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THE DYNAMIC RELATIONSHIP BETWEEN STOCK PRICES AND EXCHANGE RATES: A CASE OF KENYA

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.

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Abstract

This study investigates the price fluctuations and volatility spillover effects as well as the relationship between the stock market and the currency market in Kenya. The study developed long run and short run models for the exchange rate and stock price index with data ranging from between January 2004 to December 2014. The Data was obtained from the Nairobi Stock Exchange for the stock prices and the USD/KES exchange rate from the Central Bank of Kenya website. The study uses the Vector error correction model to determine the short run relationship and the significant price transmission effects between the markets whereas the EGARCH model is used to determine the volatility effects as well as the conditional variances of each of the variables. The study finds that there is no causal relationship between the stock market and exchange rate market; however it finds that there is significant volatility and price spillover effects from the foreign exchange market to the stock market and vice versa. This dynamic relationship opens up avenues for further research into other factors that may affect these two variables such as interest rates, which may be used to better explain the transmission of price spillovers between the currency and stock markets.

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Chapter One

1. Introduction

1.1 Background of the study

Internationalization of stock markets, liberalized capital flows and huge foreign investment in Kenyan equity markets has led stock and foreign exchange markets to be increasingly interdependent. With the Kenyan government having adjusted the foreign exchange rate policy from a fixed exchange rate regime to floating exchange rate regime in 1993 (Kisaka & Mwasaru, 2012), this has led to increased speculation on the impact of exchange rate fluctuations on the economy.

Studies on the free-floating exchange rate system argue that market forces determine foreign exchange rates. This argument is because of the assumption that in a perfect market, free of intervention by governments or monetary authorities, markets can allocate resources efficiently and determine nominal exchange rates (Kutty, 2010). However, this is only achievable if markets are free of interferences and market anomalies and distortions. These distortions may include but are not limited to sticky prices whereby in response monetary authorities may target exchange rates to correct current account deficits (Kutty, 2010).

Therefore, exchange rates are like prices of any other asset and are determined by expectations regarding future interest differentials between current account deficits, the external debt, terms of trade, interest rate differential, and economic and political conditions according to the study conducted by Kutty (2010). However, the gross domestic product (GDP), employment, interest rates, corporate performance exchange rates, trade balance, inflation, money supply, productivity rates and other such factors influence movements in the daily stock prices.

An understanding of the inter-market volatility is important for the pricing of securities within and across the markets for trading and hedging strategies as well as for formulation of regulatory policies in an emerging market like Kenya (Kisaka & Mwasaru, 2012).

One of the reasons for increased interest in studies in this field is to determine the impact of events in one market on another. The importance of such studies has come up in recent years

owing to events such as the 1987 stock market crash, the Asian currency crisis, and the recent subprime mortgage financial crisis of 2008. It has been observed that during such periods, markets tend to co-vary much more than normal, and there exists spillovers across markets and across geographical boundaries witnessed where the effects of the recent 2008 financial crisis affected countries such as Japan, Germany and so on. Occurrences such as this could be categorized under 'contagion effects', however it should be noted that the linkages between markets exist even otherwise and is backed by the growing amount of literature and academic discussions pertaining to this issue.

Theoretical evidence concerning the impact of exchange rate stability on economic growth is mixed. The evidence is mostly in favor of flexible exchange rates being of macroeconomic nature, this is because flexible exchange rates allow for an easier adjustment in response to asymmetric country specific real shocks (Schnabl, 2007). Schnabl (2007) explains further that in microeconomics, low exchange rate volatility can be associated with lower transaction costs for international trade and capital flows, which therefore contributes to higher economic growth. The study determines there are some macroeconomic benefits of fixed exchange rates such as their contribution to macroeconomic stability and they help to avoid "beggar-thy-neighbor" depreciations in highly integrated economic region.

With the loosening of foreign exchange controls and the opening of foreign markets and stock exchange markets to emerging economies, the prospect of international investment and portfolio diversification in international markets has attracted the interest of investors, corporate treasurers, central banks, regulatory authorities and academics. They seek to explain and study the interactions between the stock and foreign exchange markets. This initiative seeks to identify the main causes of the fluctuation in stock prices and returns, in turn multinationals and portfolio managers as well as policy makers can adjust their portfolios, fiscal and monetary policies accordingly.

Financial volatility is defined as a measure of variation of price of a financial instrument over time, it is important, as it is one indication of the level of risk (Ezzati, 2013). Exchange rate volatility is the risk associated with unexpected movements in the exchange rate (Ozturk, 2006). A spillover effect is the secondary effect threat that follows from a primary effect, and may occur separately in time or place from the event that caused the primary effect. Changes in volatility in

one country's financial market might be affected by the financial market volatility of other countries, a phenomenon that is referred to as volatility spillover effect (Ke, Wang, & Murray, 2010). According to Schwert (1989), volatility spillover effects or transmission of financial volatilities between countries has been changing, which has important consequences for investors and policymakers. Financial volatility spillover effects may affect investment decisions, as investors may equate higher volatility with greater risk (Ezzati, 2013). Volatility spillover effects can occur between any two markets, however this study focuses on the exchange rate volatility spillover effects of the exchange market on the stock market and vice versa in Kenya.

Past studies have determined two theories that seek to explain the relationship between the currency and stock market. The first is the traditional or flow oriented approach, which argues that exchange rates influence stock prices. Agarwal (1981)argues that changes in exchange rates provoke profits or losses in the balance sheet of multinational firms, which induces their stock prices to change. The transmission channel would affect exchange rate fluctuations, which affect firms' values through changes in competitiveness and changes in the value of firms' profits and therefore the value of equity. (Tabak, 2006)

The second approach, the portfolio or stock approach concludes that changes in stock prices affect exchange rate movements. This is can be identified through portfolio adjustments. If there were a persistent upward trend in stock prices, inflows of foreign capital would rise. However, a decrease would induce a reduction in domestic investor's wealth leading to a fall in money demand and lower interest rates, causing capital outflows therefore resulting in currency depreciation. (Tabak, 2006)

The "flow oriented" mode of exchange rate determination, (Dornbusch & Fischer, 1980)affirms that currency movements affect international competitiveness and the balance of trade position, and consequently the real output of the country, which in turn affects current and future cash flows of companies and their stock prices.

(Gavin, 1986)This paper formulates that the stock market determines the domestic aggregate demand. It seeks to show that if the stock market effects are significant then a monetary expansion can result in real exchange rate appreciation rather than depreciation. It finds that the steady state real exchange rate is unchanged by the more expansionary monetary policy.

Observations find that both price level and output are sticky, the home interest rate falls below the world rate just after the increase in the money supply, which implies that the rate of change of the real exchange rate at time zero is negative. The study concludes that the stronger the stock market effects, the larger the impact of the monetary expansion on output, and the smaller the real exchange rate depreciation.

1.2 The Kenyan Approach

The Central Bank of Kenya (2015) compiles indicative foreign exchange rates daily for use by the public. These rates reflect the average buying and selling rates of the major participants in the foreign exchange market at the open of trade every day.

