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Impact of Oil Prices on Nominal Exchange Rate: Evidence from Ghana

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Abstract:
The research work analysis the how crude oil prices have impact on the nominal exchange rate in Ghana. The problem statement of the study was that the endorsement of current floating exchange rate by Central Bank as part of economic reform program in 1983 has brought about not a single year that the currency not losing it value. This effect of the depreciation of exchange rate has posed a major challenge among individuals, business community, policy makers and government. The Government attribute these volatility in exchange rate to the gradual changes in the generational mix from hydro to thermal energy source, as the nation import more crude oil from the world market to power the generational plants in order to produces electricity couple with the amount of oil that these Ghana Chamber of Bulk Oil Distributors and Oil Marketing Companies import in the country for industries and transportation are to be the cause of the depreciation of the Cedis. The study adopted Aziz (2009) model to estimate the short run and long run relationship between oil prices and exchange rate as well as time series analysis. The study employed an Autoregressive Distributed Lag (ARDL) approach to analyse the annual data from 1983-2014 in order to get the results estimation which help achieve the above objectives. The empirical results of the study indicated that Oil prices from the international market, CPI, import tax influence nominal exchange rate in the long run. However, in the short run only the CPI that influences the nominal exchange rate in Ghana. Oil prices and import tax were not significant in the short run in determining the nominal exchange rate. Interest rate was not significant both the long run and the short run according to the study.

1. Introduction

The impact of exchange rate volatility on actual activities has been issue to widespread debate among economists. These exchange rate fluctuations can be looked it into two main ways, these are the demand side and the supply side. On the demand side, there has been a general idea that depreciation or devaluation of the currency could increase production when the country encourages net export component. Depreciation of the currency increases imported inputs cost like crude oil which causes the rises in cost of production of government and companies. However, if the declines in aggregate supply counteract the rise in aggregate demand, the depreciation of currency leads to a decline in domestic production (Bahmani-Oskooee and Kandil, 2007).

Exchange rate fluctuation is a threat to developing economies in term of financing its national budgets to meet the demand of the people. This volatility in exchange rate is normally explained by economic factors such as inflation rate, balance of payments and interest rate (Ozturk, 2006). Ozturk (2006) in his research work on the effect of price of oil and exchange rate fluctuations on economic growth argued that depreciation of currency result in a rise in export and a decline in import of the country.

The relationship between oil prices and economic activities have being a subject of discussion recent times, as changes in oil price affect domestic prices oil which in turn affect virtually everything in the country thereby reduces the standard of living of the people. Economists are of great extent concerned in finding the cause of the factors exchange rate movements which create discomfort among the populace (Anderton and Skudely, 2001).

The volatility in movement in the price of crude oil price in recently years, attaining the high record price in the 2008 has led to a growing concern about it macroeconomic consequences on Ghana. Researchers have explained that the prices of oil have major impact the macroeconomy. one of these effect is that countries that depend on the importation of oil from the world market turn to have trade balance deficit which have impact the budgets of the countries more especially the open small economy. In fact, the Central Bank of developing countries consider international crude oil prices volatility as a key risk to the maintaining fulfilled inflation target as shown by the various statements of the Monetary Policy Committees of the countries (Wakeford, 2006).

While a lot of research have been carried out in relation to the nexus between exchange rate and crude oil prices and its effect on the economy in the oil exporting countries (Oriavwote and Eriemo, 2012; Nikbakht, 2009). In spite of important roles oil plays in the economy of importing economies, not much evidence existson the connection between oil prices and exchange rate in Ghana known as a net importer of oil. Oil prices and exchange rate in Ghana has always been much contention among policy makers, economist, and businesses because of its volatility and consequent impact on various sectors of the economy. Against this background that there is the need to evaluate the connection between crude oil prices and the exchange rate in Ghana.

Although Ghana is known for extracting of oil in commercial quantities challenges facing Tema Oil Refinery in terms of inefficient equipment used in refining the oil couple with high cost of production, have made the country export its crude oil and import refined products leading to high cost of domestic oil prices. Available statistics from Ghana Energy Commission show that in 2001 oil consumption was 1,537.0 ktoe, it increased to 2,126.6 ktoe in 2007 and risen to 3,317.5 Ktoe in 2012 which show that Ghana total petroleum products Consumed is going up. This couldmean that more Cedis will be needed to purchase US dollar which in turn be used in importing oil into the country. Such a sizeable reliance on importation of crude oil from the international market could expose Ghana whenever oil prices increase which in turn have impact of economic growth and development of the people.

Endorsement of current floating exchange rate by Central Bank as part of economic reform program in 1983 has brought about not a single year that the currency not losing it value. This effect of the depreciation of exchange rate has posed a major challenge among individuals, business community, policy makers and government. The Government attribute these volatility in exchange rate to the gradual changes in the generational mix from hydro to thermal energy source, as the nation import more crude oil from the world market to power the generational plants in order to produces electricity couple with the amount of oil that these Ghana Chamber of Bulk Oil Distributors and Oil Marketing Companies import in the country are to be the cause of the depreciation of the cedis. Against this background that, the study seeks to investigate the link between oil prices from international market and nominal exchange rate and how it effects the Ghanaian economy.

1.1. Objectives

The research seeks to find out the effect of international oil prices on nominal exchange rate which in turn effect on domestic price of petroleum products in Ghana. Specific objectives are

i. To investigate the connection between oil prices and nominal exchange rate in Ghana.
ii. To examine the Short Run and the Long Run relationship between oil prices and exchange rate in Ghana.
iii. To examine how international oil prices, affect nominal exchange rate which in turn affects domestic petroleum prices in Ghana.
iv. To make recommendations based on the finding of the study.

2. Methodology

The research used a time series data in investigating the connection between oil prices, interest rate, inflation and import tax rate on exchange rate. The data was obtained from secondary source; the Brent oil prices from Energy Information Administration (EIA) and exchange rate, interest rate, Consumer Price Index (CPI) from the International Financial Statistics (IFS) published by the International Monetary Fund and import tax rate from World Development Indicators of the World Bank for period of 1983 to 2014 were used for analysis. All estimations were carried out using the E-Views software. The study adopted Autoregressive Distributed Lag approach to calculate the yearly data set.

2.1. Specification of Model

The study adopted Aziz (2009) to calculate linkage between international oil prices and exchange rate. Aziz (2009) applied the approach to calculate the long run impact of actual oil price from the international market and the actual real interest rate differential on actual (real) exchange rate among some selected net oil exporting and net oil importing countries.

