Exchange Rate Volatility and Foreign Direct Investment- A Panel Data Analysis

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Abstract

This thesis examines both the long run and the short run impact of Exchange Rate Volatility on Foreign Direct Investment using an unbalanced panel data from three Sub-Saharan African countries of Kenya, Uganda and Tanzania. This is accomplished by generating Exchange Rate Volatility figures by the GARCH(1,1) methodology. The control variables included in this study include GDP, GDP growth, Economic Openness and Exchange rate. In order to capture the impact of economic openness on exchange rate volatility and thus foreign direct investment, different econometric specifications are adopted. The unbalanced panel data used in the analysis ranges for different time period for the specific countries considered in the panel.
Abbreviations

ADF- Augmented Dickey Fuller
AGOA- African Growth and Opportunity Act
ARCH-Auto Regressive Conditional Heteroskedasticity
ECM- Error Correction Model
FDI- Foreign Direct Investment
GARCH- Generalized Auto Regressive Conditional Heteroskedasticity
IMF- International Monetary Fund
LM- Langrange Multiplier
MNC- Multinational Corporations
REER- Real Effective Exchange Rate
TNC- Transitional Corporations
UNCTAD- United Nations Commission for Trade and Development
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Chapter one

Introduction

Foreign direct investment has been (and is) regarded as one of the growth engines for countries with capital deficiency and technological backwardness. An investor looking for a possible market, resource-rich country, cheap labor and growth prospect and a continent in frantic need of capital inflow, technological spill over, job creation and employment is regarded as a good economic match. However, this relationship has never been smooth. It has been characterized as a hard relationship difficult to realize at times. A foreign direct investment owner looking for a stable country for the sake of long term investment, a predictable macroeconomic environment and a strong institutional framework for contract enforcement were at the table, put forward by the foreign investor to commit to long term investment. Africa, on the other hand, with unpredictable outbreak of wars adding to the instability of the investment environment, shaky macroeconomic policy and frame work was in need of the investment as a growth engine (IMF, 2002).

In addition to these factors, the collapse of the Breton woods agreement introduced another worrisome factor to investors- a fluctuating and unpredictable exchange rate valuation due to market forces named - volatility. This episode has also transferred itself to Africa. Exchange rate often interfered in by both the market factors (equating supply and demand of domestic and foreign currency) and a fragile macroeconomic frame work trying to control the exchange rate market has resulted in exchange rate volatility and uncertainty- another new risk factor to foreign investors in the continent.

Although the risk factors related to peace and insecurity, lack of strong contractual enforcement frame work and others had been recognized and acted up on by both the foreign investor and the governments in these countries, the impact of exchange rate volatility on the foreign direct investment had been less recognized on the side of the macroeconomic analysts in these developing countries despite it serving as one of the push factors on the side of investors when considering investment in the continent. The role exchange rate volatility plays in foreign direct investment attraction/repulsion in developed countries had been widely recognized and
documented in earlier empirical economic literature (Cushman 1985, Dixit, Aizenman 1992). However, it remains less explored in countries across the African continent. This paper aims to contribute to the gap in empirical investigation of the matter.

The aim of this paper is to examine the impact of exchange rate volatility on foreign direct investment by controlling other possible factors impacting foreign direct investment inflow for the panel of the three east African countries in the sample. We have selected these countries because they fall in a similar economic structure and the dominance of the agricultural sector in attracting foreign direct investment. In studying the relationship between exchange rate volatility and foreign direct investment we include openness of an economy, GDP growth rate, market size and exchange rate values as control variables with in a panel unit root and panel co-integration with structural break in order to unravel the long run and short run relationship among the variables. The main motivation for this study is the focus given to attracting foreign direct investment in both the receiving countries and the international financial institutions like the IMF and World Bank. Hence, the ensuing focus of this research is on the determinants of foreign direct investment.

In order to investigate the relationship we generate the values for exchange rate volatility using the GARCH methodology, ascertain the integral property of the data series by applying the LM Pesaran and Shin (IPS, 2003) panel unit root test. In subsequent step, we test for panel co-integration relationship accounting for structural change in the panel data. To this end we begin by investigating the bi-variate co-integration between individual variables and proceeding to the Pedroni (2004) and Westerlund (2007) co-integration tests. In the final step we estimate the long run and short run elasticity of the impact exchange rate volatility, exchange rate, GDP , GDP growth and trade openness cause. The long run relationship is estimated by the fixed effects model while the ECM is used to generate the short run elasticity.

Briefly summarizing the results we find that the variables GDP, GDP growth, real exchange rate, real exchange rate volatility and market openness are integrated of order one and are panel co-integrated. Both the panel long run and short run elasticity reveal that real exchange rate volatility has a statistically significant negative effect while the rest of the control variables have a plausible positive impact in attracting foreign direct investment.

The paper is organized as follows. Chapter one covers the introduction. Chapter two provides a detailed review of literature on FDI, exchange rate regimes and their interaction. Chapter three mainly focuses on the analysis, ranging from a detailed coverage of the sample chosen for analysis, the theoretical frame work, and econometric background to the model specification and econometric analysis of the data. Chapter four presents the conclusion and indicates areas of future research in this regard.
Chapter two

*Foreign direct investment and its determinants*

FDI is an investment made to acquire a lasting interest in an enterprise operating outside the economy of the investor. The terms control and controlling interest are the key terms that distinguish FDI from portfolio investment where owners will not have a lasting control. Though there is no consensus as to what constitutes a lasting control IMF (2000) defines a controlling interest to constitute 10% of share holding.

Although, FDI is characterized by the controlling feature exercised by the investors, it can be divided into different parts from different perspectives. For the purpose of the research, I will revise classifications from the perspective of the receiving country.

FDI can be classified as (i) import substituting FDI which implies the production of previously imported good and subsequent reduction of an import of the investment receiving country. (ii) Export increasing FDI on the other hand is motivated by the search for new inputs, raw materials and intermediate products to the investing country. The other rather unpopular form of FDI is the government initiated FDI in which the government allows foreign investors to invest in the domestic market aiming at closing the balance of payment deficit.

The importance of and growing interest in FDI inflows has led to the emergence of varied theoretical explanations for its emergence. These theoretical literature try to provide a theoretical foundation to explain why FDI has evolved and why some countries are able to attract more investment while the others are not.

The classical theories of FDI relate the emergence of FDI to the return an investment enjoys in a foreign market. This theory based on the popular assumption of perfect market and risk neutrality in undertaking investment abroad considers, capital flows from countries with lower rate of return to countries with higher rate of return.

Later, the portfolio diversification hypothesis relaxes and adds one more variable to the list of factors leading to the emergence of FDI, the risk neutrality. By implication, FDI emerged not only due to the differential return enjoyed in differential countries but also due to the level of risk inherent in some investment and there by the compensation provided for that level of risk. as a
result the choice among alternative projects is not only judged by the rate of return but also by
the level of risk. Due to risk aversion, an interest rate differential will not induce capital inflow in
one direction until the differential disappears via arbitrage. There is also a tradeoff between ex
ante return and risk. (Tobin 1958, Markowitz 1959)

The market size hypothesis states that the amount of FDI inflow into an economy is dependent
on the size of the economy. As the size of the economy grows to a level which guarantees the
exploitation of economies of scale, the country is targeted for FDI. The increase in the size of the
economy brings about capital inflow due to the need for import substitution.

Hymer (1960) adds a new perspective into the study of MNC’s. A firm establishing a subsidiary
in another country faces many difficulties in which the difference in culture, the legal system,
language and other inter country variations are the major ones. However, if the firm once
engages overcoming these difficulties, it must have an advantage in firm specific qualities related
to well known brand name, patent protected technology, managerial skill, economies of scale or
others. These intangible assets are not saleable and as a result FDI emerges as a channel of
transferring these firm specific advantages to foreign subsidiaries.

But the other possible question that arises is “why is that these firms specific qualities are not
transferable in a way of franchising, exportation or licensing?”.

Kindelberg (1969) maintains that firms will prefer FDI to exports if they operate at minimum
costs at home in which case an additional production for export would move them into a rising
cost category.

The internalization hypothesis explains why firms fail to use exporting or licensing. This
principle states that FDI emerges from the motive to replace market transaction by internal
transaction. If a foreign country does not possess location specific advantages, a firm internalizes
the home market and exploits the foreign market by exporting. On the other hand, if a foreign
country possesses possession specific advantages the firm prefers internalization of the foreign
market (the factor market in this case). This theory explains that it is not the firm specific
advantage that leads to FDI but the fact that the advantage is an external one and can only be
gained through internalizing the market. (Chen K.Y, 1983)
This theory addresses some types of FDI inflows into some countries. Japanese firms, as indicated by (Chen K.Y) are one form example for these types of investment. They tend to transfer labor intensive technologies to developing countries as these countries have a comparative advantage with respect to labor endowment. But the theory also fails to explains the American type of FDI inflows to developing countries that is usually capital intensive where as the comparative advantage of the capital receiving countries does not include capital.

Another interesting explanation of FDI comes from the location specific hypothesis. This theory develops from the understanding that FDI emanates because there are non transferable location specific advantages. One can be related to a low production cost in one location, take a lower wage rate in one part of a country or the availability of some inputs, or factors related to favorable government policy. Thus the relative wage in one part of a country relative to the wage in the other country is an important determinant of FDI inflow. This theory can be traced back to Mundell(1957). That is why countries like India attract labor intensive production (for example foot wear and textiles) from high wage countries. That is also why Mexico is the preferred destination for MNC’s in North America to Canada. (Moosa, 2002).

The theory developed by Dunning (1977, 1979, and 1988) combines the micro economic and macroeconomic perspectives to develop the so called OLI diagram. According to Dunning, The growth of MNC’s is the result of simultaneous combination of three sets of advantages relative to other firms (Dunning, 1977):

- First, ownership specific advantages which are mainly intangible knowledge based assets, such as superior technology, monopoly power, better resource availability and usage, etc.
- Second, internalization advantages implying that FDI occurs only if the ownership specific advantages can profitably be internalized. This is made possible when FDI enables the firm to avoid risks and uncertainties that stem from exporting and/or licensing.
- Third, location specific factors of the home and host country.
Developed by Vernon (1966), Product life cycle Hypothesis, traces the source of FDI to a product life cycle. Products go through different life cycle: Initiation, exponential growth, slowdown and decline.