1.2.1 The exchange rate trend for the last ten years

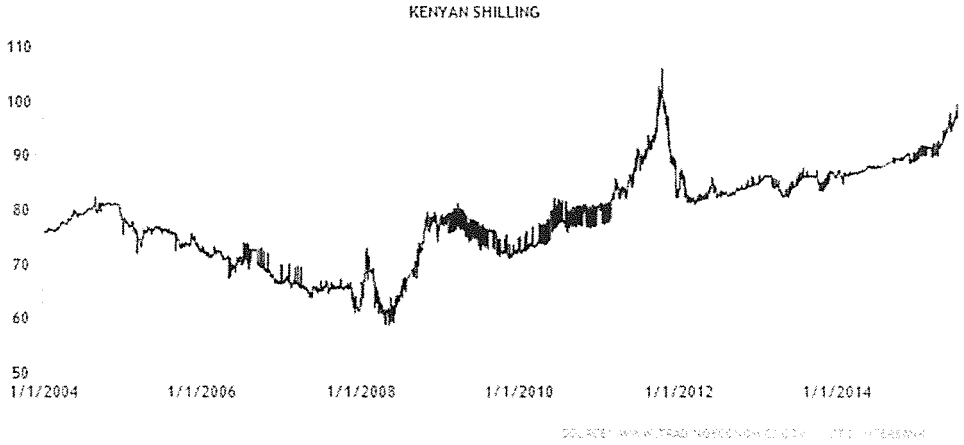

Figure 1

Figure (1) shows the exchange rate trend in Kenya for the past ten years. According to the study by Obura, Mukras, & Oima (2013) performance of securities reflects the economic situation of a country that is, in a globalised world, securities prices are affected by both the country's domestic economic situation and by foreign economic events like foreign exchange rate fluctuations and global financial crisis.

With regard to this Obura, Mukras, & Oima (2013) analyse the economic survey report of kenya conducted in the year 2011 which stated given an increased level of international flow of goods, services and capital with value of total exports growing by 25.6% from Kshs. 274.7 billions in 2007 to Kshs. 344.4 billion in 2008 while that of imports increasing by 27.4% to reach Kshs. 770.7 billion in 2008 compared to Kshs. 605.1 billion in 2007, they conclude that it is likely that

importance of the foreign economic events will continue fuelling the fluctuations in the financial sector. In 2011, imports soared mainly due to higher oil and food costs, while exports remained stagnant. The gap between imports and exports, also called current account deficit, stood at above 10% of GDP , which was at the time one of the highest in the world this has made the Kenyan economy more vulnerable to shocks (Fengler, 2011).

1.2.2 The stock market trend for the last ten years

Figure 2

Figure (2) shows the stock market trend in Kenya for the past ten years. The NSE 20-Share Index slumped by 35% in 2008, 25% since July 2008. By end-February 2009, the index had declined by 23.2% in the previous one month, by 26.8% in the previous three months and by 46% in the previous one year, offsetting the gains made in the previous three years (Mwega, 2010). In a study conducted by Mwega (2010) data collected shows that Kenya's bourse was one of the worst hit in the region in the previous one year, after Nigeria and Mauritius, countries that for long have liberalized their capital markets. It also shows a high correlation in the movements of equity prices across African countries.

Kenya has the fifth-largest bourse by market capitalization in Africa, after South Africa, Egypt, Nigeria and Morocco. In March 2009, the index fell further to about 2000 points, near its seven-year low of 1983 points (Mwega, 2010). The index then reversed its trend, picking up an upward trajectory, raising hopes that the market could finally be getting out of the woods, as the economy showed some signs of recovery. The NSE 20-Share Index improved between March

and June 2009 by 17.5%, but slumped in July-September 2009, shaving its value by 8.8%. The index increased by about 5% between end-September and December 2009 (Mwega, 2010).

In Kenya, during the recent global financial crisis, combined financial assets in the banking system grew by about 20 percentage points; from around 85 percent of GDP in 2001 to 115 percent of GDP in 2008, the Kenyan banking system is the largest in terms of total assets. According to Masha (2009) asset growth was aided by favorable external environments, which contributed to strong capital flows as well as external demand, resulting in robust growth rates. While there was strong increase in financial deepening in the aggregate, the period also had elements of financial disintermediation, as a few marginal banks were wound up, resulting in declines in total banking system assets. Banks have relatively strong links to the international financial markets through foreign ownership. In Kenya, banks with foreign equity ownership of over 50 percent constitute about 26 percent of all banks, and they control over 40 percent of the total net assets (Masha, 2009).

In this context, as shown in the stock market and exchange rate trend for the past ten years, there has been presence of fluctuations in both markets due to various reasons. In this study, the objective is to determine if the trends in the two markets are intertwined or are they independent of influence on each other. Therefore, the main implication of this study is to model the impact of volatility and spillover effects in the currency market on the stock market and vice versa.

1.3 Problem statement

Researchers and academics have conducted several studies on the subject of volatility and price spillovers between the exchange rate market and stock market. The studies have conflicting results as some support the view that the exchange rate determines the stock prices but not the reverse. This is the popular view that supports a unidirectional relationship. Alternatively, the relationship could be bidirectional specifically in a long run relationship. These conclusions influence the decisions of investors and portfolio managers in lieu of the relationship identified by past studies. Therefore, in conducting research this paper seeks to establish the relationship in both short run and long run dynamics taking into account the volatility and spillover effects of one variable against the other, which in turn will help the central bank to adjust policies and multinationals based in Kenya who trade internationally to adjust their portfolios accordingly. There have been studies conducted in Kenya on the causal relationship between exchange rates

and stock prices this study will seek to model the volatility of each market and the effect of spillovers on each other therefore accounting for the problem of exchange rate risk that companies as well as investors face.

1.4 Research objectives

This study has certain objectives:

I. Find out the relationship between the exchange rate and the stock prices
II. Determine the spillover effects of the stock market on the currency market in Kenya
III. Investigate how the effects of volatility in the currency market affect the stock market.

1.5 Research questions

This paper seeks to answer questions such as

- What is the long run and short run relationship between the stock and foreign exchange markets
- How do fluctuations in the currency markets affect the stock market
- Do volatility spillovers from both the currency and stock markets lead to this interdependency of the stock prices and the exchange rate

1.6 Purpose of study

This study seeks to enable investors and portfolio managers to make informed investment decisions. First, this paper seeks to clarify the theoretical issues of the relationship between stock and foreign exchange markets. It identifies the channels through which exogenous shocks affect these markets and link them together. Secondly, it considers simultaneously both the short-run and the long-run dynamics of the financial markets. It also seeks to formulate the causal relationship between the two variables. It will also consider the implications of volatility spillovers in the stock and exchange market, taking into consideration how these spillovers will affect the trend and movement of prices in each of the markets. This study seeks to give more insight and identify if prices in the stock market or stock price movements can be explained by factors affecting the exchange rate market or is it that factors affecting the stock market have an indirect effect in determining the exchange rate appreciation or depreciation of the country. This has both policy and investment implications as it can take into account the question whether stock prices are predictable.

Chapter Two

2 Literature review

2.1 Theoretical Framework

Theoretical models as well as scholars seeking to determine the existence of a relationship between stock prices and exchange rates have devised different theories to explain the relationship. Theory seeks to explain that a change in exchange rates would lead to a change in a firm's foreign profits and operations and therefore would affect the firm's stock prices. On the other hand, a fall in general stock prices in the stock market would lead investors to turn to other sources of higher returns, therefore causing a decrease in demand for money. This in turn pushes interest rates down causing further outflow of funds and thus depreciation of the currency.

As mentioned previously, there are two theories that seek to explain the relationship between stock markets and currency markets; the flow oriented approach and the portfolio approach.

