rate variables in Japan. According to the results of Johansen's cointegration test and the Vector Error Correction Model, the Japanese Stock Market was cointegrated with exchange rates and all other macroeconomic variables. That means the stock market returns was affected by all the macroeconomic variables in the long–run. These results were moving on the same wavelength as Ajayi and Mougoue (1996), although they only examined the relationship between stock prices and exchange rates for eight industrial economies, namely Canada, the Netherlands, Germany, Italy, Japan, France, the United Kingdom, and finally the United States. They used daily closing stock prices and exchange rates from April 1985 to July 1991. They employed the Engle and Granger (1987) test to determine the long-run relationship between the variables and the error correction model to capture the equilibrium in both short and long-run dynamics relationship between the variables. Moreover, they used the Granger-causality test to determine the direction of the relationship. Their results showed that there were significant short and long-run relationships between stock prices and exchange rates. In their short-run, their study displayed that the interaction between exchange rates and stock prices was a bi-directional for France, Germany, Italy, Japan, the United Stated and the United Kingdom. Moreover, in the long-run, the relationship was from stock prices to exchange rate. These results were possible to be more accurate if they used the Johansen cointegration rather than the Engle and Granger (1987) test (Ajayi & Mougoue, 1996, pp. 193-207).

2.4.1 During and after Asian Crisis from 1997 to 1998

The Asian financial crisis of the late 1990s sparked interest in the interaction between currency and stock markets in equally developed and developing countries. One of these studies was by Bahmani-Oskooee and Domac (1997). They employed monthly data of stock prices and spot exchange rates obtained from the financial markets of Turkey over the period from January 1986 to July 1994. Their results were based on the cointegration technique that showed stock prices and exchange rates integrated in a long-run relationship. Meanwhile, the error correction model disclosed that stock prices and exchange rates affected each other in the short run. Another study conducted by Kwon and Shin (1999) examined the long-run relationship between stock prices and the exchange rates within a set of macroeconomic variables in the Korean stock market. They used monthly data from January 1992 to December 2003 and employed both the Granger-causality test and the Vector Error Correction (VECM) Model. They found that the cointegration between stock prices and exchange rate was clear. In addition, the VECM found that the nominal exchange rate adversely affected the stock market index in the long run. On the contrary, the Granger-causality test showed the absence of short-run relationship between stock prices and all macroeconomic variables.

The interaction between stock prices and exchange rates during the Asian crisis has attracted a lot of research to focus on the Asian emerging markets. For instance, Amare and Mohsin (2000) employed the cointegration method to test the long-run relationship between stock prices and exchange rates for Hong Kong, Japan, Taiwan, Thailand, Malaysia, Singapore, Korea, the Philippines, and Indonesia. The study used the monthly data from January 1980 to June 1998 and applied the cointegration method. The positive long-run relationship from stock prices to exchange rates was found only for the Philippines and Singapore. This result was opposite to Kwon and Shin (1999) regarding Korea. This difference in results was possibly due to the number of the variables used. Two years later, Wongbangpo and Sharma (2002) examined the dynamic relations between stock market and the exchange rates within the set of macroeconomic variables for five countries that used by Amare and Mohsin (2000) namely Indonesia, Thailand, Malaysia, the Philippines and Singapore. They used monthly observations between 1985 and 1996 and employed the Granger causality test. The findings provided evidence to indicate that in the long–run the exchange rate was positively related to stock prices in the Philippines, Indonesia and Malaysia, but negatively in Thailand and Singapore (Amare & Mohsin, 2000, pp. 165-181).

Both previous studies have confirmed that there was a long-run relationship for the Philippines and Singapore with the difference in the direction of the relationship.

Meanwhile the study of Wongbangpo and Sharma (2002) showed there was a long-run relationship for Indonesia, Thailand and Malaysia, which was not shown by Amare and Mohsin (2000). In the short-run, Wongbangpo and Sharma's study (2002) showed that there was a Granger Causal relationship running from stock prices to exchange rates only in the Philippines and Singapore. Maysami, Howe, and Hamzah (2004) carried out a similar study for Singapore stock markets when they studied the long-run relationship between the Singapore stock market index and macroeconomic variables including the exchange rates, industrial production, money supply and interest rates. The study used monthly data from January 1989 to December 2001 and employed the Johansen's cointegration, Vector Error Correction (VECM) Model. They reported a significant long-run relationship between the Singapore stock market and all macroeconomic variables including exchange rate. In addition, there was a positive relationship between exchange rate and the Singapore stock market therefore; their study supported the Flow-Oriented Theory.

Another study focused on emerging markets was by Muhammad, Rasheed, and Husain (2002). They examined whether stock prices and exchange rates were related to each other or not. Both long and short-run relations between these variables are explored. They used monthly data beginning from January 1994 to December 2000 for four South Asian countries, including Sri-Lanka, Pakistan, India and Bangladesh. To examine the long and short-run relationship between stock prices and exchange rates, they employed cointegration, the Vector Error Correction (VECM) Model and standard Granger causality tests. The study showed that no short-run relationships between the variables for all the four sample economies existed. These results were in the same line with the result of Rahman and Uddin (2009b) with regards to Bangladesh, while it was not in line with the studies of (Abdalla & Murinde, 1997; Hasan & Javed, 2009; Smyth & Nandha, 2003). They showed that there was short-run relationship between two variables for India, Pakistan and Sri- Lanka. In respect to the long-run, the study showed that there was no long-run relationship between stock prices and exchange rates for India and Pakistan as well which were consistent with the results of (Abdalla & Murinde, 1997; Rahman & Uddin, 2009b; Smyth & Nandha, 2003). Meanwhile, the study showed that there was a bi-directional causality relationship between these two financial variables for Bangladesh and Sri Lanka in the long-run which was moving on the same wavelength with (Abdalla & Murinde, 1997; Rahman & Uddin, 2009a; Smyth & Nandha, 2003), which showed that the Bangladesh exchange rates and stock prices were independent.

Although, the focus was on the Asian countries during that period that did not mean that there were no other studies in other countries. On the contrary, many studies investigated the relationship between stock prices and exchange rates to know the impact of the Asian financial crisis on the economies of other countries. For example, Kim (2003) investigated the existence of long-run equilibrium relationships between the stock price and the real exchange rate in the United States. The study used monthly data from January 1974 to December 1998 applying the Johansen's cointegration analysis to detect the long-run equilibrium relationships between the variables and the Vector Error Correction Model. The results of the Johansen's cointegration test discovered that there was a long-run relationship between the price of the Poor's Composite Index of 500 Index and exchange rate. Furthermore, the results of the VECM found a strong negative relationship among the value of the U.S. dollar and the change of the price of the Poor's Composite Index of 500 Index.

Kim's results corresponded with the results of Ajayi and Mougoue (1996). However, it showed a contradiction with (Bahmani-Oskooee & Sohrabian, 1992; Nieh & Lee, 2001; Soenen & Hennigar, 1988; Stavarek, 2005a; Zhang et al., 2011). Zhang et al. (2011) found a short-run relationship between stock prices and exchange rate in the United States. One of the few studies that have used weekly data was by Obben, Pech, and Shakur (2006). They studied the New Zealand market and they tried to find out short and long-run relationships between the share prices and the trade-weighted foreign exchange index (TWI). The weekly data started from January 1999 to June 2006 and employed the cointegrating, Vector Auto Regression l and the vector error correction models. Their results implied that in both short and long-run there was bi-directional causality between the foreign exchange and stock markets. For this reason, their study supported both the Stock-Oriented and Flow-Oriented Theories.

2.4.2 During and after Financial Crises from 2007- 2008

The economic crisis had affected the economies of countries in the world. The study did not focus on specific countries but it tried to display all of the studies that examined the relationship between the exchange rate and stock price of all countries of the world. Ratanapakorn and Sharma (2007) study was one of the few studies that used quarterly data to examine the relationship between stock prices and exchange rates. They examined the short-run and long-run association among the US stock price index (the price of the Poor's Composite Index of 500 Index), exchange rate and other macroeconomic variables. The data set consisted of quarterly data from 1975 to 1999. The study employed the Johansen's cointegration method and the Vector Error Correction (VECM) Model. Their results suggested that exchange rates and every macroeconomic variable caused the US stock price index (the price of the Poor's Composite Index of 500 Index) in the long run, but the study failed to find any relationship between the two variables in the short-run. According to this finding, the study supported the Flow-Oriented Theory.

Changes in the exchange rate happened every moment, therefore, these results were possible to be more accurate if they were daily data. Richards et al. (2009) reported similar findings while their study supported the Stock-Oriented Theory. They chose the Australian stock market to examine the dynamic relationship between the Australian stock prices and the Australian-USD exchange rates. The study used daily data for the period from January 2, 2003 to June 30, 2006. They employed the cointegration, which provided evidence of a positive cointegrating relationship between the Australian stock prices and the Australian-USD exchange rate in the long run. Furthermore, the Granger-causality test found short-run relationship running from stock prices to the exchange rates during the sample period.

Through applying the Engle and Granger two-step, the Johansen and Juselius cointegration procedures Aliyu (2009) examined the long and short-run relationship between stock prices and exchange rate in Nigeria. The study used daily data from 1st February 2001 to 31st December 2008. The empirical results presented evidence of cointegration between stock prices and exchange rate. In addition, the causality test referred to strong evidence of a bi-directional causality relationship between two variables. Nieh and Yau (2009) reported similar findings when they studied "the exchange rate effects of the New Taiwan Dollar against the Japanese Yen on stock prices in Japan and Taiwan" (Nieh and Yau 2009,p,292). They analysed monthly data beginning from January 1991 to March 2008 through applying the new Threshold Error Correction Model (TECM). Their findings showed that there was a long-run relationship between NTD/JPY and the stock prices of Japan and Taiwan. This result was contradictory to what they showed in their study in 2006, when they examined the interrelationships between stock prices of Taiwan and Japan and NTD/Yen exchange rates. Yet they found no long-run relationship between stocks prices of Taiwan and Japan and exchange rates. In addition, their study (2006) showed that the stock prices of both the Taiwanese and the Japanese stock markets impacted each other (bi-directional causality). Although they used the same method in both studies and markets, they used a different period. Thus, this difference in the results could be related to difference in the period when their first study did not include the Asian crisis period, while it was included in the second study.

Another study examined the relationship in the long-run was carried by Nieh and Yau (2010) who investigated dynamic linkages between the Shanghai A-share prices and RMB/US$ exchange rates for China using daily data started from July, 21,2005, to September 30,2008. They employed Threshold cointegration Model as elaborated by Enders and Granger (1998) and Enders and Siklos (2001). Furthermore, they employed the Granger-causality test and a Conventional Error Correction Model. Their results proved the existence of a threshold cointegration relationship between exchange rate and the Shanghai A-share prices. The study also revealed a unidirectional relationship from exchange rates to the Shanghai A-share Index Returns in the long–run which support the Flow-Oriented theory. These results were influenced by the financial market turmoil in the United States sparked by the sub-prime mortgage crisis during the economic crisis.

2.4.3 Recent Research

Since understanding the relationship between exchange rates and stock prices is very important to investors, researchers and policy makers, there have been great many studies examining this relationship published over the last four years for instance,

(Abdullah et al., 2014; Adjasi, Biekpe, & Osei, 2011; Akbar, Ali, & Khan, 2012; Asaolu & Ogunmuyiwa, 2011; Attari & Javed, 2013; Lean et al., 2011; Liang et al., 2013; Maswere & Kaberuka, 2013; Rutledge et al., 2014; Tsagkanos et al., 2013) .

Parsva and Lean (2011) studied the relationship between stock returns and exchange rate in Middle Eastern countries namely Egypt, Iran, Jordan, Saudi Arabia, Oman, and Kuwait before and during the 2007 global financial crisis. The data were monthly in frequency, running from January 2004 to September 2010 by employing the Granger causality and Johansen's cointegration test. Their results were based before the crisis, where there was a bi-directional causality relationship between stock prices and exchange rates in both the short and long-run relationship for Egypt, Oman and Iran. Furthermore, there was a unidirectional causality relationship from the exchange rates to stock prices in Kuwait, while the study did not find any relationship between stock prices and exchange rates in Jordan and Saudi Arabia. These findings were inconsistent with those of Adjasi et al. (2011) with regards to Egypt. They failed to find a long-run relationship between the two variables when they studied the relationship between stock prices and exchange rates movement in seven African countries. To determine the long and short-run associations between stock prices and exchange rates, the study employed the Vector Auto Regression model, the cointegration and the Error Correction Model. The cointegration 'results indicated a long-run relationship between stock prices and the exchange rate in Tunisia. In the short-run, the error-correction model also showed that stock returns in Ghana, Mauritius, Kenya, and Nigeria "reduce when induced by exchange rate shocks but increase in South Africa and Egypt" (Adjasi et al., 2011, p. 143).

The most recent research has predominantly attempted to study the relationships between stock prices and macroeconomic variables, including exchange rate in the long-run such as Asaolu and Ogunmuyiwa (2011) and Akbar et al. (2012). The study examined the long-run relationship between the Nigerian Average Share Price and the nine macroeconomic variables using monthly data from 1986 to 2007. The Granger cause test suggested only exchange rate cause average share price, while the Johansen's cointegration test indicated that a long-run relationship existed between the average share price and the exchange rate. Akbar et al. (2012) detected an existence of a relationship in the long–run when they investigated the relationship between the Karachi stock exchange index and the macroeconomic variables. The study used monthly data from January 1999 to June 2008, using a cointegration and the VECM. They found that there was a long-run relationship between the stock market and the set of macroeconomic variables. The results of the study indicated that stock prices were negatively related to foreign exchange reserve.

Tsagkanos et al. (2013) chose the period of the recent financial crisis from January 2, 2008 to April 30, 2012 to investigate the interaction amongst stock prices and exchange rates in the European Union , and the United States. They carried out the Johansen test, VAR model and Granger-causality test to obtain both monthly and daily data. Their results exhibited that stock price movements drove exchange rate movements in both the European Union and United States in the long–run relationship. Although the study showed there was a relationship in the long run, it did not use the VECM, which it usually applies in case there is a long-run relationship. In addition, the study focused on the recent financial crisis (just five years) and thus might not give accurate results. The same direction of causality was proposed by Attari and Javed (2013) when they tried to determine both short and long relationship between Karachi Stock Exchange (KSE) and exchange rate in Pakistan. For their study, the Johansen's cointegration, vector error correction and Granger causality tests were applied on daily data of both variables from 1st January 1995 to 31st October 2012. The results of the Johansen's cointegration test suggested that the integration between stock price and exchange rate existed in the long-run relationship. Furthermore, the results of the VECM displays that there was a short-run relationship from the KSE index price to the exchange rate that was confirmed by the Granger causality test.

In the same year, Liang et al. (2013) concluded that a long-run relationship existed between the stock price and the exchange rate for the ASEAN-5 including Indonesia, Malaysia, Thailand, Singapore and the Philippines over the full study period from August 2008 to June 2011. These results were achieved by applying the panel Granger causality and panel DOLS methodologies and their result corresponded with Tsagkanos et al. (2013) and Attari and Javed (2013). Three previous studies provided evidence supporting the Portfolio balance or Stock-Oriented Theory. This was not in line with the results of Maswere and Kaberuka (2013) and they supported the Flow-Oriented Theory.

Some recent studies have supported both the Flow-Oriented and the Stock-Oriented Theories, such as Abdullah et al. (2014) and Rutledge et al. (2014). Abdullah et al. (2014) chose four South Asian countries to examine the Granger-causality relationship between stock prices and exchange rates. The study obtained monthly data about Pakistan, India, Bangladesh and Sri-Lanka over the full period from January 2008 to December 2012. To investigate the relationship, they used the Granger causality test, Johansen cointegration technique and the Vector Error correction tests. The empirical results show that there was a bi-directional long-run relationship between these variables for Bangladesh and Sri Lanka. Another recent study by Rutledge et al. (2014) estimated the interaction between Chinese Renminbi (RMB) exchange rates and Chinese stock prices based on a sample from 20 July 2001 to 21 July 2011. Standard Granger causality tests and the VECM were employed to determine the existence and direction of short-run causal relationships. Their result suggested a long-run cointegration relationship between exchange rates and the Shanghai A-share prices and for nine of ten industry indices. Furthermore, the Standard Granger causality tests reported bi-directional causality for four of the industry-specific indices (Rutledge et al., 2014, pp. 1-23).

2.5 Relevance of the Study to Current Research

The main aim of this research is to detect the existence of the long or short-run relationship between stock prices and the exchange rate of China, the European Union, the United Kingdom and the United States. Therefore, the researcher reviewed the previous studies that examined this relationship between stock prices and exchange rates with a focus on the countries included in this research. The researcher observed three issues; first there is no consistency in the results around the existence of relationships between stock prices and exchange rates and its direction. Some studies have shown that there was a short-run causality relationship based on causality tests, which is divided into three types of relationships. The first type is a unidirectional causality from exchange rates to stock price that supported the Flow-Oriented Theory. The second one is a unidirectional causality relationship from stock prices to exchange rates that supported the Stock-Oriented Theory and the third one is a Bi-detraction causality relationship that supported both theories.

The second issue is that some other studies looked at the long-run relationship between the stock prices and exchange rate based on cointegration tests. Thus, there is no empirical harmony between the researchers regarding the interactions between stock prices and exchange rates, which require the need for more research in this area. This should enrich the literature with regards to the study of the relationships between stock prices and exchange rates by using a new model. My research is novel, as it studies the same relationship and the variables yet the technique is different. The second issue is that many of the published studies that examined the relationship between stock prices and the exchange rate have been conducted in some developing countries or developed countries. However, there is a lack of research in a comparative study between developing and developed countries. My study attempts to address the gap in this area by updating the existing evidence for China, the European Union, the United Kingdom and the United States and providing new evidence to the literature review. The third issue is that not all the previous studies mentioned earlier have used the forecast test. Therefore, the current study will be a comparative study between developing and developed countries and it will examine the relationship between stock prices and exchange rate by applying the forecast test.

Table 2.1 provides a brief description of selected empirical findings that examined the same countries that are included in this the study, which reveals the existence of numerous mixed results regarding the statistical relationship between stock prices and exchange rates. In general, there has been no theoretical or empirical consensus on the direction of causation if stock prices and exchange rates are related. The disparity of results might be attributed to the different countries analysed and were subject to the different degrees of the capital mobility, trade volume and economic links among them. As for the same country investigated across the empirical studies, the existence of contradictions and inconclusive findings might also result from different methodology, time periods, and variables used in each study.

2.6 Summary

This chapter discussed four main areas of study. The first one reviewed the theories, which are related to my study with the aim of giving a clear view of them and to locate the current study within the boundaries of these theories. The second one presented what other researchers have done in studying the short-run relationship between stock prices and exchange rates. This involved previous studies conducted in some countries included in the sample of this research. The third one covered the empirical research investigating the long-run relationship between stock prices and exchange rates. Finally, with reference to different contexts, the chapter concluded by discussing the relevance of the current research with the previous studies.

Table 2.1: Review of Selected Empirical Studies in the Same Countries Included in this Study

Author(s) and Year	Country and Period of Study	Analysis Period	Methodology	Results	Theory
Aggarwal (1981)	The United States	Monthly data from 1974 to 1978	The OLS Regression Method.	There is a positive correlation between the trade-weighted exchange rate and the US stock market indices in the short run.	The Flow-Oriented Theory
Soenen and Hennigar(1988)	the United States	monthly data From 1973 to 1988	Correlation analysis	There is a negative correlation between exchange rate and stock prices in the short run	The Stock -Oriented Theory
Ma and Kao (1990)	Japan, Italy, France, West Germany, Canada, and the UK	Monthly data from January 1973 to December 1983	Simple Regression Method.	Exchange rates negatively effect the stock prices in the short run.	The Flow-Oriented Theory
Bahmani-Oskooee and Sohrabian(1992)	The United States	monthly data from July 1973 to December 1988	The Granger causality and the cointegration method	There is a bi-directional causality between stock prices and the exchange rate in the short run.	The Stock-Oriented and the Flow-Oriented Theories
Ajayi and Mougoue (1996)	Canada, France, Italy, Netherlands, Germany, Japan , the UK , and the the US	Daily data from April 1985 to July 1991	the Engle and Granger (1987), the (ECM) and the Granger-causality tests	There is a long-run relationship from stock prices to exchange rate in Germany, Italy, Japan, France, the UK, and finally the US. In the short-run, the interaction between exchange rates and stock prices was a bi-directional for France, Germany, Italy, Japan, the UK and the US.	The Stock-Oriented Theory in the long-run also both Theories in the short –run for
Nydahl and Friberg (1999)	Austria, Belgium, Japan, Denmark, Germany, Italy, France, Norway, Sweden, Finland, Netherlands, Switzerland, the UK and the US	Monthly data from 1973 to 1996	The OLS Regression Method.	There is a positive relationship from stocks prices to exchange rates	The Stock-Oriented Theory
Ajayi et al., 1998	he first group (Canada, Germany, France, Italy, Japan, the UK and the US The second group including eight Asian emerging markets (Taiwan, Philippines, Indonesia, Korea. Hong Kong, Thailand, Singapore and the Malaysia)	Daily and weekly of the advanced markets group from April 1985 to August 1991 and Asian emerging markets from December 1987 to September 1991	The Granger causality test	There is unidirectional causality from stock prices to exchange rate in all the six advanced markets in the short run. Furthermore, there is a unidirectional causality relationship running from stock prices to the exchange rate in the Philippines and Indonesia in the short run. There is a unidirectional causality relationship running from the exchange rate to stock prices in Korea in the short run. In addition there is bi-directional causality relationship in Taiwan in the short run. there is no any significant causal long or short running relationship in the Hong Kong, Thailand, Singapore and the Malaysia	The Stock-Oriented Theory for all the six advanced markets, Philippines and the Indonesia. The Flow-Oriented Theory of the Korea. Both Theories of the Taiwan
Nieh and Lee (2001)	France, Canada, Germany, Japan, Italy, the UK and the US	Daily data from October 1, 1993 to February 15, 1996.	The Engle and Granger and the Johansen tests	No long-run relationship between these two variables for each G-7 country. Short-run causality relationship running from exchange rates to stock prices that are only significant for one day in Canada, Germany and the UK, which was somewhat ambiguous. There is a negative Granger causality running from stock prices to exchange rates in Italy and Japan. The US fails to show any significant correlation between these two financial variables within the US are exogenous and not affected by each other at all.	The Flow-Oriented Theory of the Canada, Germany and the UK The Stock-Oriented Theory of the Italy and the Japan

Table 2.1 continued

Author(s) and Year	Country and Period of Study	Analysis Period	Methodology	Results	Theory
Kim (2003)	The United States	Monthly data for the January 1974 to December 1988	the multivariate cointegration and VECM test	There is a long-run relationship between S&P 500 index and exchange rate. There is a strong negative relationship between the value of the U.S. dollar and the change of the S&P 500 index.	The Flow-Oriented Theory
Murinde and Poshakwale (2004)	Hungary, Czech Republic and Poland.	Daily data divided into the pre-Euro period from data from January 2, 1995, to December 31, 2000 and the Euro period data from January 1, 1999, to December 31, 2003	Engle and Granger (198 test. a bivariate VectorAuto Regression model	There is no long -run relationship between stock prices and exchange rate for all countries The exchange rate caused stock prices in the Czech Republic, and Poland The bi-directional Granger causality is found in the Hungary. In the Euro period, there is short-run Granger-causality relationship from exchange rates to stock prices in all the three sample economies.	Both Theories
Stavarek (2005),	Austria, Germany, France, the UK, the US, Hungary, Czech Republic, Slovakia and Poland.	Monthly data and divided the Period is into two parts the first was from 1970-1992 and the second was from 1993-2003.	cointegration analysis the Vector Error Correction Model and the standard Granger-causality test for the period	The unidirectional causality runs from stock prices to exchange rates in the short -run. The causal relationship was stronger during the period 1993-2003 than in 1970-1992. Furthermore, for old EU countries which including (Austria, Germany, France, the UK) and for USA the causality relationship was stronger than for new EU countries which comprising Hungary, Czech Republic, Slovakia and Poland.	The Stock-Oriented Theory
Ratanapakorn and Sharma (2007)	The United States	The data set consists of quarterly data from 1975 to 1999.	The Johansen's cointegration method and the Vector Error Correction (VECM) Model.	exchange rate caused the US stock price index (S&P 500) in the long-run no relation between exchange rate caused the US stock price index (S&P 500) in the short-run	The Flow-Oriented Theory
Morales (2007)	Four Easter European markets Czech Republic, Hungary, Poland and Slovakia.	Daily data from 1999 to 2006	cointegration , Vector Error Correction Model and Granger causality tests	No evidence of stock prices and exchange rates moving together in the long-run of all countries with the exception of Slovakia, where cointegrating relationships were found. There is unidirectional causal relationship from the exchange rates to the stock prices in the Hungary, Czech Republic and Poland. Moreover, the ECM indicated that a short- run relationship exist between stock prices and exchange rate for Slovakian	The Flow-Oriented Theory

Table 2.1 continued

Author(s) and Year	Country and Period of Study	Analysis Period	Methodology	Results	Theory
Li and Huang (2008)	China	Daily data from July 21, 2005 to January 18, 2008	The Engle Granger cointegration, the Pairwise Granger causality tests and the VAR model to determine the lag.	There is no long-run relationship between the variables. there is a unidirectional causation from exchange rates to the Shanghai stock returns in the short-run	The Flow-Oriented Theory
Zhao (2010)	Chinese stock market	Monthly data from January 1991 to June 2009	the VAR and GARCH models	There is exists a bi-directional causality relationship volatility spillovers effect between the variables in the short-run. In the long-term, the study showed that no stable long-run equilibrium relationship between Shanghai Composite Stock Price Index and real exchange rate.	Both Theories
Kollias,Paleologou, and Mylonidis (2010)	European	Daily data from 2 January 2002 to 31 December 2008	cointegration and Granger causality tests.	There is short-run relationships and the direction is causal from exchange rates to stock prices whereas under unmoral conditions holds the reverse direction	under normal conditions/ The Flow-Oriented Theory under unmoral conditions / The Stock-Oriented Theory
Nieh and Yau (2010)	China	Daily from 21, July 2005, to 30, September 2008,	cointegration and Granger causality tests.	The existence of a threshold cointegration relationship between exchange rate and the Shanghai A-share prices. A unidirectional relationship from exchange rates to the Shanghai A-share index returns in the long -run.	The Flow-Oriented Theory
Zhang, Panagiotidis, and Alagidede (2011)	Australia, Canada, Japan, Switzerland, and the UK	Monthly data from January 1992 to December 2005	The Johansen cointegration test , three variations of Granger causality tests and the non-parametric causality approach proposed by Hiemstra and Jones (1994) test	No evidence of a long-run relationship between the stock prices and exchange rate are found. There is a unidirectional causal from exchange rates to stock prices for Canada, Switzerland, and the UK while there is a unidirectional causal relationship from stock prices to exchange rates only for Japan in the short –run.	The Flow-Oriented Theory for Canada, Switzerland, and the UK supported Japan supported the Stock-Oriented Theory
Caporale, Hunter, and Ali (2013)	Canada, Euro area, Japan, Switzerland, the UK and the US.	Weekly data from 2007 to 2010	Bivariate GARCH-BEKK model	There is unidirectional relationship from stock price to exchange rate changes in the UK and the US in the short –run. There is the unidirectional relationship from exchange rate to stock price in Canada in the short –run. . There is the bi-directional relationship in the euro area and Switzerland in the short –run.	The Stock-Oriented Theory of the UK and the US. The Flow-Oriented Theory of the Canada. Both Theories of the Euro area and Switzerland.

Table 2.1 continued

Author(s) and Year	Country and Period of Study	Analysis Period	Methodology	Results	Theory
Tsagkanos et al. (2013)	the European Union (EU) and the US	Both monthly and daily data from January 2, 2008 to April 30, 2012	Johansen Test, VAR model and Granger causality Test	Stock price movements drive exchange rate movements in both EU and the USA in the long –run relationship.	The Stock-Oriented Theory
Rutledge, Karim, and Li (2013)	China	Daily data from 20 July 2001 to 21 July 2011.	Standard Granger causality Tests and the VECM	Their result suggested a long-run cointegration relationship between exchange rates and the Shanghai A-share prices and for nine of ten industry indices.	Both Theories
Maswere and Kaberuka (2013)	France, Germany, Italy, Switzerland the UK	Monthly time series data from January 2003 to March 2011	The Johansen's cointegration test	There is the long -run with difference direction. The results of study suggested that an increase exchange rate causes stock market price to increase in the long-run.	The Flow-Oriented Theory.
Inci and Lee (2014).	France, Italy, Switzerland, Germany, the UK, Canada, Japan and the United States	Annual data from 1984 to 2009	The regression model	there is a bi-directional interaction between stock prices and exchange rate in in France, Switzerland, Canada, Germany, the UK, the US, and Japan	Both Theories
Rutledge et al. 2014;	China	daily data from 20 July 2001 to 21 July 2011	Standard Granger causality Tests and the VECM	There is a long unidirectional relationship running from exchange rate to the Shanghai A-share Index Returns	The Flow-Oriented Theory

Chapter 3: Methodology

3.1 Introduction

This chapter is divided into several sections that discuss the methodology of this study. After the introductory section, the research objectives are discussed in relation to the countries involved in the study. Then, the research questions are presented, directly followed by the research hypotheses. In addition, this chapter describes the research philosophy, research approach and data collection method and data sources. This is followed by a discussion of the appropriate techniques that support what the research aims to achieve in terms of answering each question and testing the hypotheses connected with these questions. After this, the measurement of the variables is discussed individually, with examples, starting with closing stock prices and exchange rates, followed by the unit root tests inclodíng the Dickey-Fuller and the Phillips-Perron (PP) tests, the Engle–Granger cointegration test. Some drawbacks of the Engle–Granger approach are discussed since it is applied in this study.

The Johansen's cointegration test and setting of the appropriate lag length of the models are also tackled respectively. The Vector Auto Regressive (VAR) Model and its advantages are explained in detail. The Granger-causality test under VAR and the Vector Error Correction Models (VECM) are dealt with in terms of the study's objectives. Discussing the Error Correction and estimated the Regression Model by the Weighted Least Squares (WLS) Method follows this. The equations of the Breusch–Pagan LM test and ARCH-LM are presented to explain the heteroskedasticity. This is followed by a discussion of the other models, which are essential for this study, namely the Histogram–Normality and the Breusch-Godfrey LM tests. Forecasting with Auto Correlated Errors (dynamic forecasting), the measurement of the predictive capability by Root Mean Square Percent Error and Theil's Inequality Coefficient are dealt with in last part of this chapter, except for a brief chapter summary that follows. The section about research objectives that immediately follows this paragraph discusses the rationale for the study, the general aims, and the research questions. Then, the focus turns to the selection of tests and the rationale behind this choice is discussed in detail.

3.2 Research Overall Aim and Research Objectives

The overall aim of this research is to examine the dynamic relationship between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States. In order to achieve this overall aim, the following three objectives have been formulated:

4. To detect both short and long–run relationships between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States.

5. To determine the direction of the relationship between stock prices and exchange rates and discover which of them affects the other or whether both affect each other in the previously mentioned countries.

6. To examine whether or not the data of the stock prices and exchange rate in the above-mentioned countries have good predictive ability for the future.

3.3 Research Questions

In order to achieve the objectives of this study, the following three main questions were formulated:

4- Is there any long-run relationship between:

e) The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate?
f) The FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate?
g) The FTSE 100 Index closing price and the UK Exchange Rate?
h) The Dow Jones Industrial Average Index closing price and the US Exchange Rate?

5- What is the direction of the relationship between:

e) The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate?
f) The FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate?
g) The FTSE 100 Index closing price and the UK Exchange Rate?
h) The Dow Jones Industrial Average Index closing price and the US Exchange Rate?

6- Do the data of the stock prices and exchange rates in the chosen countries have good predictive ability for the future?

3.4 Research Hypotheses

Based upon reviewing the theoretical and empirical literature in chapter two, a number of hypotheses have been formulated. This section, therefore, aims to highlight them briefly. They have been divided into three hypotheses that explore the relationship between stock prices and exchange rates in China, the European Union, the United Kingdom and the United States.

The case of China, many of the previous studies reviewed in the literature have found a short-run relationship between stock prices and exchange rate (e.g. Zhao, 2010 and Li & Huang, 2008). However, on another hand, there are very few studies that have found a long-run relationship between stock prices and exchange rate in China (e.g. Rutledge et al., 2014; Nieh and Yau, 2010). As such, building on most of the previous studies reviewed in the literature, the first hypothesis to be examined is formulated as follows:

H_1: There is no significant long-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate in China.

Secondly, with regards to the European Union, all the empirical studies reviewed in the literature have shown a short-run relationship between stock prices and exchange rate (e.g. Ma and Kao, 1990; Ajayi et al., 1998; Nydahl and Friberg, 1999; Nieh and Lee, 2001; Stavarek, 2005; Zhang et al., 2011; Caporale et al., 2013). Based on the empirical studies therefore, the second hypothesis is formulated as follows:

H_2: There is no significant long-run relationship between the FTSE Eurotop 100 Index and the Euro Exchange Rate in the European Union.

Thirdly, taking the United Kingdom into consideration, the majority of the previous studies discussed in the literature have shown a short-run relationship between stock prices and exchange rate (e.g. Ma and Kao, 1990; Ajayi et al., 1998; Nydahl and Friberg, 1999; Nieh and Lee, 2001; Stavarek, 2005; Zhang et al., 2011; Caporale et al., 2013), except Ajayi and Mougoue's (1996) study, who has found a long-run relationship between stock prices and exchange rate in the United Kingdom. Therefore, building on the majority of the previous studies discussed in the literature, the second hypothesis to be examined is formulated as follows:

H_3: There is no significant long-run relationship between the FTSE100 Index and the UK Exchange Rate in the United Kingdom.

Fourthly, with regards to the United States, the majority of the previous studies discussed in the literature have shown a short-run relationship between stock prices and exchange rate (e.g., Soenen and Hennigar, 1988; Bahmani-Oskooee and Sohrabian, 1992; Ajayi et al., 1998; Nydahl and Friberg, 1999; Nieh and Lee 2001; Stavarek, 2005; Caporale et al. 2013). Nonetheless, there are some studies that have found a long-run relationship between stock prices and exchange rate in the United States (e.g. Ajayi and Mougoue, 1996; Kim, 2003; Ratanapakorn- Sharma, 2007 and Tsagkanos et al., 2013). Consequently, the second hypothesis to be examined is formulated as follows:

H_4: There is no significant long-run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate in the United States

According to the theoretical framework, the (Share-Oriented and Flow -Oriented Theories), the Granger-causality relationship exists between stock prices and exchange rates and can run either from stock prices to exchange rates or from exchange rates to stock prices. There is no consensus on the relationship between stock prices and exchange rates from a theoretical aspect. As such, based on this theoretical framework, the fifth, sixth, seventh and eighth hypothesis are formulated as follows:

H_5: There is significant causality relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate in China.

H_6: There is significant causality relationship between the FTSE Eurotop 100 Index and the Euro Exchange Rate in the European Union.

H_7: There is significant causality relationship between the FTSE100 Index and the UK Exchange Rate in the United Kingdom.

H_8: There is significant causality relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate in the United States.

Furthermore, based upon reviewing the empirical literature, there is a large number of studies that have examined forecasting in the stock market variability between the stock prices and exchange rate (e.g. Chong & Lin, 2015; Dimpfl & Jank, 2015; Franses & Van Dijk, 1996; McMillan, Speight, & Apgwilym, 2000; Saryal, 2007; Wang, Liu, & Dou, 2012). However, to the best of the knowledge of the researcher, there is no study found in the literature that has examined the dynamic relationship between stock prices and exchange rates. Therefore, the following research hypotheses to be examined are articulated as follows:

H_9: The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate have good predictive ability for the future in China

H_{10}: The FTSE Eurotop 100 Index and the Euro Exchange Rate have good predictive ability for the future in the European Union

H_{11}: The FTSE100 Index and the UK Exchange Rate have good predictive ability for the future in the United Kingdom.

H_{12}: The Dow Jones Industrial Average Index closing price and the US Exchange Rate have good predictive ability for the future in the United States

The following table summarizes all the hypotheses and links them to the research objectives and questions.

Table 3.1: summary of all of the hypotheses and links with the research objectives and questions

Research Objectives	Research Questions	Research Hypotheses
To detect both short and long–run relationships between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States.	a. Is there any long–run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate b. Is there any long–run relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate c. Is there any long–run relationship between the FTSE 100 Index closing price and the UK Exchange Rate d. Is there any long–run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate	H_1: There is no significant long-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate H_2: There is no significant long-run relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate H_3: There is no significant long-run relationship between the FTSE 100 Index closing price and the UK Exchange Rate H_4: There is no significant long-run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate
To determine the direction of the relationship between stock prices and exchange rates and discover which of them affects the other or whether both affect each other in the previously mentioned countries.	a. what is the direction of the relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate b. what is the direction of the relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate c. what is the direction of the relationship between the FTSE 100 Index closing price and the UK Exchange Rate d. what is the direction of the relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate	H_5: There is significant causality relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate H_6: There is significant causality relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate H_7: There is significant causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate H_8: There is significant causality relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate
To examine whether or not the data of the stock prices and exchange rate in the above-mentioned countries have good predictive ability for the future	a. Do the data of the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate have good predictive ability for the future? b. Do the data of the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate have good predictive ability for the future? c. Do the data of the FTSE 100 Index closing price and the UK Exchange Rate have good predictive ability for the future? d. Do the data of the Dow Jones Industrial Average Index closing price and the US Exchange Rate have good predictive ability for the future?	H_9: The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate have good predictive ability for the future H_{10}: The FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate have good predictive ability for the future H_{11}: The FTSE 100 Index closing price and the UK Exchange Rate have good predictive ability for the future H_{12}: The Dow Jones Industrial Average Index closing price and the US Exchange Rate have good predictive ability for the future

3.5 Research philosophy

Research philosophy lies in the primary determinant of the appropriate research methodology, which depends on epistemological and ontological assumptions. "Researchers, within their views about the nature of reality applied to the phenomenon (ontology), hold various assumptions, which play a role in how the researchers acquire the knowledge about that phenomenon (epistemology)" (Creswell & Clark, 2007; Ryan, Scapens, & Theobald, 2002). Eventually, the acquisition of knowledge will help show how the research and its methodology should be conducted, in addition to understanding the methods for data collection (methodology) (ibid). Generally, the assumptions of research design can be drawn from one of the two research philosophies or paradigms namely positivism and phenomenology (Collis & Hussey, 2009; Easterby-Smith, Thorpe, & Lowe, 2002).

3.5.1 Positivism

The positivism philosophy depends on both a scientific and quantitative approach (Collis & Hussey, 2009; De Vaus, 2001; Douglas, 1976; Frankfort-Nachmias & Nachmias, 2014; Sekaran & Bougie, 2013). This philosophy has been widely used in business and management. Moreover, the research that is based on this philosophy's perspective always seeks to produce causal relationships or laws (Abgalia, 2011, pp. 138,139).

Remenyi, Williams, Money , and Swartz (1998, p. 32) showed that "working with an observable social reality and believing that the end product of such research can produce law-like generalizations similar to those produced by the physical and natural scientists". According to this perspective, it can be simply said that the researchers are independent of what they study and are value-free in choosing. The researcher should know exactly what to study and how to study it, which includes both the methods of data collection and the analysis. Moreover, the researchers should provide a large and sufficient sample size, which is required for generalization purposes, because providing a large sample allows the researchers to draw appropriate conclusions and for it to be representative of the wider population. Both the deduction and the hypothesizing are used to identify causal explanations (Easterby- Smith et al., 2002). Moreover, "this research paradigm depends on splitting the problems into the simplest possible units (reductionism) rather than analysing them in a holistic view or a whole situation" (Abgalia, 2011, p. 139). Also, a large enough sample size gives great attention to structured methodology, activation and statistical analysis for allowing replication (Lewis, Thornhill, & Saunders, 2009).

Table 3.2: Research Implication of Positivism

Implications	Description
Methodological	All research conducted using this philosophical approach should be quantitative. Only quantitative research can be the basis for valid generalisations and scientific laws.
Value-freedom	The choice of what to study and how to study it should be determined by objective criteria rather than human experiences, beliefs or interests.
Causality	Its main aim is to identify causal relationships and fundamental laws that explain human behaviour
Deduction	Hypotheses are proposed based on a logical deduction process.
Operationalisation	Concepts or variables under study need to be operationalised in a way that enables facts to be measured quantitatively
Independence	The role of the researcher is independent of the subject under examination.
Reductionism	The phenomenon under study is better understood if it is reduced to the simplest possible elements.

Adopted from Johnson and Duberley (2000, p. 39)

Table 3.2 shows the claims of positivistic research. Based on the above effects, the current study is conducted using the philosophy of this perspective, for the following reasons:

- A review of the Flow-Oriented and the Share-Oriented Theories was conducted.
- The research hypotheses were suggested (see section 3.4).
- The theoretical framework was proposed (see section 3.8) and it was decided that the study will be based on China, the European Union, the United Kingdom and finally the United States.

- The statistical tests for data analysis were determined. The data will be tested using simple regression, multiple regression and mediation regression analysis for indirect effect (interaction effect).
- This time series analysis for time series data was determined. The data will be tested using simple time series regression, the Vector Auto regression (VAR) Model, the Vector Error Correction (VECM) Model, the Auto regressive model for forecasting and the Vector Error Correction model for forecasting.
- Finally, the research data will be collected in the next stage and analysed, and a conclusion will be reached.

3.5.2 Phenomenology

Cohen and Manion (1987) define Phenomenology as "a theoretical point of view that advocates the study of direct experience taken at face value; and one which sees behaviour as determined by the phenomena of experience, rather than by external, objective and physically described reality" (Fellows & Liu, 2015, p. 72). This model tries to "to understand (verstehen) how people make sense of their worlds, with the human action being conceived as purposive and meaningful rather than externally determined by social structures, drives, the environment or economic stimuli and so on" (Gill & Johnson, 2010, p. 190). Consequently, researchers must take into account understanding and explaining different people's experiences, rather than focusing on casual relationships or laws through external factors including basic laws (Johnson & Duberley, 2000). Furthermore, the researchers in this kind of research have implicit or explicit ideas that play an important role in their interpretation and the sense-making process (Collis & Hussey, 2009). Unlike the positivism philosophy, this research model depends on splitting the problems into the simplest possible elements (reductionism), which is used to examine an entire multifaceted phenomenon (Remenyi et al., 1998). Moreover, Lewis et al. (2009) write that statistical generalization is less important in this paradigm, since it is thought that each research has its own specificity as well as a difference from other research cases. However, given the nature of this study, which is entirely based on time series analysis, this approach cannot be implemented.

3.6 Research approach

The literature discloses that there are two research approaches; the first one is the deductive approach (testing theory) and the second one is the inductive approach (building theory).

3.6.1 Deductive approach

This approach assumes that the research begins with premises which are used to work towards a logical conclusion (Williams & May, 1996) . According to De Vaus (2001), the theory testing approaches start from the general to reach the specific. This kind of research is launched through collecting data, developing hypotheses using the theory, testing the hypotheses, then supporting or modifying the theory if required (Creswell, 2003). Deductive theories reach their reasoned conclusions through applying reasons to a given set of premises (Sekaran & Bougie, 2003). Consequently, deductive research is consistent with quantitative research strategies and the positivism model (Lewis et al., 2009).

3.6.2 Inductive Approach

Williams and May (1996, p. 22) define induction as "the derivation of a general principle or possibly a law in science, which is inferred from specific observations". The inductive research procedure starts from collecting data as the first step, then analyses the data by trying to make sense of it, and finally formulates the theory. In inductive research, the researcher looks for patterns in the data and relationships between variables. On this basis, "in induction, we logically establish a general proposition based on observed facts. Generalizations in this type of research are sought from specific to other, wider context, as opposed to deductive research strategies" (Abgalia, 2011, p. 142).

Based on the above argument of the research approach, the current research is designed on the deductive approach, because the hypotheses are developed based on the literature and the theoretical framework (Flow -Oriented and Share-Oriented

Theories) .Quantitative data and statistical packages will be used to test hypothesis through applying time series analysis.

3.7 Data collection method and data sources

The current research applies time-series data of exchange rates and closing stock prices to capitalization indices of China, the United States, the United Kingdom and the European Union. More specifically, the sample period was limited by the times during which the closing stock prices were available for the Shanghai Stock Exchange Composite Index, the FTSE Eurotop 100 Index, the FTSE100 Index and Dow Jones Industrial Average Index. The data were generated over the period from January 3, 2000 to April 30, 2015. Daily observations of closing stock prices and exchange rates were gathered. There were a total of 30256 daily observations for exchange rates and closing stock prices. High-frequency data (daily data), aimed to track the pattern of movements, were used; this happened in the two time series and their significant interactions (Aliyu, 2009, pp. 12-18). Furthermore, stock prices have momentary changes, and it is illogical to use monthly data. Therefore, depending on monthly data may not be adequate to capture the effects of short-run capital movement (Benjamin, 2006, pp. 3-25). Using daily data provides more accurate results, which demonstrates the movements in stock prices and exchange rates. This study used time series analysis, which requires historical observation of stock prices and exchange rates for the sample countries. Therefore, it used daily data from 2000 to 2015 including 30256 observations.

To make sure the data are correct, the researcher collected the data of all stock prices and exchange rates from more than one source then compared them. Therefore, the Nominal Exchange Rate observations for countries in the sample were gathered from the International Financial Statistic, International Monetary Fund (IMF) and the central bank for each country. Furthermore, daily data observations for the price of each index in the sample were gathered from the Data Stream, Yahoo finance and the stock exchange market for each country.

In this study the period is divided into an in-sample and the out-of-sample data. An in-sample data set covered the period from January 3, 2000 to December 31, 2010 and included 22968 observations, whereas out-of-sample data extended from January 3, 2011 to April 30, 2015 and incorporated 7288 observations. The in-sample data were used to estimate the relationship between the variables mentioned above. The out-of-sample and in-sample data together used for estimated the forecasting will be discussed in the next chapter. All the time series were transformed into a natural log to make the data more normally distributed (Kruschke, 2010, p. 402). Moreover, "the series were transformed into a natural log such that coefficients would be interpreted as elasticities in the models" (Aliyu, 2009, p. 12).

The reason why these sources are the most suitable is that the majority of empirical research in the literature on examining the relationship between stock prices and the exchange rate aimed to find a long-run relationship between stock prices and exchange rate using similar sources. Therefore, they used time series data that require employing time series analysis as shown in chapter 2. Consequently, the research methodology of this study is designed according to previous studies and consistent with what the research aims to achieve in terms of answering each question and testing the hypotheses connected with these questions. The current study used time series regression analysis, and included many models, although some of those models have limitations. Therefore, the researcher used more than one model when testing the cointegration and causality relationship between stock prices and exchange rate.

3.8 Method and the Regression Equation

In the current research, time series techniques are employed, because they are the most appropriate techniques for what the research aims to achieve in terms of answering each question and testing the hypotheses connected with these questions. These are related to the nature of the data (closing stock prices and exchange rates). The study depends on observation for a long period, which requires employing time series techniques. In the literature, the majority of the previous studies used time series techniques and time series data (see Table 1 in Chapter 2)

The theoretical framework which underpins the methodology is based on the simple regression model, because this study uses only two variables for each country; therefore the regression of closing stock prices and exchange rates are analysed in order to determine the relationship between these two variables. They will be defined below. The regressions undertaken for each country are explained in these equations:

$$\boldsymbol{log(CH\_SP_{t-1}) = a + \beta_1\, log(CH\_ER_{t-1}) + e} \qquad \textbf{3-1}$$

$$\boldsymbol{log(EURO\_SP_{t-1}) = a + \beta_1 log(EURO\_ER_{t-1}) + e} \qquad \textbf{\textit{3-2}}$$

$$\mathbf{log(UK\_SP_{t-1}) = a + \boldsymbol{\beta}_1 log(UK\_ER_{t-1}) + e} \qquad \textbf{3-3}$$

$$\mathbf{log(US\_SP_{t-1}) = a + \boldsymbol{\beta}_1 log(US\_ER_{t-1}) + e} \qquad \textbf{3-4}$$

Where,

CH_SP is the closing price of the Shanghai Stock Exchange Composite Index

CH_ER is the Chinese Exchange Rate

EURO_SP is the closing stock price of the FTSE Eurotop 100 Index

EURO_ ER is the Euro Exchange Rate.

UK_SP is the closing stock price of the FTSE100 Index closing price

UK_ ER is the UK Exchange Rate.

US_SP is the closing stock price of the Dow Jones Industrial Average Index

US_ ER is the US Exchange Rate

(a), Is a constant, (β_1) is coefficient of the independent variable whereas (e_t) is the Standard. Error of the independent variable

3.9 Measurement of Variables

To study the dynamic relationship between stock prices and exchange rates, two variables, namely the exchange rate and the closing stock price of the sample countries of the sample (China, the European Union, the United Kingdom, and the United States) have been studied. Both variables are elaborated on a detailed account below to put the reader on the track.

3.9.1 Stock Prices

In order to explore the dynamic relationship between stock prices and exchange rates, the study used the closing stock prices of the capitalization–weighted index for the following sample countries: The Dow Jones Industrial Average Index for the United States, The FTSE 100 Index for the United Kingdom, the FTSE Eurotop 100 Index for the European Union and the Shanghai Stock Exchange Composite Index for China. The indices were measured using the daily data (on five working days) in the period of the study. The closing stock price time series data for each index is symbolised by (SP) and the first difference data for each index (denoted SP_1) is equal to log (SP_t / SP_{t-1}).

The researcher used these indices, because the study makes comparisons between developing and developed countries. These indices are capitalization–weighted indices of the sample countries. The first index is the Shanghai Stock Exchange Composite Index, which is the largest indicator in the Chinese stock market. Moreover, it includes the majority of the largest companies and state-owned businesses, which are listed in the Shanghai Stock Exchange market. Furthermore, the firms that have relatively small joint ventures or private businesses, mostly exporting companies listed in the Shenzhen Stock Exchange market, are under the Shanghai Stock Exchange market authority. This index is government-controlled, which makes it different from other indices leading the world finance markets (free stock markets).

The second index is FTSE Eurotop 100, which represents the performance of the 100 most highly capitalised blue chip companies in Europe (Valdez & Molyneux, 2010, pp. 191-192). The third index is the FTSE 100 Index, which is the largest index in the London Stock Exchange), classified as the second largest Stock Exchange in the world and the first in the European Union (Khurshed, 2011, p. 19). The FTSE 100 is an index made of the 100 largest firms listed on the London Stock Exchange. It attracts all types of firms, including start-ups and small, large, domestic and global companies. It is also seen traditionally as a good indicator of the performance of the largest companies listed in the United Kingdom. The fourth index is the Dow Jones Industrial Average Index, which is the most well-known stock index in the world. Its goal is to mostly represent the performance of the stock market by measuring the performance of firms with established track records who are dominant players in their respective industries (Odekon, 2015, p. 214). It is the most effective player in the finance world and stands behind the movements of other stock prices in the world.

3.9.2 Exchange Rates

Similarly, this study uses the nominal exchange rate for the Chinese Exchange Rate, the Euro Exchange Rate, the UK Exchange Rate and the US Exchange Rate for five working days. Using the nominal exchange rate is based on the fact that it does not include the inflation. Furthermore, the daily data for the nominal exchange rate were more easily available compared to the daily data for official and real exchange rates of each country on its own. The exchange rates time series stated in the U.S. dollar per local currency for each country is symbolized by (EX) and the first difference data for each country is symbolized by (ER_1) which is equal to log (ER_t / ER_{t-1}).

3.10 The Unit Root Tests

Knowing the difference between the stationary and non-stationary time series is very important, because "the shocks in stationary time series will be temporary, and over time their effects will be eliminated as the series revert to their long-run mean values" (Asteriou & Hall, 2011, pp. 335-336), while non-stationary time series will necessarily include permanent components. For that reason, the means and/or the variance of a non-stationary time series will depend on time, which generates too many cases where (a) the series has no long-run mean to which the series returns. (b) The variance will depend on time and will approach infinity as time goes to infinity" (Odekon, 2015, p. 335)

Given that the study uses a time series financial data, the issue of the unit roots needs to be accounted for due to two reasons. The first reason is that the spurious regression problem should be avoided. The second reason is that the order of integration for each variable included in the study should be determined. It is considered the first step towards understanding the short and long-run relationships between stock prices and exchange rates. To this end, two different unit root tests, namely the Augmented

Dickey-Fuller (ADF) (1979) and the Phillips-Perron (PP) (1988) unit root tests are applied to see whether or not the time-series data of stock prices and exchange rates are integrated of the same order. The next section explains the test.

3.10.1 The Dickey-Fuller Unit Root Test

Dickey and Fuller (1979) developed a formal procedure to test non-stationary data. The main idea of this test is that testing the non-stationary data is the equivalent of testing the existence of a unit root. Therefore, the best test is the following, which is based on the simple Auto Regressive AR (1) (cited by Asteriou & Hall, 2011, pp. 342,343).

$$\boldsymbol{y_t = \emptyset y_{t-1} + u_t} \qquad \textbf{\textit{3-5}}$$

The equation 3-5 examines whether $\emptyset = 1$ (unity and hence unit root). Evidently, the null hypothesis is $(H_0: \emptyset = 1)$, and the alternative hypothesis is $(H_1: \emptyset < 1)$. A more convenient equation can be obtained by subtracting (y_{t-1}) from both sides of the equation 3-5

$$\boldsymbol{y_t - y_{t-1} = \emptyset y_{t-1} - y_{t-1} + u_t}$$

$$\Delta \boldsymbol{y_t = (\emptyset - 1) y_{t-1} + u_t}$$

$$\Delta \boldsymbol{y_t = \gamma y_{t-1} + u_t} \qquad \textbf{\textit{3-6}}$$

Where (γ) equal $(\emptyset - 1)$.

According to the equation (3-6) the null hypothesis is $(H_0: \gamma = 0)$ and the alternative hypothesis is $(H_a: \gamma < 0)$, where if $(\gamma = 0)$ then (y_t) follows a pure random-walk model. Dickey and Fuller (1979) also suggest two alternative regression equations, which can be used to test the existence of a unit root. The first case is a constant in the random walk process as in the (3-7) equation:

$$\Delta \boldsymbol{y_t = \alpha_0 + \gamma y_{t-1} + u_t} \qquad \textbf{\textit{3-7}}$$

This case is extremely important, because it shows a definite trend in the series when $(\gamma = 0)$, which is often the case for macroeconomic variables. The second case allows the existence of a non-stochastic time trend in the model, and thus generates the following equation:

$$\boldsymbol{\Delta y_t = \alpha_0 + a_2 t + \gamma y_{t-1} + u_t} \qquad \textbf{\textit{3-8}}$$

The Dickey-Fuller test for stationary is simply the normal (t) test on the coefficient of the lagged dependent variable (y_{t-1}) from one of the three models (3-6, 3-7 or 3.8). This test has no traditional (t) distribution. Therefore, it must be used for specific critical values, which were originally calculated by Dickey and Fuller. Mckinnon (1990, pp. 1-16) classified suitable critical values for each of the three models mentioned above. This classification is shown in Table (3.3). In the three models, the test focuses on whether $(\gamma = 0)$. The DF-test statistic is the (t) statistic for the lagged dependent variable. If the value of the DF statistical is smaller in absolute terms than the critical value, and the value of the (p-probability) is more than 5%, then the null hypothesis is accepted as of a unit root test and it is concluded that (y_t) is a non-stationary process. On the other hand, if the value of the DF statistical is bigger in absolute terms than the critical value and the value of the (p-probability) is less than 5% then the null hypothesis of a unit root is rejected and it is concluded that (y_t) is a stationary process (Asteriou & Hall, 2011, pp. 343,344).

Table 3.3: Critical Values for the DF Test

Model	**1%**	**5%**	**10%**
$\Delta y_{t-1} = \gamma y_{t-1} + u_t$	-2.56	-1.94	-1.62
$\Delta y_{t-1} = \alpha_0 + \gamma y_{t-1} + u_t$	-3.43	-2.86	-2.57
$\Delta y_{t-1} = \alpha_0 + a_2 t + \gamma y_{t-1} + u_t$	-3.96	-3.41	-3.13
Standard critical values	-2.33	-1.65	-1.28

Note: Critical Values are taken from Mackinnon (1991)

Dickey and Fuller (1981) developed the test in order to eliminate autocorrelation, through including their original test as extra lagged terms of the dependent variable. Usually, the Akaike Information Criterion (AIC) or Schwartz Bayesian Criterion (SBC) determines the lag length on these extra terms (Asteriou & Hall, 2011, pp. 343,344). The three following equations show the evolution test of Dickey and Fuller:

$$\boldsymbol{\Delta y_t = \gamma y_{t-1} + \sum_{i=1}^{\rho} \beta_i \Delta y_{t-1} + u_t} \qquad \textbf{\textit{3-9}}$$

$$\boldsymbol{\Delta y_t = \alpha_0 + \gamma y_{t-1} + \sum_{i=1}^{\rho} \beta_i \Delta y_{t-1} + u_t} \qquad \textbf{\textit{3-10}}$$

$$\Delta y_t = a_0 + \gamma y_{t-1} + a_2 t + \sum_{i=1}^{\rho} \sum_{i=1}^{\rho} \beta_i \Delta y_{t-1} + u_t \qquad \textbf{3-11}$$

The difference between the three regressions is connected with the existence of the deterministic elements (a_0) and $(a_2 t)$. Table 3.3 shows the critical values of the Dickey-Fuller (DF) test. If the econometrician does not know the actual data-generating process, an important question can be raised whether it is more appropriate to estimate equation (3-9), (3-10) or (3-11). Dolado, Jenkinson, and Sosvilla-Rivero (1990) discuss a procedure through the estimation of the most general model, which indicates equation (3-11). Asteriou and Hall (2011, pp. 342-344) criticised this procedure because it was not designed to be employed in a mechanical fashion. Sometimes, plotting the data and observing the graph is very useful because it can give a clear indication of the presence or absence of deterministic regressors. Nevertheless, this procedure seems the most reasonable means to examine the unit root test when the form of the data-generating process is unknown.