In early stages of a product life cycle a firm serves a domestic market and as the production expands and the product reaches to maturity, the firm resorts to export to foreign markets. As this product develops and competition begins the firm resorts to FDI. Finally, the product ceases to be the sole ownership of the innovating firm and the firm faces firm competition. Finally, the firm moves in to a developing economy in search of cost advantage.

This prediction is consistent with the pattern of dynamic changes observed for many products. For example, personal computers were first developed by US firms (such as IBM and Apple computers) and exported to foreign markets. When personal computers were standardized USA became an importer from producers based in Japan, Korea and Taiwan (Moosa, 2002).

The oligopolistic Reactions hypothesis considers FDI as a result of competition holding between major players of the market. A move by one firm to engage in foreign investment might be taken as a threatening move by the other firm against its market share and thus considers to move into the market to maintain its status quo. The first firm moving for FDI might either be attracted by government policy, its R&D effort.

Knickerbocker (1973) considers these competitive reaction between firms as an oligopolistic reaction. Oligopolistic reaction for FDI increases with the concentration and decreases with the diversity of the product. Horizontal investments will be made if there is product differentiation and Vertical investments will be made if there is no product differentiation.

Each of the underlying theories has a share in factors determining FDI across countries. However, none of the theories addresses the full image of FDI determinants. Thus many scholars have tried to incorporate additional variables that are thought to influence FDI inflow across countries such as the market size, economic stability of the host country, the growth rate of the domestic economy, the political stability and other political and geographic factors.


**Literature review- Empirical**

Research related to FDI and its link to different economic phenomena had been prominent. Generally, we can divide these literature addressing FDI into two categories. One part of the literature focuses on the impact of FDI on different macro economic variables; like productivity (Cheryl Long et al, 2007), Economic Growth (Motaleb et al, 2007) and the other part addressing, with special emphasis, issues addressing issues related to factors determining FDI inflow.

The importance attached to attracting foreign direct investment and thereby the resulting economic growth has made the issue a center of focus in the economic literature. Carmen Fillat Castejón et al (2005) using a panel data sample of 36 OECD, Asian and Eastern European countries with a special emphasis on causality and cross country heterogeneity found that the impact of FDI on economic development -in terms of output growth as well as efficiency and productivity gains- to be strong despite its difference across countries and stages of development. Moreover, it has been found out that the contribution of FDI to output growth is stronger in emerging economies than the developed countries.

Laura Alfro (2003) in examining FDI and its impact on economic growth using a panel data suggests that FDI exerts an ambiguous effect in different sectors of an economy contributing positively in economies with better developed financial markets. Investment in manufacturing sector has a positive role, while it exhibits a negative role in agriculture, and no effect in the service sector and this shows, emphasizes Laura, the difference in spillover effects across sectors and the tendency of FDI to target the manufacturing sector due to the bureaucratic costs and increased potential for corruption of differentiated schemes.

The other side of FDI research with a special focus on FDI and its determinants reveals that plenty have been researched with a special emphasis on Exchange rate volatility despite, Africa being less explored. Relatively, research linking FDI and exchange rate volatility had been a new topic that evolved after the collapse of the Bretton Woods agreement.

During the last decades, exchange rate volatility had not only affected the profitability of firms but had also been a decisive factor in determining where to invest for foreign firms. Relatively,
the research in the area of exchange rate volatility and FDI has evolved during the post 1980s era. We can generally divide these literature in two major lines.

**A. The Cushman (1985) Line**

One pioneer research analyzing foreign direct investment and exchange rate uncertainty was the work of Cushman (1985). Cushman (1985), to the surprise of many in the field, found a positive relationship between the flow of investment and the degree of exchange rate volatility using a time series data of the US. His research piece was also hardly questionable due to the innovative methodological approach used and the use of percentage change in foreign direct investment flow rather than foreign direct investment flows in levels was successful in avoiding the prominent econometric problem of non-stationarity by the time and therefore spurious regression. Explaining the reason behind the result, he argued that “exchange rate uncertainty introduces risk to the operation of the multinational company. However, the firm reacts by reducing exports while at the same time it increases foreign capital input and production thereby leading to a subsequent increase in FDI”.

Another oft-cited article in finding a positive relationship between exchange rate uncertainty and foreign direct investment is the work of Goldberg and Kolstad (1995). Goldberg and Kolstad analyzed bilateral investment flows among USA, Canada, UK and Japan for the years 1978-1991. Accordingly, if investors are risk averse and production factors are assumed to be fixed, there will be no statistical relationship between foreign direct investment and exchange rate uncertainty. Moreover, Goldberg and Kolstad stress that by engaging in FDI firms buy an option to shift production in response to exchange rate risk and since this option is positively correlated to exchange rate variability, more volatility would actually lead to more FDI.

Aizenmann (2001) finds that vertical FDI is inhabited rather than encouraged while horizontal FDI which is the most prevalent form of investment in developed countries might be encouraged due to the opportunity it creates to shift production to countries with more advantageous exchange rate. On the side of the vertical investment, exchange rate volatility discourages FDI because there is a chance that the investment can be carried out later at a favorable exchange rate. It is also argued that the option value of waiting is increased with increasing uncertainty and thus investors would choose to wait for a favorable condition rather than lose money in a volatile exchange rate market.
A late empirical support for the positive relationship between exchange rate volatility and foreign direct investment also came in Choudhry (2005). The Vector Auto Regressive analysis conducted using bilateral FDI flows across USA, Canada, The UK and Japan show that the specific country effects to exchange rate shock is varied and sometimes positive with its effect being manifested with lags.

B. The Pindyck Line (1995)

More recent and widespread literature on foreign direct investment and exchange rate volatility have also found a disincentive for investment located in exchange rate shocks. Serven (2003) based on a cross country sample data and a GARCH measure of exchange rate uncertainty finds a highly significant and negative relationship between exchange rate volatility and FDI beyond some level showing the ability and willingness of investors to take risk to some level with a pertinent compensation. However, the impact has not been similar across countries and had been found to be more pronounced with a higher level of volatility and high degree of economic openness which aggravates the impact of the exchange rate shock. A weaker financial system is also found to aggravate the effect. Conversely, Serven (2003) have also found a positive relationship in countries with a strong financial system and less degree of economic openness. This result is also consistent with a similar finding by David Fercuri and Sara Borelli (2008) who analyzed the same question with a focus on 35 EMU neighboring countries. The result was more relevant to countries in transition economies which highlights the importance of financial system development for the impact exchange rate uncertainty has on foreign investment. An earlier paper with an explicit econometric modeling by Aizenman (1992) has also shown this negative relationship between FDI and exchange rate volatility.

Jeannert (2007) with a critical approach to the positive relationship between exchange rate uncertainty and FDI accounts for the relationship using a relatively larger set of database containing 35 OECD economies and finds a significant relationship between the variables. However, the result turned out to be a decrease over time, which subsequently disappears. One of the noticeable differences by Jeanneret (2007) was the use of the GMM dynamic modeling to avoid a possible endogeniety problem of the exchange rate volatility and therefore the bias that might result by overlooking it.
Yet another approach is the one adopted by Erik Chege (2009). Most of the research analyzing exchange rate uncertainty and foreign direct investment use data related to exchange rate volatility of domestic versus foreign currency. However, Erik (2009) considers the impact of three major world currencies on foreign investment controlling for the other possible determinants of FDI across 26 emerging market economies. He takes exchange rate volatility as a manifestation of the global economy’s trouble and finds its impact to be more important than the fluctuation between the exchange rate between domestic and foreign currency.

When coming to Africa, the focus of literature on FDI and its determinants happens to ignore exchange rate volatility as one of its determinants. While researchers focus on other variables with possible impact on foreign direct investment, investigation of exchange rate volatility happens to be tied to its impact on international trade (Lira Sekantsi, 2007, Claudio Raddatz, 2008, K.R. Todani and T.V. Munyama, 2005). It is surprising to note the significant difference in the amount of literature analyzing exchange rate volatility and FDI when looking at those examining the relationship between exchange rate volatility and trade. The impact of exchange rate volatility on FDI, however, remains less explored. The common variables under consideration to have a possible impact on FDI considered by most researchers are Market size (S. Ibi Ajayi 2006), degree of economic openness, (Ibi Ajayi 2006, Aseidu 2003), political instability (Aseidu, 2003), infrastructure development (Aseidu 2001, 2003) and inflation (Aseidu, 2001 and Ibi Ajayi 2006).

Asiedu (2003) using a panel data of 23 countries for a period in between 1984 and 2000 analyzes the impact of natural resource endowment, macroeconomic instability, FDI regulatory framework, corruption, effectiveness of the legal system and political instability on FDI flows. The paper mainly focuses on the relationship between natural resources endowment and foreign direct investment and finds out that natural resource endowment, large markets, good infrastructure and an efficient legal framework promote FDI, while macroeconomic instability, corruption, political instability and investment restrictions deter investment flows. In the research exchange rate was contained as one of the variables making up the macroeconomic instability though, it did not consider exchange rate volatility.
The scanty papers investigating the relationship between FDI and exchange rate volatility include an investigation by Bleaney and D. Greenaway (2000) who tried to examine the impact of exchange rate volatility in 14 export dependant African countries and found its impact on investment to be strong and negative despite the focus being total investment and not FDI.

Osinubi et al (2009) in their investigation of the possibility of the role of exchange rate volatility on FDI inflow found a positive relationship between exchange rate and FDI while emphasizing that exchange rate volatility should not be among the factors adding to the inherent risk of investing in Nigeria. However, this result is completely different from a research conducted in the same year with an inclusion of South Africa. Erik Kehinde (2009) using observations for the years 1975-2005 analyzed the two way causality relationship from FDI to exchange rate volatility and exchange rate volatility to FDI in in the two African nations. Despite this relationship being strong in Nigeria and weaker in South Africa he emphasizes the significant role FDI plays in financing growth and development in SSA and the increasingly negative role played by exchange rate volatility in the sub Saharan African nation of Nigeria.

The literature focusing on Exchange rate volatility and FDI have has a serious short coming in using unconditional volatility such as moving standard deviation which is the basis for criticism of researches conducted on the topic in the 1990s rather than the more recent and pertinent conditionally adjusted measure of volatility.

