EXCHANGE RATE CO-MOVEMENT AND VOLATILITY SPILL OVER IN AFRICA

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ABSTRACT

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Although research interest in why and how economies are related to each other continues to accumulate (Joyce, 2013, Todd, 2008), our understanding of the mechanisms through which economic turmoil in one region transmits to another is still unclear. The motivations for this study were to examine the volatility transmission in the African foreign exchange market and the global world through financial interdependence and factors explaining exchange rate co-movement. The thesis set out to find answers to the questions of volatility spill over within, from and to the Africa region and also to identify factors of exchange rate co-movement changes.

The study employed the multivariate GARCH with the unrestricted full BEKK version to estimate the volatility transmission. The BEKK GARCH and the panel data approach were used to analysis the determinants of co-movement. Monthly data of GHC/USD, Ksh/USD, ZAR/USD and GBP/USD for volatility transmission analyses and quarterly data for the influence of exchange rate co-movement were analysed. Data were sourced from the International Monetary Fund's direction of trade statistics and international financial statistics. The selection of countries for the study was influenced by common colonial ties, flexible exchange rate regimes, high depreciation of the currencies and competition in the same exports markets.

The results from the VAR(1)- multivariate GARCH (1,1) analysis, suggest that, there is a statistically significant mean spill over at 5% level. Regionally, significant mean transmission is found from the South Africa rand to the Ghana cedi

only. Significant mean transmission is identified mainly from the global world to Africa and bidirectional transmission between South Africa and the global world.

Exchange rate volatility transmission results show that there are high positive correlations between currencies and significant interaction between second moments of these currencies. First, global variance of exchange rates significantly influenced a volatility spill over in Africa supporting the idea that foreign exchange markets in Africa are more prone to the cross-over effect of developed economies. Regional volatility spill over is only significant from South Africa to Ghana. The BEKK estimation revealed significant correlation between African countries and the global world.

The panel data analysis of the bilateral exchange rate correlation showed that foreign exchange markets in Africa are highly positively influenced by the shock from the global world. This relates to an average world interest rate and capital account openness. Similarly, from the demand side, the trade linkage appeared to have a long run positive effect on any co-movement. Regional differences in interest rate and financial development negatively influenced the exchange rate co-movement.

The major finding implies that the foreign exchange market in Africa is more prone the global market than intra regional volatility spill over in both volatility and mean spill over. Thus, the African foreign exchange market is under meteor shower hypothesis. Exchange rate correlation is explained by a shift in the global economies and a low level of financial market development in the region.

Policy makers can achieve financial and exchange rate stability if they are able to control macroeconomic factors and cope with changing circumstances in the region and from outside. In addition, authorities should be able to moderate exchange rate fluctuations through strong institutional set-up since economic governance is now a force to be reckoned with in macroeconomic management and regional leaders should also conduct an exchange rate policy on a regional basis in order to cope with any shocks and exchange rate volatility.

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TABLE OF CONTENTS

LIST OF TABLES

Tables **Page**

LIST OF FIGURES

Figures **Page**

CHAPTER 1

INTRODUCTION

1.1 Research Problem and Statement of Objectives

The exchange rate is the most important single price in international macroeconomics and financial investments. International finance research on exchange rate volatility has been intensified after the adoption of flexible exchange rate regime. Since then foreign exchange volatility has been rising and it has been empirically difficult to predict future exchange rate values (Billio and Pelizzon, 2000; Bordo and Murshid, 2000; Forbes and Rigobon, 2002; Killian and Taylor, 2003; Kocenda and Valachy, 2006; Mendoza, Quadrini and Ros-Rull, 2009; More and Wang, 2014). Fluctuations in the nominal exchange rate volatility generate political problems for governments since it influences the behaviour of short-term capital flow which also in a way has an effect on net foreign assets.

Understanding volatility transmission and potential determinants of any co-movement thereof is of crucial importance to international portfolio investors in the region since increased volatility not only creates output lost but also increases the cost of doing business, thus enhancing uncertainty and poverty (Joyce and Nabar, 2009). Participants in the trading industry also stand to gain from a meaningful knowledge of volatility transmission and foreign exchange co-movement since they will be able to develop cutting edge hedging to minimise fluctuations in transaction costs.

Post 2008 economic turbulence studies evidence volatility spill over in Asia, and Europe, mixed and in the Americas (Kitamura, 2010, Aloui, Aissa and Nguyen, 2011, Nikkinen, Pynnonen, Ranta and Vahamaa, 2011) but little so far in Africa. In these studies, the Euro, the US dollar and the Yen dominate (Muller and Verschoor, 2009; Moshirian, 2011) in volatility spill over. Increased risk associated with exchange rate volatility is more likely to generate uncertainty which increases the level of riskiness of portfolio investment and the cost of hedging foreign exchange

risk which is essential in our understanding of the underlying foreign exchange volatility (de Zwart, Markwat, Swinkels and van Dijk, 2009). The continuous depreciation of the individual currencies in Africa was fuelled by the financial crisis of about 42% on average (Todani and Munyama, 2005; IMF, 2009). This occur because markets may be imperfect particularly in less developed countries (LDCs) and hedging may not only be imperfect but also very costly (Krugman, 1989; Doroodian, 1999; Kihangire, 2004). The trend of currency movement in Africa is shown in Table 1 and figure 1 below

Table 1.1 Local Currency Per United States Dollar Exchange Rate (2008-2014)

Year	**Cedi /USD**	**Rand /USD**	**Ks/USD**
2008	11.900 (Gh¢ 1.19)	11.86	57
2009	12400 (Gh¢ 1.24)	8.13	69
2010	13300 (Gh¢ 1.33)	7.88	81
2011	14500 (Gh¢ 1.45)	10.34	100
2012	19800 (Gh¢ 1.98)	10.11	107
2013	22000 (Gh¢ 2.20)	11	121
2014(March)	26326 (Gh¢ 2.63)	11.76	112

Source: Author's Compilation from DataStream, 2014.

Note: Cedi/USD, is the Ghana cedi per US dollar, Rand/USD is the South African rand per US dollar, Ks/USD is the Kenya shilling per US dollar.

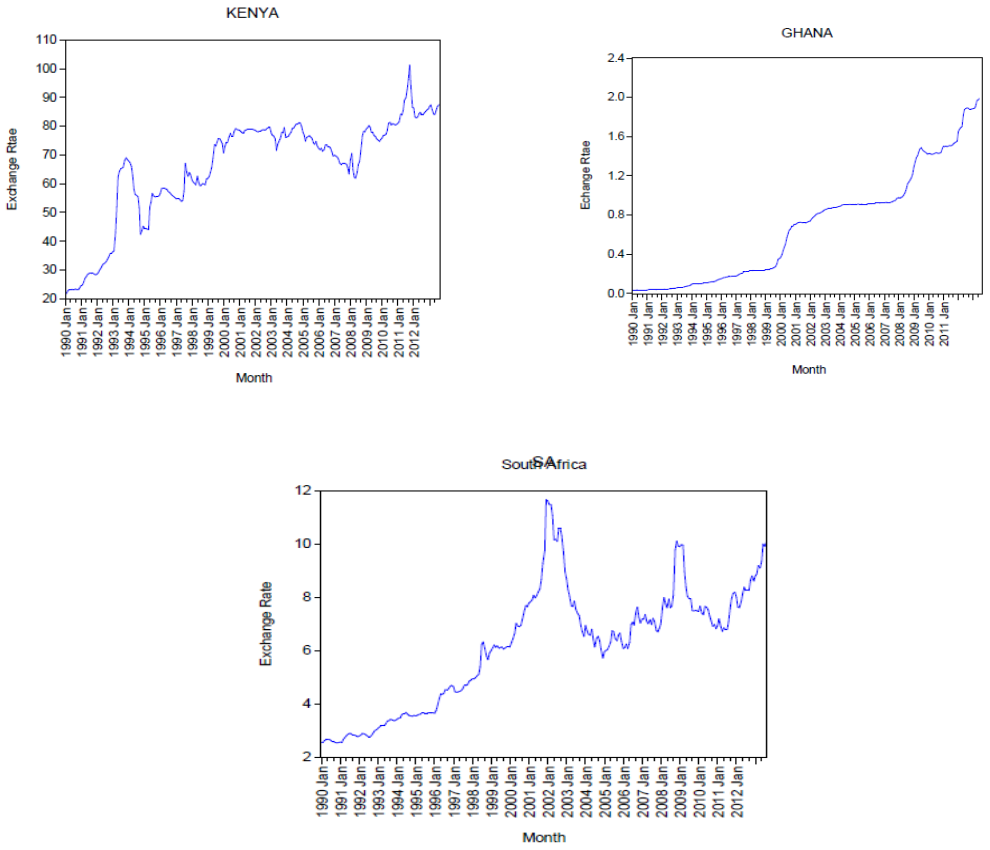

Figure 1.1 Currency Movement in Africa and Data from Data Stream

Cumulatively, in 2009, the cedi traded at ¢1.24/$ and March 21, 2014, it trades at GH¢2.63/$ implying the cedi has lost 139.49% of its value relative to the United States dollar. Likewise the South African rand and the Kenyan shilling lost equivalent values of 44.65 % and 62.32% respectively. The exchange rate being a significant component of the pricing of utilities and petroleum products means that other things being equal, if it depreciates, we can all expect to pay more for utilities and petroleum products and virtually all other commodities. These massive depreciations in the currencies end up increasing the cost of living and the cost of doing business.

The increasing globalisation in international finance and trade, fostered by advances in information and communication technologies and the deregulation of capital markets have intensified interdependencies and linkages between national and international financial markets (Baele and Soriano, 2010; Boero, Silvapulle and

Tursunalieva, 2011; Christoffersen, Errunza, Jacobs and Langlois, 2012). This has culminated in increased cross-border capital transactions. The continuous financial opening has made portfolio investors in a given market incorporate into their decisions relevant information generated in other markets. The result is rapid inter-market information transmission and greater financial integration among the world's capital markets (Todd, 2008; Boero et al., 2011; Christofersson et al., 2012; Joyce, 2013).

Financial integration in the capital markets is moved by foreign direct investment which arises when the host country has an investment opportunity that it cannot exploit by itself because it lacks the technical know-how, and has market incompleteness. A multinational corporation (MNC) with appropriate capital and technology can exploit such an opportunity but the benefits of MNC in African have not be utilized fully because of political risk and the relative small number of portfolio investors in spite of potentially large returns in many developing countries (Wesso, 2001; Janeba, 2002; Jensen, 2005; Asiedu, 2006; Asongu, 2011). The investment promotion strategies outlined by Africa Union (AU) should have boosted the attraction of international portfolio investment yet little is seen. Researches attributed this to returns uncertainty to foreign exchange volatility (Billio and Pelizzon, 2000; Bordo and Murshid, 2001; Forbes and Rigobon, 2002; Basu and Reagle, 2003; C. Sussangkam, 2010; Subbarao, 2010).

Apart from financial linkages accounting for foreign exchange volatility and spill over, trade linkages theories of contagion posit that foreign exchange volatility positively correlates with volume of trade but volume of intra trade among African countries is less relative than their inter trade in other continents like Europe, Asia and the Americas. Therefore there is less likelihood for a high volatility spill over in the region and hence making potential financial portfolio investment returns less certain. Intra-regional trade in Africa is low, accounting for about 10% compared with Asia's 48.1 and 45.5 percent for imports and exports, respectively (World Trade Organization, 2010; Ofa, Spence, Mevel and Karing, 2012).

Among reasons for this include the similar goods and services traded and the difficulty of moving goods across borders in Africa (Economic Development in Africa Report, 2009). Export of primary products is the key characteristics of Africa's trading since colonization to date. Collier and Dollar (2001 quoted in Collier, 2002)

and Gayi (2010) shows that primary commodities continue to dominate Africa's merchandise exports but Africa's share has been declining over time. With this low volume of trading in the region can there be volatility spill over in the region?

Exchange rate volatility affects developing economies more than the developed ones (Sauer and Bohara, 2001; Devereux and Lane, 2003; Serven, 2003; Hausmann, 2006; Ganguly and Breuer, 2010) and contagion is more important among developing nations than developed countries (Bae, Karolyi and Stulz, 2003). Fewer studies, however, exist to describe the dynamics of exchange rate volatility and contagion in developing countries' currency markets. This may be due to lack of quality high-frequency data from these countries, or the unattractive nature of developing countries markets compared to the highly traded currencies (Esquivel and Larrain, 2002; Assibey-Osei, 2010; Ofa et al., 2012). However, African financial markets in general are undergoing significant transformation which has raised concerns regarding its exposure to risk in case of global or regional crises, such that knowing how far a contagion can affect the infantile financial markets in Africa is a policy relevant decision.

While many studies have examined either real or nominal exchange rate volatility in Africa they are on sources or are country specific such as Ghana (Insah, 2013; Insah and Chiaraah,2013); Nigeira (Ajao and Igbekoya, 2013); Africa (Assibey-Osei, 2010). Exchange rate volatility usually emanates from domestic fiscal and monetary policies, level of output and the exchange rate regime, the openness of an economy and central bank dependence (Adom, Morshed and Sharma, 2012; Insah, 2013). For instance, an unexpected increase in public expenditures lead to a fall in the risk-adjusted long-term real interest rate causing the real exchange rate to depreciate (Corsetti and Müller, 2006; Monacelli and Perotti, 2010; Corsetti, Meier and Muller, 2011; Enders, Muller and Scholl, 2011). Even though most of these studies found evidence of volatility in exchange rate and have broadening our understanding of what persist in individual countries but what is yet unknown is the evidence of the volatility spill over effect across markets globally and in the African continent as whole.

On the methodologies front, the application of the conventional time series models such as cointegration, causality, value at risk, exponential weighted GARCH

approach and others have received much criticism in the literature (Corsetti and Müller, 2006; Osei-Asibey, 2010; Enders et al., 2011; Adom et al., 2012; Insah and Chiaraah, 2013) One strand of the criticisms is the issue of the heteroskedasticity problem when measuring correlations, caused by volatility increases during the crisis. Also an omitted variable problem arises in the estimation of cross-country correlation coefficients due to the lack of availability of consistent and compatible financial data in the regional markets.

Also, a dynamic increment in correlations is not sorted out and relying on the Cholesky factor identification of VAR, variance decompositions may be dependent on variable ordering which makes the estimated results unreliable (Diebold and Yilmaz, 2012; Klobner and Wagner, 2012). The application of Multivariate GARCH models to capture the dynamic nature of exchange rate returns which is scarce particularly in Africa would help provide a better view about volatility and spill over in the region.

Investors have difficulties in developing an appropriate safety mechanism for financial investment in Africa. Knowing the mechanism of safety in financial investment would promote investment in the continent. With sufficient applications of the conventional models (VAR, cointegration, causality), the current study intends to apply dynamic multivariate models like BEKK and BEKK-GARCH- panel data analyses which are missing from previous studies in the region to investigate the nature of volatility spill over and determine factors explaining the pattern of foreign exchange co-movement. Our understanding of volatility transmission and potential determinants thereof would be of crucial importance to African leaders, and multinational corporations contemplating the diversification benefits of undertaking international portfolio investment in the region since increased volatility not only creates output loss but also increases various facet of inequality and poverty.

In particular, the study analyses volatility spill over between and among Kenya, Ghana, South Africa and United Kingdom currencies per US dollar. These countries have been selected due to the fact that their economies have similar characteristics and simultaneously completed World Bank stabilisation policy programmes. Also they compete in the same market for exports and have common colonial ties. Therefore, examining foreign exchange volatility and factors influencing

the pattern of co-movement in these countries would give a better view of exchange rate behaviour.

In light of the preceding research gaps and grounded in the financial contagion theory, the study aims to examine the extent of volatility spill over to, from and among African countries and the global world as well as exchange rate return co-movement. Specifically, the objective of this study is to

1) Examine volatility spill over within(to, from and among) Africa and the global world

2) Determine the pattern of factors explaining foreign exchange markets co-movement

The following research questions are to guide the study:

1) Is there a volatility spill over within (to, from and among) Africa and the global world?

2) What factors explain the pattern of foreign exchange markets co-movement?

1.2 Africa Macroeconomic Environment

Africa is the world's second largest continent and it has the second largest population after Asia. The continent covers an area of 30.2 million square km representing about 20% of the total land area on earth. Africa has 54 states including various island groups. The continent economy is highly diverse. The southern parts are prosperous whereas other parts struggle for stability. The African economy is blessed with a variety of abundant natural resources which makes future growth bright. The continent commands about 90% of the world's cobalt, 50% of gold, 64% of manganese, 33% of uranium, 98% of chromium, 70% of tantalite and 90% of platinum (AfDB et al., 2012). Despite the endowment of these natural resources, Africa's per capita GDP is extremely low and it is no doubt the poorest continent. The poorest economies in the continent are Malawi and Somalia with per capita GDP of $596 and $600 respectively. The mmacroeconomic environment in Africa has not been the best and is usually characterized by fiscal and current account deficits. This has cumulatively contributed to the poor growth performance and the high level of

poverty (Clarke, 2012; Gelos and Ustyugova, 2012; Mafusiere and Brixiova, 2012; World Bank, 2012).

The poor performance of the African economies changed moderately after the implementation of the World Bank and IMF stabilization programmes in the 1980s. In early the 1990s, economic performance improved significantly and the continent has since started to catch up with the rest of the world economy. Africa's average annual GDP growth amounts to about 5% and year on year per capita GDP increases by an average of 2.5%. As a result of this marginal boom, the 2010 Africa's level of per capita income is higher than the 1995 level by 46%. The growth of African economies has been widespread with the exception of a few countries (AfDB et al., 2012; Clarke, 2012; World Bank, 2012). Recent political upheavals in the Arab countries dubbed the "Arab Spring" and the adverse external shocks from the global recession in 2009, has had a toll on the continent's average growth (Leibfritz and Flaig, 2013).

According to Leibfritz and Flaig (2013), from 1980 to the early 1990s the trend in the growth rate in Africa was at 2.5% but from 1993 to 2006, a slight increase in the trend growth rate to about 5.25% was experienced and since then there has been a steady decrease, triggered especially by relatively low growth rates in 2009 and 2011 mainly due to the Arab Spring. The value for the 2012 trend growth rate for Africa was about 4.5%. Africa's actual GDP growth excluding the Libya effect was 4.2% which is lower than the 2012 value but it is projected to be above 5% for 2014. According to these estimates, the trend growth in South Africa, the largest economy in Africa had an immediate positive growth effect of about 1%, increasing trend growth from about 1% in 1993 to about 2% in 1994. In the second largest economy in Africa, Egypt the trend growth in 2012 has been estimated to be about 4%, down from about 5% in 2002. The ongoing political conflict and uncertainty has reduced growth to around 2% in 2012 which is only half of the underlying growth path. In 2009, South Africa's GDP was $488.6 billion with Egypt's GDP standing at $479.4 billion. On a purchasing power parity basis, these countries ranked 26th and 27th in the world respectively.

Nigeria is the third largest economy in the continent, the current growth trend has been estimated at close to 7%, down from about 9% in the early 2000s. This downward trend in Africa's growth rate is due to the deep recession of 2009 which

affected the world economy and the ongoing weakness of the world economy coming from the deepening crisis in the European economies and the sluggish growth in other main advanced economies (Gelos and Ustyugova; 2012; Mafusiere and Brixiova, 2012; OECD, 2012). These recent political events make it very difficult to determine trend growth rates with some confidence.

In the 2000s, a lot of African countries benefitted from a higher GDP growth and terms of trade gains fostered by rising commodity prices. However, oil and food importing countries suffered terms-of-trade losses because the boom in the commodity prices increased import prices more than export prices. The share of exports to emerging economies' trade partners' keeps on increasing progressively, yet Europe and the United States continue to be Africa's main trading partners. For instance, China's search for natural resources to fuel industrialization led her to Sub-Saharan Africa. Trade between Africa and China in 2006 was more than $50billion. Strong oil demand by China is contributing to an increase in the bills for oil in importing African countries (Aseidu, 2006).

For many years, Africa enjoyed terms-of-trade gains such that the growth of command GDP was higher than GDP growth. For instance, from 2002 to 2011, 0.9% was the effect of the terms-of-trade and this had a positive repercussion of about 6.2% on purchasing power of consumers. But it must be said that terms of trade effect is very volatile especially during the global economic crisis of 2009 which had a negative impact on welfare. From this point of view, the analysis of Africa's growth performance needs to be broadened to include changes in terms of trade. The history of terms of trade gains shows that many African countries, notably those with resource wealth, can improve living standards of their populations more than output growth (Van Biesebroeck, 2005; Gayi, 2010).

Strong commodity prices drove Africa's exports growth to 6.1% faster than in any other region in the world in 2012 yet it accounts for only 3.5% of the world merchandise exports compare to 5% in the 1960s and it has been the lowest over the years (UNCTAD, 2010; UNECA, 2010). Another positive strives in the trading sector is intra-African trade with value-added manufacturing growing more rapidly than exports to the rest of the world. The continent can do better in sector trade if bottlenecks like poor governance and weak industrialization policies are tackled.

Stepping up Asia's growth miracle policy path which targets trade reforms and policies, efficient trade infrastructure, and incentives to support value-added technology rigorously at both regional and national levels in Africa would be essential. If African leaders follow in the steps of Asian giants properly, this would help the continent gain a stronger foothold in global value chains.

African leaders have developed a clear vision for integration but the pace of implementation has been far too slow to unlock the continent's enormous potential and turn its recent episode of high growth into an economic take-off. For Africa to be competitive in the global economy, Africa still needs higher levels of cross-border trade and investment, better institutions and bureaucracies skilled in public policy co-ordination.

On the demand side, domestic demand is often the catalyst through private consumption and investment. Large consumption in domestic sectors is moved by higher earnings coming from inflows of remittances and expanding consumer credits. Africa's private investment is usually related to oil production and mining as well as inflows of foreign direct investment. This means that a weakness in the global economy restrains Africa's export volumes and reduce some commodity prices but in some parts of Africa(North Africa, Mali, DRC and Nigeria) growth has been constrained by political tensions (WTO, 2010).

The supply side is governed by agriculture and service sectors**.** The agriculture sector employs around 60% of Africa's labour force but its share in GDP is relatively smaller, accounting for an average of 25%, showing a relatively low level of productivity and earnings. The size of the sector differs across the continent but almost every country devotes not less than 50% of labour to the sector. However, South Africa and Mauritius agricultural sectors employ less than 10% of the labour force and the share of the sector in GDP is less than 5% because these countries are tourist destinations (OECD, 2012; World Bank, 2012).

Closely related to trade integration is financial integration. The ability to attract external resources is an incentive for countries to strengthen economic links among each other and to enhance intraregional financial flows. Global capital flows to Africa has increased astronomically since the 1990s for all types of private investment and capital, reflecting greater global financial integration. Africa has enjoyed

marginal increase in external financial flows especially since the 2000s, which is projected to quadruple to about USD 200 billion in 2014. The composition and destination have also changed progressively with foreign investments and remittances from non-OECD countries underpinning this positive trend. For instance, foreign investment including direct and portfolio has increased marginally from the 2009 economic crisis and is expected to reach a record high level of USD 80 billion in 2014 to make it the largest financial flow to Africa (IMF, 2009; UNCTAD, 2010; AfDB, 2011).

In Africa, manufacturing and services sectors are the destination of foreign investment but resource-rich countries remain as first destination. Though, official development assistance's (ODA) share of total external capital flows continues to diminish, from 38% in 2000 to projected fall to 27% in 2014, official remittances have seen increasing trend since 2009 and are expected to continue this upwards trend into the long run. The truth is that ODA still represents the largest external financial flow to low-income African countries. Tax revenues though they increase every year are still meager because of politics and corruption among tax officers (OECD, 2012; World Bank, 2012). The insignificant tax revenues make external financial flows impetuous to Africa's development and any recession in the global world will surely have adverse effects on Africa's quest to develop.

The Human Development Index shows that Africa has made substantial progress in human capital development. Poverty levels are declining, incomes are rising, and education and health outcomes are improving. Annual human development growth index is 1.5% and 15 countries are classified as a medium to very high in human development. African countries with high and rising levels of human development are well integrated into global markets with diversified exports that create employment (Gereffi and Fernandez-Stark, 2011; OECD, 2013). The continent has not made much progress in the areas of inclusion, gender equality and environmental sustainability and these have inhibited human rights, improved livelihoods and the expansion of skills (Gereffi and Fernandez-Stark, 2011).

Another burden in Africa's human development is environmental challenges relating to climate change, natural resource depletion and energy access. The environmental challenges are also hindering sustainable human development. The

development agenda for Africa targets equitable and socially-inclusive economic growth, governance, social transformation and gender equality which give a promising future to the continent. Integrating into new technology and innovation are critical for ensuring value chains to raise agricultural productivity to generate jobs and increase social cohesion, particularly for countries recovering from conflict.

African countries with low levels of human capital and physical capital resources have denied the continent proper industrialization. At independence, African economies adopted Import Substitution Industrialization (ISI) policies with government protection of these industries using an infant industry argument in the 1960s to the 1970s. The policy of ISI is ideally grouped into three stages. First, locally producing previously imported goods such as finished materials, components and pharmaceuticals; second progressively decreasing the import contents of manufactured goods and the final stage entails replacing the imported goods with goods made locally from basic indigenous raw materials. The prime objectives were to enhance industrial development through technology and providing jobs as well as creating wealth for all (Khennas, 1992)

Africa's industrial landscape failed partly because of many factors. The first drawback of import substitution industrialization policy was the oil crisis of the 1970s. The 1970s oil price hikes made African countries paying hefty prices for oil and this tremendously slowed down the import substitution model (Anyang' Nyongo, 1998). Africa debt crisis in late 1970s also forced them to use GDP proceeds to service foreign debt. In essence, an indebted continent cannot industrialise due to the continent inability to purchase heavy industrial machinery (Ayittey, 2005).

Africa's millennium industrial policy aimed at transforming the continent but it has been identified with a lack of dynamism and low level of coordination, as well as inadequate consultations with stakeholders, political crises and corruption as the main obstacles to the industrialisation development in Africa (Nzau, 2010).

An assessment of Africa's industrialization failure usually ignored the inherent weaknesses of policy processes and institutions governing industrial policy. The fact is that weak institutional structures and poor policy designs are the root of Africa's industrial policy failure. Generally, for Africa to achieve inclusive and sustainable

economic growth, the building of independent institutions and a strategic policy should be a precondition for the continent's industrialization drive.

In spite of this glooming picture, the African economy will continue to experience moderate growth which has a tendency to improve the macroeconomic circumstances of African countries. But the continent biggest problems are continuing weather dependency agriculture, low national savings, high unemployment rate, heavy debt burdens, a one product economic structure and the large number of poor people. A bitter pill to swallow by African national leaders is to stress regional coordination and economic development to build capital construction, economic diversification, agriculture mechanisation, the environment, markets, and human resources to salvage the African economy from poverty.

1.3 Exchange Rate Policy in African Countries

The euphoria of independence in the early 1960s influenced exchange rate regimes in Africa. Initially all economies pegged the exchange rate but changed over time to a flexible exchange rate regime due to the adoption of the IMF's programmes in the 1980s and 1990s in Africa. The fall of Bretton Wood systems have seen Africa countries adopting a wide range of regimes, from simple pegs and basket pegs, crawling pegs, clean floats and dirty floats. Variation of exchange rate regimes suggest how uniquely important the linkages between the exchange rate regime and macroeconomic performance are. The recurring policy changes have been to maintain an exchange rate that would ensure international competitiveness while at the same time keeping the domestic rate of inflation low, conducting a strict monetary stance and maintaining positive real interest rates. A short history of exchange rate regimes in each country is provided below:

1.3.1 Ghana

Exchange rate policies in Ghana have evolved over the years due to contrasting political regimes since independence in 1957. Ghana adopted a fixed exchange rate regime till 1992. The Ghana Cedi (¢) was fixed to the convertible currencies of Britain and the United States of America. However, the foreign

exchange rate was pegged more or less by decree with series of administrative control such as import license to deal with any excess demand of foreign currency.