3.10.2 The Phillips-Perron Unit Root Test

The distribution theory supported the Dickey-Fuller tests, which are based on the assumption that the error terms are statistically independent and have a constant variance (t). Therefore, when using the Dickey-Fuller tests, one keeps in mind that the error terms must be uncorrelated, and that they have a constant variance. Phillips and Perron (1988) developed the Dickey-Fuller tests to make the (ADF) assumptions somewhat mild in relation to the error distribution (Asteriou & Hall, 2011, p. 344). The following equation describes that the Phillips-Perron (PP) test regression is the AR (1) process

$$\Delta y_{t-1} = \alpha_0 + \gamma y_{t-1} + e_t \qquad \textbf{3-12}$$

While the Dickey-Fuller test is corrected, the higher is the correlation through adding lagged different terms. Consequently, the Phillips-Perron (PP) test makes a correction to the (t-statistics) of the coefficient (γ) from the AR (1) regression to explain the serial correlation in (e_t). Therefore, the (pp) statistics considers the modifications of the ADF (t-statistics), which take into account the least restrictive nature of the error process. The asymptotic distribution of the pp (t-Statistic) test is the same as the (t-statistic) of the ADF test for this reason; the critical values of MacKinnon (1990) are still applied (Asteriou & Hall, 2011, pp. 344,346) .

If the value of the PP statistical is less in absolute terms than the critical value, and the value of the (p-probability) is bigger than five percent, then the null hypothesis is accepted of a unit root and it is concluded that (y_t) is a non-stationary process. On the other hand, if the value of the PP statistical is bigger in absolute terms than the critical value and the value of the (p-probability) is smaller than five percent, then the null hypothesis of a unit root is rejected and it is concluded that (y_t) is a stationary process (Asteriou & Hall, 2011, pp. 343,344).

3.11 Cointegration Tests

Since this study uses time series data, the second step after applying unit root tests are employing the cointegration tests in order to test the second hypothesis which is detect whether or not:-

a) The closing price of the Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate are cointegrated in the long-run and the movements which happen in the Chinese Exchange Rate as an independent variable is sufficiently significant to explain the movements of the Shanghai Stock Exchange Composite as a dependent variable in the long-run.

b) The closing price of the FTSE Eurotop 100 Index and the Euro Exchange Rate are cointegrated in the long-run and the Euro Exchange Rate movements as an independent variable are sufficiently significant to explain the movement of the FTSE Eurotop 100 Index closing price as a dependent variable in the long-run.

c) The closing price of the FTSE100 Index and the UK Exchange Rate are cointegrated in the long-run and the movements which take place in the Euro Exchange Rate as an independent variable is sufficiently significant to explain the change of the FTSE Eurotop 100 Index closing price as a dependent variable over the long term.

d) The closing price of the Dow Jones Industrial Average Index and the US Exchange Rate are cointegrated in the long-run and the movements which occur in the US Exchange Rate as an independent variable is sufficiently significant to explain the movement of the Dow Jones Industrial Average Index closing price as a dependent variable over the long term.

The results of the unit root tests for all these variables compel the researcher to employ the cointegration test. According to Harris (1995, p. 52) , " if two series data appear to move together over time, it indicates an equilibrium relationship in the long term. For example, if two variables integrated of order one $I \sim (1)$, and the residuals obtained from regressing (Y_t) and (X_t) are $I \sim (0)$, then series are Co-integrated" (Harris, 1995 cited by Adrino, 2012, p.54). Applying the cointegration tests is often necessary to test the relationship between variables, because "financial time series do not satisfy the basic assumption of stationarity required to avoid spurious inferences based on regression analysis" (Phylaktis & Ravazzolo, 2005, pp. 1032-1033). Through differencing the variables, though, some information regarding a possible linear combination between the variables at levels series may be lost when using the first difference of variables. It should be known that "economic theory does not preclude a relationship of exchange rates and stock prices in terms of levels" (ibid, 2005, p. 1032). Therefore, the best solution to allow an examination of both the levels and the first difference of variables to overcome the problem of non-stationary is using the cointegration technique. There are many ways to examine how sets of data are related. In particular, in this study, the long-run relationship between the exchange rates and stock prices can be examined by implementing the cointegration analysis to see whether the mixture of the exchange rate variables avoid spurious inferences. The analysis of the earlier empirical study focused on the linkage and stock prices variables are cointegrated or not. In addition, two classical approaches are carried out to test the existence of a cointegration relationship between variables; the Engle and Granger (1987) two-step model, and the Johansen cointegration models (1988, 1991).

3.11.1 The Engle–Granger Test

Granger (1987) noticed that there is a relationship between non-stationary processes and the concept of long-run equilibrium; known as cointegration. After that, Engle and Granger (1981) gave more formalisation to this concept by simply introducing a test, known as the EG model two-step model, for the existence of a cointegration (i.e. long-run equilibrium) relationship. In the first step, the stock prices are regressed on the exchange rates. The reverse-order regression is also taken into account. As a second step, it tests the existence of cointegration relationship. The Engle-Granger model consists of two equations as follows;

$$\boldsymbol{SP_t = \alpha + \beta ER_t + \varepsilon_t \;\; or\; ER_t = \alpha + \beta SP_t + \varepsilon_t} \qquad \textbf{3-13}$$

$$\Delta\boldsymbol{\varepsilon_t = \rho\varepsilon_{t-1} + \beta_1}\Delta\boldsymbol{\varepsilon_{t-1} + \beta_2}\Delta\boldsymbol{\varepsilon_{t-2} + \cdots + \beta_\rho}\Delta\boldsymbol{\varepsilon_{t-\rho} + \mu_t} \qquad \textbf{3-14}$$

Here (SP_t) is the logarithm of stock price index and (ER_t) is the logarithm of the exchange rate. (ε_t) is residual from the cointegrating equation while (μ_t) refers to residual from the equation of (ADF) unit root test that is assumed to be white noise (Liu, 2009, pp. 207-208).

If the residual series are stationary, then the stock price and exchange have cointegration (long-run relationship). The Engle-Granger test is not enough to determine the long-run relationship, because it suffers from some weaknesses. The first issue is related to the variables system. When estimating the long-term relationship, it should put one variable in the left-hand side and use the others as the regression. The test does not give an explanation about which of these variables can be used as a regression and why. The second problem is that there is perhaps more than one cointegration relationship when using more than two variables, while the Engle-Granger test using residuals from a single relationship cannot treat this possibility. Therefore, the basic problem is that the Engle-Granger test does not give the number of cointegration vectors. The final problem is that the Engle-Granger relies on two-step estimators. The first step generates the residual of the series, and the second step is an estimation of a regression for this series to see if the series is stationary or not. Therefore, any error occurring in the first step is carried into the second step. To avoid these problems, the Johansen model was used, as Asteriou & Hall (2011, pp. 366-367) suggest. Given all the above-mentioned weaknesses, the study employs the Johansen's cointegration test.

3.11.2 Drawbacks of the Engle – Granger Test

Asteriou & Hall (2011, p.366) report that the Engle-Granger tests are very easy to understand, though there are serious deficiencies in their methodology. The first issue is related to the system of variables. When estimating the long-term relationship, one must put one variable in the left-hand side and use the others as regressors. The tests do not give an explanation about which of these variables can be used as regressor and why. Just two variables are used (X_t) *and* (Y_t).

> "One can either regress on (Y_t) on (X_t) (i.e. $Y_t = a + \beta X_t + u_{1t}$) or choose to reverse the order and regress (X_t) on (Y_t) (i.e. $Y_t = a + \beta X_t + u_{2t}$). It can be shown, with asymptotic theory that as the sample goes to infinity the test for cointegration j on the residuals h of those two regressions is equivalent (i.e. there is no difference in testing for unit roots in (u_{1t}) and (u_{2t}). However, in practice, in economics, we rarely have very big samples and it is therefore possible to find that one regression exhibits cointegration while the other does not. This is obviously a very undesirable feature of the EG approach. The problem obviously becomes far more complicated when we have more than two variables to test" (Asteriou & Hall, 2011, p. 373) .

The second problem is the possibility of there being more than one cointegration relationship when using more than two variables; the Engle-Granger test using residuals from a single relationship cannot treat this possibility. Therefore, the basic problem is that it does not give the number of cointegration vectors. The final problem is that the Engle-Granger model relies on the two-steps estimator. The first step is to make the residual series while the second one is to estimate a regression for this series to determine whether the series is stationary or not. Hence, any error introduced in the first step is carried into the second step. To avoid these problems the Johansen approach is used to give numbers of cointegration (Asteriou & Hall, 2011, pp. 366-367).

As mentioned above, the previous studies employed the Engle-Granger test and they recognised some of its drawbacks. They reported that the Johansen's cointegration test provides more accurate results. However the researcher will use it in her study in attempting to validate the results obtained in the previous studies. Thus, the researcher applied the Johansen's cointegration test as a means to compare the results of applying both tests and achieving more accurate results. This is dealt with in the next part.

3.11.3 The Johansen's Cointegration Test

The Johansen (1988, 1991) cointegration test are used to test whether stock prices and the exchange rates are integrating in the same order (i.e. whether they move together or not in the long run) under examination. Most economic time series are non-stationary and consequently integrated. Applying the Johansen's cointegration test requires variables that are non-stationary in order to detect stationary cointegrating relationships and avoid the spurious regression problem. However, unfortunately, this is not always the case and even the variables present in the model were mix order integrated, $I\sim(0)$, $I\sim(1)$and $I\sim(2)$. In this case, cointegrating relationships might well exist. "The inclusion of these variables, though will massively affect the results of the study and more consideration should be applied in such cases" (Asteriou & Hall, 2011, p. 373).

Johansen (1988) and Johansen and Juselius (1990) demonstrate two models to determine the number of cointegrating relationships, and both depend on the estimation of the matrix ($\prod$). That means the ($k \times k$) matrix with rank (r). The first model tests the null hypothesis that "Rank ($\prod$) = r against the hypothesis that Rank is $(r + 1)$" (Asteriou & Hall, 2011, p. 373). That means the null hypothesis in this case is that there are cointegrating vectors between the variables in the long-run and there are up to (r) cointegrating, with the alternative which indicates that there are $(r + 1)$ vectors. The test statistics are based on the feature of the roots obtained from the estimation procedure. "The test consists of ordering the largest eigenvalues in descending order and considering whether they are significantly different from zero"(Asteriou & Hall, 2011, p. 373).

$$\boldsymbol{\lambda_{max}(r,r+1) = -Tln\left(1-\hat{\lambda}_{r+1}\right)} \qquad \textbf{\textit{3-15}}$$

This test is called the maximal eigenvalue statistic test, which is denoted by (λ_{max}) because it is based on the maximum eigenvalue.

The second model is called the Trace Statistic, because it is mainly based on the likelihood ratio test for the trace of the matrix. "The Trace Statistic considers whether the trace is increased by adding more eigenvalue beyond the (ith) eigenvalue" (Asteriou & Hall, 2011, p. 374). In this case, the null hypothesis is the number of cointegrating vectors between the variable, and is less than or equal to (r). From the previous analysis, it can be said that when all $(\hat{\lambda}_i = 0)$, then the Trace Statistic is equal to zero as well. Conversely, if the feature roots are closer to unity, the more negative the $ln\ (1\text{-}\hat{\lambda}_i)$ term would be and, therefore, the larger the trace statistic. The equation 3.16 shows how this statistic is calculated.

$$\boldsymbol{\lambda_{trace}(r) = -T\sum_{i=r+1}^{n} In\left(1-\hat{\lambda}_{r-1}\right)} \qquad \textbf{\textit{3-16}}$$

The usual model is to work downwards and stop at the value of (r), which is related to a test statistic that exceeds the presented critical value. If the Johansen's cointegration test result is that there is no cointegration between stock prices and the exchange rate in the long term, the Vector Auto Regression (VAR) Model is suitable to estimate the short-run relationship. Meanwhile, if the result shows no cointegration between stock prices and the exchange rate, the Vector Error Correction model (VECM) Model should be employed to estimate the short-run relationship.

Many studies have applied these tests and reached different findings. Some of these studies, such as those of Ajayi & Mougoue (1996), Kim (2003), Tsagkanos et al. (2013), Maswere & Kaberuka, (2013) have concluded that there is a long-run relationship between stock prices and exchange rates. They applied the Vector Error Correction Model (VECM) as the next step. On the other hand, other studies, such as those of studies of Nieh & Lee (2001), Murinde and Poshakwale (2000), Ratanapakorn & Sharma (2007), Kollias et al. (2010), Caporale et al. (2013) did not find integration between the variables in the long run. They applied the Vector Auto Regression (VAR) Model. However, some other studies, such as those of Muhammad et al. (2002), and Stavarek (2005), found the relationship in both the short and long run; they used the Vector Error Correction (VECM) model to disclose the relationship in the short-run. For more information, see table 1 in chapter 2.

3.12 Setting the Appropriate Lag Length of the Models

Finding the optimal lag length is a very important issue, because the model must include the Gaussian Error Terms, which are the Standard Normal Error Terms that do not suffer from the autocorrelation, the non-normality and the heteroskedasticity (Asteriou & Hall, 2011, pp. 373-375). Determining the value of the lag length is affected by the omission of variables, which might affect only the behaviour model in the short-run because the deleted variables instantly become part of the error term. Thus, the inspection of the data and the functional association is necessary before starting the estimation in order to decide whether or not to include additional variables. In the short-run, it is quite common to use the dummy variables to take into account shocks to the system, and the political events that had important impacts on macroeconomic conditions. The most common procedure in the selection of the optimal lag length is an estimate of the VAR model as a first step. On the other hand, it should be taken into account that the VAR model comprises all variables in level (non-differenced data), which is a very important point (ibid). Moreover, the VAR model should be estimated for a large number of lags and then decreased by re-estimating the VAR model for one lag less until the lag is zero, which means that the estimation should be for a VAR model for, say, 12 lags, then 11, 10 and so on until reaching zero lags. Each of these VAR models should check the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) values in addition to inspect the existence of the heteroskedasticity, serial correlation, normality of the residuals and possible ARCH effects. In general, one should choose the model that minimizes the AIC and SBC values (AIC), and select the one with the optimal lag length. The model chosen should pass all the diagnostic checks (Asteriou & Hall, 2011, pp. 373-375).

According to the econometric analysis if there is no cointegration observed between the variables the VAR model will be applied. However, if there is cointegration between the variables, the VECM will be used. This process will be elaborated on in the next part.

3.13 Vector Auto Regression (VAR) Model

It is very common in "economics to have models in which some variables are not only explanatory variables for a given dependent variable, but are also explained by the variables that are used to determine". In this situation, one can use "models of simultaneous equations, in which it is necessary to identify clearly which are the endogenous and which are the exogenous or predetermined variables" (Asteriou & Hall, 2011, p. 320). Differentiation among variables was heavily criticised by Sims (1980).

Sims (1980, pp. 1-48) cited by Asteriou & Hall (2011, p. 320) shows that all variables should be treated in the same way only if there is synchronization between them. To clarify further, there should be no difference between internal and external variables. Consequently, he develops the VAR models, but he abandons the difference between internal and external variables. In addition, he considers that all variables are treated as endogenous, because what is reduced from each equation has the same set of regression when one neglects this difference between internal and external variables. Moreover, Asteriou & Hall (2011, p. 320) argue that each variable has to be treated symmetrically when one is not confident that variables are exogenous. They then assume that there is a two-time series (x_t,y_t) and that the (y_t) series is affected by past and current values of (x_t) series; simultaneously, the (x_t) time series is affected by past and current values of the (y_t) time series. Therefore, if the researcher applies Asteriou & Hall's assumptions for the variables in this study, the simple bivariate model will be obtained as follows:

$$\boldsymbol{SP_t = \beta_{10} - \beta_{12} ER_t + \gamma_{11} SP_{t-1} + \gamma_{12} ER_{t-1} + u_{spt}} \qquad \textbf{\textit{3-17}}$$

$$\boldsymbol{ER_t = \beta_{20} - \beta_{21} y SP_t + \gamma_{21} SP_{t-1} + \gamma_{22} ER_{t-1} + u_{ERt}} \qquad \textbf{\textit{3-18}}$$

With the assumption that (SP_t, ER_t) are stationary and (u_{SPt}, u_{ERt}) are uncorrelated white-noise error terms, equations (3-17) and (3-18) represent a first-order VAR model, because the longest lag length is unity. These equations are not reduced-from equations, because (SP_t) has a contemporaneous effect on (ER_t) given by(β_{21}) just as (ER_t) will have a contemporaneous effect on (SP_t) given by (β_{12}). Matrix algebra can be used to do rewrite the system as follows (ibid, p.320).

$$\begin{bmatrix} \mathbf{1} & \boldsymbol{\beta_{12}} \\ \boldsymbol{\beta_{21}} & \mathbf{1} \end{bmatrix} \begin{bmatrix} \boldsymbol{SP_t} \\ \boldsymbol{ER_t} \end{bmatrix} = \begin{bmatrix} \boldsymbol{\beta_{10}} \\ \boldsymbol{\beta_{20}} \end{bmatrix} + \begin{bmatrix} \boldsymbol{\gamma_{11}} & \boldsymbol{\gamma_{12}} \\ \boldsymbol{\gamma_{21}} & \boldsymbol{\gamma_{21}} \end{bmatrix} \begin{bmatrix} \boldsymbol{SP_{t-1}} \\ \boldsymbol{ER_{t-1}} \end{bmatrix} + \begin{bmatrix} \boldsymbol{u_{SPt}} \\ \boldsymbol{u_{ERt}} \end{bmatrix} \qquad \textbf{\textit{3-19}}$$

or

$$\boldsymbol{\beta_{zt} = r_0 + r_1 z_{t-1} + u_t} \qquad \textbf{3-20}$$

Where;

$$\boldsymbol{B} = \begin{bmatrix} \mathbf{1} & \boldsymbol{\beta_{12}} \\ \boldsymbol{\beta_{21}} & \mathbf{1} \end{bmatrix}, \quad \boldsymbol{z_t} \begin{bmatrix} \boldsymbol{SP_t} \\ \boldsymbol{ER_t} \end{bmatrix}, \quad \boldsymbol{r_0} = \begin{bmatrix} \boldsymbol{\beta_{10}} \\ \boldsymbol{\beta_{20}} \end{bmatrix},$$

$$\boldsymbol{r_1} = \begin{bmatrix} \boldsymbol{\gamma_{11}} & \boldsymbol{\gamma_{12}} \\ \boldsymbol{\gamma_{21}} & \boldsymbol{\gamma_{21}} \end{bmatrix} \boldsymbol{and\ u_t} \begin{bmatrix} \boldsymbol{u_{SPt}} \\ \boldsymbol{u_{ERt}} \end{bmatrix}.$$

Then Asteriou & Hall multiply both sides by B^{-1} as follows:

$$\boldsymbol{z_t = A_0 + A_1 z_{t-1} + e_t} \qquad \textbf{3-21}$$

Where;

$$\boldsymbol{A_0 = B^{-1} r_0, A_1 = B^{-1} r_1 \ and \ e_t = B^{-1} u_t} \qquad \textbf{\textit{3-22}}$$

For the purposes of notational simplification, the researcher can denote as:

(a_{i0}) the (i) the *(i*th*)* element of the vector (A_0), the (a_{ij}) the element in row (i) and column (j) of the matrix (A_1), (e_{it}) the (*I*) means the third element of the vector (e_t) *(rth)* element of the vector (e_t). From this notational simplification, Asteriou & Hall (2011, p.321) rewrite the VAR models as:

$$\boldsymbol{SP_t = a_{10} + a_{11} SP_{t-1} + a_{12} ER_{t-1} + e_{1t}} \qquad \textbf{\textit{3-23}}$$

$$\boldsymbol{ER_t = a_{20} + a_{21} SP_{t-1} + a_{22} ER_{t-1} + e_{2t}} \qquad \textbf{\textit{3-24}}$$

3.13.1 Advantages of the VAR Model

The VAR model approach has some advantages. The first one is very simple: the econometrician does not need to determine which variables are internal or external, as all variables are internal (Asteriou & Hall, 2011, pp. 321-322) because simultaneous equations' structural models require that all equations in the system are identified. This means that some variables are treated as internal and that the equations include different RHS variables (Brooks, 2014, pp. 328-329). The second advantage is that the estimation is very simple, as each equation can be estimated separately with the Ordinary Least-Squares regression method (Asteriou & Hall, 20 11, pp. 321,322). The third advantage is that the forecasts can be estimated by testing the VAR model, which is better than 'traditional structural' models according to Sims (1980). Sims argues that "large-scale structural models performed badly in terms of their out-of-sample forecast accuracy" (Olsson & Grigorenko, 2013, p. 7). The fourth advantage is that the optimal lag length can be chosen from a VAR model, which is important when estimating the cointegration models (Brooks, 2014, pp. 328-329).

3.13.2 Disadvantages of VAR Modeling

The Vector Auto Regression model has faced severe criticism on various different points. The first criticism is that the VAR model is a-theoretical (as is ARMA model) because it uses little theoretical information regarding the relationships between variables to guide the model's specification. "On the other hand, valid exclusion restrictions that ensure identification of equations from a simultaneous structural system will inform on the structure of the model" (Brooks, 2014, p. 329). As a result, the VAR model is less subject to theoretical analysis and therefore, to policy prescriptions. Moreover, there also exists "an increased possibility under the VAR model that an unlucky researcher could get an essentially spurious relationship by mining the data, as it is often not clear how the VAR coefficient estimates should be interpreted models" (ibid, p. 340-341).

The second criticism relates to the loss of degrees of freedom. If one assumes that one has a three-variable VAR model, also one decides to include 12 lags for each variable in each equation; this will require estimating 36 parameters in each equation in addition to the equation constant. If the sample size is not large enough, this creates problems in estimation, because estimating that a number of parameters will consume many freedom degrees. The third criticism is that the coefficients, which are obtained from VAR models, are difficult to interpret, because they completely lack any theoretical background. In order to avoid all these pitfalls, the supporters of VAR models estimated the so-called impulse response functions (Asteriou & Hall, 20 11, pp.321-322). "The impulse response function examines the response of the dependent variable in the VAR model to shocks in the error terms" (Asteriou & Hall, 20 11, p.322).

The difficult issue here is how to define the shocks. We try to shock the structural error, which is the error in equations (3-17) or (3-18), and can be easily explained as a shock to a specific part of the structural model. Nevertheless, one only observes the decreases form errors in (3-23) and (3-24), and each is made up of a mixture of the structural errors. Therefore, one has to separate the structural errors in some way, and this is what is known as the identification problem (ibid). Finally, all the components of the VAR model should be stationary or non-stationary. Usually when one uses hypothesis tests, either singly or jointly, to examine the statistical significance of the coefficients, it is essential that all components in the VAR model are stationary. Nevertheless, many of the supporters of the VAR model recommend that difference to induce stationarity should not be applied. They argue that the aim of estimating the VAR model is purely to examine the relationships between the variables and that difference will throw away information on any long-run relationships between the series. It is also possible to mix conditions and levels together at the first difference VECM (Brooks, 2014, pp. 329-330).

3.14 Vector Error Correction (VECM) Model

When the variables are non-stationary and cointegrated, the suitable method to examine the causality relationship is the Vector Error Correction model. The VECM is equivalent to VAR model in first differences with only one difference: the addition of a vector of cointegrating residuals (Liu, 2009, pp. 210-2011). Therefore, the VECM is represented as follows:

$$\Delta SP_t = \alpha_0 + \delta_1(SP_{t-1} - \gamma ER_{t-1}) + \sum_{i=1}^{p}\alpha_{1i}\Delta SP_{t-i} + \sum_{i=1}^{p}\alpha_{1i}\Delta ER_{t-i} + v_{1t} \qquad \textit{3-25}$$

$$\Delta ER_t = \beta_0 + \delta_2(SP_{t-1} - \gamma ER_{t-1}) + \sum_{i=1}^{p}\beta_{1i}\Delta SP_{t-i} + \sum_{i=1}^{p}\beta_{2i}\Delta ER_{t-i} + v_{2t} \qquad \textit{3-26}$$

Where (SP_t) and (ER_t) refer to stock prices and exchange rates, respectively, the $(\mathrm{SP}_{t-1} - \gamma \mathrm{ER}_{t-1})$ is an error correction term taken from the cointegrating equation in which (Δ) refers to the first difference operator. (δ_1, δ_2) represent the error coefficients which capture the adjustments of both $(\Delta \mathrm{SP}_t)$ and $(\Delta \mathrm{ER}_t)$ to long-run equilibrium. In addition, the coefficients on $(\Delta \mathrm{SP}_t\ , \Delta \mathrm{ER}_t)$, which are $(\alpha_{1i}, \alpha_{2i}, \beta_{1i}$ and $\beta_{2i})$, are expected to capture the short-term dynamics of the model. For that reason, inferences regarding the causality between stock price and exchange rate can be made as follows: (ER_t) causes (SP_t) if either (δ_1) is statistically significant (the long-run causality) or the (α_{2i}) s are jointly significant (short-run causality). Likewise, (SP_t) causes (ER_t) if (δ_2), is statistically significant (the long-run causality) or the *(β_{1i}) s* are jointly significant (short-run causality). For $(\delta_1 = \delta_2 = 0)$ which implies no long-run equilibrium relationship between stock price and exchange rate (Liu, 2009, pp. 210-2011).

3.15 Granger Causality Tests

The next step after applying the cointegration tests is applying the causality tests in order to detect the direction of the relationship between variables and test the second hypothesis in this study as following:

a) H_0: There is no significant Granger-causality relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate; H_1: There is a significant Granger-causality relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate

b) H_0: There is no significant Granger-causality relationship between the price of the FTSE Eurotop 100 Index and the Euro Exchange Rate; H_1: There is a significant Granger-causality relationship between the price of the FTSE Eurotop 100 Index and the Euro Exchange Rate

c) H_0: There is no significant Granger-causality relationship between the price of the FTSE100 Index and the UK Exchange Rate; H_1: There is a significant Granger-causality relationship between the price of the FTSE100 Index and the UK Exchange Rate

d) H_0: There is no significant Granger-causality relationship between the price of the Dow Jones Industrial Average Index and the US Exchange Rate; H_1: There is a significant Granger-causality relationship between the price of the Dow Jones Industrial Average Index and the US Exchange Rate.

There are two ways to conduct the causality test, depending on the results of the relationships. If there is a short-run relationship, the Granger causality tests will be under the Vector Auto Regressive (VAR) Model while if there is a long-run relationship, the Granger causality tests will be under the Vector Error Correction (VECM). The Standard Granger-causality test (1969) is suitable for analysing the short-run relationship if a non-cointegration exists between the variables. When the variables are cointegrated, the VECM Model should be applied. This brief introduction is only a reminder, because all these issues have been referred to earlier. The following two subsections will provide a short discussion of these two techniques.

3.15.1 Granger-causality test Under the Vector Auto Regressive (VAR) Model

Granger (1969) demonstrates that the concept of causality in econometrics is quite different from the same concept that is in everyday use. It refers more to the ability of one variable to forecast and therefore cause the other (Asteriou & Hall, 2011, p. 320). As previously mentioned, one of the advantages of the VAR model is that it can be used to test the direction of causality. The EViews guide (II) indicates that the Block Exogeneity Wald and the Wald tests can be applied under the VAR model the when the variables do not have any cointegrating relationship.

$$\Delta \boldsymbol{SP_t} = \boldsymbol{a_0} + \sum_{i=1}^{p} \boldsymbol{\alpha_{1i}} \Delta \boldsymbol{SP_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\alpha_{2i}} \Delta \boldsymbol{ER_{t-i}} + \boldsymbol{v_{1t}} \qquad \textbf{3-27}$$

$$\Delta \boldsymbol{ER_t} = \boldsymbol{\beta_0} + \sum_{i=1}^{p} \boldsymbol{\beta_{1i}} \Delta \boldsymbol{SP_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_{2i}} \Delta \boldsymbol{ER_{t-i}} + \boldsymbol{v_{2t}} \qquad \textbf{3-28}$$

Where (SP_t ,ER_t) refer to the dependent and the independent variables, and (v_{1t}, v_{2t}) indicate the disturbance that is assumed to be un-correlated.

Only stationary data are used when applying the Granger causality test; otherwise, the result of the F-statistics might be spurious as the test statistics will have a non-standard distribution. For this reason, "the first differences of log-level series are used, and the first difference operator is marked by Δ" (Liu, 2009, p. 211). Equation (3-27) assumes that the current value of (SP_t) is related to past value of both (SP_t) and (ER_t). Likewise, equation 3.28 assumes that the current value of (ER_t) is related to past value of both (ER_t) and (SP_t) (Asteriou & Hall, 2011, p. 320).

3.15.2 Granger-causality test Under the Vector Error Correction (VEC) Model

According to the equations of VECM (3-25 and 3-26), the causality between the variable (ER_{t-1}) and a variable (SP_{t-1}) can be made as follows. The variable (ER_{t-1}) causes a variable (SP_{t-1}) in two cases; in the first case (δ_1) is statistically significant (the long-run causality relationship) while in the second case the (α_{2i}) are jointly significant (short-run causality relationship). Likewise, the variable (SP_{t-1}) causes (ER_{t-1}) if either (δ_2) is statistically significant (the long-run causality relationship) or the (β_{1i}) are jointly significant (short-run causality relationship). For ($\delta_1 = \delta_2 = 0$) which means there is no long–run equilibrium relationship between (SP_{t-1}) and (ER_{t-1}). From equations (3-25 and 3-26), it is clear that the causality test in the VECM framework reduces to the Standard Granger-causality test in the VAR framework (Liu, 2009, pp. 209-211).

3.16 The Error Correction Model

Engle and Granger (1987) argue that if the variables are cointegrated, the Granger test is specified and may lead to spurious causality between the variables. To overcome this weakness of the Granger test, the Engle and Granger Proposition included error terms in equations (3-27) and (3-28) which capture the long-run and short-run relationships between the variables when they are cointegrated in their levels. For more clarity, if two variables (ER_t) and (SP_t) are integrated of order one or $I\sim(1)$ they formulate the error correction model as follows:

$$\Delta \boldsymbol{ER_t} = \boldsymbol{\delta_i} + \sum_{i=1}^{p} \boldsymbol{a_i} \Delta \boldsymbol{ER_{t-i}} + \sum_{i=1}^{p} \boldsymbol{\beta_i}\, \Delta \boldsymbol{SP_{t-i}} + \boldsymbol{\gamma_1} \hat{\boldsymbol{\varepsilon}}_{\boldsymbol{1t-1}} + \boldsymbol{v_{1t}} \qquad \textbf{\textit{3-29}}$$

And

$$\Delta \boldsymbol{SP_t} = \boldsymbol{\lambda_i} + \sum_{i=1}^{p} \boldsymbol{d_i}\, \Delta \boldsymbol{ER_{t-i}} + \sum_{i=1}^{p} \boldsymbol{c_i} \Delta \boldsymbol{SP_{t-i}} + \boldsymbol{\gamma_2} \hat{\boldsymbol{\varepsilon}}_{\boldsymbol{2t-1}} + \boldsymbol{v_{2t}} \qquad \textbf{\textit{3-30}}$$

Where ($\hat{\varepsilon}_{1t-1}$ and $\hat{\varepsilon}_{2t-1}$),refers to the error correction terms obtained from the long-run model lagged once, which can be explained as the deviation of (ER_t) and (SP_t) from their long-run equilibrium values respectively. When the equations include error correction terms, the short-run dynamics are necessary to achieve the long-run equilibrium and to open a channel to detect Granger causality (Granger, 1988). The (γ_i) captures the negative causal relationships between the variables in the long-run, and is likely to be an absolute value less than one. When the value of (γi) is less than five percent, (γ_i) is not statistically significant. In this case, the system of equations suggests that the variables of the system are independent in the context of prediction (Alshogea, 2011, pp. 96-98).

On the other hand, when (γ_1) is statistically significant, but (γ_2) is not, the system of equations suggest a unidirectional causality from (SP_t) to (ER_t) which means that (SP_t) drives (ER_t) toward long-run equilibrium, but not vice versa. However, the opposite will happen when (γ_2) is significant and (γ_i) is not significant. This is logical, because if both coefficients (γ_1, γ_2) are significant, then there exists bi-directional Granger-causality relationship or feedback causal relationships in the system of equations. The (β_j) measures the short-run impact of changes in (ER_t) on (SP_t). The (d_j) measures the short-run impact of changes in (SP_t) on (ER_t), while the (v_{it}) refers to the standard error term (Alshogea, 2011, pp. 96-98).

All models discussed earlier will be used in this study in case the time series data of the variables are stationary at first difference, which means all the closing stock prices and exchange rates are integrated of order one $I \sim$ (1). Some of these models will be used to find the relationship in the short-run between stock prices and exchange rates and others will be used to found the relationship in the long-run between the previous variables. If the time series data are unexpectedly stationary at level because most time series data are stationary at first, the researcher will employ the following models.

3.17 Estimating the Regression Model by the Ordinary Least Squares (OLS) Method

Quite simply, this regression analysis is a statistical means for examining the relationship between a dependent variable and a set of independent variables called explanatory variables. This simple regression model can be described as follows.

$$\boldsymbol{SP_t = \alpha_1 + \beta_1 (ER_t) + u_i} \qquad \textit{3-31}$$

Where; (SP_t) is the value of the dependent (endogenous) variable in observation (i), (α_1) and (β_1) are parameters of the equation, (ER_t) is the value of the explanatory variable in the observation and (i) and (u_i) are the disturbance terms (Rich & Brown, 2014, pp. 354,355) .

The regression analysis task estimates the production of (b_1,b_2) parameters, based on the information included in the data set and on assumptions regarding the properties of (e). These estimates are generated through the least square method, usually called Ordinary Least Squares (OLS), which minimises the residual sum of squares. If the fitted model is simple linear, the regression is referred as

$$\boldsymbol{\widehat{SP}_t = b_1 + b_2 ER_t} \qquad \textit{3-32}$$

The residual (e_i) refers to the differences between the actual value of (Y) and the fitted value given by the regression line.

$$\boldsymbol{e_i = SP_t - \widehat{SP}_t} \qquad \textit{3-33}$$

The explanation of this linear regression equation is as follows: the one-unit increases in (ER_t), measured in units of (ER_t), will cause a (b_2) unit increase in (SP_t) (in unit of (SP_t)). The constant (b_1) gives the forecast value of (SP_t) for (ER_t) when it equals (0). “Multiple regressions allow additional factors to enter the analysis separately so that the effect of each can be estimated” (Rich & Brown, 2014, p. 355). It is useful to measure the effect of various simultaneous influences on the single dependent variable. The coefficient of the determination (R-squared statistic) is a goodness of-fit measure. It measures the extent to which the total variable of the dependent variable is explained by the regression. The coefficient of determination ranges from zero to one. The R-squared statistic of one indicates that the regression line perfectly fits the data (Rich & Brown, 2014, pp. 354,355) .

3.18 Estimating the Regression Model by the Weighted Least Squares (WLS) Method

Considering the Multiple Recreation equation:

$$\boldsymbol{SP_i = \beta_1 + \beta_2 ER_{2i} + \beta_3 ER_{3i} \ldots\ldots + \beta_k ER_{ki} + u_i} \qquad \textbf{\textit{3-34}}$$

The variance of the error term, rather than being constant, is heteroskedastic, that is; $Var(u_i) = \omega_i^2$. Each term in the equation (3-34) is divided by the standard deviation of the error term (ω_i) as follows

$$\boldsymbol{\frac{SP_i}{\omega_i} = \beta_1 \frac{1}{\omega_i} + \beta_2 \frac{ER_{2i}}{\omega_i} + \beta_3 \frac{\beta_3 ER_{3i}}{\omega_i} + \cdots + \beta_k \frac{ER_{ki}}{\omega_i} + \frac{u_i}{\omega_i}} \qquad \textbf{\textit{3-35}}$$

or:

$$\boldsymbol{SP_i^* = \beta_1 ER_{1i}^* + \beta_2 ER_{2i}^* + \beta_3 ER_{3i}^* + \cdots + \beta_K ER_{ki}^* + u_i^*} \qquad \textbf{\textit{3-36}}$$

For the modified above equations:

$$\boldsymbol{Var(u_i^*) = Var\left(\frac{u_i}{\omega_i}\right) = \frac{Var\,(u_i)}{\omega_i^2} = 1} \qquad \textbf{\textit{3-37}}$$

Therefore, the estimates obtained by the Ordinary Least Squares (OLS) of the regression *(SP_i^* to $ER_{1i}^*, ER_{2i}^*, ER_{3i}^*, \ldots\ldots, ER_{ki}^*$)* becomes the weighted Least Squares (WLS) method. In econometrics, the weighted Least Squares (WLS) method is usually used as a technique to remove the heteroskedasticity problem as suggested by (Diebold & Pauly, 1987, pp. 21-40).

3.18.1 The Breusch–Pagan LM Test

Breusch and Pagan (1979, pp. 1287-1294) developed a Lagrange Multiplier test (LM) for heteroskedasticity with five steps. The first one runs the regression as in equation (3-36) and obtains the residuals ($\hat{u}_i$) of this regression equation.

$$\boldsymbol{SP_i = \beta_1 + \beta_2 ER_{2i} + \beta_3 ER_{3i} + \cdots + \beta_k ER_{ki} + u_i} \qquad \textbf{\textit{3-38}}$$

The second step is to apply the auxiliary regression

$$\boldsymbol{\hat{u}_t^2 = a_1 + a_2 Z_{2i} + a_3 Z_{3i} + \cdots + a_p Z_{pi} + v_i} \qquad \textbf{\textit{3-39}}$$

Where ($\boldsymbol{Z_{ki}}$) refers to a set of the variables that is used to determine the error term. The third step is formulated by the null and the alternative hypotheses. The null hypothesis of the heteroskedasticity is ($\mathrm{H_0: a_1 = a_2 = \cdots a_p = 0}$), while the "the alternative hypothesis is that at least one of the ($\mathrm{a_s}$) is different from zero and that at least one of the ($\mathrm{Z_s}$) affects the variance of the residuals which will be different for different (t)" (Asteriou & Hall, 2011, p. 119). The fourth step is calculated as the ($\mathrm{LM = nR^2}$) statistic, where (n) refers to the number of observations which are used in order to estimate the auxiliary regression in step two, while the ($\mathrm{R^2}$) is the coefficient of determination of this regression. Furthermore, the LM-statistic follows the ($\mathrm{X^2}$) distribution with (p-1) degrees of freedom. In the fifth step, if the (p-value) is bigger than the level of significance $\propto$ (usually $\propto$ = 0.05), the LM-statistical test cannot accept the null hypothesis. The conclusion would be that there is significant evidence of heteroskedasticity. Otherwise, if the LM-statistical is less than the critical value, it can reject the null hypothesis and conclude that there is no significant evidence of heteroskedasticity (ibid).

3.18.2 ARCH-LM Test

The ARCH-LM test is used to detect the heteroskedasticity problem. Engle (1982) offered a new concept, allowing for autocorrelation occurring in the variance of the error terms, rather than in the error terms themselves. Engle developed the Auto Regressive Conditional Heteroskedasticity ARCH model to capture this autocorrelation. The key idea of ARCH test is that the variance of (u_t) relies on the size of the squared error term lagged one period (that is u_{t-1}^2) (Asteriou & Hall, 2011, p. 119).

$$SP_t = \beta_1 + \beta_2 ER_{2i} + \beta_3 ER_{3i} + \cdots + \beta_k ER_{ki} + u_i \qquad \textit{3-40}$$

With the assumption that the variance of the error term follows an ARCH (l) process

$$var(u_t) = \sigma_t^2 = \gamma_0 + \gamma_1 u_{t-1}^2 \qquad \textit{3-41}$$

If (γ_1) = 0, there is no autocorrelation in $var(u_t)$ and hence the $\sigma_t^2 = \gamma_0$. The equation (3.41) can be extended to include the higher-order ARCH (P) effects as the following equation.

$$var(u_t) = \sigma_t^2 = \gamma_0 + \gamma_1 u_{t-1}^2 + \gamma_2 u_{t-2}^2 + \cdots + \gamma_p u_{t-p}^2 \qquad \textit{3-42}$$

According to the (ARCH) model, the null hypothesis is:

$$H_0 = \gamma_1 = \gamma_2 = \cdots \gamma_p = 0 \qquad \textit{3-43}$$

This means that there is no effect from the ARCH. To estimate the ARCH model, the first step is applying the regression model using the OLS model as in the equation (3.40) and obtaining the residuals ($\hat{u}_t$). Then the squared residuals (u_t^2) should be regressed against a constant, ($u_{t-1}^2, u_{t-2}^2, \dots\dots, u_{t-p}^2$) (the value of ($p$) will be released by the order of the ARCH (p) being tested for). If the p-value of the Chi-Square is less than the 5% (non-significant), the ARCH model rejects the null hypothesis of no ARCH effects. The opposite is also true: if the p-value of the Chi-Square is more than the five percent (significant), the ARCH model accepts the null of the existing ARCH effects (Asteriou & Hall, 2011, p. 139).

3.18.3 The Breusch-Godfrey LM Test

It can be detected that the serial correlation by the DW statistic can be obtained from the regression model by OLS model, but the DW test has some drawbacks that make its use unsuitable in various cases. For example, it cannot be applied when a lagged dependent variable is used. In addition, it cannot take into account higher orders of autocorrelation. Therefore, the DW test may give inconclusive results. For these reasons, Breusch (1978) and Godfrey (1978) developed the Breusch-Godfrey LM test which accommodates all the above cases (Asteriou & Hall, 2011, pp. 159-160). Consider the model:

$$\boldsymbol{SP_t = \beta_1 + \beta_2 ER_{2t} + \beta_3 ER_{3t} + \cdots + \beta_k ER_{kt} + u_t} \quad \textbf{\textit{3-44}}$$

Where;

$$\boldsymbol{u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + u_t}$$

If two previous equations are combined, the Breusch-Godfrey LM equation can be obtained:

$$\boldsymbol{SP_t = \beta_1 + \beta_2 ER_{2t} + \beta_3 ER_{3t} + \cdots + \beta_k ER_{kt} + \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + u_t} \quad \textbf{\textit{3-45}}$$

From the previous equation, the null and the alternative hypotheses can be determined:

$\mathrm{H_0}$: $\rho_1 = \rho_2 = \cdots = \rho_p = 0$ No serial correlation.

$\mathrm{H_a}$: at least one of the (ρ_s) is not zero, thus, autoccorrelation.

As in the detection of the heteroskedasticity, the first step is to apply the regression model using the OLS model as in the equation (3.44) and obtain the residuals $(\hat{u}_t)$.

$$\boldsymbol{\hat{u}_t = \alpha_0 + \alpha_1 ER_{2t} \ldots\ldots \alpha_R ER_{Rt} + \alpha_R + \hat{u}_{t-1} \ldots\ldots \alpha_R + p\hat{u}_t} \quad \textbf{\textit{3-46}}$$

After this, the regression model can be run using the next equation, with the number of lags (p) being determined according to the order of serial correlation to be tested. If the p-value of the Chi-Square is less than the five percent (non-significant), the Breusch-Godfrey LM test rejects the null of no serial correlation. On the other hand, if the p-value of the Chi-Square is more than the five percent (significant) the test accepts the null of the existing autocorrelation.

3.18.4 Histogram–Normality Test

The Histogram–Normality Test is used for descriptive statistics and a histogram of the standardised residuals. Jarque-Berra (1990) developed the Jarque-Berra test for Histogram Normality Distribution following the four simple steps presented below:

The first step is applying the regression model using OLS method as in the following equation (3.48).

$$\boldsymbol{\hat{u}_t = \alpha_0 + \alpha_1 ER_{2t} \ldots\ldots \alpha_R ER_{Rt} + \alpha_R + \hat{u}_{t-1} \ldots\ldots \alpha_R + p\hat{u}_t} \qquad \textit{3-47}$$

If one calculates the second, third and fourth moments of the $(\hat{u}_t)$, it can be noted that (μ_3) is the skewness and (μ_4) is the kurtosis of these in the regression equation below:

$$\boldsymbol{\mu_2 = \frac{\Sigma\,\hat{u}^2}{n}; \quad \mu_3 = \frac{\Sigma\,\hat{u}^3}{n}; \quad \mu_4 = \frac{\Sigma\,\hat{u}^4}{n}} \qquad \textit{3-48}$$

The second step is to calculate the Jarque-Berra statistic by:

$$\boldsymbol{JB = n\left[\frac{\mu_3^2}{6} + \frac{(\mu_4 - 3)^2}{24}\right]} \qquad \textit{3-49}$$

The previous equation has a (ER^2) distribution with two degrees of freedom. The next step is finding the (ER^2) distribution with two critical values from the table of(ER^2) distribution (Asteriou & Hall, 2011, p. 185). "If the residuals are normally distributed, the histogram should be bell-shaped and the Jarque-Bera statistic would not be significant"(Brooks, 2014, p. 210). The last step is decision-making; the Jarque-Berra statistic should be non-significant. "This means that the small probability value leads to the rejection of the null hypothesis of the residuals in a normal distribution" (Ziemba, 2012, p. 442). Therefore, if the probability of the Jarque-Berra test is non-significant and less than 5 percent, the null hypothesis can be rejected, which indicates that the residual is a normal distribution of the regression model. Alternatively, the Jarque-Berra test accepts the null hypothesis if the Jarque–Berra probability is significant and more than 5 percent (Asteriou & Hall, 2011, p. 185).

3.19 Forecasting with Auto Correlated Errors (Dynamic Forecasting)

Dynamic forecasting applies when there is autocorrelation between the variables as follows:

$$\boldsymbol{SP_t = \alpha_1 + \beta_1 ER_t + u_t} \qquad \textit{3-50}$$

$$\boldsymbol{u_t = \rho u_{t-1} + \varepsilon_t} \qquad \boldsymbol{-1} < \rho < 1 \qquad \textit{3-51}$$

Where (ε_t) points out the white noise error term.

Substituting equation (3-50) and (3-51) can obtain the following equation (3-52). When the (u_t) value is put on the right hand side of the equation, the following equation is obtained:

$$\boldsymbol{SP_t = \alpha_1 + \beta_1 ER_t + \rho u_{t-1} + u_t} \qquad \textit{3-52}$$

It can forecast *(SP)* for the next time period (*t* + 1), as below:

$$\boldsymbol{SP_{t+1} = \alpha_1 + \beta_1 ER_{t+1} + \rho u_{t-1} + \varepsilon_{t+1}} \qquad \textit{3-53}$$

Therefore, the forecast for the next period has three requirements: the first is the expected value ($\alpha_1 + \beta_1 ER_{t+1}$); the second is ($\rho$) times preceding error term; and the third is a purely white noise term, whose expected value is zero. Given the value of *(ER_{t+1})*, it can estimate ($\hat{\alpha}_1$+$\hat{\beta} ER_{t+1}$) where the OLS estimators are obtained from a given sample. Furthermore, it can estimate ($\hat{\rho}\hat{u}_t$) at time (t + 1), if the value of (u_t) is already known. Therefore, the estimated value of (SP_{t+1}) in (3-52) is:

$$\boldsymbol{\hat{S}P_{t+1} = \hat{\alpha}_1 + \hat{\beta} ER_{t+1} + \hat{\rho}\hat{u}_t} \qquad \textit{3-54}$$

Following this logic:

$$\boldsymbol{\hat{S}P_{t+2} = \hat{\alpha}_1 + \hat{\beta} ER_{t+2} + \hat{\rho}^2 \hat{u}_t} \qquad \textit{3-55}$$

For the second period, and so on

Equations (3-53) and (3-54) are called dynamic forecasting; when applying these forecasts, one should take into account the errors made in the past forecasts (Gujarati & Porter, 2009, pp. 485-486).

3.19.1 Tests of Predictive Capability

In order to test the predictive capability, a forecast model created over one sample or period is employed to forecast data for some alternative sample or period. It is acceptable to test a forecast model without waiting for data to become available. In such cases, the data can be divided into two sub-samples: a test group and a forecast group. The forecaster estimates a forecasting model by employing data from the test group and uses the resulting model to forecast the data of interest in the forecast group. By comparing the forecast and the actual values, the stability of the underlying cost or demand relation can be tested (Hirschey, 2008, pp. 227-228).

There are many methods to find out the predictive capability of the models and to compare one forecasting method with another; for example, the Mean Absolute Deviation (MAD), the Root Mean Square Error (RMSE), the Mean Absolute Percentage Error (MAPE), the Theil Inequality Coefficient, the Correlation of forecasts with actual values and the quadratic score. Evaluating the predictive capability of the model can be achieved through its valid estimation, or its productive ability to reproduce the actual data in a dynamic stable simulation (Pindyck & Rubinfeld, 1991, pp. 181-182). Therefore, RMSPE and Theil's inequality coefficient (U) are considered the most common tests to enhance the validity and evaluate the predictive capability to estimated models.

3.19.2 Root Mean Square Percent Error (RMSPE)

RMSPE is the most commonly used model for error measures. It includes Mean Error (ME), and Mean Absolute Error (MAE) (Pindyck & Rubinfeld, 1991, pp. 181-182). All these error measures are used to track the suitability of the simulated data to actual data. The measure can be expressed as a percentage of the actual values of the respective variables and for comparison purposes. The definition of RMSPE is as follows:

$$\textbf{RMSPE} = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(\frac{y_t^s - y_t^a}{y_t^a}\right)^2} \qquad \textbf{3-56}$$

Where: y^s_t = simulated value of y_t

y^a_t = actual value

T = number of observations

This formulation provides the prediction error percentage. Although there are no formal criteria for the values of the RMSPE, smaller values correspond to estimations that are more correct. The advantage of RMSPE over other error measures is that larger individual errors are penalised more heavily than smaller ones (ibid).

3.19.3 Theil's Inequality Coefficient (U)

The definition of U is as follows:

$$\textbf{U} = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(y_t^s - y_t^a\right)^2}}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(y_t^s\right)^2} + \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(y_t^a\right)^2}} \qquad \textbf{3-57}$$

Where the variables are as defined for RMSPE.

The Theil inequality index can be broken-down into three components known as the proportions of inequality, which break the simulation error into three sources:

$$\textbf{U}^{\textbf{m}} = \frac{\left(\bar{y}^s - \bar{y}^a\right)^2}{\frac{1}{T}\sum_{t=1}^{T}\left(y_t^s - y_t^a\right)^2} \qquad \textbf{3-58}$$

$$\mathbf{U^s} = \frac{(\sigma_s - \sigma_a)^2}{\frac{1}{T}\sum_{t=1}^{T}(y_t^s - y_t^a)^2} \qquad \mathbf{3\text{-}59}$$

$$\mathbf{U^c} = \frac{2(1-\rho)\sigma_s\sigma_a}{\frac{1}{T}\sum_{t=1}^{T}(y_t^s - y_t^a)^2} \qquad \mathbf{3\text{-}60}$$

The three components add up to unity:

$$\mathbf{U^m + U^s + U^c = 1} \qquad \mathbf{3\text{-}61}$$

Where:

(U^m) is the bias proportion:

(U^s) is the variance proportion, which indicates the model's ability to replicate the degree of variability in the given variable;

(U^c) is the covariance proportion, and a measure of unsystematic error,

(ρ) is the correlation coefficient;

(y s) and (σs) are the mean and standard deviation of simulated values; and

(yc) and (σs) are the mean and standard deviation of actual values.

Preferably, (Um) and (Us) should be close to zero and (Uc), close to one. A high value of (Um) denotes the existence of a systematic bias, and a high value of ($U^{s)}$ indicates a large discrepancy between the variances of simulated and actual data (Schadler, 2005, pp. 25-26).

3.20 Summary

This chapter has provided an outline of the basic econometric methodology, beginning with the stationary tests (The Dickey-Fuller test and The Phillips-Perron test) to see when the time series data should be stationary in order to determine which methods the research will use. This is because if the results of time series data are stationary at the level series $I \sim (0)$, the researcher is required to employ the OLS method. On the other hand, if the results of time series data of the variables are stationary at first different series, $I\sim(1)$ cointegration tests must be used. Secondly, to test the first hypothesis of this study and to investigate whether there is a short or long-run relationship between stock prices and exchange rates; the cointegration tests incloding the Engle–Granger and the Johansen's cointegration tests were used.

Additionally, this chapter provided a detailed explanation regarding which test (the Granger causality under the Vector Error Correction Model) should be used if there is a cointegration relationship between closing stock price and exchange rate for each country. Likewise, this chapter offers explanations about which test should be employed (the Granger-causality test under the Vector Auto Regressive (VAR) Model) if there is no cointegration relationship in the long run. Moreover, this chapter has explained the forecasting methods that should be used in case the time series data are stationary at the level, and that forecasting will be estimated by Ordinary Least Square Method. The chapter has also explained that in the case that the time series data of the variables are stationary at first different series, the study should estimate the forecast with the Vector Auto Regressive (VAR) Model (when there is a short-run relationship between stock prices and exchange rate) or the VECM (when there is long-run relationship between stock prices and exchange rate). In all cases of forecasting, the chapter has shown, the predictive capability is measured by Root Mean Square Percent Error or Theil's Inequality Coefficient.

Chapter 4: Empirical Results

4.1 : Introduction

This chapter sets out the details of the empirical results obtained by analysing the data and applying the appropriate methodology. The analysis will be connected with the overall aim of the study, which is to examine the dynamic relationship between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States. In order to achieve this overall aim, this chapter presents how the researcher achieves the first and second objectives of this study, while the third objective will be discussed in the next chapter. The first objective is to detect short and long–run relationships between stock prices and exchange rates in the above-mentioned countries. The second objective is to find out the direction of the relationship between stock prices and exchange rates and which of them affects the other, or whether both affect each other in the aforementioned countries. The direction of the relationship is discussed in this chapter in order to test the assumption of the Flow-Oriented and the Stock-Oriented Theories.

After the introductory section, section 4.2 presents the descriptive statistics of stock returns and exchange rate growth while section 4.3 shows the line graphs of exchange rates of the countries in the sample. The line graphs of stock market indexes of the countries of the sample are in section 4.4. The results of the Augmented Dickey-Fuller and the Phillip Peron tests are reported in section 4.5. Determination, the optimal lag lengths of the VAR Model is in section 4.6. Section 4.7 provides the results of the cointegration tests, including both Engle-Granger and Johansen's cointegration test. The last two most important sections are 4.8 and 4.9. Section 4.8 refers to the short–run analysis including the results of both Vector Auto Regression (VAR) Model and the Pairwise Granger causality test while section 4.9 refers to the long-run analysis involving the results of Vector Error Correction model (VECM) and Wald tests.

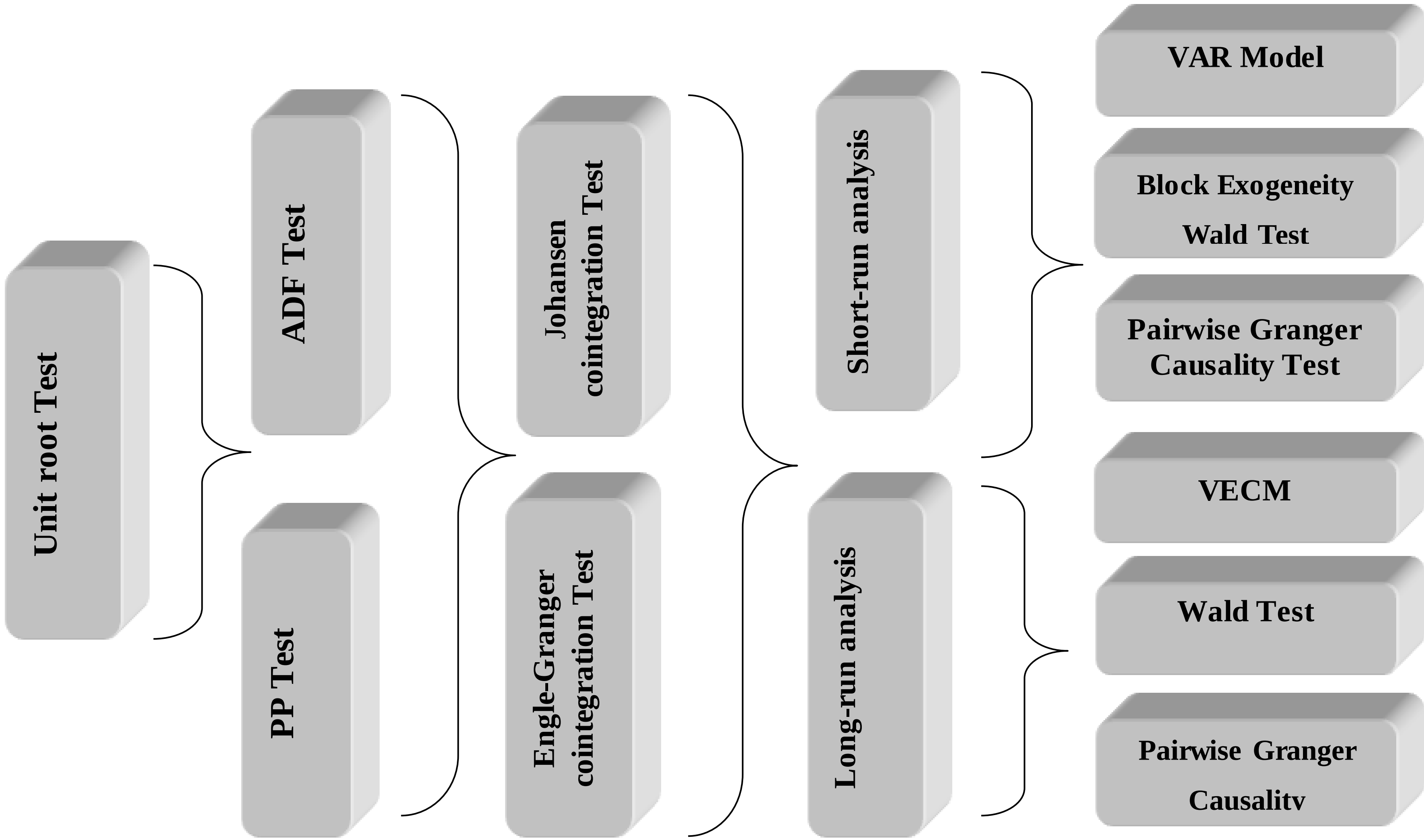


Figure 4.1 : Fundamental Tests in the Analysis

Figure 4-1 showed the structure of the analysis which includes a number of models that required detecting long and short-run relationship between stock price and an exchange rate of each country in the sample. All models included in figure 4-1 were explained in the previous chapter.