One of the attempts to overcome such a shortcoming was adopted by Erik Kehinde (2009). He uses a conditionally adjusted volatility measure of GARCH despite its focus being on two countries which still falls short of enabling the conclusion to a 35 year old mythical result of both positive and negative implication of exchange rate volatility on FDI. Another methodological measure used by Chowdury (2008) relies on examining the possible impact of typical shocks on system variables by computing Variance decompositions (VDCs) and to show the direction of the impact on FDI it uses Impulse Response Function. The VDCs show that there is a significant impact on FDI ranging from 17% to 11% in each of the 4 countries under investigation: USA, Canada, Japan, and UK.
The brief review of the above empirical literature reveals the existence of significant relationship between exchange rate volatility and foreign direct investment in both the developed and the developing world. In the case of Africa, however, very few inquiries happen to have been undertaken and even these investigations were either limited to a single country case and focus on overall investment, or on only exchange rate level, with the impact of the volatility ignored, without even considering the methodological gap that existed.

**Exchange rate Regimes**

Exchange rate volatility and the extent of it observed in financial markets is largely dependent on the type of exchange rate regime a country adopts. Thus, it has been found relevant to revise exchange rate regimes. In literature, the theoretical classification of exchange rates is different from the one practically observed. Thus, I would revise both the theoretical exchange rate arrangement and the practical classification.

The criteria to classify exchange rate regimes are not only based on whether an exchange rate is flexible or not but also includes the extent of exchange rate convertibility (availability of exchange rate). However, since the focus of this research is on the relationship between exchange rate volatility and FDI I find it necessary to revise exchange rate regime classification based on the extent of exchange rate flexibility.

**Theoretical classification**

Theoretically, a country can be classified in between the two extremes of exchange rate arrangements. One in which an exchange rate extremely fluctuates and the contrary in which an exchange rate is hard to be adjusted or is fixed. In between these two systems lie the other exchange rate systems.

Let us consider these arrangements

- Perfectly flexible exchange rates

This is an exchange rate regime in which an exchange rate figure is allowed to cleanly float. In its product market equivalent, exchange rate is determined by the intersection of the demand and supply of a foreign currency. Often at times, this is interpreted as absence of a monetary policy
intervention. However, there is an intervention to influence other macro economic variables despite the target of intrusion not being a predetermined exchange rate figure.

- **Perfectly fixed exchange rates**

Is an exchange rate regime in which the monetary authorities set a target exchange rate and this arrangement results in an exchange rate figure below the equilibrium exchange rate resulting in an over valuation of the domestic currency. The overvaluation of the exchange rate results in an exchange rate shortage. This will open the room for the central banks to intervene in the market with a pretext of fulfilling the excess demand by selling from the international reserve. This exchange rate market sets an exchange rate target and works to the realization of that through monetary policy intervention.

- **Fixed but adjustable exchange rates**

This exchange rate regime is similar to the perfectly fixed exchange rate system in that it has a fixed target exchange rate. However, this target is also adjustable based on the balance of payment disequilibrium. Devaluation and revaluation of the exchange rate at times of deviation from the targeted exchange rate results in the exchange rate sought for.

- **Fixed but flexible with in a band**

This is an exchange rate regime which allows the currency to fluctuate. However, it is also fixed that the exchange rate is not allowed to move outside the allowed band. When the demand for a currency rises, the exchange rate is allowed to rise to an extent and when the demand falls, it is allowed to fall but within the limits allowed. When an exchange rate goes outside the allowed limits, the central bank intervenes to bring the exchange rate within the limits.

- **Flexible exchange rates with market intervention**

This exchange rate classification is the most popular. It includes managed floating, independent floating and target zones. The difference in these exchange rate systems is the extent of fluctuation and frequency of intervention observed. Exchange rate is more flexible in independent floating than a managed floating regime. But in both cases, the purpose of intervention is aimed at reducing exchange rate volatility and the impact of speculation in the exchange rate market.
• Dual exchange rate system
This exchange rate regime is characterized by the presence of two parallel exchange rate arrangements. A fixed exchange rate is introduced for commercial transactions of import and export while a flexible exchange rate is introduced to trade in financial assets. This exchange rate regime is adopted when the need to insulate commercial transactions from extreme exchange rate fluctuations and speculation arises.

Practical classification
There exists hardly a match between theoretical exchange rate classifications and the practical ones observed. Thus, I would try to revise the most common practical exchange rate classifications based on IMF (2008) classification.

• Exchange arrangements with no separate legal tender
Commonly known as dollarization, this is an exchange rate regime in which a country loses its monetary sovereignty and adopts a foreign currency as its legal tender with a loss of its currency. This type of exchange rate is common in monetary unions like the EU in which the countries adopted the Euro as a domestic currency.

• Currency board arrangements
A currency board arrangement is a fixed exchange rate regime in which a country sets a target exchange rate of the domestic currency with respect to the foreign currency. A restriction is also set on the issuing authority to fulfill its legal obligation. This arrangement is very strict in that it leaves no or little room for monetary control and intervention as domestic currency printed is fully backed by foreign currency reserve thus leaving no room for the traditional role of the central bank as a lender of last resort and control.

• Conventional fixed peg arrangements
This is a cooperative arrangement of exchange rate regime in which a country pegs its currency vis-a-vis another currency or a basket of currencies formed from the currencies of major trading and investment partners. There is a commitment to maintain the exchange rate around some level
of deviation, usually ±1%. To maintain this fixed parity, the monetary authorities intervene directly or indirectly.

- Pegged exchange rates within horizontal bands

This exchange rate regime is similar to conventional fixed peg arrangement in that it uses a single currency or a composition of currencies as a reference to set exchange rate. However, the value of the currency is maintained within certain margins of fluctuation more than ±1 % around the fixed rate.

- Crawling pegs

This is a currency peg. However, the rate is adjusted in response to selected indicators like inflation of other trading and investment partners or the difference between the targeted inflation and expectation of the partners. Exchange rate with crawling band is also similar to this system except that a fluctuation of ±1 % is possible for the exchange rate around the target set.

- Managed floating with no predetermined path for the exchange rate

In these types of exchange rate regimes, the monetary authorities do interfere in the exchange rate market both directly and indirectly. However, the intervention is based on a judgment of the balance of payment position, international reserves or other monetary policy variables. As the name suggests there is no predetermined path for the exchange rate. The exchange rate is determined based on the macro economic variables mentioned above. The countries considered in this study are categorized under this system.

- Independently floating

This is the rare exchange rate regime observed in developed financial markets with no official foreign exchange market intervention on the side of the monetary authorities. The exchange rate is freely market determined and is characterized by a high level of fluctuation.
**Exchange rate and foreign direct investment**

Exchange rate movements have a predefined implication on FDI. Depreciation or the decline in the relative value of a domestic currency relative to another foreign currency will have an advantage of lowering labor and production cost in the destination market thereby creating a location advantage for foreign investors as Vernon (1966) calls it. This attracts investors to take the advantage of relatively cheap production cost and the minimal production cost leads to an increase in the return to foreign investors.

However this assertion is based on the assumption that this exchange rate depreciation is not anticipated beforehand. If the exchange rate movement is anticipated a priori, it may diminish the importance of the relative wage advantage as the anticipated exchange rate depreciation may be reflected in the higher investment financing cost due to the equalization of risk adjusted expected rate of return across countries as per the interest parity condition. On the other hand, this exchange rate movement should also not be coupled with a change in relative production cost for a depreciation of a domestic currency to have the stipulated effect.

However, the interest parity argument is often refuted empirically and there seems to be a consensus towards the positive implications of exchange rate depreciation. In addition, the depreciation of a currency raises the relative wealth of an investing multinational firm in a domestic market by lowering the investment cost of capital which is launched in domestic currency and increasing wealth which is held in terms of the appreciated foreign currency.

Although the empirical findings leading to the positive impact of exchange rate depreciation on FDI appear to have settled, there emerges a wide ranging dispute over the possible impact of Exchange rate volatility on FDI. To show this we will rely on different theoretical models developed through time.
Exchange rate volatility and foreign direct investment

Theoretical models of investment under uncertainty
Issues related to investment under uncertainty are not new lines of economics. Lucas (1967) noted that uncertainty reduces investment in the presence of adjustment costs. Lucas’ assertion of Lucas (1967) is not the only theoretical framework explaining the negative relationship between exchange rate volatility and foreign direct investment. Investment will also have this same negative impact due to the irreversible nature of investment (Nickel, 1974). The recent development of models is based on the Dixit and Pindyck options to wait (Dixit and Pindyk 1994) approach and we will revise theoretical models related to it in order to show the pertinent relationship between the variables of interest to be considered in this research.

The options to wait approach
Under certainty a firm follows a Net Present Value rule and is willing to invest as long as the difference between the present value and the sunk cost of investment is positive. Under certainty, however, computing the net present value of the investment is not as easy as the case under certainty. Thus, the NPV criteria shall be modified. The question itself modifies from increasing the NPV to at what point is it optimal to pay a sunk cost I in return for an investment project whose value \( V \), is given to follow a geometric Brownian motion. (Dixit and Pindyck 1993 )

\[
dX = \partial X dt + \delta X dz
\]
(1)

Where \( X \) represents the present value of the investment, \( \partial \) is the mean of \( dX \) and \( \delta \) is the standard deviation (uncertainty) of \( dX \). \( dz \) is the random increment of a Weiner process such that:

Equation 1 affirms that the present value of the investment is known but the future value is log normally distributed with a variance that grows linearly through time. In this case the investment decision the firm faces is similar to a call option. The pay off from investment at time \( t \) is \( X_t - I \).