Foreign exchange market experienced series of devaluation during the implementation of IMF Programmes (ERP) in the early 1980s. In particular, the Cedi was devalued in stages from ¢2.75 to US$1.00, ¢23.38 to US$1.00 in the third quarter of 1983. A multiple exchange rate of ¢30.00 to US$1.00, ¢90.00 to US$1.00 was applied to specified payment and receipts. A policy of more periodic exchange rate devaluations was introduced which required a quarterly adjustment of exchange rates in accordance with the relative inflation rates of its major trading partners for the period 1983-1984 because the real exchange rate was thought to be overvalued (Bank of Ghana).

The auction market approach with dual exchange rates was adopted in September, 1986, in order to achieve the objective of trade liberalization, leaving it partially to market forces to determine the Cedi-Dollar rates. Window one was operated as a fixed exchange rate pegged at the Cedi-Dollar exchange rate at ¢ 90.00 to US$1.00 and was mainly used in relation to earnings from the export of cocoa and residual oil products. Window two was in charge of all other transactions and was determined by demand and supply in a weekly auction conducted by the Bank of Ghana. The two systems were however unified in February 1987.

In addition, a foreign exchange bureau system was established in an attempt to absorb the parallel market into the legal foreign exchange market. These forex bureaus were officially licensed entities operated by individuals and institutions. In April 1992, the wholesale auction system was dropped for only the inter-bank market system. Both banks and forex bureaus have operated in a competitive environment since then in the environment of managed floating exchange rate. (BoG Annual Reports, various issues).

Recently, the Cedi experienced another shock, in which it was re-denominated in July, 2007 on the fact that the regime placed significant deadweight burden on the economy. This came in several forms such as high transaction cost at the cashier, general inconvenience and high risk involved in carrying loads of currency for transaction purposes, increasing difficulties in monitoring bookkeeping and statistical records. The re-denomination introduced the Ghana Cedis and the Ghana Pesewas to

address the legacy of past inflation and macroeconomic instability. The re-denomination then sets old Ten Thousand Cedis to be one Ghana Cedis, which was equivalent to one hundred Ghana Pesewas(¢10,000 =GH¢ 1.00 = 100Gp). The purchasing power or value of the currency remains the same. (BoG Annual Reports, various issues).

1.3.2 Kenya

Exchange rate policy in Kenya has undergone various regime shifts mostly driven by large balance of payments crises. From independence in the early 1960s till 1974, the Kenya shilling was pegged to the dollar with occasional discrete devaluations; the peg was changed to the Special Drawing Rate (SDR). The Kenya shilling was devalued by about 20% in real terms measured against the SDR between 1980 and 1982 because of uncertainty due to the depreciation of the nominal exchange rate by about 14%.

The devaluation was followed immediately by a regime changed to a crawling peg. The crawling peg regime had a heyday until 1990 when a dual exchange rate system was adopted. The shilling was put into a complete floating system when the official exchange rate was merged with the market rate. The floating exchange rate system was expected to provide several advantages for Kenya in early 1990s. It was to equilibrate the demand for and supply of foreign exchange by changing the nominal exchange rate instead of the levels of reserves. In addition, the floating system was to ensure a more continuous adjustment of the exchange rate to shifts in the demand for and supply of foreign exchange. Finally, the system was to give Kenya the freedom to pursue its monetary policy without worry about any balance of payments effects.

1.3.3 South Africa

Up till 1995, the exchange rate, in South Africa was a dual system. The two official rates were the commercial rand rate (managed floating) and the financial rand rate. The financial rand acted as a shock absorber for the commercial rand and traded at a significant discount between 15% and 55% to the commercial rand over the thirty years that this mechanism was in place. The commercial rand was fixed to the United

States dollar or the British pound and the float was managed to fluctuate in synchronize with the value of these currencies.

Specifically, the government in September 1975 devalued the rand against the pound by 18%. A unified rand regime was adopted on 10 March 1995 in place of the dual exchange rate system at a stable rate of R 3.60 to the US dollar. This new system marked yet another milestone in the country's integration into the global capital market.

The South African rand experienced erratic movements during the unified period. The sharp 'sell-off' in 1996 led to the rand losing 20% of its value reaching R 4.50 against the US dollar. The South African rand plummeted by over 20% in real terms in 1998, although it regained some of its composure through 1999, trading in a broad band between R 5.50 and R 6.40 to the US dollar during that year.

The New Millennium saw the rand continue its free fall, from February-August, 2003; the range was R8.06 and R5.64 per United States dollar. The beginning of the subprime mortgage crisis of 2008, in the US which precipitated into the worst recession in decades made the rand, reach a multiyear trough of R 11.855 in October 2008(Golub 2000; FEASability 2006). Policies concern over the real-economy effects of the value of the rand and its volatility has led to suggestions for a modification of inflation targeting (Frankel, 2007).

1.4 Methodology

The following methodologies are employed to study two main features of the exchange rate behaviour.

Multivariate GARCH

The Multivariate GARCH is employed to study the linkages of exchange rate because it gives assurance of a positive definiteness of the variance-covariance matrix. Other tools and methods (regime switching models, stochastic volatility, exponential weighted average model, and simple GARCH models) have been used to study volatility spill over effects but the multivariate GARCH version is the most popular one because of its time varying characteristics. The dynamic nature makes it

more powerful in explaining volatility transmission and spill over effects by capturing its own conditional variance and covariance.

1.5 Scope of the Study

This study consists of two main features of exchange rate behaviours which are volatility transmission and pattern of exchange rate co-movement. The purpose of the study is to analysis volatility transmission in the foreign exchange markets regionally and globally. Also to analyse the pattern and degree of the exchange rate co-movement. The foreign exchange markets are highly integrated such that a change in one will instantaneously cause changes in other currencies. The mechanism of interconnectivity propagates the shock to other economies due to herding behaviour or panics. The herding behaviour comes from asymmetric information due to high cost of information to investors who remain uniformed (Schmukle, 2004).

Consequently the study concentrates on the foreign exchange subcategory of the broad financial market integration. Consequences of financial market integration relating to causes and effects of volatility spill over are not focusing on this piece. Specifically, fundamental causes of contagion were tested to find if global, trade or financial links account for the exchange rate co-movement. Longer run consequences triggered by the dynamics in the co-movement is the dramatic loss of confidence of investors who had intended to invest in the region's market jeopardizing the economic growth of the region.

1.6 Contribution and Significance of the Study

A thorough understanding of the structure, drivers, and volatility transmission mechanisms is critical both investors and policymakers. Study that examines regional and global interdependence of the foreign exchange markets jointly as explicitly as done in this study in the region is little to my knowledge. Most of the past researches fail to jointly examine the relative importance of regional and global factors in volatility transmission of the African's foreign exchange markets. Quantification of

the magnitude of the volatility driven by regional and global factors, and whether these proportions have remained stable over time is limited.

In addition, a notable contribution of this research is that unlike previous literature, the attempt to link the time variation in the global and regional integration to economic fundamentals so as to establish empirically the factors that have driven Africa's volatility transmission processes. Also, a time varying multivariate vicariate BEKK GARCH and correlation series with a panel data approach to analysis volatility transmission in Africa and the developed European markets simultaneously should indicate dynamism in the foreign exchange market in African.

Finally, analysing volatility transmission processes and returns co-movement of the African foreign exchange markets in relation to their regional and global counterparts will add to the scant literature on the determinants of the interdependence of the African foreign exchange markets because unlike a general study on macroeconomic variables co-movement, this study is specific on foreign exchange linkages.

In terms of benefits, portfolio investors' knowledge of the manner and the extent to which different financial markets interrelate is crucial for the determination of efficient international hedging decisions to minimise the adverse effect of uncertainty on the expected returns of investments. Furthermore, an understanding of financial markets interrelation facilitates the identification of diversification opportunities for investors' international portfolios investment. Financial interdependence is a necessary relief on supply of appropriate capital for developing emerging market economies including those in Africa. Increased financial integration improves the supply of necessary capital thereby facilitating greater capital accumulation.

Contagion and its antecedent: volatility spillover is evidenced to be rapid and severe particularly during financial crises. The speed of the shift contagion poses a new challenge to authorities and policymakers because 'mind your own business' does not guarantees a stable and healthy financial market any more. Now exogenous financial markets can hurt domestic foreign exchange rates due to the contagion even if the domestic financial markets do not suffer from explicit mispricing. Thus, the foreign exchange market in particular, can be triggered by exogenous factors to move even though its domestic endogenous factors are significantly stable. The outcome of

this study will help policy-makers prepare a counter-fluctuation hedging policy to prevent their economies from being hurt by the global economies and to reduce the cost of externally generated financial and economic downturns.

The study will serve as surveillance and a kind of early warning signal to the region's economic planners. Is early warning signals basic idea what provokes economic crises? And if we can find relevant factors that invite crises, we are sure to predict crises. As one of the means of international financial cooperation and integration, early warning signal studies of this nature will contribute much in terms of surveillance and warning signal to economic strategy toward Africa's development quest. Financial crises in the world like the ones in Mexico and Asian capital accounts have also proved that economic crises tend to be precipitated by balance of payment deficits and others. Therefore, having fore knowledge of a possible currency crisis has the potential of averting danger of economic crises which can evolve into political crises, destabilizing the entire domestic society and unsettle the relationship between and among African nations.

1.7 Outline of the Thesis

The thesis is organised into 5 chapters. Chapter 2 reviews the literature linking Volatility of exchange rate and economies' performance, and summarizes a few key studies in this research domain. Further, empirical arguments are presented to justify the study's hypotheses.

Chapter 3 reviews the theoretical perspectives underpinning the hypothesized model. This is the financial contagion and it also discusses the key constructs of the financial contagion and how a crisis transmits from one economy to other.

Chapter 4 discusses the research methodology, data sources and empirical results of volatility transmission in the foreign exchange markets. Second, the contextual background of the study is also presented, describing the nature of volatility transmission with emphasis on the role of the foreign exchange markets in the country's economic development.

Chapter 5 presents the study on the pattern and degree of the exchange rate co-movement with application of the BEKK GARCH dynamic panel analysis by calculating correlation coefficients across markets and hypotheses testing of the fundamental theory of contagion.

Chapter 6 recaps the objectives of the study and locates the study within the larger context of financial economics research. Specifically, it summarizes the key findings, and discusses their theoretical and practical implications. It further discusses the limitations of the study and highlights some directions for future research.

CHAPTER 2

REVIEW OF RELATED STUDIES

2.1 Exchange Rate Volatility

Exchange rate fluctuations and co-movements plays essential roles in financial decision making relating to portfolio investment, risk management and policy intervention, therefore understanding its behaviours and volatility forecasts are crucial for economic growth. Prior to 1970s, exchange rate volatility was considered an exogenous factor but post- Bretton Wood studies using various data sets and econometric methods (Rose, 2000; Ito and Sato, 2006) revealed that it affects key macroeconomic variables. The development of multivariate GARCH models revitalised interest in the exchange rate fluctuations and co-movements of financial returns. Multivariate GARCH models have been used to investigate volatility and correlation transmission and spill over effects in studies of contagion (Bera and Kim, 2002; Tse and Tsui, 2002). The motivation is that they are flexible enough to represent the dynamics of the conditional variances and co-variances because asset pricing depends on the covariance of the assets in a portfolio. The literature on the market volatility are discussed as follows

Volatility in foreign exchange markets has been measured historically in several ways (Frenkel and Mussa, 1980; Kenen and Rodrik, 1986). Standard deviation of a random variable is the first choice measure of volatility in foreign exchange. Another simplest measure is rate of return on an asset (the percent rate of growth of an asset over time). An equally simple measure of volatility is the average of absolute percent changes in foreign exchange rates over a period. Applied over the time series, this measure of volatility is the mean difference of daily observations. The deficiency of these measures is their assumed constancy of variance across the time series but in reality, variance is not constant over time. Rates of return on foreign exchange, like

any financial series in general, are heteroscedastic and also leptokurtic. Thus, they exhibit excess kurtosis or fat tails in their distribution. These measures of volatility are unable to reveal the statistical properties of financial time series such as exchange rate returns.

The functions of volatility models are to describe the historical pattern of volatility to forecast future volatility, a key element in investment decisions, security valuation, risk management, and monetary policy. Volatility forecasting is important for at least three reasons: assessing investment risk; pricing derivative securities, and a signal of the stability of an economy.

The ARCH Model is a canonical theory in the development of financial econometrics that can efficiently represent typical empirical findings in financial time series. It is an econometrics model used to analyse and predict volatility based on an historical analysis of data. When analysing volatility using this method, fluctuations in volatility are identified and grouped in clusters over time. To predict future volatility, one takes the historical data in clusters, and looks at how probability distributions relate to each variable such as price over time. A major contribution of the ARCH literature is that apparent changes in the volatility of economic time series may be predictable.

The GARCH (Generalized Autoregressive Conditional Hetersoskedasticity) model is used to analyse and estimate fluctuations in financial markets in order to predict volatility of price or returns by looking at variables to own past behaviours over a series of time intervals, in order to identify correlations and unexpected outcomes. The objective of this method is to use past mistakes to accurately forecast the current situation. In recent studies, the model multivariate GARCH-in-mean specification (Kocenda and Poghosyan, 2009) is the basis of foreign exchange risk and its macroeconomic determinants in several new EU members. Observable macroeconomic factors such as consumption and inflation are analysed

The GARCH model has been extended to investigate different aspects of the correlation of exchange rates and to forecast correlations. Some of the contributors for instance Bollerslev's (1986) GARCH model, is closely related to that of Ng (2000), Baele (2005), Engle and Kroner (1995) and Engle's (2002) dynamic conditional correlation (DCC) model and these were introduced in order to extend and include

additional macroeconomic factors for instance interest rates or commodity returns. The outcome of the these studies showed that they augmented models providing marginally better out-of-sample volatility and correlation forecasts than standard GARCH models (Antonakakis, 2012) because the unexpected return of a market is influenced not only by news originating within the local market but also from foreign sources.

2.2 Financial Liberalizations Theories

The theory of financial repression hypothesis by McKinnon(1973) and the debt intermediation hypothesis of Shaw (1973) argue that financial liberalization (higher real interest rates) and development increase the incentive to save and stimulates investments due to an increased supply of credit, and raises the average efficiency of investment. They argue that policies leading to the repression of financial markets reduce the incentive to save. This view stresses the importance of free entry and competition within the financial markets as prerequisites for a successful financial intermediation.

The financial liberalization theory has been extended to include models of financial and currency crises among both developed and developing countries. These variants of the financial repression hypothesis, argue that financial crisis results from rapid reversals in international capital flows which are prompted chiefly by changes in international investment conditions. Flow reversals trigger sudden current account adjustments, and subsequently currency and banking crises (Forbes, 2002). For instance fragile financial institutions cause the build-up of unhedged short-term borrowing denominated in foreign currency which can cause capital reversals.

The Financial Repression (FR) model has seen supports over the years since it is important to the development of the world. These authors (Obstfeld, 1998; Stulz, 1999; Mishkin, 2001) argue that international capital markets can channel world savings to their most productive uses irrespective of location and that this promotes transparency and accountability, reducing adverse selection and moral hazard while alleviating liquidity problems in financial markets. Implicit in these arguments is that international capital markets help to discipline policy makers, who might be tempted

to exploit an otherwise captive domestic capital market. The implied benefits of financial liberalization include increased access to domestic and international capital markets, and increased efficiency of capital allocation.

Despite these, there have been arguments against the financial repression hypothesis. Critics have argued that the efficient markets paradigm is fundamentally misleading when applied to capital flows. For instance, the theory of the second best makes argues that removing one distortion need not be welfare enhancing when other distortions are present. If the capital account is liberalized while import competing industries are still protected, with a downwardly inflexible real wage, capital may flow into sectors in which the country has a comparative disadvantage, implying a reduction in welfare (Demirguc-Kunt and Detriagiache, 1998; Stiglitz, 2000).

If information asymmetries are endemic to financial markets this means in particular, that countries with poor corporate governance, financial liberalization either domestic or international, will not be welfare improving (Stiglitz, 2000). Moreover, in countries where the capital market is least advanced, there can be no presumption that capital will flow into where its marginal product exceeds its opportunity cost.

Finally, liberalization depends on resilient macroeconomic stability. Evidence is the financial reforms carried out in several Latin American countries during the 1970s, aimed at ending financial repression, often led to financial crises characterized by widespread bankruptcies, massive government interventions, nationalization of private institutions and low domestic saving (Diaz-Alejandro,1985; Demirguc-Kunt and Detriagiache,1998; IMF, 2007; Bértola and Ocampo, 2012).

2.3 Exchange Rate Regimes

The first generation model of currency crises posits that inconsistent macroeconomic policies make a crisis not only possible, but inevitable even if agents are fully rational. Typically, an inconsistent policy mix leads to high overall money creation, current account deficit and foreign reserves loss. The basis of the first generation model was not in line with crises during the 1990s given the level of foreign reserves held by central banks (Joyce, 2013). The failure of Krugman's

model(1979) to predict a crisis accurately prompted the self fulfilling models of second generation which come from a sudden change in expectations of investors and a third generation model also precipitated by moral hazard behaviour of financial institutions due to a government guarantee of deposit.

The wave of financial globalization for the past two decades is accompanied by crises that demonstrate the volatility of capitals flows. Episodes of currency crises in Europe, Latin America and East Asia revealed that capital inflows could be quickly reverse and pose a threat to financial stability undermining exchange rate commitments.

The troubling characteristic of a currency crisis will be that any adjustment could move from orderly to disorderly, due to a precipitous decline in the willingness of investors to hold local currency assets, causing a sharp decrease in the price of those assets and an equally sharp increase in the interest rates attached to those assets. A sudden spike in interest rates could slow domestic interest rate sensitive spending more quickly than the falling local currency can stimulate net exports. This negative impulse could cause overall economic activity to slow, perhaps to the point of stalling the economic growth. The decrease in net exports would fuel the decline in absorptions and national incomes throughout the African region.

Although asset market trade offers opportunities to raise overall economic efficiency and improve the economic welfare of borrower and lender alike, trade in assets is prone to occasional volatility, the disorderly resolution of which can lead to financial disruption and, more broadly, a slowing of economic growth. The essential weakness of asset markets is that assets are a claim on a stream of earnings over time and the future is always uncertain.

Increase in volatility due to currency and financial crises impose costs on economies in terms of lost output. An unsuccessful defence of the pegged exchange rate policy leads to force devaluation of the currency. The depreciation raises the cost of imports and servicing of the foreign debt which may induce output contraction in the short run as well as higher inflation rates. Currency, and banking dubbed twin crises have a negative impact on output which has the subsequent effect on macroeconomic volatility and contributes negatively to long term growth especially in the poorer African countries (Cerra and Saxena, 2008; Hnatkovska and Loayza,

2005). The lowering of growth by currency crises results from a fall in investment expenditures (Joyce and Nabar, 2009). Since a high interest rate is accompanied by the fall in investment there is rising unemployment which is not politically acceptable and this makes reducing exchange rate volatility an essential decision variable for portfolio investors.

Renewed interest in macroeconomic volatility is because of financial crises experienced by a number of developing countries over the past two decades which showed extreme manifestations of high-output volatility which has increased inequality and poverty in emerging market economies and poor developing economies too. The twin crises (banking and currency) have been associated with the rapid opening-up of some developing economies to global trade and financial linkages to the so called globalization. These crises are associated with an increase in poverty. The negative repercussions of financial crises extend past the time of their occurrence, can imposing intergenerational effects.

A currency crisis resulting in devaluation has a large negative impact on the economy. Devaluation increases the real prices of imports which reduces the aggregate supply when an economy heavily relies on imported inputs such as oil. Devaluation also has a negative impact on aggregate demand when a country imports many necessities such as food stuffs because the higher prices of these necessities reduce the disposable income that is available to purchase other goods.

Also it can severely weaken financial systems by reducing the value of domestic assets relative to the foreign denominated debt. When banks and other domestic financial institutions purchase domestic assets that are financed with a debt that needs to be repaid in foreign currency, devaluation will greatly reduce net worth. This causes havoc on the financial fundamentals of lenders leading to credit and output contractions in a manner that is consistent with new institutional theories of finance.

Increase in volatility either transmitted or resulting from government failure to maintain a particular exchange rate regime because of inconsistent macroeconomic policies like domestic credit expansion and budget deficits will lead to a fall in foreign reserve holdings thereby building up external debt and default risk. An external debt-overhang has a negative impact on growth and investment because high debt service

obligations act as a tax to reduce the scope for public investment which creates uncertainty about future recovery and therefore raises the cost of borrowing. This is because creditors tend to require a higher marginal return when there is uncertainty over a country's future debt servicing capacity. In such circumstances, governments are forced to finance their spending through increasing the money supply leading to high rates of inflation and a significant downward pressure on exchange rates. Unattainable external debt burdens enslave an economy into a poverty trap which can deprive that economy of sound social policies to reduce abject poverty. This makes the idea about volatility imperative to sort out since external debt burdens causing default may bar economy from foreign capital markets and will have severe effects on the poverty situation.

The devastating effect and wide scope of increase in volatility due to financial instability like the international public good as outline above makes this study necessary and timely for the African region. The African region continues to experience the dual deficits of current and capital account resulting from perennial exportation of primary products means that knowledge about volatility transmission characteristics such as sources and direction cannot be overemphasis.

2.4 Financial Time Series Correlation

The association between assets such as exchange rates, bonds and stocks is often used when measuring co-movements of prices and discovering the contagion in financial markets (Bae, 2003; Kenett, Tumminello, Madi-Asaf, Gur- Gershgoren, Mantegna and Eshel, 2010). Partial correlation measures the degree of association between two time series and its computation is done by fitting a regression model for each of these two time series onto the rest. The correlation between the residuals of pair series regression models gives the partial correlation (Kandil and Dencer, 2008). However, partial correlation is unable to distinguish between extreme values. Bae (2003) categorized extreme returns of the linkages between financial time series where he captured the transmission of financial shocks to answer regional linkages in extreme returns. A lot of researches on multivariate extreme values have provided a method to model the temporal associations for rare events (Arnold, Yan and Naoki,

2007; Chen and Chihying, 2007; Pekasiewicz, 2007). Arnold et al., (2007) examines series of algorithms under the distinction of graphical Granger methods to quantify the connectedness in time series. Tai, (2007) examines correlations between regions. The majority of these studies found strong correlation between the world financial markets (Bae, 2003; Arnold et al., 2007; Chen and Chihying, 2007; Pekasiewicz, 2007; Kenett et al., 2010; Treepongkaruna, 2012).

Knowledge of the correlation of one equity with other equities can help one estimate the expected return of a weighted average equity over known returns of other equities. Since the correlation measure gives equal weight to both small and large returns, the differential impact of large return is reduced. Absolute values of returns rise s during volatile periods so an unconditional correlation values also rises if the connectedness of two equities remains unchanged (Longin and Solnik, 1998). The constancy of this correlation prompted the development of a conditional correlation to focus on certain sections (Staricia, 1999). Studies show that a conditional correlation of multivariate normal returns always appears less that a true correlation which is explicit when a GARCH method is used to generate returns (Longin and Solnik, 1998). One solution as is offered by Longin and Solnik (1998) is based on the extreme value theory, correlation is modelled by first modeling the tails of marginal distributions with generalized Pareto distribution (Castillo, Hadib, Beatriz and Pruneda, 2009) and second is that the dependence structure between two univariate distributions of extreme values is examined. Rigidity in such models is addressed through semi-parametric models (Boldi and Davison, 2007). The advantage is that the linkage is leaned between two time series independently of the rest.

Academics have used the analogy of meteorological hypotheses of heat waves and meteor shower to explain volatility spill over. The heat wave relates to the fact that a hot day in England is likely to be followed by another hot day in England but not typically by a hot day in Bangkok. The alternative analogy is a meteor shower which rains down on the earth as it turns. A meteor shower in England will almost surely be followed by one in Bangkok. In sum, volatility appears to be a meteor shower rather than a heat wave. A heat wave is more or less a country specific characteristic in terms of macroeconomic fundamentals like fiscal and monetary policies, and that one large shock increases the conditional volatility but only in that

country. The meteor shower posits the interdependence of economies so volatility occurs not necessarily due to domestic policies but by waves from external economic activities. A meteor shower is consistent with failures of market efficiency. For instance, a shock to England's economy says appreciation of the pound sterling may create speculation in the Asian markets of the same day and not wait until the England market of the next day. Thus the conditional volatility will increase for all markets, not just for the origin of the shock.

2.5 Exchange Rate Co-movement and Volatility

Studies on the financial market volatility was pioneered by Engle (1982) with the ARCH-GARCH framework and further developed by others (Bollerslev,1986; Nelson, 1991). The first generation researchers considered the univariate ARCH-GARCH framework to model volatility clustering and pooling individually in different segments of financial markets, instead of spill overs from other segments of the financial markets. Later studies (Engle and Kroner, 1995; Ng, 2000; Engle, 2002; Baele, 2005) model a multivariate framework, which explicitly accounts for volatility spill over between markets and assets. Recent researches (Engle and Kroner, 1995; Ng, 2000; Engle, 2002; Baele, 2005) model conditional variances and co-variances across financial markets by using a multivariate-GARCH model. The multivariate-GARCH models commonly employ the VECH model (Bollerslev, Chou, Ray and Kroner, 1992) and the BEKK model of Engle & Kroner (1995); these models differ in their assumptions and specifications of the variance-covariance matrix. However they have one common advantage of modelling time varying variance and covariance estimates.

Pindyck and Rotemburg are credited with the concept of excess co-movement. Excess co-movement refers to a co-movement beyond the explanations justified by economic fundamentals. Thus, factors affecting payoffs at liquidation and financial contagion are the circumstance of its occurrence. Excess co-movement is interpreted to mean pure information transmission, wealth effects, financial constraints, sunspot equilibria, the fragility of financial markets, and the rebalancing activity of risk-averse agents and investors' trading patterns. The behavioural genesis of factors explaining

asset returns are grouped into the habitat view, and the information diffusion view. The habit view believes that the co-movement of asset prices may come due to investors categorising assets into groups and choosing to trade only a subset of all securities but when information is incorporated into some securities prices faster than others due to market frictions this might also generate co-movement.

Barberis, Shleifer, and Wurgler (2005) confirmed that the co-movement in prices reflects the co-movement in fundamental values but correlation in returns is delinked from co-movement in fundamentals. Boyer (2011) finds that economic index labels, such as Value and Growth, cause stock returns to covary in excess of implied fundamentals. According to Pirinsky and Wang (2006) and Antonakakis, (2012) a strong co-movement in the stock returns is not explained by proxies for economic fundamentals. Green and Hwang (2009) find that stocks undergoing splits experience an increase in co-movement with low-priced stocks and vice versa. Concentrating on the return correlation coefficient, Israelsen (2012) finds support for the role of correlated information in explaining excess co-movement. A series of related studies have looked at the determinants of return correlation (Chen, and Li, 2012; Israelsen, 2012; Muslu, Rebello and Xu, 2012) to show that a trading strategy based on the price convergence of these pairs can generate abnormal returns.

Antonakakis, (2012*)* observes that significant volatility spill overs and co-movements across major exchange rates in Europe declined after the introduction of the euro. Furthermore, the euro is the dominant currency in volatility transmission, since it affects the volatility expectations of the franc, the pound and the yen. In a further study, Kühl (2009) examined excess co-movement in the foreign exchange market and showed that excess co-movements can be identified whereas the covariances between fundamental processes do not play the major role. The study explains that in general it is the interplay of the variances of the fundamental processes and the sentiments terms that determine the true correlation on the foreign exchange market. According to Kühl (2008, 2009), if developments in one exchange rate market are linked over a longer period to another market, it will make empirical exchange rate models fail by not taking account for these factors.