ER = F (ROIL, IRD) ……..……... (3.1)

Where ER (actual exchange rate) is function of actual price of oil in the world market (ROIL) and the actual interest rate differential (IRD).

Since oil prices and interest rate have effect on the prices of goods and services which significantly impact the exchange rate according to Kin and Courage 2014, The study used the Aziz (2009) model but however modified it to estimate both the short term and the long run effects of crude oil prices, interest rate, import tax rate and inflation rate on nominal exchange rate in Ghana. This was put into the equation as follows.

NER = f (OPR, CPI, ITR, IMT)…… (3.2)

Where, the Nominal Exchange Rate (NER) is the function of Bent oil prices from world market, interest rate (ITR), Import tax rate (IMT) and Consumer Price Index (CPI) which are expressed in its regression form to estimate the effects.

The modified empirical model explaining the relationship between the variables chosen on nominal exchange rate in a Ghanaian set up can therefore be stated as follows

$$LNNEX = \beta_0 + \beta_1 LNOPR + \beta_2 LNCPI + \beta_3 LNITR + \beta_4 LNIMT + \sum t \ldots\ldots\ldots\ldots\ldots\ldots (3.3)$$

$\beta_1 >/< \beta,\ \beta_2 >/< \beta,\ \beta_3 >/< \beta$ and $\beta_4 >/< \beta$

Where; β_i represent the elasticity coefficients and $\sum t$ is the error term.

2.2. How the Variables were Introduced into the Model

An increase in oil prices from the world market will cause the Ghanaian cedis to depreciate which put pressure on the nominal exchange rate. This is could mean that changing of the generational mix from hydro to thermal may require more oil to power the generational plants to produce electricity couple with what BDCs import for transportation and industries will cause the nominal exchange rate to depreciate. However, a fall in oil prices could still cause the nominal exchange rate to depreciate since Ghana is known as a net importer of oil.

A rise in CPI could force the Bank of Ghana to adapt to inflationary targeting by increasing interest rate which in turn show down the economy. As result of rise in interest rate could attract more foreign investors to see Ghana as destination point for them to earn high profit from investment into economy leading to appreciation of nominal exchange rate. A decline in CPI means that general prices of goods and services within the country is low which could make people demand more goods and services from foreign countries leading to the exchange rate depreciating. Thus, Ghana is an importing nation where we import almost everywhere putting pressure on the exchange rate.

However, an increase in interest rate tend to cause exchange rate to depreciation in the essence that government will have to embark on expansionary policy by spending in the critical sector of the economy such as building infrastructures and among others which in turn increase the income level of the people. This rises in income cause people to demand more goods and services leading to the exchange rate to depreciate. A decline in interest rate tend to attract firms to borrow from banks at lower rate so as to import raw materials, others goods and services which in turn put on pressure on the cedis leading to exchange rate depreciation.

Increase in import tax rate on foreign goods especially those that are produce in the country make importation of goods unattractive to importers which reduces the pressure on the currency resulting in appreciation of the cedis. A decline in import tax on foreign goods however could encourage these importers to import all kinds of goods and services to the country leading to the exchange rate depreciating.

3. Empirical Methodology

3.1. Augmented Dickey-Fuller (ADF) Test

Most of the macroeconomic time series have the tendency to show a rising trend over time resulting in question of differencing to give a stationary property to the variable. The concept of a general movement in time series data has motivated the idea of co-integration developed by Engle and Granger (1987). The general acceptable in Cointegration analysis is to look at series properties of the data. This starts with the determination of the univariate properties of the time series.

In literature under time series, unit root test like Dickey Fuller (DF) test is commonly used for testing of stationary and non-stationary in economic data. The researcher test each of the selected variables to see at what level the variable is stationary. If all the selected variables are stationary then researcher will carry on with the study however if any of the variable is not stationary then the researcher will further test those non-stationary variables at the first difference known as integrated on order one I (1) to ensure that the variables are stationary. For this rationale behind doing Augmented Dickey Fuller test is to check the stationary of the variables used in the study. The presence of unit root in the series at its degree clearly means that the variable is non-stationary which required the researcher to order of integration one or higher. The non-existence of unit root means the variables are stationary.

3.2. Co-integration Tests

In research work, Economic time series variables are normally non-stationary and thus make OLS regression futile. To keep way from the problem of specious regression associated with non-stationary variables, researchers normally resort to co-integration analysis. Co-integration means that though individual series variable might not be stationary but their combination with other variables might result in a stationarity. This implies that co-integration exists between nonstationary variables if co-integrating regression of the residuals is stationary. (Granger, 1986). Thus, inaccuracy can only be shunned if a stationary co-integrating relationship is founded between the variables.

There are many econometric literatures showing econometric techniques that seek to examine Co-integration links among macroeconomic variables. These can be group into two main groups they are univariate and multivariate co-integration techniques. Among some of examples of univariate cointegration approach are the Engle-Granger (1987) and Fully Modified Ordinary Least Square (FMOLS) and Engle Granger (1987). Examples of multivariate cointegration approach include Johansen (1988) cointegration, Johansen and Juselius (1990) and Johansen (1995) cointegration method give full information for the utmost likelihood co-integration approach. In spite of the abovementioned co-integration methods, the study adopts the Autoregressive Distributed Lag (ARDL) technique offered by the Pesaran et al 2001 was used to investigate the relationship between oil prices and nominal exchange rate in Ghana. The selection of this model (technique) is explained by its appropriateness for the data used for the study and also more current studies recommended the used Autoregressive Distributed Lag Model to cointegration against convectional cointegration like Engle Granger (1987).

There are four reasons why the bound test approach for the study was chosen. These are including first, ARDL is applicable for both large sample size and small sample size of which the bounds test make it stronger and perform better for small sample size such as the study which has only 31 observations. Second, ARDL approach does not need all the regressors to be incorporated of the same order. In other words, it is applicable whenever regressor is purely integrated of order zero or one. Third, another complexity that Autoregressive Distributed technique try to eliminate has to do with large choices decisions which must be decided which include the

decisions concerning the number of endogenous and exogenous variables (if any) is to be added, optimal number of lag should be specified as well as treatment of deterministic level and Vector Auto Regression (VAR) order to used (Persaran et al, 2001). Also, Autoregressive Distributed Lag model addresses endogeneity challenges and incapability to test estimated coefficient in the long run (Persaran et al 2001).