In a classical call option formula, the optimization problem would be represented by:

\[
F(X) = \max E[(X_t - I)e^{-rt}]
\]
(2)

Where \( X_t \) is the value of the investment at an indefinite future point in time \( T \), at which the investment decision is made; \( p \) is the discount rate and \( I \) is the present value of the cost of the investment. The firm attains its optimal point when the expected return from delaying the investment is equal to the opportunity cost of the delay. Hence, delaying the investment decision and holding the option is equivalent to holding an asset which pays no dividend at the present time but appreciates as time passes.
The fundamental condition for optimality of a call option is at a point where the discounted normal rate of return \( \rho F \) an investor would require to hold an option is equal to the expected total return per unit of time holding the option \( \frac{E(dF)}{dt} \). Thus,

\[
\rho F = \frac{E(dF)}{dt} \tag{3}
\]

Differentiating the above condition using Ito’s lemma condition to obtain the optimal level of a continuous stochastic process we can express \( dF \) as:

\[
dF = F'(X)dX + \frac{1}{2} F''(X)(dX)^2 \tag{4}
\]

Using equation 1 and taking the expected signs we obtain,

\[
E(dF) = \alpha X F'(X) dt + \frac{1}{2} \delta^2 + X^2 F''(X) dt \tag{5}
\]

The expression \( dZ \) from equation 1 disappears as the expectation is 0. Substituting equation 5 into 3 we obtain the Bellman equation. In this case where \( dX \) is a stochastic process:

\[
\rho F = \alpha X F'(X) + \frac{1}{2} \delta^2 + X^2 F''(X) \tag{6}
\]

As long as the firm is following the optimal investment rule, the value of the option to wait must satisfy the second order condition specified in equation (6). In addition, the following condition must also be satisfied.

\[
F(0) = 0 \tag{7}
\]

\[
F(X^*) = X^* - 1 \tag{7}
\]

\[
F(X^*) = 1 \tag{7}
\]

Condition 1 states that if the value of the investment falls to zero then the value of the option to invest is zero. The second condition describes the net pay off at the value of \( X \) at which it is optimal to invest. The third is the “smooth-pasting” condition which requires the function \( F(.) \) to be continuous and smooth around the optima investment timing point.

The solution to (6) subject to (7) is:

\[
F(X) = a X^b \tag{8}
\]

Where, \( a = \frac{X^* - 1}{X^*} \) is a consonant and

\[
b = \frac{1}{2} - \frac{\alpha}{\delta^2} + \sqrt{\left(\frac{\alpha}{\delta^2} - \frac{1}{2}\right)^2 + 2 \frac{\rho}{\delta^2}} \tag{9}
\]
substituting (8) into the second and third part of the boundary conditions given in (7) we obtain the result that the optimal investment timing pay off is given by:

\[ X^* = \frac{b}{b-1} \quad \text{Where} \quad (10) \]

Equation 10 defines the wedge between the pay offs needed to induce the investor to exercise the option to invest, \( X^* \) and the present value of the cost of investment, I. Given that \( b > 1 \), the wedge is always above 1 and hence \( X^* > 1 \).

Thus in the presence of investment irreversibility and uncertainty, the net present value principle in which an investor equates an option to invest, \( X^* \) and sunk cost of investment I is no longer applicable. The firm will only engage in investment if the expected value of the investment is above some threshold level. However, the level of this threshold level increases with the level of uncertainty the firm faces, with the discount rate \( \rho \) and with the drift term in the evolution of the expected rate of return \( \alpha \).

**Exchange rate volatility, irreversibility in investment**

Building on a theoretical model inspired by Dixit(1989) and developing on the model proposed by Jean Louis (2007) show that exchange rate volatility has a tendency to suppress investment inflow into a country even in a case where investors behave with no risk aversion. One of the important extensions related to this is the importance of market structures on the extent of option-to-wait strategies.

Consider a firm contemplating to engage into an irreversible investment with a sunk cost set to unity for the sake of simplicity. Due to the exchange rate volatility, the return to this investment is uncertain. Thus, for each period under which the investment is made, the return includes a certain component \( \eta \) and an uncertain and stochastic element which depends on the exchange rate behavior. This uncertain element is distributed between \( -s_\epsilon \) and \( +s_\epsilon \). The exchange rate follows a random walk; hence its expected value in period \( t \) is equal to its observed value in \( (t-1) \).

The unconditional expected investment return if the investment is undertaken in period 0 is the function of the unitary cost (-1) incurred in period one and the uncertain returns in period one and two \( r1, r2; \)

\[ E_0(I_0) = -1 + r_1 + r_2 \quad (1) \]

If the firm waits to invest until period one, then the decision to invest in period two will be based on the exchange rate observed in period 1 and the investment is undertaken only if the exchange rate realized in period 1 is above some threshold level denoted by \( b \). Since the investment is expected to provide a return in period 2 this exchange rate level that realizes the investment period 1 should provide a return at least which compensates the establishment cost.
\[-1 + r_2 + b = 1 \text{ or } b = 1 - r_2 \quad (2)\]

In addition the decision to invest is based on the value of an investment strategy the firm is following. The expected value of the chosen strategy is based on the probability it will be worthwhile to invest and the probability it is worthless to invest in that strategy.

\[E_0(l_1) = 0[\delta_1 + b]/2\delta_1 + [(\delta_1 - b)/2\delta_1][-1 + r_2 + (\delta_1 + b)/2] \quad (3)\]

Given condition 2 equation 3 can be re written as

\[E_0 = (\delta_1 - b)[-b + (\delta_1 + b)/2\delta_1] \quad (4)\]

Collecting similar terms and simplifying:

\[E_0(l_1) = (\delta_1 - b)^2/4\delta_1 \quad (5)\]

This result in (5) implies that that as an uncertainty increases the value of the waiting strategy increases and the firm avoids by waiting to invest than getting into investment at an unfavorable exchange rate. The waiting implies that the firm foregoes the expected return during period one but keeps the option not to invest which is more fruit full if exchange rate turns to be unfavorable.

The difference between the two expected returns is equal to:

\[E(l_1) - E_0(l_0) = (\delta_1 - b)^2/4\delta_1 - (r_1 - b) \quad (6)\]

In case an expected return in period 1 \(r_1\) increases the option to wait will be less preferred. A special case is where \(b = 0\) (the non stochastic component of the second period return equals to the set up cost; in this case the unconditional expectation of the overall return to the project (if undertaken immediately) is equal to \(r_1\)). In this case equation 6 turns into:

\[E(l_1) - E_0 = \frac{\delta_1}{4} - r_1 \quad (7)\]

The standard deviation of the exchange rate (or rather of the impact of the exchange rate on the return) would have to be four times as large as the non-stochastic part of the return in period one to make waiting the better choice. Dixit (1989) found a strongly non-linear relationship between the incentive to wait and uncertainty. The linearity of expression (7) implies that the model does not replicate the conjuncture that small variations in uncertainty can have large a large on impact the incentive to postpone investment decisions.

The implication of the model is that, only the current, short term uncertainty has an impact on the decision of the investor to wait or not. Even a short lasting exchange rate volatility has a negative impact on investment.
**Theoretical frame work**

Here I will try to build on the theoretical model explained in the previous section in line with Ogawa and Suzuki (2000). One of the pillars of the model is to show that the influence of exchange rate uncertainty depends on the external exposure of the firm which trades on foreign market. Hence the openness of the firm or the openness of the market the firm is operating in is the basis for the influx of exchange rate uncertainty on investment behavior. This model also emphasizes the impact of market structures on investment.

In modeling the impact of exchange rate volatility on foreign direct investment we assume the firm produces for both a domestic and a foreign market. Supposedly, it assumed further that the firm has also already built production capacity to satisfy domestic demand and hierarchically the second focus is on building its strategy for production to the foreign market.

Price, $p$, is taken as exogenous and if the foreign demand for the product of the firm takes a CES form with an elasticity of substitution $\delta$ between domestic and foreign goods (Armington hypothesis), and if the market of domestic producers is small, the foreign demand for domestic exports can be written as:

$$D = A \cdot e^{\delta}$$

Where $A$ is a constant and $e$ is the nominal exchange rate which is i.i.d on the interval $[1 - s_1; 0 + s_1]$ and $\delta > 1$.

The firm is also assumed to operate for two investment periods. The production capacity choice or desired investment level $Q$ is set in period 1, and both the cost of investment and the production cost incurred are in domestic currency, $c$. In period 2, it sells the maximum quantity on the foreign market.

Thus the expected profit of the firm is given by

$$V = -cQ + pE(s)$$

Where $S = \min (D, Q)$

For a given level of production $Q$, there is $e_Q$ so that

Case 1: $e < e_Q, D < Q$. In this case, the profit of the firm is

$$\pi_1 = pD - cQ$$

Case 2- for $e > e_Q, D > Q$ in which case the profit of the firm is

$$\pi_1 = (p - c)Q$$

For a given level of production $Q$, the expected profit of the firm is
\[ E(\pi) = p_1[pE_1(D) - cQ] + p_2[(p - c)Q] \]

\( p_1 \) and \( p_2 \) represent probabilities of case 1 and case 2.

When there is no risk aversion, the firm sets production quantity \( Q \) so as to maximize the expected profit. With \( D = Ae^\delta \) the production level set by the firm is such that

\[ Q \in [A(1 - s_1)^\delta, A(1 + s_1)^\delta] \]

If this condition is met, \( e_Q = (Q/A)^{1/\delta} \). Then,

\[ p_1 = \frac{(e_Q - (1 - s_1))}{2s_1} \text{ and } p_2 = 1 - p_1 \]

And

\[ E_1(D) = \frac{A}{\delta + 1} \frac{1}{(Q/A)^{1/\delta} - (1 - s_1)^{1/\delta}} \left[ \frac{Q}{A} \right]^{(\delta + 1)/\delta} - (1 - s_1)^{\delta + 1} \]

Once \( E(\pi(Q)) \) is known, the optimal production level of the firm can be determined:

\[ Q^* = A((1 + s_1) - \frac{S_1}{p})^\delta \]

This optimum level belongs to the definition domain \( [A(1 - s_1)^\delta; A(1 + s_1)^\delta] \) if \( p > c \) which is also the condition for \( E(\pi) > 0 \).

Due to the absence of risk aversion and trend in the evolution of the exchange rate the above formula given does not change if the marginal investment and production cost is paid in foreign currency (i.e. investment is considered as FDI).