A volatility spill over across markets in the financial time series is ample (Nikkinen and Vahamaa, 2009). Information is the major factor driving volatility in

most of the previous research on volatility modelling. Persistence in volatility depends on persistence in the information arrival process. For instance, Andersen, Bollerslev, Diebold, & Vega, (2007) study the impacts of US macroeconomic news announcements across a range of financial markets using high-frequency data and support an instantaneous reaction to news arrivals. Laakkonen and Lanne (2010**)** similarly, indicate that macroeconomic news has a larger impact on volatility in good times than in bad times. More recent volatility linkage studies analysed money, bonds, FX and derivatives markets both inside and outside the US (Fleming, Kirby and Ostdiek, 2006; Treepongkaruna and Gray, 2009). In general, these studies observe strong information linkages and volatility spillovers across markets. Kaul and Sapp (2009) opined that an analysis of how intra-day volatility links change across the trading day might be important for understanding the impact of trading activities. Ding and Hiltrop (2010) analysed the impacts of electronic trading systems on bid-ask spread quotes in the FX market and found a significant reduction in spreads after the introduction of electronic trading systems and realised volatility linkage. Gencay, Gradojevic, and Selcuk (2009) test the informed trader hypothesis using the intra-day EUR/USD rate and find that the time-varying pattern of informed trading in the FX market results from the strategic arrival of informed traders in particular markets at particular times of the day and on particular days of the week. In a related study, McGroartya, Gwilymb, and Thomas (2009) use intra-day data to examine the role of private information in explaining intra-day empirical regularities, including the return volatility pattern in the spot FX rate, but only for major currencies.

Common factors like information that have plausible effects on a set of financial variables are considered as a first channel of volatility spill over (Ross, 1989; Bollerslev et.al, 1992). When there are fundamental linkages between markets, changes in the common factors are likely to instigate volatility spill over across markets. Ederington and Lee (1993) assert that one of the channels operates through the information spill over caused by cross market hedging. Evans and Lyon, (2002) are of the view that trader and actor in the foreign exchange and asset markets draw heavily on information as a source of volatility. Evans and Lyon (2002) speak about information integration in the context of traders extracting information from different exchange rates to determine the price of a particular currency. It was realised that

portfolio shifts and information about them can be said to cause the linkages. Kühl, (2008) on the other hand maintains that the linkages among the major exchange rates seem to be predominantly found for volatility by using market rates. Hence, public and private information seems to be the driving sources for common developments in the short-run. If information is embedded subjectively into prices, there is room for non-fundamental factors to cause changes in exchange rates simultaneously.

Significant persistence of exchange rate volatility and spill over in exchange rates were found by Chowdhury and Sarno (2004) when they applied multivariate stochastic volatility models on high frequency data of four USD exchange rates. Recently, Sahoo (2012) uses the two-step multivariate GARCH framework model to study the volatility spill over in various exchange rates relative to Indian rupee and find that volatilities in the exchange rate of the leading currencies cause volatility transmission in the Indian rupee.

Kumar (2014) used VAR (1)-MVGARCH model to study the dynamic nature of return, volatility and correlation transmission mechanism among Indian exchange rates and revealed evidence of significant volatility spill over effect from USD to GBP, euro and Japanese Yen and from GBP and Euro to USD. Similarly, he found significant unidirectional return spillover from euro and Japanese yen to USD and a bidirectional return spill over between GBP and Japanese yen. Pavlova and Rigobon (2007), used a two-country, two-good asset pricing model to analyse how demand and supply shocks affect the linkages between domestic financial markets and the exchange rate with concentration on the linkages between the conditional first moments.

Wider studies on realised volatility, seasonality and intra-day patterns in returns and volatility have examined the relation between trading hours and volatility (Fan and Lai, 2006; Takatoshi and Yuko, 2006; Banko and Flannery, 2008; Gencay et al., 2009; McGroarty et al., 2009). Michelfelder and Pandya (2005) conclude that emerging markets have higher volatility as compared to mature markets. Treepongkaruna (2012) explored volatility linkages at the intra-daily frequency in the foreign exchange market with the Fleming et. al., model (1998), findings and indicates that hourly volatility is less persistent than daily volatility and also market trading hours play a different role in driving volatility linkages for major and non-major currencies.

Treepongkaruna and Gray (2009) observe that volatility linkages between a currency pair are driven by common information. Spillover effects occur when traders take a position in one currency to offset the risk exposure of a position taken in other currencies while common information for currency pairs occurs when the local markets for both currencies are open. Evidence on nominal exchange rates of some inflation targeting countries implies increase volatility under the new monetary policy regime (Gagnon and Hinterschweiger, 2011; Berganza and Broto, 2012; De Grauwe and Ji, 2013) with evidence to the contrary from Edwards (2007) and Rose (2007)

Volatility spill over from spot to futures market has also seen intense research and generally found evidences of volatility spill over between futures and spot markets. Studies of volatility spill over in the stock markets have been grouped into volatility spill over from one market index to another (Brailsford, 1996; Ng, 2000), volatility spill over across indices (Kanes, 1998; Beirne, 2010) and finally volatility spill over from one script to another script. Tse (1999) studies DJIA spot and Futures market, Kuo, Hsu, and Chiang (2008) study how the opening of foreign investment (FI) affects information transmission between futures and spot markets in terms of volatility spill over. Kuo et al., (2008) results suggest that increased participation of FI in emerging futures market may enhance the rate of information flows and improve the quality and reliability of information transmission in local futures market.

Significant evidence also exists for a volatility spill over across different markets (Ebrahim, 2000; Chulia and Torro, 2008; Boyer, 2011). Ebrahim (2000) uses a tri-variate GARCH model to study information transmission between foreign exchange and money markets in Canada and finds a significant spill over in the conditional means and variances in foreign exchange and money markets returns. A bi-directional volatility spill over between Euro stock and bond futures markets was observed by Chulia and Torro (2008). While Boyer, (2011) finds a strong and significant volatility spill over from oil prices to stock markets in Japan, Norway, U.K. and USA. Kanas (2000) indicate a significant volatility spill over from stock return to exchange rate changes for the USA, the UK and the Japan. Concentrating on emerging Eastern European countries, (Poland, Hungry, Russia and Czech Republic), Fedorova and Saleem (2009) find evidence of direct linkage between the equity markets and the currency market. Mohamed, Chortareas, and Cipollini, (2010) study

volatility spill over between nominal exchange rates and stock returns in three MENA countries: Egypt, Morocco and Turkey. The multivariate GARCH model used does not produce evidence of cross-market effects, nevertheless, a bidirectional shock and volatility spillovers between exchange rates and stock returns exist at the industry sector level. More recent empirical studies provide evidence that exchange rate volatility impacts the volume of trade flows, although there is no general agreement on the direction of the impact (Baum, Caglayan and Talavera, 2008).

In Europe, Chelley-Steeley (2000) used a GARCH (1, 1) model to study how the relaxation of United Kingdom's exchange rate controls impacted on the transmission of equity market volatility from the UK to other equity markets. The results indicated that shocks to the UK market increased the volatility of the other countries and these effects increased as the UK exchange rate controls were removed.

Kocenda et al., (2012) find statistically significant intra-regional volatility spill over among the Central European(CE) foreign exchange markets with exception of the Czech prior to the 2008 turbulent economic crisis in their study on the dynamics of volatility transmission between CE currencies and the EUR/USD.

Kearney and Patton (2000) also employ a multivariate exponential generalized autoregressive conditional heteroscedasticity to investigate the exchange rate volatility transmission across the French franc, the German mark, the Italian lira, the British pound, and the euro. The result of the daily data shows that the German mark played a dominant role in transmitting more volatility than the other currencies but weekly data failed to find any volatility transmission.

In a related attempt, Kanas, (1998) made use of EGARCH to capture the potential asymmetric effect of innovations on volatility. He found reciprocal spill over between London and Paris, and between Paris and Frankfurt. However a unidirectional spill over from London to Frankfurt was observed. As important, Kanas (1998) find that in almost all cases spill over were found to be asymmetric in the sense that bad news in one market has a greater effect on the volatility of another market as good news. Huang (2000) observe only simultaneous interaction between the two exchange rates, particularly regarding causality in the mean and a strong causality for variance. Furthermore, the study indicates that a change in past

Deutschemark volatility Granger-caused Japanese yen volatility, but not the other way round.

In an attempt to correct some of the limitations associated with the traditional pair wise correlation and the cross correlation used in assessing co-movements, Tiwari, Andries, and Ihnatov (2013) used multiple wavelet multiple correlation and cross-correlation to investigate the behaviour of exchange rates in Central and Eastern Europe (CEE). Their study shows that exchange rates among CEE countries are nearly perfectly integrated in the short and medium run, since the outcome of one exchange rate on another can almost be explained by the happenings in another country. They found discrepancies to be too small in the very short run but tend to increase within three to six months which means that in the long run the integration of foreign exchange markets is weak.

Inagaki (2007) uses residual cross-correlation functions (CCF) to study volatility spill over between the British pound and the euro per US dollar spot rates. The study found a unidirectional spill over from the Euro to the pound. In a related study Nikkinen, et al. (2006) find additional support for the findings of Inagaki (2007) using a VAR framework on currency option data for the pound, the euro and the Swiss franc between 2001 and 2003. They additionally find that the highest correlations exist between the euro and the franc, and that the euro is the dominant currency in volatility transmission.

On similar grounds, Nikkinen (2011) focused on the cross-dynamics of the exchange rate over different time scales and shows that market expectations of these currencies are closely related irrespective of the time scales. Nikkinen (2011)'s findings indicate that the dynamic structures of exchange rate expectations may vary over different time-scales. With regards to the short run the Japanese yen has a leading role among the three but he find a significant feedback effects from the GBP/USD volatility expectations to the JPY/USD implied volatilities in the long run. The wavelet cross-correlations between the higher-order moments of option-implied exchange rate distributions indicate that the expectations about the JPY/USD rate are virtually unrelated to the developments of the European currencies, while the higher-order moments of the EUR/USD and GBP/USD densities appear strongly linked with each other.

Pérez-Rodríguez (2006) investigated the correlation between EUR, GBP, and CHF using the dynamic conditional correlation (DCC) technique and found that the correlation between these countries fluctuated significantly from 1999-2004 and also found the dynamic correlation between the Great Britain pound sterling and euro highest among the three. More recent studies adopted the copula models in similar studies. For instance Patton (2006) finds evidence that correlation between the Deutsch mark-yen and yen-dollar exchange rate is higher during times of depreciation than during periods of appreciation. In this study Patton (2006) adopts the joint density of the three currencies and finds strong evidence of a negative type asymmetry for the pre-euro period but weak evidence of a positive-type asymmetry for the post-euro period and exchange rate correlation is time-varying (Cappiello, Engle and Sheppard, 2006; Patton, 2006),

Moreover, Boero, Silvapulle and Tursumalieva (2011), applied copula models to estimate semi-parametric methods to identify major changes in the dependence structure for the Euro-British pound and the euro–yen pairs since the launch of the euro. However, these previous studies do not address how the interdependence of exchange rates was affected by the recent European crisis. Tamakoshi and Hamori (2014) examined the interdependence of the US dollar exchange rate expressed in the euro (EUR), the British pound (GBP), and the Swiss franc (CHF). Findings suggest asymmetric responses in correlation among the three exchange rates. They found higher dependence in periods of joint appreciation than in periods of joint depreciation. The results suggest that Europe's recent financial turmoil may have triggered the shift of funds flows to Sweden in particular, which is widely believed to be a safe-haven currency. Volatility spill over between the two most traded exchange rates, namely the Deutschemark-US dollar and the Japanese yen-US dollar, has been discovered by Hong (2001). Here, the causality runs from the Deutsche mark-US Dollar to the Japanese yen- US Dollar rate. A similar result is obtained by Brooks and Hinich (1999) and Inagaki (2007) but with respect to the pound sterling- US dollar exchange rate and the corresponding euro rate. The euro rate is more volatile than the pound sterling rate, as Malik (2005) has figured. The results indicate that the Euro-US dollar market acts as a source of information.

Kitamura (2010) uses a time varying-correlation model of multivariate GARCH to test for the intraday interdependent and volatility spill over among the euro, the pound and the Swiss franc markets, and found that return volatility in the euro spills into the pound and the Swiss franc and also that these markets are highly integrated with the euro. He concludes that co-movements of these currencies become much higher in proportion to the arrival of news of the euro and volatility of the euro yields uncertainty in the pound and Swiss franc markets with persistent effect. The attribution is that these countries share a common economic and political background with other euro countries relating to the geographical proximity of the United Kingdom and Switzerland (Kitamura, 2010).

Volatility spill over between the South African rand and the currencies of selected markets in developed and emerging Europe as well as Asia and Latin America show statistically significant negative exchange rate volatility spill over effects between the South African currency and the currencies in developed and emerging European markets, while no spill over effects can be established for the currencies in the Asian and Latin American markets. The results confirm the hypothesis of changing exchange rate volatility spill over across currency markets overtime (Raputsoanel, 2008).

Similarly, Mazier, Oh and Saglio (2008) used a macro-econometric multinational model to study East Asian interdependence in the face of global imbalances with the United States as well as with the rest of the world. Mazier, Oh and Saglio (2008) showed US imbalances and their expected consequences, notably a depreciation of the dollar and the slowdown of US demand, have rather contrasted effects on East Asian economies. Korea is more affected by the dollar depreciation while China is more exposed to the US slowdown but Japan, is less touched by imbalances in the US probable due to its less openness and less dependence on the US market. They also conclude that any abrupt attempt to solve East Asian exchange rate misalignments, will badly affect East Asian economics.

Another section of the literature dealing with the long term relationship between exchange rates is the application of cointegration in exchange rates pair-wise which basically test for market efficiency (Hakkio and Rush, 1989; Baillie and Bollerslev, 1991), and stability of a given monetary system mostly the European

Monetary System (EMS) before the adoption of the Euro (Norrbin, 1996; Haug, 2000). For this, longer co-movement prevails for exchange rates that participated in the EMS before the introduction of the Euro. Kühl (2008) argues that the application of a cointegration technique in the exchange rate analysis gives results which are very sensitive to the periods of observation.

Kühl (2008) shows that cointegration of the exchange rate comes up in periods when fundamental variables coincide but most of the variations in exchange rates and cannot be explained by the cointegration setting. As a result, linkages among currencies in the short-run are related to the processing of particular private information.

Linkages in the medium-term seem to be associated with the coincidence of fundamentals but with room for non-fundamental factor. Spill over effects over the medium-term cannot only distort the bilateral exchange rates but also have an impact on the cross rates. From this point of view, the non-fundamental factors impact that is generated in a specific market sectors can scatter across different exchange rates. In that case the test of structural models, i.e. fundamental theories on exchange rate determination, tend to fail because impact factors that has nothing to do with the economies involved are important in determining the cross rates.

Many studies have identified evidence of integration and interdependence between financial markets in both developed and emerging countries (Samitas and Kenourgios, 2011; Subhani, 2011; Sakthivel and Kamaiah, 2012; Tripathi and Sethi, 2012; Akhtaruzzaman and Easton, 2014). Chao and Chen (2009), employ the multivariate Vector Error Correction Models (VECM) to analyse the relationship of indices amongst the emerging markets, USA and the rest of the world economies. They observed that the USA index influences the emerging markets greatly and world factor impact on the emerging markets is not significant. Bastos and Caiado (2010) found the evidence of integration and interdependence between the stock market returns of 46 developed countries for the period 1995-2009. Similarly, Park (2010) found strong co-movement between Asian markets among the countries with more developed financial systems (Japan, Singapore, and Hong Kong in Asia) to the rest of the Asian markets. Using the time-series data ranging from June 2, 2005, to April 2, 2008, Subhani et. al. (2011) established no significant association between the stock exchange of Gulf countries and the world stock markets.

Subhani, Hasan, Mehar, and Osman (2011) identified the linkage of stock prices of Karachi and Nepal except the Dhaka stock exchange. Samitas and Kenourgios (2011) found the existence of a long-term relationship among Balkan and developed stock markets. Besides, Sakthivel and Kamaiah (2012) investigated the dynamic inter linkages among the Asian, European, and U.S markets. They realised that the U.S. and some of the European and Asian stock markets lead the Indian stock market. Tripathi and Sethi (2012) examined the inter linkages of the Indian market with the advanced emerging markets and observed that the short-term and long-term inter linkages of the Indian stock market with other markets have increased over the study period usually in an unidirectional causality.

2.6 Causes of Exchange Rate Volatility

Whilst a number of studies reviewed in the previous section look at co-movements and spill over among a number of currencies, there still remains the question of the underlying cause of these phenomena. The current section seeks to review literature on the effect of economic fundamentals on exchange rate co-movement and volatility.

Several studies (Corsetti and Müller, 2006; Monacelli and Perotti, 2010; Corsetti et al., 2011; Enders et al., 2011; Adom et al., 2012; Ajao and Igbekoya, 2013; Insah, 2013; Insah and Chiaraah, 2013;) identified domestic fiscal and monetary policies, level of output and the exchange rate regime, interest rates, the openness of an economy and central bank dependence to be the main source of exchange rate volatility. For instance, an unexpected increase in public expenditures leads to a fall in the risk-adjusted long-term real interest rate causing the real exchange rate to depreciate.

Specifically, empirical literature on the causes of exchange rate volatility in the European Monetary Union is dotted (Kobor and Szekely, 2004; Kocenda and Valachy, 2006). Notable among them is Kocenda & Valachy (2006) who investigate the exchange rate volatility for Poland, Hungary, Slovakia, and the Czech Republic under fixed and floating exchange rate regimes with the application of TGARCH. They found that volatility is greater under floating exchange rate than fixed exchange

rate regimes and volatility tends to be mainly driven by surprises. This gives an indication that the type of exchange regime can have significant impact on level of the volatility. Their study sheds light on an earlier finding by (Kobor and Szekely, 2004) that volatility in exchange rate is subject to regime switching and also evidence that the cross-correlation between exchange rates is high at periods when both rates are in volatile regimes. The implication is that higher spill over occurs during volatile period. They also argue that asymmetric effects of news decrease volatility under the floating regime and interest rate differentials impact exchange rate volatility contemporaneously under either regime. Li (2011) shows that both widening and narrowing interest rate differentials will reduce the correlation. Less economic powerful currencies co-move more closely with the currencies of some influential foreign countries during joint appreciations than joint depreciations (Li, 2011).

In a similar study, Giannellis and Papadopoulos (2011) after controlling for the monetary variables, found a significant influence of real variables and financial variables on volatility of exchange rate. The most frequent effect was observed between interest rate differential and the Polish zloty/euro and was influenced by interest rate differential. The belief is in the likelihood of the monetary side of the economy to influence exchange rate volatility. However, the study failed to find any short-run dynamics between the exchange rate and the rest of the variables for the Czech Republic and Slovakia.

The occurrence of news, whether good or bad affects real economic variables, asset yields as well as exchange rates. The role of news as an important cause of exchange rate volatility has been explained (Dornbush and Fisher, 1980; Frenkel,1981; Engle and Ng, 1993). Frenkel used monthly data to investigate the exchange rate between the Dollar/Pound, the Dollar/French Franc, and the Dollar/DeucheMark and observed that predicted changes in exchange rates capture a small percentage of actual changes. A greater percentage of actual changes can be attributed to unanticipated information in the economy. Engle and Ng (1993) observed asymmetric effect of news on exchange rate and therefore proposed various modifications to the ARCH models for estimating exchange rate volatility. For instance, the EGARCH model allow good and bad news as well as major and minor news to have different impacts on the exchange rate. In the light of this asymmetry, Galati and Ho (2003)

investigated the extent to which daily co-movement in the euro/dollar exchange rate is driven by unanticipated information. Galati and Ho (2003) found a statistically significant relation between the two variables: news and exchange rate movements but findings is in contrast with Engle and Ng (1993) on an asymmetric effect. Similarly, Sánchez-Fung (2003) studied daily returns, volatility and news in the foreign exchange market of the Dominican Republic and observed that exchange rate volatility is higher for positive news (appreciation) than for negative news (depreciation).

The literature argue that trade openness and exchange rate volatility are structurally linked. In particularly, Hau (2002) analysed the effect of openness of the economy with the tradable and the non-tradable sectors on exchange rate movements. The conclusion is that there is a structural negative link between trade integration and real exchange rate. Hau (2002) posits that relationship is robust for the assumption of the competitive as well as the monopolistic market for tradable. Results did not change when an unanticipated labour supply shock is assumed. According to Stancik (2006) a more flexible aggregate price level reduces real exchange rate volatility through a reduction in the unanticipated money supply shocks for countries with higher openness of the economy. The impact of openness of an economy on exchange rate volatility is statistically significant at least at the 5% significance level (in most cases even at the 1% significance level) and openness explains up to 52% of volatility (Stancik, 2006). Openness of the economy has a negative effect on exchange rate volatility when the TGARCH model was used to investigate the effects of three macroeconomic factors on exchange rate movements (Stanck, 2006). However, he found that the extent of the effects varies substantially across countries.

Another important area to examine volatility is in the context of national crises. These crises may be political, economic, or a combination of both. Studies on volatility during such key periods shows that uncertainty appears to jump up, generate short sharp recessions and recoveries after major shocks like the Cuban Missile crisis, the assassination of J. F. Kennedy of the USA and Colosio of Mexico, the OPEC 1971 oil-price shock and the 9/11 terrorist attack (Cetorelli and Goldberg, 2010; Kayli and Kotze, 2013). A study by Bloom et al., (2007) showed that events impact negatively on productivity growth; overshoot in output and employment

because the pause in activity freezes reallocation across units. This study resonates the notion that investors shift their attention to processing market level information following an increase in market-wide uncertainty and then subsequently divert their attention back to asset-specific information (Peng, Wei and Bollerslev, 2007). Country-specific events may perpetuate changes to the trend of the underlying volatility spill over (Kavli and Kotze, 2013).

2.7 Effects of Exchange Rate Volatility

Since the collapse of the fixed exchange rate system, nominal and real exchange rates have fluctuated widely which is considered detrimental since it reduces the volume of international trade by increasing the riskiness of trading activity and adversely affecting the optimal allocation of resources. Several studies (Clark, 1973; Ethier, 1973; Baron, 1976; Cushman, 1983; Perée and Steinherr, 1989) have shown that an increase in exchange rate volatility leads to adverse effects on the volume of international trade. Contrarily, other models (Franke, 1991; Sercu and Vanhulle, 1992) showed that exchange rate volatility will rather have a positive impact on international trade flows and ambiguous effects depending on aggregate exposure to currency risk (Viaene and de Vries, 1992). Baum, et al. (2004) found a non-linear relationship between exchange rate volatility and bilateral trade flows. For the pair of countries studied, volatility was found to have a meaningful indirect impact on bilateral trade flows through the interaction with foreign income volatility. In addition, the work shows that uncertainty in foreign income may itself play an important role in the determination of trade flows.

Huchet-Bourdon and Korinek (2010) found that exchange rate volatility has a mild effect on trade flows and found income to be a strong driver of trade. Exchange rate volatility has a significant impact on real exports on all the countries studied but is insignificant for Germany (Baum et al., 2004). In a similar vein, Huchet-Bourdon and Korinek (2010) examine the impact of exchange rates volatility on trade flows in two small open economies, and revealed that exchange volatility impacts trade flows in the small open economies more than was found for larger economies but are unable to determine the direction of the impact. Also, they observed exchange rate levels to

affect trade in almost all sectors with unequal magnitudes. Moreover, their study indicates that depreciation in the exchange rates will not lead to a strong change in trade balances. Exports respond less to exchange rate volatility than do their imports because these countries are, in a large part, commodity exporters. This is because a rise in income either domestic or foreign increases purchasing power of consumers' hence a high demand for imports. Though there is less controversy on output costs of real exchange rate volatility (Bacchetta and Wincoop, 2000; Eichengreen, 2008; Aghion, Bacchetta, Ranciere and Rogoff, 2009) and amongst others, but empirical results are indecisive on the relationship between economic growth and excessive nominal exchange rate volatility. Levine and Zervos (1998) find that stock market size, volatility, and international integration are not robustly linked with growth and that none of the financial indicators is closely associated with private saving rates.

Related exchange rate volatility and trade is employment and volatility. The relationship between exchange rate volatility and employment has become research issue because uncertainty in the exchange rate and investment is believed to affect employment negatively especially when investment is characterized by irreversibility. In line with these arguments, Demir (2010) used a number of different specifications to study the impact of exchange rate volatility on employment growth in Turkey on a panel of private firms from 1983 to 2005, and found a significant contractionary effect of real exchange rate volatility on employment in the manufacturing firms.

In a related study, Belke and Kaas (2004) concerted that the impact of the real exchange rate volatility on the total economy employment growth in Central and Eastern European countries is inversed. Particularly, the study found that real exchange rate volatility reduces employment growth and higher wages could be another possible transmission mechanism. Belke and Göcke (2001) used an employment index to confirm the negative relationship between exchange rate volatility and employment performance. Also, Andersen and Sørensen (1988) found exchange rate volatility to have a upward effect on real wages and lowers employment. Belke and Setzer (2003) used cross-country panel analysis(Czech republic, Hungary, Poland and Slovak republic) to look at the issue from labour market outcomes, and found that exchange rate volatility increases unemployment.

Adopting a similar approach, Stirböck and Buscher (2000) and Belke and Gros (2002) also found a similar result in the European Monetary Union.

In Africa, Mpofu (2013), examined the impact of the real exchange rate volatility on the employment growth in South Africa with ARDL approach to test the relevant hypothesis. The empirical findings show that real exchange rate volatility has a significant contractionary effect on the employment growth rate in South Africa. The results also show that the depreciation of the real exchange rate leads to increases in employment growth. Ndambendia and Alhayky (2011) also found a long run relationship between exchange rate volatility and economic growth in fifteen (15) Sub-Saharan African counties. Using fully modified ordinary least square (FMOLS), they found that exchange rate volatility negatively affects economic growth when the ratio of domestic credit to GDP is below the threshold value of 57%. This results show that less financially developed economies are more adversely affected by the volatility of the real exchange rate (Ndambendia and Alhayky, 2011).

In spite of few previous researches on the nature of exchange rate volatility in LDCs, the few studies suggest that a strong and high perception of volatility is highest in LDCs when compared with industrialized economies (Sauer and Bohara, 2001; Bae et al., 2003; Hausmann, Panizza and Rigobon, 2006). For instance, Sauer and Bohara (2001) and Hausmann, et al., (2006) observed that LDCs exchanged rate volatility is the highest irrespective of the estimation technique used in a study of 91 countries (comprising 22 industrialised and 69 developing economies). Esquivel and Larrain (2002) concluded that high volatile domestic currency comes from the real cost of debt servicing and the net indebtedness of most LDCs. Serven (2003) also confirmed the high exchange rate volatility experienced by developing economies and opines that this has the tendency to translate into a high degree of profitability and costs uncertainty. Devereux and Lane (2003), found that the external financial obligation of developing countries drives exchange rate volatility. Current account deficits imply a rundown on foreign currency reserves making shortages of foreign currency in LDCs possible. This has tendency of increasing the price of foreign currency resulting in the depreciation of the domestic country's currency and subsequently inducing a higher exchange rate volatility (Cashin et al., 2004).

In summary, the review about excess co-movement and volatility spill over shows that two exchange rates can be contaminated by factors stemming from another foreign exchange market. In the empirical analysis an attempt has been made to gauge excess co-movements for the exchange rate pair such as the EUR/USD and the GBP/USD as well as exchange rate and security prices. The results give evidence that excess co-movements seems to prevail during tranquil periods. The true correlation dynamic of the exchange rate seems to be related to the correlation of differences in real business cycles for exchange rates. Many attribute high exchange rate volatility to the problem of capital flights due to disturbance and uncertainty in most economies of developing nations. The source of volatility may come from domestic and foreign economic policies as well as from an economic integration. Exchange rate volatility is inversely related to employment since it creates investment uncertainty.

CHAPTER 3

THEORETICAL FRAMEWORK

3.1 Economic Contagion

Contagion comes from the scientific term contagious. It is spreadable disease which is infectious and epidemic. According to the American Heritage Dictionary, contagion is a disease transmission by direct or indirect contact. Also a disease may be transmitted by direct or indirect contact. The direct cause may consist of the bacterium or virus, of a communicable disease through touching. The psychologists see the term to be as a spreading of a behaviour pattern, attitude, or emotion from one person to another (group to group) through suggestion, propaganda, rumor, or imitation. A tendency to spread a doctrine, influence, or an emotional state constitutes contagion.

Most international financial economists are reluctant to use the word 'contagion' to describe the international transmission of financial crises because it is fraught with controversy (Favero and Giavazzi, 2002; Rigobon, 2003). The controversy over the use of the term contagion is due to the fact that it is an emotive word. Contagion causes an emotive response among both producers and consumers of international financial markets research output. The argument concerns the use of the term in part from the fact that is borrowed from epidemiology. In epidemiological terminology, contagion is intrinsically associated with disease, and even more surprisingly with death, since contagion is used interchangeably with for Bubonic Plague in Europe in earlier centuries. Another argument is that individuals fall into financial crises through no fault of their own. However, this is an idea that some analysts are inclined to strongly resist since speculators appear to discriminate in choosing the countries they attack.