Phylaktis and Ravazzolo (2005) determine that the portfolio balance model for exchange rate determination forms the basis of expecting volatility spillovers. The study determined the relationship between domestic stock and foreign exchange markets to be:

$$P_t = \alpha_0 + \alpha_1 S_t + v_t$$

Where $P_t$is the domestic stock price, S_t is the real exchange rate defined as domestic prices relative to foreign prices multiplied by the nominal exchange rate and v_t is a disturbance term. From theory, the coefficient α_1 can take either a positive or a negative value. A fall in the real exchange rate has a positive effect on the competitiveness of domestic goods versus foreign goods and the balance of trade of a country (Badrinath & Apte, 2005). This increases the level of domestic aggregate demand and the level of output.

According to this model by Phylatkis and Ravazzolo (2005), agents allocate their wealth amongst alternative assets including domestic money, and domestic and foreign securities. The role of the exchange rate is to balance the asset demands and supplies. Thus, any change in the demand for and supply of assets will change the equilibrium exchange rate. According to the study conducted by Badrinath and Apte (2005), an increase in domestic stock prices will increase wealth and the demand for money and consequently interest rates will go up. High interest rates in turn, will attract foreign capital, resulting in an appreciation of the domestic currency and a

rise in the real exchange rate therefore this would imply that return spillovers may result in volatility spillovers (Phylaktis & Ravazzolo, 2005).

However, the flow-oriented approach is explained according to Kisaka & Mwasaru (2012) whereby for a multinational firm, volatility in exchange rates causes changes to the value of that firm's foreign operation. This can lead to either a profit or a loss on its balance sheet, which in turn will change the firm's stock price. In this approach, exchange rate change is expected to lead to a change in stock price. Therefore, devaluation could either raise or lower a firm's stock price depending on whether that firm is an exporting firm or it is a heavy user of imported inputs. Nevertheless, firms that operate domestically may as well be affected by the exchange rates fluctuations, whereupon movements in the currency will influence their output and therefore demand for their goods and services (Dumas & Adler, 1984).

The study conducted on the price and volatility spillovers between stock prices and exchange rates (Yang & Doong, 2004) posits that movements of stock prices will affect future exchange rate movements. However, changes in exchange rates have less direct impact on future changes of stock prices. Empirical evidence conducted in the study support the asymmetric volatility spillover effect. In particular, it tests for mean and volatility spillovers from one market to another and conducts a search for evidence of asymmetry; that is, whether negative shocks originating in a stock market (foreign exchange market) exert more or less impact on the foreign exchange market (stock market) than a positive shock of equal magnitude.

Dimitrova (2005) investigates the trend in the U.S stock market from 1990 to 2004, concluding that a depreciation of the currency may depress the stock market whereby the stock market will react with a less than one percent decline to a one percent depreciation of the exchange rate. This also implies that an appreciating exchange rate boosts the stock market. However, the results for the hypothesis that currency depreciation may depress the stock market are insignificant. This is in line with other papers that support the hypothesis that the relationship is unidirectional.

2.2 Empirical Literature

Empirical results from a test focusing on this relationship should employ non-linear causality tests as they suggest that there is causality from exchange rates to stock prices, which is in line with the traditional approach. Findings however show no long run relationship between nominal exchange rate and the stock market in the Brazilian economy (Tabak, 2006).

The stock market and the currency market are moving in tandem with each other and there exists a bidirectional volatility spillover between the two markets in regards to the Indian market (Mishra, Swain, & Malhotra, 2007). The study examines the relationship and volatility spillovers between Indian stock and foreign exchange markets. It shows there exists a bidirectional volatility spillover between the stock and currency market however, a unidirectional long run relationship exists between these two variables. There is information flow between these two markets and there exists integration between these two markets. It suggests that investors can predict the behavior of one market by using the information in the other market.

The study in Ghana (Adjasi, Harvey, & Agyapong, 2008) attempted to identify the nature of volatility in both the stock market and the exchange rate from 1995:1 to 2005:6. Results show that there is an inverse relationship between exchange rate volatility and stock market returns. It also showed that there is presence of volatility shocks of the exchange rate on stock returns on the Ghana stock exchange.

Rahman and Uddin (2008) study the interactions between stock prices and exchange rates in the economy of Bangladesh where they take into account the monthly nominal exchange rates of the US dollar, Euro, Japanese yen, Pound sterling and the monthly values of the Dhaka Stock Exchange General Index for the period of June 2003 to March 2008. The paper concludes that there is no cointegrating relationship between the stock prices and exchange rates, which means that there is not long-term co-movement between the two variables and furthermore none of the variables are predictable based on past values of the other variable.

Morales (2008) investigates the extent of volatility spillovers between stock returns and exchange rate changes for six Latin American financial markets namely, Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela and one European financial market, Spain, and a number of exchange rates. The study seeks to identify whether the volatility spillovers between stock markets and exchange rates vary across currencies, and to investigate how the introduction

of the Euro affects the relationship. It determined, although volatility spillovers are much less prevalent from the various bilateral exchange rates to the stock markets in the countries examined and less consistent across countries and over time than the spillovers from stock markets to exchange rates, they nonetheless are present in certain instances.

Agrawal, Srivastav, & Srivastava (2010)conducted an analysis on the S&P CNX Nifty returns and Indian Rupee-US dollar exchange rates. The study conducts an investigation into the behavior and dynamics of both variables and the impact of both time series on each other. It concludes that both variables are non-normally distributed and through unit root test and Granger causality, found that there was a unidirectional relationship from the stock returns towards the exchange rates.

Zhao (2010) investigated the relationship in China's stock and exchange markets using monthly data from January 1991 to June 2009. Where results from the cointegration test show that there is no long-term equilibrium relationship between the two variables. By using MGARCH and vector auto-regression models, no mean spillovers between the stock and foreign exchange markets was determined.

Kutty (2010) in the study of the Mexican economy determines that stock prices cause exchange rates to change therefore there is only unidirectional causality, when confined to one time lag, suggesting that the influence is instantaneous and there is no long-term causality. In the period November 2003 to February 2004, there was an unambiguous upward trend in the U.S. stock market. Over the same period, the U.S. dollar kept depreciating against all major currencies.

Mbutor (2010) investigates the impact of exchange rate depreciation and equity price fluctuations on the lending behavior of banks in Nigeria. The paper identifies the link between exchange rate and the all share price index. The VAR methodology results show that exchange rate volatility and stock price fluctuations do affect the lending behavior of banks, but very insignificantly. It determined that exchange rate volatility has a relatively stronger effect on the all share index than the reverse. However, the line of causality flows from equity prices to exchange rates.

Eissa et al (2010) in the study of the presence of volatility spillovers between stock returns and nominal exchange rates in three MENA countries: Egypt, Morocco and Turkey, conclude that

there are no cross-market effects for stock price returns. However, there exists evidence of bidirectional shock and volatility spillovers between exchange rates and stock prices at sector level in Egypt and Turkey with little evidence in Morocco. In addition, the study finds evidence of a unidirectional causality link that is from exchange rates to stock returns. It argues that the different results are because of the different exchange rate regimes adopted in the three countries. In Egypt and Turkey, they employ a floating exchange rate regime while Morocco employs a more tightly managed exchange rate regime.

Anlas (2012) explores the relationship between changes in foreign exchange rates (Euro/TL, GBP/TL, JPY/TL, CHF/TL, USD/TL, CAD/TL, and SA/TL) and the Istanbul Stock Exchange by using data from 1999 to 2011. Findings show that all variables in the estimation framework are non-stationary at the initial level but stationary at a first difference level. The results indicate that there is a positive relationship between changes in the domestic U.S. Dollar and Canadian dollar and changes in ISE 100. However, fluctuations in domestic interest rates and Saudi Arabia Riyal have a negative impact on the index. This implies that the ISE 100 index is open to the effect of other countries' currencies.