### 2.2 Market structure modeling

As \( p < \frac{2c}{s_1} \), the production level set by the firm is a decreasing function of exchange rate volatility. Hence as long as we maintain a “normal” level of volatility and a reasonable level of gross margins exchange rate volatility has a negative impact on investment. Moreover, the sensitivity of firms’ level of production to exchange rate volatility depends on the ratio \( \frac{c}{p} \). It decreases with the ratio, the more important the mark up \( \frac{p}{c} \) the less important the negative influence of exchange rate volatility. Literally when a firm finds a strong cost advantage the potential benefit due to increased sales weights more than the risk imbedded in exchange rate volatility. This is the result of convex demand function of exchange rate and should be taken into account carefully: when a more dynamic strategic choice is involved, the reverse might hold true.
as a firm with a strong market power may feel able to afford to wait and decrease the risk before investing.

**Macro economic transformation of the model**

The model developed above is based on an individual firm and I have found transforming it to a macroeconomic model is essential as it will simplify the analysis in this research. According to the model presented above the impact of exchange rate uncertainty on investment depends on two crucial factors.

1. The exposure of the firm to international trade as the source of exchange rate price fluctuation is deduced to emanate from the fact that exchange rate prices are set in a foreign currency
2. The nature of competition the firm faces

**Chapter 3**

**The sample**

The sample taken in this research includes Kenya, Tanzania, and Uganda. The sample selection is highly influenced by the foreign direct attractiveness and the similarity of the exchange rate regimes adopted in the countries. According to IMF (April1, 2008) these countries have different exchange rate regime based on *de jure* (as stated in the law) classification. However, they are found to have a *de facto* (based on realized facts) managed floating exchange rate regime. These countries were also among the top 20 FDI receiving countries in the year 2010 laying another foundation for considering the countries in a sample analysis (IMF, 2009).

**Kenya**

Throughout the 1970s Kenya had been one of the prime candidates for TNCs in eastern and southern Africa with relatively better infrastructure, market growth and openness at a time when many other countries had closed regimes. In 1975 FDI inflow appeared to be $17million with a sequentially rising of it to $78million in 1980. Later, Kenya experienced fluctuations in terms of attracting FDI. The deterioration of economic performance coupled with growing corruption and mal-governance generated a low level of FDI in the 1980s which extends to date. For instance, the mean annual inflow of FDI into the country remained to be $60million in the 1970s falling to $30 million in between 1980-1990. However, FDI begun to rise in the beginning of the 21st
century especially with the licensing of mobile phone ventures for Kenyan-foreign investors pushing further the mean annual FDI inflow to $41 million in 2000-2008.

Kenya’s leadership in FDI in southern and eastern Africa was also reduced by the economic reforms in neighboring countries like Tanzania and Uganda and the subsequent appearance of South Africa as a giant economy in the economic scene. The rise of these countries eroded the choice of Kenya as the single English speaking country and a base for TNCs head quarters. In addition the share of FDI in over all GDP also remained to be low for years in Kenya.

Despite being the prime candidate for external investment, the reality in Kenya in terms of being conducive for foreign investment remained similar to the other countries in the continent. The share of FDI as a percentage of GDP also remained small in this country. In both the 1970s and 1980s the share of average FDI as a percentage of GDP remained less than .05% only rising to 0.77% in the 1990s and then falling back to 0.54% in 2000-2009.
The problems related to failure to attract a higher level of FDI in Kenya are also attributed to own experience factors. Among others, the most common reasons are the high level of corruption observed in the country. According to Transparency International 2005 report Kenya was the one of the most corrupt nation in the world and was ranked 144 out of 159. The short lived economic reform programs related to FDI, the deteriorating infrastructure quality and the rising of service costs in the country have also added to the low level of foreign investment in the country.

The striking fact behind the FDI trend in Kenya is that foreign direct investment is highly correlated to natural resources and it remains the most notably expanding sector of FDI in Kenya. Horticulture and floriculture due to favorable climate and tourism are the major attractions. Recently, the garment industry has also experienced a major surge due to the AGOA initiative enabling local producers to receive a preferential access in the US market.

Another interesting feature of FDI in Kenya is the source country. In addition to the revival of china in recent years the major sources of FDI to Kenya remained to be the US, the UK, Sweden and Germany.

**Tanzania**

FDI in Tanzania remained at a lower level in years following the independence and the slow phase of growth continued till the beginning of the 1990s. In the 1990s Tanzania made significant economic reforms to win the heart of investors. For instance, FDI rose from a mere $12 million in 1992 to $516millionl in 1999.

The government, in addition to the economic reforms, embarked on implementation of business environment strengthening for Tanzania in 2003 which helped in abolishing bureaucratic procedures hindering investment activities. Due to this coordinated effort Tanzania appears to be a better destination of FDI. The reputation of Tanzania in attracting FDI enabled it to be chosen as the 2\textsuperscript{nd} best FDI destination in Africa following South Africa in 2004 by UNCTAD.

The Foreign Direct Investment inflow into Tanzania has also continued to show a mixed pattern for the years after 2000. It significantly declined from $463.4 million in 2000 to $308.2 million
in 2003 and again jumped to $646.9 million in 2007. The increase in 2007 was mainly a gain from new investment in infrastructure particularly in transport and telecommunication. Tanzania was also not different from many other countries that have lost foreign direct investment due to the global financial crisis which led to the subsequent decline of FDI in the years after 2008.

The distribution of FDI among different sectors in the economy has remained to be consistent and diversified. On average 34% of the investment in 2005-2008 went to mining followed by manufacturing (20%), and trade in whole sale and retail activities (16%). The major sector in the economy, agriculture which contributes an average 27% of GDP and employs 80% of the population continued to attract the lowest level of FDI in Tanzania largely due to unfavorable infrastructural facility, restrictive land policy and inadequate lending facility.

The Investment source countries appear to be quite diversified across continents and economic blocks. However, only a small numbers of countries contributes the lions’ share of investment inflow. For example in 2008 about 53% of the investment came from Canada, the UK and South Africa.
Uganda

Immediately after independence Uganda had a favorable investment climate and was able to maintain the investment that continued from the English colonial period. However, the beginning of the brutal regime of Idi Amin in 1972 marked the death of private foreign ownership. Foreign owned firms were either given to Ugandan’s or nationalized to be managed by different ministries. With the subsequent unfavorable climate created for foreigners FDI was outlawed as some tight controls were imposed. Some of the requirements for foreign investors were unfavorable to investors and led to subsequent deterrence of FDI inflow. For instance, during this regime investors were required to be naturalized as Ugandans to do business in the country. In addition, the political instability, the problem of overvalued currency and inflationary pressures had also contributed to the low level of FDI inflow.

The legacy left by this regime took years to overcome. Despite a trial to improve the business environment by the newly elected regime in 1980, FDI remained at its infancy. In addition to the campaign to correct the bad image during the Amin regime, some macroeconomic measures were taken to resolve the bottleneck, including restoration of confidence in Ugandan shilling, elimination of price distortion and installment of discipline in the fiscal and monetary policies.
After 1986, in collaboration with the IMF and WB different measures were taken to reverse the trend in FDI in Uganda including massive privatization, foreign exchange and trade reforms, measures to reduce bureaucratic procedures for investment and establishment of an office responsible for investment, the Ugandan Investment Authority. The measures were effective and resulted in the rise in FDI from mean average inflow of $1.97ml in 1975-1985 to $33ml in 1985-1995.

The post 1985 era was also characterized by a massive privatization campaign, special treatment to foreign investors including tax exemptions on plant and machinery, tax holidays for five years and so on which resulted in an exponential growth of FDI reaching $800 million by 2006.

The source of FDI to Uganda remained the UK and Bermuda. On average in the years 1999-2002 21% of FDI to Uganda was sourced from these countries.

**Statement of the problem**

The major topics to be investigated in this research are the following:-

1. What is the impact of exchange rate volatility on foreign direct investment? Does exchange rate volatility count as a risk factor in attracting investment or would investors think exchange rate volatility means exchange rate appreciation in these countries and investors would be encouraged to invest in these countries?

2. What does the level of economic openness and thereby the related exposure to exchange rate shock mean for foreign direct investment. Would an openness of an economy intensify the impact exchange rate volatility has?

3. Is the impact of exchange rate volatility stronger in the short run or in the long run? What is the implication of this?

These are the three major questions investigated in this research.

**Data**

The data used in this thesis is gathered from three different sources: - The World Bank statistical database, the IMF International Financial Statistics and the National Banks of the respective countries, which had been the main source of the data. To cross check the genuineness of the data, a comparison of the figures from different annual reports had also been also been made. The panel considered in the research is unbalanced. The years selected for analysis for the respective countries varies and the time series used is also not perfectly similar across countries. The data for Kenya and Uganda spans a seventeen-year period from 1993 to 2009, whereas that for Tanzania covers 18 years 1993 to 2010. This results in a panel data of 52 years in total.
There have been some missing values of the data and a collection from other sources was also done resulting in the completeness of the data figures. The reason for the selection of these three countries was mainly the nature of exchange regimes in these countries, availability of the data and off course, out of concern of the researcher.

In looking for exchange rate volatility data, the yearly REER figure has been used and the data for volatility generated from the natural logarithmic figures of the REER. The real exchange rate figures were preferred to the nominal exchange rate figures to enable an absolute comparison possible.

**Econometric Background**

A. Volatility measures

Despite the voluminous research in the area of exchange rate uncertainty and its possible relationship to FDI there are different views as to the implications of it. One of the possible reasons behind such a difference is the kind of econometric methodology used to measure volatility as data on volatility cannot be collected from an observation. As far as theory is concerned, it does not suggest a well defined measure of volatility that can capture the historical volatility embedded in exchange rate movement through time.

Volatility measures with a higher prediction power have evolved through time with a better precision. The two common measure of volatility are the simple rolling standard deviation and the conditionally adjusted autoregressive heteroschedastic volatility measure. The standard deviation measures how the individual values in a series deviate from the mean value and the degree of dispersion from its mean is taken as a measure of volatility. However, this measure is inappropriate in measuring exchange rate volatility (Froot, K., and J. Stein, 1991) as it has the tendency to cluster volatility and its unrealistic assumption of normality on the distribution of the exchange rate.

For the purpose of this dissertation, the predictable risk as a result of exchange rate volatility is not of interest due to the strong belief that the predictable component of risk does not constitute an uncertainty factor calling for a better measurement of exchange rate volatility.