According to this figure, the first step is to examine the relationship between stock prices and the exchange rate is applying the unit root tests to know if the closing stock prices and exchange rates of all sample countries are stationary or not using the Augmented Dickey-Fuller unit root test and Phillip Peron unit root test to confirm the results. Moreover, figure 4-1 displays that the second step is to examine the relationship between stock prices and the exchange rate is employing the cointegration tests to answer the first research question by investigation the hypothesis H_1, H_2, *and* H_4, of the current research (see table 3.1 in chapter 3). Employing the cointegration tests including the Engle-Granger cointegration test and the Johansen's cointegration test to confirm the results, aims to understand whether the closing stock prices and the exchange rate are integrating of the same order (move together or not in the long-run) in the each sample countries.

Furthermore, figure 4-1 shows that in the case there is short–run relationship between stock prices and exchange rate that required employing the Wald, the Block Exogeneity Wald tests under the Vector Auto Regression (VAR) Model and Pairwise Granger causality test to answer the second research question by investigation the hypothesis H_5,H_6, H_7 *and* H_8, of the current research (see table 3.1 in chapter 3) aims to know the direction of the relationship between stock prices and the exchange rate in the short-run of the each sample countries. Additionally, figure 4-1 displays that in the case there is long relationship between stock prices and exchange rate that requisite applying the Wald, the Block Exogeneity Wald tests under the vector error correction (VEC) model and Pairwise Granger causality test to answer the second research question through investigation the hypothesis H_5,H_6, H_7 *and* H_8, of this study in order to know the direction of the relationship between stock prices and the exchange rate in the long-run in each sample countries.

There are some models used in this chapter but the figure 4-1 is not included because they usually apply before starting the process of analysing the relationship in the short or long-run.

In this study, the researcher divides the period of data collection into two phases: one for the collection of in-sample time series data and the other for the collection of the out-of-sample time series data. The in-sample time series data set covered the period from January 3, 2000 to December 31, 2010 and included 22968 observations, while the out-of-sample data extended from January 3, 2011 to March 31, 2015 and incorporated 7288 observations. The in samples data will be used in this chapter to estimate the relationship between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States to answer the first and second research questions and test the research hypotheses; H_1,H_2, H_3,H_4,H_5,H_6, H_7 *and* H_8. The out-of-sample will be used in the forecasting chapter to answer the third research question and test the research hypotheses; H_9, H_{10}, H_{11} *and* H_{12} (see table 3.1 in chapter 3). Therefore, the researcher begins the analysis with descriptive statistics of the in-sample time series data.

4.2 : Descriptive Statistics of Stock Prices and Exchange Rate Growth

To measure the descriptive statistics, the researcher used the natural log values of stock prices (SP) and exchange rates (ER) for four countries, namely China, the European Union, the United Kingdom, and the United States. Table 4-1 reports the descriptive statistics of stock prices and exchange rates of in-sample time series data starting from January 3, 2000 to December 31, 2010 to the above-mentioned countries. Moreover, the closing stock prices and exchange rates growth have been measured by taking the natural log values of the closing stock prices and exchange rates as in figure 4-1.

Table 4.1: Standard Deviation of Stock Prices and Exchange Rates

	China		European Union		United Kingdom		United States	
	CHI_ SP	CHI_ER	EUR_ SP	EUR_ER	UK_SP	UK_ER	US_ SP	US_ER
Mean	7.600507	-2.415352	7.830876	-0.197566	8.557170	0.150352	9.249553	-0.365577
Median	7.507136	-2.417533	7.816627	-0.174280	8.575369	0.163678	9.258454	-0.387013
Maximum	8.714742	-2.296066	12.29945	-0.028698	8.824398	0.293326	9.558496	-0.213960
Minimum	6.919190	-2.552892	1.127245	-0.435284	8.097731	-0.090877	8.786770	-0.501437
Std. Dev	0.398062	0.062293	0.271533	0.099360	0.163196	0.082327	0.133602	0.075537
Skewness	0.686299	-0.090026	-3.625240	-0.532614	-0.374034	-0.631769	-0.226438	0.454446
Kurtosis	2.801538	1.924705	156.3017	2.147221	2.079660	2.625892	3.173534	2.045433
Jarque-Bera	230.0082	142.1462	2814700.	222.5022	168.2096	207.6544	28.12737	207.7498
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000001	0.000000
Sum	21813.45	-6932.060	22458.95	-566.6194	24559.08	431.5114	26546.22	-1049.206
SumSq. Dev.	454.6023	11.13308	211.3837	28.30395	76.40960	19.44532	51.21057	16.36986
Observations	2870	2870	2868	2868	2870	2870	2870	2870

- **Standard Deviation**

The standard deviation measures the dispersion around the mean (or expected mean) of the series. Table 4-1 summarizes the basic statistical features of the data under consideration, including the mean, the minimum, maximum values and standard deviation, for the natural log values of the closing stock prices (SP) and exchange rates (ER) using four countries; China, the European Union, the United Kingdom, and the United States during the in-sample time series data running from January 3, 2000 to December 31, 2010 including 22976 observations after adjustments. Standard deviation is used as a measure of both risk, and unit root of the variance. It can clearly be observed from table 4-1 that the standard deviation of the Shanghai Stock Exchange Composite Index closing price of China is the highest of all; 40% against 24% of the FTSE Eurotop 100 Index closing price of the European Union, 16% of the FTSE 100 Index closing price of the United Kingdom and 13% of The Dow Jones Industrial Average Index of the United States closing price. Therefore, based on the standard deviation, China's Stock Exchange Market is the riskiest among all the stock exchange included in the sample. The European Union Stock Exchange Market came second; the United Kingdom Stock Exchange Market came in third, while the United States Stock Exchange Market is the safest among all the four countries. In addition, table 4-1 presents the characteristics of the variables distribution.

- **Jarque-Bera**

The Jarque-Bera is a statistical test that determines whether the stock prices and exchange rates are normally distributed or not. This statistic test measures the difference of the skewness and the kurtosis of the closing stock prices and exchange rates with their normal distribution. The null hypothesis of the Jarque-Bera test is that the closing stock prices, and exchange rates are normally distributed against the alternative hypothesis that they are not (Okpara & Odionye, 2012b, p. 6412). Obviously, the Jarque-Bera statistic rejects the null hypothesis of a normal distribution for the stock price and exchange rates of all countries in the sample of the study because the probability value of all variables is less than 5%.

- **Kurtosis**

Kurtosis is used as an indicator to measure the flatness of the distribution of the stock prices and exchange rates. The kurtosis of the normal distribution equals three. Therefore, if the value of kurtosis is more than three, the distribution is peaked (leptokurtic) relative to the normal distribution. If the kurtosis is less than three, the distribution is flat (platykurtic) relative to the normal distribution (EViews guide (I), P, 318). Therefore, the Kurtosis in table 4-1 demonstrates that all variables are the platykurtic distribution because the variables are less than three.

- **Skewness**

Skewness is a measure of the degree of asymmetry distribution of the stock prices and exchange rates around (EViews guide (I), P, 317). That means the value of skewness is negative which refers to "a bias towards downside exposure, which means that there are more negative changes or large negative returns than positive ones" (Alexandros, 2010, p. 80).

4.3 : Exchange Rate Line Graphs of the Sample Countries

From the first glance of figure 4-2, it can be noticed that all exchange rates are non-stationary and have a unit root test. When the line graphs of each variable is constantly rising or falling that means the series is non-stationary. Figure 4-2 also displays different exchange rates for the period from January 3, 2000 to December 31, 2010 for China, the European Union, the United Kingdom and finally the United States. Figure

4-2 also shows that the Chinese Exchange Rate (CH_ER) started to decline significantly from February 2002 until the first half of 2004, but in the second half of 2004, it gradually began to decline until it reached its lowest value in December 2004. That required the Chinese government to decide upon a quick intervention, because it has complete control on all Chinese stock markets. On 21 July 2005, the Chinese authorities started to revalue the Renminbi and officially modified the exchange rate regime. After that, the Chinese Exchange Rate gradually began to rise again until it reached the highest value in March 2009 by the end of the financial crisis, as shown in 4-2. After 2009, the Chinese Exchange Rate began fluctuation until it reached back to its highest value in May of the following year 2010.

In figure 4-2, the Euro Exchange Rate (EURO_ER) went through gradual decline starting from 2000, and reached its lowest value in the whole period of the study in late October 2000. However, it began to rise until it reached the highest value in late July, 2008. Then it declined drastically due to the financial crisis. In the beginning of December in the same year, it started to rise until November 2009 when it recorded the highest value. Then, it had a period of fluctuation in 2010, yet it did not reach the highest point of 2009. In 2000, the UK Exchange Rate went up gradually until it reached the highest value in the second half of 2002. Then, it experienced a period of slight fluctuation, yet it went down. In 2004, it changed its direction towards an increase. This rise continued for almost a year until December 2005.The UK Exchange Rate had its lowest value between late 2007 up to June 2008, which is related to the crisis affecting the whole world. In 2009, it began to improve and it reached the highest value in March in the same year. Then, this increase was followed by drastic decline in December in the same year, but it did not reach the lowest value of the period of the crisis. It recorded the highest value in June 2010 and it began to decline steadily again.

Furthermore, figure 4-2 displays that the UK Exchange Rate UK_ER recorded continuous decline during the first eight months of 2000. In the middle of September of the same year, the UK_ER started to grow up increasingly for more than six years to reach its highest value in July 2007. That dramatic rise of the UK_ER was directly before the financial crisis. Then the UK_ER declined dramatically to reach less value in January 2009 because of the financial crisis and its impact on the global exchange prices. From 2009, the UK_ER grew at increasing rates but until the end of 2010, it did not reach its highest value recorded in 2007.

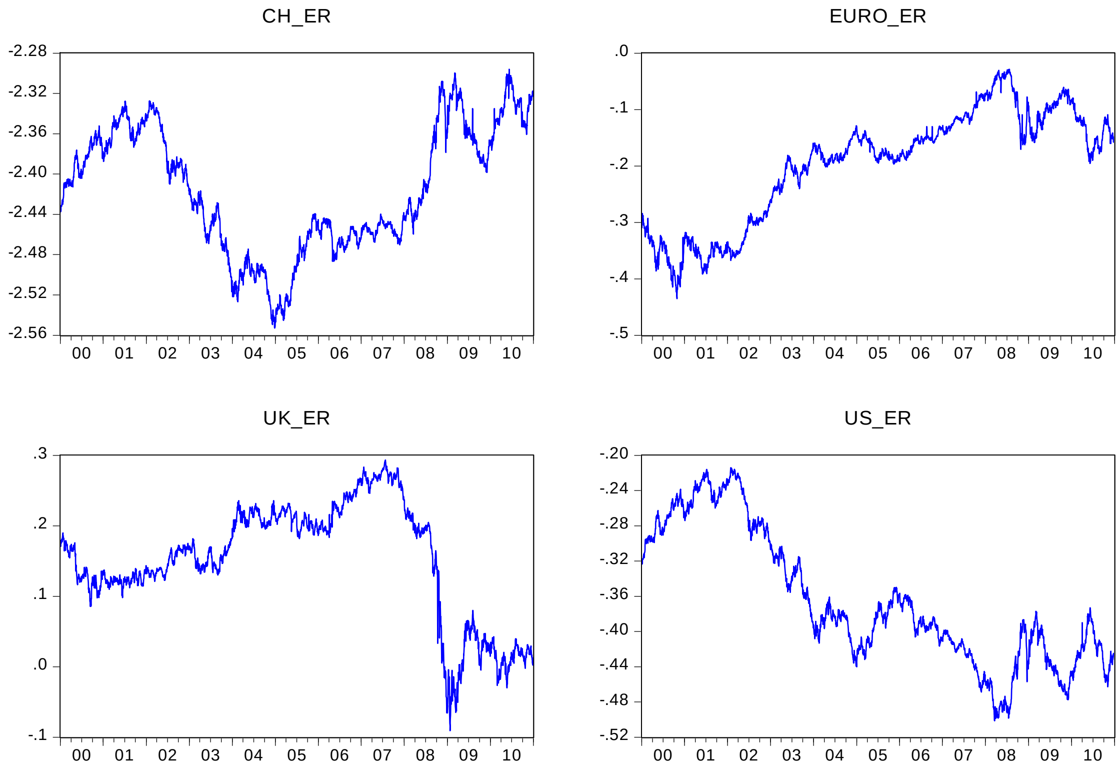


Figure 4.2 : Exchange Rate Line Graphs of the Sample Countries

4.4 : Stock Prices Line Graphs of the Sample Countries

Figure 4-3 presents' different closing stock prices indexes during in-sample time series data starting from January 3, 2000 to December 31, 2010 for China the European Union, the United Kingdom and finally the United States. From the beginning of 2000, the closing price of the Shanghai Stock Exchange Composite Index CH-SP oscillated up and down, but in June 2005, it reduced to the lowest value. Then the CH-SP continued to rise until it reached a higher value in October 2010, due to changes of the government's monetary policy. Therefore, the stock market was reformed in 2003 and 2005 and had good impact on the closing price of the Shanghai Stock Exchange Composite Index as noted in the figure 4-3. Moreover, figure 4-3 exhibits that the closing price of the FTSE Eurotop 100 Index had apparent unlimited changes during the period from 2000-2010. This is not considered strange, since the European Union area had an economic crisis during the study period. Furthermore, other crisis in other countries had an effect on the European economies. This inference is related to the FTSE Eurotop 100 Index, which is not listed in the stock exchange market for one country, such as the FTSE 100 Index, the Shanghai Stock Exchange Composite Index and the Dow Jones Industrial Average Index. The FTSE Eurotop 100 Index is made of the biggest hundred companies of the European Union. Therefore, the crisis that occurred in this period 2000-2010 had direct effects on the economies of these European countries forming the index. Meanwhile, the effects had an indirect impact on this index, as shown in 4-3. Figure 4-3 also shows that the closing price of the FTSE 100 Index continued to decline from the beginning of 2000, until it reached its lowest value in mid-March of the same year.

It seems that the economic policy adopted by the London Stock Market, such as the London Stock Exchange became demutualized in 2000 and was listed on its own main market in order to achieve more commercialization on 2001 (Bessant & Tidd, 2011, pp. 440-441), which had a negative impact on the FTSE 100 Index closing price. In 2003, the London stock exchange created the European Derivatives Exchange, known as the EDX London, to be a recognized investment exchange for international equity derivatives (ibid). That had a positive impact on the FTSE 100 Index closing price, where it can be noted that the closing price of the FTSE 100 Index continued to rise for more than three years. Twenty-nine Chinese listed companies in the London Stock Exchange helped to increase the closing price of the FTSE 100 Index in 2005 (ibid).

This policy was working to raise the FTSE 100 Index closing price until it reached its peak in the middle of July 2007. It seems that when the London Stock Exchange purchased the Borsa Italiana in 2007 (Crowd, 2015), and this had a negative impact on the closing price of the FTSE 100 Index.

From figure 4-3, it can be noted that there was a steady decline in the FTSE 100 closing prices until mid-March 2009. Then, it began to rise gradually, but it did not reach its highest value of 2007 at the end of 2010. This gradual increase in the FTSE 100 Index closing price happened because the London Stock Exchange Market Group purchased Sri Lankan technology firm 'Millennium' in 2009 (Publishing, 2014). Respectively, in 2010, the London Stock Exchange Market Group acquired a majority of the Turquoise stake, a platform facilitating the trading of stocks listed in eighteen European countries and the United States (ibid). In addition, figure 3-4 displays that the closing price of the Dow Jones Industrial Average Index continued to decline from the beginning of 2000 until it reached its lowest value in the last quarter of September 2002 according to the available data of this study. During this period, the Dow Jones Industrial Average Index had the third largest one day point drop in its history, which was related to the September 2001 events. Because of the downturn, the Dow Jones Industrial Average Index remained without achieving big profits in 2002 (Mattera, 2005, p. 50). On February 27, 2007, the closing price of the Dow Jones Industrial Average Index had its most dramatic drop, since it was the biggest point drop since 2001. This decline was caused by a global sell-off after Chinese stocks experienced a mini-crash in which the Dow Jones Industrial Average Index dropped 320 points at once (Lopes & Polson, 2010).

In September 2008, the closing price of the Dow Jones Industrial Average Index had a drop of more than 500% when the Lehman Brothers filed for bankruptcy (Schier, 2009, p. 235) that contributed to widen the financial crisis. By the end of 2009, the closing price of the Dow Jones Industrial Average Index increased "after the United States Housing Bubble and the Global Financial Crisis of 2008–2009" (Kozmetsky & Yue, 2005, p. 464).

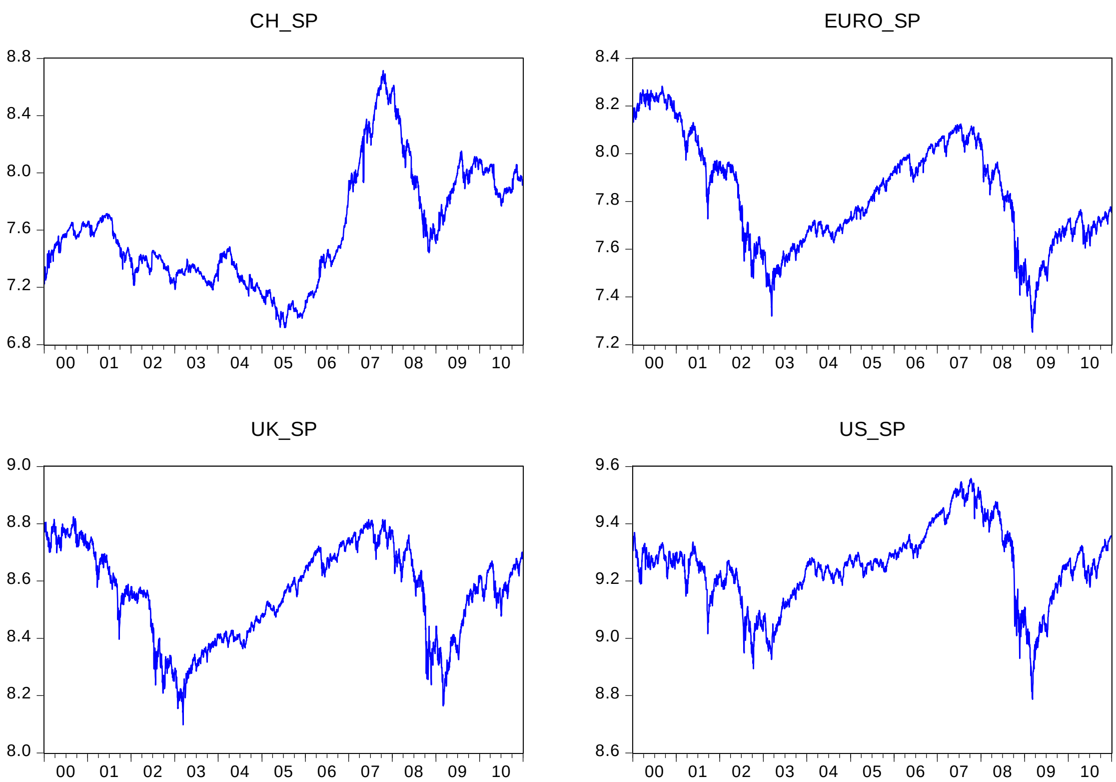


Figure 4.3: the stock price Line Graphs of the Sample Countries

4.5 : The Results of Augmented Dickey-Fuller and Phillip Peron Unit Root Tests

The following steps outlined in the methodology after transforming all the time series data into a natural logs are applying the unit root tests to understand if the time series data of the Shanghai Stock Exchange Composite Index closing price, the Chinese Exchange Rate, the FTSE Eurotop 100 Index closing price, the Euro Exchange Rate, the FTSE 100 Index closing price, the UK Exchange Rate, the Dow Jones Industrial Average Index closing price and the US the Exchange Rate are stationary or not. If the time series data of the previous variables are a random process; non-stationary, the regression analysis between closing stock prices and exchange rate for China, the European Union, the United Kingdom and the United States could generate spurious regression, and then the research results may not be reliable. Therefore, the researcher applied the unit root tests to avoid this problem.

This study employed both the Augmented Dickey-Fuller (ADF) (1979, 1981) and Phillips-Perron (PP) (1988) tests to check the unit root property for each variable aforementioned separately, as shall be seen later. The daily data lasted from January 3, 2000 to December 31, 2010 including 22887 observations of data after adjustments for all exchange rates and closing stock prices. Table 4-2 explain the results of the Augmented Dickey-Fuller test at the level series and at the first differences. From both tables it can be seen that:

1. The ADF test accepts the null hypothesis; the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate are non-stationary whereas the ADF test incepts the alternative hypothesis; the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate are stationary at level series. On the contrary, the ADF test rejects the null hypothesis and accepts the alternative hypothesis at the first difference series.

2. The ADF test cannot reject the null hypothesis; the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate are non-stationary while the ADF test rejects the alternative hypothesis; the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate are stationary at level series. In contrast, the

ADF test rejects the null hypothesis and accepts the alternative hypothesis at the first difference series

3. The ADF test accepts the null hypothesis; the FTSE 100 Index closing price and the UK Exchange Rate are non-stationary but the ADF test cannot accept the alternative hypothesis; the FTSE 100 Index closing Price and the UK Exchange Rate are stationary at level series. On the other hand, the ADF test rejects the null hypothesis and accepts the alternative hypothesis at the first difference series.

4. The ADF test cannot reject the null hypothesis; the Dow Jones Industrial Average Index closing price and the US Exchange Rate are non-stationary. In contrast, the ADF test rejects the alternative hypothesis; the Dow Jones Industrial Average Index closing price and the US Exchange Rate are stationary at level series. Vice versa at the first difference, series the ADF test reject the null hypothesis and accept the alternative hypothesis.

From the findings of the Augmented Dickey-Fuller unit root test, which set in table 4-2, it could be summarized that the ADF test accepts all null hypothesis at level series $I\sim(0)$, while it rejects all alternative hypothesis for China, the European Union, the United Kingdom, and the United States because the values of the probability for all closing stock prices and exchange rates are more than five percent and the value of the t-statistic are less than the critical values at any significance levels 1%, 5% and 10%. On the contrary, the ADF test rejects the null hypothesis; stock closing prices and exchange rates are non-stationary, and accept the alternative hypothesis; stock closing prices and exchange rates are stationary, at first difference series $I\sim(1)$ because the probability value is less than five percent and the t-statistic value is larger than the critical value. Consequently, it can be concluded that all the time series data for the previous eight variables referred to previously are non-stationary, which means all the variables are integrated of order zero $I\sim(0)$, at the levels series 1%, 5%, 10%. Then they become stationary at the first difference series which means all the variables are integrated of order one $I\sim(1)$.

Table 4.2: Results of Augmented Dickey-Fuller (ADF) Test

China

Level series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
SHCOMP Index	-1.071080	-3.432442	-2.862350	-2.567246	0.7292
Exchange Rate	-0.886913	-3.432440	-2.862349	-2.567245	0.7929

1st Difference series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
SHCOMP Index	-25.67220	-3.432443	-2.862350	-2.567246	0.0000
Exchange Rate	-42.81171	-3.432440	-2.862349	-2.567245	0.0000

European Union

Level series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTS Eurotop 100 Index	-2.748433	-3.432475	-2.862365	-2.567254	0.0661
Exchange Rate	-1.205949	-3.432440	-2.862349	-2.567245	0.6741

1st Difference series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTS Eurotop 100 Index	-23.61004	-3.432475	-2.862365	-2.567254	0.0000
Exchange Rate	-46.55250	-3.432440	-2.862349	-2.567245	0.0001

Table 4.2: continued

United Kingdom

Level series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTSE 100 Index	-2.028348	-3.432442	-2.862350	-2.567246	0.2747
Exchange Rate	-1.015381	-3.432442	-2.862350	-2.567246	0.7499

1st Difference series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTSE 100 Index	-28.03654	-3.432442	-2.862350	-2.567246	0.0000
Exchange Rate	-34.01592	-3.432442	-2.862350	-2.567246	0.0000

United States

Level series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
INDU Index	-2.120895	-3.432440	-2.862349	-2.567245	0.2365
Exchange Rate	-2.028348	-3.432442	-2.862350	-2.567246	0.2747

1st Difference series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	Prob.*
INDU Index	-43.31696	-3.432440	-2.862349	-2.567245	0.0000
Exchange Rate	-28.03654	-3.432442	-2.862350	-2.567246	0.0000

The conclusions of the Augmented Dickey-Fuller test are confirmed by the results of the Phillips-Perron statistic test. Table 4-3 displays the results of the (pp) test over in-sample time series data starting from January 3, 2000 to December 31, 2010, included the 22887 observations after adjustments for all exchange rates, and closing stock prices.

1. The PP test accepts the null hypothesis; the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate are non-stationary while the PP test incepts the alternative hypothesis; the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate are stationary at level series. Vice versa at the first difference series, the PP test rejects the null hypothesis and accepted the alternative hypothesis.

2. The PP test cannot reject the null hypothesis; the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate are non-stationary, whereas the pp test rejects the alternative hypothesis; the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate are stationary at level series. On the other hand, the PP test rejects the null hypothesis and accepts the alternative hypothesis at the first difference series.

3. The PP test cannot reject the null hypothesis; the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate are non-stationary, whereas the pp test rejects the alternative hypothesis; the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate are stationary at level series. On the other hand, the PP test rejects the null hypothesis and accepts the alternative hypothesis at the first difference series.

4. The pp test cannot reject the null hypothesis; the Dow Jones Industrial Average Index closing price and the US Exchange Rate are stationary while the PP test rejects the alternative hypothesis; the Dow Jones Industrial Average Index closing price and the US Exchange Rate are stationary at level series. On the contrary, the pp test rejects the null

hypothesis and accepts the alternative hypothesis at the first difference series.

Table 4.3: Phillips-Perron Statistic (PP) Test

China

Level series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
SHCOMP Index	-1.284857	-3.432438	-2.862348	-2.567245	0.6388
Exchange Rate	-0.948759	-3.432438	-2.862348	-2.567245	0.7730
1st Difference series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
SHCOMP Index	-61.02859	-3.432439	-2.862349	-2.567245	0.0001
Exchange Rate	-60.68956	-3.432439	-2.862349	-2.567245	0.0001

European Union

Level series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTS Eurotop100 Index	-2.748433	-3.432475	-2.862365	-2.567254	0.0661
Exchange Rate	-1.205949	-3.432440	-2.862349	-2.567245	0.6741
1st Difference series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTS Eurotop100 Index	-23.61004	-3.432475	-2.862365	-2.567254	0.0000
Exchange Rate	-46.55250	-3.432440	-2.862349	-2.567245	0.0001

Table 4.3: continued

United Kingdom

Level series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTSE 100 Index	-2.028348	-3.432442	-2.862350	-2.567246	0.2747
Exchange Rate	-1.015381	-3.432442	-2.862350	-2.567246	0.7499
1st Difference series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
-28.03654	-3.432442	-2.862350	-2.567246	0.0000	-28.03654
-34.01592	-3.432442	-2.862350	-2.567246	0.0000	-34.01592

United States

Level series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
INDU Index	-2.120895	-3.432440	-2.862349	-2.567245	0.2365
Exchange Rate	-2.028348	-3.432442	-2.862350	-2.567246	0.2747
1st Difference series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
INDU Index	-43.31696	-3.432440	-2.862349	-2.567245	0.0000
Exchange Rate	-28.03654	-3.432442	-2.862350	-2.567246	0.0000

It could be concluded that the pp test accepts the null hypothesis and rejects the alternative hypothesis at level series for China, the European Union, the United Kingdom, and the United States because of two reasons. Firstly, the probability values are more than 5%. Secondly, the t-statistic values are smaller than the critical value at any significance levels 1%, 5%, and 10%. Even though the pp test rejects the null hypothesis, closing stock prices and exchange rates are non-stationary and accept the alternative hypothesis at first difference series because the value of the probability is less than five percent and the value of the t-statistic is larger than the critical value. Therefore, the pp test provided additional support for the all closing stock prices, and exchange rate for eight variables integrated of order zero $I{\sim}(0)$, at level series (non-stationary) while they became integrated of order one $I{\sim}(1)$, at first difference series (stationary).

4.6 : Optimal Lag Lengths of the VAR Model

The next important step after knowing that the data is stationary at the first different is to determine the optimal lag length because the analyses need to be the standard normal error terms that do not suffer from non-normality autocorrelation. For this purpose, the researcher uses the Vector Auto Regression (VAR) lag order selection method available in EViews 8 package. This technique uses five different criteria, which are widely used in the literature to determine the lag lengths (Lütkepohl, 2005and Enders, 2010).

- the sequential modified likelihood ratio (LR) test statistic
- the final prediction error criteria (FPE)
- the Akaike information criterion (AIC)
- the Schwarz information criterion (SIC)
- the Hannan-Quinn information criterion (HQ)

In practice, it is impossible that all the criteria recommend one lag length as optimal. “One may have to be content with a lag length supported by 2-3 criteria only”(Mishra & Paul, 2008, p. 23). These lag specification criteria results are reported in table 4-4. To determine the Optimal Lag Lengths, the researcher used the in-sample time series data including 22976 observations after adjustments. This study showed that the optimum lag length has found lag eight in the case of the European Union, lag four for the United States while lag seven is for both China and the United Kingdom. Furthermore, automatic specification lags were based on Schwarz criterion. The first use of the optimal lag with the Johanson test is to explore if there is any long-run relationship between stock prices and exchange rate for the counties in the sample of the study. Another use of the optimal lag is with the Vector Auto Regression model (VAR), in case there is a short-run relationship between stock prices and exchange rate. Furthermore, the Vector Error Correction (VECM) Model cannot be estimated without determining the optimal lag in case there is long-run relationship.

Table 4.4: Optimal Lag Lengths of the VAR Model

China							European Union						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**	**Lag**	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	2604.242	NA	0.000556	-1.818478	-1.814313	-1.816976	0	2347.203	NA	0.000659	-1.649229	-1.645043	-1.647719
1	18910.83	32579.00	6.28e-09	-13.21092	-13.19843	-13.20642	1	11547.59	18381.36	1.02e-06	-8.116446	-8.103887	-8.111916
2	18952.86	83.90440	6.11e-09	-13.23750	-13.21668*	-13.22999	2	11784.20	472.3982	8.69e-07	-8.280029	-8.259097	-8.272480
3	18963.75	21.72340	6.08e-09	-13.24231	-13.21316	-13.23180	3	11932.70	296.2565	7.85e-07	-8.381642	-8.352338	-8.371073
4	18968.13	8.738179	6.08e-09	-13.24258	-13.20510	-13.22906	4	11999.75	133.6939	7.51e-07	-8.425988	-8.388311	-8.412398
5	18969.93	3.579423	6.09e-09	-13.24104	-13.19523	-13.22452	5	12044.89	89.92102	7.30e-07	-8.454915	-8.408866	-8.438306
6	18989.73	39.42108	6.02e-09	-13.25208	-13.19794	-13.23256*	6	12074.94	59.82846	7.16e-07	-8.473236	-8.418813	-8.453607
7	18997.40	**15.26185***	**6.01e-09***	**-13.25465***	-13.19218	-13.23212	7	12099.96	49.76462	7.06e-07	-8.488014	-8.425219	-8.465365
8	18998.82	2.833149	6.02e-09	-13.25285	-13.18205	-13.22732	**8**	12117.33	**34.54339***	**6.99e-07***	**-8.497420***	**-8.426252***	**-8.471751***
United Kingdom							**United States**						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**	**Lag**	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	4328.920	NA	0.000167	-3.023704	-3.019539	-3.022202	0	5205.954	NA	9.03e-05	-3.636586	-3.632421	-3.635084
1	17662.75	26639.71	1.50e-08	-12.33875	-12.32626	-12.33425	1	20692.16	30939.95	1.81e-09	-14.45574	-14.44325	-14.45124
2	17862.23	398.2621	1.31e-08	-12.47535	-12.45453	-12.46785	2	20712.09	39.77639	1.79e-09	-14.46687	-14.44605	-14.45936
3	17910.20	95.70775	1.27e-08	-12.50608	-12.47693	-12.49557	3	20730.53	36.79374	1.77e-09	-14.47696	-14.44781*	-14.46645*
4	17930.66	40.78016	1.26e-08	-12.51758	-12.48010*	-12.50407	**4**	20737.16	**13.21641***	**1.77e-09***	**-14.47880***	-14.44132	-14.46528
5	17944.31	27.20563	1.25e-08	-12.52433	-12.47852	-2.50781*	5	20737.57	0.825784	1.77e-09	-14.47629	-14.43048	-14.45977
6	17949.50	10.33535	1.25e-08	-12.52516	-12.47102	-12.50564	6	20738.52	1.894194	1.77e-09	-14.47416	-14.42002	-14.45464
7	17954.34	**9.630732***	**1.25e-08***	**-12.52575***	-12.46328	-12.50322	7	20742.53	7.975361	1.77e-09	-14.47417	-14.41170	-14.45164
8	17955.52	2.335505	1.25e-08	-12.52377	-12.45298	-12.49825	8	20745.34	5.588537	1.78e-09	-14.47334	-14.40254	-14.44781

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion
* Included observations (22976)

4.7 : Empirical Results of Cointegration Tests

In this section, the researcher will employ the cointegration tests to answer the first research question which is;

> *Is there any long–run relationship between stock prices and exchange rates in China, the European Union, the United Kingdom and the United States?*

Through investigation of the following hypothesis:

> *H_1: There is no significant long-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate in China.*
>
> *H_2: There is no significant long-run relationship between the FTSE Eurotop 100 Index and the Euro Exchange Rate in the European Union.*
>
> *H_3: There is no significant long-run relationship between the FTSE100 Index and the UK Exchange Rate in the United Kingdom.*
>
> *H_4: There is no significant long-run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate in the United States*

Since all closing prices for the capitalization indexes and exchange rates are integrated of the same order $I{\sim}(0)$, thus, the conditions of applying the cointegration tests are achieved. This study carried out classical methods to test the existence of a cointegrating relationship between the stock prices and exchange rates for each country in the sample. The first one is the Engle and Granger (1987) two-step cointegration test, and to confirm the results the researcher employed the Johansen's cointegration test (Johansen, 1988; Johansen and Juselius, 1990).

4.7.1 Empirical Results of the Engle-Granger Cointegration Test

Since the condition of the cointegration is achieved, which is that all closing stock prices and exchange rates are integrated of order one $I \sim (1)$. The next step in the analyses is to attempt to find any cointegration relationship between closing stock price and exchange rate for each country individually in the sample of the current study. In this study, the first model used to test a long-run relationship is the Engle-Granger two-step test (1987) with automatic lags specification based on the Schwarz Criterion in order to examine the long–run relationship between closing stock price and exchange rate for the each country in the sample. To employ the Engle-Granger two-step the researcher uses the sample time series data starting from January 3, 2000 to December 31, 2010 including 4744 observations after adjustments of all countries in the sample of the study. The null hypothesis of the Engle-Granger test is that there is no cointegration at the 5% significance level for the period under analysis between closing stock price and exchange rate for each country in the sample of the study.

Table 4.5: Results of Engle- Granger Cointegration Test

Null hypothesis: no contegration	tau-statistic	Prob.*	z-statistic	Prob.*
China				
CH_SP	-1.359560	0.8129	-3.602338	0.8382
CH_ER	-1.273259	0.8390	-3.910199	0.8163
European Union				
EURO_SP	-3.086208	0.0915	-20.03987	0.0556
EURO_ER	-1.532871	0.7504	-4.652565	0.7600
United Kingdom				
UK_SP	-1.950324	0.5540	-7.630887	0.5240
UK_ER	-1.072604	0.8876	-3.620327	0.8370
United State				
US_SP	-2.328142	0.3593	-10.73816	0.3221
US_ER	-1.359215	0.8130	-3.596594	0.8386

Notes: Notes: The optimal lag length was chosen by the Bayesian information criterion.
* Mackinnon (1996) p-value.
*Included observations: 11478

The results of the Engle-Granger cointegration test listed in table 4-5 show that the tau-statistic, which is referred by the t-statistic and the normalized autocorrelation coefficient, denoted by the z-statistic, both accept the null hypothesis of the Engle-Granger, which is no cointegration between closing stock price and exchange rate for all the countries in the sample of the study at the 5% significance level because the probability value, referred by the prob* in table 4-5, are more than 5 percent of all the cases in the sample.

The Conclusion of the Engle-Granger cointegration test is that the closing stock price and exchange rate do not move together in the long-run relationship of China, the European Union, the United Kingdom, and the United States. This result is consistent with the findings from earlier studies of China (Li and Huang, 2008), South African Market (Kumar, 2010), (Ocran, 2010) and (Kutty, 2010a), for the developed markets such as the United States, the United Kingdom, Japan, the Asian and Latin American markets (Okpara & Odionye, 2012a) (Nigeria and Kumar, 2013) for India, South Africa and Brazil, and (Amarasinghe and Dharmaratne ,2014) for Colombo.

4.7.2 Empirical Results of Johansen's Cointegration Test

To confirm the results of the Engle-Granger cointegration Test, the researcher employs the Johansen's cointegration test (Johansen, 1988, 1991). Employing this test requires using the lag eight for the European Union, lag four for the United States, and lag seven for both China and the United Kingdom according to the results of the Optimal Lag Lengths that were employed in table 4-4. Likewise, in the Engle-Granger cointegration test, the researcher uses the in-sample time series data including the same observations number after adjustments for four countries under analysis to compare between the results of both cointegration previous tests. As noted previously, there is a necessary, but insufficient, condition for a cointegrating test, which is that all the variables must integrate in the same order (Granger, 1986). The Johansen's cointegration test employs two statistics tests namely the trace and the maximal Eigenvalue tests.

The Johansen's cointegration test treats all variables as potentially endogenous. Therefore, it avoids the problem of normalizing the cointegrating vector on one of the variables as it existed in the Engle-Granger test. Although, the Johansen's cointegration test is considered more powerful than the Engle-Granger test because the Johansen's cointegration test can determine the number of the cointegrating vectors, on the other hand, the Johansen's cointegration test may be sensitive to the order of auto regressions, which was noted by Hall (1991). The results of the Johansen's cointegration test reported in tables 4-6, 4-7, 4-8 and 4-9 include the trace tests and the maximal Eigenvalue tests of each country in the sample of the study. The first column in each table tests the null hypotheses of no cointegrating relationship between closing stock price and exchange rate. The second column for each table presents the order of the Eigen values, while the third column shows the value of the Max-Eigen and Trace Statistic, while the final column refers to the probability value.

4.7.2.1 Employing the Johansen's Cointegration Test for China

The VAR Lag Order Selection Criteria determines lag seven to employ the Johansen's cointegration test between closing price of the Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate to see if there is any long-run relationship between two previous variables. To employ this test, the researcher uses the in ample time series data from January 3, 2000 to December 31, 2010 including 2862 observations after adjustments. Table 4-6 displays the results obtained from estimating the Johansen cointegration of China. The first row from the unrestricted cointegration rank test (Trace) shows that the trace statistic is 3.982109, which is considerably less than the critical value at 5% that equals 15.49471. Moreover, the value of the probability is more than 5%. Therefore, the null of no cointegrating vectors between the previous variables cannot be rejected. The Max-Eigen Statistic in the second row equals 3.319316, which is less than the critical value 14.26460 at 5% level while the value of the probability is 0.9232, which is larger than 5%. Therefore, the Trace Statistic and Maximum Eigenvalue tests accept the null hypothesis of the Johansen's cointegration, which is that there is no cointegrating between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate.

The summary drawn from applying the Johansen's cointegration test of China is that the unrestricted cointegration rank test (Trace) and the unrestricted cointegration rank test (Maximum Eigenvalue) accept the null hypothesis of this test, which is that there is no cointegrating between closing price of the Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate at the 5% level, whereas both cointegration tests reject the alternative hypothesis, which is that there is cointegration between closing price of the Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate at the 5% level. That means any changes in the Chinese Exchange Rate as independent variables are not sufficiently significant to explain the closing price movements for the Shanghai Stock Exchange Composite Index as a dependent variable over the long- run. Therefore, this study accepted the research hypotheses below:

H1: There is no significant long-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate in China.

Table 4.6: Johansen's Cointegration test Results of China

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.001159	3.982109	15.49471	0.9050
At most 1	0.000232	0.662793	3.841466	0.4156

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.001159	3.319316	14.26460	0.9232
At most 1	0.000232	0.662793	3.841466	0.4156
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****

Both Max-eigenvalue test and Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

4.7.2.2 Employing the Johansen's Cointegration Test for the European Union

Likewise, the Johansen's cointegration test is applied to check if there is any a long-run relationship between the closing price of the FTSE Eurotop 100 Index and the Euro Exchange Rate. To estimate this test, the researcher uses lag eight, which is previously determined by the VAR Lag Order Selection Criteria, as in table 4-4. The researcher uses the in-sample time series data starting from January 3, 2000 to December 31, 2010 including 4744 observations after adjustments. Table 4-7 exhibits the first row from the unrestricted cointegration rank test (Trace) which indicates that the Trace Statistic equals 23.41013, which considerably exceeded the critical value at 5%, which equals 15.49471. That means there is cointegration between the closing price of the FTSE Eurotop 100 Index and the Euro Exchange Rate. Moreover, the value of the probability is less than 5% therefore, the null hypothesis of the Johansen's cointegration test, which is no cointegrating vectors between the previous variables, cannot be accepted. The next row from table 4-7, points out that the Trace Statistic equals 1.581119, which is less than the critical value at 5% 3.841466. That means it cannot reject the null hypothesis (at most 1) cointegrating vectors in the 5% level.

The unrestricted cointegration rank test (Trace) and the unrestricted cointegration rank test (Maximum Eigenvalue) show a complete confirmation that there is one cointegration equation at the 5% level; accept the alternative hypothesis. Whilst both cointegration tests reject the null hypothesis, there is no cointegration the previous variables at the 5% level. This result means that the Euro Eexchange Rate moves as an independent variables are significant to explain the closing price movement of the FTSE Eurotop 100 Index as a dependent variable and both affect each other in the long-run. Therefore, this study rejects the research hypotheses;

H_2: There is no significant long-run relationship between the FTSE Eurotop 100 Index and the Euro Exchange Rate in the European Union.

Table 4.7: Johansen's Cointegration Test Results of the Europe Union

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.007654	23.41013	15.49471	0.0026
At most 1	0.000556	1.581119	3.841466	0.2086

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized	Eigenvalue	Max-Eigen	0.05 Critical Value	Prob.**
None	0.007654	21.82901	14.26460	0.0027
At most 1	0.000556	1.581119	3.841466	0.2086

Both Max-eigenvalue test and Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

4.7.2.3 Employing the Johansen's Cointegration Test for the United Kingdom

When the Johansen's cointegration test is applied, the lag seven is used as recommended by the VAR Lag Order Selection Criteria in tape 4-4. Table 4-8 presents the results obtained from the Johansen's cointegration test of the FTSE 100 Index closing price and the UK Exchange Rate. The analysis period was from January 3, 2000 to December 31, 2010 and included 4744 observations after adjustments. The first row from the unrestricted cointegration rank test (Trace) refers to the Trace Statistic equal 4.578908, which is less than the critical value is 15.49471 at 5%. Furthermore, the value of the probability is larger than 5%. Therefore, the unrestricted cointegration rank test can accept the null hypothesis of the Johansen's cointegration test, which is there is no cointegrating vectors between the FTSE 100 Index closing price and the UK Exchange Rate at the 5% level. Likewise, the value of the Max-

Eigen Statistic in the second row equals 3.695374, which is less than the critical value, is 14.26460 at 5%. Moreover, the value of the probability equals 0.8900, which is more than 5%. According to that, the Max-Eigen test accepts the null hypothesis: there are no cointegrating vectors between previous variables at the 5% level.

Table 4.8: Johansen's Cointegration Test Results for the United Kingdom

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**0.05 Critical Value**	**Prob.****
None	0.001290	4.578908	15.49471	0.8518
At most 1	0.000309	0.883534	3.841466	0.3472

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.****
None	0.001290	3.695374	14.26460	0.8900
At most 1	0.000309	0.883534	3.841466	0.3472

Both Max-eigenvalue test and Trace test indicates no Cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The result of the Trace Statistic is that there is no long–run relationship between the FTSE 100 Index closing price and the UK Exchange Rate. This result also confirms the Maximum Eigenvalue result test. That means the unrestricted cointegration Rank and the Max-Eigen test accepts the null hypothesis that there is no cointegration between the FTSE 100 Index closing price and the UK Exchange Rate at the 5% level. In contrast, both previous cointegration tests reject the alternative hypothesis; there is cointegrating between the FTSE 100 Index closing price and the UK Exchange Rate at the 5%. This result means any changes that happen in the UK Exchange Rate as independent variables are not sufficiently significant to explain the FTSE 100 Index closing price movements and both variables do not affect each other in the long run. Consequently, the current study accepted the research hypotheses;

> *H_3: There is no significant long-run relationship between the FTSE100 Index and the UK Exchange Rate in the United Kingdom.*

4.7.2.4 Employing the Johansen's Cointegration Test for the United States

To examine the long-run relationship between the closing stock price and exchange rate in the United States, the Johansen's cointegration test is applied using lag four, which set in advance by the VAR Lag Order Selection Criteria in table 4-4. As with China, the European Union, and the United Kingdom, the researcher uses in-sample time series data spanning from January 3, 2000 to December 31, 2010 including 2,865 observations after adjustments to test the Johansen's cointegration test. Table 4-9 shows the results of the cointegration between the Dow Jones Industrial Average Index closing price and the US Exchange Rate. From the previous table, it can be observed that the values of both the Trace Statistic and the Max-Eigen statistic respectively equal 7.799052 and 6.680281, are less than the critical values, which respectively equals 15.49471 and 14.26460 at 5%. Furthermore, the values of the probability in both the Unrestricted cointegration rank and the maximum eigenvalue tests are more than 5% critical values which are respectively equal 0.4871 0.5276. For these reasons, the Johansen's cointegration test accepts the null hypothesis of no cointegration between the Dow Jones Industrial Average Index closing price and the US Exchange Rate while it does not accept the alternative hypothesis, i.e. there is cointegration between previous variable at 5% level. This result means that any changes that happen in the US Exchange Rate as an independent variable is not significant to explain the Dow Jones Industrial Average Index closing price movements and both variables do not affect each other in the long run. Accordingly, the current study accepted the research hypotheses;

H_4: There is no significant long-run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate in the United States

Table 4.9: Johansen's Cointegration Test Results of United States

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.002329	7.799052	15.49471	0.4871
At most 1	0.000390	1.118772	3.841466	0.2902

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen	0.05 Critical Value	Prob.**
None	0.002329	6.680281	14.26460	0.5276
At most 1	0.000390	1.118772	3.841466	0.2902

Both Max-eigenvalue test and Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Based on the previous results of employing the Johansen's cointegration test for China, the European Union, the United States and the United Kingdom, the test shows one cointegrating vector between The FTSE Eurotop 100 Index closing price and the Euro Exchange Rate regarding the European Union. This reveals that there is a stable long-run equilibrium relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate. Moreover, the results of the Johansen's cointegration test indicate no existence of any long-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate. Regarding the United Kingdom, the Johansen's cointegration test displays that there is no relationship between the FTSE 100 Index closing prices and the UK exchange rate. The Johansen's cointegration test shows the same result for the United States, as there is no long-run relationship between the Dow Jones Industrial Average Index closing prices and the US Exchange Rate.

As a conclusion of applying the Engel-Granger and the Johansen's cointegration test, it can be said that the results were consistent for China, the United Kingdom and the United States. Both tests did not find any evidence of cointegration relationships between stock prices and exchange rates. However, the Johansen's test differs from Engel-Granger cointegration test in respect to the European Union. The Engel-Granger cointegration test does not find any long-run relationships between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate whereas the Johansen indicates the opposite. The researcher adopts the results of the Johansen's cointegration test for all the countries in the sample of this study. Based on the above results, now the researcher can answer the first question of the current study, which is - is there any long–run relationship between stock prices and exchange rates in China, the European Union, the United Kingdom and the United States?

The researcher answers the above question as follows.

a) There is a short-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate.

b) There is a long-run relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate

c) There is a short-run relationship between the FTSE 100 Index closing price and the UK Exchange Rate

d) There is a short-run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate

According to above results, the researcher will divide the analysis into two parts. The first part is estimating the short-run causality relationship for China, the United Kingdom and the United States, which requires the researcher to employ the Wald test or the Block Exogeneity Wald tests under the Vector Auto Regression model (VAR) and Pairwise Granger causality test to know the direction of causality relationship between;

a) The closing price of the Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate.

b) The closing price of the FTSE 100 Index and the UK Exchange Rate.

c) The closing price of the Dow Jones Industrial Average Index and the US Exchange Rate under analysis Period.

Second part is estimates the long-run causality relationship for the European Union. This requires employing the Wald test or the Block Exogeneity Wald test under the Vector Error Correction (VEC) model and Pairwise Granger causality test to know the direction of causality relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate under the analysis Period.

4.8 Estimation of Short-Run Causality Relationships for China, the United Kingdom, and the United States

The Vector Auto Regression model (VAR) is usually applied when the variables are non-cointegration. Therefore, in this section, the researcher will apply the Standard Granger causality under the VAR model through estimating the Wald, the Block Exogeneity Wald and the Pairwise Granger causality tests to answer the second research question regarding China, the United Kingdom and the United States which is:

What is the direction of the relationship between stock prices and exchange rates in China, the United Kingdom and the United States?

Through investigation of the following hypothesis:

H_5: There is a significant causality relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate of China.

H_6: There is a significant causality relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate of the European Union.

H_7: There is a significant causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate in the United Kingdom.

In order to employ the VAR model, the researcher must use stationary data at first difference series $I\sim(1)$,which means all closing stock prices and exchange rates are treated as integrated of order one. Furthermore, the choice of lags when employing the VAR model, the Wald and the Block Exogeneity Wald tests will be based on the results of optimal lag lengths of the VAR Model, while the choice of lags when applying the Pairwise Granger causality test will be based on the lowest probability values and the highest F-statistic values.

4.8.1 The Short-Run Granger-causality Relationship for China

As the Johansen cointegration result indicates there was no cointegration; a long-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate. That means both variables do not affect each other in the long-run. This section continues to search for any possible short-run causal relationships between the above variables. To clarify, the researcher attempts to ascertain the changes in the closing price of the Shanghai Stock Exchange Composite Index causes the Chinese Exchange Rate movement or the Chinese Exchange Rate movements cause the changes in the closing price of the Shanghai Stock Exchange Composite Index in the short-run or both affect each other. To achieve that, the researcher employs the Vector Auto Regression model (VAR) as a first step, then she will estimate the Wald test under the VAR model to know the direction of the short-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate.

According to the VAR Lag Order Selection Criteria estimation in table 4-4 lag seven should be used when employing the VAR model. The period under examination spanned from January 3, 2000 to December 31, 2010 including 4,744 observations after adjustments. Table 4-10 shows the estimate of the VAR model**,** which includes two equations. The first equation is the (CH_SP), as a dependent variable to see if the Chinese Exchange Rate as an independent variable is sufficiently significant to explain the Shanghai Stock Exchange Composite Index as a dependent variable. The second equation is the (CH_ER), as a dependent variable, to see if the Shanghai Stock Exchange Composite Index as an independent variable is significant to explain an independent variable the Chinese Exchange Rate. Part A in table 4-10 provides evidence that more than 50% of the probability values are not significant; more than 5%, to explain the dependent variable the CH_SP although, the F-statistic value is 7.596466, which is significant; the probability value equals zero at the 5 % level series. This result is confirmed by the R-Squared which shows that just 3.6% of the changes which happen in the Chinese Exchange Rate can be explained by the changes which occur in closing price of the Shanghai Stock Exchange Composite Index, whereas the 96.4% is unexplained, which belongs to the variables not included in the current study.

Part B in table 4-10 presents evidence that more than 75 % from the probability values are not sufficiently significant to explain the Chinese Exchange Rate as a dependent variable, although the F-statistic value equals 5.123649 and significant; the probability value equals zero at the 5 % level series. Furthermore, the R-Squared confirmed this result. It determined that just 2.5% of the changes which occurred in the closing price of the Shanghai Stock Exchange Composite Index can be explained by the Chinese Exchange Rate, while the 97.5% is unexplained which belongs to the variables not included in this study.

Table 4.10: The Results of the Vector Auto Regression (VAR) Model for China

(A) Equation (CH_SP)

		Coefficient	Std. Error	t-Statistic	Prob.
CH_SP(-1)	C(1)	-0.131907	0.018757	-7.032317	0.0000
CH_SP(-2)	C(2)	-0.034928	0.018888	-1.849271	0.0645
CH_SP(-3)	C(3)	-0.012427	0.018759	-0.662434	0.5077
CH_SP(-4)	C(4)	0.001053	0.018758	0.056159	0.9552
CH_SP(-5)	C(5)	-0.116578	0.018731	-6.223840	0.0000
CH_SP(-6)	C(6)	-0.051541	0.018820	-2.738707	0.0062
CH_SP(-7)	C(7)	0.002885	0.018706	0.154215	0.8775
CH_ER(-1)	C(8)	-0.000332	0.112882	-0.002943	0.9977
CH_ER(-2)	C(9)	-0.324011	0.113680	-2.850208	0.0044
CH_ER(-3)	C(10)	-0.265067	0.114101	-2.323091	0.0202
CH_ER(-4)	C(11)	-0.068558	0.114171	-0.600482	0.5482
CH_ER(-5)	C(12)	0.163136	0.114093	1.429846	0.1529
CH_ER(-6)	C(13)	0.011483	0.113879	0.100836	0.9197
CH_ER(-7)	C(14)	-0.081587	0.112939	-0.722401	0.4701
C	C(15)	0.000338	0.000403	0.838618	0.4018

R-squared	0.036010	Mean dependent var	0.000238
Adjusted R-squared	0.031270	S.D. dependent var	0.021900
S.E. of regression	0.021555	Akaike info criterion	-4.831188
Sum squared resid	1.322771	Schwarz criterion	-4.799955
Log likelihood	6928.430	Hannan-Quinn criter.	-4.819926
F-statistic	7.596466	Durbin-Watson stat	2.000497
Prob(F-statistic)	0.000000		

VAR Model - Substituted Coefficients

CH_SP=-0.131906938331*CH_SP(-1)-0.0349283248137*CH_SP(-2)-0.0124265494724*CH_SP(-3) + 0.00105342990099*CH_SP(-4)-0.116577514562*CH_SP(-5)-0.0515413562736*CH_SP(-6)+ 0.002884806345*CH_SP(-7)-0.000332235517427*CH_ER(-1)-0.324011163274*CH_ER(-2) - 0.265066915212*CH_ER(-3)-0.0685575143075*CH_ER(-4)+0.163135503032*CH_ER(-5) + 0.0114830783734*CH_ER(-6)-0.0815873327535*CH_ER(-7)+0.000338333054346.

