International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 774-788 www.ijaem.net ISSN: 2395-5252

Impact of Exchange Rate Volatility on FDI Flows In a Small Open Economy: Empirical Evidence from the Gambia

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Date of Submission: 21-06-2020 Date of Acceptance: 07-07-2020

ABSTRACT

The main objective of this study is to determine the effect of exchange rate volatility on foreign direct investment in The Gambia. To examine this effect, the Granger causality, Stationary/Unit root tests and Co-integration test techniques were employed on time series data for FDI, current account balance, economic openness, GDP growth rate, inflation rate, interest rate, and real exchange rate volatility from 1982 to 2014 for the Gambia. The exchange rate volatility variable was estimated using the Generalized Autoregressive Condition Heteroscedasticity GARCH (1, 1) approach. The results from this study suggest, among other things, that exchange rate volatility has a negative effect on foreign direct investment flows into the Gambia. In addition, the results from the Granger causality test is bidirectional, which suggests that exchange rate volatility Granger causes foreign direct investment, and vice versa. The paper therefore concludes that government should periodically intervene in the Gambia's financial markets in order to stabilize real exchange rate and thereby improve FDI flows into the country's economy.

I. INTRODUCTION

Since the collapse of the Breton Woods system of fixed exchange rates in 1973, there has been a substantial increase in the level of volatility in real exchange rates worldwide, which have led policymakers and economists to continue to intensively investigate the nature and effects of this volatility on foreign direct investment. Theoretical analysis suggests that uncertainty generated by greater exchange rate variability may induce risk averse agents to reduce trade volumes or increase trade prices (Jurečka, 2007). This variability in the real exchange rate is more intense in developing countries, where macroeconomic variables such as GDP, the inflation rate and the real exchange rate, tend to be extremely volatile (Dhakal et al, 2010). Furthermore, recent research has also shown that the volatility of these variables affects not only the volume and level of international trade, but also the level of private investment and the flow of the foreign direct investment (ibid). Other studies have also attempted to explain the theoretical linkage through which uncertainty affects foreign investment (Caballero, 1991; Abel and Eberly, 1994 all as cited in Dhakal et al (2010:122).

However, these studies are inconclusive in regards to the effect of exchange rate variability on FDI, because under different assumptions, exchange rate volatility tends to affect FDI in different ways (ibid). Therefore, from a theoretical perspective, the precise relationship between exchange rate variability and FDI remains uncertain (Dhakal et al, 2010). Hence, it is important to investigate the impact of exchange rate volatility on FDI flows, particularly in small open economies like the Gambia, given that the value of the country's currency, the Dalasi has over the years, fluctuated greatly against major currencies, including the US dollar, British Pound and Euro. The research questions for this paper therefore are: what is the impact of this exchange rate volatility on FDI flows in the case of the Gambia, and is there a long-run relationship between exchange rate volatility and FDI flows in the country?

The paper seeks to extend the literature by providing answers to these fundamental questions by identifying the dynamic relationships and effects of the real exchange rate variability on FDI flows in the Gambian economy and determining whether the volatility in the exchange rate is the reason for the low level of FDI flows into the Gambian economy. By collecting data on real exchange rate and FDI flows from various sources, including Central Bank of the Gambia and UNCTAD Foreign Direct Investment Database, the paper hopes to show how volatility in the real exchange rate market impacts the level of FDI flows in the Gambia. The study will conclude with recommendations for policy makers, not only in the Gambian, but those in other

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developing countries as well, who may be interested in understanding how small open economies like the Gambia manage their exchange rate system in order to attract FDI.

The rest of the paper proceeds as follows. Selected empirical literature review on the effects of exchange rate variability on foreign direct investment is presented in Section II. Section III describes the data and methodology. Section IV presents the results of the study. Section V discusses the empirical findings with conclusion and policy recommendations.

II. A REVIEW OF THE LITERATURE

Given the importance of foreign direct investment to economic growth in developing countries like the Gambia, several studies have tried to examine the factors that determine the flow of FDI into such countries. One key factor that is currently the main source of debate is the impact of exchange rate volatility on FDI flows. In this part of the paper, we will review the relevant empirical literature on the impact of real exchange rate variability on FDI flows.

The Empirical Literature

The empirical evidence on the effect of exchange rate volatility on FDI is mixed. Several studies, including Udoh and Egwaikhide (2008), Ellahi (2011) and Osinubi et al (2009) indicated a significant relationship between exchange rate volatility and FDI. For instance,(Udoh, 2008) studied the effect of exchange rate volatility and inflation uncertainty on FDI in Nigeria covering the year 1970 to 2005. Inflationary volatility, exchange rate volatility, political instability and many other macroeconomic variables were used as independent variables in determining FDI, which is the dependent variable. They used GARCH model to calculate inflation uncertainty and exchange rate volatility. The result concluded that inflation uncertainty and exchange rate volatility have a negatively significant effect on FDI in Nigeria. It may be the case that in these studies, exchange rate volatility is just a symptom of deeper institutional and structural problem in developing countries. However, other studies have noted this negative relationship for developed countries as well.

On the contrary, (Ellahi, 2011) did a similar study on exchange rate volatility on FDI in the Pakistan economy by applyi6ng modern and robust technique of Auto Regressive Distributed Lag (ARDL) in between 1980 to 2010. He took foreign direct investment as explained variable and Real Gross Domestic Product (GDP), Trade Openness, Real Exchange Rate, Capital Account Balance, and Volatility of Exchange Rate as explanatory variables. The result shows a contradictory result when applied to different time period. The exchange rate volatility has negative impact on FDI inflow in the long run and in the short run, after the structural adjustment program the study has shown positive result on FDI.

. Similarly, Osinubi (2009) conducted an empirical study on the effect of exchange rate volatility on foreign direct investment for the Nigerian economy, by applying an Error Correction Model (ECM) for the years 1970 to 2004. They took foreign direct investment (FDI) as dependent variable, while exchange rate, exchange rate volatility, interest rate and real gross domestic product as independent variable. The study finds the positive and significant result of the estimated model. So exchange rate volatility has positive and significant impact on FDI. However, this result is a complete contradiction from that of a research conducted the same year with the inclusion of South Africa by Erik (2009). Erik (ibid) uses data from 1975 to 2005 to analyze a two way causal relationship between exchange rate volatility on FDI vis-à-vis FDI on exchange rate volatility in the two African nations. Despite this relationship being strong in Nigeria and weaker in South Africa, he emphasizes the significant role foreign direct investment play in the development and financial growth in sub-Saharan Africa and the increasingly negative role played by exchange rate volatility in Nigeria.