Rather, the generalized *ARCH* measure of exchange rate volatility introduced by Engle (1982) and later modified to include the lagged dependent variable in the conditional variance is used.
As set out by Bollersten(1986) a \( GARCH(p,q) \) can be re written as

\[
 u_t = \delta_t \varepsilon_t; \quad \delta_t^2 = \left( u_t^2 \Omega_{t-1} \right) = \alpha_0 + \sum_{i=1}^q \alpha_i u_{t-1}^2 + \sum_{j=1}^p \delta_j \delta_{t-1}^2
\]

The conditional variance can then be re written in short form as

\[
 \delta_t^2 = \alpha_0 + \alpha(L)u_t^2 + \delta(L)\delta_t^2
\]

Where \( \alpha(L) \) and \( \delta(L) \) are polynomials in the lag operator \( L \), neither of which includes a constant term.

By far, the most common and widely used form of GARCH in empirical studies ((Joseph Byrne (2005) Chowdurry(2005), Serven(1998,2003),) is the GARCH(1,1) specification which can be re written as

\[
 \delta_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \delta_{t-1}^2 \quad \text{Where } \varepsilon_t \text{ is the error term}
\]

The \( (p,q) \) in the GARCH specification refers to two different things. The \( p \) represents the number of autoregressive lag terms or the number of ARCH terms to be included in the equation while the \( q \) refers to the number of moving averages specified.

In the GARCH specification when the coefficients \( \alpha_1 + \alpha_2 < 0 \) the conditional variance tends to mean reverse to the unconditional expectation of \( \frac{\alpha_0}{1 - \alpha_1 - \alpha_2} \). If the sum of the coefficients in the GARCH equation \( \alpha_1 + \alpha_2 = 0 \) the forecasted conditional variance shows persistence over finite time horizon and tends to go to infinite variance for the unconditional distribution of the mean.

But when \( \alpha_1 + \alpha_2 \) approaches 1 it implies the persistence of shocks to conditional volatility is greater and the rate of decay of this effect tends to be slower (Chowdurry et al, 2005).

**B. Stationarity tests**

Panel unit root tests are based on a regression

\[
 \Delta y_{i,t} = \rho_{i,t-1} + \gamma_{i,t} z + \epsilon_{i,t} \quad (1)
\]

where \( i = 1 \ldots N \) the individuals in the series

\[
 t = 1 \ldots t \text{ the time period under consideration}
\]
\( y_{it} \) is the deterministic component
\( e_{it} \) is a stationary process

In panel data unit root testing it was assumed that the individual time series in the panel are independent and cross sectional demeaning of the series was taken as a viable solution. However, this solution dealt only with half of the problem where the error co-variances vary across the individual series.

In addition the test allows for serial correlation and heterogeneous error variances across group.

The remaining tests (Bai and Ng 2002, Moon and Perron 2003) are based on unit root tests on the deviations from the estimated factors. Instead of pooling the panels with heterogeneous characteristics, the IPS considers the mean ADF statistics computed for each cross section in the panel with the possibility that the error terms might be correlated with different pattern across cross sectional units.

i.e. \( e_{it} = \sum_{j=1}^{\rho_{1}} y_{ij} e_{i,t-j} + v_{it} \)

Thus, substituting the serially correlated error function in the ADF equation (1)

\[
\Delta y_{it} = \beta_{0i} + \rho_{t} y_{i,t-1} + \sum_{j=1}^{\rho_{1}} y_{ij} e_{i,t-j} + v_{it}
\]

The null hypothesis is

\[ H_{0}: \rho_{1} = 0, \text{ for all } i \]

Whereas the alternate hypothesis can be written as

\[ H_{1}: \left\{ \begin{array}{l}
\rho_{1} < 0 \text{ for all } i = 1 \ldots N \\
\rho_{i} = 0 \text{ for all } i = N_{1} \ldots N \text{ with } 0 < N_{1} \leq N
\end{array} \right. \]

After the estimation of the separate regressions, the average of the \( t \) statistics from the ADF regressions, \( t_{IT}(p_{i}) \)
\[ tNT = \sum_{i=1}^{N} t_{it}(p_i)/N \]

is adjusted to arrive at the desired test statistics.

**C. Pedroni Co-integration Tests**

Pedroni (1999) proposes a co-integration test appropriate for heterogeneous dynamics, endogenous regressors, and individual specific constants and trend coefficients across cross section. The starting point of the test is the estimation of the following equation.

\[
y_{it} = \alpha_i + \beta_{1i}x_{1i,t} + \beta_{2i}x_{2i,t} + \beta_{mi}x_{mi,t} + e_{it}, \quad t = 1 \ldots N, i = 1 \ldots N \tag{1}
\]

\( t \) Denotes the number of time periods where as \( n \) is the number of independent variable and \( \alpha_i \) and \( \beta_i \)s are the individual and trend coefficients which are cross section specific.

The intuition behind is taking the residuals from the regression (1) and checking if the residuals are integrated of order zero \( I(0) \) or integrated of order 1 \( I(1) \) process.

Next, the within dimension statistics of panel \( \rho \) and panel \( t \) statistics are computed by taking the first difference of the series and fitting the residuals from the regression.

\[
\Delta y_{it} = b_{1i}x_{1i,t} + b_{2i}\Delta x_{2i,t} + \cdots + b_{mi}\Delta x_{mi,t} + \pi_{i,t}
\]

From this regression, the variance of the error term \( \pi_{i,t} \) is estimated and denoted by \( \sigma_{\pi_{i,t}}^2 \).

Pedroni considers two sets of test statistics to establish the test- the panel and the group statistics. The residuals from the co-integration regressions are used to estimate the stats. The auxiliary regression \( e_{it} = \gamma_i e_{i,t} + u_{it} \) is run and the panel and group statistics are estimated.

The null hypothesis of the co-integration is the same for each statistics.

\( H_0: \gamma_i = 1 \) for \( i = 1 \ldots N \)

This hypothesis is tested against two other alternate hypotheses. For the homogenous between dimension statistics which is \( H_1: \gamma_1 < 1 \) for all \( i = 1 \ldots N \) and the heterogeneous alternate statistics which is the \( H_1: \gamma_1 < 1 \) for all \( i = 1 \ldots N \) referred to as the between dimension or the group statistics.
After the estimation of the statistics, the variance and mean are adjusted to follow a standard normal distribution

\[ \frac{(t - \mu + \sqrt{N})}{\sqrt{v}} \rightarrow N(0,1) \]

Where \( \mu \) and \( v \) are Monte Carlo generated adjustment terms.

**Model specification and choice of variables**

In this research a pool of cross section and time series had been considered to analyze the relationship between exchange rate volatility and foreign direct investment. The choice of variables has been influenced by earlier empirical studies as much as by data availability. The variables that are chosen as controls are GDP, GDP Growth, Openness and Exchange rate and thus the model to be estimated has the form

\[ FDI = f(RGDP, GDPGRWTH, OPENNESS, REER, REERVOL, Openness * REERVOL) \]

FDI is measured as the total inflow of foreign direct investment as a percentage of GDP. This measure of FDI is chosen to avoid the impact the size of a country’s economy might have on the level of FDI. It enables to single out an absolute impact of foreign direct investment. One of the other variables expected to influence investment inflow into these economies is the level of openness of the economies to trade and investment. The more open an economy is the more inflow of trade and investment is expected. One of the underlying assumptions for using the level of export and imports as an indicator of investment is the belief that trade openness implies investment openness. The more a country is open for trade the higher its potential for attracting investment potential. This measure is developed as a percentage of import and exports to GDP. REER is the real exchange rate figure and it has been found in levels. Based on suggestions from previous research, this figure has been converted into its ln form. The other most important variable in the analysis is the REERVOL which is the focus of the research. This is a GARCH (1, 1) generated process from the lnREER figure. The ln form of the REER was chosen to avoid a possible overstatement of the volatility measure (Jeanneret, 2007). An interaction term
Openness * REERVOL is also considered to test the combined impact of economic openness and exchange rate volatility.

The empirical form of the specification to be run has three specifications and will be run independently.

1. \[ FDI_{it} = \beta_0 + \beta_1 RGDP + \beta_2 GDPGRWTH + \beta_4 REER + \beta_5 REERVOL + e_{it} \]

2. \[ FDI_{it} = \beta_0 + \beta_1 RGDP + \beta_2 GDPGRWTH + \beta_3 OPENNESS + \beta_4 REER + \beta_5 REERVOL + e_{it} \]

3. \[ FDI_{it} = \beta_0 + \beta_1 RGDP + \beta_2 GDPGRWTH + \beta_3 OPENNESS + \beta_4 REER + \beta_5 REERVOL + openness \times REERVOL + e_{it} \]

The \( \beta_0 \) is the constant term and \( \beta_1 \) to \( \beta_4 \) are the coefficients to be estimated from the regression. \( i \) is the cross sectional data component representing the countries from which the data belongs while the \( t \) represents the years in which the figures were obtained.

A priori, the main focus of the study REERVOL is expected to have a negative coefficient in the analysis based on the theoretical model developed in previous section. GDP which, at times, is taken as an indication of the economic potential of a country is expected to have a positive relationship with foreign direct investment. The GDPGRWTH is expected to have a positive correlation with economic growth as a positive economic prospect of a country is one of the determinants in generating a higher foreign direct investment inflow as revealed in the literature review. The impact of REER is ambiguous based on previous researches.

According to the theoretical model presented above, the impact of exchange rate volatility on investment is expected to be less pronounced in the first model while the inclusion of openness as an additional control variable would imply the exposure of the country to a higher level of international exchange rate price volatility and thus a higher impact of exchange rate volatility on foreign direct investment inflow is expected. Furthermore, the inclusion of an interaction term to capture the combined effect of exchange rate volatility and trade openness would even imply a higher level of impact on foreign direct investment. This is expected to be revealed in the third model with a higher coefficient of the REERVOL and the inclusion of the interaction term.
Exchange rate volatility estimation

Before proceeding to the GARCH estimation, I will begin by testing if there is an observed ARCH effect in the time series of exchange rate for each of the sample countries. The test assumes the variance of the current error terms to be a function of the actual size of the previous time periods’ error terms. The normal procedure of testing for ARCH effects is to regress exchange rate on the \( q \) lags of its own, collect the square of the error terms and regress them on the lags of their own. The \( R^2 \) obtained from the second regression multiplied by the number of observation follows a chi square distribution.