Before 1997, neither empirical evidence nor newspapers publication considered contagion to mean turmoil in international financial markets. It was a scarce terminology in the international finance literature. However, a currency crisis, in Asia, Latin America, North America and Europe, has shown that a Lexis-Nexis search of major newspapers since mid-1997 finds that almost all articles use the term referring to the spread of financial market turmoil across countries. The term contagion has become standard language in the vocabulary of international financial economists and policy makers.

As one can compare the spread of financial crises to the spread of a medical disease, the definition from the dictionary at the top of this section suggests, contagion incorporates many different ideas and concepts. At one level, contagion is a disease. The financial crises of the late 1990s that led to sharp contractions in income levels and standards of living in many emerging markets were certainly as devastating as many diseases. Contagion also refers to the transmission of a disease. As the Thai crisis spreads across the globe, it became clear to understand what prompted the initial events. This definition of contagion also demonstrates that it can occur through direct or indirect contact. The question which has been fuelled in the international financial contagion debate is do currency crises spread through direct economic linkages, such as bilateral trade flows or do they spread through indirect linkages, such as changes in investor sentiment?

The non- medical definitions of contagion is a good characteristics of the Russian default in 1998. Ample explanations for financial contagion have been common after the Russian 1998 default, based on changes in investor psychology, attitude, and behaviour. Some of the leading economies, who suffered contagion in the late 1990s, and especially countries with relatively strong fiscal and current account balances, see the spread of contagion to their economies as surprising given their strong economic fundamentals. Some blamed their subsequent difficulties on the harmful corrupting influence of investors in other countries instead of their own characteristics and policies.

International financial economists usually have narrow and broad definition of contagion. The broader definition captures the vulnerability of one country to events that occur in other countries, no matter why that vulnerability occurs or if those

linkages exist at all times. Similarly and closely linked countries in terms of market structure and history of strong direct linkages through trade and finance constitute broader contagion. In contrast, when two economies are separated by a geographical demarcation, such that they differ structurally and virtually no direct linkages exist through channels such as trade, the propagation of a crisis from one to another is commonly called shift or narrow contagion. Shift contagion is a significant increase in cross- market linkages after a shock to an individual country or group of countries.

The distinction is important when evaluating the effectiveness of financial interventions and assistance packages. For instance if one country suffers only a short-term effect by a crisis in another country, but the two countries have few linkages through trade, finance and other channels, then the appropriate effective financial assistance package would be a short-term loan to support the country. On the other hand, if they are closely linked through trade or financial flows, then the requirement is that the source economy adjusts to this shock, and the intervention will only prolong the necessary adjustment. The former policy direction relates to a shift contagion while the second is more of a broader definition condition.

3.2 Defining Contagion

In spite of considerable ambiguity in what contagion is and how we should measure it, researchers have defined it to suite themselves (Boyer, Gibson and Loretan, 1999; Forbes and Rigobon, 2002). Contagion is defined as a structural break in the data generating process of rates of return. Contagion can be thought of as an increase in the probability of a speculative attack on the domestic currency which stems not from domestic fundamentals such as money and output but from the existence of a (not necessarily successful) speculative attack elsewhere in the world. Contagion as opposed to interdependence indicates the idea that an international transmission mechanism is discontinuous as a result of financial panics, herding or switches of operations across instantaneous equilibria (Fratzscher, 2000).

Fane (2000), Goldstein et al. (2000) see the concept of contagion to be the transmission of a crisis from one economy to others, and has been an important feature in most past financial crises. It is defined as a situation in which a currency

crisis in one country increases the probability of a currency crisis in another country. The episodes of currency crises and capital flight since the 1980s have been characterized by links across countries. A historical account of currency crises in particular show that they took place almost simultaneously and the evidence is the Latin America in 1980s. Also, during the 1990s, a currency crisis in Thailand spread to other East Asian countries (1997), then to Russia (1998), Brazil(1999) and Argentina(2000). This kind of cross country linkages in the international finance literature is termed as contagion. It is usually common to find crises causing severe attacks on other currencies, despite the weak linkages of trade and capital flow among the economies concerned. When a crisis in one emerging economy triggers a broad reduction in investors' willingness to hold financial assets of other emerging economies, not just those of the crisis country is usually referred to as contagion (Todd, 2008).

The empirical literature mostly defines and characterised contagion with the investigation of currency crisis events where all unexplained turmoil (the residual) is denoted as contagion (Sachs, Tornell and Velasco, 1996; Fane, 2000; Goldstein et al., 2000) Similarly, Edwards (2000) considers contagion to be the information transfer between markets which exceeds ex ante expectations.

Considering contagion as a residual process is consistent with the definition of Masson's (1999) models which has been adopted by the IMF (see IMF 1999) because of its broadness. Masson considers contagion in currency markets as a combination of country specific events, common events which affect all markets called monsoonal effects and spill over effects, due to the known linkages between countries and economies. The remaining movement in exchange rates, unexplained by these factors is contagion.

Forbes and Rigobon (2002) define contagion as a significant increase in cross-market linkages after a shock to one country (or group of countries). According to this definition, if two markets show a high degree of co-movement during periods of stability, even if the markets continue to be highly correlated after a shock to one market, this may constitute interdependence instead of contagion. However, it is only contagion if the cross-market co-movement increases significantly after the shock. If the co-movement does not increase significantly, then any continued high level of

market correlation suggests strong linkages between the two economies that exist in all states of the world. Contagion occurs when a shock to one market or a group of markets, countries, or institutions, spread to other markets, or countries, or institutions.

Contagion is quite often different from both currency crises and banking crises. Eichengreen and Bordo (2002) see currency crisis to be mostly characterized by a forced change in parity, abandonment of a pegged exchange rate, or an international rescue whilst an episode qualifies as a banking crisis, when we observe either bank runs, widespread bank failures and suspension of convertibility of deposits into currency such that the latter circulates at a premium relative to deposits (a banking panic or significant banking sector problems). Mostly it results in the erosion of almost all of the banking system collateral which is resolved by a fiscally-underwritten bank restructuring. Contagion on the other hand looks at the aftermath of the financial and banking crises, looks at who are affected by these crises in terms of effect on real variables and portfolio investment. Interdependence means strong linkages between and among economies during period of stability but contagion comes up if an increase in linkages across markets is noticeable and significant after a crisis.

3.3 Modelling Contagion

The common methodology to contagion modelling of currency markets is to examine the effect of the crises in foreign markets on domestic markets. Eichengreen et al. (1995, 1996), believes that when foreign crises can increase the probability of a domestic crisis, it indicates evidence of contagion. The presence of contemporaneous crises themselves serve as evidence of contagion and key factor of this approach is the identification of crisis periods. An ad hoc examination of the data is proposed by Lowell, Neu and Tong (1998). Another method is by Eichengreen et al. (1996) who constructed an index of exchange market pressure (EMP) and apply a threshold criterion to that index to identify crisis periods.

These approaches differ in the frequency of data under consideration. Eichengreen, et al. (1996) consider quarterly changes in exchange rates and fundamentals

data. This is very different from other markets which concentrate on high frequency data. Recently, Cerra and Saxena (1999) applied higher frequency data to Eichengreen approach successfully. Other methods of currency market analyses focus on the short run data in part because the speed of the transmission is one of the major policy concerns. One revealing thing about these approaches is that they all test for evidence of contagion at the expense of quantifying it.

Dungey and Martin (2000) used Masson's (1999) definition to develop a model for currency market returns on a study of East Asian economies to quantify the impact of contagion and found unobservable factors to play a essential role in the markets. Once each return can be modelled in this manner spill over can be incorporated by links between the markets and contagion becomes the unexplained residual component.

The literature on the channels of financial contagion has various categorizations. Huang (2000) categorises the channels into the asset market channel, the banking channel, and the currency channel. Pritsker (2001) categorises it through real sector linkages, financial market linkages, and the interaction of financial institutions and financial markets. Claessens and Forbes, (2004) classified contagion by looking at fundamental causes like common shocks, trade linkages or financial linkages and investors' behaviour base on how risk is transferred, informational asymmetries and investor reassessments. Furfine (2003) focuses on how one (more) institutions transmit (s) risk to others due to explicit financial linkages.

Pure and signalling contagions are another way of distinction (Aharony and Swary, 1983). When all events spread across institutions, irrespective of the cause of the event it is referred to as pure contagion while signalling characterizes events whose revelation is correlated across the industry or market which may be the failure of a financial institution. For example, a credit institution's failure signals a bad condition of the overall economy. The credit institution's debt holders will, therefore, demand higher interest rates on their deposits which have consequences on the borrowing costs of these institutions. A positive signal may be interpreted by the market participants as a sign of a healthy economy.

3.4 Theoretical Framework

Theories of contagion are divided into fundamentals based and belief based theories. Fundamental based theories rely on the role of real shocks that are correlated across economies. The real shocks come in the form of changes in the terms of trade (an increase in the price of raw materials like oil), liquidity shocks (changes in monetary policy that reduces world liquidity), or macroeconomic shocks (rescissions in Europe reduces import demand and hence world aggregate demand).

Macroeconomic feedback models states that adverse expectations of a particular event such as predatory devaluation are more likely to raise borrowing costs or wages. At times, a fall in foreign exchange reserves below a certain threshold may trigger a devaluation decision. For example, a higher domestic interest rate caused by fears of devaluation or default, feeds back into an adverse way on the economy's prospects making devaluation or a default more likely because it increases the economy's foreign debt servicing. Furthermore, higher interest rates can cause a run on the banking system which reduces domestic liquidity, and leads to an outflow of reserves. The implication is that a shift in expectations is to some extent self-fulfilling. Mostly, such shocks would be commonly felt by a large number of countries.

3.4.1 Global Shock

A global shock is one type of fundamental cause of contagion. It emanates from major economic shift in industrial countries relating to changes in interest rates or currency values, a change in commodity prices, especially for economies depending on only one major export commodity and or a reduction in global growth such as the 2009 global crisis can trigger crises and large capital outflows from emerging markets. Any of these common shocks can lead to increased co- movements in asset prices and capital flows. Calvo and Mendoza (2000) pointed out that financial crises usually cause capital account reversal (sudden stop) and trigger an economic recession. Mendoza (2001) showed that sudden stops can be an equilibrium outcome in an economy with imperfect credit markets since an economic recession reduces not only domestic demand but also total output and export capability, whereas capital

outflow forces the country to increase export. Instances of common shocks include a sharp increase in US interest rates in the early 1980s which was an important factor in the Latin American debt crises and the increase in the world interest rates in 1994 also played a critical role in the Mexican crisis of 1994-1995. Similarly the incipient appreciation of the US dollar around the same period and the prolonged economic downturn in Japan contributed to the weakening of the Southeast Asian countries externally. The real shocks can also be spread through two main channels: trade linkages and financial linkages.

3.4.2 Trade Linkages

Trade linkages, which include linkages through direct trade and competitive devaluations, imply that a burst in one country reduces that country's demand for imports which also affects an aggregate demand of each of its trade partners. Trade linkages have been the common starting point of real channels of contagion studies. The economic downturn in one country can cause a reduction in income and a corresponding reduction in demand for imports, thereby affecting exports, the trade balance, and related economic fundamentals in other economies through direct trade links. Shocks to the export sector of an economy have a direct impact on import demand which adversely affects the economy's trade account. Such adverse effects on the trade account will undermine economic growth, and investors may reassess the investment risks involved especially when the deterioration is large relative to the availability of external financing.

Another possible source of trade linkages is loss of competitiveness when the currency of a major trading partner depreciates substantially. To restore competitiveness of the trading partner's currency involves devaluing its currency which may not be favourable to investors. When investors predict the policy direction of devaluation to be likely, they reduce demand for the country's assets with a possible decline in the currency demand, a fall in asset prices, and perhaps capital flight which may trigger a crisis in the end. Attesting to this fact, Glick and Rose (1999) confirmed that trade linkages help explain cross-country correlations in the foreign exchange market pressure during crisis episodes after they control for other macroeconomic factors. A common trading bloc was found to make the economy more vulnerable to contagion

from a member economy (Kaminsky and Reinhart, 1998). According to Corsetti et al. (1999), a continuous game of competitive devaluations can cause greater currency depreciations than that required by the initial deterioration in fundamentals. This kind of competitive devaluation games have been attributed to the Asian financial crisis of 1997-98.

The role played by trade in financial crises has made economists pay attention to it for two reasons. First, a trade imbalance has been shown to be one of the important factors that trigger financial crises since current account deficits from trade may decrease foreign reserves. Second, financial crises may be transmitted through trade linkages from an affected country to others despite the latter's relatively good fundamentals.

It was shown in Kali and Reyes (2007, 2010), that the statistical properties of the world trade networks are able to explain the dynamics of macroeconomic variables related to globalization, growth and financial contagion. In their study of bilateral trade linkages and crisis transmission between industrial countries**,** Eichengreen and Rose (1999) using a simple probit model for the period 1959 and 1993 find trade to be statistically important and that the probability of a financial crisis occurring in a country increased significantly if the country had high bilateral trade linkages with countries in crisis. Similarly, Glick and Rose (1999) and Forbes and Rigobon (2002) conclude that trade is an important factor in crisis transmission. Forbes and Rigobon (2001) use a company's stock market data to study the importance of trade in financial crises transmission, and constructed some statistics measuring the importance of trade linkages in transmitting crises and also confirmed the essentiality of trade in crisis transmission.

However, other studies have questioned the trade crisis linkages because usually direct bilateral trade volumes between these economies are relatively very small. For instance, Baig and Goldfajn (1999) and Masson (1998), in separate studies on the East Asian Crisis, and the Mexican crisis respectively support the conclusion that direct bilateral trade volumes between these economies were very small.

3.4.3 Financial Linkages

Shift contagion helps explain contagion between economies that are not closely related. A typical example is the case between Russia, Thailand and Brazil in

the 1990s, since these countries did not have any trade link substantially. Financial linkages are another channel for spill over and contagion effects. The occurrence of a crisis in one or more countries might induce investors to rebalance their portfolio for risk management, liquidity and other reasons. Financial linkages occur when many countries share related institutional lenders such as international portfolio funds or banks. Occurrence of a crisis in one country makes lenders realise that their wealth, and the value of their assets and collateral are falling. The realisation of an asset value reduction put pressure on investors to tighten credit constraints and to liquidate assets across their international portfolio. In this way capital flight occurs simultaneously across many countries.

A financial crisis in one economy is characterized by a substantial fall in financial activities like reductions in foreign direct investments, trade credit and other major capital outflows. There are many transmission mechanisms of financial linkages that propagate contagion which include but are not limited to common creditor, interconnected lenders, interactions under market-based financial system and portfolio rebalancing. The intensity of each depends mainly on the extent and degree of financial market integration between the economies concerned.

3.4.3.1 Common Creditor

On the common creditor, Kaminsky and Reinhart (2000) observed that a common creditor might pull lending in an economy when a real shock in another economy has weakened its capital position. The shock may begin with an international bank which then spills over to the real sectors of other economies through decreased lending by the bank. For instance, many banks in industrial countries in recent times pulled back lending to emerging market economies after sustaining losses in their securities investment when the Latin America crisis occurred (Buiter and Sibert, 2008).

The financial linkage through which contagion is transmitted becomes more complicated when there are chains of interconnected lenders. In interconnected lending, defaults by one are immediately transmitted to the others. For instance, if an international bank, say Bank A, has borrowed from Bank B in another country, and Bank B has borrowed from Bank C, it implies that a default by A affects B, which then impacts C adversely. Likewise, a real shock in Country A may cause Bank A to

incur loss in its lending business in this country. If Bank A has deposits with another bank, say Bank B, that has loans in Country B, then the problems with Bank A can cause it to withdraw its deposits from Bank B, causing problems to Bank B as well. Bank B may in turn alter its loan portfolio in Country B. Both examples result in the shock being transmitted from Country A to Country B through a chain of interconnected lenders. Goldstein and Pauzner (2004) use a self-fulfilling financial crisis model in a sequential framework, to conclude that contagion has particularly negative wealth effect.

Apart from financial contagion coming from interconnected lending, price changes, the measured risks and marked-to-market capital of financial institutions may in a modern market-based financial system transmits financial contagion. When balance sheets are marked to market, changing the asset price will be immediately reflected on balance sheets and will make financial market participants respond. Even if the risk is equally spread throughout the financial system, price changes can scale up the impact of a shock many fold. Shin and Adrian (2008), find a procyclical leverage when financial intermediaries actively adjust their balance sheets during booms and recession. Financial intermediaries tend to have high leverage during economic expansion and low leverage during busts.

Portfolio rebalancing may cause financial market contagion. (Kaminsky and Reinhart, 1998). Some financial institutions rebalance portfolio across markets due to correlated liquidity shocks. Managers of funds who may foresee future growth after a shock will raise cash by selling assets in other economies. The liquidation arises when adverse shocks in an economy reduce the value of leveraged investors' collateral and this will force them to sell part of their assets in unaffected economies to meet margin calls.

Cross-market hedging also accounts for portfolio rebalancing since investors responds to shocks by readjusting their hedges to macroeconomic risks. An experience of a wealth shock by an investor may alert him or her to re-examine riskiness of his or her portfolio holdings and bring about a voluntary decline in the leverage ratio. Therefore there is a tendency for decreasing relative risk aversion by investors to optimally choose to move their portfolios toward less risky assets in the face of a wealth shock.

3.4.3.2 Belief Based Theories

On the other hand, belief based theories of contagion are explained by self fulfilling, herding and wake-up-call channels of contagion. The self fulfilling channel of contagion follows models of liquidity and bank runs. Economic agent's form expectations based on what other agents are doing: if others run, then it is optimal for an individual to run too. Bank runs develop when liquid assets available to the bank are not enough to meet demand on deposits outstanding. A development of bank runs generates its own momentum, in a kind of self-fulfilling prophecy when the number of depositors withdrawing becomes large, the likelihood of default increases which encourages further withdrawals. Severe and serious enough bank runs can lead to bankruptcy of the banks.

The pioneered model of a bank run is credited to Diamond and Dybvig (1983) in models of liquidity. It is a realization of a shock that determines whether each individual wants to consume now rather than later. During bank runs those who have planned to defer consumption may want to withdraw their money and if they do, will exhaust the bank's liquid assets. Thus a crisis in one country leads investors to believe that investors are going to flee to other countries, regardless of their economic fundamentals. If this happens, investors across a broad range of countries begin to withdraw their funds and capital flight spreads. The level of depositors' coordination determines the outbreak of a currency crisis.

Chen (1999) provides a revealing example of self fulfilling informational contagion. He developed a panic model in which depositors respond to early noisy information because of the payoff externality imposed in the deposit contract. Depositors are divided into better informed and uninformed depositors about the bank's assets. Better informed depositors enjoy an advantage in being able to withdraw earlier in periods of bank runs. The uninformed depositors acting on this informational disadvantage are forced to respond to other sources of information such as failure of other banks before the value of bank assets is revealed. When banks' returns are highly correlated, a high bank failure rate implies that the returns of the remaining banks are likely to be low. Therefore, the uninformed will respond to this noisy information and withdraws. In this respect this model follows a common concept of herding models.

Similarly, Chari and Jagannathan's (1988) model of a panic run of uninformed depositors misinterpret liquidity withdrawal shocks as shocks caused by pessimistic information. They cannot distinguish informed investors that withdraw due to a simple liquidity shock from those that received a negative signal on the bank's assets. Here unlike Chen model, a panic is explained as the ex-post mistake, depositors make when updating their information.

One common model of two-period asset trading is by Kodres and Pritsker (2002) which focuses on contagion through cross-market rebalancing. Kodres and Pritsker (2002) posit that the balance between informed and uninformed investors plays an important role for the emergence of contagion. The number of informed investors is inversely related to the risk of contagious shocks. Moreover, a simple portfolio rebalancing which follows the rule of the portfolio theory may cause contagious effects. A shock to a single asset's return distribution may lead to a reduction in other risky asset positions (Schinasi and Smith, 2001).

Interestingly, Acharya and Yorulmazer (2003) develop a hybrid model which consists of the liability side contagion and asset side correlation. Acharya and Yorulmazer's (2003) model implies that the liability side contagion arises when one bank failure leads to the failure of other banks due to a run by their depositors while the asset side correlation comes from a similar investment strategy. Depositors consider this as bad news about the overall state of the economy. Therefore they need compensation in the form of higher promised rates on their deposits from surviving institutions. On the other hand they are satisfied with lower returns during good performance on their loans by the financial institution.

Therefore, the borrowing costs of credit institution are lower when they survive together than when one fails. This is an information spill over from one bank's failure on their borrowing costs, which may eventually lead to other institutions' failure. The banks respond by adapting their investment strategy such that they will lend to similar industries and increase the inter-bank correlation. The expected problem here is that a greater interbank correlation increases the risk of simultaneous bank failure if the industries, they lend to suffer a common shock.

Finally, De-Nicolo and Kwast (2002) investigated the relation of systemic risk and consolidation and found that when individual institutions become

more diversified, the banking system as a whole becomes more vulnerable to systemic risk. Highly consolidated firms become more similar and more vulnerable, not because of direct interdependences but also due to indirect interdependences which arise from similar assets exposures.

Herding is one of a set of theories explaining how investors' behaviour can cause contagion. Herding which relates to the Keynesian concepts of animal spirits focuses on informational asymmetries and imperfect information. Herding may be explained to mean asymmetric information and expectation formation. Investors often do not have a complete picture of the conditions in every country that can affect their portfolios' returns, partly due to the cost of gathering and processing information. In the absence of better information, a financial crisis in one country may lead investors to believe that other countries that are similar structurally could face similar problems.

At times, spill over effects are attributed to herding behaviour when fundamentals and shocks are not able to fully explain the relationship among countries. This kind of phenomenon is explained by models of expectations formation in the context of imperfect and asymmetric information. Models of expectations formation explain why herding behaviour among investors and fads can be rational. Rochet and Vives (2004) provide an example based on asymmetric information, where interbank contagion emerges due to the refusal to provide liquidity to illiquid banks after an event.

Allen and Wood (2006) identify physical exposure to mutual lending and borrowing to be caused by dissemination of liquidity shocks when they analysed liquidity shocks. In a complete market system, liquidity shock in one region may be mitigated due to the connection among the regions. But for incomplete markets, such as a unilateral, lending structure, on the other hand, may have a more imminent effect on previously unaffected regions. The possible implications of a circular lending structure in the interbank market regarding the stability of participating institutions, is provided by Eisenberg and Noe (2001).

Another good example of contagion effects via capital connections comes from Diamond and Rajan (2005). They show that bank failures can cause systemic illiquidity since a bank's failure subtracts liquidity from the system and

thereby raises the likelihood of failure of other banks due to liquidity shortages. Recapitalization of at least a few banks is suggested to avert liquidity shock. Freixas, Parigi, and Rochet (2000), focus on the coordination of the consumers of the various locations, and not on the coordination of the consumers in the same location. It is argued that a liquidity shock may make depositors run on even perfectly solvent banks, if they worry about insufficient liquid assets in the system to cushion uncertain consumption preferences.

The literature on the risk of contagion in securities settlement systems is scarce due to the virtual absence of principal risk. However, it can be shown that large and persistent settlement failures are possible, even under sufficient liquidity provision. The reason is that securities transactions involve a cash leg, a securities leg, and liquidity. For instance, central bank liquidity provision can only affect the cash side. Unfortunately, during periods of market disruptions, market participants reduce their lending in securities. Potential consequences of these disruptions was studied by Devriese and Mitchell (2005) and they find that contagion can be an issue in securities settlement systems.

The last channel of belief based theories of contagion transmission is referred to as wake -up call which is a **s**hift in investor sentiment. A crisis in one country can serve as a wake-up call for investors in financial markets to reassess other countries' fundamentals (Goldstein, 1998). The wake-up call hypothesis refers to the situation where a crisis elsewhere provides new information about the seriousness of problems in the home economy which are normally associated with similarities in the fundamentals and economic structure between economies. The risk of a crisis precipitated by a sudden change in expectation is likely to be greater when the country's share of short term obligations and maturity mismatch between assets and liabilities are large.

Here a collapse in one country alerts investors to look for similar weaknesses in other countries that were previously ignored. For example an investor might closely scrutinize other countries that share similar macroeconomic policies with the crisis country or a change in the structure of the international financial system such as a change in banking regulations or the lending policies of the IMF might cause investors to re-evaluate their risk exposure across countries explaining

why capital flight episodes are often correlated. It must be admitted that a change in beliefs is overdone due to fads. Fads may lead to a change in sentiment, which at times are deviations from the true fundamentals of the economy.

Once again, fundamentals based and belief based theories reach different policy conclusions regarding the prevention of contagion. Fundamentals based theories focus on prudent monetary and fiscal policies as well as strict financial regulation to prevent moral hazard, maintain stable macroeconomic and financial fundamentals. Belief based theories argue for stop gap measures such as capital controls as well as bailouts and emergency lending to countries experiencing or in danger of experiencing a currency crisis in order to help them defend their pegs and prevent the spread of contagion.

3.5 Summary

Contagion refers to the transmission of a crisis to other economies through direct or indirect means irrespective of whether economies share similar characteristics or not. Failures of a financial institution adversely affect other financial institutions such as a decline in an asset price leads to declines in other asset prices. The failures and asset price relationship must be different from those observed in normal economic times as well as be in excess of what can be explained by economic fundamentals.

Contagious events are negative extremes; hence they constitute crisis situations which are propagated over time rather than being caused by the simultaneous effects of common shocks. Moreover we can admit that even positive spill over may constitute some sort of contagion.

CHAPTER 4

VOLATILITY TRANSMISSION IN AFRICAN FOREIGN EXCHANGE MARKETS

4.1 Introduction

Empirically, it has been established that exchange rates approximately follow a martingale process such that future changes are essentially unpredictable on the basis of publicly available information (Killian and Taylor, 2003). The explanation for such volatility processes must lie either in the global financial market integration in market dynamics response to the news. The determination of hedging and diversification strategies by an international investor also depends crucially on the nature and magnitude of the relationships existing between different foreign exchange markets. These links have also been investigated in many different ways by a growing body of academic research attempting to describe and quantify the way in which financial markets interact (Todani and Munyama, 2005; De zwart et al., 2009; IMF, 2009).

It is no doubt that there are serious research deficits in Africa and the extant literature seems to neglect this continent despite its considerable source of necessary raw materials to the developed world. This study is moved particularly by the lack of related studies for the continent. (Billio and Pelizzon, 2000; Bordo and Murshid, 2000; Basu and Reagle, 2003; Subbarao, 2010). The study analyses how the information spill over type of contagion affects price determination in African foreign exchange markets, a continent viewed as one of the economies that are going to be among the strongest growing in the world. The current study aims at achieving two major objectives. One is to examine the dynamics of volatility transmission among African foreign exchange markets and two, to investigate financial interdependence in the foreign exchange markets between Africa and the global world. Indeed, studies of

this nature are crucial for developing policies in Africa since they are important for building accurate asset pricing models, generating accurate forecasts of the volatility of all markets, assessing the foreign exchange risk exposure and essentially important for hedging strategies and derivatives management.

The contribution of the study lies in the increased financial integration in the last decade, the analysis of volatility and its spill over is particularly important for one to know the effects of the significant addition of sophisticated financial instruments and participants in the emerging markets of Africa. In addition, the study adds to the literature on information spill over types of contagion by investigating volatility transmission of African and global foreign exchange markets subcategory of Africa frontier markets, which have received little attention. Also, the study uses a time varying bivariate and a multivariate GARCH with a BEKK unrestricted approach to analysis volatility transmission and simultaneously to captures the time-varying nature of foreign exchange market linkages.

