

# **An Empirical Study on the Long-Run Relationships between Lower Exchange Rates and Foreign Direct Investments in Developing Economies; Evidence from Tanzania**

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*The hypothesis that devaluating and depreciating the exchange rate in developing economies will lead to fast growth and economic development has drawn some controversies and debate recently in the area of development economics. Mainly, due to the delayed results in some countries especially in the Sub Sahara Africa region. In this study, the key emphasis is on the stochastic trends of the exchange rate and the net FD inflows into Tanzania. We find a significant long-run relationship between the exchange rate of Tanzanian shilling, which is on the list of weak currencies in the world, and the net FDI inflow. We employ the Augmented Dickey Fuller test (ADF), Vector error Correction Model (VECM) and the Johansen's cointegration test to measure the time series properties of the two variables. To conclude, this study suggests LDC's to include the level of the exchange rate on the settings of the policies that will attract more FDI to flow in their market.*

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Keywords *FDI, VECM, Cointegration, Exchange rate, Tanzania.*

## **1. Introduction**

There are many factors that determine the flow of FDI's in an economy especially in the LDC and developing markets. The definition and the role of the FDI in an economy have been widely discussed from different point of views and the suggestions and main points being discussed have been quiet similar in terms of interpretations and implementations. FDI is being named as a key way towards industrialization and development in small markets such as the Sub Sahara (SSA) region. Hence there have been massive policy reforms in most developing countries to attract more FDI's inflows in their economies that will stimulate employment and capital creations. For instance, dating back in the early and mid 1980's, most SSA countries devaluated their currencies and then they let the market to determine the values (exchange rate) of their currencies aiming at promoting FDI's and exports. Like on the volume of exports, FDI's net inflow in most of SSA countries, for example Tanzania, did not improve until late 1990 and earlier years of 2000's (figure 1) whereby FDI started to pick up sharply. Therefore, the key point to be identified from this paper is the long run correlations between exchange rate and FDI's net inflow.

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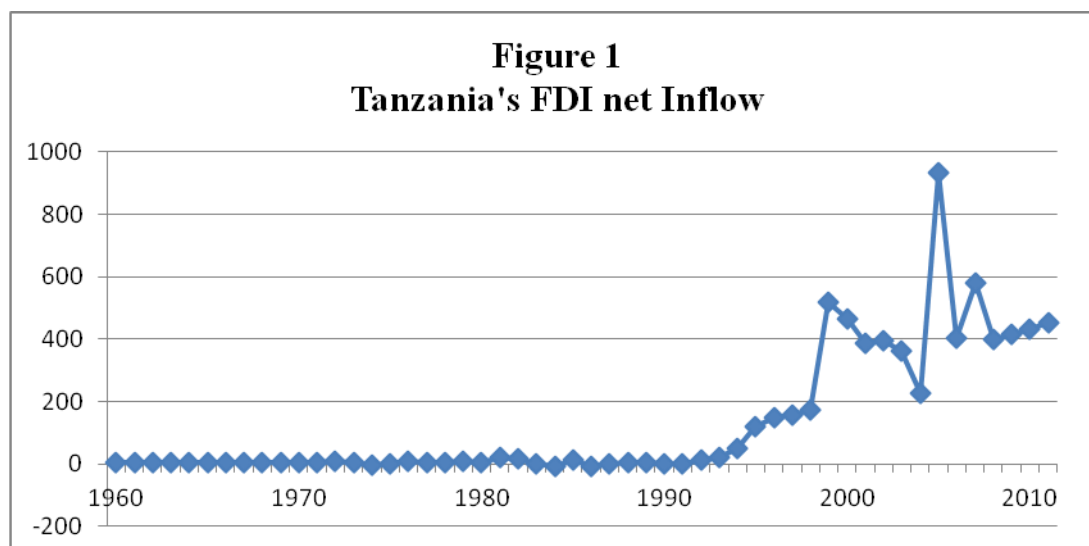


Figure 1. Tanzania's FDI net Inflow

This paper specifically examines the time series behaviors of two named variables in Tanzania's economy. Tanzania, like most of SSA countries, has struggled for number of years to attract FDI's in the economy by under tanking major adjustments on macro and structural variables. The results and trends of the FDI flow for the past 20 years in Tanzania have been disappointing and one of the variables to be blamed is the levels of the exchange rate per year which was massively devaluated to promote growth in different economic sectors. Therefore we differ with many studies which have included many structural variables that determine trade and FDI by studying the time series properties of the annual exchange rate and the net FDI inflow in Tanzania. Many recent studies have also noticed negative impacts of the recent financial/economic crisis on the flow of foreign investments especially in the more sophisticated markets. In addition, the values of the major currencies especially the US dollar and the Euro have also suffered massively as a response to the financial meltdown in the world market.