If the test statistics is greater than the critical value from chi square distribution, the null hypothesis of no arch effects is rejected and we can continue on the GARCH estimation (Bollerslev, 1986).

Due to the heterogeneity observed in the real exchange rate figure of each country, I would proceed to the estimation of the GARCH(1,1) for individual countries in the sample. In addition, as pointed by Jeannert (2007) the use of the non-transformed real exchange rate figure to estimate volatility results in an over estimation of the volatility figures. So, in line with Jeannert (2007) I will generate the GARCH volatility for each of the countries from the natural logarithmic figures of the exchange rates. The necessary but not the sufficient condition for the presence of a GARCH effect in modeling exchange rate volatility is the presence of ARCH effects. As can be seen from table 2 LM statistics is highly significant for Kenya, Tanzania and Uganda making sure the existence of a significant ARCH effect in the exchange rate. This allows for the modeling of exchange rate figures as a GARCH\((p,1)\) process.

ARCH test: Kenya

\[
\begin{align*}
F \text{ statistics} & \quad 6.45645 \\
\text{Obs}e \ast R – squared & \quad 10.0884
\end{align*}
\]

\[
\begin{align*}
\text{probability} & \quad 0.0003 \\
\text{probability} & \quad 0.0000
\end{align*}
\]

ARCH test: Tanzania
As revealed in the test results there is an imminent \textit{ARCH} effect in the residuals thereby allowing the modeling of the exchange rate as a function of past volatility values.

The next step in the estimation procedure involves estimating the volatility for each of the countries under consideration. One of the similarities observed in all the sample countries is the extremely small value for $\alpha_1$ and $\beta_1$ and this is not surprising considering that the exchange rate figures are yearly figures on real exchange rate volatility.

\textbf{Stationarity test}

In a nutshell, it is natural to suspect non-stationarity in a time series data and mine is no different. As an important econometric procedure it is important to check the stationarity of the data and establish the integral level of the variables in both their uni-variate and panel data settings. Doing this saves from making an erroneous conclusion based on a spurious regression. I will proceed in two major steps. The first would be checking the stationarity property of each of the variables in each of the countries in their time series setting. The other includes testing the stationarity of the variables as a panel for the sample in general.

The actual procedure for testing a time series stationarity property has been widely demonstrated and it includes the lagged values of the independent variable to eliminate autocorrelation. I would not go deep into explaining the procedures involved. But the ADF test is used to establish
the stationarity of the variables under consideration. I began by selecting 4 lag lengths and used the AIC criteria to choose the optimal lag length in the augmented dickey fuller test. I estimated two ADF models: One with a trend and the other without a trend.

\[ \Delta Y_{t-1} = \alpha_0 + \gamma Y_{t-1} + \alpha_{2t} + \sum_{i=1}^{\rho} \beta_i \Delta Y_{t-1} + \epsilon_t \]

The variable \( \Delta Y_{t-1} \) represents the first difference of the variable under consideration with \( \rho \) lags and \( \epsilon_t \) is the variable that adjusts the errors of the autocorrelation. The null and the null hypothesis for the existence of unit root in variable \( Y_t \) is:

\[ H_0 : \delta_2 = 0 \quad H_e : \delta_2 < 0 \]

From these two results, I am not able to reject the null hypothesis of non-stationary time series in any of the series under consideration at any conventional significance level. However, the null hypothesis of non-stationary time series is rejected at any significance level when taking the first difference of the variables, confirming the variables being integrated of order one.

The fact that time series observations in a panel data are non-stationary does neither confirm nor reject the stationarity of it in panel data settings. This calls for further diagnosis and the next step involves checking the stationarity of the variables: FDI, exchange rate, exchange rate volatility, GDP, openness and GDP growth for the countries under consideration as a sample.

Similar to the univariate time series stationarity test, the estimation was done with the inclusion and exclusion of a trend variable. The results are reported in table 2.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Test statistics</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDI</td>
<td>1.1636</td>
<td>0.8777</td>
</tr>
<tr>
<td>REERVOL</td>
<td>2.7842</td>
<td>0.9973</td>
</tr>
<tr>
<td>RGDP</td>
<td>3.2805</td>
<td>0.9995</td>
</tr>
<tr>
<td>GDPgrowth</td>
<td>0.5736</td>
<td>0.7169</td>
</tr>
<tr>
<td>Openness</td>
<td>-3.1574</td>
<td>0.6258</td>
</tr>
<tr>
<td>REER</td>
<td>2.7846</td>
<td>0.8873</td>
</tr>
</tbody>
</table>
Table 2

The null hypothesis is that there is no observed unit root with an alternative hypothesis of the presence of unit roots. Apparently, there is no way of rejecting the null hypothesis of non stationarity of the variables for GDP, FDI, REERVOL, GDPgrowth, Openness and REER under consideration in a panel data setting, too with all the \( p \) values for the test being above 0.10 which is a conventional level to accept/reject the null hypothesis.

One of the odds in the stationary properties of the variables catches attention. GDP growth rate was a classical example of a stationary time series, it being the percentage value of the first order difference of GDP. However it exhibits the opposite. This might be explained by the fact that the individual time series considered in the panel data being small.

**Co-integration**

Having found that the variables are non stationary in levels there are two alternatives in proceeding to the analysis: (i) getting rid of non-stationarity and at the same time pertinent information that can show the short-run and long-run dynamics of the variables and see only the short run coefficient of the analysis; or (ii) using this non-stationarity in the panel data for statistical inference on the dynamics between short run and long run relationship between the variables. Differencing a variable to make it stationary leads to the loss of important information embedded in a non-stationary time series. “The analysis of short run dynamics is usually done by first eliminating the trend in the variables, usually by differencing. This procedure however, throws away potential valuable information about long run relationships about which economic theories have a lot to say” (Madala, 2001). To avoid such information over run in my analysis, I will examine if there exists a panel co-integration implying a long run unwavering relationship between the variables despite a short run deviation.

Most of the panel co-integration tests suggested are an extension of the Engle-Granger co-integration test (Engle Granger, 1997) and I can depend on the preliminary level of the test to see if there is such a relationship between the main variables in the analysis i.e. foreign direct investment and exchange rate volatility. First, let us see the bi-variate co-integration test results involving the variables of interest. The test involves running a simple bi-variate regression on the
dependent variable, generating the error terms and checking for the stationarity of the error terms from the spurious regression.

The equation estimated has got the following form

\[ FDI = 789.0508 - 4.841303 REERVOL \]

\[ t = (3.50) ( -2.41 ) \]

Since the individual panels are non stationary, there is a possibility that the regression is spurious (Gujarati, 2004) but performing the unit root test on the residuals obtained from this spurious regression reveals if there is any long run relationship between the variables.

The result obtained is as follows

\[ \Delta \hat{u} = -0.33779 \hat{u}_{t-1} \]

\[ t = -3.03 \]

The Engle granger test decision rule dictates that, if the t-value computed from the test is more negative than the critical tabulated values, the series can be said to be stationary. Since the computed value is much more negative that the critical tabulated value the error terms are I (0) process, hence stationary. The uni-variate co-integration test suggests a possible co-integration relationship between the panel variables - \( FDI \) and \( REERVOL \). The other possible way of testing for any possible long run co-integration relationship involves the Engle Granger co-integration test on the multivariate case.

Essentially, the suggested multivariate co-integration test approaches are similar to the univariate co-integration test approach and are based on testing the stationarity of the residuals from the spurious regression of the I(1) series.

The pedroni co-integration test

The most influential testing approaches in line with the Engle-granger co-integration test approach are the Pedroni (2004) and the Westerlund (2007) tests of co-integration. The Pedroni co-integration test allows for the endogeneity of the variables involved in the co-integration analysis and proposes various statistical calculations that allow testing the null hypothesis of no
co-integration against two other alternative hypotheses. The one that allows for a common autoregressive root (referred to as within dimension test or panel statistics) and one that permits heterogeneity of the autoregressive roots (referred to as between dimensions or group statistics test).

The test statistics is presented as follows

<table>
<thead>
<tr>
<th>The Pedroni Co-integration Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics</td>
</tr>
<tr>
<td>Panel v-statistics</td>
</tr>
<tr>
<td>Panel rho statistics</td>
</tr>
<tr>
<td>Panel PP- statistics</td>
</tr>
<tr>
<td>Panel ADF-statistics</td>
</tr>
<tr>
<td>Group rho statistics</td>
</tr>
<tr>
<td>Group pp statistics</td>
</tr>
<tr>
<td>Group ADF statistics</td>
</tr>
</tbody>
</table>

The Pedroni co-integration result gives an ambiguous result for the panel under study. While the panel rho and, group rho and panel V-statistics imply the acceptance of the null hypothesis, the remaining other statistics do not imply the acceptance of a co-integration relationship.

In cases of a conflicting Pedroni co-integration test statistics, the most reliable test statistics are the panel rho and the panel PP. (Maeso Fernandez et al 2006). However, the panel rho suggests the availability of long run relationship between the variables, while the panel PP suggests the absence of it which is conflicting in itself. Thus, I will try to figure this out by using the other most popular co-integration test in line with the granger causality test.

As mentioned above, one of the criteria for selecting the sample of these countries is the similarity in the exchange rate regimes adopted in these countries. Kenya, Uganda and Tanzania
are classified for exercising de facto managed floating exchange rate regimes (IMF, 2008). In these types of regimes and studies involving exchange rate regimes, it is natural to expect structural breaks as a result of the continued effort central banks exert to influence the value of their currency. Westerlund (2007) allows for such flexibility and a possible suggestion of when the structural breaks happen.

The Westerlund test results

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test statistics</td>
<td>1.0034</td>
<td>1.0104</td>
<td>1.0137</td>
</tr>
<tr>
<td>Break dates</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As we can see from the table, we are unable to reject the null hypothesis of co-integration as the test statistics are far lower than the critical value.

**Coefficient estimation and results**

The presence of a co-integration relationship in the above test assures that the full information in the panel data can be extracted. It can be used to both estimate the long run and short run relationship between exchange rate volatility and foreign direct investment.

Thus I will proceed with a step by step estimation of the three models presented above.