4.2 Literature Review

There are two traditional theories about the financial interdependence of the foreign exchange markets. The first approach is the real links model of contagion (Todd, 2008). Real links have been a major feature of trade links. When two or more countries engage in trade simultaneously, compete in the same external markets, a policy change on parameters which is linked with the existing trade in one country will affect the other country's competitive advantage. As a consequence, both countries are likely to end up having similar measures to re-balance their competitive advantage. In contrast, the alternative approach relates to financial links which exist when two economies are connected through the international financial system. The mechanism of interconnectivity propagates the shock to other economies. Moreover, financial markets might transmit shocks across countries due to herding behaviour or panics. The herding behaviour comes from asymmetric information due to high cost of information to investors who remain uninformed. According to Schmukle (2004), investors try to observe future price changes based on how other markets are reacting

This type of reaction leads to herding behaviour, panics, and irrational exuberance (Schmukle, 2004).

The methods used to study volatility in the financial market particularly exchange rates have been grouped into first and second generation of researches. Commonly, these methods revolve around ARCH and GARCH models. The first generation of research led by Engle (1982) and followed by Bollerslev (1986), Nelson (1991) and others considers the univariate ARCH-GARCH framework to model volatility clustering and pooling in different segments of financial markets in isolation whiles the second generation of models concentrate on a multivariate framework to capture explicitly volatility spill over between financial markets. The forerunners of the multivariate-GARCH framework that model the conditional variances and co-variances across financial markets are Bollerslev et al. (1992) and Engle and Kroner (1995). The common characteristics of these dividing methods are that these models help in modelling time varying variance and covariance but differ in their assumptions and specifications of the variance-covariance matrix.

The ignition of interest in the nature of contagion effects on financial markets was exacerbated by the financial and economic turbulence during 2008–2009 (Aloui et al., 2011). The renewed interest in contagion effects has led to a number of empirical studies which have analysed the volatility spill over effects of exchange rate changes within the same economy like Africa. Moshirian (2011) and Muller and Verschoor (2009) study the recent economic crisis and find a massive reduction in asset prices with big as well as unanticipated movements in foreign exchange rates that affected the financial sectors in European emerging markets.

The existence of a volatility spill over implies that one large shock increases the volatilities not only in its own asset or market but also in other assets or markets. Volatility is highly associated with the rate of information flow (Ross, 1989). Evidence of a volatility spill over indicates strong cross-market dependence in the volatility process. The literature on volatility spill over gives evidence of cross market spill over effects mostly in Europe.

Significant volatility spill over between the euro, the yen, and the pound are found by Perez-Rodriguez (2006) among these currencies when he employs the DCC model of Engle (2002). Inagaki (2007) finds unidirectional volatility spill over from

the euro to the pound when investigates volatility spill over between the British pound and the euro per US dollar spot rates between 1999 and 2004 using residual cross-correlation functions. Nikkinen et al. (2006) support Inagaki's conclusion. In addition, Nikkinen et al. (2006) used a VAR methodology on currency option data between 2001 to 2003 for Europe (the pound sterling, the euro and the Swiss franc) and find that the highest correlations exist between the euro and the franc, and the euro is the dominant currency in volatility transmission. Similarly, McMillan and Speight (2010) using the US dollar, the Japanese yen and the British pound against the euro between 2002 and 2006 find the US dollar rate dominating the other two rates in terms of both return and volatility spill over. On a similar ground, Kitamura (2010), using intra-daily data finds significant return volatility spill over of the euro to the pound and the franc, between April and August, 2006 with high integration between the pound and the franc in the euro market.

Again, Nikkinen et al. (2011) used a wavelet analysis to find that option-implied expectations of the euro, the Japanese yen, and the British pound visa-vis the US dollar are closely linked. They also found that in the short run, volatility of the yen affects the volatilities of the euro and the pound but a significant feedback effect from the pound volatility expectations to the yen are also evident in the long-run. Black and McMillan (2000) using dollar exchange rates for the French franc, the Italian lira, the German mark and the British pound for the period 1974 to 1998, observed a significant volatility spill over across European currencies. Extending the study further to the common trend and volatility in the Deutschemark and the French franc per dollar exchange rates, McMillan (2001) employs a multivariate random walk stochastic volatility model to conclude that high correlation between the volatility innovations suggests that they follow a common trend hence the volatilities are cointegrated. Melvin and Melvin (2003) find evidence of statistically significant effects for both own-region and interregional spill over, but the magnitude of own-region spill over are more important than interregional spill over in their study of volatility spill over of the Deutschemark and the Japanese yen per US dollar exchange rates across regional markets in Asia, Europe and America. Horvath (2005) studies exchange rate volatility for 20 Central and Eastern European Countries (CEECs) between, 1989-1998. The results indicate that the CEECs encounter increased

exchange rate volatility of approximately the same level as the euro area countries before they adopted the Euro.

Across markets volatility transmission has been examined (Worthington and Higgs, 2004; Lee and Stewart, 2009). Using 5-minute intraday data, Bubak & Zikes, (2009) realized that volatility is approximately normally distributed and independent over time. On the other hand, they realized variance and the time-varying volatility transmission was evidence. Subsequently, In et al. (2001) find some evidence of asymmetric volatility transmission involving the Hong Kong, Korea and Thailand stock markets during the 1997-98 Asian financial crisis. Bubak et al. (2010) in the same find that the daily realized volatility of a given exchange rate depends both on its own lags as well as on the lagged realized volatilities of the other exchange rates. Statistically, significant intra-regional volatility spill over among the Central European foreign exchange markets were revealed with the exception of the Czech currency (Bubak et al., 2010). In the context of domestic financial market inter-linkage and volatility spill over, Badrinath and Apte (2003) used daily returns data for the period January 1993 to December 2001 for India and find evidences of volatility spill over across markets. Ghosh and Bhattacharya (2009) indicate that a sea change in the Indian financial market microstructure in general and the money market have significantly changed the inter-linkages. A recent study by Behera (2011) indicates that the Non-Deliverable-Forward market shocks and volatilities influence the onshore markets. Wongswan (2006) makes use of high-frequency data to study the international transmission of fundamental economic information from developed economies (United States, Japan) to emerging economies (Korea, Thailand) to reveal volatility spill over. In contrast to many other studies, Engle et al. (2009) find no volatility spill over in a study based on a daily high-low range as a proxy for volatility when the multiplicative error model of Engle (2002) was employed in different markets.

In spite of a few researches on the nature of exchange rate volatility in Less Developing Countries (LDCs), the few suggest strong as well as high perception of volatility in LDCs and highest when compared with industrialized economies. Sauer and Bohara (2001) observe that LDCs exchange rate volatility is the highest irrespective of the estimation technique used. Serven (2003) also confirmed the high

exchange rate volatility experienced by developing economies and suggests that this has the tendency to translate into a high degree of profitability and costs uncertainty. Many attribute high exchange rate volatility to the problem of capital flights caused by disturbance and uncertainty in most economies of developing nations.

Although studies indicate that exchange rate volatility affects developing economies more than the developed ones (Sauer and Bohara, 2001; Devereux and Lane, 2003; Serven, 2003; Hausmann et al., 2006) and that the contagion is more important among developing nations than developed ones (Bae et al., 2000). Fewer studies, however, exist to describe the dynamics of exchange rate volatility and contagion in developing countries' currency markets. This may be due to the lack of quality high-frequency data from these countries and the unattractive nature of developing countries markets compared to the highly traded currencies (Esquivel and Larrain, 2002; Assibey-Osei, 2010; Ofa, et al., 2012).

Many studies have examined either real or nominal exchange rate volatility in Africa but are of a country specific such as Ghana (Insah, 2013; Insah and Chiaraah, 2013); Nigeira (Ajao and Igbekoya, 2013); Africa (Osei- Assibey, 2010). Even though most of these studies found evidence of volatility in exchange rate and have broadened our understanding of what persist in individual countries what is yet unknown is the existence of volatility spill over effects in the African continent as a whole. Motivated by this gap and the low volume of trade in the region, this study intends to analyses the dynamics of volatility transmission among African foreign exchange markets. In particular, the study analyses volatility spill over in Africa and global world currencies per US dollar and the extent to which shocks to foreign exchange volatility in one market transmit to current and future volatility in other currencies. The joint behaviour of the volatility of African currencies is of key importance for international investors contemplating the diversification benefits of allocating part of their portfolio to African assets. The choice of these countries is because of their long standing trading activities and high fluctuations in the respective currencies.

4.3 Methodology

Volatility is the annualized standard deviation of daily returns. Simply stated, it's the movement of price (commonly a stock price) without regard to direction. Large average price changes in percentage terms either daily or monthly mean high volatility. Thus small average daily price changes mean low volatility and the more a stock moves, the higher its volatility. The less it moves, the lower its volatility. The methods used to study volatility transmission have undergone series of paradigm shifts from value at risk, regime switching models, stochastic volatility models, GARCH models and to others**.**

In this respect, the model adopted may be viewed as an extension of Engle (1982), Bollerslev (1986) and Engle (2002) in the sense that one assumes two or more (foreign) sources of domestic market volatility instead of just one world. Especially univariate and multivariate GARCH models have also been used to investigate volatility, correlation and spill over effects in studies of contagion.

In this stream, the multivariate GARCH BEKK has been the preferred model for exchange rate returns with news being allowed to enter the markets in an asymmetric manner. The multivariate GARCH BEKK estimates volatility and quantifies the impact of domestic and cross-border news arrivals on the conditional variance of exchange rate returns. Thus, we can determine to what extent exchange rates are affected by the heat wave and meteor shower hypotheses. Unlike the strict multivariate GARCH, the BEKK has the ability to circumvent modeling problems associated with Bollerslev's (1990) vech model. The large number of growing parameters, difficulties in obtaining a stationary process and the tendency not to get a positive definite variance matrix are resolved by the BEKK version. The strength of the BEKK version lies in its quadratic form which makes it such that no restrictions are required to ensure a positive semi definite conditional variance covariance matrix (Engle and Kroner, 1995).

The empirical tests to be conducted in this study are based on multivariate ARCH models (Bollerslev et al., 1988; Bollerslev, 1990; Engle and Kroner, 1995). The approach proposed in this study is a three-factor model in which the unexpected return of the Ghana market is influenced not only by news originating within the local

market, but also by two foreign sources: a regional shock from the African region and a global shock from other mature (world) markets. The data in this study is a return on each currency between time t and t-1(Bollerslev et al., 1988; Kearney and Patton, 2003). The joint process of the foreign exchange returns in the African region and global foreign exchange return can be specified as below:

$$\begin{bmatrix} R_{\mathrm{i},t} \\ R_{\mathrm{j},t} \end{bmatrix} = \begin{bmatrix} \alpha_{\mathrm{i},o} \\ \alpha_{\mathrm{j},o} \end{bmatrix} + \begin{bmatrix} \alpha_{i1} & \alpha_{i2} \\ \alpha_{j1} & \alpha_{j2} \end{bmatrix} \begin{bmatrix} R_{\mathrm{i},t-1} \\ R_{jt-1} \end{bmatrix} + \ldots + \begin{bmatrix} \alpha_{i1} & \alpha_{i2} \\ \alpha_{j1} & \alpha_{j2} \end{bmatrix} \begin{bmatrix} R_{\mathrm{i},t-p} \\ R_{jt-p} \end{bmatrix} + \begin{bmatrix} \eta_{\mathrm{i},t} \\ \eta_{\mathrm{j},t} \end{bmatrix} \qquad 4.1$$

$$\eta_t / \mathrm{I}_{t-1} \square \; iid \;\; N(0, \mathrm{H}_t)$$

Where $\mathrm{R}_t = \begin{bmatrix} R_{\mathrm{i},t} & R_{\mathrm{j},t} \end{bmatrix}'$ indicates the returns on market i and j respectively in the foreign exchange market at a given time t. *p* is the optimal lag order, $\eta_t = \begin{bmatrix} \eta_{\mathrm{i},t} & \eta_{\mathrm{j},t} \end{bmatrix}'$ a vector of disturbance terms. Equation 4.1 is called the conditional bivariate mean equation, basically links the joint process governing the i and j market returns at a given time, t, to their respective past returns. With the assumption of conditional bivariate normality, H_t is a (NxN) positive definite conditional variance-covariance matrix which is depended on past information I_{t-1}

As stated previously the bivariate BEKK model for multivariate GARCH(1,1) can be expressed in its general form, BEKK (p, q, K) as follows

$$\boldsymbol{H}_t = \begin{bmatrix} \boldsymbol{h}_{11} & \boldsymbol{h}_{12} \\ \boldsymbol{h}_{21} & \boldsymbol{h}_{22} \end{bmatrix} = \boldsymbol{C}'\boldsymbol{C} + \boldsymbol{A}'\boldsymbol{e}_t\boldsymbol{e}_t'\boldsymbol{A} + \boldsymbol{B}'\boldsymbol{H}_{t-1}\boldsymbol{B} \qquad 4.2$$

Where

H_t = Positive definite conditional covariance matrix

C = Parameter n x n matrix

A = Parameter n x n matrix

B = Parameter n x n matrix

e_t = error terms matrix

In this study n is four including the Kenya shilling, the Ghana Cedi, the South Africa rand and the United Kingdom pound sterling and a bivariate conditional variance covariance model is specified as

$$H_t = \begin{pmatrix} h_{11,t} & h_{12,t} \\ h_{21,t} & h_{22,t} \end{pmatrix}, \qquad C = \begin{pmatrix} c_{11} & 0 \\ c_{21} & c_{22} \end{pmatrix}$$

$$\boldsymbol{B} = \begin{pmatrix} \boldsymbol{b_{11}} & \boldsymbol{b_{12}} \\ \boldsymbol{b_{21}} & \boldsymbol{b_{22}} \end{pmatrix},$$

$$\boldsymbol{e_t} = \begin{pmatrix} \boldsymbol{e_{1,t}} & \boldsymbol{e_{2,t}} & \boldsymbol{e_{3,t}} & \boldsymbol{e_{4,t}} \end{pmatrix}'$$

For equation (4.3) while the elements of matrix A capture the effects of shocks or unexpected events on conditional variances, matrix B shows how current levels of conditional variances are affected by past conditional variances and the C matrix represents the constants. The total number of estimated parameters for the conditional variance equations in four variable case is 42, ½($5n^2$+n) where 'n' is the number of variables (exchange rates=4).

$$C'C = \begin{pmatrix} c^2_{11} + c^2_{21} + c^2_{31} + c^2_{41} & c_{21}c_{22} + c_{31}c_{32} + c_{41}c_{42} & c_{13}c_{33} + c_{41}c_{43} & c_{41}c_{44} \\ c_{22}c_{21} + c_{32}c_{31} + c_{43}c_{41} & c^2_{22} + c^2_{32} + c_{43}c_{42} & c_{32}c_{33} + c^2_{43} & c_{43}c_{44} \\ c_{33}c_{31} + c_{34}c_{41} & c_{33}c_{32} + c_{34}c_{42} & c^2_{33} + c_{34}c_{43} & c_{34}c_{44} \\ c_{44}c_{41} & c_{44}c_{42} & c_{44}c_{43} & c^2_{44} \end{pmatrix}$$

The conditional variance for each market can be expanded for the four variable GARCH (1, 1) as follows :

$$h_{11,t+1} = c^2_{11} + c^2_{21} + c^2_{31} + c^2_{41} + a^2_{11}e^2_{1,t} + 2a_{11}a_{21}e_{1,t}e_{2,t} + 2a_{11}a_{31}e_{1,t}e_{3,t} + 2a_{11}a_{41}e_{1,t}e_{4,t}$$
$$a^2_{21}e^2_{2,t} + 2a_{21}a_{31}e_{2,t}e_{3,t} + 2a_{21}a_{41}e_{2,t}e_{4,t} + a^2_{31}e^2_{3,t} + 2a_{31}a_{41}e_{3,t}e_{4,t} + a^2_{41}e^2_{4,t}$$
$$b^2_{11}h_{11,t} + 2b_{11}b_{21}h_{12,t} + 2b_{11}b_{31}h_{13,t} + 2b_{11}b_{41}h_{14,t} + b^2_{21}h_{22,t} + 2b_{21}b_{31}h_{23,t} +$$
$$2b_{21}b_{41}h_{14,t} + b^2_{31}h_{33,t} + 2b_{31}b_{41}h_{34,t} + b^2_{41}h_{44,t} \qquad 4.3$$

$$h_{22,t+1} = c^2_{22} + c^2_{32} + c_{43}c_{42} + a^2_{12}e^2_{1,t} + 2a_{12}a_{22}e_{1,t}e_{2,t} + 2a_{12}a_{32}e_{1,t}e_{3,t} + 2a_{12}a_{42}e_{1,t}e_{4,t}$$
$$a^2_{22}e^2_{2,t} + 2a_{22}a_{32}e_{2,t}e_{3,t} + 2a_{22}a_{42}e_{2,t}e_{4,t} + a^2_{32}e^2_{3,t} + 2a_{32}a_{42}e_{3,t}e_{4,t} + a^2_{42}e^2_{4,t}$$
$$b^2_{12}h_{11,t} + 2b_{12}b_{22}h_{12,t} + 2b_{12}b_{32}h_{13,t} + 2b_{12}b_{42}h_{14,t} + b^2_{22}h_{22,t} + 2b_{22}b_{32}h_{23,t} +$$
$$2b_{22}b_{42}h_{24,t} + b^2_{32}h_{33,t} + 2b_{32}b_{42}h_{34,t} + b^2_{42}h_{44,t} \qquad 4.4$$

Equations 4.3 to 4.4 constitute the conditional variance equations for the four variables: Kenya shilling, South Africa rand, Ghana cedi and United Kingdom pound sterling. These equations show how shocks and volatilities are transmitted across markets over time. A negative cross product term means that the two currencies move in opposite direction whilst positive term implies they move together. The squared term variable signs have no meaning. From these conditional variance equations, parameters to be estimated are expressed in the Table 4.1 below

From table 4.1, $h_{11,t}$ indicates the conditional volatility for the Kenya shilling at time "t' and $h_{12,t}$ shows the conditional covariance between Kenya shilling and South Africa rand in the model. The error term "e_t" in each model indicates the effect of unanticipated news or shocks in each individual model on different currencies. For $e_{1,t}e_{2,t}$ indicates cross values of error terms of news from both Kenya shilling and South Africa rand at time t.

Table 4.1 Parameters in Conditional Variance Equations without Constants

Independent Variables	$h_{11,t+1}$	$h_{22,t+1}$
$e_{1,t}e_{2,t}$	$2a_{11}a_{21}$	$2a_{12}a_{22}$
$e^2_{1,t}$	a^2_{11}	a^2_{12}
$e^2_{2,t}$	a^2_{21}	a^2_{22}
$h_{11,t}$	b^2_{11}	b^2_{12}
$h_{22,t}$	b^2_{21}	b^2_{22}
$h_{12,t}$	$2b_{11}b_{21}$	$2b_{12}b_{22}$

Shocks in individual currency market which make foreign exchange returns deviate from its mean are represented by $e^2_{1,t}$,and $e^2_{2,t}$ respectively in each country pair for Kenya, South Africa, Ghana, and United Kingdom foreign exchange markets.

4.4 Data Sources

The dataset consists of monthly exchange rates of three African countries: Ghana, Kenya, South Africa plus one European country: the United Kingdom. The choice of the United Kingdom is due to colonial trade ties with these countries. The selected African countries' economies share similar characteristics and implementation of common World Bank intervention policies and the benchmark currency is the United States of America Dollar. The exchange rates are in local currency per unit of US dollar. The sample period runs from 1st January 1990 to 31st August, 2013. All data were taken from the World Development Indicator (WDI) database. Based on exchange rates (s), the return of exchange rate changes ($r_{s,t}$) at time t is calculated as $r_{s,t} = 100 * \log(s_t / s_{t-1})$.

4.5 Empirical Results

This study employs the multivariate GARCH model to investigate the existence of volatility transmissions in the African foreign exchange market plus one European country to capture the global effect in Africa's foreign exchange market. The analysis starts with characteristics of the data such as descriptive statistics, correlation matrix and unit root test to examine the stationarility of the data. The characteristics of the data will be followed by the multivariate GARCH model results for discussion and the final section looks at policy implications of the results.

4.5.1 Description of the Data

The monthly exchange rate data in this study are represented by the return of each currency between time t and time t-1. Table 4.2 gives some of the major features of the exchange rate return variables such as mean, standard deviation, skewness, the kurtosis, Jacque-Bera and ARCH effect. While the skewness measures symmetry of the data, the kurtosis measures the peakness or flatness of the data relative to the normal distribution. When the absolute value of kurtosis is in excess of three, it means the standard deviation deviates extremely more than the normal size deviation expectation.

Results in Table 4.2 indicate that all the mean returns are positive which implies that the currencies depreciate a lot against United States dollar with the Ghana cedi having the highest mean return relative to the South Africa rand and the Kenya shillings. The United Kingdom pound sterling has the least mean return. Relatively, the South Africa rand and the Kenya shillings have the highest values for volatility with the Ghana cedi showing the least standard deviation.

Table 4.2 Summary Statistics for all Return Series

Currency	**Ksh**	**Sar**	**Ghs**	**Ukps**
Mean	0.004877	0.004859	0.014854	0.000325
Max	0.184921	0.191529	0.140951	0.127691
Min	-0.197974	-0.104673	-0.01622	-0.085859
Standard Deviation	0.033683	0.033958	0.022717	0.026943
Skewness	1.16373	1.135047	2.444068	0.909174
Kurtosis	16.63725	9.115604	10.38794	6.3712
JB	2240.88***	498.23***	918.82***	171.78***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Q-Stats(1)	0.277***	0.310***	0.815***	1.422***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Q-Stats(1)^2	37.174***	36.12***	25.18***	13.326***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Note: In parenthesis are probability of accepting the null hypothesis.
*** significance at 1%, ** significance at 5% and * significance at 10%
JB is Jacque Bera test of normality. Q Statistics and its squared test for serial correlation and heteroscedasticity
Ksh is Kenyan shillings return, Sar is the South Africa rand return , Ghs Ghana cedi return and UK ps is Great Britain pound sterling return.

Source: Authors Calculation from Data Stream

The currencies have the tendency to depreciate as indicated by positive skewness of the returns series. This means that the returns skew to the right. All the currencies return indicate excess kurtosis which is the usual characteristics of a financial time series (Lux and Marchesi, 2000; Enders et al., 2011) and the kurtosis shows volatility clustering. The Jacque-Bera statistic is used to test for the normality of the time series under the null hypothesis that the time series are approximately normal distribution. The results in Table 4.2 rejected the null hypothesis that return series are normally distributed which means that the data sets do not possess the characteristics of the normal distribution. Therefore we say that the time series have

fat tails or are leptorkurtic. The Ljung Box Q-statistics and Q-statistics squared tests for the existence of serial correlation and ARCH effect in the error term of the models. The tests statistics indicate that the null hypothesis is not accepted confirming the appropriateness of the bivariate VAR(1)-GARCH (1,1) since each test has probability value of zero, a sign of highly significant results.

Table 4.2 confirms the hypothesis that financial returns or percentage changes are known to exhibit a non-normal distribution and the percentage changes in the nominal exchange rates series analysed in this study are not different from this hypothesis (Poon and Granger, 2003). The kurtosis and skewness values indicate deviation from normal distribution and excess kurtosis respectively of monthly nominal exchange rates percentage changes for all the four countries. Generally, we observe (based on kurtosis values) that the African countries exchange rate series have fatter tails to a normal distribution than the exchange rate series from the United Kingdom. Thus, extreme prices occur in the Africa data more frequently than in the United Kingdom.

4.5.2 Correlation Between Currencies

The degree of relationship between two variables is termed as correlation. This association is useful statistic in financial time series analysis. The results of the correlation between the four currencies in this study are presented in Table 4.3 below.

Table 4.3 Correlation Matrix Between Currencies Return Series

Currency	**KeSh**	**SAR**	**GhS**	**UKPS**
KeSh	1			
SAR	0.15700**	1		
GhS	0.03277	0.042386	1	
UKPS	0.13066**	0.32027*	0.1437**	1

Note: *** significance at 1%, ** significance at 5% and * significance at 10%

Source: Author's Calculation from Data Stream

As can be seen from Table 4.3, the correlation statistics indicate that the Kenya shilling, the South Africa rand, the Ghana cedi and the United Kingdom pound have a moderate relationship among each other and are statistically significant at the appropriate level but the insignificant ones do not imply no relationship because this is constant correlation statistics. Correlation statistics are less than 0.50 indicating an average correlation and does not rule out the possibility that the time series may move together strongly. Correlation between the South Africa rand and the Ghana cedi is the highest followed by the United Kingdom pound sterling and the South Africa rand.

The movement of the exchange rate returns is displayed in the figure 4.2 below

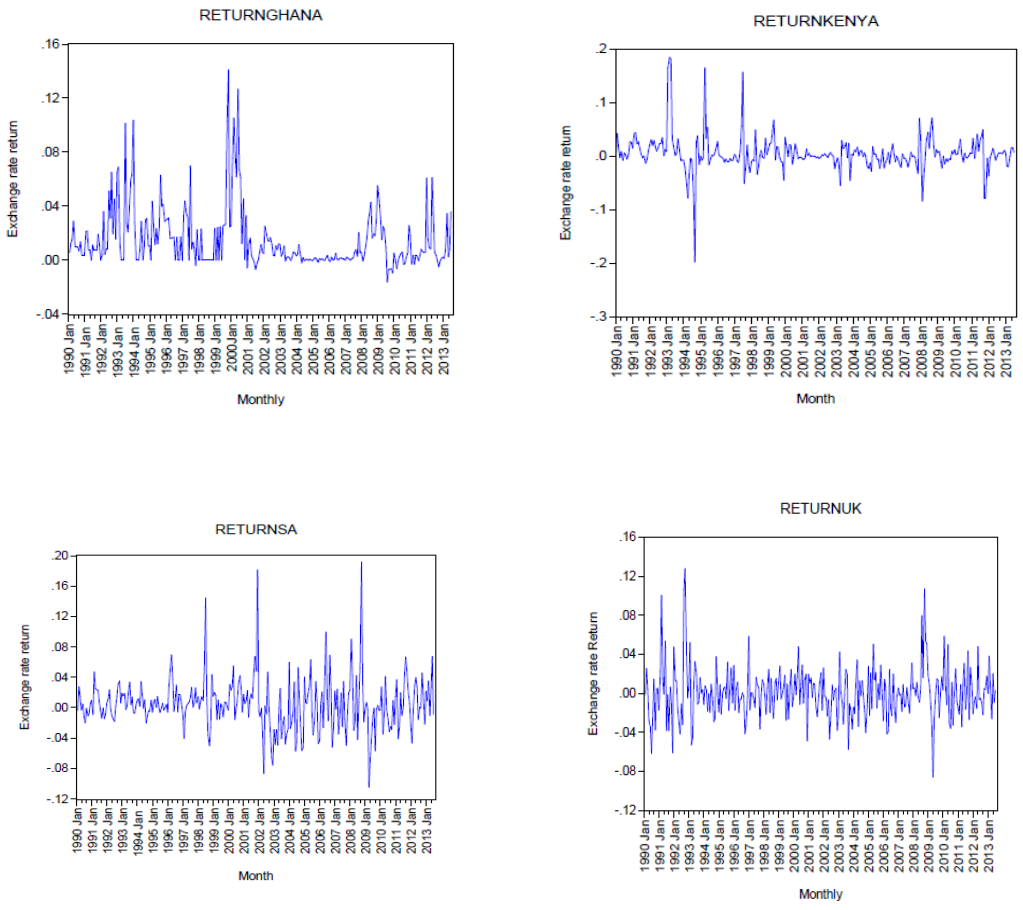

Figure 4.1 Movement of Exchange Rate Return

Source: IFS, IMF

Figure 4.1 reports exchange rate returns for the currencies which are all positive. The return of the Ghana cedi is 15% high and purely positive. Exchange rate return volatilities tend to be persistent; Periods of a very high and a very low variation have the ability to last for months and tend to produce volatility clusters. Graphically, volatility clusters are observed as continued periods of high or low volatility as are exhibited. The exchange rate returns series experimented with in this research exhibit this property throughout the monthly plots.