## 2. Methodology

In order to estimate the causal correlation between exchange rate and FDI in Tanzania, we employ VECM instead of VAR as our data set was not stationary at level data, rather first and second difference. Therefore, before employing the VECM process, we were satisfied by the estimated order of integration of exchange rate and FDI after setting up the VAR model at the level data (not differences) regardless of the orders of integration between the two variables and their lags. The lag length is specified by the researchers where by number of years that would allow enough amount of iteration is applied as will be shown in the results tables and graphs. There have been a wide range of studies on the relationship between the exchange rate and the flow of FDI's in an economy. In more advanced markets, some studies have employed cross section approaches to evaluate the relationships between the two variables and found very interesting results. This study is more interested on employing time series procedures to estimate and forecast the correlations between the selected variables. Studies such as Froot, 1991: and Cushman, 1985: Klein, 1994: Goldberg, 1995: and Goldberg, (1993) have also employed different time series and panel procedures to estimate the impact of the levels of exchange rate to the FDI net inflows.

Therefore the key point of this analysis is to measure the long run relationships by estimating cointegrating vectors of the key equation of the study. Therefore, measuring the cointegrating

points and variable lags, it become easier to estimate the long-run and short-run interdependence of the shillings value (Tanzania's exchange rate) and the flow of foreign direct investments hence one can easier suggest an appropriate exchange rate (equilibrium) that can persuade more foreign investments in the economy. Therefore, as we noted above, before introducing the restrictions on the VECM process, an appropriate (optimal) amount of lags (as will be specified below) that corrects the unobserved residuals for both the exchange rate and FDI flow is included in the equation and hence the granger causality test between the two variables is carried. In our analysis we carried a granger causality test (the null hypothesis is no granger causality between variables and their lags) assuming that the probability value of the first lag of the exchange rate are zero in the first equation of FDI flows under the standard Wald test (as shown by equation 1 below). The process is the same on the vise versa in the exchange rate equation where we assume that the first lags of the FDI flows are zero. Since we employ the Wald test, no additional lags are included onto both the two equations. We follow the following process,

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \dots + \alpha_p y_{t-p} + \varepsilon_t \quad (1)$$

Where by  $\varepsilon_t$  captures the residuals at time t, y is the first variable assuming the first variable (if y is the exchange rate, then the second variable FDI is zero) and vise versa. Then from equation (1)  $y_{t-p}$  is retained in the equation if and only if it has a significant parameter observed by the values of the standard errors, t-statistics and the P-values.  $p$  is the maximum (optimal) lag length at which the lagged variables are significant. Then after restricting the first step that the second variable is zero, we now include the augmented autoregressive process whereby the second variable X (assuming exchange rate or FDI) is included as showed below;

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \dots + \alpha_p y_{t-p} + \beta_p x_{t-p} + \dots + \beta_q x_{t-q} + \varepsilon_t \quad (2)$$

Whereby,  $x$  is the second variable for testing the causal relationship between  $y$  and  $x$  that is FDI and exchange rate respectively other factors being constant. The granger process assumes that all the lagged parameters of  $x$  that are identified to be solely significant by their probability values and their standard error indicates to have a significant causal impact on the parameters of  $y$ . This can also be observed by the value of the  $f$ -test which has a null hypothesis of rejecting the existence of impacts of the second variables joint lags of both  $y$  and  $x$ . Therefore the null hypothesis is, if the values of  $x$  are assumed to be constant (from equation 2), then the values of  $x$  does not Granger cause  $y$  if the lagged parameters of  $x$  are not retained in the equation. Therefore, from this procedure of the Engle-Granger, the identification of the Vector error correction Model helps to show the relationship between  $y$  and  $x$  overtime.