A study by Alaba (2003) on inward FDI to Nigeria confirms a controversy in the empirical literature on the effect of exchange rate volatility. His analysis focuses on two sectors- the agricultural and the manufacturing sectors. The study focus on these two sectors because they are the most important sectors which are considered very significant in diversifying the Nigerian economy from its oil sector. He also adopted both black market and official exchange rate because the black market handles substantial proportion of the Nigerian foreign exchange trading. His empirical analysis determined the relationship between systematic movement and exchange rate volatility, output, economic performance and FDI. Alaba`s study reveals that exchange rate volatility in the official market is significant at 1% for foreign direct investment to agricultural sector at the same time insignificant for the manufacturing sector. However, the coefficient of exchange volatility at the official market shows insignificant result for FDI in both sectors. The result obtained using the parallel market exchange rate suggests that both systematic movement of exchange rate and its volatility is significant at 1% for flow of FDI to agriculture in Nigeria. As for the manufacturing sector, both movement in parallel market exchange rate and its volatility are significant at 10%.

Alaba`s study on the parallel market rate obtained both negative and positive signs for exchange rate volatility in the two different sectors. The negative coefficient obtained for parallel market exchange volatility in the manufacturing sector suggests that volatility tends to reduce investment to the sector, while the same ironically attracts investment to agriculture.

A study conducted by Gorg (2001) on both inward investment to the US from 12 developed countries and outward US foreign investment from those same countries for the period 1983 to 1995 provides further evidence on this issue. In his study he uses log of annual mean of the monthly exchange rate for a given year to calculate the level of the real exchange rate. The volatility of exchange rate is measured by the standard deviation of the log of the monthly changes in the exchange rate. His control variables are relative interest rate, labour cost, US GDP, partner country`s GDP, freight cost, distance between the partner countries and the US, and language which is a dummy. His study finds a zero effect between exchange rate volatility on US FDI. Such a finding runs contrary to most of the past literatures.

As can be seen from the foregoing review of the literature, the effect of exchange rate volatility on foreign direct investment still remains ambiguous, and because of the fundamental heterogeneity of these empirical analyses, there is no definitive study to date that settles the theoretical and practical disputes on the effect of exchange rate volatility on FDI. The main drawbacks of these empirical works is that they do not consider the latest and most comprehensive data available and the number of countries considered is too small to be able to provide clear-cut results. Above all, little attention, if any, has been devoted to studying the effects of real exchange rate volatility on FDI flows in the context of small open economies such as the Gambia. As a result, this paper will build on the above studies by examining the impact of real exchange rate variability on flows in the Gambia.

III. BACKGROUND

In this section, we will provide a brief description of the nature and pattern of foreign direct investment (FDI) and the movements in the exchange rate in the Gambia. This approach will provide proper perspectives on the results of the econometric analysis we will be performing later in the paper, on the impact of exchange volatility on FDI flows in the Gambia.

i. Foreign direct investment

Foreign direct investment is an investment made to acquire long-term interest in an organization operating outside of the economy of the investor. There are several benefits that the Least Developed sub-Saharan African countries like the Gambia can derive from FDI. These include technological spillovers, improvements in the quality of human resources, improved managerial skills and increased productivity (MacDougall, 1960; and Blomström and Kokko, 1997 as cited in Ogunleye, 2008). Given the capital deficient nature in the sub-Saharan Africa region and the potential benefits to be derived from foreign direct investment, FDI inflows are seen as essential for growth and development in the region (Ogunleye, 2008). As a result, the issue of attracting foreign direct investment (FDI) has assumed a prominent place in the strategies of economic renewal being advocated by policy makers at the national, regional, and international levels (UNCTAD, 2004).

Despite these benefits from FDI, lack of foreign capital continues to be an endemic problem in most countries in sub-Saharan Africa, including the Gambia. Studies have consistently shown that sub-Saharan Africa's share in total global FDI flows are not only small but volatile and unpredictable.

Although The Gambia is relatively stable, its performance in attracting foreign investors leaves much to be desired. According to the balance of payments statistics, foreign direct investment inflows for the Gambia increased from US$5.2 million 1988 to an average of US$3.2 million between 1989 and 1993, representing a 16.0 percent increase. In 1994, net foreign direct investment inflows declined quite precipitously to US$ 4.7 million, before steadily increasing to US$8.2 million in 1999. It however, fell quite dramatically to US$3.15 million in 2000 (Touray, 2016). According to UNCTAD (2014), this declining trend in the FDI flows in the Gambia has continued, with the amount of FDI inflows to the country declining from $49.8 million during the period 2000-2008 to $25.3 million in 2013.

ii. Exchange rate movements

As in most other small open economies, the Gambia's real exchange rate is influenced mostly by the vagaries in the external front in the form of external shocks which emanate chiefly from the unfavourable movements in the prices of agricultural commodities. In addition, the Gambia also depends heavily on the tourism sector and

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remittances from Gambians living abroad - both major sources of Gambian exports and foreign exchange earnings, which means that negative external shocks such as recessions and economic downturns in North America, Europe and the Nordic countries, as was the case in 2009, increases the level of volatility in the foreign exchange market.

As noted before, the collapse of the Bretton Woods Agreement has worsened the situation for foreign direct investors. The collapse has created a fluctuating and unpredictable exchange rate valuation due to volatility. Exchange rate often interfered in both the factors market and a fragile macroeconomic framework trying to control the exchange rate market has resulted in exchange rate volatility and uncertainty (Melku, 2002).

This exchange rate volatility has varying economic consequences, particularly in developing countries. First of all, is the negative impact it has on investors' confidence as it make decision making and investment planning very difficult.

In the context of The Gambia - a small open economy that imports about 70 percent of basic commodities consumed by Gambians, the impact of exchange rate volatility is more severe as the Gambian currency, the Dalasi, performs badly in the currency markets.

As can be seen from the foregoing review, the precipitous decline in FDI flows in the Gambia coincided with the period when real exchange rates in the country were volatile, which suggests that there is a nexus between the two variables. This paper will therefore attempt, through econometric analysis, to examine the exact relationship between FDI flows and real exchange rate variability in the Gambia.

IV. DATA, MODEL SPECIFICATION AND METHODOLOGY

The study is based on secondary time series data and focuses on long-run analysis to check the impact of exchange rate variability on FDI in the Gambia. The variables used in the study are FDI, Current Account Balance, Economic Openness, GDP growth, Inflation, Real exchange rate, and exchange rate variability. Data on these variables were collected for the period 1980 – 2014. The study will apply a test of correlation and regression using E-views software to determine the relationship between Exchange Rate Variability and FDI.