Rjoub (2012) examines the linkages between Turkish stock prices and exchange rates taking into account the effects of the world market and the US stock market, in the floating exchange rate period. From long run cointegration tests, the study determines that the exchange rate has a negative impact, and the US stock market has a positive impact on the Turkish stock market. The causality investigation concluded that there was a two-way relationship between the Turkish stock prices and the exchange rate.

Olugbenga (2012) identifies that in the short run, exchange rate has a positive significant impact on stock performance in Nigeria as opposed to the long run, which is significantly negative. The study concludes that the negative influence of exchange rate on Nigerian stock market performance could be because of heavy devaluation of the currency since the introduction of the structural adjustment program in 1986.

The study (Kisaka & Mwasaru, 2012)examined the causal relationship between foreign exchange rates and stock prices in Kenya from November 1993 to May 1999. The results show that exchange rates and stock prices are non-stationary and cointegrated. The study concludes the

exchange rates cause stock prices and there exists unidirectional causality from exchange rates to stock prices.

Zubair (2013) uses cointegration test to test for the possibility of co-integration and Granger-causality to estimate the causal relationship between stock market index and monetary indicators before and during the global financial crisis for Nigeria, using monthly data for the period 2001–2011. Results suggest absence of long-run relationship before and during the crisis. It concludes that an absence of a direct link between the stock index and exchange rates shows inefficiency in the market.

The analysis (Andreou, Matsi, & Savvides, 2013) of the bi-directional linkages between the stock and foreign exchange markets of a number of emerging economies shows that there is strong evidence of bidirectional causality in variance between the foreign exchange market and stock market in all emerging economies but Colombia. Global and regional stock markets also contribute significantly to volatility spillovers. The study applies the notion of shift contagion and determines that the Asian crisis has had a significant effect on the volatility transmission mechanism between the foreign exchange market and the emerging stock market (in both directions). In addition, more flexible exchange rate regimes are associated with higher volatility spillovers between the foreign exchange and stock market for the majority of emerging economies.

The study of the stock price and exchange rate relationship has been of importance in recent years, where scholars seek to determine the various factors that may contribute to stock price predictability therefore, in reviewing the literature done before, the paper finds that there is mixed findings and interpretations of this relationship. Research by Dimitrova (2005), Mishra et al. (2007), Agrawal (2010), Kutty (2010), Mbutor (2010), Eissa et al. (2010), Olugbenga (2012) and Kisaka & Mwasaru (2012) find the presence of a unidirectional relationship between the stock market and currency market. However, Anlas (2012) and Rjoub (2012) find presence of a bidirectional relationship.

In terms of volatility spillovers between the markets, Yang and Doong (2004), Mishra et al. (2007), Adjasi et al. (2008), Morales (2008), Eissa et al. (2010) and Andreou et al (2013) find presence of bidirectional volatility spillovers. However, some research found that there was no

relationship between exchange rates and stock prices such as Tabak (2006), Rahman & Uddin (2008), Zhao (2010) and Zubair (2013).

2.3 Knowledge Gap

While there is literature, regarding the relationship between the currency market and the stock market in Kenya there is little research done on the case of volatility in both markets and the effects that one market has on the other. This study seeks to determine if the hypothesis proven by the various research conducted in other countries and regions applies in the Kenyan situation whereby it seeks to add to the existing literature by quantifying and determining the volatility spillover effects of the exchange rate market (stock market) on the stock market (currency market). Therefore, in order to analyze the implications of stock price changes on exchange rates and vice versa, in the examination; the bivariate EGARCH model is applied.

Chapter Three

3 Data and Methodology

3.1 Data

The study, in the estimation of this relationship uses weekly data that is Friday closing exchange rates and stock price weekly averages obtained from the Central Bank of Kenya website and the Nairobi Stock Exchange respectively. The exchange rate will be the US Dollar against the Kenyan shilling, which is obtained from the Central Bank website; the sample period will run from 02 January 2004 to 02 January 2015, which yields approximately 520 observations. The rationale behind this is that a large spread will allow us to determine the trend during times such as major events that affected the country such as the post-election violence and the financial crisis while also observing the trend during times of relative calm.

The use of weekly data is justified in that use of high frequency data that is daily stock prices contains too much noise; however, use of monthly or quarterly data will not determine the relevant information in the stock market and exchange rate trends. Therefore, the use of data during this period is justified as it allows for the determination of the relationship of the exchange rate on stock prices pre-financial crisis and post financial crisis. The sample period also offers a view of how major economic and financial global events affect local currency and stock prices.

3.2 Methodology

In order to determine the short run and long run dynamic relationship between stock prices and exchange rates use the vector autoregressive model (VAR). In using VAR, each variable is a linear function of past lags of itself and past lags of other variables. This model is useful for multivariate time series data. However, if the data series are found to be cointegrated the study estimates a vector error correction model (VECM), which is an extension of the VAR model but with the inclusion of an error correction term to the equation. To determine the volatility and spillover effects, the study models stock price volatility and exchange rate volatility as well as model the interdependencies between the two variables. The main aim is to determine the relationship and influences between the currency markets and stock market if there is presence of any such dependencies or not. The research design to be used will be quantitative in nature.

The first step is to perform a stationarity test on each of the relevant variables that are included to ensure that the results from the analysis are not spurious since there are autocorrelation and ARCH effects in the series. This is important in order to determine if error correction models must be included in the VAR model if the results determine the variables to be cointegrated. Apply the Dickey Fuller (DF) test or Augmented Dickey-Fuller test (ADF) to determine if there is presence of serial correlation and to test for stationarity and use the Lagrange Multiplier (LMF) test, to determine that sufficient number of lags have been added to the ADF test to ensure that there is no serial correlation present and that the results found are valid.

The LMF test is used given that it is valid in the presence of lagged dependent variables as well as having the advantage of testing for first and higher orders of serial correlation (Morales, 2008), using the Johansen Cointegration test to investigate the long-run relationship between Stock Prices and Exchange Rates. As Enders (2004) notes given that the results of the test can be quite sensitive to the lag length, the most common procedure is to estimate a Vector Autoregression (VAR) model on the undifferenced data in order to determine the lag length for the cointegration test.

To convert the data to be used into continuously compounded rates of return and exchange rate changes, take the first difference of the log prices that is:

$$R_t = ln(P_t) - ln(P_{t-1}) \qquad \textit{Equation 1}$$

This is to show the rates of change of the data series. This is because the data may contain data gaps due to inconsistencies such as holidays and other closing days where the exchange rate data does not match the data in the stock market.

Modelling of the conditional variances of and volatility spillovers between the two markets will be done through a multivariate version of Nelson's (1991) Exponential generalized autoregressive conditionally heteroskedastic (EGARCH) model. An advantage of using the EGARCH model is the log form of conditional variance, which thereby guarantees that the variance is positive (Yang & Doong, 2004). The EGARCH model is used to determine whether the volatility spillovers are asymmetric (Nelson, 1991). If it is determined that there is an asymmetric spillover from stock returns to the exchange rate changes this would mean that the effect of bad news in the stock market on the exchange rate would be greater than the effect of good news from that particular market.