Then, based on the process of estimating the VECM, Engle and Granger (1987) specified a two-step estimation process for dynamic modeling which has become strong on advanced data analysis. The first step assume that  $y$  (FDI) is stationary I(1) in such a way that the OLS process is suitable for estimating the equation as follows;

$$y_t = \alpha_0 + \alpha x_t + \Phi \quad (3)$$

Then the cointegrating residuals  $\hat{\phi} = y_t - \hat{\alpha}_0 - \hat{\alpha}x_t$  can be tested by the Dickey Fuller test to find out whether they have a unit root by measuring the auto-regression of  $\hat{\Phi}$  as shown below;

$$\Delta\hat{\Phi}_t = \rho_1\Delta\hat{\Phi}_{t-1} + \varepsilon_t \quad (4)$$

Then, if  $\rho = 0$  then we reject the null hypothesis (non stationary) against the alternative of  $\rho < 0$  (stationary). On the other hand given the fact that the OLS estimations reduces the residual variance of equation (3) and hence producing weak results, there are needs to include the trends and intercept into equation (4) so as to estimate the extended DF test known as Augmented Dickey fuller test shown below;

$$\Delta\hat{\Phi}_t = \rho_1\hat{\Phi}_{t-1} + \sum_{i=1}^p \gamma_i\Delta\hat{\Phi}_{t-i} + \varepsilon_t \quad (5)$$

Therefore, since the residuals of equation (3) are rejecting the null hypothesis of the existence of a unit root, the term  $\hat{\Phi}_{t-1}$  is included in the VECM process while the remaining parameters are estimated by OLS. There other unit root testing that can also measure the degree of convergences of the FDI and exchange rate as will be shown by the results. Finally, we identify the long-run short run relationships between FDI and exchange rate by restricting that exchange rate shocks have no impacts on FDI in the short run rather in the long-run. That also means, by imposing restrictions into the VECM process, we estimate the impulse responses since a shocks in one variable can generate variations in it-self and to the other variables in the model. The procedures and types of impulse responses to be employed are explained in the results presentation but mostly we employ the approaches that will help to trace the time path of various shocks. Therefore, to conclude this part, the above procedures are expected to produce results that examine the short run and long run relationship between FDI and exchange rate in Tanzania. Some of the specified procedures have been named as weak but, by estimating the results stage by stage as specified above we hope to produce efficient and significant results. The most interesting results are those that include long-run restrictions since they are more directly related to macro-economic equations. This is due to the fact that most developing countries do not include the exchange rate in the policy formulations.

### 3. Data

The annual data set from 1960 to 2011 is gathered from the World Bank and UCTAD for the exchange rate of Tanzania who is the case study of this study. We follow all the necessary econometric procedures suggested above so as to identify the stochastic trends, long-run and short run correlations and finally estimate the long run equilibrium relationships of the exchange rate and FDI flow. We therefore employ the Official exchange rate and the Net FDI inflow. Unlike other studies which use FDI outflows and total FDI flows as dependent variables, this study employs the FDI inflows given the fact that FDI inflows matters more on growth and development as compared to the former. Therefore the rest of the paper is organized as follows; first we present the results and finally we present the interpretations and policy implications and the conclusion.

Table 1 Null Hypothesis: Official Exchange Rate has a unit root

Variable	ADF on OER	ADF on D(OER)	ADF on D(OER,2)
Official Exchange Rate(-1)	0.039**	-	-
D(Official Exchange Rate(-1))	0.345**	-0.375**	2.731***
D(Official Exchange Rate(-2))	-	-	1.958**
D(Official Exchange Rate(-3))	-	-	1.543**
D(Official Exchange Rate(-4))	-	-	0.747**
D(Official Exchange Rate(-5))	-	-	0.901*
C	0.000	0.000	0.000
Test critical values: 1% level	-3.568	-3.568	-3.589
5% level	-2.921	-2.921	-2.929
10% level	-2.599	-2.599	-2.603
R2	0.43	0.15	0.79
Augmented Dickey-Fuller test statistic (P-Value)	1.000 (2.995)	0.06 (-2.864)	0.000 (-4.699)

T-stat in parenthesis, Lag length follows the Schwarz criterion. OER stands for "Official exchange rate". \*, \*\*, \*\*\* implies significant at 1%, 5% and 10% degrees of freedom.