(B) Equation (CH_ER)

		Coefficient	Std. Error	t-Statistic	Prob.
CH_SP(-1)	C(16)	-0.003307	0.003116	-1.061243	0.2887
CH_SP(-2)	C(17)	-0.001549	0.003138	-0.493783	0.6215
CH_SP(-3)	C(18)	-0.004737	0.003117	-1.519888	0.1287
CH_SP(-4)	C(19)	-0.002718	0.003116	-0.872207	0.3832
CH_SP(-5)	C(20)	0.002275	0.003112	0.730971	0.4649
CH_SP(-6)	C(21)	-0.007704	0.003127	-2.463943	0.0138
CH_SP(-7)	C(22)	-0.004005	0.003108	-1.288558	0.1977
CH_ER(-1)	C(23)	-0.128612	0.018754	-6.857760	0.0000
CH_ER(-2)	C(24)	-0.069374	0.018887	-3.673145	0.0002
CH_ER(-3)	C(25)	-0.022275	0.018957	-1.175051	0.2401
CH_ER(-4)	C(26)	0.016865	0.018968	0.889118	0.3740
CH_ER(-5)	C(27)	-0.021421	0.018955	-1.130085	0.2585
CH_ER(-6)	C(28)	0.020900	0.018920	1.104650	0.2694
CH_ER(-7)	C(29)	0.012812	0.018764	0.682823	0.4948
C	C(30)	5.03E-05	6.70E-05	0.750601	0.4530

R-squared	0.024576	Mean dependent var	3.79E-05
Adjusted R-squared	0.019780	S.D. dependent var	0.003617
S.E. of regression	0.003581	Akaike info criterion	-8.421043
Sum squared resid	0.036512	Schwarz criterion	-8.389810
Log likelihood	12065.51	Hannan-Quinn criter.	-8.409781
F-statistic	5.123649	Durbin-Watson stat	2.001341
Prob(F-statistic)	0.000000		

VAR Model - Substituted Coefficients

CH_ER = - 0.00330717406099*CH_SP(-1) - 0.00154948191831*CH_SP(-2) - 0.00473688131927*CH_SP(-3) - 0.00271819892688*CH_SP(-4) + 0.00227472848278*CH_SP(-5) - 0.00770395726548*CH_SP(-6) - 0.00400467035025*CH_SP(-7) - 0.128611639736*CH_ER(-1) - 0.0693736170167*CH_ER(-2) - 0.0222750683951*CH_ER(-3) + 0.0168650354461*CH_ER(-4) - 0.0214211629714*CH_ER(-5) + 0.0208997915441*CH_ER(-6) + 0.0128122498863*CH_ER(-7) + 5.03109060137e

In order to know the direction of the relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate, the researcher applied the Wald test under the VAR model. She did not get any results when applying the Wald test to see if the Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price as in part A in table 4-10 or from the Shanghai Stock Exchange Composite Index closing price to the Chinese Exchange Rate as in part B in table 4-10 (see appendices 6(A)). Therefore, the researcher employed the Block Exogeneity Wald test to detect the direction of the relationship between two previous variables as in table 4-11

Table 4.11: Results of the VAR Granger-Causality for China

Dependent variable: CH_SP				**Dependent variable: CH_ER**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
CH_ER	15.63555	7	0.0287	CH_SP	11.47559	7	0.1192
All	15.63555	7	0.0287	All	11.47559	7	0.1192

Table 4-11 shows that the Block Exogeneity Wald test rejected the null hypothesis that the Chinese Exchange Rate is not a Granger-Cause the Shanghai Stock Exchange Composite Index closing price based on the chi-squared test of 15.63555 with df7 and the value of the probability is 0.0287. On the other hand, the null hypothesis that the Shanghai Stock Exchange Composite Index closing price is not a Granger-Cause of the Chinese Exchange is not rejected based on the chi-squared test of 11.47559, with df 7 and the value of the probability equals 0.1192. According to the Block Exogeneity Wald test, there is a unidirectional causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price.

This result is confirmed by the Pairwise Granger causality test. The researcher used the stationary time series data, which means that the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate are integrated of order one $I\sim(1)$, when applying the Pairwise Granger causality test. In addition, the lag six is used according to the lowest probability values and the highest F-statistic values. Table 4-12 shows that there is a short-run Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price, while there is no a short-run Granger-causality relationship running from the Shanghai Stock Exchange Composite Index closing price to the Chinese Exchange Rate. Because the probability value of null hypotheses of no Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite closing price equals 1.8%, which is less than 5%. Therefore, the null hypotheses can be rejected, whereas the probability value of the null hypotheses of no Granger Causality from the Shanghai Stock Exchange Composite Index closing prices to the Chinese Exchange Rate is more than 5% thus, the null hypotheses can be accepted.

Table 4.12: Results of The Pairwise Granger Causality Test for China

Null Hypothesis	F-Statistic	P-value	Decision	Lag
CH_ER does not Granger Cause CH_SP	0.28579	0.5930	Accept H0	1
CH_SP does not Granger Cause CH_ER	0.33195	0.5646	Accept H0	
CH_ER does not Granger Cause CH_SP	2.98407	0.0507	Reject H0	2
CH_SP does not Granger Cause CH_ER	0.14934	0.8613	Accept H0	
CH_ER does not Granger Cause CH_SP	3.76478	0.0103	Reject H0	3
CH_SP does not Granger Cause CH_ER	0.74131	0.5273	Accept H0	
CH_ER does not Granger Cause CH_SP	2.91101	0.0204	Reject H0	4
CH_SP does not Granger Cause CH_ER	0.81572	0.5150	Accept H0	
CH_ER does not Granger Cause CH_SP	3.01078	0.0103	Reject H0	5
CH_SP does not Granger Cause CH_ER	0.92269	0.4650	Accept H0	
CH_ER does not Granger Cause CH_SP	**2.55470**	**0.0181**	**Reject H0**	**6**
CH_SP does not Granger Cause CH_ER	**1.63368**	**0.1337**	**Accept H0**	

It can be concluded that both the Block Exogeneity Wald and the Pairwise Granger causality tests report that there is short-run Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price, which supports the arguments of the Flow-Oriented Theory. Therefore, this study accepted the fifth research hypotheses;

H_5: There is a significant causality relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate of China

Through the concept of the Flow-Oriented Theory, there is a positive relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate. Thus, in terms of policy relevance, the findings implied that the government should be cautious in their implementation of exchange rate policies, because they affect stock markets in the short-run. This result is consistent with the results obtained by (Huang, 2008; Rutledge et al. 2014; Nieh and Yau, 2010).

4.8.2 The Short-Run Causality Relationship for the United Kingdom

The result of Johansen's cointegration test in table 4-8 demonstrates that there is no long-run relationship between the FTSE 100 Index closing price and the UK Exchange Rate. Therefore, the researcher can apply the causality tests under the VAR model to ascertain if the change in the closing price of the FTSE 100 Index causes the UK Exchange Rate movement or the UK Exchange Rate movement causes the changes in the FTSE 100 Index closing price in the short-run or both affect each other.

According to VAR Lag Order Selection Criteria estimation as in table 4-4 the researcher used lag seven to estimate the VAR model. The sample period for the empirical work spanned from January 3, 2000 to December 31, 2010 including 4744 observations after adjustments. Table 4-13 shows the estimate of the VAR model includes two equations. The first equation is UK_SP, as a dependent variable to see if the UK Exchange Rate as an independent variable is significant to explain the FTSE 100 Index as a dependent variable. The second equation is UK_ER as a dependent variable to see if the FTSE 100 Index as an independent variable is significant to explain an independent variable the UK Exchange Rate. Part A in table 4-13 provides evidence that more than 50% from the probability value are not significant at 5% to explain the changes that have occurred in the dependent variable the FTSE 100 Index although the F-statistic value is 0.146663, which is significant at the 5 % level series because the probability value is 0.008 and more than 0.005. This result is confirmed by the (R-Squared) which show that just 15% of the changes which occur in the UK Exchange Rate can be explained by the FTSE 100 Index closing price, while the 85 % is unexplained, which belongs to the variables not included in the current study.

In addition, it can be seen from table 4-13, part B that more than 50% from the probability values are significant to explain the UK Exchange Rate, as dependent variable regardless of the F-statistic value that equals 36.12284 and is significant at the 5 % levels series because the probability value equals zero. The R-Squared confirms this result, where it shows only 15% of the changes which occur in the closing price of the FTSE 100 Index can be explained by the UK Exchange Rate, while the 85% is unexplained, which belongs to the variables not involved in the current search.

To detect the direction of the relationship between the closing price of the FTSE 100 Index and the UK Exchange Rate the researcher applies the Wald test under VAR model. Like in China, the researcher did not obtain any results when applying the Wald test to see if the Granger-causality relationship running from the UK Exchange Rate to the FTSE 100 Index closing price as in part A in table 4-13 or from the FTSE 100 Index closing price to the UK Exchange Rate as in part B from the same table, (see appendices 6(B)). Consequently, the researcher applied the Block Exogeneity Wald test as in table 4-14 to know the direction between the FTSE 100 Index closing price and the UK Exchange Rate.

Table 4.13: Vector Auto Regression Test Results for the United Kingdom

(A) Equation D(UK_SP)

		Coefficient	Std. Error	t-Statistic	Prob.
UK_SP(-1)	C(1)	-0.137066	0.018760	-7.306206	0.0000
UK_SP(-2)	C(2)	-0.084498	0.018948	-4.459441	0.0000
UK_SP(-3)	C(3)	-0.066489	0.019007	-3.498058	0.0005
UK_SP(-4)	C(4)	0.064241	0.019013	3.378727	0.0007
UK_SP(-5)	C(5)	-0.030879	0.019006	-1.624723	0.1043
UK_SP(-6)	C(6)	-0.056046	0.018945	-2.958410	0.0031
UK_SP(-7)	C(7)	0.002532	0.018762	0.134956	0.8927
UK_ER(-1)	C(8)	0.033569	0.031866	1.053412	0.2922
UK_ER(-2)	C(9)	-0.065152	0.034465	-1.890375	0.0588
UK_ER(-3)	C(10)	-0.092828	0.035058	-2.647847	0.0081
UK_ER(-4)	C(11)	-0.014418	0.035154	-0.410139	0.6817
UK_ER(-5)	C(12)	-0.017421	0.035056	-0.496950	0.6193
UK_ER(-6)	C(13)	-0.018207	0.034481	-0.528030	0.5975
UK_ER(-7)	C(14)	-0.037812	0.031851	-1.187138	0.2353
C	C(15)	-5.82E-05	0.000257	-0.226416	0.8209

R-squared	0.150839	Mean dependent var	-3.56E-05
Adjusted R-squared	0.146663	S.D. dependent var	0.014003
S.E. of regression	0.008091	Akaike info criterion	-5.731697
Sum squared resid	1.999664	Schwarz criterion	-5.700464
Log likelihood	0.150839	Hannan-Quinn criter.	-5.720436
F-statistic	0.146663	Durbin-Watson stat	2.001423
Prob(F-statistic)	0.008091		

VAR Equation

UK_SP=-0.137066288762*UK_SP(-1)-0.0844976677119*UK_SP(-2) - 0.0664885435662*UK_SP(-3) + 0.0642405348231*UK_SP(-4)-0.0308794383386*UK_SP(-5)-0.0560459562841*UK_SP(-6)+0.00253200455457*UK_SP(-7) + 0.0335685438106*UK_ER(-1)- 0.0651515149563*UK_ER(-2) - 0.0928275312384*UK_ER(-3)-0.0144178529301*UK_ER(-4)-0.0174211535583*UK_ER(-5)-0.0182068345716*UK_ER(-6) - 0.0378119699062*UK_ER(-7) - 5.81820968258e-05

(B) Equation D(UK_ER)

		Coefficient	Std. Error	t-Statistic	Prob.
UK_SP(-1)	C(16)	0.036726	0.011047	3.324582	0.0009
UK_SP(-2)	C(17)	-0.002914	0.011157	-0.261187	0.7940
UK_SP(-3)	C(18)	0.016904	0.011192	1.510307	0.1311
UK_SP(-4)	C(19)	-0.013728	0.011196	-1.226164	0.2202
UK_SP(-5)	C(20)	-0.019290	0.011191	-1.723632	0.0849
UK_SP(-6)	C(21)	-0.006025	0.011155	-0.540138	0.5891
UK_SP(-7)	C(22)	0.005456	0.011048	0.493853	0.6214
UK_ER(-1)	C(23)	-0.410729	0.018764	-21.88905	0.0000
UK_ER(-2)	C(24)	-0.207522	0.020294	-10.22571	0.0000
UK_ER(-3)	C(25)	-0.109134	0.020643	-5.286665	0.0000
UK_ER(-4)	C(26)	-0.075321	0.020700	-3.638747	0.0003
UK_ER(-5)	C(27)	-0.045804	0.020642	-2.218913	0.0266
UK_ER(-6)	C(28)	-0.005817	0.020304	-0.286492	0.7745
UK_ER(-7)	C(29)	0.013331	0.018755	0.710781	0.4773
C	C(30)	-0.000109	0.000151	-0.721516	0.4707

R-squared	0.150839	Mean dependent var	-5.88E-05
Adjusted R-squared	0.146663	S.D. dependent var	0.008759
S.E. of regression	0.008091	Akaike info criterion	-6.790911
Sum squared resid	0.186375	Schwarz criterion	-6.759678
Log likelihood	9732.793	Hannan-Quinn criter.	-6.779649
F-statistic	36.12284	Durbin-Watson stat	1.999664
	0.000000		

VAR Equation

UK_ER = 0.0367257324834*UK_SP(-1) - 0.00291414367026*UK_SP(-2) + 0.01690361817*UK_SP(-3) - 0.0137277543357*UK_SP(-4) - 0.0192898664934*UK_SP(-5) - 0.00602539206113*UK_SP(-6) + 0.00545587979798*UK_SP(-7) - 0.410729235532*UK_ER(-1) - 0.207522286069*UK_ER(-2) - 0.109134092168*UK_ER(-3) - 0.0753209237257*UK_ER(-4) - 0.0458035829443*UK_ER(-5) - 0.00581679072236*UK_ER(-6) + 0.0133308772966*UK_ER(-7) - 0.000109175144441

Table 4-14 provides evidence that the Block Exogeneity Wald test rejected the null hypothesis that the UK Exchange Rate is not a Granger-cause of the FTSE 100 Index closing price based on the chi-squared test of 13.44870, with df7 and the probability value is more than 5%, which equals 0.0619. On the other hand, the null hypothesis that the FTSE 100 Index closing price is not a Granger-cause of the UK Exchange Rate is not rejected based on the chi-squared test of 18.58240, with df 7 and the probability value is over 5%, which equals 0.0096. It can be concluded from the Block Exogeneity Wald test that there is a bi-directional causality relationship between the UK Exchange Rate and the Shanghai Stock Exchange Composite Index closing price.

Table 4.14: VAR Granger-Causality Tests for the United Kingdom

Dependent variable: CH_SP				**Dependent variable: CH_ER**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
UK_ER	13.44870	7	0.0619	UK_SP	18.58240	7	0.0096
All	13.44870	7	0.0619	All	18.58240	7	0.0096

To confirm these results, the researcher employed the Pairwise Granger causality test with six lags without estimating the VAR model. The choice of lags was based on the lowest probability values and the highest F-statistic values and therefore lag three was used. Furthermore, the Pairwise Granger causality test was applied at the first difference series of the FTSE 100 Index closing price and the UK Exchange Rate. The period under analysis was from January 3, 2000 to December 31, 2010 including 4744 observations for each lag after adjustments. Table 4-15 indicates that the most striking result of the short-run Granger-causality test is for lag six. The null hypothesis is no Granger-causality relationship running from the UK Exchange Rate to the FTSE 100 Index closing price can be rejected because the probability value is less than 5%. In addition, the null hypothesis of no Granger-causality relationship from the FTSE 100 Index closing price to the UK Exchange Rate cannot be accepted, because the probability value equals 0.0023, which is less than 0.05.

According to the Block Exogeneity Wald test and the Pairwise Granger causality test the bi-directional causality was found between the FTSE 100 Index closing price and the UK Exchange Rate in the case of the United Kingdom, which supports the arguments of both the Stock-Oriented and the Flow-Oriented Theories. That means the FTSE 100 Index closing price and the UK Exchange Rate affect each other in the short-run.

Table 4.15: Pairwise Granger Causality Test Results for the United Kingdom

Null Hypothesis	F-Statistic	P-value	Decision	Lag
US_ER does not Granger Cause US_SP	4.08842	0.0342	Reject H0	1
US_SP does not Granger Cause US_ER	4.50788	0.0036	Reject H0	
US_ER does not Granger Cause US_SP	3.20535	0.0407	Reject H0	2
US_SP does not Granger Cause US_ER	4.78514	0.0031	Reject H0	
US_ER does not Granger Cause US_SP	**4.01572**	**0.0073**	**Reject H0**	**3**
US_SP does not Granger Cause US_ER	**4.85611**	**0.0023**	**Reject H0**	
US_ER does not Granger Cause US_SP	3.09763	0.0148	Reject H0	4
US_SP does not Granger Cause US_ER	3.89904	0.0037	Reject H0	
US_ER does not Granger Cause US_SP	2.49838	0.0289	Reject H0	5
US_SP does not Granger Cause US_ER	3.67422	0.0026	Reject H0	
US_ER does not Granger Cause US_SP	2.01730	0.0601	Reject H0	6
US_SP does not Granger Cause US_ER	3.07601	0.0053	Reject H0	

Based on the results, which have been discussed above that have relation to the United Kingdom, it can be said that the current study accepted the research hypotheses:

> *H_6: There is a significant causality relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate of the European Union.*

This result is similar to the result obtained by Ajayi and Mougoue (1996) and of Inci and Lee (2014).

4.8.3 The Short-Run Causality Relationship for the United States

The results for the United States are not different from those reported for the United Kingdom and China. The Johansen cointegration does not support the existence of any long-run relationship between closing price of the Dow Jones Industrial Average Index and the US Exchange Rate. Therefore, in this part, the researcher is attempting to know if the changes in the closing price of the Dow Jones Industrial Average Index causes the US Exchange Rate movement or the US Exchange Rate movement causes the changes, which happen in the Dow Jones Industrial Average Index in the short - run or both affect each other.

In the same way as with the United Kingdom and China, the researcher applies the Vector Auto Regression model (VAR) and then estimates the Wald test under the VAR model to know the direction of the short-run relationship between closing price of the Dow Jones Industrial Average Index and the US Exchange Rate. According to the VAR Lag Order Selection Criteria, estimation in table 4-4 lag four should be used when employing the VAR model. Table 4-16 displays the estimation of the VAR model included to estimate the probability values, which are required to examine the Wald test to know the direction of the short-run relationship between the variables, mentioned above. In addition, table 4-16 illustrates two equations. The first equation is the (US_SP), as a dependent variable to see if the US Exchange Rate as an independent variable is sufficiently significant to explain the Dow Jones Industrial Average Index closing price movement as a dependent variable. The second equation is the (US_ER), as a dependent variable to see if the Dow Jones Industrial Average Index closing price as an independent variable has enough significance to explain an independent variable the US Exchange Rate movement. Part A in table 4-16 indicates that most of the probability values are more than 5%, which means the US Exchange Rate as an independent variable is not sufficiently significant to explain the dependent variable the Dow Jones Industrial Average Index closing price, even though the probability of the F-statistic value is significant and equals zero at the 5% level. The same result was obtained by the R-Squared, which shows that just 2.2% of the changes which happened in the UK Exchange Rate can be explained by the Dow Jones Industrial Average Index closing price, while the 97.8.% is unexplained, which belongs to the variables not dealt with in the current study.

Table 4.16: The Results of the Vector Auto Regression (VAR) for the United States

(A) Equation (US_SP)						(B) Equation (US_ER)					
		Coefficient	**Std. Error**	**t-Statistic**	**Prob.**			**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
US_SP(-1)	C(1)	-0.116344	0.018707	-6.219341	0.0000	US_SP(-1)	C(10)	-0.000617	0.004682	-0.131736	0.8952
US_SP(-2)	C(2)	-0.077590	0.018794	-4.128482	0.0000	US_SP(-2)	C(11)	-0.017937	0.004703	-3.813585	0.0001
US_SP(-3)	C(3)	0.043899	0.018841	2.329981	0.0199	US_SP(-3)	C(12)	0.005889	0.004715	1.248847	0.2118
US_SP(-4)	C(4)	0.006376	0.018721	0.340560	0.7335	US_SP(-4)	C(13)	0.003118	0.004685	0.665501	0.5058
US_ER(-1)	C(5)	-0.035777	0.074776	-0.478449	0.6324	US_ER(-1)	C(14)	-0.044271	0.018714	-2.365621	0.0181
US_ER(-2)	C(6)	-0.014903	0.074845	-0.199115	0.8422	US_ER(-2)	C(15)	-0.014209	0.018731	-0.758549	0.4482
US_ER(-3)	C(7)	-0.169312	0.074632	-2.268623	0.0234	US_ER(-3)	C(16)	-0.015878	0.018678	-0.850066	0.3954
US_ER(-4)	C(8)	-0.016436	0.074610	-0.220296	0.8257	US_ER(-4)	C(17)	0.006322	0.018673	0.338569	0.7350
C	C(9)	-5.56E-06	0.000242	-0.022996	0.9817	C	C(18)	-4.19E-05	6.05E-05	-0.692034	0.4890
R-squared		0.022777	Mean dependent var		1.66E-06	R-squared		0.008843	Mean dependent var		-3.95E-05
Adjusted R-squared		0.020039	S.D. dependent var		0.013075	Adjusted R-squared		0.006067	S.D. dependent var		0.003249
S.E. of regression		0.012943	Akaike info criterion		-5.853335	S.E. of regression		0.003239	Akaike info criterion		-8.623777
Sum squared resid		0.478465	Schwarz criterion		-5.834612	Sum squared resid		0.029968	Schwarz criterion		-8.605054
Log likelihood		8393.903	Hannan-Quinn criter.		-5.846585	Log likelihood		12362.56	Hannan-Quinn criter.		-8.617027
F-statistic		8.320749	Durbin-Watson stat		2.000481	F-statistic		3.185263	Durbin-Watson stat		2.000590
Prob(F-statistic)		0.000000						0.001332			

VAR Equation	VAR Equation
US_SP = - 0.116344280588*US_SP(-1) - 0.0775899019872*US_SP(-2) + 0.0438991970108*US_SP(-3) + 0.00637564850428*US_SP(-4) - 0.0357766511895*US_ER(-1) - 0.0149027190062*US_ER(-2) - 0.169312167898*US_ER(-3) - 0.0164363803566*US_ER(-4) - 5.56242786344e-06.	**US_ER** = - 0.000616751309986*US_SP(-1) - 0.017937188949*US_SP(-2) + 0.00588870343708*US_SP(-3) + 0.0031180697964*US_SP(-4) - 0.0442706403214*US_ER(-1) - 0.0142086197525*US_ER(-2) - 0.0158775893674*US_ER(-3) + 0.00632197575971*US_ER(-4) - 4.18929166114e-05

The results obtained have not changed in part B in table 4-16. The majority of the probability values are more than 5%, which indicates the Dow Jones Industrial Average Index closing price as an independent variable is not sufficiently significant to explain a dependent variable the US Exchange Rate, although the F-statistic value is 3.185263 and significant, which equals zero at the 5% level. The R-Squared confirms this result, showing only 0.8% of the changes that happened in the closing price of the Dow Jones Industrial Average Index can be explained by the US Exchange Rate while the 99.2% is unexplained which belongs to the variables not included in this study.

For the United States, the researcher did not obtain any results when employing the Wald test to detect the direction of the relationship in the short-run (see appendices 6(C)). However, results were obtained when applying the Block Exogeneity Wald test as shown in table 4-17

Table 4.17: VAR Granger Causality/Block Exogeneity Wald Tests for the United States

Dependent variable: CH_SP				**Dependent variable: CH_ER**			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
US_ER	5.360222	4	0.2523	UK_SP	18.27151	4	0.0011
All	5.360222	4	0.2523	All	18.27151	4	0.0011

The estimation of the Block Exogeneity Wald test in table 4-17 shows that there was a short-run Granger-causality relationship running from the Dow Jones Industrial Average Index closing price to the US Exchange Rate. The Wald test accepts the null hypothesis that the US Exchange Rate is not a Granger-Cause, the Dow Jones Industrial Average Index closing price. These results are based on the chi-squared test, which equals 5.360222 with df4, and the probability value equals 0.2523. On the other hand, the null hypothesis that the Dow Jones Industrial Average Index closing price is not a Granger-Cause of the US Exchange rate that is not accepted, because the chi-squared test of 18.27151, with df 4 and the probability value is 00.0011, which is less than 5%. Based on the above, it can be concluded that there is a unidirectional causality short-run relationship running from the Dow Jones Industrial Average Index closing price to the US Exchange Rate.

To confirm this result, the study used the Pairwise Granger causality test to estimate the relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate without the need to estimate the VAR model. The researcher used six lags to ascertain the direction of the relationship between the above variables when estimating the Pairwise Granger causality test as in table 4-18. According to the highest F-statistic values and the lowest probability values, lag three was selected to explain the result of the Pairwise Granger causality test. To estimate the Pairwise Granger causality test, the data of both the Dow Jones Industrial Average Index closing price and the US Exchange Rate should be integrated of order one $I{\sim}(1)$ for in-sample time series data started from January 3, 2000 to December 31, 2010.

Table 4.18: Pairwise Granger Causality Test Results for the United States

Null Hypothesis:	F-Statistic	P-value	Decision	Lag
US_ER does not Granger Cause US_SP	0.39023	0.5322	Accept H0	1
US_SP does not Granger Cause US_ER	0.06760	0.7949	Accept H0	
US_ER does not Granger Cause US_SP	0.18766	0.8289	Accept H0	2
US_SP does not Granger Cause US_ER	5.15332	0.0007	Reject H0	
US_ER does not Granger Cause US_SP	**1.84641**	**0.1366**	**Accept H0**	**3**
US_SP does not Granger Cause US_ER	**5.84831**	**0.0006**	**Reject H0**	
US_ER does not Granger Cause US_SP	1.34006	0.2526	Accept H0	4
US_SP does not Granger Cause US_ER	4.56788	0.0011	Reject H0	
US_ER does not Granger Cause US_SP	1.19706	0.3080	Accept H0	5
US_SP does not Granger Cause US_ER	3.66763	0.0026	Reject H0	
US_ER does not Granger Cause US_SP	1.80036	0.0951	Accept H0	6
US_SP does not Granger Cause US_ER	3.35753	0.0027	Reject H0	

From table 4-18 it can be noticed that the Pairwise Granger causality test at lag three indicates that there is no Granger-Cause relationship running from the US Exchange Rate to the Dow Jones Industrial Average Index closing price. The null hypothesis of no a short- run Granger-causality relationship running from the US Exchange Rate to the Dow Jones Industrial Average Index closing price is accepted because the probability value is above 5% which is about 14%. The probability value of the null hypothesis of no Granger-causality relationship running from the Dow Jones Industrial Average Index closing price to the US Exchange Rate is 0.0006, which is less than 5%. Consequently, the null hypothesis of the Pairwise Granger causality test can be rejected.

It can be summarized that both the Block Exogeneity Wald and the Pairwise Granger causality tests exhibited that there was a short-run Granger-causality relationship running from the Dow Jones Industrial Average Index closing price to exchange rate, which corresponds with the arguments of the Stock-Oriented Theory. Therefore, the current study accepts the following hypothesis

> *H_7: There is a significant causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate in the United Kingdom.*

This finding is consistent with results of some studies that had been conducted by Nydahl and Friberg (1999),Caporale et al., (2013),Stavarek (2005),Caporale et al. (2013),Tsagkanos, Athanasios, and Costas (2013) in the United States.

4.8.4 Long-Run Relationship for the European Union

To remind, the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate of the European Union are non-stationary at the level series then both variables became stationary at first difference series; both variables are integrated of order one $I \sim (1)$. Therefore, both variables achieved the condition of the Johansen's cointegration test. Thus, the Johansen's cointegration test was applied to determine the number of cointegrating relationships between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate. The results of this test were; there is 1 cointegrating Eqn (s) at the 0.05 level between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate. That means both previous variables mentioned move together in the long-run.

Usually, The Vector Error correction (VECM) model is estimated when the long-run relationships between variables exist. Therefore, the researcher applied the Standard Granger Causality under the VECM to answer the second research question regarding the European Union which is-what is the direction of the relationship between stock prices and exchange rates in the European Union?

Through investigation the fowling hypothesis;

H8: There is significant causality relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate the United States.

Through testing the previous hypothesis, the researcher can know whether the changes in the closing price of the FTSE Eurotop 100 Index cause the Euro Exchange Rate movement or the Euro Exchange Rate movement cause the changes in the closing price of the FTSE Eurotop 100 Index or both affect each other in the short and long-run.

The researcher takes into account three important issues when employing the VECM. The first issue is using lag eight, according to the VAR Lag Order Selection Criteria Estimation, which is shown in table 4-4. The second issue is using the number of cointegration, which was one cointegration equation at 0.05% level. The third one is using data of the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate at level series; rather than at first difference series because the EViews program when estimating the VECM automatic changes the time series data from at level series to at first difference series as in the case of estimated the Johansen's cointegration test.

The researcher employed the VECM using lag eight identified previously by VAR Lag Order Selection Criteria estimation in table 4-4. The period under examination spanned from January 3, 2000 to December 31, 2010 including 4744 observations after adjustments. From the VECM estimation, it can be seen that the VECM output includes two parts; the first part is shown in table 4-19 and describes the results from the first step of Johansen test. The second part of the output is illustrated in table 4-19, which explains the results from the second step of the VAR model in first difference series. Moreover, the second part of the output contains the results of error correction terms, which were estimated from the first step. The error correction terms clarifies (CointEq1). This part of the output of VECM has the same format as the output of the unrestricted VAR model with one difference; the output of the unrestricted VAR model does not include the equation of the error correction terms. At the top of the VECM output, two Error Correction models of the dependent variables can be seen. The first one is D (EURO_ SP), and the second one is D (EURO_ ER). At the bottom of the VECM output table, there are two values of the log likelihood reported for the system. The first value, labelled Log Likelihood (d.f.adjusted), is calculated using the determinant of the residual covariance matrix (reported as Determinant Residual Covariance), using little sample degrees of freedom correction (EViews Guide two p 479-479). This is the log likelihood value reported for the unrestricted VAR. The value of the Log Likelihood is calculated using the residual covariance matrix, exclusive of correcting for degrees of freedom. This value of the log likelihood is somewhat similar to the one reported in the cointegration test output (ibid). The first part of the VECM estimation shown in the following table.

Table 4.19: Estimation of The Vector Error Correction for The European Union

cointegrating Eq:	CointEq1
EURO_SP(-1)	1.000000
EURO_ER(-1)	0.883953 (0.45227) [1.95447]
C	-7.655636

From table 4-19 it can be formally stated the normalized long-run cointegration equation between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate is

$$\mathbf{EURO\_SP} = -7.655636 + 0.883953\ \mathbf{EURO\_ER} \qquad 4\text{-}1$$

where: the EURO_SP is the closing price of the FTSE Eurotop 100 Index and the EURO_ER refers to the Euro Exchange Rate.

Equation 4-1 refers to the VECM equation, which demonstrates that there is a significant negative long-run relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate. This means that the Euro Exchange Rate impacts negatively on the FTSE Eurotop 100 Index closing price, thus, increasing the Euro Exchange Rate will lead to reduction in the FTSE Eurotop 100 Index closing price about 88%.

The second part of the VECM estimation is demonstrated in table 4-20, which is considered insufficient to explain the direction of the long and short relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate Consequently, this estimation does not include the probability values. the researcher estimated the equation model from the previous estimation step of the VECM as shown in table 4-21.

Table 4.20: Vector Error Correction Estimates for the European Union

Error Correction:	D(EURO_SP)	D(EURO_ER)
CointEq1	-0.064916, (0.01512),[-4.29405]	-0.000825, (0.00044),[-1.87504]
D(EURO_SP(-1))	-0.818783, (0.02300),[-35.5957]	0.001046, (0.00067),[1.56229]
D(EURO_SP(-2))	-0.706452 ,(0.02725),[-25.9208]	0.000794, (0.00079),[1.00094]
D(EURO_SP(-3))	-0.598760 ,(0.02956),[-20.2534]	0.000401, (0.00086),[0.46553]
D(EURO_SP(-4))	-0.493090, (0.03044),[-16.1987]	0.000272 ,(0.00089),[0.30653]
D(EURO_SP(-5))	-0.390096, (0.03002),[-12.9947]	1.21E-05, (0.00087),[0.01383]
D(EURO_SP(-6))	-0.291636, (0.02824),[-10.3258]	-0.000146, (0.00082),[-0.17717]
D(EURO_SP(-7))	-0.193900, (0.02481),[-7.81428]	-0.000342, (0.00072),[-0.47300]
D(EURO_SP(-8))	-0.096276 ,(0.01875),[-5.13597]	-0.000244 ,(0.00055),[-0.44659]
D(EURO_ER(-1))	0.574990,(0.64625),[0.88973]	-0.110240, (0.01881),[-5.86071]
D(EURO_ER(-2))	0.217557 ,(0.65049),[0.33445]	-0.165203, (0.01893),[-8.72551]
D(EURO_ER(-3))	-0.094768, (0.65918),[-0.14377]	-0.011730, (0.01919),[-0.61137]
D(EURO_ER(-4))	-0.044342 ,(0.66001),[-0.06718]	-0.019115 ,(0.01921),[-0.99504]
D(EURO_ER(-5))	0.139316, (0.65951),[0.21124]	0.010317, (0.01920),[0.53747]
D(EURO_ER(-6))	0.133987 ,(0.65997),[0.20302]	0.044110, (0.01921),[2.29627]
D(EURO_ER(-7))	0.230091, (0.65087),[0.35351]	0.008746 ,(0.01894),[0.46168]
D(EURO_ER(-8))	0.062604, (0.64597), [0.09692]	-0.003950, (0.01880),[-0.21006]
C	-0.000692 ,(0.00317), [-0.21831]	6.48E-05,[0.70258], (9.2E-05)
R-squared	0.440854	0.038455
Adj. R-squared	0.437487	0.032664
Sum sq. resids	80.36220	0.068081
S.E. equation	0.168722	0.004911
F-statistic	130.9278	6.641125
Log likelihood	1033.400	11081.46
Akaike AIC	-0.714819	-7.788423
Schwarz SC	-0.677109	-7.750713
Mean dependent	-0.000132	5.07E-05
S.D. dependent	0.224959	0.004993
Determinant resid covariance (dof adj.)	6.86E-07	
Determinant resid covariance	6.78E-07	
Log likelihood	12115.04	
Akaike information criterion	-8.501963	
Schwarz criterion	-8.422353	

* Included observations: 2838 after adjustments
*Standard errors in ( ) & t-statistics in [ ]

Table 4.21: Estimated Model Equation for the European Union

Equation:D(EURO_SP)=*C(1)*(EURO_SP(1)+0.883953297799*EURO_ER(1)7.65563641111)+C(2)*D(EURO_SP(1))+C(3)*D(EURO_SP(2))+C(4)*D(EURO_SP(3))+C(5)*D(EURO_SP(4))+C(6)*D(EURO_SP(5))+C(7)*D(EURO_SP(6))+C(8)*D(EURO_SP(7))+C(9)*D(EURO_SP(8))+C(10)*D(EURO_ER(1))+C(11) *D(EURO_ER(2))+C(12)*D(EURO_ER(3))+C(13)*D(EURO_ER(-4)) +C(14)*D(EURO_ER(-5))+C(15)*D(EURO_ER(-6))+C(16) *D(EURO_ER(-7)) + C(17)*D(EURO_ER(-8)) + C(18)*

Equation(EURO_ER)=*C(19)*(EURO_SP(1)+0.883953297799 *EURO_ER(1)7.65563641111)+C(20)*D(EURO_SP(1))+C(21)*D(EURO_SP(2))+C(22)*D(EURO_SP(3))+C(23)*D(EURO_SP(4)) +C(24)*D(EURO_SP(5)) +C(25)*D(EURO_SP(6))+C(26)*D(EURO_SP(7))+C(27)*D(EURO_SP(8))+C(28)*D(EURO_ER(1))+C(29)*D(EURO_ER(2))+C(30)*D(EURO_ER(3))+C(31)*D(EURO_ER(4))+C(32)*D(EURO_ER(5))+C(33)*D(EURO_ER(6))+C(34)*D(EURO_ER(7))+C(35)*D(EURO_ER(-8)) + C(36)*

Table 4-21 displays two error correction terms or two equations. The first equation is D (EURO_SP) and the second one is D (EURO_ER). To estimate the VECM the researcher used both equations, but separately, in order to firstly estimate the probability values, and secondly, to know the direction of the long and short-run relationship from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price or vice versa as in tables 4-22 and 4-23.

4.9 Short-Run Causality Relationship under the VECM Running from the Euro Exchange Rate to the FTSE Eurotop 100 Index Closing Price

At this stage, from the estimation of the Vector Error Correction Model, the researcher applies the VECM using the equation: D (EURO_SP) as a dependent variable to see if an independent variable the Euro Exchange Rate is sufficiently significant to explain the dependent variable the FTSE Eurotop 100 Index closing price as in table 4-22. The researcher also used the Wald test to ascertain the short-run relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate. Furthermore, table 4-22 displays additional three issues:

- The long-run causality relationship exists if the sign of the C (1) is negative, significant and the probability value is less than 5%. Consequently, it can be said that there is a negative long relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price because the value of C (1) is negative -0.064916 and the probability value is significant; less than 5%. Furthermore, from the C (1), it can determine the speed of adjustment, which equals 6.4%.

- Although more than half of the probability values are significant; less than 5% and the F-statistic value is 130.9278, which is considered highly significant equal zero at the 5% level, but does not mean the existence of short-run relationships running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price, which will be tested by applying the Wald test.

- From R-Squared, it can determine the percentage of the change in the FTSE Eurotop 100 Index closing price as dependent variable, which is explained by the Euro Exchange Rate as an independent variable. The R-Squared equals 0.440854 that means just 44.7% of the change in the FTSE Eurotop 100 Index closing price can be explained by the Euro Exchange Rate whereas the 55.3% is unexplained, which belongs to the variables not involved in this study.

Table 4.22: Results of Vector Error Correction Model Using Equation D(EURO_SP)

		Coefficient	Std. Error	t-Statistic	Prob.
CointEq1	C(1)	-0.064916	0.015118	-4.294049	0.0000
D(EURO_SP(-1))	C(2)	-0.818783	0.023002	-35.59566	0.0000
D(EURO_SP(-2))	C(3)	-0.706452	0.027254	-25.92079	0.0000
D(EURO_SP(-3))	C(4)	-0.598760	0.029563	-20.25340	0.0000
D(EURO_SP(-4))	C(5)	-0.493090	0.030440	-16.19868	0.0000
D(EURO_SP(-5))	C(6)	-0.390096	0.030020	-12.99469	0.0000
D(EURO_SP(-6))	C(7)	-0.291636	0.028243	-10.32585	0.0000
D(EURO_SP(-7))	C(8)	-0.193900	0.024813	-7.814282	0.0000
D(EURO_SP(-8))	C(9)	-0.096276	0.018745	-5.135967	0.0000
D(EURO_ER(-1))	C(10)	0.574990	0.646253	0.889729	0.3736
D(EURO_ER(-2))	C(11)	0.217557	0.650489	0.334451	0.7381
D(EURO_ER(-3))	C(12)	-0.094768	0.659179	-0.143767	0.8857
D(EURO_ER(-4))	C(13)	-0.044342	0.660015	-0.067183	0.9464
D(EURO_ER(-5))	C(14)	0.139316	0.659506	0.211244	0.8327
D(EURO_ER(-6))	C(15)	0.133987	0.659973	0.203019	0.8391
D(EURO_ER(-7))	C(16)	0.230091	0.650867	0.353514	0.7237
D(EURO_ER(-8))	C(17)	0.062604	0.645967	0.096915	0.9228
C	C(18)	-0.000692	0.003168	-0.218309	0.8272

R-squared	0.440854	Mean dependent var	-0.000132
Adjusted R-squared	0.437487	S.D. dependent var	0.224959
S.E. of regression	0.168722	Akaike info criterion	-0.714819
Sum squared resid	80.36220	Schwarz criterion	-0.677109
Log likelihood	1033.400	Hannan-Quinn criter.	-0.701217
F-statistic	130.9278	Durbin-Watson stat	2.017621
Prob(F-statistic)	0.000000		

* Included observations: 2838 after adjustments

After the researcher had employed the VECM using the equation: D (EURO_SP), she applies the Wald test to detect if there was any the short-run causality relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price as shown in table 4-23

Table 4.23: Wald test using equation D(EURO_SP)

Test Statistic	Value	df	Probability
t-statistic	0.050236	2823	0.9599
F-statistic	0.002524	(1, 2823)	0.9599
Chi-square	0.002524	1	0.9599

The estimation of the Wald test, as in table 4-23, demonstrates that it can accept the null hypotheses;

*C(10)*D(EURO_ER(-1))+C(11)*D(EURO_ER(-2))+C(12)*D(EURO_ER(-3))+C(13)* D(EURO_ER(-4)+C(15)*D(EURO_ER(-6))+C(16)*D(EURO_ER(-7)) +C(17)* D (EURO_ER (-8))=0*

This is because the probability value of Chi-square is 0.9599, which is more than 5%. This implies that there is no short-run causality relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price, although more than half of the probability values are significant at 5% level; less than 5 %, as in table 4-23.

Based on the above analysis, to estimate the VECM using the equation: D (EURO_SP) as a dependent variable, it can be said that there was a negative long-run causality relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price, whereas there is no short-run relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price.

4.10 Short-Run Causality Relationship under the VECM Running from the FTSE Eurotop 100 Index Closing Price to the Euro Exchange Rate

Likewise, the researcher can apply the VECM again, but this time using the Equation D (EURO_ER) as the dependent variable, rather than D (EURO_SP), to know firstly if the FTSE Eurotop 100 Index closing price was sufficiently significant to explain the changes that occurred in the Euro Exchange Rate as an independent variable. Secondly, if there were long and the short-run relationships from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate as in table 4-24. From this table, three issues can be detected. The first one is that the type of the long- run relationship is a negative or the positive, which runs from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate. The second issue is the possibility of applying the Wald test to know if there was short causality relationship running from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate. The third issue was determining the percentage of the changes in the Euro Exchange Rate, which can be explained by the FTSE Eurotop 100 Index closing price movements as an independent variable. In addition, table 4-24 shows that:

- From C (19), it can be said that there was not a long-run relationship running from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate, because the probability values of the C (19) was non-significant more than 5%, although the Coefficient value of the C (19) had a negative signal is -0.000790. Furthermore, from the C (19), it can determine the speed of adjustment, which equals 3.2%.
- Although the value of the F-statistic is 6.594377, which was significant, the probability value equals zero at the 5% level, but the possibility of the short-run causality relationship running from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate did not exist because the majority of the probability values are non-significant; more than 5% which will be confirmed by applying the Wald test.
- From R-Squared, it can be determined that the percentage of the changes in the Euro Exchange Rate, which is explained by the FTSE Eurotop 100 Index closing price as an independent variable. The R-Squared equals 0.038168 that means just 3.2% of the Euro Exchange Rate that can be explained by changes in the FTSE Eurotop 100 Index closing price while the 96.8 % is unexplained, which belongs to the variables not included in the current search.

Table 4.24: Results of Vector Error Correction Model Using Equation D(EURO_ER)

		Coefficient	Std. Error	t-Statistic	Prob.
CointEq1	C(19)	-0.000790	0.000440	-1.797138	0.0724
D(EURO_SP(-1))	C(20)	0.001011	0.000670	1.509493	0.1312
D(EURO_SP(-2))	C(21)	0.000761	0.000794	0.958602	0.3378
D(EURO_SP(-3))	C(22)	0.000370	0.000861	0.429410	0.6676
D(EURO_SP(-4))	C(23)	0.000243	0.000886	0.274016	0.7841
D(EURO_SP(-5))	C(24)	-1.47E-05	0.000874	-0.016861	0.9865
D(EURO_SP(-6))	C(25)	-0.000173	0.000822	-0.210828	0.8330
D(EURO_SP(-7))	C(26)	-0.000363	0.000723	-0.502398	0.6154
D(EURO_SP(-8))	C(27)	-0.000257	0.000546	-0.470722	0.6379
D(EURO_ER(-1))	C(28)	-0.110349	0.018821	-5.863061	0.0000
D(EURO_ER(-2))	C(29)	-0.164584	0.018937	-8.691128	0.0000
D(EURO_ER(-3))	C(30)	-0.010070	0.019183	-0.524978	0.5996
D(EURO_ER(-4))	C(31)	-0.019517	0.019197	-1.016675	0.3094
D(EURO_ER(-5))	C(32)	0.010450	0.019207	0.544077	0.5864
D(EURO_ER(-6))	C(33)	0.042714	0.019209	2.223640	0.0262
D(EURO_ER(-7))	C(34)	0.008954	0.018955	0.472381	0.6367
D(EURO_ER(-8))	C(35)	-0.005027	0.018807	-0.267291	0.7893
C	C(36)	6.09E-05	9.22E-05	0.660223	0.5091

R-squared	0.038168	Mean dependent var	4.67E-05
Adjusted R-squared	0.032380	S.D. dependent var	0.004995
S.E. of regression	0.004914	Akaike info criterion	-7.787233
Sum squared resid	0.068210	Schwarz criterion	-7.749545
Log likelihood	11087.55	Hannan-Quinn criter.	-7.773640
F-statistic	6.594377	Durbin-Watson stat	1.999639
Prob(F-statistic)	0.000000		

* Included observations: 2838 after adjustments

Likewise, after this, the researcher employed the VECM using the equation; D (EURO_ER) as the dependent variable, rather than the Equation D (EURO_SP). The researcher can employ the Wald test under the VECM using the equation D(EURO_ER) as the dependent variable to test if there was a short-run causality relationship running from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate. Table 4-25 shows that the Wald test accepts the null hypothesis;

*C(20)*D(EURO_SP(-1))+C(21)*D(EURO_SP(-2))+C(22)*D(EURO_SP(-3))+ C(23)*D(EURO_SP(-4))+ C(24)*D(EURO_SP(-5))+ C(25)*D(EURO_SP (-6))+ C (26)*D (EURO_SP (-7)) + C (27)*D (EURO_SP (-8)) =0*

Because the probability value of the Chi-square is 0.8171 which is more than 5%. This implies that there is no short-run causality relationship from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate.

According to the results of the VECM using the Equation D (EURO_ER) as the dependent variable, there was no long or a short-run relationship running from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate.

Table 4.25: Wald Test Using Equation D(EURO_ER)

Test Statistic	Value	df	Probability
t-statistic	-0.231242	2825	0.8171
F-statistic	0.053473	(1, 2825)	0.8171
Chi-square	0.053473	1	0.8171

To confirm the results in respect to the short-run causality relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate, the researcher applied the Pairwise Granger causality test with six different lags using the first difference series of the previous variables; both variables are integrated of order one, $I\sim(1)$. The researcher used in-sample time series data spanned from January 3, 2000 to December 31, 2010 including 4744 observations for each lag after adjustments.

Table 4.26: Pairwise Granger Causality Test Results for the European Union

Null Hypothesis	F-Statistic	P-value	Decision	Lag
EURO_ER does not Granger Cause EURO_SP	0.20830	0.6481	Accept H0	1
EURO_SP does not Granger Cause EURO_ER	0.29018	0.5901	Accept H0	
EURO_ER does not Granger Cause EURO_SP	0.28069	0.7553	Accept H0	2
EURO_SP does not Granger Cause EURO_ER	0.33205	0.7175	Accept H0	
EURO_ER does not Granger Cause EURO_SP	0.37947	0.7678	Accept H0	3
EURO_SP does not Granger Cause EURO_ER	0.22302	0.8804	Accept H0	
EURO_ER does not Granger Cause EURO_SP	0.29427	0.8818	Accept H0	4
EURO_SP does not Granger Cause EURO_ER	0.16475	0.9563	Accept H0	
EURO_ER does not Granger Cause EURO_SP	0.22294	0.9528	Accept H0	5
EURO_SP does not Granger Cause EURO_ER	0.13358	0.9847	Accept H0	
EURO_ER does not Granger Cause EURO_SP	0.19051	0.9796	Accept H0	6
EURO_SP does not Granger Cause EURO_ER	0.10946	0.9954	Accept H0	

It can be seen from table 4-26 that there was no short-run Granger-causality relationship from the Euro Exchange Rate to the FTSE Eurotop 100 Index stock prices or from the FTSE Eurotop 100 Index stock prices to the Euro Exchange Rate at any lags, because the probability value in both cases for each lags are more than 5%. This result confirms the result obtained from the Wald test.

The conclusion that can be drawn from the long-run analysis is that there is a negative long relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price. However, no short–run-relationship exists from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price. On the other hand, there is not any short or long relationship running from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate for the period under analysis. Consequently, the results of this study support the flow-Oriented theory, suggesting that changes in exchange rates lead to changes of stock price with respect to the European Union. Therefore, the current study accepts the following hypothesis

> *H8: There is significant causality relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate the United States.*

The results of this study are consistent with the results obtained by, Kollias et al. (2010) with respect to the direction of the relationship between stock price and exchange rate in the European Union.

From the findings of the Wald, the Block Exogeneity Wald tests whether under the VAR model or the VECM model and the Pairwise Granger causality test for the sample countries in this study the researcher could answer the second question of the current study, which is: what is the direction of the relationship between stock prices and exchange rates in China, the European Union, the United Kingdom and the United States?

The researcher answers the above question as follows:

- There is a unidirectional Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price, which supports the Flow-Oriented Theory.

- There is a unidirectional Granger-causality relationship running from the Euro Exchange Rate to FTSE Eurotop 100 Index closing prices, which supports the Flow-Oriented Theory.

- There is a unidirectional Granger-causality relationship running Rate from the Dow Jones Industrial Average Index closing price to the US Exchange Rate the, which supports the share-Oriented Theory.

- There is a bi-directional Granger-causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate, which supports the Flow-Oriented and the Share-Oriented Theories.

Table 4-27 summaries the main finding of this chapter, linking with the first and second research objective and hypotheses H_1,H_2, H_3,H_4, H_5,H_6, H_7 *and* H_8, for each country in the sample study

4.11 A discussion between comparative analysis results of China, the European Union, the United Kingdom and the United States

This chapter has analysed the nature of the linkage between stock prices and exchange rates to answer, as mentioned previously, the first and second questions of the current study through investigation hypotheses; H_1, H_2, H_3, H_4, H_5, H_6, H_7, H_8 for each country in the sample. The researcher uses the capitalization–weighted index, the closing stock prices, and the nominal exchange rate for each country in the sample. Furthermore, in this chapter she uses just the in-sample time series date spanning from January 3, 2000 to December 31, 2010. The total daily observations are 22976 for all exchange rates and closing stock prices. The results of the Augmented Dickey-Fuller (ADF) and Phillip Peron (pp) test indicated that all stock prices and exchange rates were non-stationary at level series, while it became stationary at first difference series. Consequently, all the individual variables are treated as integrated of order one I~(1).

To examine the cointegration, the current study used the Engel-Granger and the Johansen's cointegration test. Comparing the findings of the Johansen cointegration and the Engel-Granger cointegration test, both tests were consistent for China, the

United Kingdom, and the United States. The results of tests have not found any evidence of cointegrating relationships between stock prices and exchange rates, However, the Johansen's cointegration test differs from Engel-Granger cointegration test in respect to the European Union. The Engel-Granger cointegration test does not find any long relationships between the FTSE Eurotop 100 Index closing price and exchange rate. Yet, the Johansen's cointegration test found the long-run relationships between the FTSE Eurotop 100 Index closing price and exchange rate. This implies that the FTSE Eurotop 100 Index closing price and exchange rate move together in the long-run relationship. Therefore, it can be said that the first objective of this study is achieved, which determines the relationship in the long-run for each country in the sample study.

Usually, the VAR model estimated when the short-run relationship between the variables exist. In addition, when there is a long-run relationship between variables, the VECM estimates to detect two issues. The first one is to determine if there is a long-run relationship between the variables or not. The second issue is determining the possibility of applying the Wald tests or not. Given that, this study includes both the long and the short relationship between stock prices and exchange rates for each country in the sample during the period from January 3, 2000 to December 31, 2010. Therefore, the analysis is divided into two parts: the first part is the short-run analysis for China, the United Kingdom, and the United States comprising of the causality tests under the VAR model, while the second part is the long-run analysis for the European Union, including the causality tests under the under the VECM.

The results of the VAR model show that the Wald tests failed to explain the causal relationship between variables, because more than 50% of the probability values are not significant to explain the dependent variable, therefore, the researcher did not obtain any results when employing the Wald test under the VAR model for China, the United Kingdom, and the United States. That is quite different in the long-run analysis when applying the Wald test under the VECM model when the researcher obtained results of the Wald test. Furthermore, the researcher determined the type of a negative or the positive and direction of the relationship in the long run, under the estimation of the VECM, while she could only determine the direction of the relationship in the short- run under the estimation of the VAR model. That is due to two reasons, which are detailed as follows. The first reason involves the characteristics of both VAR model and VECM. The VAR model used stationary data and when applying the VECM, non-stationary data were used (Asteriou & Hall, 2011, pp. 319-390). The second reason involves the VECM model, including the error correction model, which determines the equation of the long-run (CointEq1), whereas the VAR model is not included in the error correction model.

The researcher applied the Block Exogeneity Wald test under the VAR model to detect the short-run relationship between stock prices and exchange rates for China, the United Kingdom, and the United States. Furthermore, the study employed the Pairwise Granger causality test at the first difference series I~(1) to all closing stock prices and exchange rates for all countries of the sample to confirm the Granger-causality relationship for both short and long-run relationships. The choice of the lags that were used when estimating the Pairwise Granger causality test was based on the lowest probability values and the highest F-statistic values. In the case of China, lag six was used while lag three was used for both the United Kingdom and the United States. The Block Exogeneity Wald and the Pairwise Granger causality tests report that there was unidirectional causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price in the short-run, which supports the arguments of the Flow-Oriented Theory in the case of China. Additionally, both tests illustrated that there was a unidirectional causality relationship running from the Dow Jones Industrial Average Index closing price to the US Exchange Rate, which corresponds to the arguments of the Stock-Oriented Theory. In regard to the United Kingdom, both tests exhibited that the bi-directional causality was found between the FTSE 100 Index closing price and the UK Exchange Rate in the case of the United Kingdom, which supports the arguments of both the Stock-Oriented and the Flow-Oriented Theories.

The second part is the long-run analysis for the Euro Exchange Rate, which required employing the VECM, the Wald, and the Pairwise Granger causality tests. The results of the VECM showed that there was a negative long relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price, whereas there was no long relationship running from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate. The Wald test displayed that there was no short-run causality relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price and from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate. This result is confirmed by the result of the Pairwise Granger causality test. As a conclusion of the long-run causality relationship for the European Union, it has a negative long relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price. However, no existence for any short–run casualty relationship from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price was detected. On the other hand, there was not any short or long relationship running from the FTSE Eurotop 100 Index closing price to the Euro Exchange Rate for the period under analysis. Therefore, the results of the current study with respect to the European Union support the Flow-Oriented Theory which suggests that changes in exchange rate lead to changes in stock price.

Table (4-27) exhibits summary of the main results linking with the first and second research objectives and questions also hypothesis; H_1, H_2, H_3, H_4, H_5, H_6, H_7, H_8 for each country in the sample.

Table 4.27: summary of the main results linking with the first and second research objectives ,questions and hypotheses for each country

Research Objectives	Research Questions	Research Hypotheses	Finding
To detect both short and long–run relationships between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States.	a. Is there any long–run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate	H_1: There is no significant long-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate	There is a short-run relationship between Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate of China
	b. Is there any long–run relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate	H_2: There is no significant long-run relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate	There is a long-run relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate of the European Union
	c. Is there any long–run relationship between the FTSE 100 Index closing price and the UK Exchange Rate	H_3: There is no significant long-run relationship between the FTSE 100 Index closing price and the UK Exchange Rate	There is a short-run -run relationship between the FTSE 100 Index closing price and the UK Exchange Rate of the United Kingdom
	d. Is there any long–run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate	H_4: There is no significant long-run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate	There is a short-run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate the United States
To determine the direction of the relationship between stock prices and exchange rates and discover which of them affects the other or whether both affect each other in the previously mentioned countries.	a. what is the direction of the relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate	H_5: There is significant causality relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate	There is unidirectional Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price which supports the Flow-Oriented Theory.
	b. what is the direction of the relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate	H_6: There is significant causality relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate	There is unidirectional Granger-causality relationship running from the Euro Exchange Rate to FTSE Eurotop 100 Index closing prices, which supports the Flow-Oriented Theory.
	c. what is the direction of the relationship between the FTSE 100 Index closing price and the UK Exchange Rate	H_7: There is significant causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate	There is the bi-directional Granger-causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate, which supports the Flow-Oriented and the Share-Oriented Theories.
	d. what is the direction of the relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate	H_8: There is significant causality relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate	There is unidirectional Granger-causality relationship running from the Dow Jones Industrial Average Index closing price to the US Exchange Rate the, which supports the Share-Oriented Theory

4.12 Summary

This chapter began by presenting the plan to divide the analysis in accordance with the objectives and questions of research by testing different hypotheses. Then the researcher moved to time series analysis, which included the in-sample time series data from January 3, 2000 to December 31, 2010 and included 22968 observations after adjustments. The researcher started the analysis with some tests are considering the process of analysing the relationship in the short or long-run e.g. descriptive statistics of stock prices and exchange rate growth, optimal lag and the unit root tests. The researcher applied the Augmented Dickey-Fuller and Phillips-Perron Statistic unit root tests which concluded that all stock prices and exchange rates of the time series data are stationary at the first difference series, which means that the variables are integrated of one I~(1). Then, she examined the cointegration relationship between the variables of each country in the sample tests by using the Engel-Granger and the Johansen's cointegration test.

The results of the Engel-Granger and the Johansen's cointegration test have not found any evidence of the cointegrating relationships between stock prices and exchange rates for China, the United Kingdom, and the United States, while the results of tests have found the cointegrating relationships between stock prices and exchange rates for the European Union. Subsequently, the researcher moved to apply the Block Exogeneity Wald test under the VAR model and the Pairwise Granger causality test to detect the short-run relationship between stock prices and exchange rates for China, the United Kingdom, and the United States. Also, the researcher detects the existence of the unidirectional Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price for China, which supports the Flow-Oriented Theory, while there is a unidirectional Granger-causality relationship running from the Dow Jones Industrial Average Index closing price to the US Exchange Rate the for the United States, which supports the Share-Oriented Theory. Moreover, the researcher found a bi-directional Granger-causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate for the United Kingdom, which supports the Flow-Oriented and the Share-Oriented Theories.