3.3. Theoretical Framework

The ARDL approach to Co-integration originated by Pesaran et al..., (2001) is applied in this study to run the long run effect regression equation of the dependent and independent variables. The study used Persaran et al (2001) to modelled equation (3.3) as the general Vector Autoregressive model of order P in Z_t

$$z_t = c_0 + \beta t + \sum_{t-1}^{t} \emptyset\, Z_{t-1} + \varepsilon_{tj}, \quad t = 1,2,3 \ldots\ldots T \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

Where C_0 represents (k+1) a vector of the intercepts and β indicating a (k+1) of the movement coefficient. Persaran et al., (2001) expand the model by deriving a Vector Error Correction Model (VECM) which is as follows.

$$\Delta z_t = C_o + \beta t + \pi\, \Delta\, Z_{t-1} + \sum_{t-1}^{P} \Gamma\, \nabla\, Z_{t-1} + \varepsilon_t, \quad t = 1,2,3 \ldots\ldots T \ldots\ldots\ldots\ldots (3.5)$$

Where (K+1) *(K+1) = matrices $\pi = I_{k+1} + \sum_{t-1}^{P} \psi_i$, $-\Gamma_i = \sum_{j=t+1}^{P} \psi_j$, I = 1,2,3…… P-1 to obtain the long run multiplierand short run coefficients of the VECM. Z_t denotes the vector of variables y_t and x_t separately. Precisely y_t denote the dependent variable with a unit root as stated as LnNER, whilst x_t is vector matrix of I(0) and I(1) independent variables which are $LnOPR_t$, $LnCPI_t$, $LnITR_t$, $LnIMT_t$ and $\varepsilon_t=(\varepsilon_{1t}, \varepsilon_{2t})$ is a vector of residual which has a mean of zero and homoscedastic process. Another condition of the VECM is to make an assumption which will help the study get a unique long run relationship among the variables. This is written as follows,

$$\Delta y_t = c_{y0} + \partial_{yy} y_{t-1} + \partial_{xx} x_{t-1} + \sum_{t-1}^{P} \lambda \Delta\, y_{t-1} + \sum_{i=0}^{P-1} \xi_i \Delta\, x_{t-1} + \varepsilon_{yt},$$

$$t = 1,2,3 \ldots\ldots T \quad \ldots\ldots 3.6$$

Based on the conditional VECM, the study gives an appropriate specification framework as follows

$$LN\,NEX = \alpha_0 + \sum_{t-1}^{s} \beta_1\, \Delta LNNEX_{t-1} + \sum_{t-1}^{t} \beta_2\, \Delta LNOPR_{t-1} + \sum_{t-1}^{u} \beta_3\, \Delta\, LN\,CPI_{t-1} + \sum_{t-1}^{x} \beta_4\, \Delta\, LN\,ITR_{t-1} + \sum_{t-1}^{y} \beta_5\, \Delta\, LN\,IMT_{t-1} + \alpha_1\, LN\,NEX_{t-1} + \alpha_2\, LN\,OPR_{t-1} + \alpha_3\, LN\,CPI_{t-1} + \alpha_4\, LN\,ITR_{t-1} + \alpha_5\, LN\,IMT_{t-1} + U_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

All the variables of the study are defined from Equation (3). From equation (3), the elasticities estimations of the β_t represents the short run relationship of the regression. α_o represents the drift component. From equation (4) the dependent variable (LNNEX) is the unit root and the elasticities estimations of α_t of the independent variables represent the long run relationship. α_o represents the drift component and U_t represent error item.

3.4. ARDL Cointegration Procedure

According the Pesaran et al (2001), there are three stages or steps in ARDL procedure used in estimating the long run relationship between all the variables in an equation. The first stage is to examine the presence of relationship among all the variables in the equation. This is done in the study by estimating equation (3.7) by Ordinary least square and carrying out F-test for joint significance of the related lagged coefficient. Regarding equation (3.7) the hypothesis is named as

H_0 : $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 0$

H_1 : $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq 0$

Because of the fact that asymptotic distribution of the F statistics are not standard under the Null hypothesis of Co-integration of all the variables chosen in the study, Pesaran et al 2001 presented two sets of asymptotic critical values for inference as way of removing any doubt when using ARDL model. The first stage (lower bound) take on that all the variables are I(0) while the second (upper bound) take on that all the variables are I(1). The calculated F statistics of equation (3.7) is compared to the critical values and if the result shows that F statistics is greater than the upper bound critical value, then the null hypothesis of no co-integration is rejected which means that there is a steady state among the variables under consideration. Alternatively, if the calculated F statistics is below the lower bound critical value then it means that the null hypothesis of no co-integration cannot be rejected showing that there isnon-existence of long run relationship among the variables. The last point is that if the estimated F statistics value is within the lower and the upper bound critical values then it means that the results is indecisive indicating from Pesaran et al (2001) that the time series properties of the variables must be known first before any inference can be made. Pesaran et al (2001) further stated that the approximate critical values obtained from the study should be used.

The second stage involves calculating the result of the long run and short run coefficients the same equations. It is key to state that second stage is conducted only if there is sign of a long run relationship in the F statistics and the upper bound critical value as explained in stage one (Narayan et al 2004). The estimating of the long run and short run models in equation (3.6) is based on Akaike Information criteria (1973). When it turns out to be evident that a long run relationship (co-integration) exists among the variables, the ARDL (s, t, u, x, y) long run model can be calculated as

$$LNNEX = \beta_0 + \sum_{i=1}^{s} \beta_1 LNNEX_{t-1} + \sum_{i=0}^{t} \beta_2 LNOPR_{t-1} + \sum_{i=0}^{u} \beta_3 LNCPI_{t-1} + \sum_{i=0}^{x} \beta_4 LNITR_{t-1} + \sum_{i=0}^{y} \beta_5 LNIMT_{t-1} + U_t \dots\dots\dots\dots\dots\dots\dots (3.8)$$

Where all variables in the study are earlier defined. The final step requires specification of the Autoregressive Distributed model to the changes in the short run which are done by building an Error Correction Model to analysis the changes in the independent variables impact on the nominal exchange rate (dependent variable) in the short run. The short run equation is calculated as

$$LNNEX = \beta_0 + \sum_{i=1}^{s} \beta_1 LNNEX_{t-1} + \sum_{i=0}^{t} \beta_2 LNOPR_{t-1} + \sum_{i=0}^{u} \beta_3 LNCPI_{t-1} + \sum_{i=0}^{x} \beta_4 LNITR_{t-1} + \sum_{i=0}^{y} \beta_5 LNIMT_{t-1} + \psi ECM_{t-l} + U_t \dots\dots\dots\dots\dots\dots\dots (3.9)$$

All variables in the study are earlier defined, Δ shows the difference operator and ECM_{t-l} is the one period lagged error correction term whiles β_s means short run dynamic coefficients of the model merging to equilibrium. The co efficient error term (ψ) calculates the speed of adjustment to attain equilibrium in the event of shock to the system in the short run.