In using the EGARCH model as opposed to the GARCH model, the study seeks to allow for volatility testing without imposing additional restrictions on the parameters as seen in the GARCH model. One of the primary restrictions imposed by the GARCH model as discussed by Mishra et al (2007) is that it enforces a symmetric response of volatility to positive and negative shocks. This arises due to the conditional variance being a function of the magnitudes of lagged residuals and not their signs that is by squaring the lagged variables in the conditional volatility equation, the sign is lost (Mishra, Swain, & Malhotra, 2007). By using GARCH, one would have to impose restrictions on the model parameters to keep the conditional volatility positive (Nelson, 1991).

To study the relationship between exchange rates and stock prices, there is need to establish whether changes in stock prices causally affect exchange rates or vice versa. The original model of Granger (1969) is used because of its simplicity but also the existence of causal ordering in Granger's theory points to a low causation and implies predictability and exogeneity (Kisaka & Mwasaru, 2012). Granger's four definitions of causality are considered using the following model;

$$Ex_t = \sum_{j=1}^{m} \alpha_j EX_{t-j} + \sum_{j=1}^{n} \beta_j SP_{t-j} + \varepsilon_t \qquad \textit{Equation 2}$$

$$SP_t = \sum_{j=1}^{m} c_j EX_{t-j} + \sum_{j=1}^{n} d_j SP_{t-j} + \varepsilon_t \qquad \textit{Equation 3}$$

Where Ex_t is the exchange rate; SP_t is the stock price index; α_j, β_j are coefficients of the exchange rate equation; c_j, d_j are the coefficients of the stock price equation; and ε_t are the white noise error terms. Kisaka and Mwasaru (2012) discuss Granger's four definitions of causality which comprise unidirectional causality from SP to EX; unidirectional causality from EX to SP; bidirectional causality between EX and SP; and independence between EX and SP. These definitions imply that for SP to Granger-cause EX, the coefficient $\beta_j \neq 0$ in equation (2), whereas $c_j = 0$ in equation (3). Otherwise, for EX to Granger-cause SP, $c_j \neq 0$ whereas$\beta_j = 0$. If the study allows for the possibility of $j = 0$ in the summation symbol of equation (2) and (3), the relationship between the two time series is determined to be instantaneous. This implies that, instantaneous causality is established when the inclusion of the present values of the independent variable improves the prediction or goodness of fit or R-square of both equations (Kisaka & Mwasaru, 2012).

To determine the volatility spillovers between the exchange rate and stock prices, determine the vector autoregression (VAR) model of the conditional mean equation. It indicates β_0, β_{t-1} are parameters to be estimated, ε_t is the residual and the error correction term (ECT_{t-1}) represents the cointegrating relationship between the stock market prices and exchange rates. Therefore, if the coefficients β are statistically significant then they reflect the extent of the volatility spillovers across the currency and stock market. This means that information determined in one market becomes part of the information set in the other market so it can be used by portfolio managers to estimate the changes or effects in that market (Yang & Doong, 2004). The actual model to be used is specified as follows:

$$S_t = \beta_{S,0} + \sum_{i=1}^{n} \beta_{S,i} S_{t-i} + \sum_{i=1}^{n} \beta_{E,i} E_{t-i} + ECT_{t-1} + \varepsilon_{S,t} \qquad \textit{Equation 5}$$

$$E_t = \beta_{E,0} + \sum_{i=1}^{n} \beta_{E,i} E_{t-i} + \sum_{i=1}^{n} \beta_{S,i} S_{t-i} + ECT_{t-1} + \varepsilon_{E,t} \qquad \textit{Equation 6}$$

Where $(\varepsilon_{S,t}|\Omega_{t-1}) \sim N(0, \sigma^2_{s,t})$ and $(\varepsilon_{E,t}|\Omega_{t-1}) \sim N(0, \sigma^2_{E,t})$

In this case, therefore, use the bivariate exponential GARCH (EGARCH) model specified by Morales (2008), to model conditional variances and volatility between the stock prices and exchange rates, with the following specifications:

$$log(\sigma^2_{S,t}) = \alpha_{S,0} + \sum_{j=1}^{ps} b_{S,j}\, log\left(\sigma^2_{S,t-j}\right) + \begin{matrix} \beta_{S,S}\left(\left|z_{S,t-1}\right| - E\left|z_{S,t-1}\right|\right) + \left(\theta_{S,S} Z_{S,t-1}\right) + \\ \beta_{S,E}\left(\left|z_{E,t-1}\right| - E\left|z_{E,t-1}\right|\right) + \left(\theta_{S,E} Z_{E,t-1}\right) \end{matrix} \qquad \textit{Equation 7}$$

$$log(\sigma^2_{E,t}) = \alpha_{E,0} + \sum_{j=1}^{pe} b_{E,j}\, log\left(\sigma^2_{E,t-j}\right) + \begin{matrix} \beta_{E,E}\left(\left|z_{E,t-1}\right| - E\left|z_{E,t-1}\right|\right) + \left(\theta_{E,E} Z_{E,t-1}\right) + \\ \beta_{E,S}\left(\left|z_{S,t-1}\right| - E\left|z_{S,t-1}\right|\right) + \left(\theta_{E,S} Z_{S,t-1}\right) \end{matrix} \qquad \textit{Equation 8}$$

Where $\sigma_{S,E} = \rho_{S,E}\sigma_{S,t}\sigma_{E,t}$

The parameters $\beta_{S,S}$and $\theta_{S,S}$ capture the last period forecast variance and stock market news effects, respectively. Whereas the parameters $\beta_{S,E}$ and $\theta_{S,E}$ indicate the foreign exchange market's spillover effects on the stock market returns conditional variance. Further, the θ's allow asymmetry in effects of news from the respective market. The estimated parameter of GARCH term that is $b_{S,j}$ indicates persistence of volatility in the stock market asset returns.

Asymmetry exists if $\delta_{i,i}$ where $i = E\ or\ S$ is negative and statistically significant. In the equation, $|Z_{j,t-1}| - E(|Z_{j,t-1}|)$ measures the size effect of an innovation whereas $\theta_{E,S}Z_{S,t-1}$measures the corresponding sign effect (Yang & Doong, 2004). $\beta_{E,E}$ measures

volatility in the currency market while $\beta_{S,S}$ measures volatility in the stock market. To show volatility spillover effect, a negative $\beta_{E,S}$with positive significant $b_{i,j}$ implies that a negative shock in the stock market increases volatility in the exchange market by more than a positive shock of equal magnitude. This also applies where $\beta_{E,S}$is positive with a negative significant $b_{i,j}$ which implies that a negative shock in the stock market decreases volatility in the exchange market. In the case of a negative (positive)$Z_{j,t}$, with a negative $\beta_{S,S}$enhances (reduces) the size effect (Yang & Doong, 2004), all parameters are explained in table (1).

Assuming normality, the log-likelihood function of the multivariate EGARCH model is determined using the Quasi-Maximum Likelihood Estimation (QMLE) by Berndt et al. (1974), expressed in the form:

$$L(\theta) = -\left(\frac{1}{2}\right)(NT)\ln(2\pi) - \left(\frac{1}{2}\right)\sum_{t=1}^{T}(\ln|H_t| + \varepsilon_t' H_{t-1}\varepsilon_t) \qquad \textit{Equation 9}$$

Where N is the number of equations in this case there are only two, T is the number of observations and θ is the vector of parameters that are estimated. $\varepsilon_t$denotes the 2x1 column vector with $\varepsilon_{S,t}$ and $\varepsilon_{E,t}$as elements and H_t is the conditional variance-covariance matrix with the conditional variances $\sigma_{St}^2$and σ_{Et}^2on the diagonal and the covariance $\sigma_{SE,t}$ off diagonal (Apte, 2001) . QMLE is determined to be consistent with a limiting normal distribution if the conditional mean and variances are specified correctly. However, theory proves that stock returns are non-normally distributed. This is in accordance with Bollerslev and Wooldridge (1992) who suggest that robust standard errors take into account the non-normality of residuals.