With regards to the long-run, the researcher applies the Block Exogeneity Wald test under the VAR model and the Pairwise Granger causality test to detect the long-run relationship between stock prices and exchange rates for the European Union. She demonstrated that there is a unidirectional Granger-causality relationship running from the Euro Exchange Rate to FTSE Eurotop 100 Index closing prices, which supports the Flow-Oriented Theory.

Chapter 5: Forecasting Analysis

5.1 Introduction

The main goal of this chapter is to present the details of the empirical results obtained by analysing the out-of-sample time series data and applying the appropriate forecasting methodology. The analysis will be connected with the third objective of the study, which is to examine whether the data of the stock prices and exchange rate in China, the European Union, the United Kingdom and the United States have a good predictive ability for the future, while in the previous chapter the researcher achieved the first and the second objectives of this study.

This chapter is organized as follows. Section 5.2 gives a general idea of the forecasting in econometrics and its types. Then, section 5.3 presents some indicators that determine the ability of the model to forecast. After that, section 5.4 demonstrates the descriptive statistics of stock prices and exchange rate growth. Section 5.5 shows the results of the Optimal Lag Lengths of the VAR model, while Section 5.6 presents the empirical results of the unit root tests (the Augmented Dickey-Fuller test and the Phillip Peron test). The most important sections of this chapter are 5.7 and 5.8, which show the empirical results of the VAR Forecast and the VECM Forecast.

As a reminder, since this chapter aims to apply the VAR Forecast and the VECM Forecast, whether in the short or long run, based on the results of chapter four, the researcher divides the data into two parts based on the phases of the study. The first part is the in-sample time series data for the period from January 3, 2000, to December 31, 2010, as mentioned in the previous chapter. It includes the descriptive statistics, a line growth of stock prices and the exchange rates of the sample countries. Following this, the optimal Lag Lengths were determined from the in-sample time series data. The optimal Lag Lengths was determined because it was very important to complete other tests such as the Johansen, the Vector Auto Regression model (VAR), the Vector Error Correction (VECM) Model and other models, which were required for analysis in the previous chapter. Then, the researcher examined the unit root tests of the in-sample time series data, which are considered the first step in carrying out the analysis. In this chapter, the tests used for the in-sample time series data in chapter

4 will be applied to the second part of the data, i.e. out-of-sample time series data. The period corresponding to these data was January 3, 2011, on March 31, 2015, and the data included 8848 observations for five working days of closing stock prices and exchange rates for the sample countries of this study. The out-of-sample will be used in this chapter to answer the third research question which is: do the data of the stock prices and exchange rates in China, the European Union, the United Kingdom and the United States have a good predictive ability for the future?

To answer the previous question, the researcher used the out-of-sample to test the following research hypotheses;

> *H_9: The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate have good predictive ability for the future in China*

> *H_{10}: The FTSE Eurotop 100 Index and the Euro Exchange Rate have good predictive ability for the future in the European Union*

> *H_{11}: The FTSE100 Index and the UK Exchange Rate have good predictive ability for the future in the United Kingdom.*

> *H_{12}: The Dow Jones Industrial Average Index closing price and the US Exchange Rate have good predictive ability for the future in the United States*

The researcher will start the analysis by the descriptive statistics, the line growth of closing stock prices and the exchange rates of the sample countries. Then, the unit root tests will be employed to see if all the variables are stationary or not. After this, the researcher will apply the VAR Forecast and the VECM Forecast for the dependent variables (the Shanghai Stock Exchange Composite Index closing price, the FTSE Eurotop 100 Index closing price, the FTSE 100 Index closing price and the Dow Jones Industrial Average Index closing price). Employing the VAR Forecast and the VECM Forecast will be based on the results of the Vector Auto Regression model (VAR) and the Vector Error Correction (VECM) Model regarding the nature of the relationship between the closing stock prices and the exchange rates for each financial market included in this study. In this chapter, the researcher will replace the countries China, the European Union, the United Kingdom and the United States with the China model, the European Union model, the United Kingdom model and the United States model respectively to explain the results of forecasting.

5.2 Forecasting In Econometrics

Although the word ‘forecasting’ is sometimes given different meanings in different studies, it will be used synonymously in this study. Forecasting simply means “an attempt to determine the values that a series is likely to take” (Brooks, 2014, p. 285). Future expectations are very important, because financial decisions often include the long-run commitment of resources and the returns that in turn will depend on what happens. Accordingly, the decisions made today will reflect any forecasts of the future of countries. Brooks (2014, pp. 285-290) provides some examples in finance, where econometric models are used for forecasting. These include forecasting tomorrow’s return on a particular share, forecasting the volatility of bond returns, “forecasting the price of a house given its characteristics, forecasting the correlation between the US and the UK stock market movements tomorrow, forecasting the riskiness of a portfolio over the next year, and forecasting the likely number of defaults on a portfolio of home loans”(Brooks, 2014, pp. 285-290).

From the above examples, it is evident that forecasting can be employed in either the cross-sectional or the time series context. Therefore, it is useful to differentiate between the two approaches to forecasting. The first one is econometric (structural) forecasting which relates a dependent variable to one or more independent variables. Such models work well in the long term, because the long-run relationship between variables often arises from no-arbitrage or market efficiency conditions. The best example of the econometric forecasting in the long-run is that of exchange rate forecasts based on forecasting power parity. The second approach is time series forecasting, which is used in this study. It includes trials to forecast the future values of a series, given its previous values of the error term (Brooks, 2014, pp. 285-290). When studying forecasting, it is useful to distinguish between the in-sample and the out-of-sample forecasts. To understand this difference, it is helpful to consider the following quote in Brooks (2014, pp. 285-290), which demonstrates the importance of the performance of an out-of- sample forecast:

> "In-sample forecasts are those generated for the same set of data that was used to estimate the model's parameters. One would expect the 'forecasts' of a model to be relatively good in sample, for this reason. Therefore, a sensible approach to model evaluation through an examination of forecast accuracy is not to use all of the observations in estimating the model parameters, but rather to hold some of the observations back. The latter sample, sometimes known as the holdout sample, would be used to construct out-of- sample forecasts".

Pindyck and Rubinfeld (1991, pp. 181-182) provided another explanation to time series forecasting. They reported that it is useful to differentiate between ex-post and ex-ante-forecasting. In the time-series models, both forecast the values of a dependent variable beyond the time period in which the model is estimated. Nevertheless, in an ex-post forecast-observation both internal variables and the external explanatory variables are certainly known during the forecast period. As a result, ex-post forecasts can be examined against data available and could offer a method to evaluate a forecasting model. An ex-ante forecast "predicts values of the dependent variable beyond the estimation period, applying explanatory variables that may or may not be fully understood" (Pindyck and Rubinfeld, 1991, pp. 181-182).

Conditional and unconditional forecasts can also be distinguished from each other. In an unconditional forecast, values for all the explanatory variables in the forecasting equation are certainly determined. Both ex-post and ex-ant forecasts may be unconditional. On the other hand, in a conditional forecast, the values for one or more explanatory variables are not known, so that guesses (or forecasts) must be used to determine the dependent variable (Pindyck & Rubinfeld, 1991, pp. 181-182). Normally, the in-sample data constitutes about 80% of the data, while the out-of-sample data make 20% of the entire data set. In this study, the in- sample time series data is from January 3, 2000 to December 31, 2010 while the out-of-sample time series data set is from January 3, 2011 to March 31, 2015.

5.3 Forecasting Accuracy

There are many means to detect forecasting accuracy and comparing one forecasting method with another. "In all the methods, the forecasts and forecast errors referred to are errors in forecasting extra-sample observations" (Kennedy, 2003, p. 334).

5.3.1 The Mean Absolute Deviation (MAD)

The MAD is "the average of the absolute values of the forecast errors" (Anderson, Sweeney, Williams, Camm, & Cochran, 2015, p. 746). This measure is suitable when the cost of forecast errors is proportional to the absolute size of the forecast error. This criterion is also known as Mean Absolute Error (MAE). Since this measure is sensitive to scaling, it cannot be used to compare forecasting success across data sets with different scales (Kennedy, 2003, p. 334).

5.3.2 The Root Mean Square Error (RMSE)

In this section, the RMSE is presented. It is "the square root of the average of the squared values of the forecast errors. This measure implicitly weights large forecast errors more heavily than small ones" and is suitable for situations in which the cost of an error augments as the square of that error. This quadratic loss function is commonly used. This measure is sensitive to both scaling, and outliers. (Kennedy, 2003, p. 334).

5.3.3 The Mean Absolute Percentage Error (MAPE)

The MAPE refers to "the average of the absolute values of the percentage errors" (Kennedy, 2003, p. 334). Similarly, (Swanson & Tayman, 2012, p. 385) provide more explanation about this definition, and they report that the MAPE refers to "the arithmetic average of absolute percent differences between a set of estimates and corresponding census numbers, and also it is frequently used in an ex-post facto test of accuracy" (Kennedy, 2003, p. 334). This measure is advantageous; it is also dimensionless. It is more "appropriate when the cost of the forecast error is more closely related to the percentage error than to the numerical size of the error". On the other hand, this indicator suffers from two problems: the first one is that "the base for measuring percentage can be zero, rendering it undefined, or of huge magnitude, creating a severely skewed distribution" (ibid). The second problem is that it "puts a heavier penalty on positive errors than on negative errors (because for a given forecast the base for calculating the percentage is smaller for an overestimate than for an underestimate" (Kennedy, 2003, p. 334).

5.3.4 The Theil Inequality Coefficient

The Theil inequality coefficient "measures the degree of differences in dynamic coefficient between two-time series (Schadler, 2005, p. 27). Moreover, the "Theil inequality coefficient always lies between zero and one" (Plasmans, 2006, p. 253). Based on this, if the value of the Theil inequality coefficient equals zero, the model has perfect predictions, whereas if the value equals one, the model has poor predictions (Dixon, 2011, pp. 184-185).

5.3.5 The Correlation of Forecasts with Actual Values

According to this measure, the "actual changes (not the levels) of the variable being forecasted are regressed on the forecasts of these changes and the resulting is used as a measure of forecasting accuracy" (Kennedy, 2003, p. 334). It is a relatively simple task to make the calculation using statistical software and basic spreadsheet making the calculation of (R). In general, "correlations between forecast and actual values in excess of 0.99 (99 %) are highly desirable and indicate that the forecast model being considered constitutes an effective tool for analysis" (Hirschey, 2008, p. 227).

5.3.6 The Quadratic Score

This procedure is known as the Brier score. It is another popular alternative to percentage correct for a qualitative variable. "This is the qualitative variable equivalent of the RMSE criterion, calculated as the sum over all observations of $(1-\rho)^2$where (p) is the forecasted probability of the outcome that actually occurred" (Kennedy, 2003, pp.334- 335).

In the literature, there are several arguments around the most appropriate methods for forecasting. There seems to be a consensus that it would be appropriate to have a combined forecast as a weighted average of a variety of forecasts, each generated by applying different techniques. If the rules on which these different forecasts are based are sufficiently different from one another, this average should prove to be of significance to any single forecasting technique, because the errors in the separate forecasts will tend to cancel one another. Good forecasts do not emerge from the application of a preferred model specification, but from integrating results from a variety of reasonable models (Kennedy, 2003, p. 363). One means of finding the weights for the combined forecast is to regress the real values on all the competing forecasts "including an intercept" as the "inclusion of the intercept sops up any bias in the forecasts". "There is considerable evidence; however, that in most applications the sampling variability introduces more than offsets the advantage of combining. Consequently, practitioners typically adopt equal weights, or shrink the regression weights towards equality" (ibid, p. 363).

In this study, the researcher adopts the Root Mean Square Error (RMSPE) to validate and evaluate the predictive capability of models. Before estimating the forecasting, the researcher should start with some descriptive statistics of the out-of-sample data and then examine the unit root tests and determine the Optimal Lag Lengths for all stock prices and exchange rates in the sample countries.

5.4 Descriptive Statistics of Closing Stock Prices and Exchange Rates Growth

For the descriptive statistics data, this study applies the natural log values of stock closing prices (SP) and exchange rates (ER) for four countries (China, the European Union, the United States and the United Kingdom), as in the previous chapter. Table 5.1 illustrates the descriptive statistics of the out-of-sample time series data from January 3, 2011 to March 31, 2015 of (a) the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate (b) the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate (c) the FTSE 100 Index closing price and the UK Exchange Rate (d) the Dow Jones Industrial Average Index closing price and the US Exchange Rate. Furthermore, all growth in closing stock prices and exchange rates has been measured by taking the natural log of the values of these prices and rates.

Table 5.1 summarizes the basic statistical advantages of the sample data, including the means, the minimum, maximum values and standard deviation covering 22956 observations after adjustments. From the standard deviation, the researcher can measure the unit root and the risk of the eight variances. Thus, Table 5.1 demonstrates that the closing stock price of the United States is the highest at 16%, followed by those of China (at 15%), the European Union (at 12%) and the United Kingdom (at 8%) in that order. Consequently, based on the standard deviation, the Dow Jones Industrial Average of the United States is the riskiest among all the stock exchange markets included in the sample.

The closing price of the Shanghai Stock Exchange Composite Index comes second and the closing price of the FTSE Eurotop 100 Index comes third, while the closing price of the FTSE 100 Index is the least risky among all the four countries. In addition, Table 5.1 presents the characteristics of the variables distribution. Obviously, Table 5.1 indicates that the Jarque-Bera statistic rejects the null hypothesis of a normal distribution for the closing stock prices (of China, the United States, and the United Kingdom) and the exchange rates (of the European Union, the United Kingdom, and the United States) because the probability value for these variables was less than 5%. On the other hand, the Jarque-Bera statistic accepts the null hypothesis of a normal distribution for the closing stock prices of the European Union and the Chinese Exchange Rate, because the probability value was more than 5%. Furthermore, from Table 5.1 it can be seen that the distributions of all the variables are peaked (leptokurtic) relative to the normal, because the values of kurtosis are more than three. The next two figures describe the exchange rates and closing stock prices line graphs of the sample countries during the out-of-sample time series data from January 3, 2011, to March 31, 2015, through figure 5.1 and figure 5.2

Table 5.1 : Standard Deviation of Closing Stock Prices and Exchange Rates

	China		European Union		United Kingdom		United States	
	CHI_ SP	CHI_ER	EUR_ SP	EUR_ER	UK_SP	UK_ER	US_ SP	US_ER
Mean	7.766708	-2.261407	7.789931	-0.147374	8.724954	0.041405	9.563959	-0.425147
Median	7.733535	-2.256499	7.780449	-0.141428	8.734180	0.035193	9.541623	-0.429558
Maximum	8.678443	-2.132547	8.079918	-0.085374	8.859032	0.105504	12.01613	-0.314223
Minimum	7.575590	-2.354943	7.502313	-0.262395	8.506019	-0.010586	9.273813	-0.484404
Std. Dev	0.145762	0.044729	0.115281	0.031418	0.081758	0.028376	0.160498	0.029286
Skewness	1.508141	0.118884	0.020628	-0.940003	-0.354768	0.422174	3.279104	1.167221
Kurtosis	6.747441	3.348730	2.552211	3.839299	2.051450	2.047992	50.84942	5.451580
Jarque-Bera	1043.286	8.031445	9.200890	192.8675	63.78662	73.60806	106521.0	523.3338
Probability	0.000000	0.018030	0.010047	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	8403.578	-2446.842	8506.605	-160.9327	9518.924	45.17292	10482.10	-465.9615
Sum Sq. Dev.	22.96749	2.162706	14.49917	1.076942	7.286036	0.877644	28.20663	0.939128
Observations	1082	1082	1092	1092	1091	1091	1096	1096

5.4.1 Closing Stock Price Line Graphs of the Sample Countries

The Shanghai Stock Exchange Composite index started to rise from the end of 2010. It had achieved some rise in the first quarter of the year and then it began to decline gradually with some fluctuations. It reached the lowest value in March 2012. Then it experienced a period of fluctuation during 2013 and 2014. From October 2014, it began to rise noticeably up to the end of March 2015. The movements in the indexes were not limited to Shanghai Stock Exchange Composite Index, but they included other indexes. For instance, The FTSE Eurotop 100 Index rose for two months in 2011. Then it began to decline until the end of 2011. After that decline, it began to rise and reached the highest value in the middle of March of that year. The decline lasted three months and it reached the highest in the beginning of June, but not comparable to the decline of 2011. In the middle of June 2012, it started to rise gradually until the end of 2014. In the beginning of 2015, it had a drastic rise. Similarly, the FTSE 100 Index had a drastic decline by the beginning of 2011 and its highest decline started from July to August in the same year. In March 2012, it began to rise. Another decline was recorded in May 2012. A period of fluctuation was experienced until the end of 2014. By the beginning of 2015, it recorded noticeable rises, like other indexes. The Dow Jones Industrial Average Index differs from other indexes. It started to rise gradually in the first seven months of 2011; however, a decline was recorded in August of the same year. From August to October of the same year, it tried to rise. Then starting from October 2011, it began to rise gradually and in increasing levels.

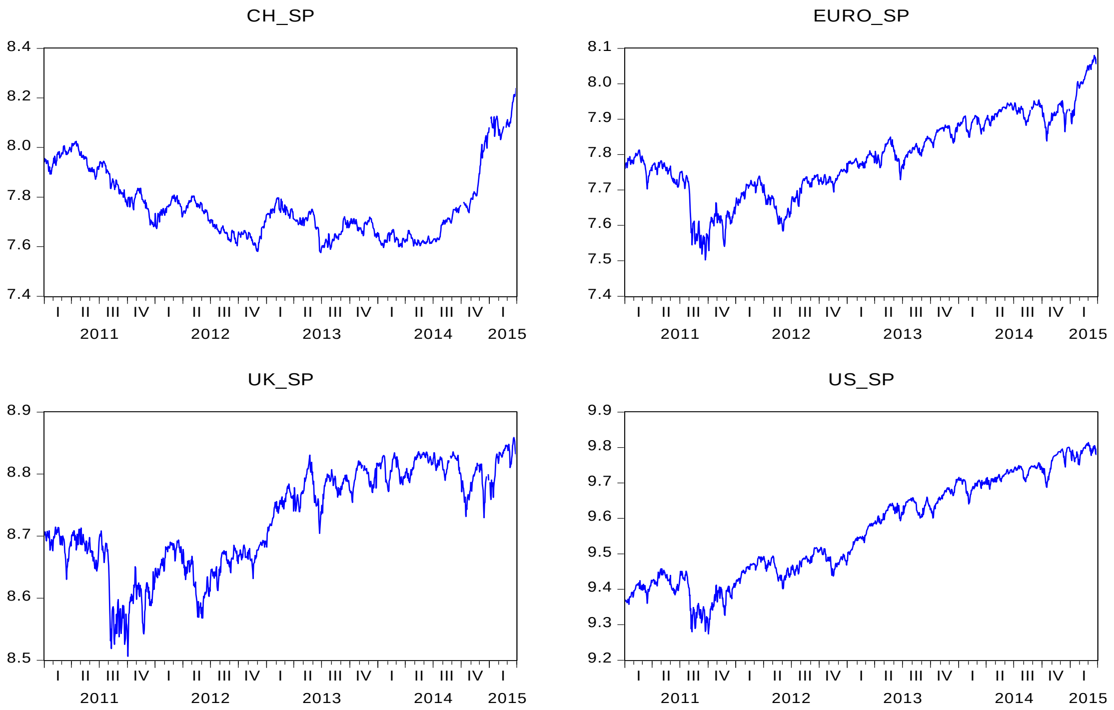


Figure 5.1: Exchange Rates Line Graphs of the Sample Countries

5.4.2 Exchange Rate Line Graphs of the Sample Countries

From Figure 5.2, it can be noticed that the Chinese Exchange Rate and the US Exchange rate were somehow similar in terms of their movements in the period starting from January 3, 2011, to March 31, 2015. They experienced a decline in the first three months of 2011. They rose gradually up to March 2015. To the contrary, The Euro Exchange Rate rose in the first three months of 2011. Then, it declined and reached its lowest value in July 2012. The gradual rise was recorded in 2014, but it declined in 2015, which is the opposite of the other exchange rates that recorded a gradual rise in the same period. Likewise, The UK Exchange Rate encountered decline at increasing levels from 2010 until the end of 2011 and reached the lowest value. Then it began to rise and recorded its highest value in May 2012. June 2012 was a period of decline. It achieved the highest value ever recorded in January 2013. After this time, it declined considerably, recorded the lowest value in March 2013. Then it began to rise and achieved a high value in July 2014. However in 2015, it declined again but different from the previous decline. Then it began to rise at different levels.

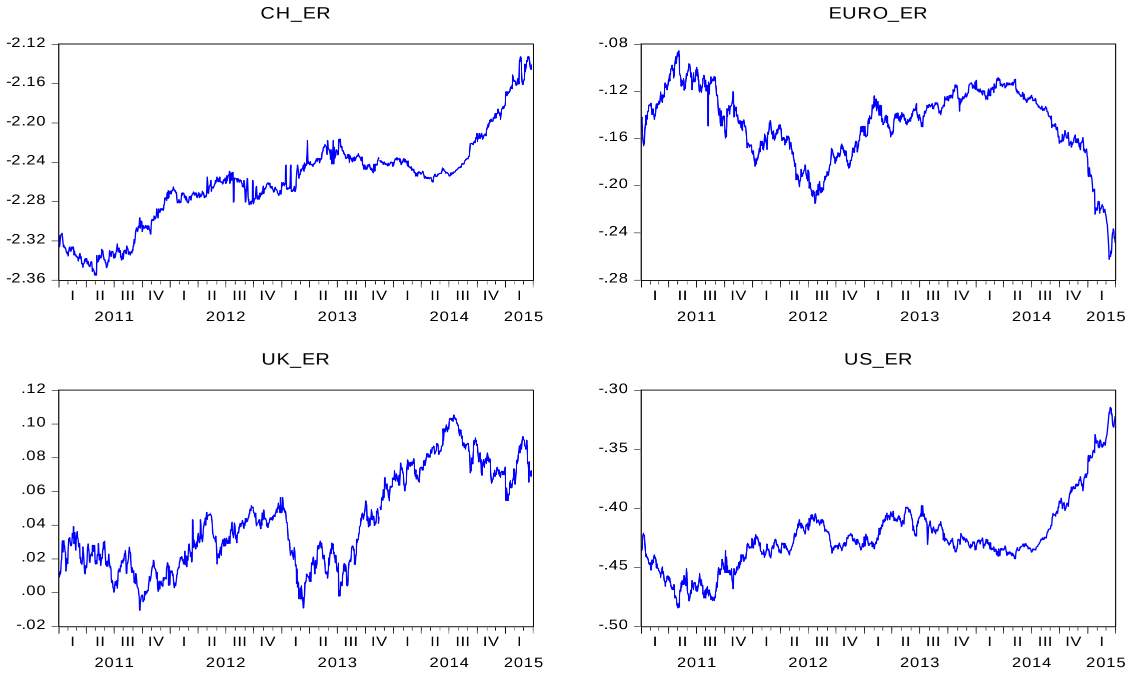


Figure 5.2: Stock Price line graphs of the sample countries

5.5 Optimal Lag Lengths of the VAR Model

As was noted in the previous chapter, the researcher estimated the optimal lag because the Vector Auto Regression model (VAR) and the Vector Error Correction (VECM) Model cannot be estimated without determining the optimal lag. Through these previous models, the researcher estimated the forecasting for China, the European Union, the United States and the United Kingdom, which is the aim of this chapter. In this chapter, the selection of the lags number is made using a maximum of 12 lags in order to allow adjustments in the model and to fulfil well-behaved residuals for all time periods (the in-sample and the out-of-sample data from January 3, 2000 to March 31, 2015). Table 5.2 shows the lag lengths selected by different information criteria. The researcher found lag seven in cases of China and the European Union, while she found lag eleven in the case of the United Kingdom. Moreover, the researcher found lag three in the case of the United States. The automatic specification lags were based on the Schwarz criterion.

Table 5.2: Optimal Lag Lengths of the VAR Model

china							European Union						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**	**Lag**	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	2607.247	NA	0.000921	-1.314122	-1.310952	-1.312998	0	4977.863	NA	0.000276	-2.518149	-2.514970	-2.517022
1	26457.75	47664.91	5.50e-09	-13.34262	-13.33311	-13.33925	1	26975.93	43962.73	4.05e-09	-13.64875	-13.63921	-13.64537
2	26517.24	118.8349	5.35e-09	-13.37061	-13.35476	-13.36499	2	27023.22	94.45881	3.96e-09	-13.67066	-13.65476	-13.66502
3	26550.98	67.35956	5.27e-09	-13.38561	-13.36342*	-13.37774	3	27068.69	90.78783	3.88e-09	-13.69164	-13.66939*	-13.68375
4	26555.98	9.972308	5.27e-09	-13.38612	-13.35758	-13.37600	4	27077.72	18.00985	3.87e-09	-13.69419	-13.66558	-13.68404*
5	26558.01	4.057235	5.27e-09	-13.38513	-13.35025	-13.37276	5	27081.54	7.620664	3.87e-09	-13.69410	-13.65913	-13.68169
6	26582.23	48.28632	5.22e-09	-13.39533	-13.35411	-13.38071*	6	27084.65	6.209723	3.87e-09	-13.69365	-13.65232	-13.67899
7	26589.21	**13.89191***	**5.21e-09***	**-13.39683***	-13.34927	-13.37996	**7**	27089.94	**10.53690***	**3.87e-09***	**-13.69430***	-13.64661	-13.67739
8	26590.94	3.448260	5.22e-09	-13.39568	-13.34178	-13.37657	8	27092.59	**5.279165**	**3.87e-09**	**-13.69362**	-13.63957	-13.67445
9	26594.39	6.877558	5.22e-09	-13.39541	-13.33517	-13.37404	9	27093.34	1.494106	3.88e-09	-13.69197	-13.63157	-13.67055
10	26596.26	3.704914	5.22e-09	-13.39433	-13.32775	-13.37072	10	27097.59	8.445620	3.88e-09	-13.69210	-13.62534	-13.66842
11	26597.15	1.786378	5.23e-09	-13.39276	-13.31984	-13.36690	11	27100.14	5.071918	3.88e-09	-13.69137	-13.61824	-13.66543
12	26600.32	6.286832	5.23e-09	-13.39234	-13.31308	-13.36423	12	27103.07	5.822276	3.88e-09	-13.69082	-13.61135	-13.66263
United Kingdom							**United States**						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**	**Lag**	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	5629.679	NA	0.000201	-2.838678	-2.835508	-2.837554	0	6007.075	NA	0.000166	-3.029041	-3.025871	-3.027917
1	27024.95	42758.17	4.13e-09	-13.62873	-13.61922	-13.62535	1	28995.36	45941.78	1.53e-09	-14.62263	-14.61312	-14.61925
2	27089.17	128.2843	4.01e-09	-13.65910	-13.64325	-13.65348	2	29039.81	88.78593	1.50e-09	-14.64303	-14.62718*	-14.63741
3	27108.80	39.17588	3.98e-09	-13.66698	-13.64479	-13.65911	**3**	29053.86	28.05181	**1.49e-09***	**-14.64810***	-14.62591	-14.64023*
4	27126.04	34.41571	3.95e-09	-13.67367	-13.64513*	-13.66355	4	29057.56	7.390217	1.49e-09	-14.64795	-14.61942	-14.63783
5	27137.66	23.16220	3.94e-09	-13.67751	-13.64263	-13.66514*	5	29057.84	0.558522	1.49e-09	-14.64607	-14.61120	-14.63371
6	27142.78	10.20189	3.93e-09	-13.67807	-13.63686	-13.66345	6	29061.78	7.858535	1.49e-09	-14.64604	-14.60483	-14.63143
7	27149.19	12.77331	3.93e-09	-13.67929	-13.63173	-13.66242	7	29067.08	10.54860	1.49e-09	-14.64670	-14.59914	-14.62983
8	27150.85	3.310043	3.93e-09	-13.67811	-13.62421	-13.65899	8	29070.45	6.720979	1.49e-09	-14.64638	-14.59249	-14.62727
9	27155.76	9.782208	3.93e-09	-13.67857	-13.61833	-13.65721	9	29077.03	13.10168*	1.49e-09	-14.64768	-14.58745	-14.62632
10	27156.16	0.797892	3.94e-09	-13.67675	-13.61018	-13.65314	10	29079.39	4.681510	1.49e-09	-14.64685	-14.58028	-14.62324
11	27170.13	**27.76788***	**3.92e-09***	**-13.68178***	-13.60886	-13.65592	11	29081.18	3.556442	1.49e-09	-14.64574	-14.57282	-14.61988
12	27172.23	4.166834	3.92e-09	-13.68082	-13.60156	-13.65271	12	29082.43	2.492317	1.50e-09	-14.64435	-14.56509	-14.61624

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

5.6 Empirical Results of the Unit Root Tests (The Augmented Dickey-Fuller Test and the Phillip Peron Test

Since employing the unit root test in Chapter 4 included only the in-sample time series data, this chapter examines the unit root of the out-of-sample time series data, as a first step before forecasting, for (a) the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate (b) the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate (c) the FTSE 100 Index closing price and the UK Exchange Rate (d) the Dow Jones Industrial Average Index closing price and the US Exchange Rate. This research relies on the same unit root tests that are used in the previous chapter. The number of observations was 8848 after adjustments for eight previous variables which were used to employ both the Augmented Dickey-Fuller (ADF) (1979, 1981) and Phillips-Perron (PP) (1988) tests. Furthermore, the period under examination was January 3, 2011 to March 31, 2015.

Table 5.3: Results of the Augmented Dickey-Fuller (ADF) Test

China					
Level series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
Shanghai Stock Exchange Composite index	-0.854932	-3.436395	-2.864098	-2.568183	0.8024
Exchange Rate	-0.159494	-3.436395	-2.864098	-2.568183	0.9409
1st Difference series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
Shanghai Stock Exchange Composite index	-17.14523	-3.436395	-2.864098	-2.568183	0.0000
Exchange Rate	-32.04700	-3.436395	-2.864098	-2.568183	0.0000
European Union					
Level series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTS Eurotop100 Index	-0.533191	-3.436094	-2.863965	-2.568112	0.8821
Exchange Rate	-0.096271	-3.436273	-2.864043	-2.568154	0.9480
1st Difference series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTS Eurotop100 Index	-32.46412	-3.436116	-2.863974	-2.568117	0.0000
Exchange Rate	-27.09541	-3.436273	-2.864043	-2.568154	0.0000

Tables 5.3 above and 5.4 below present summaries of the ADF test results of time series data of regarding each set of closing stock prices and exchange rates in the four countries of the sample: China, the European Union, the United States and the United Kingdom. The p-probability value is found to be larger than 5% and the t-statistic value is less than the critical value at level series. Therefore, the ADF test cannot reject the null hypothesis, which is that all the closing stock prices and exchange rates

have a unit root. This means that all the variables are integrated of zero $I \sim (0)$ which requires the application of the ADF test again, but at first Difference series. The Augmented Dickey-Fuller test accepts the null hypothesis, which is that all closing stock prices and exchange rates series have a unit root at any significance levels of 1%, 5%, and 10%. Now it can be said that the time series for each closing stock prices and exchange rates are stationary in the first difference series, which means the variables are integrated of one $I \sim (1)$.

Table 5.4: Results of the Augmented Dickey-Fuller (ADF) Test

United Kingdom					
Level series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTSE 100 Index	-1.848152	-3.436105	-2.863969	-2.568115	0.3572
Exchange Rate	-1.442208	-3.436216	-2.864018	-2.568141	0.5626
1st Difference series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTSE 100 Index	-33.53247	-3.436132	-2.863981	-2.568121	0.0000
Exchange Rate	-37.13555	-3.436216	-2.864018	-2.568141	0.0000
United States					
Level series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
Dow Jones Industrial Average index	-1.754405	-3.436089	-2.863962	-2.568111	0.4035
Exchange Rate	0.387176	-3.436199	-2.864011	-2.568137	0.9824
1st Difference series	**(ADF) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	Prob.*
Dow Jones Industrial Average index	-18.08831	-3.436094	-2.863965	-2.568112	0.0000
Exchange Rate	-39.26498	-3.436199	-2.864011	-2.568137	0.0000

The results of the Augmented Dickey-Fuller test are unconfirmed by the results of the Phillips-Perron statistic test. Tables 5.5 and 5.6 show the results of the PP test under the analysis period. Clearly, the time series data of the Chinese Exchange Rate, the Euro Exchange Rate, the UK Exchange Rate and the US Exchange Rate are non-stationary at level series because the value of the p-probability is more than 5% and the value of the t-statistic are less than the critical value at any significance level of 1% 5% 10%. That means the null hypothesis (the time series data of the exchange significance levels of 1%, 5%, and 10%. Moreover, the Phillips-Perron Statistic test applies to closing stock prices for the Shanghai Stock Exchange Composite Index, the FTS Eurotop100 Index, the FTSE 100 Index and the Dow Jones Industrial Average index. The PP test results are on the same wavelength with the results of the ADF test, which does not accept the null hypothesis (the closing stock prices are stationary at level series), because the values of the p- probability are more than 5% and the values of the t-statistic are less than the critical values at any significance level of 1%, 5%, 10% (all stock prices are integrated of zero $I \sim (0)$. On the other hand, the null hypothesis is accepted at first Difference series, because the probability value becomes less than 5% and the value of the t-statistic becomes larger than the critical values at any significance levels of 1%, 5%, 10%. The conclusion that can be drawn is that the results of the Phillips-Perron Statistic test for eight variables time series data (which are previously mentioned as being from January 3, 2011 to March 31, 2015) is that all the variables are non-stationary at level series $I \sim (0)$ then become stationary at first difference series, $I \sim (1)$.

Table 5.5: The Phillips-Perron Statistic (PP) Test for China and European Union

China					
Level series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
the Shanghai Stock Exchange Composite	-0.854932	-3.436395	-2.864098	-2.568183	0.8024
Exchange Rate	-2.568147	0.249120	-3.436244	-2.864031	0.9755
1st Difference series	(pp) test statistic	critical values at 1%	critical values at 5%	critical values at 10%	Prob.*
the Shanghai Stock Exchange Composite	-48.38090	-3.436165	-2.863996	-2.568129	0.0001
Exchange Rate	-44.02824	-3.436319	-2.864064	-2.568165	0.0001
European Union					
Level series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTS Eurotop100 Index	-0.357002	-3.436094	-2.863965	-2.568112	0.9137
Exchange Rate	-0.268060	-3.436160	-2.863994	-2.568128	0.9270
1st Difference series	(pp) test statistic	critical values at 1%	critical values at 5%	critical values at 10%	Prob.*
FTS Eurotop100 Index	-32.55706	-3.436116	-2.863974	-2.568117	0.0000
Exchange Rate	-38.06449	-3.436216	-2.864018	-2.568141	0.0000

According to the results of the Augmented Dickey-Fuller and the Phillips-Perron unit root tests, the current study rejects the null hypothesis (with regard to the out-of-sample time series data) which is that closing prices of the indices and their corresponding exchange rates are non-stationary at level series $I \sim (0)$ for: (a) the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate; (b) the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate; (c) the FTSE 100 Index closing price and the UK Exchange Rate; and (d) the Dow Jones

Industrial Average Index closing price and the US Exchange Rate. Conversely, this study accepts the alternative hypothesis that all the variables mentioned above are stationary at first difference series $I\sim(1)$.

Table 5.6: Phillips-Perron Statistic (PP) Test for United Kingdom and United States

United Kingdom					
Level series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTSE 100 Index	-1.616568	-3.436105	-2.863969	-2.568115	0.4737
Exchange Rate	-1.406518	-3.436160	-2.863994	-2.568128	0.5804
1st Difference series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
FTSE 100 Index	-33.87843	-3.436132	-2.863981	-2.568121	0.0000
Exchange Rate	-37.69280	-3.436216	-2.864018	-2.568141	0.0000
United States					
Level series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
Dow Jones Industrial Average Index	-14.00573	-3.436046	-2.863943	-2.568101	0.0000
Exchange Rate	0.487569	-3.436149	-2.863989	-2.568125	0.9863
1st Difference series	**(pp) test statistic**	**critical values at 1%**	**critical values at 5%**	**critical values at 10%**	**Prob.***
Dow Jones Industrial Average index	-362.5669	-3.436051	-2.863946	-2.568102	0.0001
Exchange Rate	-39.33164	-3.436199	-2.864011	-2.568137	0.0000

5.7 Empirical Results of the VAR Forecast

In this part the researcher applies the VAR Forecast for the countries that have a short-run relationship between closing stock prices and exchange rate and VEC Forecast for countries have a long-run relationship between variables previously mentioned to examine the following hypothesizes;

H_9: The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate have good predictive ability for the future

H_{10}: The FTSE Eurotop 100 Index and the Euro Exchange Rate have good predictive ability for the future

H_{11}: The FTSE100 Index and the UK Exchange Rate have good predictive ability for the future

H_{12}: The Dow Jones Industrial Average Index closing price and the US Exchange Rate have good predictive ability for the future

After achieving the first and the second research objectives, the researcher will attempt to achieve the third objective through applying the forecast using the in-sample time series data, which, if achieved, might add another contribution to this study. The researcher could not find a study employing the VAR Forecast to predict the relationship between stock prices and exchange rates. To the best of the researcher's knowledge and belief, such a study does not exist. Therefore, the researcher did not refer to that in the literature review chapter, although there are many studies that have employed the forecast by the ARCH model to examine the volatility of the relationship between the return stock prices and exchange rate and other variables. Therefore, in this study the researcher divides the period of data collection into two phases: one for the collection of in-sample time series data and the other for the collection of the out-of-sample time series data.

The in-sample time series data covers the period from January 3, 2000 to December 31, 2010 and included 22976 observations which have already been used in the previous chapter to employ the Vector Auto regression (VAR) Model and the Vector Error Correction Model (VECM) and other tests. Out-of-sample time series data were collected during the period from January 3, 2011 to March 31, 2015 and included 8848 observations, which were used for estimation, employing the VAR Forecast and the VECM Forecast. The Forecast tests were based on the results of the Vector Auto Regression model (VAR) and the Vector Error Correction (VECM) Model through the nature of the relationship between the closing stock and the exchange rates for each financial market included in this study. Therefore, the researcher will use the stationary time series data, $I \sim (1)$, for stock prices and exchange rates of China, the United Kingdom and the United States, because there are short-run relationships between stock prices and exchange rates based on the results of the VAR model used in chapter four. As it is well known, the Vector Auto Regression model (VAR) is undertaken for the first difference series of the data when employing the EViews program.

On the other hand, the researcher will use the non-stationary time series data at the level series $I{\sim}(0)$ for the closing price of the FTSE Eurotop 100 Index and the Euro Exchange Rate to employ the VECM Forecast of the European Union model, because there is a long-run relationship between the closing price of the FTSE Eurotop 100 Index and the Euro Exchange Rate, based on the results of the VECM model used in chapter four. The Vector Error Correction (VECM) Model is undertaken for the level data when employing EViews program, as it is commonly known.

5.7.1 The VAR Forecast for China Model

Only as a reminder, this study shows the existence of short-run Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price during the in-sample time series data from January 3, 2000 to December 31, 2010 and includes 4744 observations after adjustments. These results support the arguments of the Flow-Oriented Theory, and are based on the results of the Block Exogeneity Wald test under the Vector Auto Regression model (VAR). In the same way, employing the VAR Forecast will be under the Vector Auto Regression model (VAR) because there is a short-run relationship between the price of the Shanghai Stock Exchange Composite Index (CH_SP) and the Chinese Exchange Rate (CH_ER). After the researcher gets the results from the VAR model of China, as in chapter four, she will use the VAR equation of the dependent variable ((CH_SP)) (CH_SP C CH_SP(-1) CH_SP(-2) CH_SP(-3) CH_SP(-4) CH_SP(-5)CH_SP(-6) CH_SP(-7) CH_ER(-1) CH_ER(-2) CH_ER(-3) CH_ER(-4)CH_ER(-5) CH_ER(-6) CH_ER(-7)), using lag seven according to Optimal Lag Lengths test to test the forecasting accuracy to the China model (see appendices 9 (A)). The forecast model could be applied to the dependent variable (the Shanghai Stock Exchange Composite Index closing price), using the out-of-sample time series data from January 3, 2011 to March 31, 2015 which includes 2212 observations after adjustments as shown in Figure 5.3.

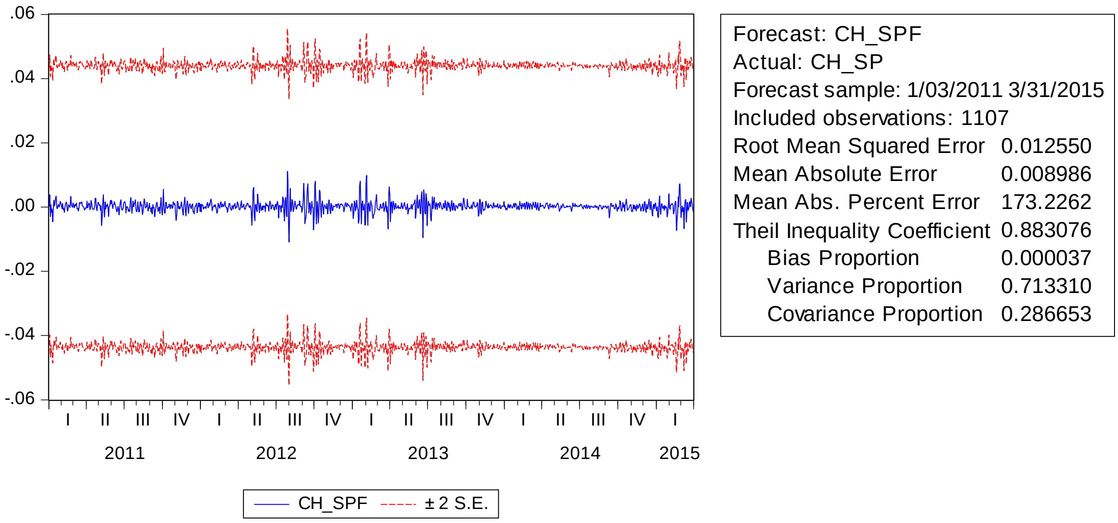


Figure 5.3: Estimation VAR Forecasting Accuracy of the China Model (Dynamic Forecasting)

As noted previously, this study will depend on the Root Mean Squared Error to measure the extent to which the forecast is accurate or not accurate. According to the Root Mean Squared Error, forecasting accuracy is measured by the smallest value of the Root Mean Squared Error better forecast, which equals 0.012550. This means that the China model has a forecasting ability during the out-of- sample time series data, while the researcher cannot graphically determine the gap between the forecasted dependent variable (CH_SPF) and the actual dependent variable (CH_SP) because she uses a huge amount of data as shown in figure 5.4. Nevertheless, the researcher determines mathematically this gap by finding the difference between the value of the (CH_SP) and the (CH_SPF), where the smaller the value is, the better the forecast will be. The gap between the actual value of the Shanghai Stock Exchange Composite Index closing price and the forecast value of the Shanghai Stock Exchange Composite Index closing price is (0.027101382), which means that the China model's ability to forecast estimated regression models is very satisfactory. This result is consistent with the above result of the Root Mean Squared Error. Therefore, this study accepted the ninth research hypotheses;

> *H9: The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate have good predictive ability*

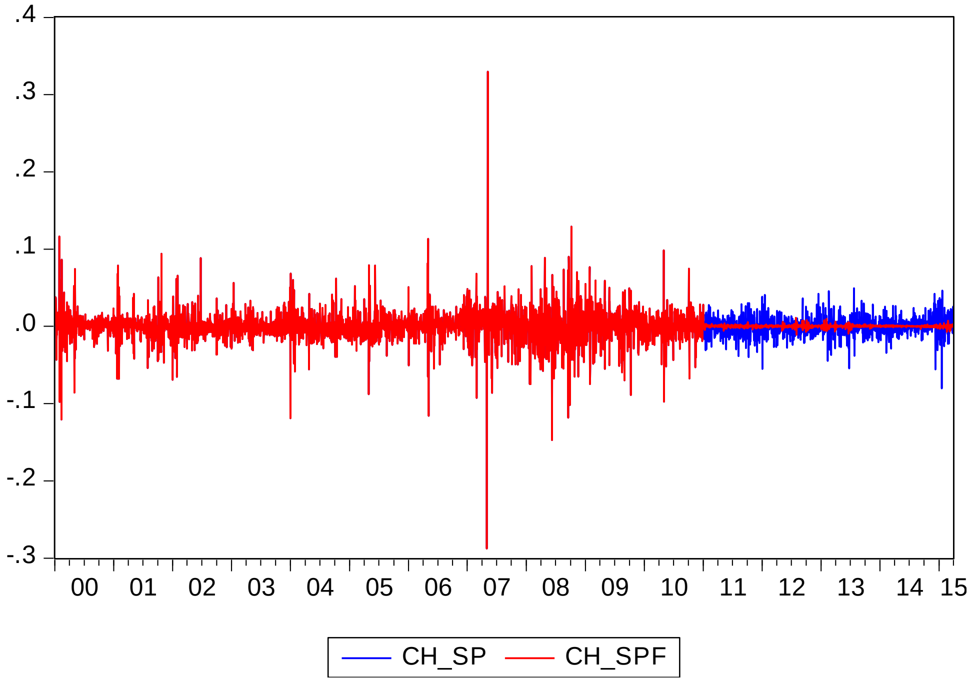


Figure 5.4: graph of the Forecasted and Actual Dependent Variable (The Closing Price of the Shanghai Stock Exchange Composite Index

5.7.2 The VAR Forecast for the European Union Model

As the researcher previously pointed out in chapter four, there is a negative long relationship running from the Euro Exchange Rate to the closing price of the FTSE Eurotop 100 Index during the period started from January 3, 2000 to December 31, 2010 and included 4,744 observations after adjustments. Furthermore, the results of this study with respect to the European Union support the Flow-Oriented Theory, suggesting that the changes in exchange rates lead to changes in stock prices. These results were obtained from the results of the Block Exogeneity Wald test under the Vector Error Correction Model. In the same way, the researcher will employ the VECM Forecast under the VECM, because there is a long-run relationship between the closing price of the FTSE Eurotop 100 Index (EURO_SP) and the Euro Exchange Rate (EURO_ER). She uses the VECM equation of the dependent variable (EURO_SP C EURO_SP(-1) EURO_SP(-2) EURO_SP(-3) EURO_SP(-4) EURO_SP(-5) EURO_SP(-6) EURO_SP(-7) EURO_ER(-1) EURO_ER(-2) EURO_ER(-3) EURO_ER(-4) EURO_ER(-5) EURO_ER(-6) EURO_ER(-7), using lag seven according to the results of optimal lag lengths to test the forecasting accuracy of the European Union model (see appendices 9 (B)). The forecast model is applied to the dependent variable (the closing price of the FTSE Eurotop 100 Index) as illustrated in Figure 5.5, using the out-of-sample data starting from January 3, 2011 to March 31, 2015, which includes 2212 observations after adjustments as shown in Figure 5.5.

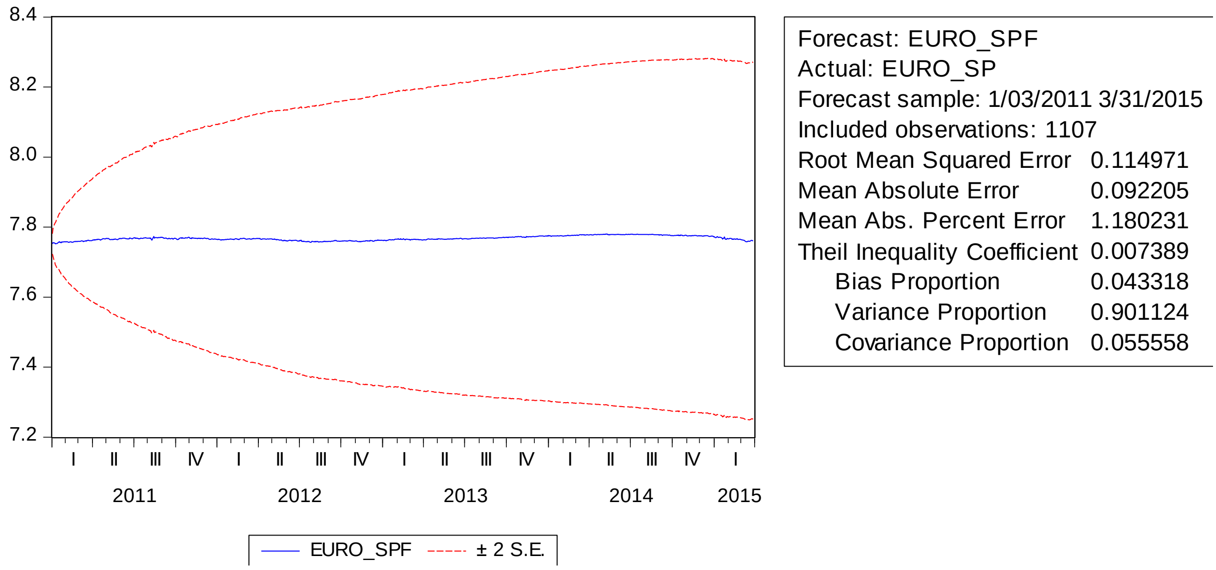


Figure 5.5: Estimation VECM Forecasting Accuracy of the European Union Model (Dynamic Forecasting)

From Figure 5.5, the researcher can conclude that the European Union model has forecasting ability, but is not particularly strong during the out-of-sample time series data, because the Root Mean Square equals 0.114971, which is less than one but is not very close to zero. In the European Union model, the researcher can determine graphically and computationally the gap between the forecasted dependent variable (EURO_SPF) and the actual dependent variable (EURO_SP), because she used non-stationary time series data $I \sim (0)$,when estimating the VECM Forecast rather than using stationary time series data $I \sim (0)$, as in the VAR Forecast. From Figure 5.6, it can be observed that the gap between the forecasting (EURO_SPF) and the actual (EURO_SP) are not very small, which means that the ability of the VECM Forecast of the European Union model not a strong also it is unsatisfactory enough. This result confirms mathematically calculation that the gap between the equal value of the FTSE Eurotop 100 Index closing price and the forecast value of the FTSE Eurotop 100 Index closing price equals to 105.7531. Therefore, the current study accepts the following hypothesis:

H10: The FTSE Eurotop 100 Index and the Euro Exchange Rate have good predictive ability for the future in the European Union

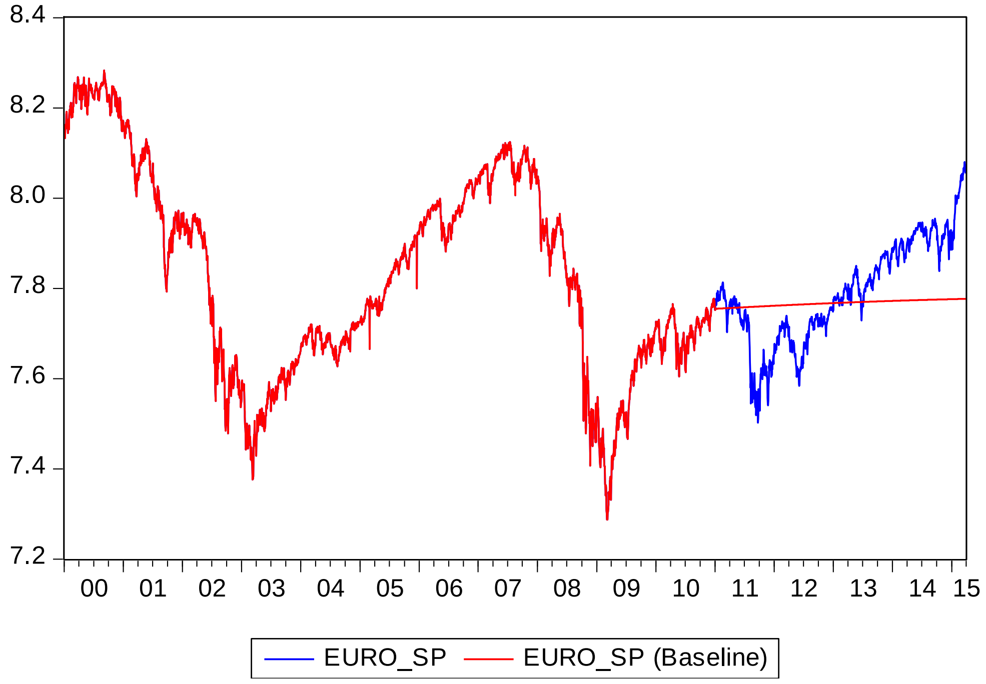
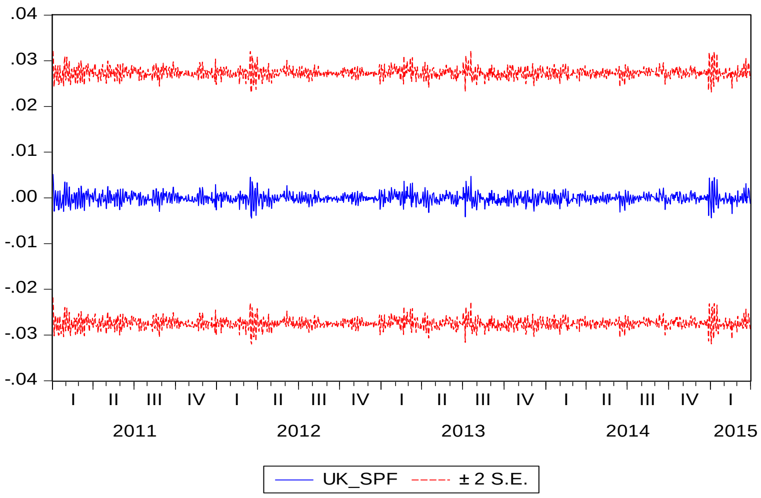


Figure 5.6: Graph of the Forecasted and Actual Dependent Variable (the price of the FTSE 100 Index)

5.7.3 The VAR Forecast of the United Kingdom Model

The results of the previous chapter refer to the existence of the bi-directional Granger-causality relationship between the closing price of the FTSE 100 Index and the UK Exchange Rate during the in-sample time series data from January 3, 2000 to December 31, 2010, which included 4744 observations after adjustments. This result supports the arguments of both the Share-Oriented and the Flow-Oriented Theories and is based on the results of the Block Exogeneity Wald test under the Vector Auto Regression model (VAR). In the same way, employing the VAR Forecast will be under the Vector Auto Regression model (VAR), because of the existence of a short-run relationship between the closing price of the Dow Jones Industrial Average Index and the UK Exchange Rate. Likewise, the researcher will be using the VAR equation to the dependent variable (UK_SP C UK_SP(-1) UK_SP(-2) UK_SP(-3) UK_SP(-4) UK_SP(-5) UK_SP(-6) UK_SP(-7) UK_SP(-8) UK_SP(-9) UK_SP(-10) UK_SP(-11) UK_SP(-12) UK_ER(-1) UK_ER(-2) UK_ER(-3) UK_ER(-4) UK_ER(-5) UK_ER(-6) UK_ER(-7) UK_ER(-8) UK_ER(-9) UK_ER(-10) UK_ER(-11) UK_ER(-12)) to test the forecasting accuracy of the United Kingdom model using lag twelve, according to Optimal Lag Lengths test (see appendices 9 (C)). The forecast model is applied to the dependent variable (the closing price of the Dow Jones Industrial Average Index), using the out-of-sample data from January 3, 2011 to March 31, 2015 which includes 2212 observations after adjustments, as demonstrated in figure (5.7).