3.5. Results of the Unit Root Test

In time series data, it is relevant to look at the properties of time series data before analysis and inferences are made since most time some of the data are non-stationarity in their levels. A test for stationarity of the data variables was completed to confirm that selected variables are not integrated of order two I (2) so as to keep away from false outcomes. The ARDL collapse with I(2) series as the calculated F statistic offered by Persaran et al (2001) are not suitable in the existence of I(2). This is explained as that test bound is established under assumptions that data variables are integrated of either order zero or one.

Augmented Dickey Fuller (ADF) test was done confirm for the unit root and order of integration of the variables data. Table 1 presents the results of the unit root test. The regression test incorporated both a constant and the first differences. The regression test comprises both nonlinear and linear trend for both the log levels and the first differences.

VARIABLES	LOG LEVEL		FIRST DIFFERENCE	
	NON LINEAR TREND	LINEAR TREND	NON LINEAR TREND	LINEAR TREND
LNEXR	-4.542192	-4.728501	-6.587324**	-6.370639**
LNOPR	-0.365699	-2.442521	-5.960307**	-6.253700**
LNCPI	-3.346129	0.04885	-3.49444**	-4.092332**
LNITR	-1.6879	-2.294383	-5.500778**	-5.414050**
LNIMT	-1.494684	-1.329106	-5.931130**	-5.994971**

Table 1: Result of the Unit Root Test

Note that rejection of the Null hypothesis of the unit root is at 5%

The ADF test entails testing the null hypothesis to find out if stationary or nonstationary exists within the data variables as against the alternative hypothesis. From Table 1, it can be noted from column of one and two that, when the regression was calculated at log level (nonlinear and linear trend) two of the variables was discover to be the stationary. They are exchange rate and Consumer Price Index. The rest of the variables were nonstationary because calculated numbers of the test statistic for the variables of linear and nonlinear trend at it log level were lower than the critical values of the ADF in absolute term at the 5 percent level of significance. This means that the null hypothesis of the non-stationary variables cannot be rejected based on the values of the ADF unit root test. This required the study to do integrated at their first difference or higher since some of the variables were not stationary at the log level.

At the first difference, all the variables became stationarity as found in column three and four of Table 1 because estimated coefficient of the test statistic of the all variables data were higher than the critical values of ADF unit root test in absolute term at 5 percent level of significance. This means that the null hypothesis of non-stationarity is rejected and the alternative hypothesis is accepted as the first difference of the variables is integrated of order zero showing that they are stationary.

3.6. Bounds Test for long Run Relationship of the variables

To test for co-integration between nominal exchange rate and the other variables for Ghana, equation (1) is estimated using the Autoregressive Distributed Lag (ARDL) model to Cointegration. The result of the bound test method to co-integration is shown in Table 2. Before a decision rule is made, one has to look at how Pesaran et al (2001) explain, the computed F-statistics compared with the critical value of upper bound before inference could be drawn. From the Table 2, it can be stated that the computed F-value = 10.60740 is greater than the critical value of the upper bound of 4.01 at the 5% level of significance. This means that there is a strong evidence of long run connections amongst the variables and therefore null hypothesis of the no co-integration can be rejected.

Critical values	F statistic =	10.60740 **
	Lower I(0)	Upper bound I(1)
1%	3.74	5.06
5%	2.86	4.01

Table 2: Bound Test for Long Run Relationship

Note the rejection of the null hypothesis of unit root at 5%

3.7. Diagnostic and Stability Tests

In time series analysis, it is suitable and good to perform diagnostic test so as to ensure that estimated results meet the standard linear regression assumptions, notice possible spurious results and correct such defects if any, to keep away from the likelihood of the spurious result and conclusions. The study used Eviews 9 and the results are show in Table 3.

Test Statistics	LM Version	F Version
A. Series Correlation	CHSQ (1) = 0.4170 (0.3222) F (1, 21)	0.685624 (0.3222)
B. Functional Form	CHSQ (1) = 1.24941 (0.2253) F (1, 21)	6.2513 (0.2253)
C. Normality	CHSQ (1) = 11.69614 (0.2885)	Not applicable
D. Heterosecdasticity	CHSQ (1) = 0.7115 (0.6384) F (8,22)	0.67082 (0.6698)

Table 3: diagnostic test results

A: Lagrange multiplier test of residual correction
B: Ramsey's RESET test using the square of the fitted values
C: based on a test of Skewness and Kurtosis of residuals.
D: Based on the regression of the residual on squared fitted values.

3.8. A test which is based on Skewness and Kurtosis of residuals

From the study, null hypotheses testing of series correlation, functional form, normality and heteroscedasticity: shows no autocorreclation, Correct functional form, normally distributed residuals and no hetroscedasticity (homoscedasticity) respectively from the result. From the Table 3, it is observed that the null hypotheses cannot be rejected at significance level of 5% for the given P values 0.322, 0.2253 and 0.6698 respectively. This means the nominal exchange rate passes all the diagnostic tests which implies that nominal exchange rate does not experience any problem connected to serious serial correlation, functional forms, normal distribution and heteroscedasticity in that order. Also in the co-integration analysis, stability of coefficients in the regression was used for the study known be crucial in research. The study also used CUSUM (Cumulative Sum) and the CUSUMSQ (Cumulative Sum of Squares) to test for stability of the coefficients in thenominal exchange rate. This test is a graphically test which is shown in appendix I.

3.9. Results and Discussions of the Long Run Co efficient of the Nominal Exchange rate function.

After finding out whether there is existence of co-integration, stability and diagnostic test in variables, the next area in the procedure of ARDL is the estimation of the long run relationship between the variables in the nominal exchange rate. The long run coefficients of the model were estimated from the ARDL (1, 1, 0, 1, 1) selected based on Akaike Information Criterion using Eviews 9.0 and the results generated are shown in Table 4.