4.5.3 Unit Root Test

Prior to 1982, studies assumed that all variables particularly macroeconomic variables are stationary but Nelson and Plosser's (1982) study of the stationarity of key macroeconomic variables proved otherwise. Replication of the Nelson and Plosser (1982) study by Stock and Watson (1986) confirm earlier results suggesting that the logarithm of real GNP contains a unit root, at least since World War I. This means in general that, almost all macroeconomic variables are non stationary. Therefore like other time series variable, the exchange rate has to be examined to test for its stationarity status. Augmented Dickey –Fuller (ADF) (1979) and Philip-Perron (1988) tests are employed in this study. The choices of these methods are due to their popularity and ease with their interpretation. Both Augmented Dickey–Fuller and Philip-Perron tests have a null hypothesis that time series have a unit root (non stationary). It means that the movements of a stochastic process depends on time trend and the variance of the series diverges to infinity with time trend. Both tests are used to determine whether the time series data are I (1) process with a stochastic trend-non stationary or I(0) process –stationary. Hence rejection of the null implies a stationary variable. The infinite order of a autoregressive model to test for unit root is specified as

$$\Delta X_t = \mu + \rho X_{t-1} + \sum_{i=1}^{k} \Delta X_{t-i+1} + \varepsilon_t \qquad 4.5$$

Equation (4.8) is the estimator of the unit root without time trend. If ρ =0 means that the time series data is non stationary at level. Based on Nelson and Plosser

(1982) the first difference equivalent of equations (4.8) with time trend is expressed below as

$$\Delta^2 X_t = \mu + \phi t + \rho \Delta X_{t-1} + \sum_{i=1}^{k} \Delta^2 X_{t-i+1} + \varepsilon_t \qquad 4.6$$

The results of the unit root tests of these time series data of exchange rate returns are reported in the Table 4.4 below

Table 4.4 Unit Root Test of Variables

Variable	**ADF Test**	**Philip Person(PP)**	**DF-GLS**
	Constant	Constant	Constant
	t-stats	Adj t-stat.	Adj t-stat.
Ksh	10.915***[0]	10.924***[5]	10.972***[0]
	(0.0000)	(0.0000)	(0.0000)
Sar	11.691***[]	11.629***[2]	11.604***[0]
	(0.0000)	(0.0000)	(0.0000)
Ghs	4.110***[3]	10.177***[11]	3.781***[3]
	(0.0000)	(0.0000)	(0.0000)
Ukps	14.507***[0]	14.428***[7]	14.553***[0]
	(0.0000)	(0.0000)	(0.0000)

Note: *** significant at 1%, ** significant at 5% and *** significant at 1%

In parenthesis is the probability of accepting null hypothesis of the non stationaryvariable. In bracket is the optimal lag length of ADF based on the minimumAkaike information criterion and for PP the lag length is determined by the optimalbandwith of the Bartlet kernel . DF is Dickey Fuller generalized least squared.

Source: Data Stream

The results show that exchange rate returns series are stationary for all the tests with constant. Thus, the null hypothesis of non stationary series is rejected.

4.5.4 Empirical Regression Results

Tables 2-3 present the results of the bivariate VAR (1)-BEKK (1,1) model for the regional and global world. Panel A and B present the estimation of the equations (1) and (3)-(5) respectively. Panel C shows the diagnostic tests of the innovation series of the model based on the Ljung-Box test statistic which shows that there is no serial correlation and the Ljung-Box squared shows that there is significant ARCH effect justifying the use of the multivariate GARCH model. Panel D reports Wald test tests for spill over effects. The result indicates that there is a significant spill over effect from South Africa to Ghana only in the region. The null hypothesis of no volatility spill over effect is rejected for the global volatility spill over between Ghana and the United Kingdom, South Africa and the United Kingdom. However, globally, Kenya does not receive any significant spill over effect.

For the first moment, there is a significant unidirectional mean spill over from the market of South Africa to Ghana. No mean spill over between Ghana and Kenya, Kenya and South Africa in the region. From the global empirical results, there is strong evidence of interdependence of unidirectional mean spill over between Ghana and the United Kingdom, Kenya and the United Kingdom while South Africa and the United Kingdom exhibit persistent bidirectional mean spill over. The significant global mean spill over effects is a demonstration of the meteor shower hypothesis which states that it rains down on the earth as it turns. Thus a shock in the United Kingdom will almost surely be followed by one in Africa. Thus what happens in the United Kingdom economy will have subsequent effects on African economies.

Table 4.5 Estimation of the Bivariate Full BEKK Model for Regional Volatility Transmission

A		**Mean Equation**	
Parameter	**Kenya-South Africa**	**Kenya-Ghana**	**Ghana -South Africa**
α1	0.00292*	5.54E-04	0.00539***
α2	0.00329*	0.00528***	0.00227
β11	0.41099**	0.40944***	0.46127**
β12	0.03737	0.10784	-0.03457*
β21	-0.00579	-0.03489	0.04218
β22	0.37353***	0.45989***	0.37232***
R_1^2	0.16859	0.17495	0.33194
R_2^2	0.13147	0.33927	0.12828
B	Kenya-South Africa	**Volatility Equation**	
c11	0.00941	0.01887	0.00372***
c21	-0.00129	-0.00126	0.00088
c22	0.00970**	0.00185	0.00712***
a11	0.58935*	0.74077**	0.46978***
a12	0.08999	0.0372	0.00642
a21	-0.09999	0.04469	0.02595
a22	0.49429***	0.56657*	0.50856**
b11	0.77709***	0.52895	0.88023***
b12	-0.05301	0.21271	0.85411**
b21	0.05971	-0.09274	-0.03263
b22	0.83353***	0.83103*	0.86312***
		Diagnostic Test	
LB(4)	0.3459 (0.9867)	0.4354 (0.9795)	12.5595 (0.0136)
LB(4)^2	2.7604 (.5987)	55.1238 (3.06e-11)	2.6539 (.6173)
LB(8)	8.2378 (0.4106)	6.5145 (0.5898)	9.4392 (0.6528)
LB(8)^2	14.377 (0.0725)	104.5798 (0.000)	14.8356 (0.0624)
		Test of Volatility Spill Over Effects	
Wald (a12=b12= 0)	3.9406 (0.1394)	0.2378 (0.9956)	5.6744* (0.0586)
Wald (a21=b21= 0)	0.2147 (0.8982)	0.0088 (0.8879)	0.4850 (0.7846)

Note: * , **, and *** denotes significance at 10%,5% 1% level respectively.
LB (n) is the Ljung-Box of in innovation series at the nth lag. While aii and aijrepresents own and cross shocks spill over, bii and bij denotes effect of own volatlity and its spill over to other markets. In parenthesis is probability of accepting the null hypothesis.

Table 4.6 Estimation of the Bivariate Full BEKK Model for the Global Volatlity Transmission

		Mean Equation	
Parameter	Kenya -UK	Ghana-UK	South Africa-UK
α1	0.00291*	0.00563***	0.00378**
α2	-2.04E-04	-0.00144	-3.01E-04
β11	0.41157**	0.45473***	0.346584***
β12	0.11614**	0.03507	0.10692*
β21	0.04569	0.15050*	0.14733**
β22	0.12949*	0.12685*	0.09012
R_1^2	0.17712	0.33468	0.13411
R_2^2	0.02959	0.03439	0.0501
		Volatility Equation	
c11	0.00655***	0.00329	0.00738***
c12	0.01741***	0.00107	-0.01104**
c21	-0.00251	0.01135	0.02343***
a11	0.56889***	0.40128***	-0.00149
a12	-0.12129*	-0.12491	-0.05277**
a21	0.03636	0.11246	0.05407***
a22	0.33443***	0.35851	0.06256*
b11	0.82698***	0.87071***	0.96982***
b12	-0.17049***	0.107065*	0.00035**
b21	0.00481	-0.03868	-0.00155***
b22	0.66719***	0.83182*	0.97007***
c11	0.00655***	0.00329	0.00738***
		Diagnostic Test	
LM(4)	0.3915(0.9832)	3.6711(0.4523)	1.2841(0.8641)
LM(4)^2	41.9429(1.71e-08)	17.527(.0015)	2.2674(0.6885)
LM(8)	7.2016(0.5150)	13.0969(0.1086)	8.8712(0.3533)
LM(8)^2	19.1213(0.0142)	19.4101(0.0128)	18.2345(0.0195)
		Test of Volatility Spill over Effects	
Wald (a12=b12= 0)	0.1551(0.9423)	0.1227(0.9405)	2.74E+04***(0.000)
Wald (a21=b21= 0)	3.7277(0.1551)	1.55E+05***(0.000)	456.6793***(0.000)

Note: *, ** ,*** denotes significance at 10%, 5% , 1% level respectively. The LB(n) is Ljung-Box innovation series at the nth lag length. While aii and aij represent the own and spill over shocks bii and bij denote volatility effect of own variance and volatility transmission. In parenthesis is the probability of accepting the null hypothesis.

Source: Data Stream

Regional volatility transmission shows that there is weak evidence of intra regional volatility spill over effects. The unidirectional volatility spill over between Ghana and South Africa may come from marginal trade between the two nations. Ghana buys consumables from South Africa and also sells gold to her. The insignificant spill over between Kenya and Ghana may be due to the relatively low volume of trade between them. The study results appear to support Glick and Rose's (1999) and Forbes' (2000) conclusions that trade is an important factor in volatility spill over and high among economies with strong trade ties. The significant volatility spill over between Ghana and South Africa implies that policymakers in Ghana should strictly observe economic activities in South Africa.

Comparatively, the global volatility spill over effect is very significant to the region indicating that African foreign exchange rates are more prone to world exchange rate volatility than intra regional volatilities. Ghana and Kenya received significant unidirectional volatility spill over from the United Kingdom. There is strong evidence of significant bidirectional and persistent shock volatility spill over between South Africa and the United Kingdom foreign exchange markets. However, an unidirectional spill over effect from the United Kingdom to Kenya is found for the Kenyan shillings and the Ghana cedi. In the region, less trade is carried out because of the supply of the same primary export commodities hence weak linkages whiles the region trades mostly with Europe and other continents.

The region also seeks more financial assistance from the rest of the world than from the region itself which is determined mostly by trade volumes and fundamentals of the domestic economies. These findings converge with those of Kitamura (2010), Melvin and Melvin (2003), Perez-Roddrique (2006) and McMillan and Speight (2010). The results are consistent with the meteorological analogy hypotheses of heat wave and meteor showers that country specific factors are important in explaining volatility transmission.

Comparing the volatility spill over effects from the region and the global world, in general, the volatility spill over effects from the global exchange rate fluctuations strongly affect the region's foreign exchange markets more than regional volatility spill over. Though regional volatility is relatively significant, it is unidirectional mostly from South Africa to others. Low volume of trade in the region,

may explain the poor insignificant volatility spill over. This may mean that international portfolio investors in the region are likely to face less challenges regarding exchange rates risk exposure. The results indicate the presence of sharing common information by investors in these sectors and this is likely to increase the cost of cross-market hedging.

The implication of the empirical results of mean and volatility spill over in the foreign exchange market is that individual economy's policy and efforts to stabilise the exchange rate would be futile since the volatility comes from outside. The dependence of the African economy on the outside world means that a global crisis like the European Union's crisis will put severe financial stress on Africa's financial market. In this case, the idea of forming common currency union will be of essential help because exchange rate stability will be managed at one central point. Though much of the shock comes from outside, big economies in Africa can also transmit shock within Africa so small economies like Kenya and Ghana should be on alert as trade and financial integrations are growing. The global world should also monitor big economies like South Africa because they can pass the shock to the global world financial market. With one effort, African leaders can develop one strategy to address and manage the volatility spill over effects from outside in the continent.

4.6 Conclusion and Implications

The study uses the BEKK kind of multivariate GARCH models to investigate volatility spill over in the African foreign exchange markets. The results show that volatility transmission in Africa follows meteor shower hypothesis and volatility spillover effect is strong from China and UK to African market. Regional volatility transmission and spillover seems not be strong. It is only between the rand and the naira that signals volatility transmission and spillover. This result contrasts international evidence presented by Cockerell, and Shoory (2012) and Glick and Rose (1999)

On the policy implication, the fact that volatility transmission and spill over is marginal regionally, to some extent, should be of high relevance to policy makers, traders, investors and regulatory authorities. For policy makers and regulatory

authorities, the paper has the following policy recommendations: first, as high degree of trade openness does not only increase the foreign exchange co-movement, but it also increases currency risk exposure; the regulatory authority should introduce guidelines that enable investors to have a considerable level of currency stability. Considerable trade openness is needed, because too much or too little trade openness will negatively affect investors and traders behaviour and stability (Milesi-Ferretti and Tille, 2010).

Second, since macroeconomic announcements have direct and indirect impacts on asset prices. global shock such as changes in trade balance has been found to play a significant role in volatility transmission, exchange rate co-movement and accelerating currency risk. Thus regulatory initiative that allows investors to reduce currency risk exposure significantly for risk management purposes must be pursued. For investors, mechanisms should be put in place to measure the direct and immediate impact of news release and also be aware of the risk of transmission of volatility to other markets. Availing themselves of the investment opportunities and hedging against the risk of contagion are of great importance for the actors in the region especially in the foreign exchange market.

Finally, the findings of this paper show that volatility transmission and spillover in Africa is characterized by meteor shower hypothesis, which could affect exchange rate co-movement and risk exposure. Therefore, regulatory, supervisory and monetary authorities should co-ordinate to put in place a comprehensive regulatory framework that would allow investors and traders to have a substantial amount of currency stability that is robust and consistent with any coordination policy. Currency union in the region would be prudent for exchange rate policy coordination since management would be done at one point.

CHAPTER 5

THE PATTERN OF EXCHANGE RATE COMOVEMENT IN AFRICA

5.1 Introduction

Changes in a country's exchange rate have a significant impact on its financial market operations and development as well as on other financial markets. Exchange rates changes affect international competitiveness and thus influence real income and output. Efforts aimed at assessing the co-movement patterns of currencies is imperative because a strong co-movement between currencies have important implications for economic policies and international capital budgeting decisions, since negative shocks affecting one market may be transmitted quickly to another through contagious effects. This issue has become more serious with the occurrence of recent black swan events that engulfed the United States' economy with a series of negative shocks consisting of disappointing economic growth, and financial scandals. Financial markets in particular the stock market fell by almost 17%, other important markets around the world experienced similar downturns and some examples are the markets of Ireland (14%), Mexico (11%), and Hong Kong (6%) **(**Lin, 2012**)**. Over the same period Iceland's stock market experienced positive returns of 26%, South Africa 21%, Ghana 32%, South Korea 12%, and Colombia 11% (Allen and Wood, 2006; Joyce and Nabar, 2009; Bawumia, 2014).

Foreign exchange markets in Africa were no exception. For example, on average, African currencies depreciated by 42%, specifically, the Ghana cedi depreciated by almost 56%, the South Africa rand by 45%, the Nigeria naira by 62% and the Kenyan shilling by 63% (Bawumia, 2014). This demonstrates that shocks to the developed economies' financial markets often spread to emerging markets which destabilize negatively the exchange rate policy. The critical issue is that such

interdependence has the potential to affect imports competitiveness as well as increasing risk exposure to traders and investors. In this era of globalization and financial market integration, understanding currency co-movements is not only essential but necessary for different insights on risks management. When asset markets are under integration, returns will be lower and volatility greater as well as the correlation between asset markets tending to be higher (Coudert, Couharde and Mignon, 2011; Lin, 2012).

This study examines dynamic linkages in the foreign exchange market after relatively recent globalisation and financial market integration in Africa. The focus on Africa stems from her relatively recent integration with mature markets in Europe and North America. Africa is interesting to analyse since the market is fragile as well as growing in terms of market capitalization. The study tries to analyses why foreign exchange markets often appear to have such large depreciation or appreciation together, yet receive diverse effects from other financial markets. More specifically, the paper attempts to answer two questions. First, how important are bilateral trade flows, and trade competition in third markets? And second, can capital account liberalisation produce exchange rate dependence?

Simultaneously considering bilateral trade, trade competition and capital account openness, this study makes a modest contribution to the examination of exchange rate correlations in Africa where the literature on co-movement is scant. Although information on bilateral trade flows abounds, the other variables are fairly new to this literature. A study that simultaneously controls for bilateral trade flows, trade competition, and capital account openness is rare in the literature. Mostly, studies (Bacchetta and Benhima, 2010; Kalemli-Ozcan, Papaioannou and Perri, 2010; Harju and Hussain, 2011; Ju and Wei, 2011) consider one or two of these linkages to examine a range of questions. However, omitting a subset of these variables could severely bias coefficient estimates. Simultaneously controlling for all three variables provides a more accurate estimate of the importance of different types of trade and financial channels in explaining cross-country co-movement in foreign exchange markets. This attempt should help reduce the effect of an omitted variable bias in the estimated results to give the relative importance of these variables. Using a dynamic panel analysis, the results reveal that exchange rates' co-movement in Africa are

externally determined. The trade effect takes a longer time to adjust to than the financial market, since adjustment in the financial market is quicker compared to trade adjustment.

5.2 Literature

Minsky's 1974 financial instability hypothesis opines that market volatility depends on knowledge of financial interdependence and trends. Wealth induces financial actors to engage in more risky behaviour, thereby undermining economic stability. Financial booms are considered a sense of safety on the part of investors although both risk and prices are rising simultaneously. Economic trends can be explained by the profit seeking drive of economic players (Polterovich, 2008; Whalen, 2012;). A manifestation of the financial instability hypothesis was evident during the technological bubble burst in the United States 2000s housing crisis when the predicted consequence of the hypothesis was shown in the visible actions of institutional investors. Financial institutions assumed to be too big to fail failed and its negative ramification on other economies shown.

Push factors are generally defined as circumstances in another country or group of countries that are outside a country's control of contagion. Contagion literature has identified a variety of reasons accounting for the spread of contagion from one country to other (Claessens et al., 2001; Moore and Wang, 2014). Mechanisms for contagion transmission have broadly been broken into trade channels (direct trade, competition in third markets, and changes in import prices), financial channels (including bank lending or portfolio flows), and similar economic characteristics. Forbes (2002), and Abeysinghe and Forbes (2005) focus on contagion through trade but (Kaminsky et al., 2001; Broner et al., 2006) focus on the role of financial linkages. The relative role of each channel in spreading a crisis has been assessed with each channel having ambiguous impact (Blanchard et al., 2010; Kalemli-Ozcan et al., 2010; Dungey, Fry, González-Hermosillo and Martin, 2011; Beirne and Gieck, 2012). Simultaneous examination of the role of domestic and global factors in explaining crises have found all the three channels to be important with global market factors exhibiting dominating effects.

On the other hand, pull factors such as the size, depth, and fragility of a country's financial system can either attract or drive capital flows out of the country. Recent theoretical studies (Caballero, Farhi and Gourinchas, 2008; Mendoza et al., 2009; Ju and Wei, 2011; Bacchetta et al., 2013) confirm the pull factors role and empirical support of these models are provided by Mendoza & Terrones (2008) and Forbes (2010). Changes in domestic growths are often caused by global productivity shocks which generates lending booms and busts, and associated shifts in capital flows (Aguiar and Gopinath, 2007; Broner et al., 2010). The extent of the financial market liberalisation and integration effect on foreign exchange volatility has been recognised to increase it (Calvet et al., 2006; Edison and Warnock, 2008; Milesi-Ferretti and Tille, 2010).

Recent literature has identified commodity prices as robust in explaining the behaviour of the commodity currencies (Cashin, Cespedes and Sahay, 2004). Chen and Rogoff, (2012) find that the Chilean peso's behaviour is due to dynamics in the commodity currencies. Similarly, Cowan et al. (2007) and Larraín, (2013) find that copper and oil prices are important determinants of the short term dynamics of currencies. Other factors including interest rate differential, and global financial distress, critically affect the peso exchange rate. Interest differential becomes more like a exogenous variable with the full-fledged inflation targeting regime and a floating exchange rate (McGettigan et al., 2013). Beine (2004) applied a multivariate GARCH model to intervention in foreign exchange rates and found that increases in the covariance tend to be associated with concerted interventions and these significantly affect the market expectations about future exchange rate co-movements. Nikkinen and Vahamaa (2009*)* also found support for this assertion.

5.3 Methodology

5.3.1 Methodology

For the study of sources of exchange rate comovement, fundamental based theories of the contagion effect on it will be examined. The Conditional Constant Correlation (CCC) provides the dynamics for the variances and correlations but assumed conditional correlations are constant and therefore the conditional covariances

are proportional to the product of the corresponding conditional standard deviations (Bollerslev , 1990).

The failure of the conditional constant correlation in empirical studies suggests that correlations among financial time series are dynamic and vary over time (Capiello et. al., 2006). The Dynamic Conditional Correlation (DCC) and BEKK model were developed to overcome this disadvantage of constant correlation. To overcome the assumption of time invariant correlation, Engle and Sheppard (2001), Engle (2002), and Tse and Tsui (2002) developed models for estimating time-varying correlations. The difference between the Engle (2002) and the Tse and Tsui (2002) models is that the former makes use of a representation of the correlation process which is similar to the GARCH process, whereas in the latter the correlations are weighted sums of past correlations (Bauwens et al., 2006). This study focuses on Engle and Kroner's (1995) dynamic conditional correlation, the GARCH model (BEKK-GARCH) which is a two-step estimation procedure. In the first step, the individual conditional variances are specified as univariate GARCH processes and in the second step the standardized residuals from the first step are used to construct the conditional correlation matrix. This method guarantees positive definiteness of the covariance matrix and it also enables the estimation of time-varying volatilities, covariances and correlations. From the bivariate BEKK, the correlation series is defined as:

$$\rho_{ij,t} = \rho_{ji,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t} q_{jj,t}}} \qquad 5.1$$

Where $q_{ii,t}^{-1/2}$ is a typical univariate GARCH type model, $Q_t = q_{ij,t}$ is a NxN symmetric positive definite matrix given by

$$Q_t = (1-\alpha-\beta)\bar{Q}_t + \alpha u_{t-1} u'_{t-1} + \beta Q_{t-1}. \qquad 5.2$$

$$u_t = (u_{1t}, u_{2t}, \ldots, u_{Nt})'$$

Where $u_t = (u_{1t}, u_{2t}, ..., u_{Nt})'$ is the Nx1 vector of standardized residuals, $\bar{Q}_t$ is the NxN unconditional variance matrix of u_t, α and β are nonnegative scalar parameters satisfying $\alpha + \beta < 1$.

The estimator of Quasi-Maximum Likelihood (QML) is the estimation method of DCC model under a multivariate student distribution (Fiorentini et al., 2003). The multivariate student distribution is applied.

Table 5.1 Variable Definitions

Variables	**Variable Definitions (Measurement)**	**Source**
Exchange rate	Local currency per United States Dollar	IFS, IMF
Correlation (ρ)	Bilateral exchange rate correlation. Measured as the ratio of covariance to the product of standard deviation	IFS, IMF
Trade Intensity	The ratio of the sum of export to and import from country I to j to the sum of I and j GDP measured level bilateral intra trade	DOTS, IMF
Trade competition	The ratio of fraction of exports of country I and j to the sum of total exports in the same exports markets. The level of competition by countries in the same exports markets	DOTS, IMF
Capital Account Liberalisation(KAOPEN)	The sum of IMF binary restrictions on multiple exchange rates, current account transactions, capital account transactions and surrender of exports proceeds. Capital account openness	Chinn and Ito Index

Table 5.1 (Continued)

Variables	Variable Definitions (Measurement)	Source
Common Shock		
World interest rate	Average short term interest rate of Japan, United Kingdom and United States. Measured how changes in the global market affect the developing markets	IFS, IMF
Gold price	Measured synchronizations of developed economies with emerging markets	IFS, IMF
Oil price	Measured synchronization of developed economies with emerging markets	IFS, IMF
Control Variables		
Financial development	The differential of the ratio of broad money supply to GDP. Determine level of financial market growth	Central banks of the countries
Interest rate differential	The differential of the policy rate. Measured financial stability in the economy	IFS, IMF
Inflation differential	Difference of consumer price index growth. Measured the extend of macroeconomic stability	IFS, IMF

5.3.2 Linear Specification

After establishing evidence of a significant time-varying correlation between the changes in exchange rates, the potential determinants behind the linkage are examined. The global economic shock represents by short term interest rate, oil and gold prices, financial integration is accounted for by a capital account liberalisation, and the trade linkage is incorporated into the model by bilateral trade and trade

competition (Frankel and Rose, 1998; Glick and Rose, 1999; Fidrmuc, 2004; Siedschlag and Tondl, 2011). Similarly from (Kodres and Pritsker, 2002; Kose et al., 2003; Walti, 2005), the co-movement model is specified as

$$\rho_{ij,t} = f(trade, fin, global) \tag{5.3}$$

$$\begin{aligned}\rho_{ij,t} = {} & \beta_0 + \beta_1 op_t + \beta_2 gold_t + \beta_3 worldrate_t + \beta_4 btrade_{ij,t} \\ & + \beta_5 com_{ij,t} + \beta_6 fdd_{ij,t} + \beta_7 \inf_{ij,t} + \beta_8 rd_{ij,t} + \beta_9 kaopen_t + \varepsilon_{,t}\end{aligned} \tag{5.4}$$

This study uses a panel data analysis to improve the data frequency. The problem with ordinary panel data is that the explanatory variables may be endogenous. Bi- causality may run in both directions from co-movement to trade intensity and from trade intensity to co-movement as well as regressors correlated with the error term. Another problem is the time-invariant country characteristics (fixed effects) which may be correlated with the explanatory variables. The fixed effects are contained in the error term in equation (5.4), which consists of the unobserved country-specific effects, v_i and the observation-specific errors, e_{it} :

$$u_{it} = e_{it} + v_i \tag{5.5}$$

Equally important related problem is autocorrelation which arises in face of the lagged dependent variable. The dynamic panel data analysis is powerful to overcome these related problems. Instead of using only the exogenous instruments listed above, lagged levels of the endogenous regressors in trade, finance and global linkages are also added. This makes the endogenous variables pre-determined and therefore not correlated with the error term in the equation (5.4)

$$\begin{aligned}\Delta\rho_{ij,t} = {} & \beta_0 \Delta\rho_{ij,t-1} + \beta_1 \Delta op_t + \beta_2 \Delta gold_t + \beta_3 \Delta worldrate_t + \beta_4 \Delta btrade_{ij,t} \\ & + \beta_5 \Delta com_{ij,t} + \beta_6 \Delta fdd_{ij,t} + \beta_7 \Delta \inf_{ij,t} + \beta_8 \Delta Rd_{ij,t} + \beta_9 \Delta kaopen_t \varepsilon_{,t}\end{aligned} \tag{5.6}$$

The first-difference transformation by GMM removes the fixed country-specific effect because it does not vary with time.

$$\Delta u_{it} = \Delta e_{it} + \Delta v_i \qquad 5.7$$

The first-differenced lagged dependent variable is also instrumented with its past levels. In large-T panels, a shock to the country's fixed effect, which shows in the error term, will decline with time. Similarly, the correlation of the lagged dependent variable with the error term will be insignificant. These characteristics of the dynamic panel data analysis make it necessary for this study. The empirical equations to determine parsimonious model are as follows

$$\Delta\rho_{ij,t} = \beta_0\Delta\rho_{ij,t-1} + \beta_1\Delta op_t + \beta_2\Delta gold_t + \beta_3\Delta worldrate_t + \beta_4\Delta btrade_{ij,t} + \beta_6\Delta fdd_{ij,t} + \beta_7\Delta \inf_{ij,t} + \beta_8\Delta Rd_{ij,t} + \beta_9\Delta kaopen_t\varepsilon_{,t}. \qquad 5.8$$

$$\Delta\rho_{ij,t} = \beta_0\Delta\rho_{ij,t-1} + \beta_1\Delta op_t + \beta_2\Delta gold_t + \beta_3\Delta worldrate_t + \beta_5\Delta com_{ij,t} + \beta_6\Delta fdd_{ij,t} + \beta_7\Delta \inf_{ij,t} + \beta_8\Delta Rd_{ij,t} + \beta_9\Delta kaopen_t\varepsilon_{,t} \qquad 5.9$$

$$\Delta\rho_{ij,t} = \beta_0\Delta\rho_{ij,t-1} + \beta_2\Delta gold_t + \beta_3\Delta worldrate_t + \beta_4\Delta btrade_{ij,t} + \beta_6\Delta fdd_{ij,t} + \beta_7\Delta \inf_{ij,t} + \beta_8\Delta Rd_{ij,t} + \beta_9\Delta kaopen_t\varepsilon_{,t} \qquad 5.10$$

$$\Delta\rho_{ij,t} = \beta_0\Delta\rho_{ij,t-1} + \beta_1\Delta op + \beta_3\Delta worldrate_t + \beta_4\Delta btrade_{ij,t} + \beta_6\Delta fdd_{ij,t} + \beta_7\Delta \inf_{ij,t} + \beta_8\Delta Rd_{ij,t} + \beta_9\Delta kaopen_t\varepsilon_{,t} \qquad 5.11$$

$$\Delta\rho_{ij,t} = \beta_0\Delta\rho_{ij,t-1} + \beta_3\Delta worldrate_t + \beta_4\Delta btrade_{ij,t} + \beta_6\Delta fdd_{ij,t} + \beta_8\Delta Rd_{ij,t} + \beta_9\Delta kaopen_t\varepsilon_{,t} \qquad 5.12$$

Wooldridge's serial correlation test in linear panel-data models start with

$$\Delta corr_{it} = \Delta X_{it}\beta_1 + \Delta\varepsilon_{it} \qquad 5.13$$

Wooldridge's procedure begins by estimating the parameters of equation 5.13 and obtaining the residuals $\hat{e}_{it}$. If $\hat{e}_{it}$ are not serially correlated, then the hypothesis that $corr(\Delta e_{it}\Delta e_{it-1}) = -0.5$ should be accepted.