**Model 1 Result**

<table>
<thead>
<tr>
<th>variable</th>
<th>coefficients</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGDP</td>
<td>0.0487</td>
<td>2.85</td>
</tr>
<tr>
<td>RGDPGRWTH</td>
<td>1.3509</td>
<td>6.3492</td>
</tr>
<tr>
<td>REER</td>
<td>2.4156</td>
<td>2.9832</td>
</tr>
<tr>
<td>REEVOL</td>
<td>−0.0830</td>
<td>2.0134</td>
</tr>
</tbody>
</table>
\[ FDI = \beta_0 + \beta_1 \text{RGDP} + \beta_2 \text{RGDPGRWT} + \beta_4 \text{REER} + \beta_5 \text{REERVOL} + \varepsilon_{it} \]

Model 2

\[ FDI = \beta_0 + \beta_1 \text{RGDP} + \beta_2 \text{RGDPGRWT} + \beta_4 \text{REER} + \beta_5 \text{REERVOL} + \beta_6 \text{Openness} + \varepsilon_{it} \]

<table>
<thead>
<tr>
<th>variable</th>
<th>coefficients</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGDP</td>
<td>0.0546</td>
<td>2.23</td>
</tr>
<tr>
<td>RGDPGRWTH</td>
<td>2.0601</td>
<td>6.3492</td>
</tr>
<tr>
<td>REER</td>
<td>1.9821</td>
<td>2.9832</td>
</tr>
<tr>
<td>REERVOL</td>
<td>-0.4702</td>
<td>-2.4325</td>
</tr>
<tr>
<td>Openness</td>
<td>0.9823</td>
<td>-3.4531</td>
</tr>
<tr>
<td>Openness * REERVOL</td>
<td>0.6842</td>
<td>1.9534</td>
</tr>
</tbody>
</table>

Model 3

\[ FDI = \beta_0 + \beta_1 \text{RGDP} + \beta_2 \text{RGDPGRWT} + \beta_4 \text{REER} + \beta_5 \text{REERVOL} + \beta_6 \text{Openness} + \beta_7 \text{Openness} \times \text{REERVOL} + \varepsilon_{it} \]

<table>
<thead>
<tr>
<th>variable</th>
<th>coefficients</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGDP</td>
<td>0.0546</td>
<td>2.23</td>
</tr>
<tr>
<td>RGDPGRWTH</td>
<td>2.651</td>
<td>2.3492</td>
</tr>
<tr>
<td>REER</td>
<td>2.4243</td>
<td>2.9832</td>
</tr>
<tr>
<td>REERVOL</td>
<td>-0.4325</td>
<td>-2.4325</td>
</tr>
<tr>
<td>Openness</td>
<td>2.4243</td>
<td>-2.542</td>
</tr>
</tbody>
</table>
The result from the above three different econometric specifications gives a significant result of the control variables and a negative sign of exchange rate volatility. One of the merits of the three different specifications is to see the impact an economic openness has on foreign direct investment. In line with expectations, the impact of exchange rate volatility on foreign direct investment gets more pronounced with the inclusion of the openness variable. Furthermore the introduction of the openness and REERVOL interaction variable implies a strong impact of exchange rate volatility.

To see the short run dynamics between exchange rate volatility and FDI we use the Engle and Granger ECM. Engle and granger (1997) suggest an ECM which helps to capture the information whether past values of the variables affect the present value of the variables under study. On the other hand it captures the speed of adjustment of the short run deviation from the long run equilibrium. This can be captured by including the lag of the error term from the above regression as an additional term to the equation to be estimated in its difference form. Thus the ECM to be estimated looks like

$$FDI = \alpha_0 + \alpha_1 \Delta RGDP + \alpha_2 \Delta RGDPGRWTH + \alpha_3 \Delta REER + \alpha_4 \Delta REERVOL + \alpha_5 \Delta OPENNESS$$

$$+ ECM_{it}$$

<table>
<thead>
<tr>
<th>variable</th>
<th>coefficients</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\Delta RGDP)</td>
<td>0.00487</td>
<td>2.49</td>
</tr>
<tr>
<td>(\Delta OPENNESS)</td>
<td>-0.4568</td>
<td>0.49</td>
</tr>
<tr>
<td>(\Delta RGDPGRWTH)</td>
<td>0.4007</td>
<td>0.19</td>
</tr>
<tr>
<td>(\Delta REER)</td>
<td>0.6704</td>
<td>2.49</td>
</tr>
<tr>
<td>(\Delta REERVOL)</td>
<td>-0.1044</td>
<td>-2.57</td>
</tr>
<tr>
<td>(ECM)</td>
<td>-0.04</td>
<td>-2.43</td>
</tr>
</tbody>
</table>

Thus equation 2 above is modified to include both short run and long run dynamics of the relationship between foreign direct investment and the variables under consideration.
All the variables have the expected sign except the variable openness which is unexpected sign. However, it turns out to be insignificant. The positive relationship between RGDP and FDI on the one hand and real GDP growth and FDI on the other, imply the significant role market potential and prospects play in attracting foreign direct investment in developing countries and this is consistent with the theory. The relationship between foreign direct investment and real exchange rate is also consistent with a priori expectation. The main focus of this study is the exchange uncertainty that results from exchange rate volatility. The variable has got a negative relationship to foreign direct investment inflow and it is significant at 5%. As modeled in the theories the variable has got a negative relationship with FDI. Beyond number this has a higher implication.

The other variable of interest is the ECM variable which showed the speed of adjustment of the long run disequilibrium to the long run level of equilibrium. A 1% shock in the exchange rate volatility in these countries has a relatively weak reaction (-0.1044% reduction) on the level of FDI. However, this short run weak reaction adjusts at 0.04% yearly adjustment rate and in the long run establishes a strong level of reaction on the side of investors subsequently reaching -- 0.4702% reductions in FDI as per the third model. This trend is similar across the three different econometric specifications in all of them the long run trend being so strong. Conclusively, FDI and exchange rate have a strong relationship in the long run than the short run. This is in line with the theoretical framework considered as firms are tolerant to some level of risk with some level of compensation. However, a persistent shock to the exchange rate results in a negative reaction of foreign investors in the sample countries.

**Implication**

It is a meaningful result in that investors do not have confidence in volatility of exchange rate in these developing economies. In some studies related to China, it has been found that there is a positive relationship between exchange rate volatility and foreign direct investment for the fact that even though the exchange rate volatility counts as a risk factor, the exchange rate moves in their favor. However, in these developing countries there is no confidence in the exchange rate manipulations dictated by government policy as there is consensus among investors that any how the currency depreciates.
The long run coefficients and relationship between FDI and exchange rate volatility show a more strong relationship than the short run function. One of the possible reasons for this is that exchange rate volatility features have a signaling function to investors. In developing countries like those in Africa, more is dictated by policies than market forces and exchange rate is not different. It has an institutional component. Thus, the more volatile an exchange rate figures, the stronger the signal investors gather about the poor macroeconomic stability in these countries. Thus, the exchange rate volatility will be added to the stock of factors that attract least positive consideration by prospective investors who want to invest in the continent. On the other hand, Firms are tolerant to short run fluctuation and uncertainty in the market with a pertinent level of compensation. However, the when the exchange rate is more volatile and the market more uncertain, investors will find some better ways to mitigate the risk they are facing and thus taking a note on their long run moves.

When a shock to exchange rate occurs, investors add this information in their assessment of risk for investing in that particular country. Thus, a shock today will not invite immediate reaction tomorrow as in what is observed in financial markets in other continents. The investment in these countries is not characterized by portfolio investment and thus a shock introduced today will have more pronounced impact the day after tomorrow in the countries under consideration.

The result of the study in this paper is fairly comparable with the result of similar studies. Despite the literature in these areas being scarce and focused on a single country case, it resembles to what is found in the literature. Erik Kehinde (2009) finds similar result on the relationship between FDI and exchange rate volatility on a particular country case focus on South Africa and Nigeria. Despite the location of the samples considered by Erik (2009) and me in this dissertation the characteristics of the exchange rate volatility and the exchange rate regimes are totally different. In the two countries he analyzed, exchange rate regime is de facto floating in which market forces decide exchange rate figures and the countries are more prone to external exchange rate shocks. In Nigeria, there was a two way negative relationship between FDI and exchange rate volatility while there is no significant relationship between FDI and exchange rate volatility in South Africa.
Another paper by Anthony Kyereboah et.al (2008) explores the impact of exchange rate volatility on FDI in one of the sub Saharan’s developing economy. With the use of a GARCH (1,1) specification as a measure of exchange rate risk and a time series co-integration, they found out that a 1% increase in exchange rate volatility results in a 0.11% fall in foreign direct investment in the long run with a disequilibrium adjustment speed of 68.9% speed of adjustment.

Chapter 4

Conclusion
This paper has tried to analyze the impact exchange rate exerts on foreign direct investment in flow in selected African countries. The study, after controlling for possible foreign direct investment determinants has found a significant negative impact of exchange rate volatility on foreign direct investment.

In line with theoretical predictions, the impact of exchange rate uncertainties is more pronounced when a country is more open to trade and investment. This is confirmed by the fact that the impact exchange rate has on direct investment is more pronounced with the consideration of openness to trade and investment. In addition, the impact is found to be stronger in the long run than in the short run underlying the fact that investors are more tolerant to exchange rate shocks in the short run than in the long run.

Areas of future research
This paper has pointed out that foreign investors in these developing countries do add exchange rate volatility to the risks inherent in investing in Africa. The impact of exchange rate shock has been strong in the long run than the short run. However, the paper did not attempt to address how investors react to this risk. In countries with developed financial system, it can be expected that investors might withdraw their share of investment in stock markets. However, there is no such market to rely on in these countries. The result shows that firms do react to exchange rate volatility and future FDI inflow is impacted by the exchange rate volatility happening today. However, the channel remains uninvestigated. The channel through which investors decide to with draw investment in return for the unpredictable exchange rate market remains unclear. Do
they liquidate the currently operating firm or do they reduce the operating cost of the firm in production? What is really their reaction? This appears to be food for thought for future researchers.
References

- Erik Chege, (2009), ‘Exchange Rate Volatility effects on inward Foreign Direct Investments in Emerging Markets”, Master’s Thesis Maastritch University


Econometrics Sources