The relevant terms in this study are summarized in the table below concerning the equations (5)-(8):

DESCRIPTION OF PARAMETERS

PARAMETERS	STOCK RETURNS	EXCHANGE RATES
Stochastic error term	$\varepsilon_{S,t}$	$\varepsilon_{E,t}$
Information set at time t-1	Ω_{t-1}	Ω_{t-1}
Conditional(time varying) variances	$\sigma_{S,t}$	$\sigma_{E,t}$
Standardized residuals assumed to be normally distributed with mean 0 and variances of $\sigma_{S,t}, \sigma_{E,t}$	$z_{S,t} = \varepsilon_{S,t}/\sigma_{S,t}$ $(\varepsilon_{S,t}\|\Omega_{t-1}) \sim N(0, \sigma_{S,t}^2)$	$z_{E,t} = \varepsilon_{E,t}/\sigma_{E,t}$ $(\varepsilon_{E,t}\|\Omega_{t-1}) \sim N(0, \sigma_{E,t}^2)$

Persistence of volatility	$\sum_{j=1}^{pS} b_{S,j}$	$\sum_{j=1}^{pE} b_{E,j}$
ARCH effect where the parameters $\theta_{S,S}, \theta_{E,E}$ allow this effect to be asymmetric	$\lvert z_{E,t-1}\rvert - E\lvert z_{E,t-1}\rvert + \theta_{S,E} Z_{E,t-1}$	$\lvert z_{S,t-1}\rvert - E\lvert z_{S,t-1}\rvert + \theta_{E,S} Z_{S,t-1}$
Volatility spillover	$\beta_{S,E}(\lvert z_{E,t-1}\rvert - E\lvert z_{E,t-1}\rvert) + (\theta_{S,E} Z_{E,t-1})$	$\beta_{E,S}(\lvert z_{S,t-1}\rvert - E\lvert z_{S,t-1}\rvert) + (\theta_{E,S} Z_{S,t-1})$
Measures of spillovers	$\beta_{S,E}$	$\beta_{E,S}$
Asymmetry of spillovers	$\theta_{S,E}$	$\theta_{E,S}$
Correlation coefficient for standardized residuals	$\boldsymbol{\rho_{S,E}}$	$\boldsymbol{\rho_{E,S}}$

Table 1

Source: (Morales, 2008)

Note:$\theta_{S,E} < 0$ This implies that negative exchange rate shocks increase the volatility of stock returns more than positive shocks.

CHAPTER 4

4 Analysis and Findings

4.1 Descriptive statistics

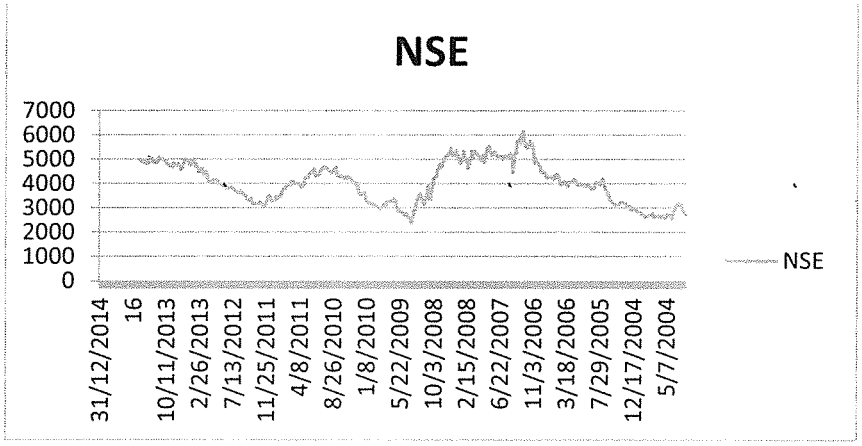

Figure 3: NSE-20 Index Trend for 2004-2014

The graph displayed above shows the trend of the NSE-20 stock index for the period between beginning of 2004 and end of 2014. The graph shows that there have been significant rise and falls of the stock price index in the time chosen. There is a significant dip in the stock price index around 2008-2009 this could be due to the effects of the global credit crunch and subsequent financial crisis that originated in the US and that was felt around the world especially in stock markets that were dominated by multinational companies, who mainly traded in the US stock markets. Therefore with the gradual strengthening of the US stock markets there is a gradual rise in the value of stocks and the market is seen to recover.

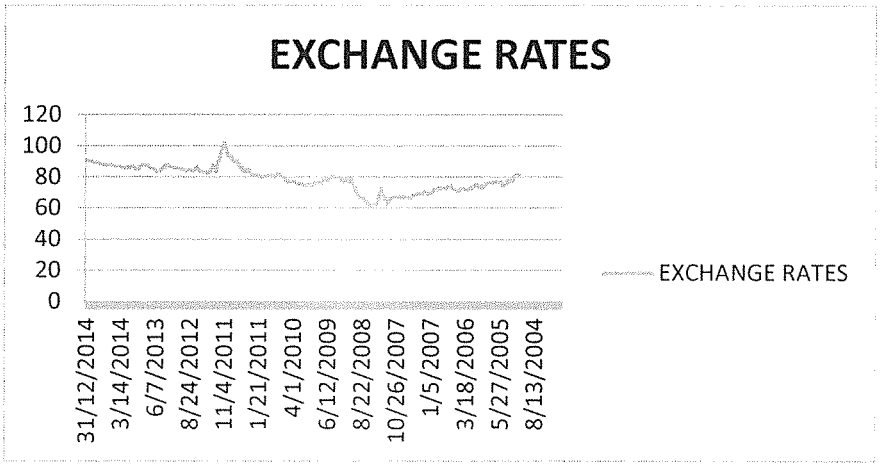

Figure 4: Exchange rate trend for 2004-2014

In 2007-2008 there is a dip in the exchange rate meaning that the Kenyan shilling depreciates against the dollar. This could be due to the insecurity experienced within the country during the post-election violence that led to fewer tourists and lack of exports as businesses were closed and the country was considered to be in a volatile environment. This dip is followed by a subsequent appreciation of the currency due to the depreciation of the US dollar which occurred as a result of the global credit crunch. However, as the dollar strengthens in subsequent years and with the effect of the fall and gradual rise in oil prices leads to first an appreciation then a gradual depreciation in the currency with it stabilizing around 90Kes/Dollar. The table below presents some descriptive statistics for the two variables that is USD/KES exchange rate and the NSE-20 stock index.

	EXCHANGE_RATES	NSE
Mean	78.08919	4188.935
Median	77.78890	4163.640
Maximum	101.9470	6161.460
Minimum	61.70110	2375.010
Std. Dev.	7.730373	778.1973
Skewness	0.081775	0.010424
Kurtosis	2.728658	2.117271
Jarque-Bera	2.045152	15.88527
Probability	0.359667	0.000355
Sum	38185.62	2048389.
Sum Sq. Dev.	29162.23	2.96E+08
Observations	489	489

Table 2: Descriptive Statistics

4.2 Preliminary Tests

4.2.1 Unit Root Test

To check stationarity of the series of stock returns, unit root test is applied at level. For the study, the Augmented Dickey Fuller test was considered based on its superiority over the DF test, this is based on the fact that the DF test is only valid if the error term is shown to be uncorrelated.