Akaike Information criterion of ARDL (1, 1, 0, 1,1) Dependent variable is LNEXR

Variables	Co efficient	Standard Error	T statistics	P values
LNOPR	-0.505389	0.188963	-2.674536	0.0138**
LNCPI	1.196165	0.059451	20.120128	0.000**
LNIMT	0.1411275	0.63155	2.236973	0.0357**
LNITR	-0.100123	0.228661	-0.4378	0.6658
C	-2.832871	1.164361	-2.432983	0.0236**

Table 4: Estimated Long Run Coefficients using ARDL approach

Above from the result above, the coefficient of Oil prices is negative (-0.505389) which is at 5% significance level. This means that there is a long run negative relationship between exchange rate and oil prices. This implies that a rise in price of oil from world market will lead to depreciation of the nominal exchange rate which in turn affects the domestic oil price in Ghana since exchange rate is one of determining variable used by NPA in pricing petroleum products. Thus 1% changes in oil prices from the world market will lead to long run depreciation of the cedis by 0.505389. This confirms the finding Kin and Courage 2014 that international oil prices have a substantial effect on the nominal exchange rate in South Africa

The coefficient of CPI from the Table 4 shows a positive which is significant at 5% significance level. This implies that, a unit change in CPI result in nominal exchange rate appreciation by 1.196165 in the long run. That is an increase in CPI means that there is general rise of goods and services which forces the Central bank increase its policy interest rate so as slow the economy down. As a result of an increase interest rate attract more foreign investors to invest their funds for businesses, deposit and buy bonds in the country leading to appreciation of the exchange rate. This confirm to theory and also the finding Englema and Aliyu (2010) that revealed inflation rate has a strong links on exchange rate.

Moreover, interest rate in Ghana lead to a decline in exchange rate in Ghana as indicate by a negative sign shown in the result. The coefficient of interest rate is insignificant in determining exchange rate in Ghana. The extents tell us that a 1% change in interest ratechanges exchange rate by approximately by -0.100123. This indicates that a rise in interest rate in long run means that Government may embark expansionary policy through spending in critical sectors of the economy which in turn increase the income level of people. As result of these rise in income, will make people able to demand of goods and services leading to the exchange rate depreciating but not significant to influence nominal exchange rate in Ghana. This affirms to the mundelling model.

Again, the coefficient of import tax rate was found positive (0.1411275) from the estimated long run result and significant in determining Exchange rate movement in Ghana. This magnitude tells us that 1% change in import tax changes exchange rate by 0.1411275. This indicates that any time government increases import taxes on foreign goods makes importation of goods unattractive to importers which reduce the pressure of the currency resulting in appreciation of cedis (exchange rate).

3.10. To Show how These Affect Domestic Price Petroleum Products

The changing of generational mix from hydro to thermal energy source means that more crude oil may be needed in the long run to power the generational plants so as to produce electricity coupling with what Ghana Chamber of Bulk oil Distributors and Oil Marketing Companies import into the country for production and transportation purposes put pressure on the Cedis. Due to the adoption of full deregulation policy in the oil downstream sector where prices of petroleum products change every two weeks and exchange rate been one of the key parameters in determining prices of petroleum products by the National Petroleum Authority. This means that whenever the nominal exchange rate depreciates within the period will force Ghana Chamber of Bulk Oil Distributors and Oil Marketing Companies to find additional money to augment their cash in order to purchase same or more crude oil from world market. This situation increases operational cost of companies which force they pass it on the final prices of petroleum products causing it to increase in the long run. This may thus increase the domestic oil prices in Ghana.

3.11. Results of Estimated Error Correction Model of the ARDL Model

Normally, Error Correction Model (ECM) offers the ways of finding out how the behavior of the short run of the variables connects to the behavior of the long run. The presence of cointegration relationship between the selected data indicates that the calculation of Error Correction model to establish the changes in the nominal exchange rate. The Error Correction Model describes how there is changes in the short run and its coefficient determine the speed of correction to equilibrium when there is a shock to the system. Table 4 gives the results of the short run changes of exchange rate equation.

Akaike Information criterion of ARDL (1, 1, 0, 1,1)

Dependent variable is LNEXR

Regressors	coefficient	Standard Error	T Ratio	P Values
D(LNOPR)	-0.179114	0.148915	-1.202788	0.2418
D(LNCPI)	1.305220	0.390406	3.342812	0.0029**
D(LNIMT)	0.099969	0.051142	1.954727	0.0634
D(LNITR)	0.0185386	0.162460	I.14115	0.2661
ECM	-0.707618	0.112333	-6.299297	0.000*

Table 5: Error Correction Model for the chosen ARDL Model

Note: the rejection of the null Hypothesis at 5% level of significant. Result was obtained from Eviews 9.0

R-Squared	0.788633	**R-Bar Squared**	0.711772
S.E of Regression	0.148128	**F Statistics**	10.26054
Mean of Dependent Variable	0.264383	**SD of Dependent variable**	0.275911
Residual Sum of Square	0.482722	**Equation Log Likelihood**	20.52859
Akaike information Criterion	-0.743783	**Schwarz Bayesian criterion**	-0.327461
DW Statistics	1.570544	**Hannan-Quinn Criterion**	-0.608070

Table 6

*ECM = LNEXR-(1.1962*LNCPI +0.1413LNIMT-0.1001*LNITR-0.5054*LNOPR-2839)*

The outcomes of Table 5 indicates that the model pass the diagnostic test. The study has DW-statistics 1.570544 which means that, there is certainly not a strong serial correlation in the residuals. The general regression of the study is substantial at 5% as indicated from R-squared and the F-statistic. The estimated value of R squared of 0.711772 indicates that about 71.1% variation in the dependent variables (LNEXR) is described by changes in the independent variables. Furthermore, F statistics values of 10.26054 allude to joint significance of determinant of nominal exchange rate in Ghana.

From Table 5, the estimated value of the variables gave a curious outcome where all the variables exception of CPI are not significant in the short run and also maintain their signs accept of interest rate which changes from negative to positive. The coefficient shows the short run elasticities.

In the model, the coefficient of oil prices variable has negative sign which is not statistically significant at 5% significant level. This indicates that price of oil from the world market which has a negative coefficient is insignificant in determining nominal exchange rate in Ghana in the short run. This means that a rise in oil prices from the world market tend to depreciate the exchange rate. Thus, a fall in exchange rate as result of depreciation will increase BDCs and OMCs the amount of money needed in exchange for foreign currency so as to purchase of oil prices from world market. In this model, the CPI has a substantial appreciating effect on the nominal exchange rate in Ghana. This implies that long run and short run of CPI have impact on nominal exchange rate.