Forecast: UK_SPF	
Actual: UK_SP	
Forecast sample: 1/03/2011 3/31/2015	
Included observations: 1107	
Root Mean Squared Error	0.010299
Mean Absolute Error	0.007304
Mean Abs. Percent Error	193.0326
Theil Inequality Coefficient	0.904006
Bias Proportion	0.000335
Variance Proportion	0.769111
Covariance Proportion	0.230554

Figure 5.7: Estimation of VAR Forecasting Accuracy for the United Kingdom Model (Dynamic Forecasting)

In the same way, the researcher relies on the Root Mean Squared Error to determine if the forecasting is good or not. Figure 5.7 demonstrates that the value of Root Mean Squared Error is less than one (0.010299) and very close to zero. This means that the actual value of UK_SP and the forecast value of UK_SPF are moving closely to each other and that the predictive power of the United Kingdom model and exchange rate are good or satisfactory. This result is confirmed when the researcher calculates the difference (determining it as 0.160755) between the actual value of the FTSE 100 Index closing price (UK_SP) and the forecast value of the FTSE100 Index closing price (UK_SPF). On the other hand, the researcher cannot graphically determine the gap between the actual dependent variable (UK_SP) and the forecasted dependent variable (UK_SPF), given a large number of observations which were used when estimating the forecast for the closing price of the FTSE 100 Index as shown in Figure 5.8. Through the results which have been mentioned above, it can be said that the current study accepted the research hypotheses;

H11: The FTSE100 Index and the UK Exchange Rate have good predictive ability for the future

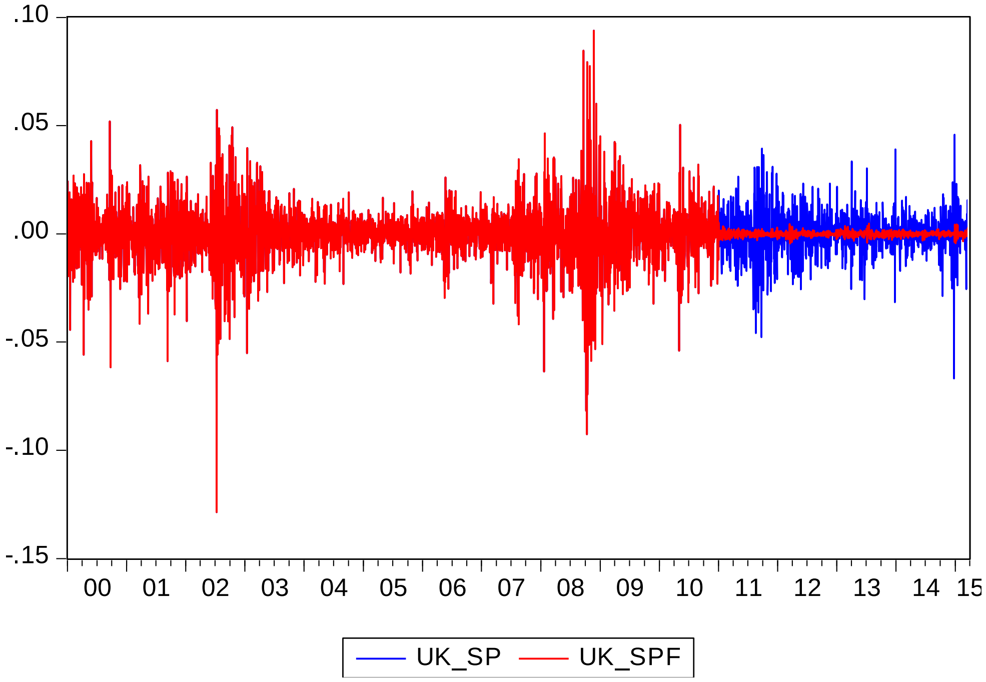


Figure 5.8: Graph of the Forecasted and the Actual Dependent Variable (closing price of the FTSE 100 Index)

5.7.4 The VAR Forecast for the United States Model

The results of the previous chapter indicate that there is short-run Granger-causality relationship running from the closing price of the Dow Jones Industrial Average Index to the US Exchange Rate during the in-sample time series data from January 3, 2000 to December 31, 2010 and included 4744 observations after adjustments. These results correspond to the arguments of the Share-Oriented Theory and are based on the results of the Block Exogeneity Wald test under the Vector Auto Regression model (VAR). In the same way, employing the VAR Forecast will be under the Vector Auto Regression model (VAR) using the lag three and the VAR equation to the dependent variable (US_SP C US_SP(-1) US_SP(-2) US_SP (-3) US_ER(-1) US_ER(-2) US_ER(-3)) (see appendices 9 (D)). The forecast model is applied to the dependent variable (the closing price of the Dow Jones Industrial Average Index closing price) using the out-of- sample data starting from January 3, 2011to March 31, 2015, which includes 2212 observations after adjustments as shown in Figure 5.9

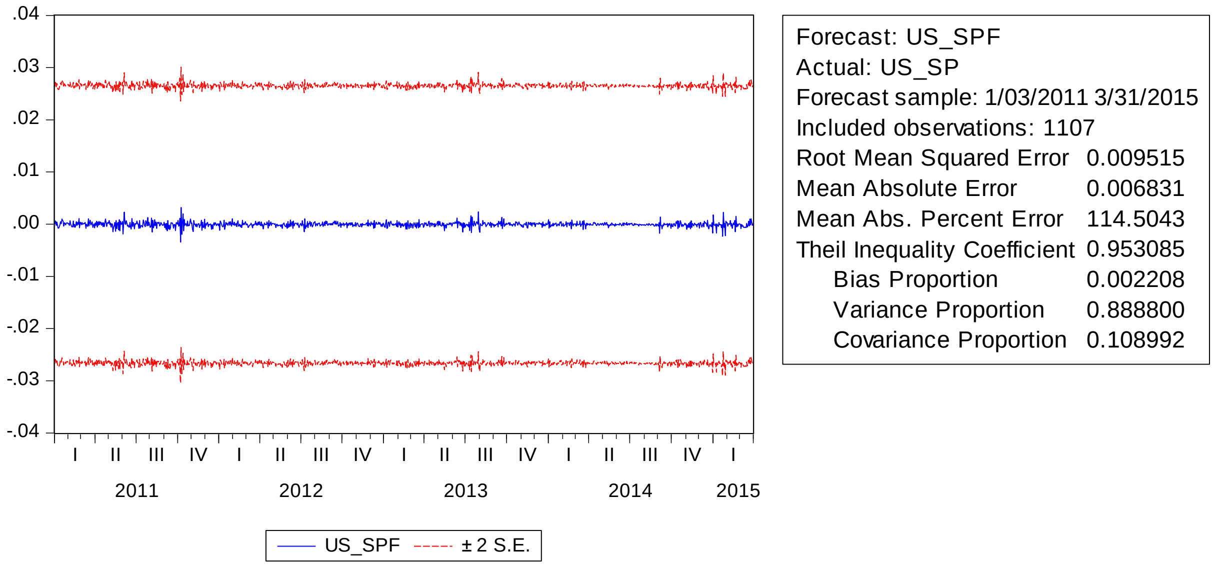


Figure 5.9: Estimation of VAR Forecasting Accuracy for the United States Model (Dynamic Forecasting)

Figure 5.9 demonstrates the suitability of the United States model for application to the forecast. The smallest value of the Root Mean Squared Error means the best forecast, and that has been achieved with the United States model, where this equals 0.009515. This means that the actual dependent variable (US_SP) and the forecast dependent variable (US_SPF) are moving closely to each other and that the predictive power of the United States model is a good or satisfactory. The researcher can determine the value of the forecast by the Root Mean Squared Error, but she failed to graphically identify the gap between the actual dependent variable (US_SP) and the forecasted dependent variable (US_SPF), because, as mentioned earlier, this study uses a large number of the observations as shown in figure (5.10). However, the gap can be mathematically determined by finding the difference between the actual value of the depended variable (US_SP) and the forecast value of the dependent variable (US_SPF). If the results are very small and less than zero, then it is good. The gap between the actual value of the closing price for the Dow Jones Industrial Average Index (US_SP) and the forecast value of the closing price for the Dow Jones Industrial Average Index (US_SPF) equals 0.027101382. This result confirms the Root Mean Squared Error result. Therefore, the current study accepts the following hypothesis.

H12: The Dow Jones Industrial Average Index closing price and the US Exchange Rate have good predictive ability for the future

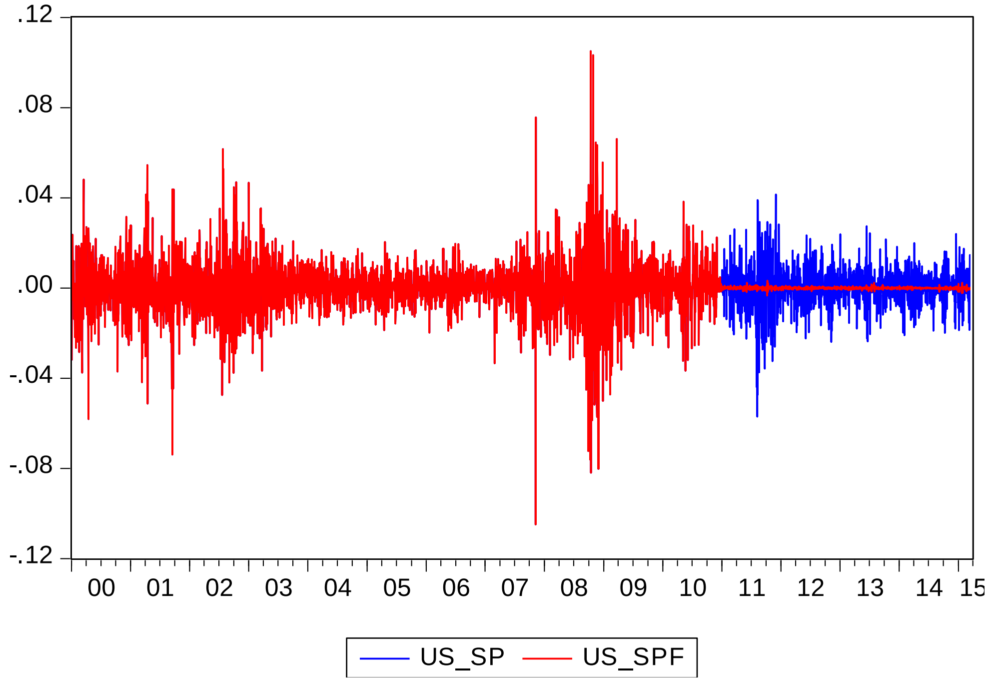


Figure 5.10: Graph of the Forecasted and the Actual Dependent Variable (closing price of the Dow Jones industrial average index)

5.8 A discussion of the forecasting findings of the sample countries

The conclusion that can be drawn from the VAR Forecast and VECM Forecast is that the researcher succeeded in applying the VAR Forecast of China, the United States and the United Kingdom models and employed the VECM Forecast of the European Union model. The result was that the ability to forecast estimated regression models was seen as very satisfactory for all models according to the Root Mean Squared Error, except in the case of the European Union model. The latter had a weak forecasting ability with respect to the Root Mean Squared Error, which, though less than one, was still not negligible when compared to the values of this in the calculations related to the other countries in the study. Although the researcher found good results for China, the United States, and the United Kingdom models, she could not graphically identify the gap between the actual stock prices and forecast stock prices for all countries for which estimations were done. However, there was an exception; the European Union model, due to the fact that the number of observations was very high. Meanwhile, the researcher could mathematically determine the gap by finding the difference between the actual dependent variable (SP) and the forecasted dependent variable (SPF); whenever this value is very small (less than one and close to zero) is when the prediction is considered good. Based on the foregoing, the researcher could answer the second question of the current study, which is: do the data of the stock prices and exchange rates in China, the European Union, the United Kingdom and the United States have a good predictive ability for the future?

The researcher answers the above question as follows:

- The Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate have a good predictive ability for the future because the Root Mean Square is less than one and it is very close of the zero.

- The FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate have predictive ability for the future but not strong, because the Root Mean Square is less than one but it is not very close of the zero.

- The FTSE 100 Index closing price and the UK Exchange have a good predictive ability for the future because the Root Mean Square is less than one and it is very close of the zero.

- The Dow Jones Industrial Average Index closing price and the US Exchange Rate have a good predictive ability for the future because the Root Mean Square is less than one and it is very close of the zero

Table 5-7 summarises the main finding of forecasting analysis linking with the third research objective and hypotheses H_9,H_{10}, H_{11} *and* H_{12} of the current study

Table 5.7: Summarizes the main results of forecasting chapter linking with the third objective and the hypotheses for each country

Research Objectives	Research Questions	Research Hypotheses	Finding
To examine whether or not the data of the stock prices and exchange rate in the above-mentioned countries have good predictive ability for the future	a. Do the data of the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate have good predictive ability for the future?	H_9:The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate have good predictive ability for the future	The Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate have a good predictive ability for the future because the Root Mean Square is less than one and it is very close of the zero.
	b. Do the data of the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate have good predictive ability for the future?	H_{10}:The FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate have good predictive ability for the future	The FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate have predictive ability for the future but not a strong because the Root Mean Square is less than one but it is not very close of the zero.
	c. Do the data of the FTSE 100 Index closing price and the UK Exchange Rate have good predictive ability for the future?	H_{11}:The FTSE 100 Index closing price and the UK Exchange Rate have good predictive ability for the future	The FTSE 100 Index closing price and the UK Exchange have a good predictive ability for the future because the Root Mean Square is less than one and it is very close of the zero .
	d. Do the data of the Dow Jones Industrial Average Index closing price and the US Exchange Rate have good predictive ability for the future?	H_{12}: The Dow Jones Industrial Average Index closing price and the US Exchange Rate have good predictive ability for the future	The Dow Jones Industrial Average Index closing price and the US Exchange Rate have a good predictive ability for the future because the Root Mean Square is less than one and it is very close of the zero

5.9 Summary

This chapter began by discussing the theoretical issues around the calculations and tests that follow, giving a general idea of forecasting in econometrics and the types of forecasting and the indicators that determine the ability of a model to forecast. Then, the researcher moved to the econometric analysis of the extended time series data, which included the out-of- sample time series data from January 3, 2011 until March 31, 2015 with 8848 observations after adjustments. The researcher started the analysis with descriptive statistics of stock prices and exchange rates growth. Then the researcher applied the unit root tests to see whether the out-of-sample time series data are stationary or not. The researcher applied the Augmented Dickey-Fuller and Phillips-Perron Statistic unit root tests, which concluded that all stock prices and exchange rates of the time series data are stationary at the first difference series, which means that the variables are integrated of one $I(1)$. The researcher relied on the results of the VAR model in chapter four for China, the United Kingdom and the United States when applied to the VAR Forecasting, because there was a short-run relationship between closing stock prices and exchange rates in these countries.

Furthermore, the researcher depended on the results of the (VECM) Model in chapter four for the European Union model when applied the VECM Forecasting, because there is a long-run relationship between stock price and exchange rate. Based on that, the researcher used the stationary time series data *I* when estimating the VAR model of stock prices and exchange rates for China, the United Kingdom and the United States, while the researcher used the non-stationary time series data *I* when estimating the VECM for stock price and exchange rate for the European Union. The researcher succeeded in applying the VAR Forecast of China, the United States, and the United Kingdom models and employed the VECM Forecast of the European Union model. The researcher found good results for China, the United States, and the United Kingdom models, while this result applies to the European Union, with some reservations.

Chapter 6: Discussion of the Results

6.1 Introduction

This chapter discusses the key results of this research. The topics that have been identified by the analysis of the data in the previous chapters are discussed in relation to the objectives of the study and the available literature in this area. Specifically, it was undertaken to achieve the overall research aim, which is to examine the dynamic relationship between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States. In order to achieve this overall research aim, the following three objectives have been formulated:

1. *To detect short and long–run relationships between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States.*

2. *To find out the direction of the relationship between stock prices and exchange rates and which of them affects the other or whether both affect each other in the aforementioned countries.*

3. *To examine whether the data of the stock prices and exchange rate in the aforementioned countries have good predictive ability for the future*

Accordingly, this chapter is divided into three main sections based on the three previous objectives and results achieved in this study. The first section aims to study the relationship between closing stock prices and exchange rates in the long-run in China, the United Kingdom, the European Union and the United States, based on the results of the Engle–Granger (1981,1987), and the Johansen (1988, 1991) cointegration tests. In the second section, the researcher explores the direction of the relationship between closing stock price and exchange rate in the short and a long–run in the countries under study, based on the results of the Granger causality tests. The last section tackles the results of the forecast tests of stock prices and exchange rate in the short and long run of the sample countries.

To achieve the three previous objectives, the researcher was required to divide the time series data into two parts. The first one is the in-sample time series data set covered the period January 3, 2000 to December 31, 2010 and included 22968 observations after adjustments, which were used to achieve the first and second objectives that were achieved in chapter 4. The second part is out-of-sample time series data, which extended from January 3, 2011 to March 31, 2015 and incorporated 7288 observations after adjustments that were used to achieve the third objective that achieved in chapter 5.

6.2 Long Relationships between Stock Prices and Exchange Rates in the Sample Countries

This section detects whether the current study achieved the first objective of the study which, is to detect short and long–run relationships between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States by investigating the following research hypotheses.

H_1: There is no significant long-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate in China.

H_2: There is no significant long-run relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate of the European Union

H_3:There is no significant long-run relationship between the FTSE 100 Index closing price and the UK Exchange Rate of the United Kingdom

H_4:There is no significant long-run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate the United States

All previous hypotheses refer to the fact that closing stock prices and the exchange rates are integrating of the same order (both variables move together or not in the long-run). To achieve the first objective and test research hypotheses H_1, H_2, H_3, H_4, the study carried out classical approaches to test the existence of a cointegrating relationship between the stock prices and exchange rates for all the countries in the sample of this study. The first one is the Engle and Granger (1987) two-step test, and the second one is the Johansen's cointegration test (Johansen, 1988; Johansen and Juselius, 1990). To employ these cointegration tests, the researcher used the in-sample time series data which started from January 3, 2000 to December 31, 2010 and including 22976 observations after adjustments. The starting point of the discussion is to detect both short and long relationships between closing stock price and exchange rate is China.

6.2.1 Short-Run Relationship for China

Exploring the Engel-Granger and the Johansen's cointegration test of the sample, evidence from the data suggests that the closing price of the Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate were not related, therefore, this study cannot reject the null hypothesis of cointegration is there are no cointegrating relationships between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate. In addition, the Chinese Exchange Rate movements as an independent variable are not significant to explain the movements of the Shanghai Stock Exchange Composite Index closing price as a dependent variable over the long-run in China. On the contrary, the current study can reject the alternative hypothesis of cointegration is there are cointegrating relationships between the closing price of the Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate, also the Chinese Exchange Rate movements are an independent variable that is sufficiently significant to explain the movements that occur in the Shanghai Stock Exchange Composite Index closing price as a dependent variable over the long-run in China. Therefore, this study accepted the research hypotheses: *H_1: There is no significant long-run relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate in China.*

This result is consistent with the results of Zhao (2010) and Li and Huang (2008), who accept the hypothesis of no cointegration between stock prices and exchange rate in the long-run. Li and Huang (2008) detect that there is a relationship between the Shanghai Stock Exchange A-Share Stock Returns Index and the Chinese Exchange Rate in the short-run. This is what the current research showed, although, the current study used the Shanghai Stock Exchange Composite Index while their study used the Shanghai Stock Exchange A-share Stock Returns Index. Furthermore, the results of the current study confirm the results of Zhao (2010) regarding the existence of a relationship in the short-run, when he tested the relationship between the Chinese

Exchange Rate and Shanghai Composite Stock Index, although he used the real exchange rate, which includes inflation, but this study uses the nominal exchange rate and it does not include inflation.

On the other hand, the results of this study are not moving on the same wavelength with some of the previous studies, which cannot reject the null hypothesis of no cointegration between stock prices and exchange rates in the long–run (e.g. Rutledge et al. 2014; Nieh and Yau 2010). They find that there is a long-run relationship between the Shanghai A-share Index Returns and exchange rate, based on the results of cointegration tests, which differ from the results of the current study. This difference exists between a long-run or short-run relationship, which was due to two reasons. The first one is the difference in the period, and it is the impact of the financial market turmoil of the United States that was sparked by the sub-prime mortgage crisis during the economic crisis. The second reason is the difference in the method; they used Threshold cointegration and Momentum Threshold Error-correction (M-TECM) Model, which are different from what the current study employed. Although the current study used the same technique and included daily data, which Rutledge et al (2014)'s study included, however, their results were quite different. They find a long, unidirectional relationship running from exchange rate to the Shanghai A-share Index Returns, which is supported by the results of Nieh and Yau (2010)'s study. This could be due to the period of the current study, since that was the longest, and the most important reason that could be related to differences in the lag length, which is a necessary step in testing the cointegration.

6.2.2 Short-Run Relationship for the United Kingdom

The Engel-Granger and the Johansen's cointegration test showed that there is no long-run relationship between the price of the FTSE 100 Index and the UK Exchange Rate of the United Kingdom. Therefore, this study accepts the null hypothesis of cointegration, which is that there are no cointegrating relationships between the FTSE 100 Index closing price and the UK Exchange Rate. In addition, the UK Exchange Rate movements as an independent variable are not sufficiently significant to explain the movement of the FTSE 100 Index closing price as a dependent variable over the long-run. On the other hand, this study rejects the alternative hypothesis of cointegration, which is that there is a cointegrating relationship between the FTSE 100 Index closing price and the UK Exchange Rate also the UK Exchange Rate movement as an independent variable is significant to explain the movement of the FTSE 100 Index closing price as a dependent variable in the long-run. Consequently, the current study accepted the research hypotheses: *H_3: There is no significant long-run relationship between the FTSE 100 Index closing price and the UK Exchange Rate of the United Kingdom*.

The result of this study is consistent with the findings of Ma and Kao (1990, Ajayi et al. (1998), Nydahl and Friberg (1999), Nieh and Lee (2001), Stavarek (2005), Zhang et al. (2011), Caporale et al. (2013) as all of these studies showed that there is no long-run relationship between stock prices and exchange rates, which corresponds with the finding of this study through the research hypothesis, and the results regarding the United Kingdom. On the other hand, the current study differs from results obtained by Ajayi and Mougoue (1996). They found significant short and long-run relationships between stock price and the exchange rate. This result was potentially more accurate if they had used the Johansen's cointegration test (1988, 1991) in their analysis rather than the Engle and Granger (1987) test, because the Engle and Granger test have some weaknesses, which have already been mentioned in the methodology chapter (see table 2.1 in chapter two). In general, most of the previous studies that have examined the relationship between stock price and the exchange rate of the United Kingdom Stock Market showed that there is a relationship in the a short-run (see table 2.1 in chapter two).

6.2.3 Short-Run Relationship for the United States

Through employing both the Engel-Granger and the Johansen's cointegration test, this study concluded that a long-run relationship between the Dow Jones Industrial Average Index and the exchange rate of the United States does not exist. Therefore, the current research accepts the null hypothesis of cointegration: there are no cointegrating relationships between the Dow Jones Industrial Average Index closing price and the US Exchange Rate. Additionally, the US Exchange Rate movements as an independent variable are not sufficiently significant to explain the movement of the Dow Jones Industrial Average Index closing price as a dependent variable over the long term.

On the contrary, this study cannot accept the alternative hypothesis of cointegration; there are cointegrating relationships between the price of the Dow Jones Industrial Average Index closing price and the US Exchange Rate also the US Exchange Rate movements as an independent variable is significant to explain the movement of the Dow Jones Industrial Average Index closing price as a dependent variable over the long run. Accordingly, the current study accepted the research hypotheses*; H_4: There is no significant long-run relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate in the United States.*

According to some studies discussed in chapter two that studied this relationship in the United States Stock Market and showed agreement with the results obtained by this study, there is a relationship in the short-run (e.g., Soenen and Hennigar 1988; Bahmani-Oskooee and Sohrabian, 1992; Ajayi et al., 1998; Nydahl and Friberg, 1999; Nieh and Lee 2001; Stavarek, 2005; Caporale et al. 2013). On the other hand, other studies were inconsistent with the results of this study; similar to the results of Ajayi and Mougoue (1996), Kim (2003) Ratanapakorn, Sharma (2007) and Tsagkanos et al., (2013). Ajayi and Mougoue (1996) employed Engel-Granger cointegration test for testing the long-run relationship between stock prices and exchange rate, which suffers from some weaknesses as previously mentioned. To avoid these problems, the current research uses the Engel-Granger cointegration test and the Johansen (1988, 1991) cointegration tests, which are considered a more advanced econometric test than employing Engel-Granger cointegration test alone to detect the long-run relationship. Furthermore, my time-series estimations do not support the findings of the studies of Kim (2003) and Ratanapakorn and Sharma (2007). Both studies applied the Johansen's cointegration test, which the researcher used. Kim (2003) found that there is a negative long-run relationship between the prices of the Poor's Composite Index, the 500 Index and exchange rate during the period from January 1974 to December 1998. Furthermore, he reinforced his results by applying the Vector Error Correction (VECM) Model. In addition, Ratanapakorn and Sharma (2007) found a long-run relationship between stock prices and the exchange rate. This difference may possibly be due to the fact that Kim (2003) used monthly data and Ratanapakorn and Sharma (2007) used the quarterly data, while the present study used daily data, which enables the research to better capture the dynamics of the relationship between stock price and exchange rate. This finding is moving in the same wavelength with Tsagkanos et al. (2013), who reported that there is long-run relationship although their study focused on the recent financial crisis, and they used just five working years, which might not give accurate results.

Some studies have offered evidence of the existence of a relationship between stock prices and exchange rates in the short and long-run, such as Stavarek (2005) who reported that there is a significant correlation between stock prices and exchange rate, and both variables are affected by each other in the short and long-run concerning the United States. Moreover, he divided the period into two parts and he mentioned that the relationship was more powerful in the long-run, as well as the short-run during the period 1993-2003 then during 1970-1992, in which he used the monthly data.

6.2.4 Long-Run Relationship for the European Union

The current study demonstrates that the Johansen's cointegration test result differs from the Engel-Granger cointegration test results in respect to the European Union. The Engel-Granger cointegration test does not find any long relationships between the price of the FTSE Eurotop 100 Index and the Euro Exchange Rate. On the contrary, the Johansen's test found a long-run relationship between the price of the FTSE Eurotop 100 Index and the Euro Exchange Rate. The trace test indicates one cointegrating Eqn (s) at the 0.05 at level. This study adopted the results of the Johansen's cointegration test (Johansen, 1988; Johansen and Juselius, 1990), because the Engel-Granger cointegration test (1987) has some drawbacks, which were mentioned in the methodology chapter. Therefore, this study rejects the null hypothesis of cointegration ; there are no cointegrating relationships between the price of the FTSE Eurotop 100 Index and the Euro Exchange Rate also the Euro Exchange Rate movements as an independent variable is not sufficiently significant to explain the movement of the FTSE Eurotop 100 Index closing price as a dependent variable over the long term in the European Union. In contrast, this study accepts the alternative hypothesis of cointegration; there are cointegrating relationships between the price of the FTSE Eurotop 100 Index and the Euro Exchange Rate also the Euro Exchange Rate movements as an independent variable is sufficiently significant to explain the movement of the FTSE Eurotop 100 Index closing price as a dependent variable over the long term in the European Union. Therefore, this study rejects the research hypotheses H_2; there is no significant long-run relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate of the European Union.

Some other studies, such as (Murinde and Poshakwale, 2004; Morales, 2007; Kollias et al. (2010); Caporale et al. (2013) have shown different results from what this study has found. All of these results referred to the existence of a short-run relationship between stock prices and exchange. There are four possible primary reasons for these different results. Firstly, Murinde and Poshakwale (2004) used the Engle and Granger (1987) test only, which as noted earlier is not sufficient to detect the relationship between the variables in the long term. Secondly, Morales (2007) used daily time series data to capture the changes in stock prices, which is considered a good point, but his analysis period was somewhat short; it did not exceed seven years. Thirdly, Kollias et al. (2010) used two indexes; the FTSE Eurotop 300 and FTSE eTX All-Share Index Share Index while the current study uses just the FTSE Eurotop 100 Index, in addition to the different period of analysis. Finally, the fact that their results are different from Caporale et al. (2013) can be due to the difference in the data used in both studies.

Table (4-28) in chapter four exhibits the summary of the main results that are discussed in all sections 6.2 linking with the first and the second research objectives, questions and research hypotheses; H_1, H_2, H_3, H_4, H_5 H_6, H_7, H_8 for each country in the sample.

6.3 Direction of the Relationship between Stock prices and Exchange Rates

Usually, the Vector Auto Regression model (VAR) is applied when the variables are non- cointegration, whereas the Vector Error Correction (VECM) Model is used when the variables were cointegration. Therefore, the current study used the VAR model based on the fact that there are short-run Granger-causality relationships for China, the United Kingdom and the United States, using the Wald, the Block Exogeneity Wald and Pairwise Granger causality tests. The researcher used the VECM based on there being a long-run Granger-causality relationship for the European Union using the Wald and Pairwise Granger causality tests. The researcher employed all the previous tests to achieve the second research objective, which is - what is the direction of the relationship between stock prices and exchange rates in China, the United Kingdom and the United States?

Through testing the following hypothesis:

H_5: There is a significant causality relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate of China

H_6: There is a significant causality relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate of the European Union

H_7: There is a significant causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate in the United Kingdom

H_8: There is significant causality relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate the United States

The result of the VAR model displays that the Wald tests fail the explanation of the causal relationships between closing stock prices and exchange rates for China, the United Kingdom and the United States (see appendices 6 (A,B,C)). Therefore, the researcher employed the Block Exogeneity Wald test to detect the causal relationship between closing stock prices and exchange rates and confirms the results by used the Pairwise Granger causality test for the countries who have a short-run relationship between closing stock prices and the exchange rates.

6.3.1 Direction of the Relationship between the Shanghai Stock Exchange Composite Index Closing Price and the Chinese Exchange Rate

The Block Exogeneity Wald test under the Vector Auto Regression model (VAR) and the Pairwise Granger causality test indicated that there is no evidence to support the

Share-Oriented Theory in the short-run in the case of China. On the other hand, these tests show that there is a positive relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate, which means there is unidirectional causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price. Therefore, the current study accepts the hypothesis *H_5: There is a significant causality relationship between the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate of China*. Based on the above discussion, the findings of this study with regards to China supports the Flow-Oriented Theory. In general, this theory states that there is a positive relationship between stock prices and the exchange rate.

In particular, Flow-Oriented Theory reports that there is a positive correlation between the Shanghai Stock Exchange Composite Index closing price and the Chinese Exchange Rate and any increase in the Chinese Exchange Rate as independent variable leads to an increase in the price of the Shanghai Stock Exchange Composite Index as a dependent variable. In fact, this is true because the Chinese government is in full control of both stock markets, the Shanghai Stock Exchange and the Shenzhen Stock Exchange markets through the control of exchange rate. Consequently, the Chinese Government should be cautious in their implementation of Exchange Rate Policies for two reasons. Firstly, the authorities can affect stock markets in the short-run. Considering that the exchange rate is no longer fixed, the government can consider that the impact of exchange rate changes does not limit only to trade flows but also impacts financial markets.

The second one is the Chinese government has completely controlled both stock markets of the Shanghai Stock Exchange and the Shenzhen Stock Exchange markets. Therefore, the Chinese government can apply the exchange rate policies for stock markets, especially since the majority companies which the Shanghai Stock Exchange Composite Index included were large, state-owned business. Based on what is explained above, we can say that the current research accepts the research hypotheses H_5; there is a significant causality relationship between the Shanghai Stock Exchange Composite Index closing price and the exchange rate of China.

The results of this study are moving in accord with some previous studies, which support the Flow-Oriented Theory whether in the long, or short-run such as Huang, (2008), Rutledge et al. (2014), Nieh and Yau, (2010). Li and Huang (2008) explore the positive relationship between the Shanghai Stock Exchange A-share stock returns index and the Chinese Exchange Rate in the short-run. Their study and the current study support the Flow-Oriented Theory, although the current study used the Shanghai Stock Exchange Composite Index, while their study used the Shanghai Stock Exchange A-share Stock Returns Index. Furthermore, the current research included the period before and after China revalues the renminbi and officially modified the exchange rate regime in 2005, while their study was limited to the period during and after the modified exchange rate regime. Similar results were explored by Rutledge et al. (2014) and Nieh and Yau (2010), when they examined the relationship between the Shanghai Stock Exchange A-share Stock Returns Index and the Chinese Exchange Rate. Regardless, both studies used daily time series data ranging from 2001 -2011 (see table 2.1 in chapter two), which is considered the unstable period. This is because it includes the period of the financial market turmoil of the United States sparked by the sub-prime mortgage crisis, during the economic crisis when they estimated this relationship.

Some researchers have shown completely different findings of the results of the current study, in which the relationship between the stock price and the exchange rate is spillovers relationship. For example, Zhao (2010) found a bi-directional causality relationship volatility spillovers effect between the real exchange rate and the Shanghai Composite Stock Price Index in the short-run, which supported both the Share-Oriented and the Flow-Oriented Theories. That means there is a spillover relationship, which was sometimes positive in others negative between Shanghai Composite Stock Price Index and the Chinese Exchange Rate in the short run. Although he used the same index that was used in the current study (Shanghai Composite Stock Price Index), the different results were expected, because he used the real exchange rate, that means his study includes the impact of inflation on the exchange rate, which is different from what the researcher used while the current study used the nominal exchange rate that does not include inflation rate. Furthermore, he used the Vector Auto Regression and multivariate generalized the Autoregression conditional heteroskedasticity (GARCH) models, which is different from what the researcher used in the current study.

6.3.2 Direction of the Relationship among the FTSE 100 Index Closing Prices and the UK Exchange Rate

The most interesting finding is that the current study rejects most of the previous studies that demonstrate that there is only a unidirectional relationship running from stock price to exchange rates or vice versa of the United Kingdom (see table 2.1 in chapter two). The results of this study display that the bi-directional causality has been found in the case of the United Kingdom, which supports the arguments of both the Share-Oriented and the Flow-Oriented Theories. This means the FTSE 100 Index closing price lead to the UK Exchange Rate, according to the Share-Oriented Theory. On the other hand, the exchange rate leads to the FTSE 100 Index closing price according to the Flow-Oriented Theory. Based on the results previously mentioned which are obtained from the Block Exogeneity Wald test and the Pairwise Granger causality test, the current research rejects the null hypothesis of causality; there is no significant Granger-causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate. On the other hand, this thesis cannot reject the alternative hypothesis of causality; that there is a significant causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate. According to the results which have been mentioned directly above in relation to the United Kingdom it can say that the current study accepted the research hypotheses; *H_6: There is a significant causality relationship between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate of the European Union.*

The findings of the current study are similar to the result obtained by Ajayi and Mougoue (1996), when they examined the relationship between stock prices and exchange rates for the United Kingdom and other seven industrial countries. Both the current research and their study used daily data and almost applied the same analysis method, but they differed in the period and the economic situation of that period respectively. Their study was only for six years and the London Stock Exchange was in constant evolution during that period. On the other hand, the period of the current study started from January 3, 2000, to March 31, 2015, and included all the changes that have occurred in the London Stock Exchange, which will be explained later. Similar results were achieved by Chen and Chen (2012) for the United Kingdom when investigating the relationship between stock prices and exchange rates in twelve OECD (The Organization for Economic Cooperation and Development) countries. To determine the direction of the relationship, they used the Linear Granger causality test, whereas this research employs the Block Exogeneity Wald test and the Pairwise Granger causality tests. However, both studies obtain the same result. Also, the results confirm the finding of Inci and Lee (2014), where their finding displays that there is a bi-directional interaction between stock prices and exchange rate in the United Kingdom, although different methods used a regression model, whereas the current study uses the Vector Auto Regression method.

The results of the current study differ from the results of all the following studies, which are divided into two parts. The first one supports the Flow-Oriented Theory while the other parts support the Share-Oriented Theory. Ma and Kao (1990) and Zhang et al. (2011) were supportive of the Flow-Oriented Theory when they tested the relationship between stock prices and exchange rate in the United Kingdom. Ma and Kao (1990) examined the degree of stock price reaction to exchange rate changes in the United Kingdom and five industrialized economies using monthly data from January 1973 to December 1983. Their findings support the Flow-Oriented Theory, where they found the values of exporting firms' stock were sensitive to changes in foreign exchange rates. That means any change in the foreign exchange rate leads to a change in the stock prices, while the changes in the stock price do not affect the exchange rate, which was not consistent with the results of this study, considering that this study showed mutual effects between the stock price and exchange rate.

This difference in results is related to their use of monthly data, and their employment of the asset-pricing model, which has not been applied in this research. In addition, the current study uses the closing price of the FTSE 100 Index closing price, which was not established yet. "Where the FTSE 100 Index began on 3 January 1984 with a base level of 1000; the highest value reached to date is 6950.6 on 30 December 1999" (Pearce, 2012, p. 151). Also, the results of the current research are different from the findings of Zhang et al. (2011), who found a unidirectional causal relationship running from exchange rates to stock prices for the United Kingdom, when they studied the causal relationship between stock prices and exchange rates in this country and four other industrial countries. They used monthly data, while the researcher used daily data. This reason is sufficient to give alternative results in addition to using differences in period, index and the type of exchange rate.

Other researchers supported the Share-Oriented Theory when examining the relationship between stock prices and exchange in the UK, such as Ajayi and Mougoue,(1996), Nydahl and Friberg, (1999), Nieh and Lee,(2001), Stavarek, (2005), Caporale et al. (2013). Ajayi & Mougoue (1996) demonstrated that there is unidirectional causality relationship running from stock prices to exchange rate of the United Kingdom, while this study found the bi-directional relationship between stock prices and exchange rate although both their studies and the current study used daily time series data to detect the direction relationship by employing the Granger causality test. This difference in results is due to the sample period and the extent of its stability whereas their study extended from April 1985 to August 1991 and included the Big Bang on 27 October 1986 which was one of the most important developments in the history of the London Stock Exchange (Khurshed, 2011, pp. 19-21).

Furthermore, the findings of the current study are inconsistent with the results of Nydahl and Friberg (1999), who examined the valuation of the stock market and the effective nominal exchange rate in the United Kingdom, and another ten industrialized countries. They found a negative relationship from stock prices to exchange rates. Therefore, their results supported the Share-Oriented Theory, which states that changes in the stock price negatively affect the changes of the exchange rate. This difference in the results was expected, although their study and the current study used a nominal exchange rate when examining the relationship between stock prices and the exchange rate for the same country, but using a different index. In addition, they applied an Ordinary least Square (OLS) Regression Method while this study employed the Vector Auto Regression model (VAR). This implies that their time series data for the FTSE 100 Index closing price and the UK Exchange Rate stationary is at a level $I \sim(0)$, while the time series for stock prices and exchange rate are stationary at the first different $I \sim(1)$. Another study that confirmed the existence of the unidirectional causality relationship running from stock prices to exchange rate of the United Kingdom was conducted by Nieh and Lee (2001). They used daily data and different models, which are used in the current study, while the results of this study are not consistent with their study, because they used just three years starting from October 1, 1993 to February 15, 1996, which is a somewhat short period for testing the relationship between the exchange rate and stock price. On the other hand, that period was a good period of the London Stock Market, because it underwent a big development that time, which is called (BB)1.

Stavarek (2005a) also obtained different results from the finding of this study by employing monthly data and dividing the period into two parts: the first period was from 1970-1992, while the second one was from 1993-2003. He found evidence of both short and long-run Granger-causality relationship running from stock prices to exchange rates, but their empirical results indicated that the unidirectional causality relationship that runs from stock prices to exchange rates were more powerful long-run as well as short-run relations during the period 1993-2003 than during 1970-1992. Although the study used a good period of ten years to analysis the relationship between the variables, however, it used monthly time series data, which cannot capture the changes in stock prices. The results of Stavarek (2005b) were expected to be different from the results of this research because Stavarek (2005) used ten years to examine the relationship between variables, which was the best period of the London Stock Market. That ten years included the Big Bang (BB), which was one of the most important developments of the London Stock Exchange that have already been noted previously and in October 1997, the exchange rate presented the (SETS) its Electronic Order Book (Khurshed, 2011, p. 19). This new trading system depends on a computerized price display called by SEAQ (Stock Exchange Automated Quotation system). Through the SEAQ system, traders could see buying and selling prices on screens of computers and finalize deals by telephone (Khurshed, 2011, pp. 19-21). In 2000, The London Stock Exchange became demutualized, and in 2001 listed on its own main market in order to achieve more commercialization. In 2003, the London

[1] . The (BB) was a package of reforms that transformed the exchange and the City. Liberalising the way in which stock broking companies operated and banks and fetching in investment. "The exchange ceased granting voting rights to individual members and became a private company. The Big Bang also saw the start of moves towards fully electronic trading and the closure of the trading floor." (Whitaker's, 2012, p. 549).

stock exchange created the European Derivatives Exchange, which are known as the EDX London, to recognise investment exchange for international equity derivatives (Whitaker's, 2011, p. 549).

Caporale et al. (2013) found the unidirectional relationship running from the stock price to exchange rate changes in the United Kingdom. These results are different from the results of this study, because they used weekly data and applied a Bivariate GARCH-BEKK test, which is not used in the current study. In addition to that, they chose the banking crisis period from 2007 to 2010 to examine the relationship between stock prices and exchange rates. This period contained many changes in the London Stock Exchange. In 2007, the London Stock Exchange purchased the Borsa Italiana and in 2009 the (LSE) Group purchased Sri Lankan technology firm Millennium IT that supplies technology to stock exchanges, brokerages also regulators around the world. Furthermore, in 2010, the London Stock Exchange Market Group acquired a majority of the Turquoise stake, a platform facilitating the trading of stocks listed in 18 European countries and the United States (Publishing, 2014). All of these changes affected different indices and affected the exchange rate.

6.3.3 Direction of the Relationship between the Dow Jones Industrial Average Index and the US Exchange Rate

The Block Exogeneity Wald and the Pairwise Granger causality tests reported that there is no evidence to support the Flow-Oriented Theory in the short-run in the case of the United States. In contrast, both tests showed that there is a negative relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate, which means there is a unidirectional causality relationship running from the closing price of the Dow Jones Industrial Average Index to the US Exchange Rate. Therefore, this study cannot accept the null hypothesis of causality: there is no significant causality relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate. In contrast, this study accepts the alternative hypothesis of causality: there is a significant causality relationship between the closing price of the Dow Jones Industrial Average Index and the US Exchange Rate.

Based on the above results, the findings of this study with regards to the United States support the Share-Oriented Theory. In general, this theory states that there is a negative relationship between stock price and the exchange rate. In particular, there is a negative correlation between the Dow Jones Industrial Average Index closing price and the US Exchange Rate. That means any increase in the US Exchange Rate as an Independent variable leads to a decrease in the price of the Dow Jones Industrial Average Index. Therefore the current study accepts the hypothesis, *H_7: There is a significant causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate in the United Kingdom*

The result of this study support the findings of Soenen and Hennigar (1988) Nydahl and Friberg (1999), Caporale et al. (2013), Stavarek (2005), Tsagkanos et al. (2013) regarding the United States. Although, Soenen and Hennigar (1988) and Nydahl and Friberg (1999) employed the Ordinary Least Square Method, which is completely different from what the current research uses, while their study obtained the same result: there is a negative correlation between stock prices and exchange rate which support Share-Oriented Theory. Both studies used the Ordinary Least Square Method, which means their data of stock prices and exchange rates was stationary at a level series; both variables are integrated of order zero $I\sim(0)$ while the current study used data of the Dow Jones Industrial Average Index closing price and the US Exchange Rate at first difference series $I\sim(1)$. This is a fundamental difference between the current study and their study, in addition to the difference in the indexes and the periods used in each study.

A similar result was found by Stavarek (2005), who reports that there is a unidirectional Granger-causality relationship running from stock prices to the exchange of the United States Stock market. This study differed from the current research by using monthly data, rather daily data and the different period, which differs from what the researcher used. On the other hand, his study was consistent with the present study regarding the type of analysis method. Caporale et al. (2013) chose the banking crisis period, which is not a stable period for studying the relationship between stock prices and the exchange rate. In that time the United States Stock Market suffered from instability, because of “a global sell-off after the Chinese stocks experienced a mini-crash on February 27, 2007 and financial crisis in 2008 and the United States Housing Bubble and the Global Financial Crisis of 2008–2009" (Kozmetsky & Yue, 2005, p. 464). The period of their study started from 2007 to 2010 and therefore it included all previous events. Their study reached the same findings of the current research, although, this study used daily data rather than weekly data. In addition, this study includes more observations for a longer period, which started from January 3, 2000 to March 31, 2015. Likewise, the results of the current study are consistent with the finding of Tsagkanos et al. (2013) despite the differences, which is referred to in the previous studies. They demonstrate that the movements that occurred in the stock price drive to the movements in the exchange rate of the United States Stock Market, which supports the Share- Oriented Theory. That means there is a negative relationship between stock price movements and exchange rate during the period of the recent financial crisis.

The Dow Jones Industrial Average Index closing price and the US Exchange Rate relationship in this thesis are consistent with all the following studies regarding the existence of a short-run relationship between stock prices and exchange rate, while they are inconsistent with the direction of this short-run relationship. For example, the results of the current research are completely inconsistent with the results of Aggarwal (1981) regarding the direction of United States' relationship. His study examined the relationship between stock prices and exchange rate in the United States Stock Market, during the period that did not exceed 1981. Moreover, his study did not use the method used by the researcher in this study, and also it concluded that the movements that happened in the exchange rate drive to the movements in the stock price, which supports the Flow-Oriented Theory. This difference between the present results and his result is to be expected, because of the differences in the period and the method used. The period of his study did not exceed 1988. In that time, the method, which the researcher used, has not been applied yet. In the 1990s, fast developments happened in econometrics, which became included in the unit root, the cointegration, and the Granger-causality tests. This gave motivation to researchers to produce more studies in this area using these models. Therefore, studies which investigate the relationship between two variables or more in this area follow another direction in research. It does not only look for a correlation between variables, it also looks for the direction of the relationship between the variables and this relationship is in the short or long run. Therefore, the results of those studies became more clear, accurate, and comprehensive than those studies which employ the Ordinary Least Squares Method. This does not mean that the Ordinary least Squares Method is not good, since it is still used in the present day with studies that use time series data which is stationary at level series $I \sim (0)$. Since the studies that examine the relationship between stock prices and exchange rate used time series data which often are stationary at first difference series, all the variables are integrated of order one $I{\sim}(1)$ so employing the unit root, the cointegration and the Granger causality tests are suitable to this type of study. Some researchers demonstrated different results than those of the current study, because they sought to combine two or more of the variables to examine this relationship, such as Kim (2003). His studies reported a negative relationship between the price of the Poor's Composite Index of 500 Index and the U.S value for the period from January 1974 to December 1988, when he examined the relationship between stock prices and a set of variables, including exchange rate in the United States.

Other researchers differ from the researcher through supporting both the Share-Oriented and the Flow-Oriented Theories when examining the relationship between stock prices and exchange in the United Stated Stock Market (e.g., Ajayi and Mougoue, 1996; Bahmani-Oskooee and Sohrabian 1992; Ratanapakorn and Sharma 2007). Ajayi and Mougoue (1996) demonstrate that the interaction between exchange rates and stock prices was bi-directional for the United States Stock Market in the short-run. This conclusion is based on the results from the Granger-causality test for daily data of closing stock prices and exchange rates from April 1985 to July 1991. As the researcher noted earlier, the current study and their study used daily data and nearly the same analysis method, but differed in the period and the economic situation of that period. This could be the cause of the difference in results. Bahmani-Oskooee and Sohrabian (1992) obtained similar results. Their study is considered one of the most important studies in this area. It was the first study that employed the cointegration method to test the correlation between the Poor's Composite Index of 500 stocks and the US Exchange Rate from July 1973 to December 1988. The previous results were reinforced by Ratanapakorn and Sharma (2007), who supported the flow- Oriented Theory. They examined the short-run and long-run relationship between the Poor's Composite Index of 500 stocks and exchange rate and other macroeconomic variables. They used the quarterly data for their analysis. Their findings reported that the US Exchange Rate caused the Poor's Composite Index of 500 Index during the period from 1975 to 1999. This research differs both previous studies, since it uses daily data for the Dow Jones Industrial Average Index closing price, rather than monthly or quarterly data, for the Poor's Composite Index of 500 stocks and, of course, the different period and the extent of stability.

Some studies differed in principle from the results of this study with respect to the United States. They found no evidence for either the Flow-Oriented or the Stock-Oriented Theories, indicating stock prices and exchange rates. One such study is that of Nieh and Lee (2001), who found no significant correlation between the stock prices and exchange rate. Their studies proved that two financial variables related to the United States did not have any effect on each other. The results of the current research showed the opposite: it concluded that there is evidence of a relationship between the price of the Dow Jones Industrial Average Index and the US Exchange Rate. Their results were potentially more accurate if they used a period more than three years starting from October 1, 1993, to February 15, 1996.

6.3.4 Direction of the Relationship between the FTSE Eurotop 100 Index and the Euro Exchange Rate

According to the Block Exogeneity Wald test under the Vector Error Correction (VEC) Model and Pairwise Granger causality test, there is evidence to support the Flow-Oriented Theory in the short-run in the case of the European Union. Overall, this theory states that there is a positive relationship between stock prices and the exchange rate. In particular, with regards to the European Union case, it states that there is a positive relationship between the FTSE Eurotop 100 Index closing price and the Euro Exchange Rate and any increase in the Euro Exchange Rate is an independent variable drive to a rise in the closing price of the FTSE Eurotop 100 Index. According to Granger term, this relationship means there is a unidirectional causality relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index. Based on the above results, this study accept hypothesis *H_8: There is* *significant causality relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate the United States*

Based on the above results the current study accepts hypothesis H8: There is significant causality relationship between the Dow Jones Industrial Average Index closing price and the US Exchange Rate the United States

The majority of research that studied the relationship between stock prices and exchange rate in the European Union countries included some countries from the European Union to study this relationship, using the stock price of the indexes of those countries, such as Murinde and Poshakwale (2004), Stavarek (2005), and Morales (2007). All these studies found the relationship between stock prices and exchange rate with various directions, but they cannot be compared with the results of this study, because they did not employ this relationship in the European Union Stock Market (see table 2.1 in chapter two). On the other hand, the current study used the FTSE Eurotop 100 Index closing price, which includes more than a hundred bigger companies of the European Union. This reason is enough to show different results between the current study and the previous ones, except a few studies that used the European Union Stock Market, but used different indexes, such as Kollias et al. (2010), Caporale et al. (2013), and Tsagkanos et al. (2013). The current research results are unconfirmed with the results of the Tsagkanos et al. (2013). They supported the Share-Oriented Theory, which posits that stock price movements lead to exchange rate movements in the European Union Stock Market. That means there is a negative relationship between stock prices and exchange rates during the period of the recent financial crisis from January 2, 2008 to April 30, 2012. On the contrary, the results of this study confirmed the results, which are obtained from the study of Kollias et al. (2010) although they used the different indexes of what the researcher used; they still examined this relationship in the European Union Stock Market. They used the price of the FTSE Eurotop 300 and FTSE eTX All-Share Index Share Index, while this research used the closing price of the FTSE Eurotop 100 Index to estimate the relationship between stock prices and exchange rate. There is possibly some similarity of results, because this study and their study used daily data for the application of the same method and the sample period of this study included the sample period of their study, where their study started from January 2, 2002 to December 31, 2008 while the time series of this study started from January 3, 2000 to March 31, 2015. Caporale et al. (2013) disagreed with the results of this study regarding the European Union, since they reported that there is a bi-directional causality relationship between stock prices and exchange rate in the euro area when they examined the nature of the relationship between stock prices and exchange rates in six developed countries. The results of the current study do not support these findings, because there is a difference in the quality of data used. This study uses daily data, rather than weekly data and it includes more observations for a longer period. Table (4-28) in chapter four displays the summary of the main results, which are discussed in all sections 6.2 linking with the second objective, question of this research and research hypotheses; H_5 H_6, H_7, H_8 for each country in the sample.

6.4 Employing the VAR Forecast and the VECM Forecast of the Dynamic Relationship between Stock Prices and Exchange Rates

This study attempted to apply the forecasting technique using the VAR Forecasts in the case there is a short-run relationship between stock prices and exchange rates and using the VEC Forecasts in case there is a long-run relationship between stock prices and exchange rates. Despite this, the researcher could not find a study employing the VAR Forecast and the VEC Forecasts to predict the dynamic relationship between stock prices and exchange rates. To the best of her knowledge and belief, such a study does not exist. On the other hand, the researcher found many studies have employed the forecast by the ARCH model to examine the volatility of the relationship between the return stock prices and exchange rates and other variables (e.g.Chong & Lin, 2015; Dimpfl & Jank, 2015; Franses & Van Dijk, 1996; McMillan, Speight, & Apgwilym, 2000; Saryal, 2007; Wang, Liu, & Dou, 2012). However, to the best knowledge of the researcher, there is none. Therefore, the researcher did not refer to the previous studies in the literature review chapter. Consequently, the researcher in this section can't link the forecasting findings of this study with relevant literature. As indicated at the beginning of this section, the researcher employed the VAR Forecasts and the VEC Forecasts to answer the third research question which is; do the data of stock prices and exchange rates in China, the European Union, the United Kingdom and the United States have a good predictive ability for the future?

To answer the previous question, the researcher used the out-of-sample to test the following research hypotheses;

H_9: The Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate have good predictive ability for the future in China

H_{10}: The FTSE Eurotop 100 Index and the Euro Exchange Rate have good predictive ability for the future in the European Union

H_{11}: The FTSE100 Index and the UK Exchange Rate have good predictive ability for the future in the United Kingdom.

H_{12}: The Dow Jones Industrial Average Index closing price and the US Exchange Rate have good predictive ability for the future in the United States

The researcher was able to estimate the VAR Forecast depending on the results of the Vector Error Correction for China, the United Kingdom and the United States models, because there was a short-run relationship. In addition, she was able to estimate the VECM Forecast of the European Union model depending on the results of the Vector Error Correction Model because there was long-run relationship between stock prices and the exchange rate. This is can be the best contribution of this research. The researcher used the stationary time series data $I\sim(1)$ when estimating the VAR model of the (a) closing price of the Shanghai Stock Exchange Composite Index and the Chinese Exchange Rate (b) the closing price of the FTSE 100 Index and the UK Exchange Rate (c) the closing price of the Dow Jones Industrial Average Index and the US Exchange Rate.

The researcher used the VAR model equation for China, the United Kingdom and the United States models with lag seven, twelve and three respectively to estimate the VAR Forecast using the out-of-sample time series data starting from January 3, 2011 to March 31, 2015, which included 8848 observations after adjustments for each country. Furthermore, she used the stationary time series data, all closing stock prices and exchange rates are integrated of order one $I\sim(1)$ when estimated the VAR model for above-mentioned countries. Additionally, the researcher used the non-stationary time series data $I\sim(0)$, when estimating the VECM for the FTSE Eurotop 100 Index and the Euro Exchange Rate for the European Union model with lag seven to estimate the VECM Forecast using the out-of-sample time series data including 2212 observations after adjustments.

The researcher succeeded to employ the VAR Forecast of dependent variables for China, the United States and the United Kingdom models and employed the VECM Forecast of the dependent variables for the European Union model. The current research was adopted on the Root Mean Squared Error to measure the performance of models in terms of its ability to forecast. According to the Root Mean Squared Error, all the countries in the sample of this study had satisfying forecasting ability to estimate out-regression models, except the European Union model. It had weak forecasting ability with consideration of the Root Mean Squared, which was less than one, yet it was great when compared with other countries in the study, when its value of the RMSE equalled 0.11.

The best model for the ability to forecast was the United States model, the United Kingdom, China and the European Union. Although the researcher achieved good results for the four countries mentioned above, while she could not graphically identify the gap between actual stock prices and forecast stock price for all countries, except the European Union model, because the number of observations was so large. Meanwhile the researcher could mathematically determine the gap through finding the difference between the actual dependent variables (SP) and the forecasted dependent variables (SPF) and whenever the result is very small and its value is less than 1, the better it is. According to the results that have already explained above, the current study accepts the following hypothesis H_9, H_{10}, H_{11}, H_{12}, which have already been clarified at the beginning of this section. Furthermore, Table 5-7 in chapter 5 demonstrates a summary of the main finding of forecasting analysis linking with the third research objective, question and linking with research hypotheses H_9, H_{10}, H_{11} and H_{12} of the current study

6.5 Summary

This chapter discussed the results of this study, according to the overall research aim, questions and hypotheses. It also referred to the previous studies that investigated the relationship. In the same countries, without referring to the same studies that examined the same relationship, but in other countries not included in this research, which have been covered in the literature review chapter. The research confirmed the existence of a unidirectional Granger-causality relationship running from the Chinese Exchange Rate to the Shanghai Stock Exchange Composite Index closing price in the short-run. This result supports the arguments of the Flow-Oriented Theory. Additionally, this study showed that there is a unidirectional Granger-causality relationship running from the Dow Jones Industrial Average Index closing price to the US Exchange Rate in the short-run, respectively corresponding with the arguments of the Share-Oriented Theory. With respect to the United Kingdom, bi-directional causality has been found between the FTSE 100 Index closing price and the UK Exchange Rate in the short-run, which supports the Flow-Oriented and the Share-Oriented Theories. In contrast to the results of the previous countries, this study showed that there was long-run relationship between stock prices and exchange rate running from the Euro Exchange Rate to the FTSE Eurotop 100 Index, which supports the Flow-Oriented Theory. In addition, this chapter discussed the findings about employing the VAR Forecast and the VECM Forecast in the current research.

Chapter 7: Summary and Conclusions

7.1 Introduction

This chapter draws together the conclusions and implications of this research. It begins with a summary of the research objectives that have been achieved. Discussing the limitation of the study is another point tackled in this chapter. Some ideas for further research are presented, with the hope that other researchers in this field benefit from them. Then, theoretical and practical implications of findings are discussed at the end of this study.

7.2 Achieving Research Objectives

To achieve the research objectives, answer the research questions and test the research hypotheses, the researcher divided the time series data into two parts. The first one is the in-sample time series data set covering the period from January 3, 2000 to December 31, 2010, which included 22,968 observations after adjustments, which were used to achieve the first and second research objectives through emanation the research hypotheses; H_1, H_2, H_3, H_4, H_5, H_7 and H_9. The second one is out-of-sample time series data, which extended from January 3, 2011 to March 31, 2015 and incorporated 7,288 observations after adjustments that were used to achieve the research objective by testing the research hypotheses; H_9, H_{10}, H_{11}, H_{12}. Before applying any test to achieve the research objectives or answer the research questions or testing the research hypotheses, the researcher began with some descriptive statistics of the out-of-sample data, then examined the unit root tests and determined the Optimal Lag Lengths for all stock prices and exchange rates of the sample study.

The first research objective was to detect long–run relationships between stock prices and exchange rates in China, the United Kingdom, the European Union and the United States. To achieve this objective, the researcher used the in-sample daily time series data which started from January 3, 2000 to December 31, 2010 and including 22,976 observations after adjustment to employ two cointegration tests. The first one is the Engle and Granger (1987) two-step model, and the second one is the Johansen cointegration models (Johansen, 1988; Johansen and Juselius, 1990). The results of these two cointegration tests confirmed that there were no relationships between stock prices and exchange rate in China, the United Kingdom, and the United States. However, the Johansen's test differed from the Engel-Granger cointegration test in respect to the European Union. The Engel-Granger cointegration test did not find any long relationships between the FTSE Eurotop 100 Index closing prices and the Euro Exchange Rate, whereas the Johansen indicates the opposite. The researcher adopts the results of the Johansen's cointegration test for all the countries in the sample of this study.