4.1 Data Sources and Definition of Variables

For the purpose of this study, data from the World Bank database will be used. The data is time series data for the period 1982 to 2014.The reason for including data from the 1980s is because of data availability. Moreover, the Gambia changed its exchange rate regime from fixed exchange rate regime to a flexible exchange rate regime in 1986. In addition, starting from 1982 will ensure that the influence of the fixed exchange rate regime will be captured as well as to meet the minimum sample size of 30 required for time series analysis. All the series are annual data usually the end of year values and are described in sections 4.1.1 to 4.1.8 below:

4.1.1 Foreign direct investment inflow

This variable is the dependent variable in the model and is represented in the model as "*X*" in equation (1). It is the net inflows of investment in which the investor has a controlling management interest in an enterprise operating in an economy. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.

4.1.2 Current Account Balance

This variable is a control variable in the model and it is meant to make the model more stable. It is presented in the model as "*CAB*" and since it is a measured variable, we will not be using a proxy for it. It is obtained by taking the sum of net exports of goods and services, net primary income, and net secondary income.

4.1.3 Openness

Openness is also a control variable in the model and it is meant to make the model more stable. It is represented in the model as "*OPEN*" and it is obtained by taking the sum of export and import divided by GDP.

4.1.4 GDP growth

GDP growth is an independent variable in the model. It is the annual percentage growth rate of GDP in the Gambia at market prices based on constant local currency and it is represented in the model as "*GDPG*". Aggregates are based on constant 2005 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

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4.1.5 Inflation Rate

The Consumer Price Index (CPI) is the proxy for the inflation and is obtained by taking the weighted averages of prices of all consumer goods and services and it reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used. This variable just like the growth rate, is in percentage (i.e. percentage change in CPI) and it is represented as "*INF*" in the model.

4.1.6 Interest rate

Real interest rate is an independent variable in the model. It is the lending interest rate adjusted for inflation as measured by the GDP deflator and it is represented as "INTR" in the model. The terms and conditions attached to lending rates differ by country, thus, limiting their comparability.

4.1.7 Real Exchange Rate

Real Exchange Rate is a control variable in the model and it is used in the regression to avoid model mis-specification. The real Exchange Rate used is the effective exchange rate, which is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs. The real Exchange Rate is represented in the models as "*RER".*

4.1.8 Real Exchange Rate uncertainty

Real exchange rate uncertainty unlike the other variables used in the model, is not observable but rather a measured variable. In this study, GARCH (1, 1) is used to estimate it. The volatility will be measured from the real effective exchange rate which is taken as a proxy for exchange rate, which is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies), divided by a price deflator or index of costs. The volatility is represented in the models as "*RERVO".*

4.2 Model specification

To investigate the effect of Exchange Rate Variability on FDI, there are several factors that should be taken into consideration. First, factors other than those used to measure exchange rate variability that would affect FDI need to be identified. It is important for all these factors to be included to allow for consistency with the predictions of macroeconomic theory. Otherwise, one will run the risk of model misspecification. Various models were used in trying to estimate the effect of exchange rate variability on FDI. The choice of variable for this paper has been influenced by earlier empirical studies as much as by data availability. However, the focus will be on the impact of exchange rate variability and FDI inflow into the Gambian economy. Hence, the study will be using the multi-regression model specified in Equation (1):

$$\boldsymbol{X} = \int(\boldsymbol{CAB}, \boldsymbol{OPEN}, \boldsymbol{GDPG}, \boldsymbol{INTR}, \boldsymbol{RER}, \boldsymbol{RERVO}, \boldsymbol{INF}) \quad \ldots\ldots\ldots\ldots\ldots\ldots \textbf{(1)}$$

Where,
X = ForeignForeign direct investment inflow into the Gambia
CAB = Current Account Balance
OPEN = Openness
GDPG = GDP growth
INF = Inflation
INTR = Interest rate
RER = Real Exchange Rate
RERVO = Real Exchange Rate volatility
e = random error term

To represent this function into econometrics form, the model is re-specified as in equation (2):

$$FDI = \beta_o + \beta_1 CAB + \beta_2 OPEN + \beta_3 GDPG + \beta 4\, INTR + \beta 5 INF + \beta 6 RER + \beta 7 RERVO + e \quad \ldots\ldots(2)$$

Where:
β_o= the intercept/ mean of the equation
β_1 to $\beta 7$= the coefficient of the explanatory variables
e = the error term

4.3 A Priori Results

Theory suggests that the sign of the first three betas – β_1, β_2, β_3, are all expected to be positive. That is to say a favorable current account balance, the more open the country`s economy to international trade, and a positive GDP growth will all lead to an increase in FDI inflow in the country. β5 is predicted to be negative in that, a higher inflation will discourage FDI thus reducing FDI inflows and vice versa. **The expected signs of β6 and β7 are uncertain. The main focus of th**is paper is to establish the sign of the coefficient RERVO (**β**7).However there is no clear-cut *a priori* expectation about the sign of RERVO (**β**7), as theories mentioned in Section II can explain both positive and negative impact for the effect of exchange rate volatility on foreign direct investment. The exchange rate volatility is regarded as risks in most empirical work: the higher the exchange rate volatility in a particular country may therefore influence risk averse foreign investors to reduce trade in that country.

This study assumes that foreign direct investors may anticipate future exchange rate volatility better than average foreign exchange market participants. Therefore, they can hedge their positions to offset the cost of the high foreign exchange volatility. Moreover, assuming that the exchange volatility is as a result of fundamentals, any attempt by the authorities to reduce the volatility by means of exchange controls or other restrictions on trade would render their actions harmful to foreign trade and could reduce it even further. Therefore, the effect of exchange rate volatility on foreign direct investment is difficult to determine ex ante**.** It is rather an empirical matter for each country. Therefore, if this study is able to establish that the coefficient of RERVO (**β**7) is positive and statistically significant, then it could be concluded that exchange rate variability has a positive effect on FDI inflow in the Gambia. If on the other hand, the coefficient is negative and statistically significant, then the conclusion would be that exchange rate variability has a negative effect on FDI inflow in the country. However, if the coefficient is neither positive nor negative and statistically insignificant, then the conclusion would be that exchange rate variability has no effect on FDI inflow in the Gambian context.

V. METHODOLOGY

The explanatory variables described in the previous section were selected based on the review of the empirical literature on the effect of exchange rate volatility on FDI. Again, there might be a question on the linear specification of the model used however, Chakrabarti (2001) has confirmed that in country-specific analysis, using semi-log form of modeling FDI determination can improve the overall fit and the significance of the coefficients.