5.3.3 Data and Measurement

The dependent variable is the bilateral exchange rate correlations. Bilateral correlations in foreign exchange markets are computed on the basis of the dynamic conditional correlation BEKK advanced by Engle and Kroner (1995) using quarterly domestic currency exchange rates per US Dollar. The quarterly data cover the period 1990-2013 from Ghana, Kenya, South Africa and come from the International Financial Statistics issued by the International Monetary Fund. Over this period, the global world economy experienced unprecedented economic crises of various types consisting typically of the Asian flu, the American financial crunch and the European sovereign debt crisis, which might have caused business cycles' synchronization which may meteor shower to African markets.

5.3.3.1 Independent Variable

Emerging countries have been undergoing a large globalization and integration process, both in terms of real and financial transactions. Globalisation reflected by trade and financial integration may have positive and negative sides for investors due to bilateral macroeconomic and financial assets correlations. The recent literature tends to emphasize the crucial role of trade and financial openness in the co-movement of economies (Wacziarg & Welch, 2008). This study focuses only on the factors influencing foreign exchange markets' co-movement and independent variables as described below.

5.3.3.2 Trade

Trade integration serves as a transmission channel of contagion since it increases transactions in the foreign exchange market. As volume of trade grows, it affects financial integration hence co-movement. The study is interested to learn about the role of trade integration policy on currency markets' co-movement in terms of bilateral trade and competition trade. Bilateral trade intensity is computed in two ways. The first indicator of trade integration relates to Frankel and Rose (1998),

Fidrmuc (2004) and Siedschlag (2010), an index which is more convincing than other measures relating bilateral trade of the partners to total worldwide trade of both partners as suggested in Imbs (2004) and Fidrmuc, Iwatsubo, and Ikeda (2010) and writes

$$bilatrade = \frac{X_{ij} + M_{ji}}{GDP_{i,t} + GDP_{j,t}}$$

where $X_{i,j,t}$ denotes total merchandise exports from country i to j in quarter t, $M_{i,j,t}$ denotes imports from j to i, and $GDP_{i,t}$ denotes nominal GDP in country i. Bilateral trade data are from the International Monetary Fund's Direction of Trade Statistics. This is the standard benchmark for bilateral trade. Pretorius (2002) and Sachs, and Warner (1995) assert that trade intensity tends to increase for a large majority of country pairs reflecting the tendency towards higher globalization. The second indicator of trade integration is by Glick and Rose's (1999) method of trade integration which assesses the extent to which two countries compete in the same export markets. It is possible that these countries competing in the same export markets exchange rates may react similarly to shocks originating in these export markets and engage in competitive devaluation. Glick and Rose (1999) trade indicator is given by

$$\text{Trade competition} = \sum_{1}^{k} \frac{x_{ik,t} + x_{jk,t}}{X_{i,t} + X_{j,t}} \left(1 - \frac{x_{ik,t} / X_{i,t} - x_{jk,t} / X_{j,t}}{x_{ik,t} / X_{i,t} + x_{jk,t} / X_{j,t}}\right)$$

Where

$x_{ik,t}$ *and* $x_{jk,t}$ represent exports from country i and j to country k respectively. Also $X_{i,t}$ *and* $X_{j,t}$ are total exports of country i and j respectively. The quarterly data cover the 1990 to 2013 for South Africa, Kenya, Ghana, and come from the International Monetary Fund's Direction of Trade Statistics. The trade variable determines and captures the extent of the open characteristics of these economies in terms of exports and imports with global world particularly the American and Europe. Strong and significant impact of the trade variable on the correlation implies economic integration may matter for the linkage. International trade either

competition or bilateral impact positively on co-movement and remain the important determinant of the effect of large markets on other markets (Kose et al., 2003; Chinn and Forbes, 2004).

5.3.3.2 Financial Liberalization

High capital mobility has a tendency to increase risk of cross-border financial contagion, in particular when the region's economies become more interdependent (Sandra, 2007; Beirne, Guglielmo, Caporale, Schulze-Ghattas and Spagnolo, 2010; Yu, Fung and Tam, 2010). For instance, Cetorelli and Goldberg (2010) argue that international banks were instrumental in transmitting financial shocks from one country to another during the global financial crisis.

Many attempts have been made to measure the extent of financial openness but the conventional measures fail to account for the intensity of capital controls and do not convey any information about the status of liberalisation or restriction of capital accounts (Grilli and Milesi-Ferretti, 1995; Glick and Hutchison, 2001; Edison et al., 2002). A composite measure of financial regulation was developed by Quinn (2003) that ranges from 0 to 14, with 14 representing the least regulated and most open regime. While this index is considered to have high coverage intensity of capital; the dataset is not publicly accessible. In recent times, Chinn- Ito's (2002) compiled index which has a major merit of wide coverage (more than 100 countries) for a long time of period (1970 through 2000s) and also measures the intensity of capital controls, insofar as the intensity is correlated with the existence of other restrictions on international transactions, is better. The Chinn-Ito index (2002) is called KAOPEN, is the first principal component of the four IMF binary variables and higher values indicate greater financial openness. The KAOPEN index measures the *extensity* of capital controls because it may not directly refer to the stringency of restrictions on cross-border transactions, but to the existence of different types of restrictions. Measuring the extensity of capital controls may be a good proxy to the measure of intensity of capital controls than other measures**.** The Chin -Ito index (2002) is popular now because the index is publicly available.

The Chinn-Ito index (2002) is considered to be *de jure as it* measures financial openness because it attempts to measure regulatory restrictions on capital account transactions rather than price-based measures on financial openness, based on

the interest rate parity approach (Montiel, 1995; De-Gregorio, 1998; Cheung et al., 2006). The price-based measures are described as *de facto* measures on financial integration. The KAOPEN consists of the standardized principal component of SHAREk3, K_1,K_2 *and* K_4. The K_1 indicates the presence of multiple exchange rates; K_2 indicates restrictions on current account transactions; SHARE K_3 indicates restrictions on capital account transactions; and K_4 indicates the requirement of the surrender of export proceeds. In this paper KAOPEN is used to measured financial liberalization, due to its wide coverage and extensity.

5.3.3.3 Global /Common Shock

Globalization has increased economic interdependence internationally such that any study of synchronization should consider advanced economies effects on economic linkages. Previous studies on the impact of economic integration on the synchronization of a business cycle (Flavin et al., 2002; Hamilton, 2003; Kose et al., 2003; Chinn and Forbes, 2004) normally include global interest rates, oil prices, gold prices and commodity prices as global variables. This study controls for interest rates, oil prices, and gold prices as global variables. A global effect is captured by short term interest rates, gold and oil prices. For instance, for interest rate differentials, the degree of capital market integration between these countries and the global world is gauged as a channel to the correlation of foreign exchange markets. If this effect is significant, then financial integration plays a major role in the foreign exchange market comovement which is derived from the traditional macroeconomic view. The global world is represented by the United States, the United Kingdom and Japan due to the size and the effect of their economies on others.

5.3.3.4 Control Variables

Co-movement among output or financial variables are determined by differences countries macroeconomic factors like interest rate and inflation rate such that when these variables are high, the co-movement is low and vice versa. Following Pretorius (2002) and Walti (2005), additional control variables of a financial development differential, interest rate differentials and the inflation differential are included as macroeconomic determinants that are assumed to influence exchange rate co-movement. Financial development differential is measured as the ratio of a broad money supply to the gross domestic product. The inflation differential is calculated as

the difference in the growth rate of consumption price indices. Finally, an interest rate differential is the 3 months interest rate of government policy rates (Pretorius, 2002).

Caglayan and Demir's (2012) show that better access to external funds because of low interest rates reduces the exchange rate co-movement. It is believed that well-developed financial markets should allow agents to hedge the exchange rate risk which helps in dampening the negative effect on trade. Aghion et al. (2009) show that the local financial development plays a key role in the magnitude of the repercussions linked to exchange rate volatility. The negative impact of the real exchange rate volatility on productivity growth decreases with a country's financial development.

5.3.3.5 Data Sources

The dataset consists of quarterly exchange rates of three African countries: Ghana, Kenya, and South Africa. The exchange rates are in local currency per unit of US dollar. The sample period runs from 1st quarter 1990 to second of quarter of 2014. All data were taken from International Monetary Fund's Direction of Trade Statistics, International Financial Statistics of International Monetary Fund(IMF), IMF balance of payment, Trademap, and Central banks of each country. Based on exchange rates (s), the return of exchange rate changes ($r_{s,t}$) at time t is calculated as $r_{s,t} = 100 * \log(s_t / s_{t-1})$

The data applied in this study are the quarterly foreign exchange rates per US dollar, Gross Domestic Product, short term interest rate, broad money supply (M2), blend (UK) oil price, gold price, and value of exports. Panel unit root test based on the Im, pesaran and Shin W-Stat, Levin, Lin and Chu t and ADF Fischer Chi square were carried out.

5.4 Empirical Results

5.4.1 Descriptive Statistics of Variables

5.4.1.1 Regional Correlation

As can be seen from figure 5.1, correlation is the association between variables mostly from key macroeconomic variables like the exchange rate in volatility studies. There is a high correlation between African currencies. This

indicates that the currencies highly moved together in regional terms. The correlations show that an exchange rate responds to contemporaneous change from other markets for all the selected Africa countries. In other words, an exchange rate is contemporaneously affected by change in key macroeconomic variables. This ordering reflects the fact that exchange rate behaviour is mostly determined by key macroeconomic variables.

Correlation between Returns

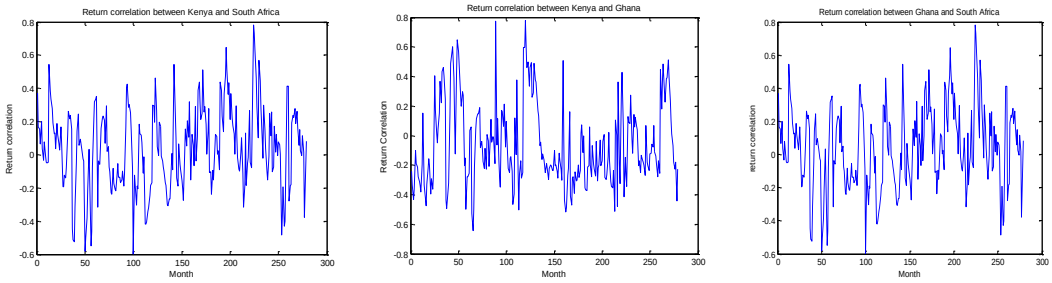

Figure 5.1 Correlation Between Currencies in Africa

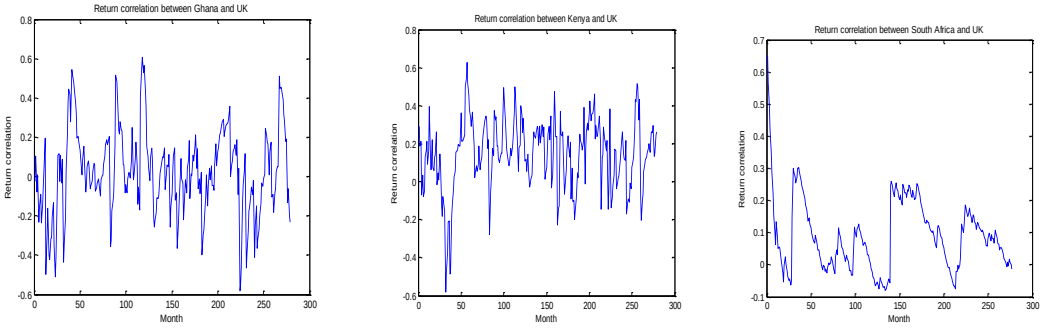

Figure 5.2 Global Currencies Correlation

Source: Data Stream

Figure 5.2, exhibits how a global foreign exchange market correlates with its counterparts in Africa. There is a high correlation between Africa currencies and the global world. This indicates high relationship between African currencies and global currencies. The correlations show that the exchange rate in Africa responds to contemporaneous changes from other regions.

Table 5.2 Descriptive Statistics of Regional Bilateral Trade Variables

Variable	**Trade_ghsa**	**Trade_kegh**	**Trade_kesa**
Mean	0.00083	8.20E-05	0.00148
Max	0.00339	0.000246	0.003444
Min	0.0000	0.0000	0.00000
Standard Deviation	0.000607	5.84E-05	0.000829
Skewness	1.250107	0.440617	-0.384751
Kurtosis	6.610394	2.385794	2.491534
Jarque-Bera	77.14***	4.6153*	3.4027
	(0.0000)	(0.0995)	(0.1824)
Observations	94	94	94

Note: In Parenthesis is the Probability of Accepting the Null Hypothesis.
Source: Data from IFS, IMF

This ordering reflects the fact that exchange rate behaviour is mostly determined by key macroeconomic variables. Correlation between African currencies and the global currencies indicates that the regional and global currencies moved together.

Table 5.1 reports the regional bilateral trade in Africa. The average bilateral trade in Africa is relatively low. The mean regional bilateral trade is about 0.000077, it is high between Kenya and South Africa followed by trade between Ghana and South Africa but that of Kenya and Ghana is relatively small.

The volatility of the bilateral trade in Africa shows that the Kenya and the South Africa trade is pretty volatile relative to the Kenya and Ghana trade. There is an excess kurtosis for the Ghana and South Africa bilateral trade but trade between Kenya and South Africa and Kenya and Ghana exhibit no excess kurtosis since the absolute value of the kurtosis is less than three. Skewness indicates both long left and right tails which also deviates from zero for Ghana and South Africa.

The relatively low level of bilateral trade in the region is in line with the works of Ofa et al., (2012). WTO's WTR, (2011) and Gayi (2010). For instance, Gayi

(2010) concludes that the low volume of bilateral trade is due to production and exportation of similar primary products.

The trade competition among African countries in the new emerging economies and traditional exports market is presented in Table 5.2. Trade competition in the new emerging economies (BRICS) and in the traditional exports markets indicates that competition is higher in the traditional market than in the BRICS.

The average trade competition in the traditional export markets is about 0.247 with corresponding value of 0.0724 in the BRICS whilst the least average value stands at zero for both markets. The volatility of trade competition is also high in traditional export markets than in BRICS markets.

Table 5.3 Descriptive Statistics of Trade Competition

Variable	Com_ghsa	Com_kegh	Com_kesa	Comp_ghsa	Comp_kegh	Comp_kesa
Mean	0.070899	0.046430	0.101083	0.255894	0.212658	0.273975
Max	0.480811	0.165119	0.706257	0.569916	0.317920	0.588532
Min	0.000000	0.000335	0.0000	0.000000	0.119850	0.00000
Standard Deviation	0.091775	0.040127	0.140771	0.207157	0.047412	0.213479
Skewness	2.026370	1.066028	2.123325	-0.145963	0.272974	-0.257598
Kurtosis	8.044894	3.700488	7.965127	1.453184	2.29642	1.456351
Jarque-Bera	165.758***	19.936***	168.9675***	9.8080**	3.139287	10.483***
	(0.00000)	(0.00005)	(0.00000)	(0.00742)	(0.20812)	(0.00529)
Observations	94	94	94	94	94	94

Note: Com is the trade competition in the emerging economies (BRICS-Brazil, India, Russia, China, South Africa). Comp is the trade competition in the big economies(United States of America, United Kingdom, Germany, Japan and Australia.

Source: Data from IFS, IMF

The highest volatility of trade competition is reported by traditional export markets between Kenya and South Africa followed by Ghana and South Africa. In BRICS, the Kenya and South Africa competition is the highest but when

ranked with a traditional source, it accounts for the third highest volatility, and the least trade competition also comes from BRICS. The small average trade competition may mean no strong competition among these countries probably they sell different goods in these markets. Jacque-Bera statistics indicate that trade competition is not normally distributed. It can be seen that there is no excess kurtosis because the statistics of kurtosis is hardly in excess of three. The high trade competition in traditional exports market of African countries attests to the fact that the region is glued to their old markets for securities and a maintenance of the long term developed relationship and partnership.

The descriptive statistics presented in Table 5.3 below shows that comparatively, South Africa's economy is the best followed by Kenya's and the last is Ghana's in terms of performance relating to capital account openness, financial development, interest and inflation rates. Ghana has the highest interest rate of 35% followed by Kenya of 23% and South Africa's interest rate maximum at about 12%. The minimum value and volatility of the interest rates trace the same order of ranking. South Africa has a minimum interest rate of 5% with volatility of almost 4. While Ghana has the second minimum interest rate of about 13% that of Kenya is almost 17%. The volatility is 11 and 5 for Ghana and Kenya respectively. The kurtosis is far below three indicating no excess with skewness portraying long right tails.

Inflation rates in the region put Ghana at about 4%, Kenya at 3% and South Africa at 1.7%. The volatility ranking is the same as the mean with the values ranging from 0.04 for Ghana, 0.03 for Kenya and 0.01 for South Africa. Meanwhile there is no excess kurtosis for South Africa but there is presence of excess kurtosis for Ghana and Kenya. Skewness is in the long right tail for all.

Financial development measured by the ratio of a broad money supply to gross domestic product shows that South Africa is more developed financially at 63% than Kenya and Ghana at about 40% and 25% respectively. Financial development volatility is averagely higher for Ghana and Kenya than for South Africa. Skewness is long left tail for Ghana but right long tails for Kenya and South Africa with no excess kurtosis for each country.

Table 5.4 Descriptive Statistics of the Variables

Variable	Mean	Max	Min	Std. Deviation	Skewness	Kurtosis	Jacque-Bera	Obs
Interest Rate_Ghana	25.481	35.00	12.50	10.893	0.5854	2.080	8.405***	94
							(0.0149)	94
Interest Rate_Kenya	23.219	33.20	16.50	4.9239	0.6179	2.127	8.681***	94
							(0.0130)	
Interest Rate_S.Africa	11.697	21.85	5.00	4.1549	0.1248	2.094	3.3468	94
							(0.1876)	
Inflation_Ghana	4.723	1.927	-3.614	0.0415	0.7088	3.755	9.777***	94
							(0.0075)	
Inflation_Kenya	3.134	1.740	-3.289	0.0379	1.3711	5.657	55.283***	94
							(0.0000)	
Inflation_S. Africa	1.769	4.432	-1.191	0.0111	0.2815	2.712	1.5153	94
							(0.4688)	
M2_gdp Ghana	25.80	34.31	13.99	5.412	-0.3998	2.299	4.4731	94
							(0.1068)	
M2_gdp Kenya	39.75	51.79	29.37	5.760	0.61929	2.851	6.1759**	94
							(0.0459)	
M2_gdp S.Africa	63.37	85.14	46.59	12.09	0.3786	1.679	9.174***	94
							(0.0102)	
Kaopen_Ghana	-1.2589	-0.1173	-1.8750	0.3895	0.3577	4.727	13.254	90
							(0.0013)	
Kaopen_Kenya	0.4101	1.1109	-1.8750	1.2226	-1.1944	2.498	22.593***	90
							(0.0000)	
Kaopen_S. Africa	-1.1509	-0.1173	-1.8750	0.4055	0.8053	5.071	26.099***	90
							(0.0000)	

Table 5.4 (Continued)

Variable	Mean	Max	Min	Std. Deviation	Skewness	Kurtosis	Jacque-Bera	Obs
Oil Price	43.779	121.11	11.643	32.424	0.9569	2.488	15.536*** (0.0004)	94
Gold Price	601.66	1717.7	259.30	430.12	1.4679	3.799	36.646*** (0.0000)	94
World interest Rate	3.0233	9.2670	0.1253	2.1436	0.8333	4.012	15.051*** (0.0005)	94

Note: In Parenthesis is the Probability of Accepting the Null Hypothesis that the Variables are Normally Distributed.

Source: Data Stream

Capital account openness (Kaopen) shows that Kenya has high capital account openness followed by South Africa and Ghana having low capital account liberalisation. Ghana has more restrictions on export and import receipts as well as tax payment on international financial transactions. A cursory glance at the index reported by Chinn- Ito reveals that the status of the capital account openness is not stable. Economies might change the restrictions frequently to suit a changing domestic economic fundamental stress.

Global variables are represented by oil price, gold price and the average world interest rate. Oil and gold prices are highly volatile with average prices of about 44 and 602 dollars respectively. The mean average global interest rate stands at 3% which is even far less that the minimum average mean rate in Africa. The global variables are not normally distributed as indicated by the Jacque Bera test.

The inference from Tables 5.2 and 5.3 is that Kenya has the highest average capital account openness higher than Ghana and South Africa but relatively South Africa is better than Ghana.

Financial development differential averages are negative between Ghana and South Africa and Kenya and South Africa pairs confirming that comparatively, the financial development is better in South Africa than in Kenya and Ghana respectively. The positive mean of Kenya and Ghana financial development differential also proves a higher financial development in Kenya than Ghana.

The interest rate differentials between Ghana and South Africa, Kenya and South Africa are positive denoting that the interest rates in Ghana and Kenya are almost twice bigger than in South Africa. The volatility of interest rates differential is high between Kenya and Ghana revealing the instability of the monetary policies in these countries.

Inflation differentials are positive for all. This means that the low mean inflation rate in Kenya relative to Ghana is not advantageous because the differential mean is positive revealing that a fluctuation in inflation rates for both countries may be quite high. However, since South Africa has a very small inflation rate, its differentials with either Ghana or Kenya result in a positive value. South Africa might probably enjoy stable inflation hence low interest rate.

In sum, the descriptive statistics show that South Africa's economy is in a better position than Ghana and Kenya. For Kenya and Ghana, Kenya stands tall in terms of a resilient economy. It is only in the inflation rate that Ghana runs pari pasu with Kenya.

The specification test results are reported at the bottom of the tables to indicate the nature of the estimation process and the choice of particular techniques. First, the Hausman test is used to make decisions on the fixed effect or random effect was not performed in this study because the number of cross sections is less than the number of time series period. The decision to use a fixed effect was informed by Gujarati and Porter, (ch. 16, pp. 650-651, 2008) who states that in such situations, the fixed effect is preferred to a random effect. The Wooldridge serial correlation test is significant indicating rejection of no first order serial correlation in the fixed effect model.

5.4.2 Regression Analysis

Tables 5.6 and 5.7 present the estimation results of panel data models. In contrast to the estimated models of Table 5.6, the specifications of Table 5.7 allows for some dynamics in the co-movement through the addition of an Autoregressive of order one (R(1)) term. The dynamic specification is supported by the significant AR(1) component due to the acceptance of autocorrelation by the Wooldridge test in the fixed effect specifications. Moreover, the main results relating to the impact of trade, global effect as well as financial liberalization qualitatively changed in the dynamic specifications.

Table 5.5 Fixed Effect Panel Data Results

Variable	(1)	(2)	(3)	(4)	(5)	(6)
constant	0.1777***	0.1762***	0.1734**	0.1649**	0.1627**	0.2064***
	(0.0249)	(0.0234)	(0.0273)	(0.0352)	(0.0285)	(0.0007)
Bilateral trade intensity	0.7385	0.4922	0.7223	0.9699	0.7056	
	(0.9322)	(0.9528)	(0.9336)	(0.911)	(0.935)	
Trade competition in BRICS	0.1523	0.1422				
	(0.6382)	(0.6436)				
Trade competition in trad. markets	-0.0147		0.0066	0.0506	0.0348	
	(0.9200)		(0.9619)	0.7068	(0.7761)	
inflation Differential	0.0717	0.0726	0.0682	0.0091	0.0673	
	(0.8683)	(0.8663)	(0.8744)	(0.983)	(0.8758)	
Interest Rate Differential	-0.0037*	-0.0037*	-0.0036*	-0.0039**	-0.0037**	-0.005**
	(0.0636)	(0.0635)	(0.0691)	(0.0448)	(0.0267)	(0.0182)
Financial Development Differential	-0.009***	-0.009***	-0.009***	-0.008***	-0.009**	-0.007**
	(0.0031)	(0.0001)	(0.0026)	(0.0046)	(0.0014)	(0.0002)
World interest Rate	0.0287***	0.0292***	0.0283**	0.0303***	0.0313	0.0210***
	(0.0287)	(0.0158)	(0.0303)	(0.0197)	(0.0049)	(0.0109)
oil Price	0.0016	0.0016	0.0016		0.0011	
	(0.2233)	(0.2163)	(0.2289)		(0.1517)	
Gold price	-6.54E-05	-5.93E-05	-4.28E-05	5.39E-05		
	(0.5584)	(0.5271)	(0.6706)	(0.3762)		
Financial liberilsation	0.0505***	0.0507***	0.0510***	0.0572**	0.0537**	0.0548**
	(0.004)	(0.0037)	(0.0036)	(0.0007)	(0.0011)	(0.0005)

Table 5.5 (Continued)

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Number of Obs	276	276	276	276	276	276
R	0.128	0.127	0.127	0.122	0.126	0.123
F-stat.	3.2397	3.5465	3.5244	3.7251	3.8705	6.4831
	(0.0002)	(0.0011)	(0.001)	(0.0001)	(0.000)	(0.000)
LM B-P	25. 6***		24.6**	25.7**		
	25.8**	25. 5***	25.7** *	26.3***		

Note: In parenthesis is the probability of accepting the null hypothesis of the statisitic. This is a fixed effect panel data. The *, **, and *** denotes significant level at 10%, 5% and 1% respectively. LM B-P (Breusch Pagan) p-value of the test with the null hypothesis of no first order serial correlation (Wooldrige)

LM : $\hat{e}_{it} = \rho \hat{e}_{it-1} + \varepsilon_{it}$

Source: Datastream

Due to the presence of serial correlation, Table 5.6 presents dynamic panel data results. Estimating the models with dynamic panel data, the results showed the AR(1) term to be around 0.535 and highly significant. It shows that the dynamics might be quite different when we fail to account for unobserved heterogeneity. The fixed effect panel may underestimate adjustment time to a long run equilibrium. Moreover, the Arellano-Bond test for autoregressive of order two (AR(2)) in first differences accept the null of no second order serial correlation which is consistent with the literature (Bertil and Soderstron, 2007). Finally, J-statistic tests accept the validity of the instruments.

Estimation results suggest that in general, macroeconomic variables such as the interest differential, capital account openness and bilateral trade are robustly related to foreign exchange co-movement, but the inflation differential and financial development differential are poorly related. These results are in line with the findings of Todd (2008) and Brière, Chapelle and Szafarz, (2010). All of them found real variables to explain European stock returns instead of domestic variables. In the models, the average world interest rate tends to be consistently positive and significantly related to foreign exchange co-movement which is intuitive because African countries mostly seek financial assistant from the global world whose success depends on the interest rate. This evidence is consistent with Bastos and Caido (2010).

This result suggests that financial shocks are transmitted through internationally active banks which support Cetorelli and Goldberg's (2011) argument that international financial markets were instrumental in transmitting financial shocks from one country to another during the Global Financial Crisis. Therefore a crisis such as the European one can have direct financial effects on African countries through reductions in trade credit, foreign direct investment and portfolio investment which can increase risk of cross-border financial contagion, in particular when the region's economies become more interdependent. African financial firms may be dominated by global major banks with strong reliance on financial services and consumer finance. The receiving of these services from the global world has increased dependence on interest income. Since volatility and co-movement are linked externally, external financial flows are impetuous to Africa's development and any recession in the global world will surely have adverse effects on Africa quest to develop.