Moreover, the coefficient of interest rates this time changes to a positive sign. It is also not statistically different from Zero at 5% level of significance in the short run. This means that interest rate has an appreciation impact on nominal exchange rate in Ghana but not significant in influencing the short run nominal exchange rate according to the study. Lastly, the import tax coefficient maintained its positive sign. This implies that importation tax on foreign goods result in an appreciation effect on nominal exchange rate in Ghana but however not significant in determining the short run nominal exchange rate according to the study.

The Error Correction Model (ecm) is highly significant at 1% of significance and also has the right sign after the result of the coefficient of estimated. This is a sign of joint significance of the long run coefficients. From the estimated result of Table 5 of the study, the estimated value of the Error Correction model is -0.707618 which take high speed of adjustment to equilibrium after a shock. This is because nearly more than 70% of disequilibrium from the preceding (earlier) year's rises in the variables (shock) which in turn correct itself in the long run equilibrium of the present year.

4. Summary of the Findings

Firstly, the coefficient of crude oil prices is negative and significant at 5% which indicates that a rise in crude oil prices from the world market has a depreciating impact on nominal exchange rate in Ghana in the long run however in the short run these a rise in crude oil prices is insignificant in determining nominal exchange rate which affect domestic oil prices in Ghana.

Secondly, the study discovers that CPI has an appreciation impact on nominal exchange rate in a Ghana at 5% significance level. The result of the findings shows that an increase in CPI has appreciation impact on the nominal exchange rate in the both the long run and the short run in Ghana according the study. Thus, CPI influences the nominal exchange rate in Ghana.

Thirdly, it was reveals from the study that interest rate has a negative sign in the long run which indicates an increase in interest rate result in exchange rate depreciation but the sign however changes to positive in the short run which means that interest rate lead to appreciation of the exchange rate but not significantly explained nominal exchange rate movement in Ghana. The changing of the sign of interest rate in the short run and long run nominal exchange movement suggest how the Bank of Ghana arrives at their policy interest rate.

Fourthly, it was reveals from the study that import tax has a positive sign and significant at 5% level. This means that import tax lead to appreciation of the nominal exchange in the long run but in the short run the rise in import tax is insignificant in determining the nominal exchange rate in Ghana.

5. Conclusion

The motive of the study is to investigate the impact of international oil prices on the nominal exchange rate in Ghana. The study adopted Aziz (2009) to estimate both the short run and long run linkage between oil prices from the world market and exchange rate in Ghana.

The objective of the study to examine the connection between crude prices of oil and nominal exchange rate which in turn affect petroleum prices in Ghana and also come out with recommendations. The study used a set of annual data from 1983 to 2014 along with of time series analysis. The study employed an Autoregressive Distributed Lag (ARDL) model to analysis the yearly data from 1983-2014 in order to get the results estimation which helps achieve the above objectives.

The empirical results of the study indicated that oil prices influence nominal exchange rate in the long run. This means that an increase in this variable will increase the domestic petroleum products in Ghana since exchange rate used in purchasing crude oil form part of the determinant variables set up national Petroleum Authority in pricing domestic oil price in Ghana. However, in the short run only the CPI that influences the nominal exchange rate in Ghana. Oil prices and import tax are not significant in determining the nominal exchange rate in the short run. Interest rate was not significant both the long run and the short run according to the study.

5.1. Policy Implications and Recommendations

The research findings discussed above have revealed some policy related variables that have significant impact on nominal exchange rate within the period under study. Based on this, they study recommends the following as way to help reduce nominal exchange rate from rising which in turn affect domestic petroleum prices.

Government should setup strategic oil reserves throughout the country so as to ensure that the economy does not suffer any time the oil prices changes on the world market which in turn reduces the pressure on the nominal exchange rate. Thus, government not able to meet its annual budgets anytime there is an increase in crude oil prices from the world market which put pressure on the nominal exchange rate causing domestic oil prices to increase.

Government should promote the Renewable energy by encouraging investors to enter into those areas like the solar, wind wave, biogas among others and also encourage schools, hospitals, government and private officials and individual homes to use all form of

renewable energy so as help reduce the amount of oil that could be used in powering the generational plants to produce electricity. This will reduce the pressure of the international oil prices on the nominal exchange rate.

Government should privatize some portion of the energy sector so that these companies will produce efficient source of power within country thereby reducing the wastages impose by the energy companies which make them pass on into the price of electricity bills to the final consumers. In addition to this government should pay its debt own to these energy companies in order not to increase operational cost of which they pass on into the final consumers in form of charges of electricity bills to the final consumers. When this happen, it will reduce the burden on household within the country since electricity prices is one of component in determining CPI in Ghana. This will turn reduces the nominal exchange rate in Ghana

Government should reduce the taxes on petroleum products but rather widen the tax net throughout the country. This can be done by registering all businesses within country in order to track their businesses and for them to pay tax so as to help improve the exchange rate. For instances, these mobile money businesses that is spinning up throughout the country should be asked to pay some tax within certain period so as to improve the nominal exchange rate and also help increase government revenue.

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Appendix

ARDL Bounds Test				
Date: 04/08/16 Time: 10:41				
Sample: 1984 2014				
Included observations: 31				
Null Hypothesis: No long-run relationships exist				
Test Statistic	Value	k		
F-statistic	10.60740	4		
Critical Value Bounds				
Significance	I0 Bound	I1 Bound		
10%	2.45	3.52		
5%	2.86	4.01		
2.5%	3.25	4.49		
1%	3.74	5.06		
Test Equation:				
Dependent Variable: D(LNEXR)				
Method: Least Squares				
Date: 04/08/16 Time: 10:41				
Sample: 1984 2014				
Included observations: 31				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCPI)	1.105993	0.411399	2.688368	0.0134
D(LNITR)	0.164755	0.178766	0.921623	0.3667
D(LNOPR)	-0.128085	0.178746	-0.716579	0.4812
C	-1.680857	0.942321	-1.783741	0.0883
LNCPI(-1)	0.697849	0.199459	3.498706	0.0020
LNIMT(-1)	0.019094	0.063107	0.302572	0.7651
LNITR(-1)	-0.083152	0.176052	-0.472314	0.6414
LNOPR(-1)	-0.238247	0.188212	-1.265846	0.2188
LNEXR(-1)	-0.618102	0.138557	-4.461009	0.0002
R-squared	0.788633	Mean dependent var		0.264383
Adjusted R-squared	0.711772	S.D. dependent var		0.275911
S.E. of regression	0.148128	Akaike info criterion		-0.743780
Sum squared resid	0.482722	Schwarz criterion		-0.327461
Log likelihood	20.52859	Hannan-Quinn criter.		-0.608070
F-statistic	10.26054	Durbin-Watson stat		1.570544
Prob(F-statistic)	0.000007			