The most common conditional measures of volatility are: conditionally adjusted Autoregressive Hetroschedastic (ARCH) by Engel (1982), moving average standard deviation measure of volatility by Zubair and Jega (2008) and Gujarati (2003) measure volatility in terms of Mean adjusted and the squared deviation of the variance of each series in the sample (Touray, 2016). Another very important measure of volatility is the Generalized Conditional Heteroscedasticity (GARCH) series, proposed by Bollersley (1986).

The most unconditional mean approach, which is commonly used and traditional methodology of measuring the effect of exchange rate volatility, is the standard deviation(usually the moving average standard deviation with different moving averages of 3 months 12 months etc) of the unconditional mean approach (Touray, 2016). This moving average standard deviation method of computing exchange rate volatility is obtained using the formula:

$$RERVO_t = \left[\frac{1}{n-1}\sum_{i-1}^{n}(E_{t-i-1} - E_{t-1})^{º}\right]½$$

Where: $\boldsymbol{RERVO_t}$ is the volatility, $\boldsymbol{n}$ represents the sample sizes, $\boldsymbol{E_{t-i-1}}$ represent monthly exchange rate period and $\boldsymbol{E_{t-1}}$ is the average moving average of exchange rate. However n-1 is used instead of $\boldsymbol{n}$ because of a larger sample size standard deviation (Touray, 2016). Some studies use the natural logarithms of the computed exchange rate volatility whereas others studies do not. Regardless of whether one uses the natural logarithm or not, a lot of studies pointed out the limitations of using this particular method of measuring exchange rate volatility. For example, standard deviation assumes normality of returns. In fact returns are leptokurtotic (i.e. exhibit fat tails) so the normality assumption lead to under estimation of volatility (Touray, 2016).

It is against these challenges of using unconditional mean approach that research moved towards the use of conditional mean approach in measuring exchange rate volatility. As mentioned earlier, the conditional mean approach Z-score, ARCH and GARCH series with GARCH are the most commonly used measures of volatility. "Generalized Autoregressive conditional Heteroscedasticity (GARCH) is an extension of Autoregressive Conditional Heteroscedasticity (ARCH), which is used to model Heteroscedasticity and not correct Heteroscedasticity in a time series data (Touray, 2016). ARCH model by Engle (1982) was introduced in time series econometrics analysis in an attempt to simultaneously model the mean and variance of a series instead of using ad hoc variable choices for series and/or data transformations used in the conventional ways" (Touray, 2016). However, ARCH/GARCH models thus far have ignored information on the direction of returns; only the magnitude matters. However, there is very convincing evidence that the direction does affect volatility.

There are different types and levels of GARCH models but for the purpose of this dissertation, an attempt will be made to employ conditionally adjusted Autoregressive Conditional Heteroscedasticity (ARCH) to measure the real exchange rate volatility and Generalized Conditional Heteroscedasticity GARCH (1, 1) for modeling heteroskedastic conditional volatility (Dlamini, 2014).. The justification of which is that it is the most commonly used measure of conditional volatility and also it is enough to capture the volatility in exchange rate and is believed to generate superior results (Dlamini,2014).

The ARCH is defined in terms of the distribution of errors of a dynamic linear regression model. For example assume a dependent variable ρt is generated by the autoregressive process:

$$\rho t = \beta o + \sum_{i=1}^{k} \beta i \rho t - 1 + \epsilon t$$

To generate the ARCH (P) process, we have to express the conditional variance of the above equation as a function of it lag squared:

$$Q^2 = \mu o + \sum_{i=1}^{\rho} \varepsilon^2 t - i^k$$

$$\varepsilon / \Omega t - i \sim N(0, Q^2 t)$$

Where xxxx denote the conditional variance of the information set that is available at time$t - i$and of all $i = 1, 2, 2 \ldots\ldots p$ and $\mu 1 + \mu 2 + u3 + \mu p < 1$ are necessary to make$\varepsilon^2 t$ positive and covariance stationary.

According to Engel (1995) one of the setbacks of the ARCH model was that it looked more like a moving average specification than Auto regression. Hence GARCH model which include the lagged conditional variance terms as autoregressive terms was proposed by Bollerslev (1986) came into being. It takes the form:

$$Q^2 = \mu o + \sum_{i=1}^{\rho} \gamma t Q^2 t - 1 + \sum_{i=1}^{\rho} \upsilon t \varepsilon^2 t - 1$$

According to the ARCH model above the value of the variance (Q^2)now depends on the lag values$(Q^2 t - 1)$ of the exchange rate, which are captured by the lagged squared residual terms $(\varepsilon^2 t - 1)$, and on the past values of itself$(Q^2 t - 1)$, which are capture by the lagged terms. The autoregressive root which governs the persistence of volatility shocks is the sum of $(\gamma + \upsilon)$. in many applied setting this root is close to unity, so that shocks disappear out.

5.1 Steps to follow in the Econometric Estimation

5.1.1 Stationary/Unit root test

In other to avoid producing a spurious regression that is regressing a non-stationary time series on another non-stationary time series, we need to first of all check if all time series are all individually integrated at order 1. All the time series data of our variables of interest are tested in order to determine their time series properties. That is, if the entire individual are I (1). If so, the Engel-Granger test could also be used to verify whether the above FDI equation is meaningful and whether the variables have long-run equilibrium relationship or not. According to this approach, the dependent variable (γt) and the independent variables $\boldsymbol{\beta} i \boldsymbol{x} it$ in the equation below form a long- term relationship. If all variables are integrated of the same order, then the residuals of the model is said to be stationary.

$$\gamma t = \boldsymbol{\beta} oi + \sum_{i=1}^{n} \boldsymbol{\beta} i \boldsymbol{x} it + \boldsymbol{e} t$$

The stationarity of the above regression residuals et is tested by applying the Augmented Dickey Fuller (ADF) unit root test:

$$\Delta \boldsymbol{\gamma} it = \boldsymbol{\beta} \boldsymbol{oi} + \boldsymbol{\rho} i \boldsymbol{\gamma} it - 1 + \sum_{j=1}^{\rho 1} \boldsymbol{\gamma} ij \boldsymbol{e} i,t - j + \mathbf{v} it$$

$$\Delta \boldsymbol{\gamma} it = \boldsymbol{\beta} \boldsymbol{oi} + \boldsymbol{\rho} i \boldsymbol{\gamma} it - 1 + \boldsymbol{\beta} 2i + \sum_{j=1}^{\rho 1} \boldsymbol{\gamma} ij \boldsymbol{e} i,t - j + \mathbf{v} it$$