Table 2 Null Hypothesis: FDI Net Inflow has a unit root

Variable	ADF on FDINETINFLOW	ADF on D(FDINETINFLOW)	ADF on D(FDINETINFLOW,2)
FDINETINFLOW(-1)	-0.817***	-1.608***	1.888
D(FDINETINFLOW(-1))	0.536*	-	-3.988
D(FDINETINFLOW(-2))	0.350	-	-5.126
D(FDINETINFLOW(-3))	1.098**	-	-5.947*
D(FDINETINFLOW(-4))	0.307	-	-6.837*
D(FDINETINFLOW(-5))	0.928**	--	-7.751**
D(FDINETINFLOW(-6))	1.886***	-	-6.974**
D(FDINETINFLOW(-7))	-0.076	-	-7.005**
D(FDINETINFLOW(-8))	2.282**	-	-5.516**
D(FDINETINFLOW(-9))	-0.891*	-	-4.805***
D(FDINETINFLOW(-10))	3.029***	-	-2.777***
C	20.855	14.216	-16.368
Test critical values: 1% level	-3.601	-3.568	-3.611
5% level	-2.935	-2.921	-2.939
10% level	-2.606	-2.599	-2.608
R-squared	0.73	0.80	0.976
Augmented Dickey-Fuller test statistic	0.003 (-4.064)	0.000 (-14.026)	0.979 (0.384)

T-stat in parenthesis, Lag length follows the Schwarz criterion. FDI NET INFLOW stands for "FDI Net Inflow". \*, \*\*, \*\*\* implies significant at 1%, 5% and 10% degrees of freedom.

The long run restrictions imposed in the VECM process above explains that the Tanzanian shillings exchange rate shocks do not impact the FDI net inflow. Therefore, the lower and upper bounds are estimated by unit standard errors. The literature suggests that the short run shocks can be obtained from the standard VAR model to estimate the inter-dependence of the

two variables within the time lag. The  $R^2$ , standard errors and the t statistics of the VECM process in the above table are strongly significant to support the fact that there is a long-run convergence between the two variables are their lags hence the long-term correlation is significant for policy formulation and analysis. This can also be proved by the impulse responses as explained below.

Table 3 Vector Error Correction Estimate

Error Correction	D(FDINETINFLOW)	D(OER)
CointEq1	-9.838 (-35.538) [-0.277]	0.00003 (-0.00001) [ 2.94030]
D(FDINETINFLOW(-1))	-0.742 (-0.148) [-5.003]	9.67E-08 (-4.3E-08) [ 2.27311]
D(FDINETINFLOW(-2))	-0.229 (-0.151) [-1.516]	5.13E-08 (-4.3E-08) [ 1.18114]
D(OER(-1))	538113.4 (-568512) [ 0.947]	0.363988 (-0.16298) [ 2.23331]
D(OER(-2))	141810.5 (-568960) [ 0.249]	-0.10519 (-0.16311) [-0.64489]
C	-1.584 (-24.896) [-0.064]	2.31E-05 (-7.1E-06) [ 3.23129]
R2	0.41	0.49
Adj. R2	0.35	0.43
Akaike information criterion	-5.10	
Schwarz criterion	-4.56	
Chi-square(1)	17.905	
Probability	0.000	
Cointegrating Equation:	Cointegrating Equation	
FDINETINFLOW(-1)	0.000	
OER(-1)	1402.404	
C	-0.506	

Standard errors in ( ) & t-statistics in [ ]. OER stands for the Official Exchange rate while FDINETINFLOW stands for the FDI net inflows. Convergence achieved after 1 iterations. LR test for binding restrictions (rank = 1). Not all cointegrating vectors are identified.

The impulse responses applied above is an additional check of the cointegrating levels of the Official exchange rate and foreign direct investments net inflow. The generalized impulses One S.D innovations are estimated from the restricted VECM so as to draw more meaningful interpretations for the short run and long run responses of shocks. Therefore, from the above impulse estimations, the recursive structure assumes that the first variables to appear, explains the other variable but not the vice versa. Therefore, both FDI net inflows and the official exchange rate indicate to have positive long run correlations. For instance in the response of FDI net inflow to official exchange rate positive implying FDI net inflow granger cause the exchange rate. In addition, the response of the exchange rate to the FDI net inflow is also positively correlated implying the exchange rate granger cause the FDI net inflow of Tanzania.