The second research objective was to find out the direction of the relationship between stock prices and exchange rates and which of them affects the other, or whether both affect each other in the sample countries. To achieve this objective, the researcher also used the in-sample daily time series data to apply the Wald, the Block Exogeneity Wald tests under the Vector Auto Regression model (VAR) and Pairwise Granger causality test of China, the United Kingdom, and the United States; because there was short–run relationship between stock prices and exchange rates. While the researcher used the Wald, the Block Exogeneity Wald tests under the Vector Error Correction (VEC) Model and Pairwise Granger causality test of the European Union, because there was long–run relationship between the closing price of the FTSE Eurotop 100 Index and the Euro Exchange Rate.

The results of the previous causality tests showed that there was a unidirectional causality relationship running from the Chinese Exchange Rate to the closing price of the Shanghai Stock Exchange Composite Index, which supports the Flow-Oriented Theory. Moreover, the causality tests displayed the unidirectional causality relationship running from the closing price of the Dow Jones Industrial Average Index to the US Exchange Rate, which supports the Share-Oriented Theory. The results of causality tests in the United Kingdom were interesting as they showed that there is bi-directional Granger-causality relationship between the FTSE 100 Index closing price and the UK Exchange Rate, which supports the arguments that each variable affects the other (the Flow-Oriented and Share–Oriented Theories). Regarding the European Union, the results of the causality tests disclosed the existence of a unidirectional causality relationship running from the Euro Exchange Rate to the FTSE Eurotop 100 Index closing price which supports the Flow-Oriented.

Thus, there is no mutual agreement between the researchers with regards to investigating the interactions between exchange rates and stock prices. Such issues are in need of more empirical research in this financial area to enrich the literature, contribute to the development of knowledge in the study of the stock prices, and exchange rate not only in the mentioned above countries.

7.3 Limitations of the Study

It is worth noting that there are some limitations of this research. Firstly, it only employs stable two variables, therefore, the value of the error was big and the value of the (was small when estimating the VAR Forecast and the VEC Forecast. That means the percentage of dependent variables that could explain the movements, which occur, on the independent variable was very small.

Although the researcher found a satisfactory forecast ability of China, the United States and the United Kingdom Models based on the results obtained from the Mean Absolute percentage error, graphically, she could not identify the gap between actual stock prices and forecast stock price for all countries estimated, except the European Union model, because the number of observations was very big. Meanwhile, the researcher could mathematically determine the gap through finding the difference between the actual dependent variables (SP) and the forecasted dependent variables (SPF) and whenever the result is very small and its value is less than 1, the better it is. Furthermore, this study did not pay attention to the movements of interest rates, which may considerably have an influence on stock prices. The stock prices basically move inversely with the interest rates, while the exchange rates (domestic currency) follow the same direction of the interest rates. Relying on interest is related to its movements, which are constant, while the current study used daily data. In addition to that, most of the time series data are stationary at the first different. That means the delta of the interest rate equals zero, while using daily or monthly data which is the situation of the current study. Therefore, the benefit of using the interest rate does not change the value of the errors to which the researcher referred above. However, using the interest rate provides satisfactory results in the case of employing annual data.

The third limitation of the current research was its focus on the linkage between stock price and exchange rate and not using the levels of time series data. Such limitations were due to econometric assumptions about stationary of time series. This is based on the results of the unit root tests, which was the first step in conducting the analysis.

7.4 Suggestions for Future Research

From the findings presented in this thesis, a number of promising research ideas are discussed. These ideas can be useful for those who might have the interest to conduct further research. They are saummarised as follows.

- The researcher suggests that the research may be extended to investigate the linkage between stock prices and some macroeconomic variables. For example, (interest rate, inflation and exchange rate) and testing the cointegration and causal relationships, as well as the forecasting ability of stock prices with macroeconomic variables in a future study.

- The current research was able to estimate the forecast of the in-sample (the VAR Forecast and the VECM Forecast), which means using data available, employing the forecast and comparing between the actual and the forecast. The results obtained were very close to the reality. The value of MAPE was very small. Therefore, future research can use the same technique employing out-of-sample to forecast future years. Therefore, the researcher has the intention to employ the results obtained from the current study on her own country, aiming to test the relationship between stock prices and exchange rates. Therefore, a great deal of research is still required to be conducted about the growing future investigation of the movements between exchange rates and stock prices, in terms of theory and empirical work.

7.5 Theoretical and practical implications of findings

Based on the results obtained from the current study, the researcher shows some practical implications of these findings, which are summarised below:

- Knowledge of the relationship between stock prices and exchange rates is very important for the development of the stock market, in which authorities are required to follow the movements of developed stock markets for better decisions and development of equity market.

- Studying the causality relationship between stock prices and exchange rates in the four major stock markets in the world can be given to regulators who are interested in the suitable functioning of financial markets, and for multinational corporations, financial institutions, or individual investors who are interested in internationally diversified portfolios and management of foreign exchange risks.

- The research speculated that the contrasts in the results between four economies are due to the differences in the structure and characteristics of each financial market in the study sample (government control the stock market or free stock markets). These contrasts observed in the relationship between changes in stock prices and changes in exchange rate should be taken into account for each of the monetary policymakers and investors.

- The results of the current research showed that the causal relationship should be a necessary part of the design of exchange rate policies for China. The Chinese government should be cautious in their implementation of exchange rate policies for two reasons. Firstly, its influence can affect stock markets in the short-run. In case the exchange rate is no longer constant, the government can consider that the impact of exchange rate changes does not contract only the trade flows but also affect the financial markets. The second reason is the Chinese government has complete control of stock markets. Therefore, it can apply the exchange rate policies for stock markets, especially since the majority of the companies included were large and completely owned by the government, state-owned business.

- This study showed that there is a long-run relationship between stock price and exchange rate in the European Union, which enables the local and foreign investors, especially those who are listed in the FTSE Eurotop Index to take successful investment decisions. An understanding of the relationship between these variables will help investors to adjust or manage their portfolios in a more efficient manner.

- The findings of this study showed that the value of the error was big, because it included the value of error, plus the value of the macro-economic variables that are not covered in this study (e.g. interest rate, inflation and exchange rate). Therefore, policymakers should seek to minimize macroeconomic fluctuations, considering the effect of macroeconomic variables changes on the stock market when formulating economic policy.

- Using these forecasting results is very important for financial policy makers, since it provides prediction of the future for stocks prices and exchange rates options.

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Appendices (1): Augmented Dickey–Fuller Unit Root Test of the Sample Time Series Data

A. Augmented Dickey–Fuller test of the Shanghai Stock Exchange Composite Index at (level /intercept)

Null Hypothesis: CH_SP has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.071080	0.7292
Test critical values:	1% level	-3.432442	
	5% level	-2.862350	
	10% level	-2.567246	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CH_SP)
Method: Least Squares
Date: 01/06/14 Time: 23:17
Sample (adjusted): 1/11/2000 12/31/2010
Included observations: 2864 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CH_SP(-1)	-0.001088	0.001016	-1.071080	0.2842
D(CH_SP(-1))	-0.123666	0.018602	-6.648116	0.0000
D(CH_SP(-2))	-0.035462	0.018732	-1.893102	0.0584
D(CH_SP(-3))	-0.012368	0.018729	-0.660382	0.5091
D(CH_SP(-4))	0.003655	0.018721	0.195244	0.8452
D(CH_SP(-5))	-0.109811	0.018576	-5.911453	0.0000
C	0.008550	0.007734	1.105381	0.2691

R-squared	0.028800	Mean dependent var	0.000212
Adjusted R-squared	0.026760	S.D. dependent var	0.021914
S.E. of regression	0.021619	Akaike info criterion	-4.828049
Sum squared resid	1.335305	Schwarz criterion	-4.813482
Log likelihood	6920.767	Hannan-Quinn criter.	-4.822797
F-statistic	14.12018	Durbin-Watson stat	2.008244
Prob(F-statistic)	0.000000		

B. Augmented Dickey–Fuller Test of the Shanghai Stock Exchange Composite Index at (1 St Difference)

Null Hypothesis: D(CH_SP) has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-25.67220	0.0000
Test critical values:	1% level	-3.432443	
	5% level	-2.862350	
	10% level	-2.567246	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CH_SP,2)
Method: Least Squares
Date: 01/06/14 Time: 23:18
Sample (adjusted): 1/12/2000 12/31/2010
Included observations: 2863 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CH_SP(-1))	-1.341048	0.052237	-25.67220	0.0000
D(CH_SP(-1),2)	0.211782	0.046739	4.531116	0.0000
D(CH_SP(-2),2)	0.177114	0.041437	4.274276	0.0000
D(CH_SP(-3),2)	0.164822	0.035289	4.670623	0.0000
D(CH_SP(-4),2)	0.166535	0.027982	5.951542	0.0000
D(CH_SP(-5),2)	0.050825	0.018659	2.723892	0.0065
C	0.000305	0.000404	0.754665	0.4505

R-squared	0.567921	Mean dependent var	2.50E-05
Adjusted R-squared	0.567013	S.D. dependent var	0.032808
S.E. of regression	0.021588	Akaike info criterion	-4.830879
Sum squared resid	1.331065	Schwarz criterion	-4.816308
Log likelihood	6922.404	Hannan-Quinn criter.	-4.825625
F-statistic	625.6496	Durbin-Watson stat	2.000080
Prob(F-statistic)	0.000000		

C. Augmented Dickey–Fuller Test of the Chinese Exchange Rate at (level /intercept)

Null Hypothesis: CH_ER has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.886913	0.7929
Test critical values:	1% level	-3.432440	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CH_ER)
Method: Least Squares
Date: 01/06/14 Time: 23:13
Sample (adjusted): 1/06/2000 12/31/2010
Included observations: 2867 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CH_ER(-1)	-0.000954	0.001075	-0.886913	0.3752
D(CH_ER(-1))	-0.126212	0.018659	-6.764033	0.0000
D(CH_ER(-2))	-0.066666	0.018655	-3.573562	0.0004
C	-0.002256	0.002598	-0.868345	0.3853

R-squared	0.018852	Mean dependent var	3.97E-05
Adjusted R-squared	0.017823	S.D. dependent var	0.003615
S.E. of regression	0.003582	Akaike info criterion	-8.424181
Sum squared resid	0.036742	Schwarz criterion	-8.415864
Log likelihood	12080.06	Hannan-Quinn criter.	-8.421183
F-statistic	18.33637	Durbin-Watson stat	2.002467
Prob(F-statistic)	0.000000		

D. Augmented Dickey–Fuller Test of the Chinese Exchange Rate at (1 St Difference)

Null Hypothesis: D(CH_ER) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-42.81171	0.0000
Test critical values:	1% level	-3.432440	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CH_ER,2)
Method: Least Squares
Date: 01/06/14 Time: 23:14
Sample (adjusted): 1/06/2000 12/31/2010
Included observations: 2867 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CH_ER(-1))	-1.194082	0.027891	-42.81171	0.0000
D(CH_ER(-1),2)	0.067223	0.018644	3.605595	0.0003
C	4.75E-05	6.69E-05	0.709617	0.4780

R-squared	0.561411	Mean dependent var	-4.12E-07
Adjusted R-squared	0.561105	S.D. dependent var	0.005407
S.E. of regression	0.003582	Akaike info criterion	-8.424604
Sum squared resid	0.036752	Schwarz criterion	-8.418366
Log likelihood	12079.67	Hannan-Quinn criter.	-8.422355
F-statistic	1833.019	Durbin-Watson stat	2.002552
Prob(F-statistic)	0.000000		

E. Augmented Dickey–Fuller Test of the FTSE Eurotop 100 Index price at (level /intercept)

Null Hypothesis: EURO_SP has a unit root
Exogenous: Constant
Lag Length: 14 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.748433	0.0661
Test critical values:	1% level	-3.432475	
	5% level	-2.862365	
	10% level	-2.567254	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EURO_SP)
Method: Least Squares
Date: 01/07/14 Time: 22:46
Sample (adjusted): 1/24/2000 12/31/2010
Included observations: 2823 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EURO_SP(-1)	-0.038822	0.014125	-2.748433	0.0060
D(EURO_SP(-1))	-0.876249	0.022926	-38.22143	0.0000
D(EURO_SP(-2))	-0.795575	0.028130	-28.28207	0.0000
D(EURO_SP(-3))	-0.719966	0.031656	-22.74348	0.0000
D(EURO_SP(-4))	-0.646759	0.034105	-18.96370	0.0000
D(EURO_SP(-5))	-0.576616	0.035743	-16.13226	0.0000
D(EURO_SP(-6))	-0.511824	0.036717	-13.93966	0.0000
D(EURO_SP(-7))	-0.448859	0.037109	-12.09554	0.0000
D(EURO_SP(-8))	-0.387332	0.036940	-10.48536	0.0000
D(EURO_SP(-9))	-0.328472	0.036201	-9.073691	0.0000
D(EURO_SP(-10))	-0.272969	0.034851	-7.832491	0.0000
D(EURO_SP(-11))	-0.217906	0.032777	-6.648083	0.0000
D(EURO_SP(-12))	-0.162735	0.029779	-5.464678	0.0000
D(EURO_SP(-13))	-0.107323	0.025472	-4.213421	0.0000
D(EURO_SP(-14))	-0.053407	0.018843	-2.834303	0.0046
C	0.303037	0.110663	2.738366	0.0062

R-squared	0.456471	Mean dependent var	-0.000115
Adjusted R-squared	0.453567	S.D. dependent var	0.225669
S.E. of regression	0.166817	Akaike info criterion	-0.738182
Sum squared resid	78.11334	Schwarz criterion	-0.704484
Log likelihood	1057.944	Hannan-Quinn criter.	-0.726024
F-statistic	157.1600	Durbin-Watson stat	2.006617
Prob(F-statistic)	0.000000		

F. Augmented Dickey–Fuller Test of the FTSE Eurotop 100 Index price (1 St Difference)

Null Hypothesis: D(EURO_SP) has a unit root
Exogenous: Constant
Lag Length: 13 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-23.61004	0.0000
Test critical values:	1% level	-3.432475	
	5% level	-2.862365	
	10% level	-2.567254	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EURO_SP,2)
Method: Least Squares
Date: 01/07/14 Time: 22:47
Sample (adjusted): 1/24/2000 12/31/2010
Included observations: 2823 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO_SP(-1))	-7.375345	0.312382	-23.61004	0.0000
D(EURO_SP(-1),2)	5.463110	0.304928	17.91609	0.0000
D(EURO_SP(-2),2)	4.634307	0.291753	15.88434	0.0000
D(EURO_SP(-3),2)	3.883798	0.274131	14.16766	0.0000
D(EURO_SP(-4),2)	3.209117	0.253037	12.68240	0.0000
D(EURO_SP(-5),2)	2.607134	0.229265	11.37172	0.0000
D(EURO_SP(-6),2)	2.072439	0.203484	10.18476	0.0000
D(EURO_SP(-7),2)	1.603179	0.176302	9.093377	0.0000
D(EURO_SP(-8),2)	1.197906	0.148303	8.077403	0.0000
D(EURO_SP(-9),2)	0.853954	0.120070	7.112112	0.0000
D(EURO_SP(-10),2)	0.567970	0.092204	6.159960	0.0000
D(EURO_SP(-11),2)	0.339548	0.065413	5.190844	0.0000
D(EURO_SP(-12),2)	0.168840	0.040574	4.161312	0.0000
D(EURO_SP(-13),2)	0.056137	0.018839	2.979853	0.0029
C	-0.000992	0.003144	-0.315437	0.7525

R-squared	0.818194	Mean dependent var	-3.37E-07
Adjusted R-squared	0.817287	S.D. dependent var	0.390718
S.E. of regression	0.167012	Akaike info criterion	-0.736203
Sum squared resid	78.32355	Schwarz criterion	-0.704611
Log likelihood	1054.151	Hannan-Quinn criter.	-0.724804
F-statistic	902.6429	Durbin-Watson stat	2.007169
Prob(F-statistic)	0.000000		

G. Augmented Dickey –Fuller Test of the Euro Exchange Rate (level /intercept)

Null Hypothesis: EURO_ER has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.205949	0.6741
Test critical values:	1% level	-3.432440	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EURO_ER)
Method: Least Squares
Date: 01/06/14 Time: 23:21
Sample (adjusted): 1/06/2000 12/31/2010
Included observations: 2867 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EURO_ER(-1)	-0.001112	0.000922	-1.205949	0.2279
D(EURO_ER(-1))	-0.107565	0.018446	-5.831403	0.0000
D(EURO_ER(-2))	-0.158832	0.018413	-8.626283	0.0000
C	-0.000159	0.000204	-0.778797	0.4362

R-squared	0.034474	Mean dependent var	4.67E-05
Adjusted R-squared	0.033462	S.D. dependent var	0.004988
S.E. of regression	0.004904	Akaike info criterion	-7.796065
Sum squared resid	0.068858	Schwarz criterion	-7.787749
Log likelihood	11179.66	Hannan-Quinn criter.	-7.793067
F-statistic	34.07412	Durbin-Watson stat	2.003215
Prob(F-statistic)	0.000000		

H. Augmented Dickey –Fuller Test of the Euro Exchange Rate at (1 St Difference)

Null Hypothesis: D(EURO_ER) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-46.55250	0.0001
Test critical values:	1% level	-3.432440	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EURO_ER,2)
Method: Least Squares
Date: 01/06/14 Time: 23:22
Sample (adjusted): 1/06/2000 12/31/2010
Included observations: 2867 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO_ER(-1))	-1.267358	0.027224	-46.55250	0.0000
D(EURO_ER(-1),2)	0.159251	0.018411	8.649926	0.0000
C	6.09E-05	9.16E-05	0.664451	0.5065

R-squared	0.558329	Mean dependent var	-3.95E-06
Adjusted R-squared	0.558021	S.D. dependent var	0.007377
S.E. of regression	0.004905	Akaike info criterion	-7.796255
Sum squared resid	0.068893	Schwarz criterion	-7.790017
Log likelihood	11178.93	Hannan-Quinn criter.	-7.794006
F-statistic	1810.233	Durbin-Watson stat	2.003346
Prob(F-statistic)	0.000000		

I. Augmented Dickey –Fuller Test of the FTSE100 Index Price at (level /intercept)

Null Hypothesis: UK_SP has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.028348	0.2747
Test critical values:	1% level	-3.432442	
	5% level	-2.862350	
	10% level	-2.567246	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UK_SP)
Method: Least Squares
Date: 01/13/14 Time: 09:55
Sample (adjusted): 1/10/2000 12/31/2010
Included observations: 2865 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UK_SP(-1)	-0.003206	0.001581	-2.028348	0.0426
D(UK_SP(-1))	-0.134677	0.018663	-7.216277	0.0000
D(UK_SP(-2))	-0.088091	0.018788	-4.688598	0.0000
D(UK_SP(-3))	-0.063881	0.018782	-3.401189	0.0007
D(UK_SP(-4))	0.073970	0.018635	3.969331	0.0001
C	0.027395	0.013528	2.024978	0.0430

R-squared	0.035061	Mean dependent var	-3.41E-05
Adjusted R-squared	0.033374	S.D. dependent var	0.014000
S.E. of regression	0.013765	Akaike info criterion	-5.731302
Sum squared resid	0.541699	Schwarz criterion	-5.718820
Log likelihood	8216.091	Hannan-Quinn criter.	-5.726802
F-statistic	20.77653	Durbin-Watson stat	1.996443
Prob(F-statistic)	0.000000		

J. Augmented Dickey –Fuller Test of the FTSE100 Index Price (1 St Difference)

Null Hypothesis: D(UK_SP) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-28.03654	0.0000
Test critical values:	1% level	-3.432442	
	5% level	-2.862350	
	10% level	-2.567246	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UK_SP,2)
Method: Least Squares
Date: 01/13/14 Time: 09:56
Sample (adjusted): 1/10/2000 12/31/2010
Included observations: 2865 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UK_SP(-1))	-1.218529	0.043462	-28.03654	0.0000
D(UK_SP(-1),2)	0.081980	0.036368	2.254193	0.0243
D(UK_SP(-2),2)	-0.007696	0.028270	-0.272220	0.7855
D(UK_SP(-3),2)	-0.072889	0.018638	-3.910789	0.0001
C	-4.06E-05	0.000257	-0.157882	0.8746

R-squared	0.570375	Mean dependent var	-7.28E-06
Adjusted R-squared	0.569774	S.D. dependent var	0.020997
S.E. of regression	0.013772	Akaike info criterion	-5.730562
Sum squared resid	0.542479	Schwarz criterion	-5.720160
Log likelihood	8214.031	Hannan-Quinn criter.	-5.726812
F-statistic	949.2403	Durbin-Watson stat	1.996290
Prob(F-statistic)	0.000000		

K. Augmented Dickey –Fuller Test of the UK Exchange Rate at (level /intercept)

Null Hypothesis: UK_ER has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.015381	0.7499
Test critical values:	1% level	-3.432442	
	5% level	-2.862350	
	10% level	-2.567246	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UK_ER)
Method: Least Squares
Date: 01/13/14 Time: 09:41
Sample (adjusted): 1/10/2000 12/31/2010
Included observations: 2865 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UK_ER(-1)	-0.001876	0.001848	-1.015381	0.3100
D(UK_ER(-1))	-0.404032	0.018726	-21.57615	0.0000
D(UK_ER(-2))	-0.198544	0.020094	-9.880661	0.0000
D(UK_ER(-3))	-0.100990	0.020084	-5.028429	0.0000
D(UK_ER(-4))	-0.058925	0.018686	-3.153419	0.0016
C	0.000179	0.000317	0.563887	0.5729

R-squared	0.143343	Mean dependent var	-5.81E-05
Adjusted R-squared	0.141844	S.D. dependent var	0.008755
S.E. of regression	0.008110	Akaike info criterion	-6.789321
Sum squared resid	0.188047	Schwarz criterion	-6.776839
Log likelihood	9731.703	Hannan-Quinn criter.	-6.784821
F-statistic	95.67808	Durbin-Watson stat	2.005007
Prob(F-statistic)	0.000000		

L. Augmented Dickey –Fuller Test of the UK Exchange Rate at (1 St Difference)

Null Hypothesis: D(UK_ER) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-34.01592	0.0000
Test critical values:	1% level	-3.432442	
	5% level	-2.862350	
	10% level	-2.567246	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UK_ER,2)
Method: Least Squares
Date: 01/13/14 Time: 09:42
Sample (adjusted): 1/10/2000 12/31/2010
Included observations: 2865 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UK_ER(-1))	-1.767033	0.051947	-34.01592	0.0000
D(UK_ER(-1),2)	0.361514	0.043415	8.326851	0.0000
D(UK_ER(-2),2)	0.161701	0.032095	5.038213	0.0000
D(UK_ER(-3),2)	0.059660	0.018672	3.195144	0.0014
C	-0.000104	0.000152	-0.685000	0.4934

R-squared	0.679051	Mean dependent var	3.17E-06
Adjusted R-squared	0.678603	S.D. dependent var	0.014306
S.E. of regression	0.008110	Akaike info criterion	-6.789659
Sum squared resid	0.188115	Schwarz criterion	-6.779257
Log likelihood	9731.186	Hannan-Quinn criter.	-6.785908
F-statistic	1512.772	Durbin-Watson stat	2.005132
Prob(F-statistic)	0.000000		

M. Augmented Dickey–Fuller Test of the Dow Jones Industrial Average Index at (level /intercept)

Null Hypothesis: US_SP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.120895	0.2365
Test critical values:	1% level	-3.432440	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US_SP)
Method: Least Squares
Date: 01/13/14 Time: 10:19
Sample (adjusted): 1/06/2000 12/31/2010
Included observations: 2867 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
US_SP(-1)	-0.003848	0.001815	-2.120895	0.0340
D(US_SP(-1))	-0.116198	0.018637	-6.234877	0.0000
D(US_SP(-2))	-0.080981	0.018608	-4.351944	0.0000
C	0.035613	0.016785	2.121667	0.0340

R-squared	0.020256	Mean dependent var	1.40E-05
Adjusted R-squared	0.019229	S.D. dependent var	0.013080
S.E. of regression	0.012953	Akaike info criterion	-5.853531
Sum squared resid	0.480381	Schwarz criterion	-5.845214
Log likelihood	8395.036	Hannan-Quinn criter.	-5.850532
F-statistic	19.73035	Durbin-Watson stat	1.992823
Prob(F-statistic)	0.000000		

N. Augmented Dickey–Fuller Test of the Dow Jones Industrial Average Index at (1^{St} Difference)

Null Hypothesis: D(US_SP) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-43.31696	0.0000
Test critical values:	1% level	-3.432440	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US_SP,2)
Method: Least Squares
Date: 01/13/14 Time: 10:19
Sample (adjusted): 1/06/2000 12/31/2010
Included observations: 2867 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(US_SP(-1))	-1.201081	0.027728	-43.31696	0.0000
D(US_SP(-1),2)	0.082734	0.018601	4.447828	0.0000
C	1.66E-05	0.000242	0.068764	0.9452

R-squared	0.557743	Mean dependent var	-3.70E-06
Adjusted R-squared	0.557434	S.D. dependent var	0.019483
S.E. of regression	0.012961	Akaike info criterion	-5.852658
Sum squared resid	0.481135	Schwarz criterion	-5.846421
Log likelihood	8392.786	Hannan-Quinn criter.	-5.850410
F-statistic	1805.938	Durbin-Watson stat	1.992938
Prob(F-statistic)	0.000000		

O. Augmented Dickey–Fuller Test of the US Exchange Rate at (level /intercept)

Null Hypothesis: US_ER has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.066364	0.7310
Test critical values:	1% level	-3.432438	
	5% level	-2.862348	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US_ER)
Method: Least Squares
Date: 01/13/14 Time: 10:21
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
US_ER(-1)	-0.000856	0.000803	-1.066364	0.2863
C	-0.000352	0.000300	-1.175191	0.2400

R-squared	0.000396	Mean dependent var	-3.92E-05
Adjusted R-squared	0.000048	S.D. dependent var	0.003249
S.E. of regression	0.003249	Akaike info criterion	-8.620484
Sum squared resid	0.030257	Schwarz criterion	-8.616328
Log likelihood	12368.08	Hannan-Quinn criter.	-8.618985
F-statistic	1.137131	Durbin-Watson stat	2.088674
Prob(F-statistic)	0.286349		

P. Augmented Dickey –Fuller Test of the US Exchange Rate at (1 St Difference)

Null Hypothesis: D(US_ER) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=27)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-56.02363	0.0001
Test critical values:	1% level	-3.432439	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US_ER,2)
Method: Least Squares
Date: 01/13/14 Time: 10:21
Sample (adjusted): 1/05/2000 12/31/2010
Included observations: 2868 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(US_ER(-1))	-1.045112	0.018655	-56.02363	0.0000
C	-3.95E-05	6.06E-05	-0.652252	0.5143

R-squared	0.522703	Mean dependent var	1.48E-06
Adjusted R-squared	0.522537	S.D. dependent var	0.004697
S.E. of regression	0.003246	Akaike info criterion	-8.622365
Sum squared resid	0.030189	Schwarz criterion	-8.618208
Log likelihood	12366.47	Hannan-Quinn criter.	-8.620866
F-statistic	3138.648	Durbin-Watson stat	2.001196
Prob(F-statistic)	0.000000		

Appendices (2): Phillips –Perron Unit Root Test of the Sample Time Series Data

A. Phillips –Perron Test of the Shanghai Stock Exchange Composite Index at (level /intercept)

Null Hypothesis: CH_SP has a unit root
Exogenous: Constant
Bandwidth: 26 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.284857	0.6388
Test critical values:	1% level	-3.432438	
	5% level	-2.862348	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000480
HAC corrected variance (Bartlett kernel)	0.000349

Phillips-Perron Test Equation
Dependent Variable: D(CH_SP)
Method: Least Squares
Date: 01/06/14 Time: 23:18
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CH_SP(-1)	-0.001541	0.001028	-1.498514	0.1341
C	0.011966	0.007826	1.529022	0.1264

R-squared	0.000783	Mean dependent var	0.000255
Adjusted R-squared	0.000434	S.D. dependent var	0.021925
S.E. of regression	0.021920	Akaike info criterion	-4.802092
Sum squared resid	1.377617	Schwarz criterion	-4.797936
Log likelihood	6890.601	Hannan-Quinn criter.	-4.800594
F-statistic	2.245544	Durbin-Watson stat	2.237129
Prob(F-statistic)	0.134110		

B. Phillips–Perron Test of the Shanghai Stock Exchange Composite Index at (1St Difference)

Null Hypothesis: D(CH_SP) has a unit root
Exogenous: Constant
Bandwidth: 24 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-61.02859	0.0001
Test critical values:	1% level	-3.432439	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000474
HAC corrected variance (Bartlett kernel)	0.000414

Phillips-Perron Test Equation
Dependent Variable: D(CH_SP,2)
Method: Least Squares
Date: 01/06/14 Time: 23:18
Sample (adjusted): 1/05/2000 12/31/2010
Included observations: 2868 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CH_SP(-1))	-1.120059	0.018544	-60.39984	0.0000
C	0.000274	0.000406	0.674775	0.4999

R-squared	0.560034	Mean dependent var	-1.63E-07
Adjusted R-squared	0.559881	S.D. dependent var	0.032812
S.E. of regression	0.021768	Akaike info criterion	-4.816067
Sum squared resid	1.358026	Schwarz criterion	-4.811909
Log likelihood	6908.239	Hannan-Quinn criter.	-4.814568
F-statistic	3648.141	Durbin-Watson stat	2.007444
Prob(F-statistic)	0.000000		

C. Phillips –Perron Test of the Chinese Exchange Rate at (level /intercept)

Null Hypothesis: CH_ER has a unit root
Exogenous: Constant
Bandwidth: 9 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.948759	0.7730
Test critical values:	1% level	-3.432438	
	5% level	-2.862348	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.31E-05
HAC corrected variance (Bartlett kernel)	9.70E-06

Phillips-Perron Test Equation
Dependent Variable: D(CH_ER)
Method: Least Squares
Date: 01/06/14 Time: 23:15
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CH_ER(-1)	-0.001319	0.001084	-1.216893	0.2237
C	-0.003147	0.002618	-1.201899	0.2295

R-squared	0.000516	Mean dependent var	3.82E-05
Adjusted R-squared	0.000168	S.D. dependent var	0.003614
S.E. of regression	0.003614	Akaike info criterion	-8.407264
Sum squared resid	0.037447	Schwarz criterion	-8.403108
Log likelihood	12062.22	Hannan-Quinn criter.	-8.405765
F-statistic	1.480828	Durbin-Watson stat	2.235265
Prob(F-statistic)	0.223745		

D. Phillips –Perron Test of the Chinese Exchange Rate at (1St Difference)

Null Hypothesis: D(CH_ER) has a unit root
Exogenous: Constant
Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-60.68956	0.0001
Test critical values:	1% level	-3.432439	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.29E-05
HAC corrected variance (Bartlett kernel)	1.18E-05

Phillips-Perron Test Equation
Dependent Variable: D(CH_ER,2)
Method: Least Squares
Date: 01/06/14 Time: 23:16
Sample (adjusted): 1/05/2000 12/31/2010
Included observations: 2868 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CH_ER(-1))	-1.118801	0.018543	-60.33627	0.0000
C	4.43E-05	6.70E-05	0.660747	0.5088

R-squared	0.559515	Mean dependent var	1.09E-06
Adjusted R-squared	0.559361	S.D. dependent var	0.005407
S.E. of regression	0.003589	Akaike info criterion	-8.421115
Sum squared resid	0.036919	Schwarz criterion	-8.416958
Log likelihood	12077.88	Hannan-Quinn criter.	-8.419616
F-statistic	3640.465	Durbin-Watson stat	2.016005
Prob(F-statistic)	0.000000		

E. Phillips –Perron Test of the FTSE Eurotop 100 Index price at (level /intercept)

Null Hypothesis: EURO_SP has a unit root
Exogenous: Constant
Bandwidth: 39 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-48.37965	0.0001
Test critical values:	1% level	-3.432442	
	5% level	-2.862350	
	10% level	-2.567246	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.041618
HAC corrected variance (Bartlett kernel)	0.223389

Phillips-Perron Test Equation
Dependent Variable: D(EURO_SP)
Method: Least Squares
Date: 01/07/14 Time: 22:47
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2865 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EURO_SP(-1)	-0.340560	0.014044	-24.24937	0.0000
C	2.666780	0.110045	24.23356	0.0000

R-squared	0.170393	Mean dependent var	-0.000137
Adjusted R-squared	0.170103	S.D. dependent var	0.224018
S.E. of regression	0.204077	Akaike info criterion	-0.339939
Sum squared resid	119.2368	Schwarz criterion	-0.335779
Log likelihood	488.9630	Hannan-Quinn criter.	-0.338439
F-statistic	588.0319	Durbin-Watson stat	2.524274
Prob(F-statistic)	0.000000		

F. Phillips –Perron Test of the FTSE Eurotop 100 Index price at (1St Difference)

Null Hypothesis: D(EURO_SP) has a unit root
Exogenous: Constant
Bandwidth: 521 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-581.3398	0.0001
Test critical values:	1% level	-3.432444	
	5% level	-2.862351	
	10% level	-2.567246	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.037725
HAC corrected variance (Bartlett kernel)	0.000541

Phillips-Perron Test Equation
Dependent Variable: D(EURO_SP,2)
Method: Least Squares
Date: 01/07/14 Time: 22:48
Sample (adjusted): 1/05/2000 12/31/2010
Included observations: 2862 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO_SP(-1))	-1.498785	0.016207	-92.47840	0.0000
C	-0.000213	0.003632	-0.058766	0.9531

R-squared	0.749392	Mean dependent var	-6.46E-07
Adjusted R-squared	0.749305	S.D. dependent var	0.388056
S.E. of regression	0.194298	Akaike info criterion	-0.438153
Sum squared resid	107.9694	Schwarz criterion	-0.433989
Log likelihood	628.9975	Hannan-Quinn criter.	-0.436652
F-statistic	8552.255	Durbin-Watson stat	2.331239
Prob(F-statistic)	0.000000		

G. Phillips –Perron Test of the Euro Exchange Rate (level /intercept)

Null Hypothesis: EURO_ER has a unit root
Exogenous: Constant
Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.340961	0.6124
Test critical values:	1% level	-3.432438	
	5% level	-2.862348	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	2.49E-05
HAC corrected variance (Bartlett kernel)	1.63E-05

Phillips-Perron Test Equation
Dependent Variable: D(EURO_ER)
Method: Least Squares
Date: 01/06/14 Time: 23:23
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EURO_ER(-1)	-0.001455	0.000939	-1.549583	0.1214
C	-0.000233	0.000208	-1.120754	0.2625

R-squared	0.000837	Mean dependent var	5.47E-05
Adjusted R-squared	0.000488	S.D. dependent var	0.004998
S.E. of regression	0.004997	Akaike info criterion	-7.759461
Sum squared resid	0.071575	Schwarz criterion	-7.755305
Log likelihood	11132.95	Hannan-Quinn criter.	-7.757963
F-statistic	2.401207	Durbin-Watson stat	2.177719
Prob(F-statistic)	0.121352		

H. Phillips –Perron Test of the Euro Exchange Rate at (1St Difference)

Null Hypothesis: D(EURO_ER) has a unit root
Exogenous: Constant
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-60.01349	0.0001
Test critical values:	1% level	-3.432439	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	2.47E-05
HAC corrected variance (Bartlett kernel)	1.90E-05

Phillips-Perron Test Equation
Dependent Variable: D(EURO_ER,2)
Method: Least Squares
Date: 01/06/14 Time: 23:23
Sample (adjusted): 1/05/2000 12/31/2010
Included observations: 2868 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO_ER(-1))	-1.091726	0.018567	-58.79818	0.0000
C	5.40E-05	9.28E-05	0.582488	0.5603

R-squared	0.546750	Mean dependent var	-7.68E-06
Adjusted R-squared	0.546592	S.D. dependent var	0.007379
S.E. of regression	0.004969	Akaike info criterion	-7.770690
Sum squared resid	0.070751	Schwarz criterion	-7.766533
Log likelihood	11145.17	Hannan-Quinn criter.	-7.769191
F-statistic	3457.226	Durbin-Watson stat	2.031757
Prob(F-statistic)	0.000000		

I. Phillips –Perron Test of the FTSE100 Index at (level /intercept)

Null Hypothesis: UK_SP has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.118730	0.2374
Test critical values:	1% level	-3.432438	
	5% level	-2.862348	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000196
HAC corrected variance (Bartlett kernel)	0.000141

Phillips-Perron Test Equation
Dependent Variable: D(UK_SP)
Method: Least Squares
Date: 01/13/14 Time: 09:54
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UK_SP(-1)	-0.003905	0.001601	-2.439096	0.0148
C	0.033384	0.013703	2.436170	0.0149

R-squared	0.002071	Mean dependent var	-3.40E-05
Adjusted R-squared	0.001723	S.D. dependent var	0.014006
S.E. of regression	0.013994	Akaike info criterion	-5.699646
Sum squared resid	0.561469	Schwarz criterion	-5.695490
Log likelihood	8178.142	Hannan-Quinn criter.	-5.698148
F-statistic	5.949190	Durbin-Watson stat	2.244539
Prob(F-statistic)	0.014784		

J. Phillips –Perron Test of the FTSE100 Index at (1^{St} Difference)

Null Hypothesis: D(UK_SP) has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-60.76935	0.0001
Test critical values:	1% level	-3.432439	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000193
HAC corrected variance (Bartlett kernel)	0.000191

Phillips-Perron Test Equation
Dependent Variable: D(UK_SP,2)
Method: Least Squares
Date: 01/13/14 Time: 09:55
Sample (adjusted): 1/05/2000 12/31/2010
Included observations: 2868 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UK_SP(-1))	-1.125022	0.018525	-60.72950	0.0000
C	-4.63E-05	0.000259	-0.178436	0.8584

R-squared	0.562715	Mean dependent var	-1.27E-05
Adjusted R-squared	0.562562	S.D. dependent var	0.021007
S.E. of regression	0.013894	Akaike info criterion	-5.714058
Sum squared resid	0.553242	Schwarz criterion	-5.709901
Log likelihood	8195.960	Hannan-Quinn criter.	-5.712560
F-statistic	3688.072	Durbin-Watson stat	2.019626
Prob(F-statistic)	0.000000		

K. Phillips –Perron Test of the UK Exchange Rate (level /intercept)

Null Hypothesis: UK_ER has a unit root
Exogenous: Constant
Bandwidth: 31 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.252143	0.6537
Test critical values:	1% level	-3.432438	
	5% level	-2.862348	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	7.63E-05
HAC corrected variance (Bartlett kernel)	2.59E-05

Phillips-Perron Test Equation
Dependent Variable: D(UK_ER)
Method: Least Squares
Date: 01/13/14 Time: 09:43
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UK_ER(-1)	-0.005172	0.001983	-2.607796	0.0092
C	0.000723	0.000340	2.125348	0.0336

R-squared	0.002366	Mean dependent var	-5.52E-05
Adjusted R-squared	0.002018	S.D. dependent var	0.008750
S.E. of regression	0.008741	Akaike info criterion	-6.640918
Sum squared resid	0.219047	Schwarz criterion	-6.636762
Log likelihood	9528.396	Hannan-Quinn criter.	-6.639419
F-statistic	6.800600	Durbin-Watson stat	2.662427
Prob(F-statistic)	0.009160		

L. Phillips –Perron Test of the UK Exchange Rate (1^{St} Difference)

Null Hypothesis: D(UK_ER) has a unit root
Exogenous: Constant
Bandwidth: 26 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-89.92040	0.0001
Test critical values:	1% level	-3.432439	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	6.80E-05
HAC corrected variance (Bartlett kernel)	3.34E-05

Phillips-Perron Test Equation
Dependent Variable: D(UK_ER,2)
Method: Least Squares
Date: 01/13/14 Time: 09:44
Sample (adjusted): 1/05/2000 12/31/2010
Included observations: 2868 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UK_ER(-1))	-1.335347	0.017602	-75.86177	0.0000
C	-7.52E-05	0.000154	-0.488209	0.6254

R-squared	0.667556	Mean dependent var	3.30E-06
Adjusted R-squared	0.667440	S.D. dependent var	0.014299
S.E. of regression	0.008246	Akaike info criterion	-6.757441
Sum squared resid	0.194886	Schwarz criterion	-6.753284
Log likelihood	9692.170	Hannan-Quinn criter.	-6.755942
F-statistic	5755.009	Durbin-Watson stat	2.105581
Prob(F-statistic)	0.000000		

M. Phillips–Perron Test of the Dow Jones Industrial Average Index at (level /intercept)

Null Hypothesis: US_SP has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.325469	0.1640
Test critical values:	1% level	-3.432438	
	5% level	-2.862348	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000171
HAC corrected variance (Bartlett kernel)	0.000136

Phillips-Perron Test Equation
Dependent Variable: D(US_SP)
Method: Least Squares
Date: 01/13/14 Time: 10:20
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
US_SP(-1)	-0.004763	0.001828	-2.606103	0.0092
C	0.044062	0.016907	2.606227	0.0092

R-squared	0.002363	Mean dependent var	6.69E-06
Adjusted R-squared	0.002015	S.D. dependent var	0.013091
S.E. of regression	0.013077	Akaike info criterion	-5.835158
Sum squared resid	0.490313	Schwarz criterion	-5.831002
Log likelihood	8372.535	Hannan-Quinn criter.	-5.833660
F-statistic	6.791775	Durbin-Watson stat	2.212081
Prob(F-statistic)	0.009205		

N. Phillips–Perron Test of the Dow Jones Industrial Average Index at (1St Difference)

Null Hypothesis: D(US_SP) has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-60.16365	0.0001
Test critical values:	1% level	-3.432439	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000169
HAC corrected variance (Bartlett kernel)	0.000155

Phillips-Perron Test Equation
Dependent Variable: D(US_SP,2)
Method: Least Squares
Date: 01/13/14 Time: 10:20
Sample (adjusted): 1/05/2000 12/31/2010
Included observations: 2868 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(US_SP(-1))	-1.109755	0.018547	-59.83570	0.0000
C	1.86E-05	0.000243	0.076674	0.9389

R-squared	0.555405	Mean dependent var	1.15E-05
Adjusted R-squared	0.555249	S.D. dependent var	0.019497
S.E. of regression	0.013002	Akaike info criterion	-5.846698
Sum squared resid	0.484519	Schwarz criterion	-5.842541
Log likelihood	8386.165	Hannan-Quinn criter.	-5.845199
F-statistic	3580.311	Durbin-Watson stat	2.017061
Prob(F-statistic)	0.000000		

O. Phillips –Perron Test of the US Exchange Rate (level /intercept)

Null Hypothesis: US_ER has a unit root
Exogenous: Constant
Bandwidth: 13 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.034952	0.7428
Test critical values:	1% level	-3.432438	
	5% level	-2.862348	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.05E-05
HAC corrected variance (Bartlett kernel)	1.00E-05

Phillips-Perron Test Equation
Dependent Variable: D(US_ER)
Method: Least Squares
Date: 01/13/14 Time: 10:22
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
US_ER(-1)	-0.000856	0.000803	-1.066364	0.2863
C	-0.000352	0.000300	-1.175191	0.2400

R-squared	0.000396	Mean dependent var	-3.92E-05
Adjusted R-squared	0.000048	S.D. dependent var	0.003249
S.E. of regression	0.003249	Akaike info criterion	-8.620484
Sum squared resid	0.030257	Schwarz criterion	-8.616328
Log likelihood	12368.08	Hannan-Quinn criter.	-8.618985
F-statistic	1.137131	Durbin-Watson stat	2.088674
Prob(F-statistic)	0.286349		

P. Phillips –Perron Test of the US Exchange Rate (1^{St} Difference)

Null Hypothesis: D(US_ER) has a unit root
Exogenous: Constant
Bandwidth: 13 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-55.99325	0.0001
Test critical values:	1% level	-3.432439	
	5% level	-2.862349	
	10% level	-2.567245	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.05E-05
HAC corrected variance (Bartlett kernel)	1.08E-05

Phillips-Perron Test Equation
Dependent Variable: D(US_ER,2)
Method: Least Squares
Date: 01/13/14 Time: 10:22
Sample (adjusted): 1/05/2000 12/31/2010
Included observations: 2868 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(US_ER(-1))	-1.045112	0.018655	-56.02363	0.0000
C	-3.95E-05	6.06E-05	-0.652252	0.5143

R-squared	0.522703	Mean dependent var	1.48E-06
Adjusted R-squared	0.522537	S.D. dependent var	0.004697
S.E. of regression	0.003246	Akaike info criterion	-8.622365
Sum squared resid	0.030189	Schwarz criterion	-8.618208
Log likelihood	12366.47	Hannan-Quinn criter.	-8.620866
F-statistic	3138.648	Durbin-Watson stat	2.001196
Prob(F-statistic)	0.000000		

Appendices (3): the Engle-Granger Cointegration

A. The Engle-Granger cointegration test for the Shanghai Stock Exchange Composite Index closing price and the Chinese exchange rate

Date: 01/12/14 Time: 09:18
Series: CH_SP CH_ER
Sample: 1/03/2000 12/31/2010
Included observations: 2870
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=27)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
CH_SP	-1.359560	0.8129	-3.602338	0.8382
CH_ER	-1.273259	0.8390	-3.910199	0.8163

*MacKinnon (1996) p-values.

Intermediate Results:

	CH_SP	CH_ER
Rho - 1	-0.001552	-0.001524
Rho S.E.	0.001141	0.001197
Residual variance	0.000531	1.43E-05
Long-run residual variance	0.000349	1.15E-05
Number of lags	5	1
Number of observations	2864	2868
Number of stochastic trends**	2	2

**Number of stochastic trends in asymptotic distribution

Date: 01/19/14 Time: 11:12
Series: CH_SP CH_ER
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=27)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
CH_SP	-25.74345	0.0000	-17927.76	0.0000
CH_ER	-42.90165	0.0000	-3684.264	0.0000

*MacKinnon (1996) p-values.

Intermediate Results:

	CH_SP	CH_ER
Rho - 1	-1.348569	-1.196232
Rho S.E.	0.052385	0.027883
Residual variance	0.000465	1.28E-05
Long-run residual variance	0.010029	1.48E-05
Number of lags	5	1
Number of observations	2863	2867
Number of stochastic trends**	2	2

**Number of stochastic trends in asymptotic distribution

B. The Engle-Granger cointegration test for the FTSE Eurotop 100 Index price and the Euro Exchange Rate

Date: 01/12/14 Time: 09:20
Series: EURO_SP EURO_ER
Sample: 1/03/2000 12/31/2010
Included observations: 2868
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=27)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
EURO_SP	-3.086208	0.0915	-20.03987	0.0556
EURO_ER	-1.532871	0.7504	-4.652565	0.7600

*MacKinnon (1996) p-values.
Intermediate Results:

	EURO_SP	EURO_ER
Rho - 1	-0.046976	-0.006260
Rho S.E.	0.015221	0.004084
Residual variance	0.027946	0.000410
Long-run residual variance	0.000637	2.80E-05
Number of lags	13	8
Number of observations	2826	2841
Number of stochastic trends**	2	2

**Number of stochastic trends in asymptotic distribution

Date: 01/19/14 Time: 11:13
Series: EURO_SP EURO_ER
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2865 after adjustments
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=27)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
EURO_SP	-23.60997	0.0000	811.6774	1.0000
EURO_ER	-46.46269	0.0001	-4301.307	0.0000

*MacKinnon (1996) p-values.
Intermediate Results:

	EURO_SP	EURO_ER
Rho - 1	-7.376426	-1.265606
Rho S.E.	0.312428	0.027239
Residual variance	0.027876	2.40E-05
Long-run residual variance	4.24E-05	3.40E-05
Number of lags	13	1
Number of observations	2823	2859
Number of stochastic trends**	2	2

**Number of stochastic trends in asymptotic distribution

C. The Engle-Granger cointegration test for the FTSE100 Index Price and the UK Exchange Rate

Date: 01/13/14 Time: 22:39
Series: UK_SP UK_ER
Sample: 1/03/2000 12/31/2010
Included observations: 2870
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=27)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
UK_SP	-1.950324	0.5540	-7.630887	0.5240
UK_ER	-1.072604	0.8876	-3.620327	0.8370

*MacKinnon (1996) p-values.
Intermediate Results:

	UK_SP	UK_ER
Rho - 1	-0.003346	-0.002098
Rho S.E.	0.001715	0.001956
Residual variance	0.000206	6.80E-05
Long-run residual variance	0.000130	2.46E-05
Number of lags	4	3
Number of observations	2865	2866
Number of stochastic trends**	2	2

**Number of stochastic trends in asymptotic distribution

Date: 01/19/14 Time: 11:14
Series: UK_SP UK_ER
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=27)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
UK_SP	-28.02030	0.0000	-3484.242	0.0000
UK_ER	-33.99388	0.0000	-12031.55	0.0000

*MacKinnon (1996) p-values.
Intermediate Results:

	UK_SP	UK_ER
Rho - 1	-1.218994	-1.768484
Rho S.E.	0.043504	0.052024
Residual variance	0.000189	6.56E-05
Long-run residual variance	0.000188	0.000370
Number of lags	3	3
Number of observations	2865	2865
Number of stochastic trends**	2	2

**Number of stochastic trends in asymptotic distribution

D. The Engle-Granger Cointegration for the Dow Jones Industrial Average Index price and the US Exchange Rate

Date: 01/13/14 Time: 22:31
Series: US_SP US_ER
Sample: 1/03/2000 12/31/2010
Included observations: 2870
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=27)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
US_SP	-2.328142	0.3593	-10.73816	0.3221
US_ER	-1.359215	0.8130	-3.596594	0.8386

*MacKinnon (1996) p-values.
Intermediate Results:

	US_SP	US_ER
Rho - 1	-0.004523	-0.001445
Rho S.E.	0.001943	0.001063
Residual variance	0.000170	1.63E-05
Long-run residual variance	0.000117	1.23E-05
Number of lags	2	2
Number of observations	2867	2867
Number of stochastic trends**	2	2

**Number of stochastic trends in asymptotic distribution

Date: 01/19/14 Time: 11:15
Series: US_SP US_ER
Sample (adjusted): 1/04/2000 12/31/2010
Included observations: 2869 after adjustments
Null hypothesis: Series are not cointegrated
Cointegrating equation deterministics: C
Automatic lags specification based on Schwarz criterion (maxlag=27)

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
US_SP	-43.40289	0.0000	-3767.609	0.0000
US_ER	-56.04309	0.0001	-2997.804	0.0000

*MacKinnon (1996) p-values.
Intermediate Results:

	US_SP	US_ER
Rho - 1	-1.203146	-1.045259
Rho S.E.	0.027720	0.018651
Residual variance	0.000168	1.05E-05
Long-run residual variance	0.000200	1.05E-05
Number of lags	1	0
Number of observations	2867	2868
Number of stochastic trends**	2	2

**Number of stochastic trends in asymptotic distribution

Appendices (4): Johansen's Cointegration Test

A. The Johansen's cointegration test for the Shanghai Stock Exchange Composite Index price and the Chinese exchange rate

Date: 01/12/14 Time: 09:17
Sample (adjusted): 1/13/2000 12/31/2010
Included observations: 2862 after adjustments
Trend assumption: Linear deterministic trend
Series: CH_SP CH_ER
Lags interval (in first differences): 1 to 7

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.001159	3.982109	15.49471	0.9050
At most 1	0.000232	0.662793	3.841466	0.4156

Trace test indicates no Cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.001159	3.319316	14.26460	0.9232
At most 1	0.000232	0.662793	3.841466	0.4156

Max-eigenvalue test indicates no Cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

CH_SP	**CH_ER**
-2.409806	11.60536
-1.112226	-12.38353

Unrestricted Adjustment Coefficients (alpha):

D(CH_SP)	0.000261	0.000306
D(CH_ER)	-0.000115	1.71E-05

1 Cointegrating Equation(s):	Log likelihood	18998.49

Normalized cointegrating coefficients (standard error in parentheses)

CH_SP	CH_ER
1.000000	-4.815890
	(3.67791)

Adjustment coefficients (standard error in parentheses)

D(CH_SP)	-0.000630
	(0.00097)
D(CH_ER)	0.000278
	(0.00016)

B. The Johansen's cointegration test for the FTSE Eurotop 100 Index price and the Euro Exchange Rate

Date: 01/12/14 Time: 09:20
Sample (adjusted): 1/14/2000 12/31/2010
Included observations: 2841 after adjustments
Trend assumption: Linear deterministic trend
Series: EURO_SP EURO_ER
Lags interval (in first differences): 1 to 8
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.007654	23.41013	15.49471	0.0026
At most 1	0.000556	1.581119	3.841466	0.2086

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.007654	21.82901	14.26460	0.0027
At most 1	0.000556	1.581119	3.841466	0.2086

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

EURO_SP	EURO_ER
-4.775874	-4.221650
0.101526	-9.991713

Unrestricted Adjustment Coefficients (alpha):

D(EURO_SP)	0.013593	-0.001553
D(EURO_ER)	0.000173	0.000106

1 Cointegrating Equation(s):	Log likelihood	12115.04

Normalized cointegrating coefficients (standard error in parentheses)

EURO_SP	EURO_ER
1.000000	0.883953
	(0.45227)

Adjustment coefficients (standard error in parentheses)

D(EURO_SP)	-0.064916
	(0.01512)
D(EURO_ER)	-0.000825
	(0.00044)

C. The Johansen's cointegration test for the FTSE100 Index Price and the UK Exchange Rate

Date: 01/13/14 Time: 22:38
Sample (adjusted): 1/13/2000 12/31/2010
Included observations: 2862 after adjustments
Trend assumption: Linear deterministic trend
Series: UK_SP UK_ER
Lags interval (in first differences): 1 to 7

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.001290	4.578908	15.49471	0.8518
At most 1	0.000309	0.883534	3.841466	0.3472

Trace test indicates no Cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.001290	3.695374	14.26460	0.8900
At most 1	0.000309	0.883534	3.841466	0.3472

Max-eigenvalue test indicates no Cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

UK_SP	UK_ER
-6.197379	0.283937
1.678524	-12.73654

Unrestricted Adjustment Coefficients (alpha):

D(UK_SP)	0.000492	5.56E-06
D(UK_ER)	7.38E-06	0.000142

1 Cointegrating Equation(s): Log likelihood 17955.08

Normalized cointegrating coefficients (standard error in parentheses)

UK_SP	UK_ER
1.000000	-0.045816
	(1.02823)

Adjustment coefficients (standard error in parentheses)

D(UK_SP)	-0.003050
	(0.00159)
D(UK_ER)	-4.57E-05
	(0.00094)

D. The Johansen's cointegration test for the Dow Jones Industrial Average Index price and the US Exchange Rate

Date: 01/13/14 Time: 22:29
Sample (adjusted): 1/10/2000 12/31/2010
Included observations: 2865 after adjustments
Trend assumption: Linear deterministic trend
Series: US_SP US_ER
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.002329	7.799052	15.49471	0.4871
At most 1	0.000390	1.118772	3.841466	0.2902

Trace test indicates no Cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.002329	6.680281	14.26460	0.5276
At most 1	0.000390	1.118772	3.841466	0.2902

Max-eigenvalue test indicates no Cointegrationn at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

US_SP	US_ER
-7.918373	-6.606554
1.107671	-12.45433

Unrestricted Adjustment Coefficients (alpha):

D(US_SP)	0.000622	1.89E-05
D(US_ER)	-1.66E-05	6.35E-05

1 Cointegrating Equation(s): Log likelihood 20761.30

Normalized cointegrating coefficients (standard error in parentheses)

US_SP	US_ER
1.000000	0.834332
	(0.64814)

Adjustment coefficients (standard error in parentheses)

D(US_SP)	-0.004925
	(0.00191)
D(US_ER)	0.000131
	(0.00048)

Appendices (5): VAR model

A. The VAR model for the Shanghai Stock Exchange Composite Index price and the Chinese Exchange Rate

	CH_SP	CH_ER
CH_SP(-1)	-0.131907, (0.01876),[-7.03232]	-0.003307, (0.00312),[-1.06124]
CH_SP(-2)	-0.034928,(0.01889),[-1.84927]	-0.001549, (0.00314),[-0.49378]
CH_SP(-3)	-0.01242 ,(0.01876),[-0.66243]	-0.004737, (0.00312),[-1.51989]
CH_SP(-4)	0.001053, (0.01876),[0.05616]	-0.002718, (0.00312),[-0.87221]
CH_SP(-5)	-0.116578, (0.01873),[-6.22384]	0.002275, (0.00311),[0.73097]
CH_SP(-6)	-0.051541, (0.01882),[-2.73871]	-0.007704, (0.00313),[-2.46394]
CH_SP(-7)	0.002885, (0.01871),[0.15422]	-0.004005, (0.00311),[-1.28856]
CH_ER(-1)	-0.000332, (0.11288),[-0.00294]	-0.128612, (0.01875),[-6.85776]
CH_ER(-2)	-0.324011, (0.11368),[-2.85021]	-0.069374, (0.01889),[-3.67315]
CH_ER(-3)	-0.265067, (0.11410),[-2.32309]	-0.022275, (0.01896),[-1.17505]
CH_ER(-4)	-0.068558, (0.11417),[-0.60048]	0.016865,(0.01897),[0.88912]
CH_ER(-5)	0.163136, (0.11409),[1.42985]	-0.021421, (0.01896),[-1.13008]
CH_ER(-6)	0.011483 ,(0.11388),[0.10084]	0.020900, (0.01892),[1.10465]
CH_ER(-7)	-0.081587 ,(0.11294),[-0.72240]	0.012812,(0.01876),[0.68282]
C	0.000338 ,(0.00040),[0.83862]	5.03E-05, (6.7E-05),[0.75060]
R-squared	0.036010	0.024576
Adj. R-squared	0.031270	0.019780
Sum sq. resids	1.322771	0.036512
S.E. equation	0.021555	0.003581
F-statistic	7.596466	5.123649
Log likelihood	6928.430	12065.51
Akaike AIC	-4.831188	-8.421043
Schwarz SC	-4.799955	-8.389810
Mean dependent	0.000238	3.79E-05
S.D. dependent	0.021900	0.003617