In all the above equation, emphasis is on $\boldsymbol{\rho}$, leading to a null hypothesis of;

Ho: $\boldsymbol{\rho} 1 = \mathbf{0}$, for all $\boldsymbol{i}$ implying $\boldsymbol{\gamma} 1 = 0$ with the alternative being

H1: $\boldsymbol{\rho} 1 \neq 0$ implying $\boldsymbol{\gamma} 1 \neq 0$

If we reject the null hypothesis (Ho: $\boldsymbol{\rho} 1 = \mathbf{0}$, for all$\boldsymbol{i}$implying $\boldsymbol{\gamma} 1 = 0$), we could conclude that the series are stationary at the same order- that is to say the variables does not contain unit root. However, if we do not reject the null hypothesis, we conclude that the series contain a unit root, therefore non-stationary. However it does not matter that the number of lagged difference term $\sum_{j=1}^{\rho 1} \gamma^{ij} e^{i,t-j)}$ to be included in the ADF is empirically determined base on the statistical criteria which minimum Akaike Information Criterion (AIC), Schwartz Information Criterion (SIC) or the simple t-statistics or even using the P-value.

5.1.2 Vector Auto regression (VAR)

After testing for stationarity we will now turn to the Vector Auto Regression (VAR) model to take account of all the dynamic co-integration interrelationships among the variables, more so, the impact of random disturbance on the system of variance the result in forecasting systems of interrelated time (Arize, 2005) .Structural VAR require Identifying Assumptions (IS) that is use to allow people to interpret correlation as causally. These identifying assumptions can be used in the entire VAR model; this is so that all of the links in the model are spell out, so that only a specific causal link is identified (Bongani, 2014). There is no consensus as to the number of variable required in a VAR model that will provide a plausible interpretation of an economy. (Bongani, 2000). included eleven variable in a study conducted for the Australian economy. However, (Kim, 2000) argued that using seven variables is enough for a study in smaller economies.

The basic structural VAR model in my study contains eight endogenous variables which is within the recommended range. The matrix for our equation of the VAR model is as follows:

For our model above, the VAR model of all the equations are specified. The matrix form of the equation of the VAR model is selected as follows:

$$fdi = a_{10} + \sum_{i=1}^{n} \partial_{1i}\text{fdi}_{t-1} + \sum_{i=1}^{n} \emptyset_{1i}\text{CABG}_{t-1} + \sum_{i=1}^{n} \gamma_{1i}\text{open}_{t-1} + \sum_{i=1}^{n} \beta_{1i}\text{GDPG}_{t-1} + \sum_{i=1}^{n} \varphi_{1i}\text{INTR}_{t-1} + \sum_{i=1}^{n} \sigma_{1i}\text{INF}_{t-1} + \sum_{i=1}^{n} \delta_{1i}\text{RER}_{t-1} + \sum_{i=1}^{n} \rho_{1i}\text{RERVO}_{t-1} + \mu_{1i}$$

$$\text{CABG} = a_{20} + \sum_{i=1}^{n} \emptyset_{1i}\text{CABG}_{t-1} + \sum_{i=1}^{n} \partial_{1i}\text{fdi}_{t-1} + \sum_{i=1}^{n} \gamma_{1i}\text{open}_{t-1} + \sum_{i=1}^{n} \beta_{1i}\text{GDPG}_{t-1} + \sum_{i=1}^{n} \varphi_{1i}\text{INTR}_{t-1} + \sum_{i=1}^{n} \sigma_{1i}\text{INF}_{t-1} + \sum_{i=1}^{n} \delta_{1i}\text{RER}_{t-1} + \sum_{i=1}^{n} \rho_{1i}\text{RERVO}_{t-1} + \mu_{2i}$$

$$\text{open} = a_{30} + \sum_{i=1}^{n} \gamma_{1i}\text{open}_{t-1} + \sum_{i=1}^{n} \partial_{1i}\text{fdi}_{t-1} + \sum_{i=1}^{n} \emptyset_{1i}\text{CABG}_{t-1} + \sum_{i=1}^{n} \beta_{1i}\text{GDPG}_{t-1} + \sum_{i=1}^{n} \varphi_{1i}\text{INTR}_{t-1} + \sum_{i=1}^{n} \sigma_{1i}\text{INF}_{t-1} + \sum_{i=1}^{n} \delta_{1i}\text{RER}_{t-1} + \sum_{i=1}^{n} \rho_{1i}\text{RERVO}_{t-1} + \mu_{3i}$$

$$\text{GDPG} = a_{40} + \sum_{i=1}^{n} \beta_{1i}\text{GDPG}_{t-1} + \sum_{i=1}^{n} \partial_{1i}\text{fdi}_{t-1} + \sum_{i=1}^{n} \emptyset_{1i}\text{CABG}_{t-1} + \sum_{i=1}^{n} \gamma_{1i}\text{open}_{t-1} + \sum_{i=1}^{n} \varphi_{1i}\text{INTR}_{t-1} + \sum_{i=1}^{n} \sigma_{1i}\text{INF}_{t-1} + \sum_{i=1}^{n} \delta_{1i}\text{RER}_{t-1} + \sum_{i=1}^{n} \rho_{1i}\text{RERVO}_{t-1} + \mu_{4i}$$

$$\text{INTR} = a_{50} + \sum_{i=1}^{n} \varphi_{1i}\text{INTR}_{t-1} + \sum_{i=1}^{n} \partial_{1i}\text{fdi}_{t-1} + \sum_{i=1}^{n} \emptyset_{1i}\text{CABG}_{t-1} + \sum_{i=1}^{n} \gamma_{1i}\text{open}_{t-1} + \sum_{i=1}^{n} \beta_{1i}\text{GDPG}_{t-1} + \sum_{i=1}^{n} \sigma_{1i}\text{INF}_{t-1} + \sum_{i=1}^{n} \delta_{1i}\text{RER}_{t-1} + \sum_{i=1}^{n} \rho_{1i}\text{RERVO}_{t-1} + \mu_{5i}$$

$$\text{INF} = a_{60} + \sum_{i=1}^{n} \sigma_{1i}\text{INF}_{t-1} + \sum_{i=1}^{n} \partial_{1i}\text{fdi}_{t-1} + \sum_{i=1}^{n} \emptyset_{1i}\text{CABG}_{t-1} + \sum_{i=1}^{n} \gamma_{1i}\text{open}_{t-1} + \sum_{i=1}^{n} \beta_{1i}\text{GDPG}_{t-1} + \sum_{i=1}^{n} \varphi_{1i}\text{INTR}_{t-1} + \sum_{i=1}^{n} \delta_{1i}\text{RER}_{t-1} + \sum_{i=1}^{n} \rho_{1i}\text{RERVO}_{t-1} + \mu_{6i}$$