Response to Generalized One S.D. Innovations

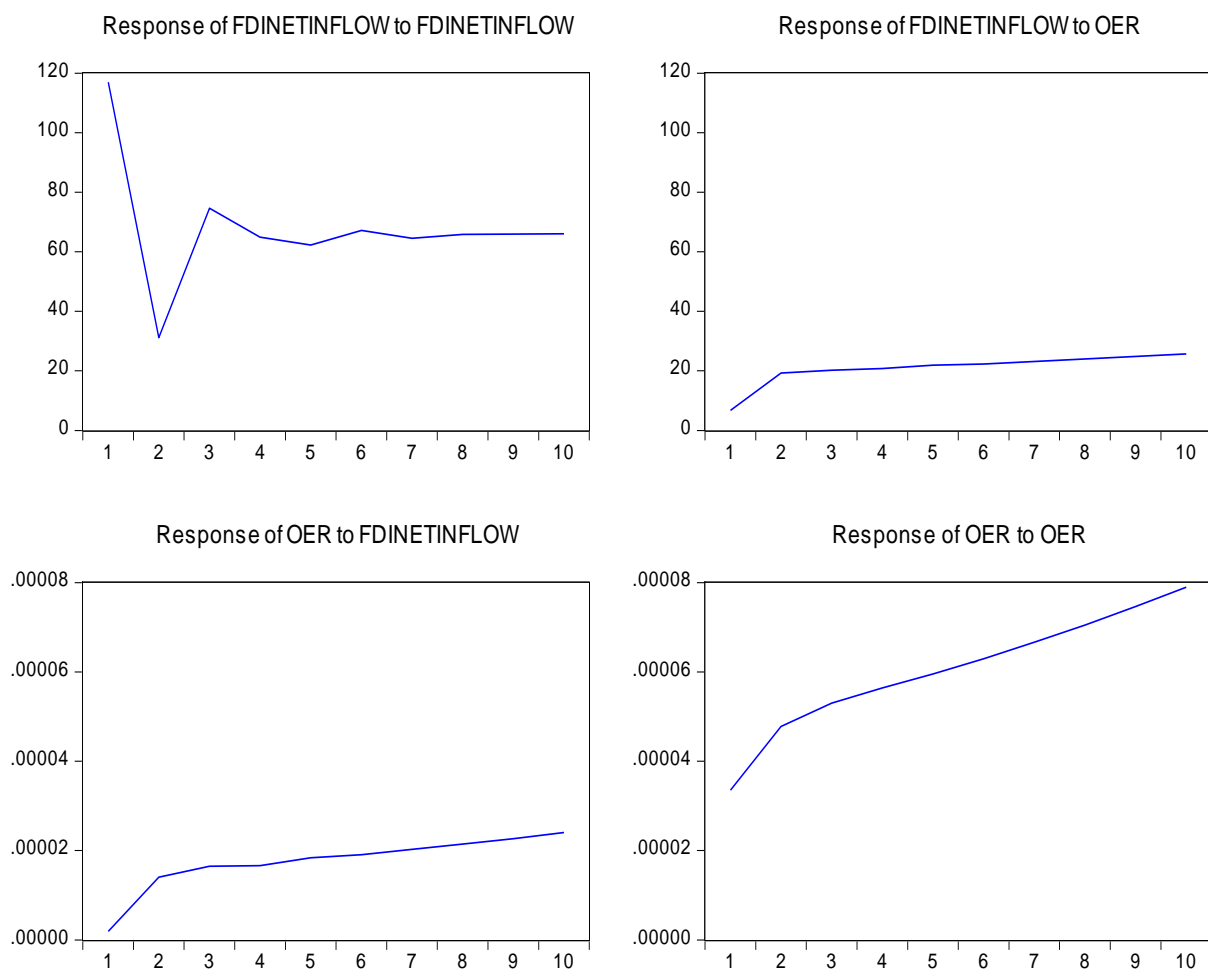
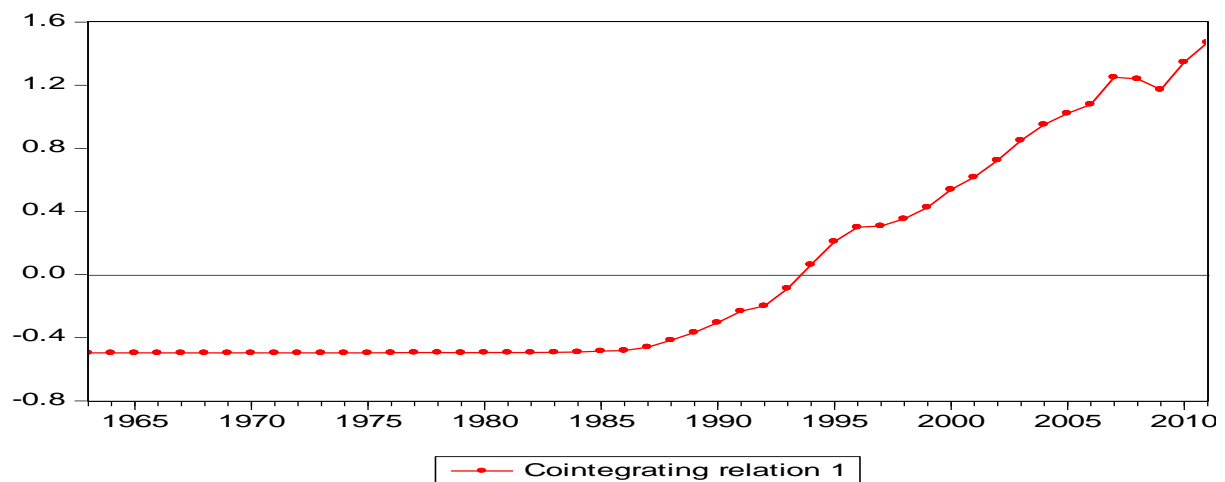