Due to multiple challenges facing Africa's regional integration, it is imperative on the part of African leaders to accelerate integration by taking a second look at current methods, strategies of addressing obstacles that hinder integration and renew commitments to reach these goals by providing more resources to the Africa Union and the ARECs. Since volatility and co-movement are linked externally, accelerating integration by addressing obstacles that hinder integration is impetuous to Africa's development will cushion and absorb adverse effects of any recession in the global world.

Surprisingly oil and gold prices alternate signs in the models in the dynamic panel data. In the fixed effect model while the oil price correlates positively to foreign exchange co-movements, the gold price moves inversely to it, but both are statistically insignificant. The specifications in a dynamic model show that the two variables alternate signs, however they are insignificant. The global risk aversion increment tends to lead to greater synchronization as reflected by the positive sign of oil and gold prices. The changing signs of gold and oil prices are surprising. Periods of higher oil and gold prices are usually associated with recessions and we know that business cycles are more synchronized during such periods. Changes in oil prices are a common shock to oil importing countries, and this makes business cycles more synchronized during economic downturns. Specification in the fixed effect panel indicates that oil price increases exhibit a statistically insignificant coefficient, it remains that they cause more correlated foreign exchange market co-movements. Contrary, oil price decreases co-movements which contradict our hypothesis as shown in the dynamic models. The results here share support with Beirne and Gieck (2012) who observe that cross-country linkages explain business cycle synchronization globally. We expect to observe stronger foreign exchange market co-movements when oil prices increase and little effect when such prices decrease. Hence, we would have expected a positive sign of oil and gold prices on foreign exchange co-movement.

Glick and Rose (1999) and Chinn and Forbes(2004) identify trade intensity and competition in the same market to be the main channels of contagion effects. Though the effect of trade is either intensity or competition in financial markets especially foreign exchange co-movement remains ambiguous in most empirical evidence (Otto et al., 2001; Kose et al., 2003).

The study finds robust support for the positive effect of trade intensity and competition on the foreign exchange co-movement. For trade intensity, it is positively related to co-movement in both specifications and is highly significant in dynamic models suggesting robustness of trade linkages in explaining the foreign exchange co-movement.

A further investigation shows that trade competition in the new emerging economies is insignificantly positively related to foreign exchange co-movement but competition in the traditional export markets appears negative and significant.

Table 5.6 Dynamic Panel Data Results

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Correlation(-1)	0.530***	0.5309***	0.5244***	0.5312***	0.5319***	0.5279***
	(0.000)	(0.000)	(0.000)	(0.0000)	(0.000)	(0.000)
Bilateral trade intensity	11.647***	11.415***	11.622***	11.557***	11.480***	11.133***
	(0.000)	(0.000)	(0.0003)	(0.000)	(0.000)	(0.000)
Trade competition in BRICS	0.7748	0.7849		0.7884	0.7987	
	(0.2107)	(0.1926)		(0.182)	(0.1832)	
Trade competition in trad. markets	-0.280***		-0.296***			
	(0.000)		(0.000)			
Inflation Differential	-0.0825	-0.0826	0.029748	-0.0815	0.0857	
	(0.7921)	(0.7862)	0.9306	(0.7822)	(0.7884)	
Interest Rate Differential	-0.006***	--0.0057***	--0.0049***	-0.0058**	-0.0058**	-0.0048**
	(0.000)	(0.0001)	(0.000)	(0.000)	(0.000)	(0.0244)
Financial Development Differential	0.0038	0.0042	0.005	0.00388	0.004	
	(0.7933)	(0.7817)	(0.6764)	(0.8018)	(0.7936)	
World interest Rate	0.0564***	0.0534***	0.0575***	0.0529***	0.0528***	0.0481***
	(0.000)	(0.0004)	(0.000)	(0.0037)	(0.0016)	(0.0287)
Oil Price	0.0003	(0.0002)	3.94E-05		-1.11E-05	
	(0.8485)	(0.9043)	(0.9832)		(0.9852)	
Gold price	-3.16E-05	2.48E-05	4.66E-05	1.37E-05		
	(0.8454)	(0.868)	(0.7485)	(0.8416)		
Financial Liberalisation	0.0718***	0.0730***	0.0709***	0.0732***	0.0729***	0.0695***
	(0.000)	(0.0143)	(0.0001)	(0.000)	(0.0001)	(0.0025)

Table 5.6 (Continued)

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Number of Obs.	275	275	275	275	275	275
Q(2)	0.6993	0.7267	0.7456	0.7281	0.7279	0.7989
	(0.4844)	(0.4674)	(0.456)	(0.467)	(0.4667)	(0.4243)
J-Statistic	217.41***	216.90***	227.19***	217.71***	217.45***	230.22***
	(0.0108)	(0.0132)	(0.0036)	(0.0137)	(0.0141)	(0.0051)

Note: In parenthesis are the standard errors of coefficients. The *, **, and *** significant at 10%, 5% and 1% respectively. Q() and J represents second order serial correlation and validity of instruments. P-value is in bracket.

Source: Data from IFS - IMF

The works of Joyce and Nabar (2009) and Allen and Wood (2006) are similar to the results here that trade intensity and competition are essential in influencing co-movement. The robust trade linkages might be a reflection that trade liberalization reforms but take time to exert significant effects on the size of trade. The inverse relationship exhibited by competition in the traditional export markets reflects on the supply of different exports products such that the trading countries do not compete for sales hence, no links with currency co-movement.

The fact that such reforms exert a significant impact beyond the traditional role of trade suggests the existence of signaling effects for international investors. Portfolio investors can buy and sell foreign assets. Reforms aimed at promoting trade relationships might lead to a reduction in the level of asymmetric information and favouring the size of cross border investment (Schmukle, 2004). Asymmetric information is important for home country biasness, since trade intensity ultimately leads to an increase in the correlation.

For instance, a unit increase in the trade intensity leads to increase in the foreign exchange co-movement by almost 0.76% in the fixed effect model but it is about 11% in the dynamic model. The findings are not surprising, because studies on business cycle co-movements show that enhanced trade linkages foster more correlated business cycles. These results confirm that the effects of intra-industry trade are stronger than effects related to the specialization of production along the lines of comparative advantage.

Trade increases in transaction in the foreign exchange market and being significant mean that for Africa, trade integration creates linkages in the financial market but it has a long term effect so authorities should not neglect the effect of trade integration on the financial market when developing policies for the financial sector. The volatile political conflicts in Africa and a poor rule of law may limit the spill over effect of trade integration. Though, the empirical results give a positive effect of trade on co-movement, leaders of African economies should try to work much better on achieving democratic and independent institutions to speed up trade integration regionally in order to enjoy the full benefits of trade linkages relating to growth in the financial markets.

Financial liberalization is also found to have positive and significant impact on foreign exchange co-movement. This impact is highly significant in all models. The results are in line with those of Walti (2008). The impact might be driven by both a signalling effect and a direct bilateral investment. The strong effect of financial liberalization on foreign exchange co-movement in the region is in order since almost all African countries borrow funds from the same sources such as the International Monetary Fund, the World Bank and Bond markets in Europe and the Americas respectively as well as from foreign own financial institutions in the region. Milesi-Ferretti and Tille (2010) see the extent of financial market liberalization and integration with global markets to make foreign exchange volatility increase significantly thereby attesting to correlational contagion.

In spite of empirical evidence supporting theoretical underpinnings of financial integration, African economies are not likely to enjoy the growth promoting benefits of financial integration because of the sluggish macroeconomic management policy in the region. High interest and inflation rates are typical macroeconomic problems facing the region. The benefit of financial globalisation in Africa can be fruitful if authorities in Africa can rigorously ensure a sound and resilient macroeconomic environment. The crucial thing to be done is to move towards full capital account openness and practice proper economic governance in order to enjoy growth promoting benefits of financial liberalisation. A holistic risk management approach is important because a financial integration has the potential to alter the nature, frequency and impact on risks faced by the economic system.

Other macroeconomic variables like interest rate differential, inflation differential and financial development differential are also found to relate to foreign exchange co-movement. Interest rate and financial development differentials are negative and highly significant in the fixed effect model, but in the dynamic model, financial development differential is insignificant when it turns positive. Thus, a high interest rate differential among economies decrease the foreign exchange co-movement (Li, 2011). The negative financial development differential implies low financial market integration which has the capacity to reduce foreign exchange co-movement. Coefficients of the inflation differential are consistently changing signs, but it is statistically not different from zero. The inconsistency may come from

colinearity between interest rate and inflation rate. The collinearity between interest rate and inflation rate comes from the Fischer effect that when interest rates are high it attracts hot money and low interest rates eject hot money. The negative differentials imply a low degree of financial market integration and competition in Africa which can likely reduce correlation in specified markets like foreign exchange market.

The effects of regional differences in interest rate, inflation rate and financial development especially interest rate differential is found to be negative and significant for African co-movements. This result implies that a one percent increase in interest rate differential reduces exchange rate co-movement by 0.05%. This result is consistent with extant literature that provides mixed results as to the relationship between stock return volatility and interest rate volatility (Kasman et al., 2011). It is possible African financial firms are mitigating the effects of interest rate volatility by taking offsetting positions in balance sheet activities.

There is the need to strengthen coordination among the Africa Regional Economic Cooperations (ARECs) to set convergence criteria to reduce differences in these variables to a bearable minimum since individual countries cannot overcome them alone. Therefore it is imperative on the part of African leaders to accelerate integration by taking a second look at the strategy of addressing obstacles that hinder integration and renew commitments to build strong institutions such as the Africa Union and the ARECs with more resources to lead the development quest.

5.5 Conclusions and Policy Implication

This study contributes to literature by providing empirical evidence on foreign exchange market co-movement. In particular, using quarterly dynamic panel data sets from 1990–2013, the study analyses potential variables underlying foreign exchange co-movements in Africa. This study provides the following key results: first, the results demonstrate that on the average, exchange rates co-movements were externally determined through trade. Second, capital account openness has positive effect on co-movement. Third, the result also shows that the low level of financial development and other regional macroeconomic variables negatively affects exchange rate co-movement. The results thus provide support to the existing findings that exchange rate

co-movement for economies that depends predominantly on trade is high and such economies are more risky and less resilient to crisis (Wen-Chung and Hsiu, 2008; Walti, 2011)

On the policy implication, the fact that the level of economic integration affects foreign exchange co-movement, and currency stability, to some extent, should be of high relevance to policy makers, traders, investors and regulatory authorities. For policy makers and regulatory authorities, the paper has the following policy recommendations: first, as high degree of trade openness does not only increase the foreign exchange co-movement, but it also increases currency risk exposure; the regulatory authority should introduce guidelines that enable investors to have a considerable level of currency stability. Considerable trade openness is needed, because too much or too little trade openness will negatively affect investors and traders behaviour and stability (Milesi-Ferretti and Tille, 2010).

Second, global shock such as changes in world interest rate has been found to play a significant role in enhancing exchange rate co-movement and accelerating currency risk. So does capital account openness. Thus regulatory initiative that allows investors to withhold a significant portion of their capital in foreign currency for risk management purposes must be pursued. For investors, mechanisms should be put in place to attract investors as well as adopting strategies that will reduce risk exposure of investors. With regard to market participants, if traders are aware that capital account openness and average world interest rate produces currency co-movement, the sizeable amount of their investment should be directed towards forward contract or options with considerable stability.

Finally, the findings of this paper show that trade openness in itself is not detrimental to co-movement, but the level and the application of it could affect exchange rate risk exposure. Therefore, regulatory, supervisory and monetary authorities should co-ordinate to put in place a comprehensive regulatory framework that would allow investors and traders to have a substantial amount of currency stability that is robust and consistent with any coordination policy. A single regulatory authority like currency union would be prudent decision in the region.

CHAPTER 6

CONCLUSIONS AND POLICY IMPLICATIONS

6.1 Introduction

This chapter pulls the threads together by recapitulating the objectives of the study and its salient findings. Specifically, I summarize the main work and the salient findings. This will be followed by the discussion of the theoretical and practical implications of the findings. Finally, I discuss the limitations of the study and map out some directions for future research.

6.2 Summary

To understand the role of the exchange rate is to accept the arguable fact that it is the most important single price in international macroeconomics and financial investments. The Bank for International Settlement (2007) Triennial Survey suggests that the total daily turnover in the global exchange rate market is $3.2 trillion. International finance research on exchange rate volatility has been intensified after the adoption of the flexible exchange rate regime. Since then foreign exchange volatility has been rising (Billio and Pelizzon, 2000; Bordo and Murshid, 2001; Forbes and Rigobon, 2002). Post-Bretton Woods exchange rate volatility appears to be empirically difficult to predict future exchange rate values (Killian and Taylor, 2003). The majority of recent studies on exchange rate volatility have been specifically on highly traded currencies of developed economies with researches on emerging and poor markets in Africa almost non-existent (Nikkinem et al., 2011).

Although research interest in why and how economies are related to each other continues to accumulate (Todd, 2008; Joyce, 2013), our understanding of the mechanisms through which economic turmoil in one region transmits to another is

still unclear. The motivations for this study were to examine the volatility transmission in African foreign exchange market and the global world through financial interdependence. Second was to examine the pattern of factors explaining exchange rate co-movement. While foreign exchange market researchers agree that foreign exchange rate volatility affects all economic agents there is difficulty in predicting exchange rate volatility. Not much research has considered the exchange rate volatility issues across African markets (Killian and Taylar, 2003; Adjao and Igbekoya, 2013; Ofa et al., 2013). Secondly, there are calls to use a dynamic level approach to simultaneously examine the impact of volatility spill over transmission and the factors that underlie this relationship of comovement analysis (Adom et al., 2012; Diebold and Yildmaz, 2012; Klobner and Wagner, 2012**).** Thirdly, despite the critical role of Africa's economies to the global world, (WTO, 2010; Mpofu**,** 2013; Ofa et al., 2013)**,** most contagion research studies (Sauer and Bohara, 2001; Devereux and Lane, 2003; Servsen, 2003) have neglected Africa to study Europe, the Americas and Asia.

The study employed multivariate GARCH unrestricted full BEKK version to estimate the volatility transmission. The BEKK GARCH and panel data approach were used to analyse the determinants of co-movement. Monthly data of GHC/USD, Ksh/USD, ZAR/USD and GBP/USD for volatility transmission analyses and quarterly data for the influence of exchange rate co-movement were used. The choice of these countries is influenced by their relative much similarity in liberalized markets, flexible exchange rate regimes, high depreciation of the currencies and competition in the same exports markets. The thesis set out to find answers to the questions of volatility spill over within, from and to the Africa region and also to identify factors of exchange rate co-movement changes.

6.3 Summary of Findings

6.3.1 Mean Spill Over Findings

In general, the findings supported the hypotheses tested. First, there is a statistically significant mean spill over coefficient at a 5% level. Regionally, some level of mean transmission is found from the South Africa rand to the Ghana cedi

only. Significant mean transmission is identified mainly from the global world to Africa and bidirectionally between South Africa and the global world.

6.3.2 Exchange Rate Co-movement

Shock from the global world positively influenced exchange rate co-movement through the average world interest rate. Second, the influence of financial linkages on the exchange rate co-movement is exerted through capital account liberalisation. Similarly, from the demand side, trade linkage appeared to have a positive effect on co-movement. Of equal importance is that a high interest rate differential impacts negatively on exchange rate co-movement.

6.3.3 Volatility Spill Over Findings

Exchange rate volatility transmission results show that there are high positive correlations between currencies and significant interaction between second moments of these currencies. In addition, the impacts of shocks between these currencies are not significant from Kenya to either Ghana or South Africa. First, global variance of exchange rates significantly influence volatility spill over in Africa supporting the high weight of the cross-over effect of developed economies on emerging markets. Second, a regional volatility spill over has not got a significant influence on foreign exchange markets especially from Kenya to others. Evidence of a volatility spill over is from South Africa to Ghana only. BEKK estimation reveals a significant correlation between and among exchange rate returns.

6.4 Theoretical Implications

First, our findings show a partial relationship between the Africa region's foreign exchange markets. Prior, volatility transmission research testing volatility clustering shows that foreign exchange markets in Africa exhibit volatility clustering and high realised volatility than developed economies (Devereux and Lane, 2003; Sauer and Bohara, 2003; Osei-Assibey, 2010). However, these findings reveal that historical trade linkages between economies are of great importance to volatility spill over. In other words, an economy engaging in competitive advantage trading with

other partners is an essential element linking the economies through broad level market contagion. Regional results also mean that, a shift contagion is not significant in Africa. The implications of the findings for the volatility spill over based contagion, is that in testing the contagion, the focus should particularly be on the competitive advantage of a trade relationship. This is because in order to minimize the unprecedented negative effects of economic integration shocks, economies must first develop an appropriate cushion to effectively absorb unexpected shocks from trade partners and prospective ones. (Imbs, 2004; Cowan et al., 2007**).**

Theoretically, our findings counter balanced limitations on a number of methodological strengths. First, researchers (Diebold and Yildmaz, 2012; Klobner and Wagner, 2012) have called for a dynamic approach to understanding the exchange rate volatility transmission. We propose and test hypotheses drawn from financial interdependence mechanisms through contagion which enhances volatility transmission and co-movement outcomes in the foreign exchange markets with a dynamic GARCH model of unrestricted full BEKK. Second, data collected across countries helped to reduce common method bias suggesting that our findings are substantive in nature. Third, unlike previous research studies, we simultaneously examined mechanisms through which volatility transmission and co-movement influence Africa's foreign exchange markets at both regional and global levels.

6.5 Practical Implications

The findings from this study reveal that key linkages from global, trade and financial markets are of particular importance for exchange rate fluctuations and co-movement in these countries. In other words, changes in economic fundamentals of advanced economies affect exchange rates in the Africa region. In addition, exchange rate volatility probably results in a higher degree of spill over transmission among these currencies. The structural change comes from the adoption of more a flexible exchange rates regime that follows the forces of demand and supply in the foreign exchange market. This has enhanced high volatility and transmission of shocks to each other. One particular reason for the astronomical increase in exchange rate volatility is probably the global financial integration. The international capital markets

integration has worsened and created volatile economic environments, characterized by more severe economic shocks including crises, persistence, and contagion (Subbarao, 2010; Joyce, 2013; McGettigan et. al., 2013).

It is imperative on the part of policy makers to understand factors affecting the exchange rates to deviate from its fundamental values and how shocks affect exchange rates as well as these being transmitted to other currencies in this region for them to achieve a financial stability. Thus policy makers can manage exchange rate volatility and fluctuations if they are able to control key macroeconomic factors and provide the right environmental incentives for the markets to develop their ability to cope with changing circumstances both domestically and globally.

To the poor emerging small open economies, like Africa markets, government policies should be able to moderate exchange rate fluctuations. This is because recent econometric studies of the East Asian crisis show that exchange rate policy frameworks may help to reduce the negative spill over effects from high volatility in international financial market (Ito and Orii, 2009; C. Sussangkarn, 2010; Whalen, 2012). A strong institutional set up in terms of a credible monetary policy committee ensuring price stability, fiscal discipline on part of government and transparency are a vital anchore on which financial stability dwells. The problem of policy makers lies not in the choice of the exchange rate system, but in the effective institutions and policies underpinning it (Ito and Orii, 2009; C. Sussangkarn, 2010). The disruptive effect of exchange rate volatility on exports and investment makes most of monetary policy makers prioritise exchange rate stability. (Aghion et al., 2009; Ndambendia and Alhayky, 2011; Mpofu, 2013).

The study of Mpofu (2013), suggests that the size of the volatility effect is reduced if there is greater stability of the exchange rate and that this requires that monetary policy makers pay attention to the exchange rate stability. The onus now on monetary policy makers is the selection of the appropriate intervention policy like export promotion to exchange rate changes in order to take care of the exchange rate. However, policy makers should be aware about cost-benefit implications of interventions as well. In our view, good strategic policies should provide the right incentives for the markets to develop their ability to cope with changing circumstances or various shocks in the private sector.

Currently, from the third generation model of a currency crisis, it is widely accepted that the government and the private sectors are instrumental in the foreign exchange markets stability by providing appropriate financial regulations, monitoring and supervision of industries in the sector (Cerra and Saxena, 2008; Joyce and Nabar, 2009). Successful experience of exchange rate stability in some countries like Singapore and Mexico in recent times demonstrate the rigor of government policies in exchange rate stability (Chan-Lau, 2007; Larrian, 2013).

With the unstoppable global financial integration heating up, it is opined that policy makers should provide an overall set of policies and instruments in the exchange rate interventions. Proper monitoring and supervision of Africa's developing financial system is the important factor to enlarge the economy's resistance to shocks. A sound and efficient financial system with well developed liquid capital markets contribute to efficient intermediation of financial flows. This helps reduce the serious exchange rate fluctuations. Opening the domestic banking sector to greater competition also stimulates them to improve their performances in the long run but deregulation should be gradual and done with great decorum.

Empirical evidence indicates a high correlation between exchange rates and other key macroeconomic volatility in the face of worldwide external shocks. It is important for policy makers to pursue closer monitoring as well as develop early warning systems about the emergence of risks and vulnerabilities in the financial system in order to minimize cost of crisis lost.

Finally, episodes of financial crisis in Asia and Latin America have shown that the majority of the crises are precipitated by poor macroeconomic fundamentals. Hence resilient and sound macroeconomic policies seem to encourage a macroeconomic balance with lower exposure to speculative currency attacks, and volatility in capital flows together may soften the negative spill over effects from high volatility in international financial market. Sound macroeconomic policies also yield price stability in the system resulting in better exchange rate stability. Moreover, in the African emerging economies, a general understanding of the perspective that leads to the contagion and its characteristics should be paramount to the region's policy makers. Africa policy makers should establish a macroeconomic variables study center to advise governments on likely remedial action before catastrophes occur.

Since volatile exchange rate impacts negatively on investors activities including consumption and decision making on portfolio and risk management, safety mechanism relevant to risk mitigation should be promoted. Private sector participants like local men and women in trading can use derivatives to mitigate risk from exchange rate volatility in the underlying asset by hedging like future contract, forward contract and option to reduce some of the risk underlying exchange rate volatility.

6.6 Future Exchange Rate Policy

The general overall results of the thesis support the idea that the fundamental based contagion is the major source of exchange rate co-movement. Furthermore, exchange rates of the selected countries have high positive correlations and significant interaction between second moments of these currencies in the region. The high volatility transmission is facilitated by many factors. First, these countries have a strong economic relationship. Each of them is a major trading partner of others including export, import, foreign direct investment and portfolio investment. Some firms such as telecommunications and banks from South Africa are actively doing business in Ghana and in other African countries. A change in one currency is thus simultaneously transmitted to other currencies. The implication of the above is that increased exchange rate volatility is entirely the result of more unanticipated shocks to mismatch currencies and maturities originating from an increasingly external volatile economic environment (Ito and Orii, 2009).

Moreover, belief based causes of contagion coming from investors' sentimental market psychology and attitude factors are also vital sources of exchange rate volatility transmission. Even though there are no apparent common fundamentals between currencies, speculations based on fads, and panics instinct these might be rapidly transmitted as well. Thus, it is found that it is probably possible that most of these currencies move together through belief **(**Schmukler, 2004). Due to the positive correlations and significant interaction between second moments of these currencies in the region, in the near future, African leaders should base much on building economic agents confidence especially investors by ensuring sound and good news

about the macroeconomic environment and the free flow of valuable macroeconomic news.

Finally, the canonical trade theories on optimal currency areas explain that the degree of factor mobility, trade integration, and the similarity of regional production patterns should be the relevant criteria to assess the readiness to form a monetary union. The ultimate goal to establish monetary union by 2020 in ECOWAS countries (Magbagbeola, 2013) to eliminate exchange rate volatility and its negative effect on trade flows across the region to enhance economic competitiveness as a whole is necessary. This means that a closer move towards economic integration and financial sectors linkages is not only necessary but also a sufficient condition. Furthermore, the financial and monetary integrations of the Africa Union in four thematic pillars: capital market development; capital account liberalization; liberalization of financial services and currency cooperation will also lead to a closer relationship between them. The central bank of the Union should conduct an exchange rate policy on a regional basis in order to cope with any shocks and fluctuations instead of using individual country policies. The future exchange rate policy direction of each country should seek to stimulate regional cooperation to enhance a strong financial system throughout the region to make the dream of ECOWAS viable.

6.7 Limitations and Directions for Future Research

Similar to other researches, we encountered many limitations and difficulties in writing this thesis. Some of the limitations and related possible further future researches on volatility transmission in Africa are outlined for a solution to the problem of foreign exchange uncertainty.

First, given the use of cross country markets data for volatility transmission and sources of co-movement, and investors' sentiment effect cannot be inferred. Although this study used the fundamental-based view of contagion and the relationships and these are consistent with the theoretical predictions, it is possible that the effects of the psychological attitude of investors may take a toll on volatility transmission and causes of co-movement in foreign exchange markets. Future research that employs a non fundamental belief based contagion research to examines

the relationship between volatility spill over and sources of co-movement in foreign exchange market may provide important outcomes and unique insights into not only the nature of the volatility spill-over and co-movement in foreign exchange markets but also provide necessary ideas on contagion to help realise the benefits of financial stability.

In spite of investigating volatility spill over and co-movement, the analysis of institutional and the micro structural dynamics of exchange rate behaviour as information becomes much available in the region would be of crucial value to African economies. The premise of institutional economics is to explain economic trends through the influence of institutions on markets. Mention can be made of institutions such as political, legal, educational, and social systems determine and characterize its economy. A thorough understanding of all the legal, political, and cultural institutions that encompass African society, as well as their role in the foreign exchange market, is needed to explain and ensure occurrences of financial stability. The philosophy behind is that people interact with institutions on a daily basis, and institutional environments shape the way people perceive economic relations. For example, market transactions cannot be made without canonical procedures such as the drawing of contracts, the inspection of products. Given this concern, future research may include institutional and the micro structural dynamics of exchange rate behaviour, particularly in Africa.

Third, although we proposed and tested hypotheses drawn from a contagion model, the equity market context of the study (i.e. using data from a sample of Africa's stocks markets) may have influenced the findings which may limit the generalisability of the findings to economic sectors. However, this limitation is mitigated by the fact that much of volatility spill over research has been conducted in the emerging economies of Asia (Evans and Lyon, 2002; Mazier et al., 2008) that share relevant socio cultural values such as high power distance and relationship orientation with countries in the sub-Saharan Africa. We would encourage future studies to consider the stock and foreign exchange markets to replicate and extend our findings in Africa.

Lastly, using intra-day data to estimate daily exchange rate volatility could be essential for future research since researchers have been urged to focus on the need for high frequency financial data for volatility spillover (Osei-Assibey, 2010; Klobner and Wagner, 2012). The essence of the argument is that high frequency data like intra-day data are more valuable and more revealing than others (Corsetti et al., 2002; Enders et al., 2011). Consequently, more research should focus on using intra-day data to estimate exchange rate volatility transmission. Since, volatility transmission represents a significant opportunity for the extant contagion literature; such studies have the potential to provide the theoretical and empirical foundation for a deeper understanding of the financial interdependence processes linking volatility spill over.

6.8 Conclusions

Furthermore, the findings suggest a cross-level influence of South Africa currency outcomes in Ghana and a possible shift contagion to the global world. Changes in global economic activities affect African economic behavioural outcomes. Foreign exchange co-movements are influenced by trade integration, financial and world interest rates. Theoretically the findings counter balance limitations on the methodological level through a dynamic approach to volatility transmission and foreign exchange markets are prone to the global market than intra regional volatility. A simultaneous examination of Africa and the global world makes the findings substantive in nature.

This highlights the need to include a global economic activities perspective in any contagion intervention strategy in Africa as a way of enhancing financial stability in the region in ways that allow the individual economies to achieve desirable economic performance outcomes. In conclusion, this study contributes to the current stand of the financial interdependence between economies in Africa and the global world. It highlights the critical role of contagion as an important link in the relationship between economies and therefore provides a more complete test of contagion in the foreign exchange market.

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