International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 774-788 www.ijaem.net ISSN: 2395-5252

RER

$$= a_{70} + \sum_{i=1}^{n} \delta_{1i}\mathrm{RER}_{t-1} + \sum_{i=1}^{n} \partial_{1i}\mathrm{fdi}_{t-1} + \sum_{i=1}^{n} \emptyset_{1i}\mathrm{CABG}_{t-1} + \sum_{i=1}^{n} \gamma_{1i}\mathrm{open}_{t-1} + \sum_{i=1}^{n} \beta_{1i}\mathrm{GDPG}_{t-1} + \sum_{i=1}^{n} \varphi_{1i} \mathrm{INTR}_{t-1} + \sum_{i=1}^{n} \sigma_{1i}\mathrm{INF}_{t-1} + \sum_{i=1}^{n} \rho_{1i}\mathrm{RERVO}_{t-1} + \mu_{7i}$$

$$\mathrm{RERVO} = a_{80} + \sum_{i=1}^{n} \rho_{1i}\mathrm{RERVO}_{t-1} + \sum_{i=1}^{n} \partial_{1i}\mathrm{fdi}_{t-1} + \sum_{i=1}^{n} \emptyset_{1i}\mathrm{CABG}_{t-1} + \sum_{i=1}^{n} \gamma_{1i}\mathrm{open}_{t-1} + \sum_{i=1}^{n} \beta_{1i}\mathrm{GDPG}_{t-1} + \sum_{i=1}^{n} \varphi_{1i}\mathrm{INTR}_{t-1} + \sum_{i=1}^{n} \sigma_{1i}\mathrm{INF}_{t-1} + \sum_{i=1}^{n} \delta_{1i}\mathrm{RER}_{t-1} + \mu_{8i}$$

Where FDI is foreign direct investment, CAB is current account balance, OPEN is openness, GDPG gross domestic product growth, INF inflation rate, RER real interest rate and RERVO is exchange rate volatility. $\mu_{1i}, \mu_{2i}, \mu_{3i}, \mu_{4i}, \mu_{5i}, \mu_{6i}, \mu_{7i}, \mu_{8i}$ are uncorrelated white noise. However determination of the lag length of the model will also depend on likelihood efficiency criterion (like the Akaike information criterion AIC Swartz criterion SBC of the model which is estimated at different lag length).

5.1.3 Granger Causality and Co-integration

Causality effect has become an important property in contemporary time series analysis given that it very difficult in determining which variable or lagged of the variables have a significant effect on each dependent variable and which do not when the lags included in the VAR are many (Touray, 2016) Therefore, to know variable that Granger cause the dependent variables, we apply a test called Granger causality test. A variable is said to granger cause another variable when the lag of the variable is significant in predicting the present value of the other variable. On the other hand, if the lag of a variable does not predict the present value of the other variables, then we say the variable does not Granger cause another variable.

VI. EMPIRICAL RESULTS

The major objective of this paper is to assess the effect of exchange rate volatility on foreign direct investment (FDI). Therefore, in this chapter, we will discuss the result from the GARCH model used to estimate exchange rate volatility, pre estimation test and also the results from empirical estimations as well as the post estimation.

6.1 GARCH estimation of the exchange rate volatility

We start with the application of the GARCH (1, 1) approach to estimate the exchange rate volatility of the Gambian dalasi against the US dollar. The real Exchange Rate used is the effective exchange rate which is the nominal effective exchange rate (a measure of the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs. The results of GARCH (1, 1) model exchange rate volatility are presented in the

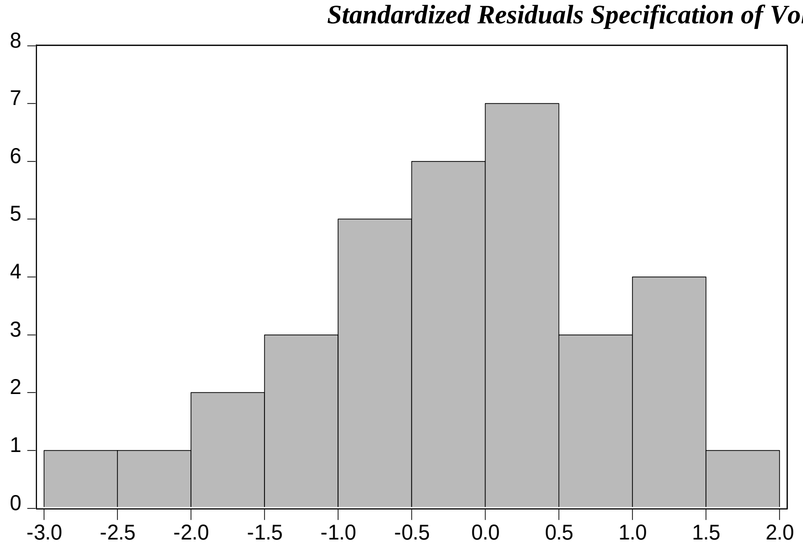
Table 1
Table 1: ARCH/GARCH Specification of Volatility

Dependent Variable: D (REAL_EFF_EXCH Method: ML ARCH - Normal distribution (BFGS/Marquardt steps) Sample: 1982-2014 Coefficient co-variance computed using outer product of gradients GARCH = C (3) + C (4)*RESID (-1)^2 + C (5)*GARCH (-1)				
Variable	Coefficient	Std. error	Z-Statistic	Prob
C	-0.683874	2.029640	-0.336943	0.7362
AR (1)	0.431721	0.003944	109..4590	0.0000
Variance Equation				
C	49.09209	29.59948	1.658546	0.0972
RESID (-1)^2	1.697467	0.524546	3.236070	0.0012
GARCH (-1)	-0.103251	0.033748	-3.059510	0.0022

R-squared	-0.340441	Mean dependent var	-5.607947	
Adj. R-squared	-0.383681	S.D. dependent var	16.96896	
S.E. of regression	19.96059	Akaike info criterion	8.002369	
Sum squared resid	12351.18	Schwarz criterion	8.229113	
Log likelihood	-127.0391	Hannan-Quinn criter	8.078662	
Durbin-Watson stat	2.814359			
Inverted AR Roots	.43			

From the results in Table 1, the coefficients are efficient and unbiased estimates as shown by the pre-estimation test for normality, autocorrelation heteroskesdasticity. The lower part of the output in Table 1 refers that the sum of the ARCH parameters RESID $(-1)^2$) that correspond to μ.