Table 1

ARDL Cointegrating And Long Run Form				
Dependent Variable: LNEXR				
Selected Model: ARDL(1, 1, 0, 1, 1)				
Date: 04/08/16 Time: 10:42				
Sample: 1983 2014				
Included observations: 31				
Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCPI)	1.305220	0.390456	3.342812	0.0029
D(LNIMT)	0.099969	0.051142	1.954727	0.0634
D(LNITR)	0.185386	0.162460	1.141115	0.2661
D(LNOPR)	-0.179114	0.148915	-1.202788	0.2418
CointEq(-1)	-0.707618	0.112333	-6.299297	0.0000
Cointeq = LNEXR - (1.1962*LNCPI + 0.1413*LNIMT -0.1001*LNITR				
-0.5054*LNOPR -2.8329)				
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCPI	1.196165	0.059451	20.120128	0.0000
LNIMT	0.141275	0.063155	2.236973	0.0357
LNITR	-0.100123	0.228661	-0.437868	0.6658
LNOPR	-0.505389	0.188963	-2.674536	0.0138
C	-2.832871	1.164361	-2.432983	0.0236

Table 2

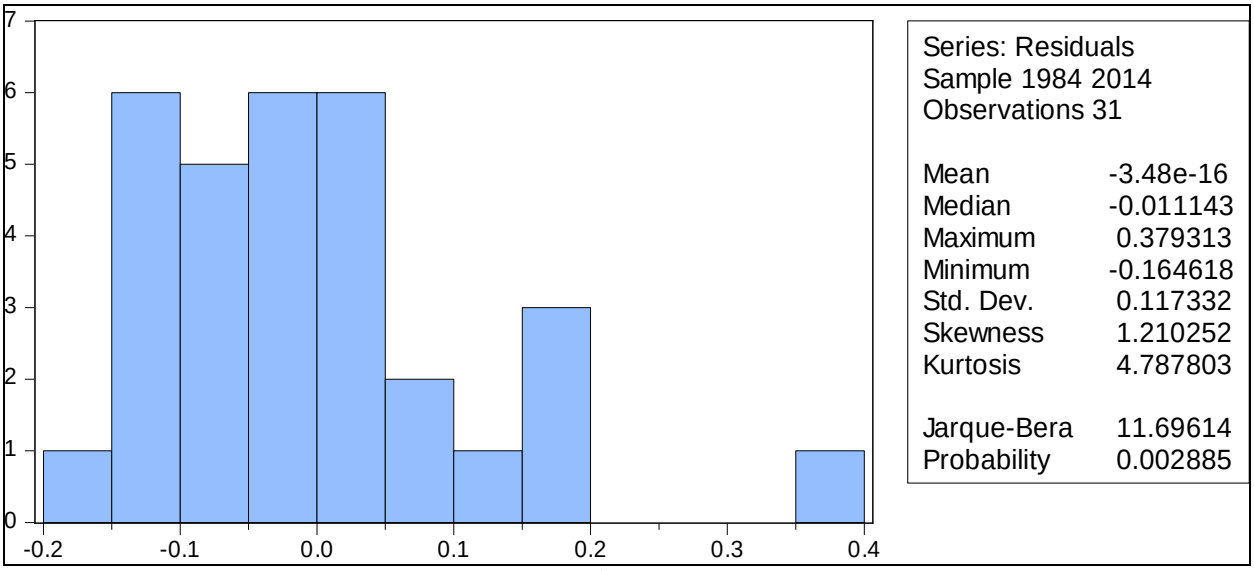

Figure 1

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.685624	Prob. F(1,21)		0.4170
Obs*R-squared	0.980112	Prob. Chi-Square(1)		0.3222
Test Equation:				
Dependent Variable: RESID				
Method: ARDL				
Date: 04/08/16 Time: 10:42				
Sample: 1984 2014				
Included observations: 31				
Presample missing value lagged residuals set to zero.				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEXR(-1)	-0.033727	0.120253	-0.280471	0.7819
LNCPI	-0.134598	0.425546	-0.316296	0.7549
LNCPI(-1)	0.163022	0.427180	0.381625	0.7066
LNIMT	0.004917	0.051853	0.094835	0.9253
LNITR	0.014754	0.164601	0.089632	0.9294
LNITR(-1)	0.069391	0.207014	0.335198	0.7408
LNOPR	0.073453	0.174260	0.421513	0.6777
LNOPR(-1)	-0.033329	0.124941	-0.266757	0.7923
C	-0.513174	1.079682	-0.475301	0.6395
RESID(-1)	0.257624	0.311132	0.828024	0.4170
R-squared	0.031617	Mean dependent var		-3.48E-16
Adjusted R-squared	-0.383405	S.D. dependent var		0.117332
S.E. of regression	0.138003	Akaike info criterion		-0.867382
Sum squared resid	0.399943	Schwarz criterion		-0.404805
Log likelihood	23.44442	Hannan-Quinn criter.		-0.716594
F-statistic	0.076180	Durbin-Watson stat		1.965813
Prob(F-statistic)	0.999796			

Table 3

Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.670820	Prob. F(8,22)		0.7115
Obs*R-squared	6.079073	Prob. Chi-Square(8)		0.6384
Scaled explained SS	5.798513	Prob. Chi-Square(8)		0.6698
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Date: 04/08/16 Time: 10:42				
Sample: 1984 2014				
Included observations: 31				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010168	0.176791	0.057514	0.9547
LNEXR(-1)	-0.014661	0.022625	-0.647981	0.5237
LNCPI	-0.000186	0.078643	-0.002362	0.9981
LNCPI(-1)	0.025522	0.075809	0.336666	0.7396
LNIMT	0.001158	0.010301	0.112466	0.9115
LNITR	0.036169	0.032722	1.105358	0.2809
LNITR(-1)	-0.032619	0.037853	-0.861732	0.3981
LNOPR	0.010418	0.029994	0.347352	0.7316
LNOPR(-1)	-0.038641	0.023652	-1.633713	0.1165
R-squared	0.196099	Mean dependent var		0.013323
Adjusted R-squared	-0.096228	S.D. dependent var		0.026357
S.E. of regression	0.027596	Akaike info criterion		-4.104557
Sum squared resid	0.016754	Schwarz criterion		-3.688239
Log likelihood	72.62064	Hannan-Quinn criter.		-3.968848
F-statistic	0.670820	Durbin-Watson stat		1.829552
Prob(F-statistic)	0.711538			