TABLE 2: AUGMENTED DICKEY FULLER TEST

Null Hypothesis: NSE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=18)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-21.40498	0.0000
Test critical values:	1% level	-3.442367	
	5% level	-2.866733	
	10% level	-2.569596	

The results show that the ADF test statistic of the stock price data series is greater than the critical value at one percent significance level therefore reject the null hypothesis and accept the alternative that the stock return has no unit root, so the series is found to be stationary at level.

Table 3: Augmented DF test

Null Hypothesis: EXCHANGERATES has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic based on SIC, MAXLAG=18)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.61080	0.0000
Test critical values:	1% level	-3.442578	
	5% level	-2.866826	
	10% level	-2.569646	

The results for the unit root test conducted on the exchange rate change series show that the ADF test statistic is greater than the critical value at one percent significance level. Therefore reject the null hypothesis that the exchange rate series has unit root and accept the alternative, so the series is fond to be stationary at level.

4.2.2 Serial Correlation Test

In this test the first part is the most important that represents the two statistical tests F-statistic and R-squared and the probabilities associated with these tests. The null hypothesis of the test is that there is no serial correlation of the equation errors up to the maximum lags specified.

Table 4:LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.562862	Probability	0.210591
Obs*R-squared	3.131335	Probability	0.208949

The results of the test show that the probability of the test is above 0.05 therefore fail to reject the null hypothesis and therefore conclude that there is no serial correlation.

4.2.3 Johansen Co-integration Test

In estimating cointegration, there are some tests to consider; the Engle-Granger and the Johansen test. Brooks (2008) posits that the lack of testability of the hypotheses concerning the cointegrating relationship makes the use of Engle-Granger test less superior compared to the Johansen test. Given that from the Unit root test previously estimated, the variables are found to be stationary at the same order that is I(0), there exists the possibility that they may be cointegrated. Therefore perform the Johansen Test;

Table 3: Cointegration Test

Date: 11/02/15 Time: 11:12
Sample (adjusted): 11/11/2004 2/06/2014
Included observations: 483 after adjustments
Trend assumption: Linear deterministic trend
Series: EXCHANGERATES NSE
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 *	0.189308	161.7621	15.49471	0.0001
At most 1 *	0.117543	60.39659	3.841466	0.0000

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The results show that the trace statistics are greater than the critical value at the 5% significance level which therefore means that the null hypothesis: there is no cointegrating equation, is rejected. The test finds there are two co-integrating equations between the variables. Therefore conclude that the exchange rate data is cointegrated with the stock return data.

4.2.4 Granger Causality Test

The Granger Causality test is used to check the causal relationship between the variables. The test is such that if the p-value is less than 5% then reject the null hypothesis, where the null hypothesis is that variable X does not Granger Cause Y.

Table 6: Causality Test

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 11/12/15 Time: 15:24
Sample: 1 581
Included observations: 485

Dependent variable: D(LOG_EXCHANGE)

Excluded	Chi-sq	df	Prob.
D(LOG_NSE)	7.029415	2	0.0298
All	7.029415	2	0.0298

Dependent variable: D(LOG_NSE)

Excluded	Chi-sq	df	Prob.
D(LOG_EXCHANGE)	34.29937	2	0.0000
All	34.29937	2	0.0000

According to the results the test finds that the P-values are significant that is they are less than 0.05 therefore reject the null hypothesis on both cases. This implies that there is a causal relationship between the two variables that is exchange rates granger cause stock prices and stock prices granger cause exchange rates. Therefore conclude that there is a bidirectional relationship between the two variables.

4.3 Model Test

4.3.1 VECM Model

This model is used to determine the short run relationship between the variables. The model is estimated below:

Table 7: Vector error correction model

Vector Error Correction Estimates
Date: 11/12/15 Time: 18:16
Sample (adjusted): 43 528
Included observations: 486 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LOG_NSE(-1)	1.000000
LOG_EXCHANGE(-1)	1.891737

	(0.19486)	
	[9.70824]	
C	-0.001343	

Error Correction:	D(LOG_NSE)	D(LOG_EXCHANGE)
CointEq1	-0.591985	-0.206626
	(0.05352)	(0.02309)
	[-11.0608]*	[-8.94697]*
D(LOG_NSE(-1))	-0.180700	0.088696
	(0.04514)	(0.01948)
	[-4.00342]*	[4.55398]*
D(LOG_EXCHANGE(-1))	0.654885	-0.360618
	(0.09472)	(0.04087)
	[6.91387]*	[-8.82302]*
C	-3.33E-05	-1.73E-06
	(0.00129)	(0.00056)
	[-0.02585]	[-0.00311]
R-squared	0.392978	0.400393
Adj. R-squared	0.389200	0.396661
Sum sq. resids	0.389588	0.072540
S.E. equation	0.028430	0.012268
F-statistic	104.0135	107.2868
Log likelihood	1042.712	1451.182
Akaike AIC	-4.274535	-5.955482
Schwarz SC	-4.240081	-5.921028
Mean dependent	-3.35E-05	-1.78E-06
S.D. dependent	0.036377	0.015794
Determinant resid covariance (dof adj.)		1.19E-07
Determinant resid covariance		1.17E-07
Log likelihood		2498.338
Akaike information criterion		-10.24007
Schwarz criterion		-10.15394

For the VECM estimated of the two cointegrating series, results show that the coefficients of the estimation are significant except for the constant of the stock returns data series.

The estimated error correction coefficient indicates that 59.198% deviation of the NSE-20 Index return from its long run equilibrium level is corrected each period in the short run. It can also be observed that given the coefficient 0.6548 is significant and positive there is a significant price spillover from the foreign exchange market to the stock market. This implies that a 1% positive change in the exchange rate results in a 0.6548 increase in stock returns.

The coefficient 0.206626 represents the error correction parameter that measures how the deviation of the USD/KES exchange rate change from its long run equilibrium is corrected at each period in the short run. The coefficient 0.0886 shows there is a significant, as observed from its t-statistic, and positive price spillover from the stock market to the foreign exchange market. This implies that a 1% positive change in stock prices leads to an 8.886% positive change in exchange rates in Kenya.

4.3.2 ARCH Test

Before estimating the EGARCH model it is prudent to begin by conducting the ARCH heteroskedasticity test, to check whether ARCH effects exist in the data or not. This is done to determine if the model chosen that is EGARCH, is appropriate for the data. The results of the test are given below:

Table 8:ARCH test

ARCH Test: Exchange rates			
F-statistic	14.03633	Probability	0.000199
Obs*R-squared	13.72291	Probability	0.000212

The data series of the foreign exchange rate USD/KES is passed through the heteroskedasticity ARCH test to check for ARCH effects. The results show that the probabilities are less than 0.05 therefore reject the null hypothesis that there is no arch effect and find that there is arch effect. Therefore conclude that residuals are normally distributed so accept this model.

Table 9: ARCH test of stock returns

ARCH Test: Stock Returns			
F-statistic	53.65071	Probability	0.000000
Obs*R-squared	48.91906	Probability	0.000000

The data series of stock returns is passed through the heteroskedasticity ARCH test to check whether there is arch effect or not. The results show that the probabilities obtained are less than 0.05 and hence are significant therefore reject the null and accept the alternative that there is arch effect in the series of stock returns.