B. The VAR model for the United Kingdom

	UK_SP	UK_ER
UK_SP(-1)	-0.137066, (0.01876),[-7.30621]	0.036726, (0.01105),[3.32458]
UK_SP(-2)	-0.084498, (0.01895),[-4.45944]	-0.002914 ,(0.01116),[-0.26119]
UK_SP(-3)	-0.066489,(0.01901),[-3.49806]	0.016904 ,(0.01119),[1.51031]
UK_SP(-4)	0.064241, (0.01901),[3.37873]	-0.013728, (0.01120),[-1.22616]
UK_SP(-5)	-0.030879,(0.01901),[-1.62472]	-0.019290, (0.01119),[-1.72363]
UK_SP(-6)	-0.056046, (0.01894),[-2.95841]	-0.006025, (0.01116),[-0.54014]
UK_SP(-7)	0.002532, (0.01876),[0.13496]	0.005456,(0.01105),[0.49385]
UK_ER(-1)	0.033569, (0.03187),[1.05341]	-0.410729, (0.01876), [-21.8890]
UK_ER(-2)	-0.065152, (0.03446),[-1.89038]	-0.207522 ,(0.02029),[-10.2257]
UK_ER(-3)	-0.092828,(0.03506),[-2.64785]	-0.109134, (0.02064),[-5.28667]
UK_ER(-4)	-0.014418,(0.03515),[-0.41014]	-0.075321, (0.02070),[-3.63875]
UK_ER(-5)	-0.017421, (0.03506),[-0.49695]	-0.045804,(0.02064),[-2.21891]
UK_ER(-6)	-0.018207, (0.03448),[-0.52803]	-0.005817,(0.02030),[-0.28649]
UK_ER(-7)	-0.037812 ,(0.03185),[-1.18714]	0.013331,(0.01876),[0.71078]
C	-5.82E-05, (0.00026),[-0.22642]	-0.000109, (0.00015),[-0.72152]
R-squared	0.041847	0.150839
Adj. R-squared	0.037135	0.146663
Sum sq. resids	0.537525	0.186375
S.E. equation	0.013741	0.008091
F-statistic	8.881567	36.12284
Log likelihood	8217.059	9732.793
Akaike AIC	-5.731697	-6.790911
Schwarz SC	-5.700464	-6.759678
Mean dependent	-3.56E-05	-5.88E-05
S.D. dependent	0.014003	0.008759
Determinant resid covariance (dof adj.)	1.23E-08	
Determinant resid covariance	1.22E-08	
Log likelihood	17953.23	
Akaike information criterion	-12.52497	
Schwarz criterion	-12.46250	

* Included observations: 2838 after adjustments
*Standard errors in ( ) & t-statistics in [ ]

C. The VAR model for the United States

	US_SP	US_ER
US_SP(-1)	-0.116344, (0.01871),[-6.21934]	-0.000617, (0.00468),[-0.13174]
US_SP(-2)	-0.077590, (0.01879),[-4.12848]	-0.017937,(0.00470),[-3.81359]
US_SP(-3)	0.043899, (0.01884),[2.32998]	0.005889,(0.00472),[1.24885]
US_SP(-4)	0.006376 ,(0.01872),[0.34056]	0.003118,(0.00469),[0.66550]
US_ER(-1)	-0.035777 ,(0.07478),[-0.47845]	-0.044271 ,(0.01871),[-2.36562]
US_ER(-2)	-0.014903, (0.07484),[-0.19911]	-0.014209 ,(0.01873),[-0.75855]
US_ER(-3)	-0.169312, (0.07463),[-2.26862]	-0.015878, (0.01868),[-0.85007]
US_ER(-4)	-0.016436, (0.07461),[-0.22030]	0.006322, (0.01867),[0.33857]
C	-5.56E-06 ,(0.00024),[-0.02300]	-4.19E-05 ,(6.1E-05),[-0.69203]
R-squared	0.022777	0.008843
Adj. R-squared	0.020039	0.006067
Sum sq. resids	0.478465	0.029968
S.E. equation	0.012943	0.003239
F-statistic	8.320749	3.185263
Log likelihood	8393.903	12362.56
Akaike AIC	-5.853335	-8.623777
Schwarz SC	-5.834612	-8.605054
Mean dependent	1.66E-06	-3.95E-05
S.D. dependent	0.013075	0.003249
Determinant resid covariance (dof adj.)	1.76E-09	
Determinant resid covariance	1.75E-09	
Log likelihood	20757.96	
Akaike information criterion	-14.47815	
Schwarz criterion	-14.44071	

* Included observations: 2838 after adjustments

*Standard errors in ( ) & t-statistics in [ ]

Appendices (6): Wald Test Results under the VAR Model

A. The Wald test results under the VAR Model for China

(A) Equation D(CH_SP)				(B) Equation D(CH_ER)			
Test Statistic	**Value**	**df**	**Probability**	**Test Statistic**	**Value**	**df**	**Probability**
F-statistic	NA	(1, 2847)	NA	F-statistic	NA	(1, 2847)	NA
Chi-square	NA	1	NA	Chi-square	NA	1	NA
Null Hypothesis*: CH_SP=C(1)*CH_SP(-1)+C(2)*CH_SP-2)+C(3) *CH_SP (-3)+C(4)*CH_SP(-4)+C(5)*CH_SP(5)+C(6)*CH_SP(6)+C(7)*CH_SP(7)+ C(8)*CH_ER(1)+C(9)*CH_ER(2)+C(10) *CH_ER(-3)+ C(11)*CH_ER(-4)+ C(12)*CH_ER(-5) + C(13) *CH_ER(-6) + C(14)*CH_ER(-7) + C(15)*				**Null Hypothesis***:CH_ER=C(16)*CH_SP(1)+C(17)*CH_SP(2)+C(18)*CH_SP(3)+C(19) *CH SP(4)+C(20)*CH_SP(5)+C(21)*CH_SP(6)+C(22)*CH_SP(7)+C(23)*CH_ER(1)+ C(24)*C H_ER(2)+C(25)*CH_ ER(3)+C(26)*CH_ER(-4) + C(27)*CH_ER(-5) + C(28) *CH_ER(-6)+C(29)*CH_ER(-7) + C(30)*			
Null Hypothesis Summary:				**Null Hypothesis Summary:**			
Normalized Restriction (= 0)		**Value**	**Std. Err.**	**Normalized Restriction (= 0)**			
-C(15) - C(8)*CH_ER(-1) – C(9)*CH_ER(-2) – C(10)*CH_ER(-3) – C(11)*CH_ER(-4) – C(12)*CH_ER(-5) – C(13)*CH_ER(-6) – C(14)*CH_ER(-7) + CH_SP – C(1)*CH_SP(-1) – C(2)*CH_SP(-2) – C(3)*CH_SP(-3) – C(4)*CH_SP(-4) – C(5)*CH_SP(-5) – C(6)*CH_SP(-6) – C(7)*CH_SP(-7)		NA	1.51E+39	-C(30)+CH_ER - C(23)*CH_ER(-1) - C(24)*CH_ER(-2) - C(25)*CH_ER(-3) - C(26)*CH_ER(-4) - C(27)*CH_ER(-5) - C(28)*CH_ER(-6) - C(29)*CH_ER(-7) - C(16)*CH_SP(-1) - C(17)*CH_SP(-2) - C(18)*CH_SP(-3) - C(19)*CH_SP(-4) - C(20)*CH_SP(-5) - C(21)*CH_SP(-6) - C(22)*CH_SP(-7)		NA	2.51E+38
Restrictions are linear in coefficients Restrictions evaluated at observation (t = "1/03/2000")				Restrictions are linear in coefficients Restrictions evaluated at observation (t = "1/03/2000")			

B. The Wald test results under the VAR Model for the United Kingdom

(A) Equation D(UK_SP)

Test Statistic	**Value**	**df**	**Probability**
F-statistic	NA	(1, 2847)	NA
Chi-square	NA	1	NA
Null Hypothesis: *UK_SP = C(1)*UK_SP(-1) + C(2)*UK_SP(-2) + C(3)*UK_SP(-3) + C(4)*UK_SP(-4) + C(5)*UK_SP(-5) + C(6)*UK_SP(-6) + C(7)*UK_SP(-7) + C(8)*UK_ER(-1) + C(9)*UK_ER(-2) + C(10)*UK_ER(-3) + C(11) *UK_ER(-4) + C(12)*UK_ER(-5) + C(13)*UK_ER(-6) + C(14)*UK_ER(-7) + C(15)*			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
-C(15) - C(8)*UK_ER(-1) - C(9)*UK_ER(-2) – C(10)*UK_ER(-3) – C(11)*UK_ER(-4) – C(12)*UK_ER(-5) – C(13)*UK_ER(-6) – C(14)*UK_ER(-7) + UK_SP – C(1)*UK_SP(-1)- C(2)*UK_SP(-2) – C(3)*UK_SP(-3) – C(4)*UK_SP(-4) – C(5)*UK_SP(-5) – C(6)*UK_SP(-6) -			
C(7)*UK_SP(-7).		NA	2.51E+38
Restrictions are linear in coefficients Restrictions evaluated at observation (t = "1/03/2000")			

(B) Equation D(UK_ER)

Test Statistic	**Value**	**df**	**Probability**
F-statistic	NA	(1, 2847)	NA
Chi-square	NA	1	NA
Null Hypothesis: *UK_ER = C(16)*UK_SP(-1) + C(17) *UK_SP(-2) + C(18)*UK_SP(-3) + C(19)*UK_SP(-4) + C(20)*UK_SP(-5) + C(21)*UK_SP(-6) + C(22)*UK_SP(-7) + C(23)*UK_ER(-1) + C(24)*UK_ER(-2) + C(25) *UK_ER(-3) + C(26)*UK_ER(-4) + C(27)*UK_ER(-5) + C(28)*UK_ER(-6) + C(29)*UK_ER(-7) + C(30)*			
Null Hypothesis Summary:		Value	Std. Err.
Normalized Restriction (= 0)			
-C(30) + UK_ER - C(23)*UK_ER(-1) - C(24)*UK_ER(-2) - C(25)*UK_ER(-3) - C(26)*UK_ER(-4) - C(27)*UK_ER(-5) - C(28)*UK_ER(-6) - C(29)*UK_ER(-7) - C(16)*UK_SP(-1) - C(17)*UK_SP(-2) - C(18)*UK_SP(-3) - C(19)*UK_SP(-4) - C(20)*UK_SP(-5) - C(21)*UK_SP(-6) -			
C(22)*UK_SP(-7)		NA	1.84E+53
Restrictions are linear in coefficients Restrictions evaluated at observation (t = "1/03/2000")			

C. The Wald test results under the VAR Model for the United States

(A) Equation D(CH_SP)				(B) Equation D(CH_ER)			
Test Statistic	**Value**	**df**	**Probability**	**Test Statistic**	**Value**	**df**	**Probability**
F-statistic	NA	(1, 2856)	NA	F-statistic	NA	(1, 2856)	NA
Chi-square	NA	1	NA	Chi-square	NA	1	NA
Null Hypothesis: US_SP = C(1)*US_SP(-1) + C(2)*US_SP(-2) + C(3)*US_SP(-3) + C(4)*US_				**Null Hypothesis**: US_ER = C(10)*US_SP(-1) + C(11) *US_SP(-2) +			
C(6)*US_ER(-2) + C(7)*US_ER(-3) + C(8) *US_ER(-4) + C(9)				C(12)*US_SP(-3) + C(13)*US_SP(-4) +C(14)*US_ER(-1) + C(15)*US_ER(-2) +			
				C(16)*US_ER(-3) + C(17)*US_ER(-4) + C(18)			
Null Hypothesis Summary:				Null Hypothesis Summary:		Value	Std. Err.
Normalized Restriction (= 0)		Value	Std. Err.	Normalized Restriction (= 0)			
-C(9) - C(5)*US_ER(-1) – C(6)*US_ER(-2) – C(7)*US_ER(-3) – C(8)*US_ER(-4) + US_SP- C(1)*US_SP(-1) – C(2)*US_SP(-2) –				-C(18) + US_ER - C(14)*US_ER(-1) - C(15)*US_ER(-2) - C(16)*US_ER(-3) - C(17)*US_ER(-4) - C(10)*US_SP(-1) C(11)*US_SP(-2) - C(12)*US_SP(-3) C(13)*US_SP(-4)			
C(3)*US_SP(-3) -		NA	1.84E+53	C(22)*CH_SP(-7)		NA	5.30E+91
Restrictions are linear in coefficients Restrictions evaluated at observation (t = "1/03/2000")				Restrictions are linear in coefficients Restrictions evaluated at observation (t = "1/03/2000")			

Appendices (7): Augmented Dickey–Fuller Unit Root Test of the Sample Time Series Data

A. Augmented Dickey–Fuller test of the Shanghai Stock Exchange Composite Index at (level /intercept)

Null Hypothesis: CH_SP has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.854932	0.8024
Test critical values:	1% level	-3.436395	
	5% level	-2.864098	
	10% level	-2.568183	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CH_SP)
Method: Least Squares
Date: 05/03/15 Time: 09:11
Sample (adjusted): 1/17/2011 3/31/2015
Included observations: 1044 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CH_SP(-1)	-0.007120	0.008328	-0.854932	0.3928
D(CH_SP(-1))	-6.18E-05	0.031310	-0.001975	0.9984
D(CH_SP(-2))	-0.017258	0.031302	-0.551333	0.5815
D(CH_SP(-3))	-0.658749	0.031297	-21.04845	0.0000
D(CH_SP(-4))	-0.003374	0.035137	-0.096025	0.9235
D(CH_SP(-5))	-0.026696	0.035117	-0.760193	0.4473
D(CH_SP(-6))	-0.393403	0.035116	-11.20291	0.0000
D(CH_SP(-7))	0.002770	0.030681	0.090282	0.9281
D(CH_SP(-8))	-0.005522	0.030675	-0.180013	0.8572
D(CH_SP(-9))	-0.189707	0.030670	-6.185477	0.0000
C	0.055654	0.064629	0.861139	0.3894

R-squared	0.315190	Mean dependent var	0.000255
Adjusted R-squared	0.308560	S.D. dependent var	0.042606
S.E. of regression	0.035428	Akaike info criterion	-3.832158
Sum squared resid	1.296550	Schwarz criterion	-3.779994
Log likelihood	2011.387	Hannan-Quinn criter.	-3.812374
F-statistic	47.54467	Durbin-Watson stat	1.993752
Prob(F-statistic)	0.000000		

B. Augmented Dickey–Fuller test of the Shanghai Stock Exchange Composite Index at (1St Difference)

Null Hypothesis: D(CH_SP) has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-17.14523	0.0000
Test critical values:	1% level	-3.436395	
	5% level	-2.864098	
	10% level	-2.568183	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CH_SP,2)
Method: Least Squares
Date: 05/03/15 Time: 12:55
Sample (adjusted): 1/17/2011 3/31/2015
Included observations: 1044 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CH_SP(-1))	-2.329401	0.135863	-17.14523	0.0000
D(CH_SP(-1),2)	1.323410	0.125479	10.54690	0.0000
D(CH_SP(-2),2)	1.300255	0.114189	11.38687	0.0000
D(CH_SP(-3),2)	0.635668	0.101359	6.271473	0.0000
D(CH_SP(-4),2)	0.627905	0.088020	7.133695	0.0000
D(CH_SP(-5),2)	0.596960	0.072867	8.192407	0.0000
D(CH_SP(-6),2)	0.199392	0.053562	3.722624	0.0002
D(CH_SP(-7),2)	0.199799	0.043351	4.608874	0.0000
D(CH_SP(-8),2)	0.191986	0.030550	6.284402	0.0000
C	0.000409	0.001096	0.373114	0.7091

R-squared	0.655042	Mean dependent var	5.77E-05
Adjusted R-squared	0.652040	S.D. dependent var	0.060051
S.E. of regression	0.035423	Akaike info criterion	-3.833367
Sum squared resid	1.297467	Schwarz criterion	-3.785945
Log likelihood	2011.017	Hannan-Quinn criter.	-3.815381
F-statistic	218.1630	Durbin-Watson stat	1.994655
Prob(F-statistic)	0.000000		

C. Augmented Dickey–Fuller test of the Chinese Exchange Rate at (level /intercept)

Null Hypothesis: CH_ER has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.159494	0.9409
Test critical values:	1% level	-3.436395	
	5% level	-2.864098	
	10% level	-2.568183	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CH_ER)
Method: Least Squares
Date: 05/03/15 Time: 09:06
Sample (adjusted): 1/06/2011 3/31/2015
Included observations: 1044 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CH_ER(-1)	-0.000428	0.002684	-0.159494	0.8733
D(CH_ER(-1))	-0.178601	0.029971	-5.959210	0.0000
D(CH_ER(-2))	-0.265336	0.029813	-8.899990	0.0000
C	-0.000770	0.006076	-0.126743	0.8992

R-squared	0.089574	Mean dependent var	0.000142
Adjusted R-squared	0.086948	S.D. dependent var	0.003930
S.E. of regression	0.003756	Akaike info criterion	-8.327356
Sum squared resid	0.014668	Schwarz criterion	-8.308388
Log likelihood	4350.880	Hannan-Quinn criter.	-8.320162
F-statistic	34.10743	Durbin-Watson stat	2.036582
Prob(F-statistic)	0.000000		

D. Augmented Dickey–Fuller test of the Chinese Exchange Rate at (1^{St} Difference)

Null Hypothesis: D(CH_ER) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-32.04700	0.0000
Test critical values:	1% level	-3.436395	
	5% level	-2.864098	
	10% level	-2.568183	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CH_ER,2)
Method: Least Squares
Date: 05/03/15 Time: 09:07
Sample (adjusted): 1/06/2011 3/31/2015
Included observations: 1044 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CH_ER(-1))	-1.444533	0.045075	-32.04700	0.0000
D(CH_ER(-1),2)	0.265608	0.029750	8.928020	0.0000
C	0.000199	0.000116	1.709199	0.0877

R-squared	0.600855	Mean dependent var	1.96E-06
Adjusted R-squared	0.600088	S.D. dependent var	0.005936
S.E. of regression	0.003754	Akaike info criterion	-8.329248
Sum squared resid	0.014668	Schwarz criterion	-8.315021
Log likelihood	4350.867	Hannan-Quinn criter.	-8.323852
F-statistic	783.5372	Durbin-Watson stat	2.036780
Prob(F-statistic)	0.000000		

E. Augmented Dickey–Fuller test of the FTSE Eurotop 100 Index price at (level /intercept)

Null Hypothesis: EURO_SP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.533191	0.8821
Test critical values:	1% level	-3.436094	
	5% level	-2.863965	
	10% level	-2.568112	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EURO_SP)
Method: Least Squares
Date: 05/03/15 Time: 09:13
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1097 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EURO_SP(-1)	-0.001421	0.002664	-0.533191	0.5940
C	0.011339	0.020759	0.546228	0.5850

R-squared	0.000260	Mean dependent var	0.000272
Adjusted R-squared	-0.000653	S.D. dependent var	0.010167
S.E. of regression	0.010170	Akaike info criterion	-6.336922
Sum squared resid	0.113255	Schwarz criterion	-6.327806
Log likelihood	3477.802	Hannan-Quinn criter.	-6.333473
F-statistic	0.284293	Durbin-Watson stat	1.954587
Prob(F-statistic)	0.594009		

F. Augmented Dickey–Fuller test of the FTSE Eurotop 100 Index price (1^{St} Difference)

Null Hypothesis: D(EURO_SP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-32.46412	0.0000
Test critical values:	1% level	-3.436116	
	5% level	-2.863974	
	10% level	-2.568117	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EURO_SP,2)
Method: Least Squares
Date: 05/03/15 Time: 09:13
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1093 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO_SP(-1))	-0.980200	0.030193	-32.46412	0.0000
C	0.000287	0.000307	0.932721	0.3512

R-squared	0.491356	Mean dependent var	1.86E-05
Adjusted R-squared	0.490890	S.D. dependent var	0.014229
S.E. of regression	0.010152	Akaike info criterion	-6.340400
Sum squared resid	0.112449	Schwarz criterion	-6.331257
Log likelihood	3467.029	Hannan-Quinn criter.	-6.336940
F-statistic	1053.919	Durbin-Watson stat	2.003366
Prob(F-statistic)	0.000000		

M. Augmented Dickey–Fuller test of the Euro Exchange Rate (level /intercept)

Null Hypothesis: EURO_ER has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.096271	0.9480
Test critical values:	1% level	-3.436273	
	5% level	-2.864043	
	10% level	-2.568154	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EURO_ER)
Method: Least Squares
Date: 05/03/15 Time: 09:17
Sample (adjusted): 1/06/2011 3/31/2015
Included observations: 1065 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EURO_ER(-1)	-0.000368	0.003818	-0.096271	0.9233
D(EURO_ER(-1))	-0.154873	0.030590	-5.062798	0.0000
D(EURO_ER(-2))	-0.091930	0.030546	-3.009527	0.0027
C	-0.000131	0.000573	-0.228396	0.8194

R-squared	0.028717	Mean dependent var	-5.70E-05
Adjusted R-squared	0.025971	S.D. dependent var	0.003897
S.E. of regression	0.003846	Akaike info criterion	-8.279984
Sum squared resid	0.015691	Schwarz criterion	-8.261315
Log likelihood	4413.091	Hannan-Quinn criter.	-8.272910
F-statistic	10.45657	Durbin-Watson stat	1.980127
Prob(F-statistic)	0.000001		

G. Augmented Dickey–Fuller test of the Euro Exchange Rate at (1^{St} Difference)

Null Hypothesis: D(EURO_ER) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-27.09541	0.0000
Test critical values:	1% level	-3.436273	
	5% level	-2.864043	
	10% level	-2.568154	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EURO_ER,2)
Method: Least Squares
Date: 05/03/15 Time: 09:17
Sample (adjusted): 1/06/2011 3/31/2015
Included observations: 1065 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO_ER(-1))	-1.247381	0.046037	-27.09541	0.0000
D(EURO_ER(-1),2)	0.092196	0.030407	3.032087	0.0025
C	-7.69E-05	0.000118	-0.652150	0.5144

R-squared	0.577235	Mean dependent var	2.69E-05
Adjusted R-squared	0.576439	S.D. dependent var	0.005906
S.E. of regression	0.003844	Akaike info criterion	-8.281853
Sum squared resid	0.015692	Schwarz criterion	-8.267851
Log likelihood	4413.087	Hannan-Quinn criter.	-8.276548
F-statistic	725.0165	Durbin-Watson stat	1.980213
Prob(F-statistic)	0.000000		

H. Augmented Dickey–Fuller test of the FTSE100 Index Price at (level /intercept)

Null Hypothesis: UK_SP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.848152	0.3572
Test critical values:	1% level	-3.436105	
	5% level	-2.863969	
	10% level	-2.568115	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UK_SP)
Method: Least Squares
Date: 05/03/15 Time: 09:19
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1095 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UK_SP(-1)	-0.006769	0.003663	-1.848152	0.0649
C	0.059171	0.031959	1.851478	0.0644

R-squared	0.003115	Mean dependent var	0.000109
Adjusted R-squared	0.002203	S.D. dependent var	0.009918
S.E. of regression	0.009907	Akaike info criterion	-6.389331
Sum squared resid	0.107276	Schwarz criterion	-6.380201
Log likelihood	3500.159	Hannan-Quinn criter.	-6.385876
F-statistic	3.415664	Durbin-Watson stat	2.022851
Prob(F-statistic)	0.064850		

I. Augmented Dickey–Fuller test of the FTSE100 Index Price (1^{St} Difference)

Null Hypothesis: D(UK_SP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-33.53247	0.0000
Test critical values:	1% level	-3.436132	
	5% level	-2.863981	
	10% level	-2.568121	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UK_SP,2)
Method: Least Squares
Date: 05/03/15 Time: 09:20
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1090 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UK_SP(-1))	-1.015997	0.030299	-33.53247	0.0000
C	0.000135	0.000300	0.450615	0.6524

R-squared	0.508232	Mean dependent var	2.72E-06
Adjusted R-squared	0.507780	S.D. dependent var	0.014138
S.E. of regression	0.009919	Akaike info criterion	-6.386865
Sum squared resid	0.107048	Schwarz criterion	-6.377702
Log likelihood	3482.842	Hannan-Quinn criter.	-6.383397
F-statistic	1124.426	Durbin-Watson stat	2.005779
Prob(F-statistic)	0.000000		

J. Augmented Dickey–Fuller test of the UK Exchange Rate at (level /intercept)

Null Hypothesis: UK_ER has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.442208	0.5626
Test critical values:	1% level	-3.436216	
	5% level	-2.864018	
	10% level	-2.568141	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UK_ER)
Method: Least Squares
Date: 05/03/15 Time: 09:21
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1075 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UK_ER(-1)	-0.005145	0.003568	-1.442208	0.1495
D(UK_ER(-1))	-0.123207	0.030366	-4.057430	0.0001
C	0.000299	0.000177	1.684831	0.0923

R-squared	0.017737	Mean dependent var	8.04E-05
Adjusted R-squared	0.015905	S.D. dependent var	0.003320
S.E. of regression	0.003294	Akaike info criterion	-8.590785
Sum squared resid	0.011630	Schwarz criterion	-8.576887
Log likelihood	4620.547	Hannan-Quinn criter.	-8.585522
F-statistic	9.678866	Durbin-Watson stat	2.020848
Prob(F-statistic)	0.000068		

K. Augmented Dickey–Fuller test of the UK Exchange Rate at (1^{St} Difference)

Null Hypothesis: D(UK_ER) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-37.13555	0.0000
Test critical values:	1% level	-3.436216	
	5% level	-2.864018	
	10% level	-2.568141	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UK_ER,2)
Method: Least Squares
Date: 05/03/15 Time: 09:22
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1075 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UK_ER(-1))	-1.125968	0.030320	-37.13555	0.0000
C	8.80E-05	0.000101	0.875842	0.3813

R-squared	0.562407	Mean dependent var	1.97E-05
Adjusted R-squared	0.561999	S.D. dependent var	0.004979
S.E. of regression	0.003295	Akaike info criterion	-8.590707
Sum squared resid	0.011653	Schwarz criterion	-8.581442
Log likelihood	4619.505	Hannan-Quinn criter.	-8.587198
F-statistic	1379.049	Durbin-Watson stat	2.022035
Prob(F-statistic)	0.000000		

L. Augmented Dickey–Fuller test of the Dow Jones Industrial Average Index at (level /intercept)

Null Hypothesis: US_SP has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.754405	0.4035
Test critical values:	1% level	-3.436089	
	5% level	-2.863962	
	10% level	-2.568111	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US_SP)
Method: Least Squares
Date: 05/03/15 Time: 09:24
Sample (adjusted): 1/14/2011 3/31/2015
Included observations: 1098 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
US_SP(-1)	-0.027184	0.015495	-1.754405	0.0796
D(US_SP(-1))	-0.838854	0.033124	-25.32479	0.0000
D(US_SP(-2))	-0.709114	0.041262	-17.18582	0.0000
D(US_SP(-3))	-0.594718	0.045621	-13.03599	0.0000
D(US_SP(-4))	-0.479175	0.047534	-10.08069	0.0000
D(US_SP(-5))	-0.371394	0.047264	-7.857807	0.0000
D(US_SP(-6))	-0.272418	0.044765	-6.085470	0.0000
D(US_SP(-7))	-0.183042	0.039653	-4.616152	0.0000
D(US_SP(-8))	-0.089196	0.030206	-2.952909	0.0032
C	0.261823	0.148237	1.766245	0.0776

R-squared	0.430601	Mean dependent var	0.000378
Adjusted R-squared	0.425891	S.D. dependent var	0.099033
S.E. of regression	0.075037	Akaike info criterion	-2.332603
Sum squared resid	6.126056	Schwarz criterion	-2.287054
Log likelihood	1290.599	Hannan-Quinn criter.	-2.315370
F-statistic	91.42089	Durbin-Watson stat	2.014095
Prob(F-statistic)	0.000000		

M. Augmented Dickey–Fuller test of the Dow Jones Industrial Average Index at (1^{St} Difference)

Null Hypothesis: D(US_SP) has a unit root
Exogenous: Constant
Lag Length: 8 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-18.08831	0.0000
Test critical values:	1% level	-3.436094	
	5% level	-2.863965	
	10% level	-2.568112	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US_SP,2)
Method: Least Squares
Date: 05/03/15 Time: 09:25
Sample (adjusted): 1/17/2011 3/31/2015
Included observations: 1097 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(US_SP(-1))	-5.029598	0.278058	-18.08831	0.0000
D(US_SP(-1),2)	3.159071	0.264073	11.96286	0.0000
D(US_SP(-2),2)	2.413351	0.240537	10.03319	0.0000
D(US_SP(-3),2)	1.777353	0.210466	8.444837	0.0000
D(US_SP(-4),2)	1.251396	0.175930	7.113042	0.0000
D(US_SP(-5),2)	0.826999	0.138767	5.959637	0.0000
D(US_SP(-6),2)	0.494785	0.100756	4.910722	0.0000
D(US_SP(-7),2)	0.245339	0.063860	3.841815	0.0001
D(US_SP(-8),2)	0.082029	0.030231	2.713408	0.0068
C	0.001946	0.002265	0.859169	0.3904

R-squared	0.810929	Mean dependent var	1.25E-06
Adjusted R-squared	0.809363	S.D. dependent var	0.171599
S.E. of regression	0.074924	Akaike info criterion	-2.335621
Sum squared resid	6.101927	Schwarz criterion	-2.290039
Log likelihood	1291.088	Hannan-Quinn criter.	-2.318375
F-statistic	518.0168	Durbin-Watson stat	2.012227
Prob(F-statistic)	0.000000		

N. Augmented Dickey–Fuller test of the US Exchange Rate at (level /intercept)

Null Hypothesis: US_ER has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.387176	0.9824
Test critical values:	1% level	-3.436199	
	5% level	-2.864011	
	10% level	-2.568137	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US_ER)
Method: Least Squares
Date: 05/03/15 Time: 09:27
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1078 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
US_ER(-1)	0.001225	0.003163	0.387176	0.6987
D(US_ER(-1))	-0.181319	0.030213	-6.001351	0.0000
C	0.000625	0.001350	0.462511	0.6438

R-squared	0.032452	Mean dependent var	8.79E-05
Adjusted R-squared	0.030652	S.D. dependent var	0.003009
S.E. of regression	0.002963	Akaike info criterion	-8.802458
Sum squared resid	0.009438	Schwarz criterion	-8.788591
Log likelihood	4747.525	Hannan-Quinn criter.	-8.797206
F-statistic	18.02807	Durbin-Watson stat	2.015965
Prob(F-statistic)	0.000000		

O. Augmented Dickey–Fuller test of the US Exchange Rate at (1^{St} Difference)

Null Hypothesis: D(US_ER) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-39.26498	0.0000
Test critical values:	1% level	-3.436199	
	5% level	-2.864011	
	10% level	-2.568137	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(US_ER,2)
Method: Least Squares
Date: 05/03/15 Time: 09:27
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1078 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(US_ER(-1))	-1.180177	0.030057	-39.26498	0.0000
C	0.000103	9.02E-05	1.140166	0.2545

R-squared	0.588958	Mean dependent var	4.87E-06
Adjusted R-squared	0.588576	S.D. dependent var	0.004618
S.E. of regression	0.002962	Akaike info criterion	-8.804173
Sum squared resid	0.009439	Schwarz criterion	-8.794929
Log likelihood	4747.449	Hannan-Quinn criter.	-8.800673
F-statistic	1541.739	Durbin-Watson stat	2.015437
Prob(F-statistic)	0.000000		

Appendices (8): Phillips –Perron Unit Root Test of the Sample Time Series Data

A. Phillips–Perron test of the Shanghai Stock Exchange Composite Index at (level /intercept

Null Hypothesis: CH_SP has a unit root
Exogenous: Constant
Bandwidth: 46 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.041718	0.0013
Test critical values:	1% level	-3.436138	
	5% level	-2.863984	
	10% level	-2.568122	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.001714
HAC corrected variance (Bartlett kernel)	0.001509

Phillips-Perron Test Equation
Dependent Variable: D(CH_SP)
Method: Least Squares
Date: 05/03/15 Time: 09:11
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1089 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CH_SP(-1)	-0.037495	0.008613	-4.353354	0.0000
C	0.291467	0.066911	4.356033	0.0000

R-squared	0.017136	Mean dependent var	0.000231
Adjusted R-squared	0.016232	S.D. dependent var	0.041779
S.E. of regression	0.041438	Akaike info criterion	-3.527390
Sum squared resid	1.866518	Schwarz criterion	-3.518220
Log likelihood	1922.664	Hannan-Quinn criter.	-3.523920
F-statistic	18.95169	Durbin-Watson stat	1.954066
Prob(F-statistic)	0.000015		

B. Phillips–Perron test of the Shanghai Stock Exchange Composite Index at (1St Difference)

Null Hypothesis: D(CH_SP) has a unit root
Exogenous: Constant
Bandwidth: 223 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-48.38090	0.0001
Test critical values:	1% level	-3.436165	
	5% level	-2.863996	
	10% level	-2.568129	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.001751
HAC corrected variance (Bartlett kernel)	0.000261

Phillips-Perron Test Equation
Dependent Variable: D(CH_SP,2)
Method: Least Squares
Date: 05/03/15 Time: 09:12
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1084 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CH_SP(-1))	-0.993671	0.030400	-32.68635	0.0000
C	0.000197	0.001272	0.154549	0.8772

R-squared	0.496837	Mean dependent var	-6.12E-06
Adjusted R-squared	0.496372	S.D. dependent var	0.059022
S.E. of regression	0.041886	Akaike info criterion	-3.505899
Sum squared resid	1.898278	Schwarz criterion	-3.496695
Log likelihood	1902.197	Hannan-Quinn criter.	-3.502415
F-statistic	1068.398	Durbin-Watson stat	2.006789
Prob(F-statistic)	0.000000		

C. Phillips–Perron test of the Chinese Exchange Rate at (level /intercept)

Null Hypothesis: CH_ER has a unit root
Exogenous: Constant
Bandwidth: 59 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.249120	0.9755
Test critical values:	1% level	-3.436244	
	5% level	-2.864031	
	10% level	-2.568147	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.53E-05
HAC corrected variance (Bartlett kernel)	6.07E-06

Phillips-Perron Test Equation
Dependent Variable: D(CH_ER)
Method: Least Squares
Date: 05/03/15 Time: 09:09
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1070 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CH_ER(-1)	-0.001926	0.002700	-0.713490	0.4757
C	-0.004220	0.006108	-0.690809	0.4898

R-squared	0.000476	Mean dependent var	0.000138
Adjusted R-squared	-0.000459	S.D. dependent var	0.003913
S.E. of regression	0.003914	Akaike info criterion	-8.246543
Sum squared resid	0.016363	Schwarz criterion	-8.237243
Log likelihood	4413.900	Hannan-Quinn criter.	-8.243020
F-statistic	0.509068	Durbin-Watson stat	2.286261
Prob(F-statistic)	0.475698		

D. Phillips–Perron test of the Chinese Exchange Rate at (1St Difference)

Null Hypothesis: D(CH_ER) has a unit root
Exogenous: Constant
Bandwidth: 49 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-44.02824	0.0001
Test critical values:	1% level	-3.436319	
	5% level	-2.864064	
	10% level	-2.568165	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.50E-05
HAC corrected variance (Bartlett kernel)	6.07E-06

Phillips-Perron Test Equation
Dependent Variable: D(CH_ER,2)
Method: Least Squares
Date: 05/03/15 Time: 09:10
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1057 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CH_ER(-1))	-1.140872	0.030379	-37.55417	0.0000
C	0.000172	0.000119	1.440052	0.1501

R-squared	0.572063	Mean dependent var	3.10E-05
Adjusted R-squared	0.571657	S.D. dependent var	0.005924
S.E. of regression	0.003877	Akaike info criterion	-8.265508
Sum squared resid	0.015860	Schwarz criterion	-8.256117
Log likelihood	4370.321	Hannan-Quinn criter.	-8.261949
F-statistic	1410.316	Durbin-Watson stat	2.089212
Prob(F-statistic)	0.000000		

E. Phillips–Perron test of the FTSE Eurotop 100 Index price at (level /intercept)

Null Hypothesis: EURO_SP has a unit root
Exogenous: Constant
Bandwidth: 12 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.357002	0.9137
Test critical values:	1% level	-3.436094	
	5% level	-2.863965	
	10% level	-2.568112	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000103
HAC corrected variance (Bartlett kernel)	8.90E-05

Phillips-Perron Test Equation
Dependent Variable: D(EURO_SP)
Method: Least Squares
Date: 05/03/15 Time: 09:14
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1097 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EURO_SP(-1)	-0.001421	0.002664	-0.533191	0.5940
C	0.011339	0.020759	0.546228	0.5850

R-squared	0.000260	Mean dependent var	0.000272
Adjusted R-squared	-0.000653	S.D. dependent var	0.010167
S.E. of regression	0.010170	Akaike info criterion	-6.336922
Sum squared resid	0.113255	Schwarz criterion	-6.327806
Log likelihood	3477.802	Hannan-Quinn criter.	-6.333473
F-statistic	0.284293	Durbin-Watson stat	1.954587
Prob(F-statistic)	0.594009		

F. Phillips–Perron test of the FTSE Eurotop 100 Index price at (1St Difference)

Null Hypothesis: D(EURO_SP) has a unit root
Exogenous: Constant
Bandwidth: 13 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-32.55706	0.0000
Test critical values:	1% level	-3.436116	
	5% level	-2.863974	
	10% level	-2.568117	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000103
HAC corrected variance (Bartlett kernel)	8.54E-05

Phillips-Perron Test Equation
Dependent Variable: D(EURO_SP,2)
Method: Least Squares
Date: 05/03/15 Time: 09:14
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1093 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO_SP(-1))	-0.980200	0.030193	-32.46412	0.0000
C	0.000287	0.000307	0.932721	0.3512

R-squared	0.491356	Mean dependent var	1.86E-05
Adjusted R-squared	0.490890	S.D. dependent var	0.014229
S.E. of regression	0.010152	Akaike info criterion	-6.340400
Sum squared resid	0.112449	Schwarz criterion	-6.331257
Log likelihood	3467.029	Hannan-Quinn criter.	-6.336940
F-statistic	1053.919	Durbin-Watson stat	2.003366
Prob(F-statistic)	0.000000		

G. Phillips –Perron test of the Euro Exchange Rate (level /intercept)

Null Hypothesis: EURO_ER has a unit root
Exogenous: Constant
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.268060	0.9270
Test critical values:	1% level	-3.436160	
	5% level	-2.863994	
	10% level	-2.568128	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.52E-05
HAC corrected variance (Bartlett kernel)	1.11E-05

Phillips-Perron Test Equation
Dependent Variable: D(EURO_ER)
Method: Least Squares
Date: 05/03/15 Time: 09:18
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1085 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EURO_ER(-1)	-0.002989	0.003802	-0.786242	0.4319
C	-0.000525	0.000572	-0.917079	0.3593

R-squared	0.000570	Mean dependent var	-8.46E-05
Adjusted R-squared	-0.000352	S.D. dependent var	0.003906
S.E. of regression	0.003907	Akaike info criterion	-8.250179
Sum squared resid	0.016533	Schwarz criterion	-8.240982
Log likelihood	4477.722	Hannan-Quinn criter.	-8.246697
F-statistic	0.618176	Durbin-Watson stat	2.290248
Prob(F-statistic)	0.431898		

H. Phillips–Perron test of the Euro Exchange Rate at (1St Difference)

Null Hypothesis: D(EURO_ER) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-38.06449	0.0000
Test critical values:	1% level	-3.436216	
	5% level	-2.864018	
	10% level	-2.568141	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.50E-05
HAC corrected variance (Bartlett kernel)	1.39E-05

Phillips-Perron Test Equation
Dependent Variable: D(EURO_ER,2)
Method: Least Squares
Date: 05/03/15 Time: 09:18
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1075 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO_ER(-1))	-1.146044	0.030288	-37.83880	0.0000
C	-0.000102	0.000118	-0.859498	0.3903

R-squared	0.571618	Mean dependent var	-1.19E-05
Adjusted R-squared	0.571219	S.D. dependent var	0.005922
S.E. of regression	0.003878	Akaike info criterion	-8.265317
Sum squared resid	0.016134	Schwarz criterion	-8.256052
Log likelihood	4444.608	Hannan-Quinn criter.	-8.261808
F-statistic	1431.775	Durbin-Watson stat	2.006609
Prob(F-statistic)	0.000000		

I. Phillips –Perron test of the FTSE100 Index at (level /intercept)

Null Hypothesis: UK_SP has a unit root
Exogenous: Constant
Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.616568	0.4737
Test critical values:	1% level	-3.436105	
	5% level	-2.863969	
	10% level	-2.568115	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	9.80E-05
HAC corrected variance (Bartlett kernel)	7.82E-05

Phillips-Perron Test Equation
Dependent Variable: D(UK_SP)
Method: Least Squares
Date: 05/03/15 Time: 09:20
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1095 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UK_SP(-1)	-0.006769	0.003663	-1.848152	0.0649
C	0.059171	0.031959	1.851478	0.0644

R-squared	0.003115	Mean dependent var	0.000109
Adjusted R-squared	0.002203	S.D. dependent var	0.009918
S.E. of regression	0.009907	Akaike info criterion	-6.389331
Sum squared resid	0.107276	Schwarz criterion	-6.380201
Log likelihood	3500.159	Hannan-Quinn criter.	-6.385876
F-statistic	3.415664	Durbin-Watson stat	2.022851
Prob(F-statistic)	0.064850		

J. Phillips –Perron test of the FTSE100 Index at (1^{St} Difference)

Null Hypothesis: D(UK_SP) has a unit root
Exogenous: Constant
Bandwidth: 12 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-33.87843	0.0000
Test critical values:	1% level	-3.436132	
	5% level	-2.863981	
	10% level	-2.568121	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	9.82E-05
HAC corrected variance (Bartlett kernel)	7.60E-05

Phillips-Perron Test Equation
Dependent Variable: D(UK_SP,2)
Method: Least Squares
Date: 05/03/15 Time: 09:21
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1090 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UK_SP(-1))	-1.015997	0.030299	-33.53247	0.0000
C	0.000135	0.000300	0.450615	0.6524

R-squared	0.508232	Mean dependent var	2.72E-06
Adjusted R-squared	0.507780	S.D. dependent var	0.014138
S.E. of regression	0.009919	Akaike info criterion	-6.386865
Sum squared resid	0.107048	Schwarz criterion	-6.377702
Log likelihood	3482.842	Hannan-Quinn criter.	-6.383397
F-statistic	1124.426	Durbin-Watson stat	2.005779
Prob(F-statistic)	0.000000		

K. Phillips –Perron test of the UK Exchange Rate (level /intercept)

Null Hypothesis: UK_ER has a unit root
Exogenous: Constant
Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.406518	0.5804
Test critical values:	1% level	-3.436160	
	5% level	-2.863994	
	10% level	-2.568128	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.09E-05
HAC corrected variance (Bartlett kernel)	7.67E-06

Phillips-Perron Test Equation
Dependent Variable: D(UK_ER)
Method: Least Squares
Date: 05/03/15 Time: 09:22
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1085 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UK_ER(-1)	-0.006229	0.003553	-1.753248	0.0798
C	0.000326	0.000178	1.837726	0.0664

R-squared	0.002830	Mean dependent var	6.97E-05
Adjusted R-squared	0.001910	S.D. dependent var	0.003314
S.E. of regression	0.003310	Akaike info criterion	-8.581595
Sum squared resid	0.011869	Schwarz criterion	-8.572398
Log likelihood	4657.515	Hannan-Quinn criter.	-8.578113
F-statistic	3.073877	Durbin-Watson stat	2.248315
Prob(F-statistic)	0.079842		

L. Phillips –Perron test of the UK Exchange Rate (1^{St} Difference)

Null Hypothesis: D(UK_ER) has a unit root
Exogenous: Constant
Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-37.69280	0.0000
Test critical values:	1% level	-3.436216	
	5% level	-2.864018	
	10% level	-2.568141	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.08E-05
HAC corrected variance (Bartlett kernel)	9.07E-06

Phillips-Perron Test Equation
Dependent Variable: D(UK_ER,2)
Method: Least Squares
Date: 05/03/15 Time: 09:23
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1075 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UK_ER(-1))	-1.125968	0.030320	-37.13555	0.0000
C	8.80E-05	0.000101	0.875842	0.3813

R-squared	0.562407	Mean dependent var	1.97E-05
Adjusted R-squared	0.561999	S.D. dependent var	0.004979
S.E. of regression	0.003295	Akaike info criterion	-8.590707
Sum squared resid	0.011653	Schwarz criterion	-8.581442
Log likelihood	4619.505	Hannan-Quinn criter.	-8.587198
F-statistic	1379.049	Durbin-Watson stat	2.022035
Prob(F-statistic)	0.000000		

M. Phillips–Perron test of the Dow Jones Industrial Average Index at (level /intercept)

Null Hypothesis: US_SP has a unit root
Exogenous: Constant
Bandwidth: 21 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-14.00573	0.0000
Test critical values:	1% level	-3.436046	
	5% level	-2.863943	
	10% level	-2.568101	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.008816
HAC corrected variance (Bartlett kernel)	0.016536

Phillips-Perron Test Equation
Dependent Variable: D(US_SP)
Method: Least Squares
Date: 05/03/15 Time: 09:25
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1106 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
US_SP(-1)	-0.187636	0.017558	-10.68680	0.0000
C	1.795279	0.167978	10.68756	0.0000

R-squared	0.093751	Mean dependent var	0.000380
Adjusted R-squared	0.092930	S.D. dependent var	0.098674
S.E. of regression	0.093977	Akaike info criterion	-1.889718
Sum squared resid	9.750253	Schwarz criterion	-1.880661
Log likelihood	1047.014	Hannan-Quinn criter.	-1.886293
F-statistic	114.2078	Durbin-Watson stat	2.727783
Prob(F-statistic)	0.000000		

N. Phillips–Perron test of the Dow Jones Industrial Average Index at (1st Difference)

Null Hypothesis: D(US_SP) has a unit root
Exogenous: Constant
Bandwidth: 180 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-362.5669	0.0001
Test critical values:	1% level	-3.436051	
	5% level	-2.863946	
	10% level	-2.568102	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.007304
HAC corrected variance (Bartlett kernel)	0.000104

Phillips-Perron Test Equation
Dependent Variable: D(US_SP,2)
Method: Least Squares
Date: 05/03/15 Time: 09:26
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1105 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(US_SP(-1))	-1.499859	0.026079	-57.51261	0.0000
C	0.000575	0.002573	0.223297	0.8233

R-squared	0.749926	Mean dependent var	-1.17E-05
Adjusted R-squared	0.749700	S.D. dependent var	0.170977
S.E. of regression	0.085540	Akaike info criterion	-2.077860
Sum squared resid	8.070731	Schwarz criterion	-2.068796
Log likelihood	1150.017	Hannan-Quinn criter.	-2.074432
F-statistic	3307.701	Durbin-Watson stat	2.325422
Prob(F-statistic)	0.000000		

O. Phillips –Perron test of the US Exchange Rate (level /intercept)

Null Hypothesis: US_ER has a unit root
Exogenous: Constant
Bandwidth: 10 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.487569	0.9863
Test critical values:	1% level	-3.436149	
	5% level	-2.863989	
	10% level	-2.568125	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	8.98E-06
HAC corrected variance (Bartlett kernel)	6.22E-06

Phillips-Perron Test Equation
Dependent Variable: D(US_ER)
Method: Least Squares
Date: 05/03/15 Time: 09:28
Sample (adjusted): 1/04/2011 3/31/2015
Included observations: 1087 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
US_ER(-1)	-0.000374	0.003147	-0.118912	0.9054
C	-6.93E-05	0.001342	-0.051599	0.9589

R-squared	0.000013	Mean dependent var	9.00E-05
Adjusted R-squared	-0.000909	S.D. dependent var	0.002998
S.E. of regression	0.002999	Akaike info criterion	-8.779029
Sum squared resid	0.009761	Schwarz criterion	-8.769845
Log likelihood	4773.402	Hannan-Quinn criter.	-8.775553
F-statistic	0.014140	Durbin-Watson stat	2.369278
Prob(F-statistic)	0.905367		

P. Phillips–Perron test of the US Exchange Rate (1^{St} Difference)

Null Hypothesis: D(US_ER) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-39.33164	0.0000
Test critical values:	1% level	-3.436199	
	5% level	-2.864011	
	10% level	-2.568137	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	8.76E-06
HAC corrected variance (Bartlett kernel)	8.59E-06

Phillips-Perron Test Equation
Dependent Variable: D(US_ER,2)
Method: Least Squares
Date: 05/03/15 Time: 09:29
Sample (adjusted): 1/05/2011 3/31/2015
Included observations: 1078 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(US_ER(-1))	-1.180177	0.030057	-39.26498	0.0000
C	0.000103	9.02E-05	1.140166	0.2545

R-squared	0.588958	Mean dependent var	4.87E-06
Adjusted R-squared	0.588576	S.D. dependent var	0.004618
S.E. of regression	0.002962	Akaike info criterion	-8.804173
Sum squared resid	0.009439	Schwarz criterion	-8.794929
Log likelihood	4747.449	Hannan-Quinn criter.	-8.800673
F-statistic	1541.739	Durbin-Watson stat	2.015437
Prob(F-statistic)	0.000000		

Appendices (9): VAR Forecast

A. The VAR Forecast test for the Shanghai Stock Exchange Composite Index price and the Chinese exchange rate

Dependent Variable: CH_SP
Method: Least Squares
Date: 05/21/15 Time: 13:02
Sample (adjusted): 1/13/2000 12/31/2010
Included observations: 2862 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000328	0.000403	0.813760	0.4159
CH_SP(-1)	-0.132173	0.018757	-7.046573	0.0000
CH_SP(-2)	-0.034897	0.018888	-1.847590	0.0648
CH_SP(-3)	-0.012680	0.018758	-0.676000	0.4991
CH_SP(-4)	0.000855	0.018757	0.045601	0.9636
CH_SP(-5)	-0.117172	0.018729	-6.256025	0.0000
CH_SP(-6)	-0.051972	0.018819	-2.761616	0.0058
CH_SP(-7)	0.002312	0.018706	0.123601	0.9016
CH_ER(-1)	0.003191	0.112888	0.028269	0.9774
CH_ER(-2)	-0.324920	0.113686	-2.858042	0.0043
CH_ER(-3)	-0.267458	0.114109	-2.343894	0.0192
CH_ER(-4)	-0.067118	0.114180	-0.587826	0.5567
CH_ER(-5)	0.162368	0.114102	1.423013	0.1548
CH_ER(-6)	0.011739	0.113888	0.103072	0.9179
CH_ER(-7)	-0.084099	0.112948	-0.744579	0.4566

R-squared	0.036246	Mean dependent var	0.000230
Adjusted R-squared	0.031507	S.D. dependent var	0.021904
S.E. of regression	0.021556	Akaike info criterion	-4.831053
Sum squared resid	1.322950	Schwarz criterion	-4.799820
Log likelihood	6928.237	Hannan-Quinn criter.	-4.819792
F-statistic	7.648156	Durbin-Watson stat	2.000514
Prob(F-statistic)	0.000000		

B. The VAR Forecast test for the FTSE100 Index Price and the UK Exchange Rate

Dependent Variable: UK_SP
Method: Least Squares
Date: 05/21/15 Time: 16:57
Sample (adjusted): 1/20/2000 12/31/2010
Included observations: 2857 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.99E-05	0.000252	-0.238134	0.8118
UK_SP(-1)	-0.139850	0.018823	-7.429714	0.0000
UK_SP(-2)	-0.082935	0.019007	-4.363295	0.0000
UK_SP(-3)	-0.065289	0.019042	-3.428693	0.0006
UK_SP(-4)	0.057883	0.019080	3.033634	0.0024
UK_SP(-5)	-0.027594	0.019131	-1.442339	0.1493
UK_SP(-6)	-0.045838	0.019155	-2.393079	0.0168
UK_SP(-7)	0.020541	0.019149	1.072708	0.2835
UK_SP(-8)	0.029279	0.019148	1.529131	0.1263
UK_SP(-9)	0.001729	0.019124	0.090428	0.9280
UK_SP(-10)	0.031140	0.019072	1.632751	0.1026
UK_SP(-11)	-0.013741	0.018991	-0.723540	0.4694
UK_SP(-12)	0.017714	0.018747	0.944902	0.3448
UK_ER(-1)	0.171257	0.046781	3.660800	0.0003
UK_ER(-2)	-0.106517	0.047256	-2.254013	0.0243
UK_ER(-3)	-0.137891	0.047286	-2.916097	0.0036
UK_ER(-4)	-0.008047	0.047402	-0.169754	0.8652
UK_ER(-5)	0.012600	0.047413	0.265756	0.7904
UK_ER(-6)	-0.060111	0.047415	-1.267759	0.2050
UK_ER(-7)	-0.088538	0.047427	-1.866812	0.0620
UK_ER(-8)	-0.079892	0.047392	-1.685776	0.0919
UK_ER(-9)	-0.012836	0.047301	-0.271380	0.7861
UK_ER(-10)	-0.147755	0.047226	-3.128645	0.0018
UK_ER(-11)	-0.015014	0.047349	-0.317081	0.7512
UK_ER(-12)	0.031129	0.046905	0.663666	0.5070

R-squared	0.053876	Mean dependent var	-2.89E-05
Adjusted R-squared	0.045858	S.D. dependent var	0.013754
S.E. of regression	0.013435	Akaike info criterion	-5.773227
Sum squared resid	0.511158	Schwarz criterion	-5.721096
Log likelihood	8272.054	Hannan-Quinn criter.	-5.754429
F-statistic	6.719327	Durbin-Watson stat	1.999317
Prob(F-statistic)	0.000000		

C. The VAR Forecast test for the Dow Jones Industrial Average Index price and the US Exchange Rate

Dependent Variable: US_SP
Method: Least Squares
Date: 05/21/15 Time: 17:03
Sample (adjusted): 1/07/2000 12/31/2010
Included observations: 2866 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.30E-05	0.000246	-0.175117	0.8610
US_SP(-1)	-0.124530	0.018674	-6.668618	0.0000
US_SP(-2)	-0.054299	0.018792	-2.889525	0.0039
US_SP(-3)	0.046094	0.018702	2.464657	0.0138
US_ER(-1)	-0.028125	0.075487	-0.372579	0.7095
US_ER(-2)	0.001613	0.075403	0.021398	0.9829
US_ER(-3)	-0.151517	0.075283	-2.012640	0.0442

R-squared	0.021618	Mean dependent var	-3.14E-05
Adjusted R-squared	0.019564	S.D. dependent var	0.013284
S.E. of regression	0.013153	Akaike info criterion	-5.821904
Sum squared resid	0.494606	Schwarz criterion	-5.807345
Log likelihood	8349.788	Hannan-Quinn criter.	-5.816655
F-statistic	10.52844	Durbin-Watson stat	1.999549
Prob(F-statistic)	0.000000		

D. The VECM Forecast test for The FTSE Eurotop 100 Index price and the Euro Exchange Rate

Dependent Variable: EURO_SP
Method: Least Squares
Date: 05/21/15 Time: 16:37
Sample (adjusted): 1/12/2000 12/31/2010
Included observations: 2855 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.013070	0.009923	1.317168	0.1879
EURO_SP(-1)	0.876475	0.018754	46.73639	0.0000
EURO_SP(-2)	0.078062	0.024963	3.127068	0.0018
EURO_SP(-3)	-0.025525	0.024996	-1.021176	0.3073
EURO_SP(-4)	0.088681	0.024920	3.558602	0.0004
EURO_SP(-5)	-0.057409	0.024998	-2.296560	0.0217
EURO_SP(-6)	0.001213	0.024982	0.048554	0.9613
EURO_SP(-7)	0.036858	0.018751	1.965638	0.0494
EURO_ER(-1)	0.155733	0.055351	2.813562	0.0049
EURO_ER(-2)	-0.130439	0.074152	-1.759079	0.0787
EURO_ER(-3)	0.059317	0.074288	0.798471	0.4247
EURO_ER(-4)	-0.192546	0.074796	-2.574282	0.0101
EURO_ER(-5)	0.095877	0.074498	1.286971	0.1982
EURO_ER(-6)	0.024778	0.074396	0.333059	0.7391
EURO_ER(-7)	-0.010884	0.055348	-0.196640	0.8441

R-squared	0.995927	Mean dependent var	7.829536
Adjusted R-squared	0.995907	S.D. dependent var	0.224500
S.E. of regression	0.014363	Akaike info criterion	-5.643117
Sum squared resid	0.585860	Schwarz criterion	-5.611820
Log likelihood	8070.550	Hannan-Quinn criter.	-5.631831
F-statistic	49603.18	Durbin-Watson stat	1.999477
Prob(F-statistic)	0.000000		