Table 4

Ramsey RESET Test				
Equation: UNTITLED				
Specification: LNEXR LNEXR(-1) LNCPI LNCPI(-1) LNIMT LNITR LNITR(				
-1) LNOPR LNOPR(-1) C				
Omitted Variables: Squares of fitted values				
	Value	df	Probability	
t-statistic	1.249410	21	0.2253	
F-statistic	1.561026	(1, 21)	0.2253	
F-test summary:				
	Sum of Sq.	df	Mean Squares	
Test SSR	0.028576	1	0.028576	
Restricted SSR	0.413001	22	0.018773	
Unrestricted SSR	0.384425	21	0.018306	
Unrestricted Test Equation:				
Dependent Variable: LNEXR				
Method: ARDL				
Date: 04/08/16 Time: 10:43				
Sample: 1984 2014				
Included observations: 31				
Maximum dependent lags: 1 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (1 lag, automatic):				
Fixed regressors: C				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNEXR(-1)	0.412042	0.146552	2.811581	0.0105
LNCPI	1.324341	0.385874	3.432055	0.0025
LNCPI(-1)	-0.494267	0.372760	-1.325966	0.1991
LNIMT	0.102241	0.050535	2.023182	0.0560
LNITR	0.268434	0.173653	1.545809	0.1371
LNITR(-1)	-0.247973	0.185702	-1.335329	0.1961
LNOPR	-0.166445	0.147401	-1.129199	0.2715
LNOPR(-1)	-0.246034	0.127938	-1.923069	0.0681
C	-1.989161	0.866855	-2.294686	0.0322
FITTED^2	0.022676	0.018149	1.249410	0.2253
R-squared	0.996612	Mean dependent var		-1.567150
Adjusted R-squared	0.995160	S.D. dependent var		1.944873
S.E. of regression	0.135299	Akaike info criterion		-0.906956
Sum squared resid	0.384425	Schwarz criterion		-0.444380
Log likelihood	24.05782	Hannan-Quinn criter.		-0.756168
F-statistic	686.4291	Durbin-Watson stat		1.912308
Prob(F-statistic)	0.000000			
*Note: p-values and any subsequent tests do not account for model				
selection.				

Table 5

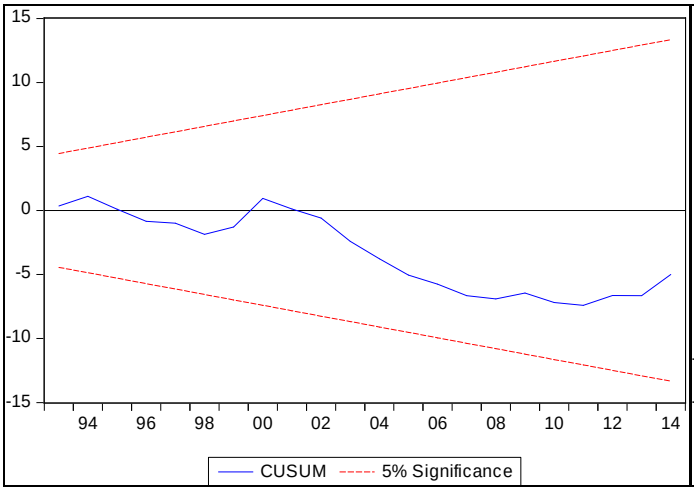

Figure 2

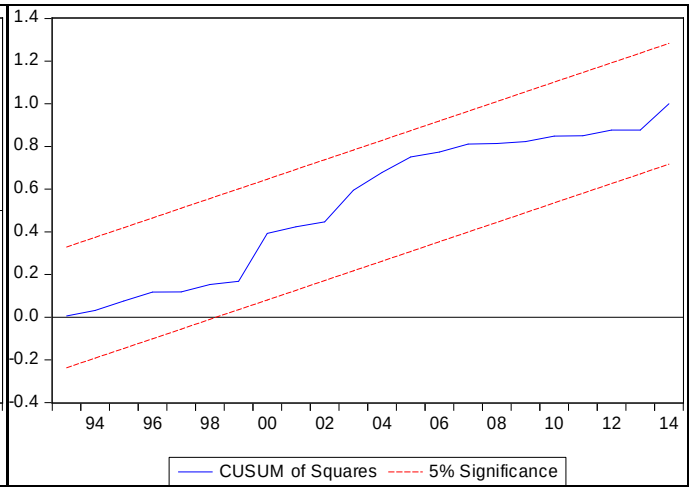

Figure 3

Dependent Variable: LNEXR				
Method: ARDL				
Date: 04/08/16 Time: 10:40				
Sample (adjusted): 1984 2014				
Included observations: 31 after adjustments				
Maximum dependent lags: 1 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (1 lag, automatic): LNCPI LNIMT LNITR LNOPR				
Fixed regressors: C				
Number of models evalulated: 16				
Selected Model: ARDL(1, 1, 0, 1, 1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNEXR(-1)	0.292382	0.112333	2.602818	0.0162
LNCPI	1.305220	0.390456	3.342812	0.0029
LNCPI(-1)	-0.458792	0.376386	-1.218939	0.2358
LNIMT	0.099969	0.051142	1.954727	0.0634
LNIMT (1)	0.10777	0.48160	1.96123	0.0487
LNITR	0.185386	0.162460	1.141115	0.2661
LNITR(-1)	-0.256235	0.187935	-1.363422	0.1865
LNOPR	-0.179114	0.148915	-1.202788	0.2418
LNOPR(-1)	-0.178509	0.117432	-1.520109	0.1427
C	-2.004590	0.877750	-2.283784	0.0324
R-squared	0.996360	Mean dependent var		-1.567150
Adjusted R-squared	0.995037	S.D. dependent var		1.944873
S.E. of regression	0.137014	Akaike info criterion		-0.899771
Sum squared resid	0.413001	Schwarz criterion		-0.483452
Log likelihood	22.94645	Hannan-Quinn criter.		-0.764061
F-statistic	752.8393	Durbin-Watson stat		1.679017
Prob(F-statistic)	0.000000			
*Note: p-values and any subsequent tests do not account for model selection.				

Table 6