Table 4 Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized Eigenvalue	Trace Statistics	0.05	Pob.**	
Critical Value				
Hypothesized No of CE(s)				
None *	0.424	32.157	15.495	0.000
At most 1 *	0.099	5.086	3.842	0.024
Trace test indicates 2 cointegrating equations at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized Eigenvalue	Trace Statistics	0.05	Pob.**	
Critical Value				
Hypothesized No of CE(s)				
None *	0.42	27.07	14.26	0.000
At most 1 *	0.10	5.09	3.84	0.024
Trace test indicates 2 cointegrating equations at the 0.05 level				
Tests of cointegration restrictions:				
Hypothesized No of CE(s)	Log-likelihood	LR Statistic	Degrees of Freedom	Pobability
1	138.91	17.91	1.000	0.000

Lags interval (in first differences): 1 to 2. Trend assumption: Linear deterministic trend

The null hypothesis that the series are not cointegrated is rejected at 5% of freedom and the alternative cannot be rejected since the trace statistics and Maximum-eigenvalue test indicates two (2) cointegrating equations. That also means there is a long run equilibrium relationship between Tanzania's official exchange rate (Tanzania shillings Vs USD) and the FDI net inflow (Johansen, 1991 and 1995). That also implies that the long run adjustments in FDI have similar impacts (positive/negative) impacts to the movements of the annual exchange rate of Tanzania.



## 5. Conclusion

This paper examines the short run and long run correlations between FDI net inflows to Tanzania and the levels of exchange rate per year. We clearly assume “other factors” that determines FDI inflows and exchange rates per year are constant so as to run time series statistical procedures. The procedures being employed by this study has become very famous in estimating the long run romantics between variables of an equation and hence the results being produced are very powerful in explain the relationship between the levels of the exchange rate and the FDI net inflow. Therefore given the fact that most of time series variables behave like a random walk, first we carefully investigated the stochastic trend of the two variables whereby the ADF test is widely used to estimate the coefficients of the lags of the variables hence project their long run behaviors. Then in the second phase we employ the VECM process which helps to restrict the short run against the long-run relationships between the exchange rate and the FDI net inflows.

In addition, the VECM process identifies other unreported outputs such as the variance decomposition, residuals, Granger causality and the lag selection procedures. All the outputs from this process produce results which have similar implication to the study and hence concluding that the two variables have long run equilibrium relationships. The third and last process employed is the Johansen cointegration test which helps to identify the cointegrating equations using the trace statistics and Maximum-eigenvalue of the model. Therefore both, the ADF, VECM and Johansen results rejects the null hypothesis that the long run convergences are significant in such as a way that the exchange rate and the FDI net inflows are adjusting equally hence we cannot reject the alternative hypothesis that the two variables explains each other in the longer term.



As for policy implications, it is important to entertain some adjustments on the official exchange rate as an indicator of the stability of the medium of exchange in an economy so as to ensure stable FDI net inflows in the long run. Other variables such as technology, infrastructures, political stability, improving the living standard, etc, are also crucial on encouraging more FDIs. It is not easier, however, to capture the short run romantics of the two variables since structural and other policy related variables tend to play a significant role on ensuring stable FDI inflows within a short time span. Like any kind of research, this paper is not immune from limitations especially on the data set which range from 1960 – 2011 annual data. Perhaps monthly or quarterly data on the selected variables could have allowed this study to employ even more econometric procedures. Therefore, we recommend further investigation especially in developing economies where there are scarce of data and studies in such areas.

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