Graph 1
Standardized Residuals Specification of Volatility

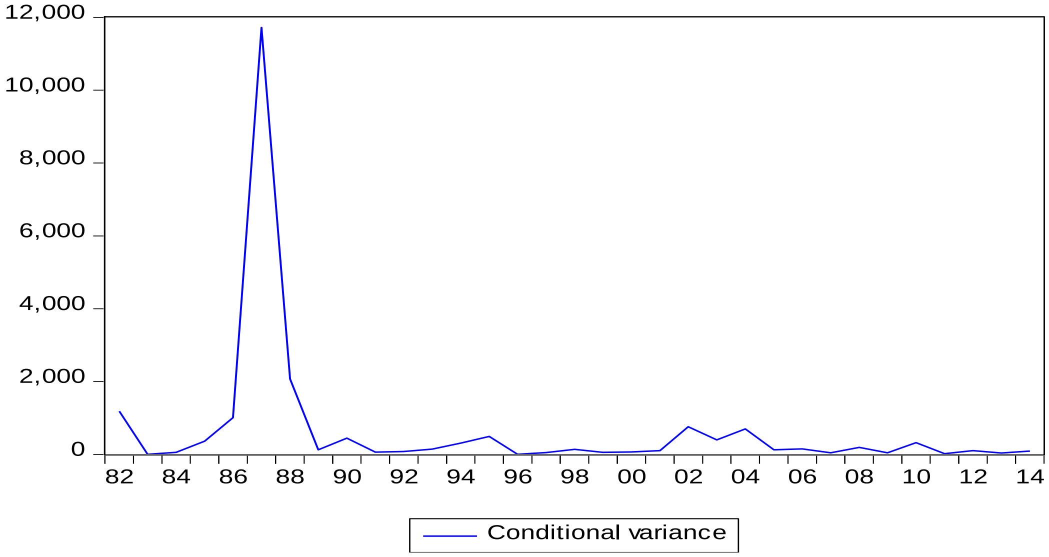


Series: Standardized Residuals	
Sample 1982 2014	
Observations 33	
Mean	-0.207735
Median	-0.217604
Maximum	1.551812
Minimum	-2.622866
Std. Dev.	1.055135
Skewness	-0.330616
Kurtosis	2.488775
Jarque-Bera	0.960545
Probability	0.618615

The coefficients above are efficient and unbiased as shown in the pre-estimation test of normality, heteroskesdasticity and autocorrelation. The test for normality yields a Jargue-Bera of 0.960545 with a probability of 0.618615 therefore; the null hypothesis of residuals being normally distributed is not rejected (Touray, 2016). More so, the serial correlation and heteroskedasticity test on ARCH effect both shows that the residual of the model are homoscedastic with a p-value of 0.7207 and no serial correlated, all these, therefore, makes the above model the best unbiased estimate of exchange rate volatility whose movement overtime is shown in the Graph 2 below.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 774-788 www.ijaem.net ISSN: 2395-5252

Graph 2
Dalasi/US Dollar exchange rate volatility (estimated by GARCH (1, 1))



These results are consistent with finding from previous studies done on the Gambia by Touray (2016), which shows the persistence of volatility in the exchange rate market in the Gambia overtime.

6.2 *Pre-estimation Tests*

6.2.1 Stationary/Unit root test

According to Granger (1969), stationarity tests are the pre-estimated teat for avoiding spurious regressions. It is the recommended starting point in any cointragration analysis as well as regression analysis (Touray, 2016). If a series is non-stationary, therefore the order of integration is determined by the number of times it has to be differentiated for it to be stationary. If two or more series are stationary of the same order, there exists the possibility to estimate a linear relationship between them (Engel, 1987). The Augmented Dickey Fuller (ADF) test is used in this study to test for unit roots. As with most time series data, not all variables were stationary at their levels. GDP growth, current account balance, inflation real interest rate, and exchange rate volatility are all I(0) whiles foreign direct investment, openness and real exchange rate, were found to be I(1). However, the first differences of the entire variable are stationary. Thus, the variables are integrated of order one, that is, I (1). The results for stationarity test are presented in the Table 2.

Table2
Table Unit Root Test

The Null hypothesis	**t-Statistic**	**Prob.***	
Null Hypothesis: CURRENT_A_C_B has a unit t	***-4.3983***	***0.0015***	***I(0)***
Null Hypothesis: FDI has a unit root	***-6.0239***	***0.0000***	***I(1)***
Null Hypothesis: GDP_GROWTH has a unit root	***-6.9844***	***0.0000***	***I(0)***
Null Hypothesis: IFLATION_CP has a unit root	***-3.1652***	***0.0311***	***I(0)***
Null Hypothesis: OPENNESS has a unit root	***-6.8336***	***0.0000***	***I(1)***
Null Hypothesis: REAL_EFF_EXCH has a unit t	***-6.4609***	***0.0000***	***I(1)***
Null Hypothesis: REAL_INTEREST_RATE has a t root	***-4.4439***	***0.0012***	***I(0)***
Null Hypothesis: RERVO has a unit root	***-4.5439***	***0.0010***	***I(0)***

International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 774-788 www.ijaem.net ISSN: 2395-5252

From the above result, it is observed that current account balance, balance GDP, inflation real interest rate and exchange rate volatility are integrated at their levels while foreign direct investment, openness and real effective exchange rate are significant from their first differential. The presence of unit root for three of the variables justifies the adoption of VAR modeling technique. Technically, endogenous variables under VAR system are explained by the lagged values of the variables and lagged values of all other variables in the system.

6.2.2 The maximum number of lag length selection for the VAR

Before moving with our VAR estimation, it is important first to determine the number of lagged length to include in the equation. To know the number of lag length to be included in this study, we will use the likelihood test or the information criterion (Touray, 2016). Eviews 9 will help us determine the maximum number of lag length, as shown in the Table 3 below.

Table 3
VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1393.125	NA	2.50e+29	90.39519	90.76525	90.51582
1	-1235.621	223.5547	6.89e+26	84.36264	87.69319	85.44832
2	-1122.660	102.0294*	7.53e+25*	81.20386*	87.49490*	83.25458*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

However 2 Lag length is used in conducting this lag length selection test, because the data used for this study is annual data, and the number of lag length for annual time series data is two. As can be seen from the Table 3, the maximum number of lag length for our VAR model is 2 lag lengths which is chosen by Akaike, Schwarz and Hannan-quinn criteria. Therefore in our study we will continue to use VAR (2) in our estimation model as in Touray (2016).