4.3.3 EGARCH Model

Table 10: EGARCH-NSE

Dependent Variable: LOG_NSE
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 11/06/15 Time: 19:43
Sample (adjusted): 41 528
Included observations: 488 after adjustments
Convergence achieved after 32 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(5)
*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1)) + C(7)
*ABS_EXP_ZET + C(8)*ZET

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.002069	0.000924	2.240177	0.0251
LOG_EXCHANGE	0.006667	0.066552	0.100176	0.9202
Variance Equation				
C(3)	-1.812487	0.318487	-5.690925	0.0000
C(4)	0.543644	0.072568	7.491536	0.0000
C(5)	-0.087783	0.048529	-1.808878	0.0705
C(6)	0.815613	0.038522	21.17269	0.0000
C(7)	-8.687637	3.812089	-2.278970	0.0227
C(8)	-5.252581	2.231074	-2.354284	0.0186

R-squared	-0.001534	Mean dependent var	0.001050
Adjusted R-squared	-0.003595	S.D. dependent var	0.026717
S.E. of regression	0.026765	Akaike info criterion	-4.663826
Sum squared resid	0.348160	Schwarz criterion	-4.595132
Log likelihood	1145.973	Hannan-Quinn criter.	-4.636843
Durbin-Watson stat	1.842964		

The results above show that from the mean equation the log (GARCH) and variables are statistically significant in explaining the dependent variable at 5% significance level. This can be interpreted that volatility does affect the NSE-20 index return and its effect is positive therefore implying that increase in the NSE-20 index yield increases yield in the same index. However, the coefficient for log (exchange) is not statistically significant at 5% significance level meaning that volatility in the USD/KES exchange rate has no significant effect on the NSE-20 index yield

With regards to the variance equation, the results show that the coefficient 8.687637 is statistically significant and negative and also shows a positive significant coefficient of 0.815613 which implies that a negative shock in the exchange rate market increases volatility in the stock market by more than a positive shock of equal magnitude. This effect is known as the volatility

spillover effect. In the case of a negative $Z_{E,t}$, which is represented by the coefficient 5.2525 this is shown to enhance negatively the size effect of the shock.

The model is such that if C7 is significant and negative there is a leverage effect, this is shown in the model by the coefficient -8.6876. The coefficient -0.087 in this case is significant and it is negative therefore this implies that there is a leverage effect and conclude there is negative correlation between past return and future volatility of return. The higher the leverage effect the greater the risk of volatility.

The conditional variance Log (GARCH) is the dependent variable, which is the variance of the residuals derived from the mean equation. Leverage effect is where a positive shock has less effect on the conditional variance compared to a negative shock.

Table 11: EGARCH-Exchange rates

Dependent Variable: LOG_EXCHANGE
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 11/06/15 Time: 19:58
Sample (adjusted): 41 528
Included observations: 488 after adjustments
Convergence achieved after 84 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
LOG(GARCH) = C(3) + C(4)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(5)
*RESID(-1)/@SQRT(GARCH(-1)) + C(6)*LOG(GARCH(-1)) + C(7)
*ABS_EXP_ZST + C(8)*ZST

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000512	0.000311	1.645206	0.0999
LOG_NSE	-0.028689	0.008258	-3.474010	0.0005
	Variance Equation			
C(3)	-0.059550	0.474920	-0.125389	0.9002
C(4)	0.461282	0.070263	6.565058	0.0000
C(5)	-0.142227	0.031718	-4.484076	0.0000
C(6)	0.904318	0.021411	42.23553	0.0000
C(7)	56.15236	22.72544	2.470903	0.0135
C(8)	-57.75695	22.11770	-2.611345	0.0090

R-squared	-0.003999	Mean dependent var	0.000132
Adjusted R-squared	-0.006065	S.D. dependent var	0.011298
S.E. of regression	0.011333	Akaike info criterion	-6.612138
Sum squared resid	0.062417	Schwarz criterion	-6.543444
Log likelihood	1621.362	Hannan-Quinn criter.	-6.585155
Durbin-Watson stat	1.958405		

The results above show that from the mean equation the log (GARCH) and variables are

statistically significant in explaining the dependent variable at 5% significance level. This can be interpreted that volatility does affect the exchange rate and its effect is positive therefore implying that increase in exchange rate changes increases volatility in the same market. Furthermore, the coefficient for log (NSE) is statistically significant at 5% significance level meaning that volatility in the NSE-20 index yield has a significantly negative effect on the USD/KES exchange rate.

With regards to the variance equation, the results show that the coefficient 56.15236 is statistically significant and positive and also show a negative significant coefficient of 0.9043 which implies that a negative shock in the stock market decreases volatility in the exchange market. In the case of a positive $Z_{E,t}$, which is represented by the coefficient 0.4612, with a positive C4 as is the case in the results, this is shown to enhance positively the size effect of the shock.

The coefficient C7 is significant and positive thus there is leverage effect this is shown in the model by the value 56.15236. The coefficient -0.1422 in this case is significant and it is negative therefore this implies that there is a leverage effect and conclude that there is negative correlation between past return and future volatility of exchange rates. In regards to the R-squared and the adjusted R-squared, they are not significant in this model that is they are only valid in interpretation of the mean equation whereas EGARCH and GARCH models deal with the variance equation.

CHAPTER 5

5 Conclusion and Recommendations

The study attempted to analyze the relationship between the currency market and the stock market in Kenya with regards to the USD/KES exchange rate and the NSE-20 INDEX. The study employed the Bivariate EGARCH model in its analysis and the results revealed that the movements in the currency market do indeed have a significant impact on the stock price movements, specifically stock price returns. This relationship was also replicated in the case of volatility spillover effects from the stock market to the exchange rate market.

The study finds that there is a bidirectional relationship between the currency market and the stock market. Therefore in setting monetary policy the Central Bank and Monetary policy committee should consider the impact of devaluation or overvaluation of the currency on the stock market and the general impact this would have on the economy as a whole.

In the estimation of the vector error correction model (VECM) to determine the price spillovers, the study concluded that there is significant positive price transmission between the currency and stock market. This would mean that for investors and investment managers, they can make predictions on the movements of stocks prices and on the returns received by monitoring the US dollar/Kenya shilling exchange rate. Companies can also reevaluate the prices of their stocks in the market to take into account the exchange rate risk that arises with the cointegration of these two markets.

The estimation of the EGARCH model finds that there are significant volatility spillover and asymmetrical effects between the Kenyan stock market and its currency market. The study concluded that a negative shock in the exchange rate market increases volatility in the stock market by more than a positive shock of equal magnitude while in the alternate case of a shock in the stock market, a negative shock in the stock market decreases volatility in the exchange market.

The study investigated the presence of leverage effects in both markets this is also concluded from the EGARCH model. It finds that in the currency market there is a leverage effect and concludes that there is negative correlation between past return and future volatility of exchange rates similarly in the stock market there is found to be leverage effects. These conclusions have

significant implications in that where there is volatility in return especially in stock returns, the risk of the business goes up and investors would opt to shift their fund to less risky investments.

With the globalization of capital markets and liberalization of the capital account, investors would be expected to diversify their portfolios across currencies and national stock markets. In the computation of portfolio risk, exchange risk would have to be included as determined from the observations made above, which would result in a closer link between the stock market and the foreign exchange market.

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