6.2.3 Granger Causality test

Granger Causality test model is used in order to examine the causal relationships between the variables under examination. The model that was established in our previous discussion was used in order to examine the causal relationships between the variables under examination. The granger causality test result shows that exchange rate volatility does significantly forecast foreign direct investment flow in the country and vice versa. The relationship between exchange rate volatility and foreign direct investment is Bidirectional- they both affect each other. The result further shows that exchange rate volatility can also predict the country`s current account balance, inflation rate, openness and real effective exchange rate.

Table 4
VAR Granger Causality after VAR Tests Results

Null Hypothesis	**P-values**	**Directional causality**
FDI does not Granger Cause RERVO *RERVO does not Granger Cause FDI*	*0.0007* *0.0299*	***Bidirectional***
RERVO does not Granger Cause CURRENT_A_C_B *CURRENT_A_C_B does not Granger Cause RERVO*	*0.0386* *0.3426*	***Unidirectional***
RERVO does not Granger Cause IFLATION_CP *IFLATION_CP does not Granger Cause RERVO*	*0.0000* *0.1895*	***Unidirectional***
RERVO does not Granger Cause OPENNESS *OPENNESS does not Granger Cause RERVO*	*0.0019* *0.2655*	***Unidirectional***
RERVO does not Granger Cause REAL_EFF_EXCH *REAL_EFF_EXCH does not Granger Cause RERVO*	*0.0033* *0.5048*	***Unidirectional***

International Journal of Advances in Engineering and Management (IJAEM)
Volume 2, Issue 1, pp: 774-788 www.ijaem.net ISSN: 2395-5252

FDI does not Granger Cause REAL_EFF_EXCH *REAL_EFF_EXCH does not Granger Cause FDI*	*0.0310* *0.9781*	***Unidirectional***
GDP_GROWTH does not Granger Cause OPENNESS *OPENNESS does not Granger Cause GDP_GROWTH*	*0.0373* *0.6335*	***Unidirectional***
GDP_GROWTH does not Granger Cause REAL_INTEREST_RATE *REAL_INTEREST_RATE does not Granger Cause GDP_GROWTH*	*0.0444* *0.4097*	***Unidirectional***
REAL_INTEREST_RATE does not Granger Cause OPENNESS *OPENNESS does not Granger Cause REAL_INTEREST_RATE*	*0.0019* *0.8967*	***Unidirectional***

6.2.4 Co-integration test results

The variables are considered co-integrated if they have long-run linear relationship among them. If the null hypothesis of no co-integration is rejected then the linear combination of the variable is stationary, therefore, a non-spurious long-run relationship exists between them as such, consistent estimate of the long-run relationship is evident. Johansen test for co-integration is what is used to test the long-run relationship of the variables. However, there are several methods of testing for co-integration but for this study, Johansen`s co-integration test is conducted after estimating the VAR model. Johansen`s co-integration makes used of maximum and Trace-statics to determine the number of co-integration equation both of which can could either give similar results but it could also give different results. However, in this study, both Eigen-value and trace-statistics give the same results; which is, at most 4 co-integrating equations. This result implied that the variables have a long run equilibrium relationship. The variables may drift from each other; but will only be in the short run, in the long run they all will move together. The Engel-Granger co-integration test from the table bellow yield a p-value greater than 0.05 percent, thus rejecting the null hypothesis that variable are not co-integrated.

Table 5
VAR Granger Causality after VAR Tests Results

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	*Eigenvalue*	*Trace Statistic*	*0.05 Critical Value*	*Prob.***
*None **	*0.954976*	*295.7272*	*159.5297*	*0.0000*
*At most 1 **	*0.842705*	*199.6101*	*125.6154*	*0.0000*
*At most 2 **	*0.822898*	*142.2715*	*95.75366*	*0.0000*
*At most 3 **	*0.741592*	*88.60963*	*69.81889*	*0.0008*
At most 4	*0.497280*	*46.66001*	*47.85613*	*0.0645*
At most 5	*0.466288*	*25.34063*	*29.79707*	*0.1496*
At most 6	*0.123321*	*5.875778*	*15.49471*	*0.7102*
At most 7	*0.056281*	*1.795732*	*3.841466*	*0.1802*

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	*Eigenvalue*	*Max-Eigen Statistic*	*0.05 Critical Value*	*Prob.***
*None **	*0.954976*	*96.11709*	*52.36261*	*0.0000*
*At most 1 **	*0.842705*	*57.33865*	*46.23142*	*0.0023*
*At most 2 **	*0.822898*	*53.66186*	*40.07757*	*0.0008*
*At most 3 **	*0.741592*	*41.94962*	*33.87687*	*0.0044*
At most 4	*0.497280*	*21.31938*	*27.58434*	*0.2574*

At most 5	*0.466288*	*19.46485*	*21.13162*	*0.0842*
At most 6	*0.123321*	*4.080046*	*14.26460*	*0.8508*
At most 7	*0.056281*	*1.795732*	*3.841466*	*0.1802*

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

VII. CONCLUSION AND POLICY RECOMMENDATION

The main objective of this paper was to assess the effect of exchange rate volatility on foreign direct investment inflows in the Gambia during the period 1980 to 2014. The GARCH (1, 1) approach was used to estimate the real exchange rate volatility of the Dalasi to the US dollar. The Vector Autoregressive VAR model was also used to analyze the effect of the exchange rate volatility on FDI. All the variables were tested for stationarity using Augmented Dickey Fuller (ADF) test and with the exception of current account balance, GDP, inflation, real interest rate and exchange rate volatility, all the other variables were found to be Non-stationary at their level. The Johansen co-integration test was performed to establish the existence of long-run relationship among the variables, and the results show the existence of such a relationship. Also, a Granger causality test was conducted on the variables and the results show that there is bidirectional causality from exchange rate volatility to FDI and vice versa. In addition, there was a unidirectional causality from exchange rate volatility to openness, inflation, real exchange rate and real interest rate, but not vice versa which was expected because all these variables are functions of exchange rate volatility.

Our findings have some implications for policy-making. Since exchange rate volatility negatively affects foreign direct investment in the Gambia, policy makers in the country should strive to achieve exchange rate stability. In light of the empirical findings in this study, the paper therefore concludes that government should continue its financial market intervention policies that are aimed at stabilizing the exchange rate market so as to improve FDI flows into the Gambian economy. It is well known, particularly within the circles of Keynesian economics that financial markets are inherently prone to failure. As a result, the guiding hand of the state is therefore needed to intervene periodically to correct for apparent market failures, particularly in the context of financial systems and markets like those in the Gambia and elsewhere in the developing world, which are characterized by weak institutions and systems.

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