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Article

The causes of the fluctuation in the exchange rate in South Africa

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The Causes of the Fluctuation in the Exchange Rate in South Africa

Noluthando Qwelani[1], Akeem Adewale Oyelana[2]

Abstract: This study uses the OLS estimation method to analyze the factors that determine exchange rate variation in South Africa. Two groups of explanatory variables are used: the first group comes from extant empirical studies and the other group consists of new variables. The analysis of existing variables reveals that the variables are individually and jointly insignificant. The explanatory variables used in the regression include Gross Domestic Product, Consumer Price Index and Inflation Rate. Quarterly data for these variables are used in the estimation. The second regression uses the following explanatory variables: South Africa's Foreign Reserves, South Africa's Total Money Stock, South Africa's Prime Overdraft Rate and the USA Interest rate. According to the results, all the variables but one (South Africa's Foreign Reserves) are found to be statistically significant. The coefficient of determination was remarkably higher than the one obtained from the first regression. The study calls for the South African policymakers to increase the interest rate in order to reverse the adverse effects of steady depreciation that has been experienced in the exchange rate recently.

Keywords: Foreign Reserves; Gross Domestic Product (GDP); Interest Rate (IR)

JEL Classification: D51

Introduction and Background

The exchange rate is defined as the value of currency for the purpose of conversion to another currency. (Garman & Kohlhagen, 1983) Therefore, the volatility of exchange rate is the variation of the value of the currency that is intended to be converted into another currency. (Hassan 2016) Those variations at times cause bigger problems within the economy, such as discouraging exportation by lowering the value of returns; that is, if it declines most of the times. Also, it is not an easy task for the exchange rate variation to be managed if the policymakers have no clear understanding of what the causes (determinants) of the exchange rate variation are, which is therefore the reason why it is imperative for the economists or researchers to look at this topic once in a while by researching on it.

It is very important to emphasize that similar studies regarding to this research has been conducted by focusing on causes of fluctuation in the exchange rate in different economies such as India, Poland and Australia. Therefore, this study is undoubtedly focused on the South African economy. In an attempt to examine the various causes of fluctuation in the exchange rate, the paper compared the South African currency to the dollar, as it has been the main problem on the South African exchange rate even in the previous years.

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Given the background information from studies taken from the previous study on exchange rate variations for different economies, this section presents the challenges and effects of exchange rate variations. Consequently, exchange rate variation is a problem in many other economies. (Breedon et al., 2011; European Central Bank, 2008) It might also be possible that the determinants of the variation of the exchange rate in South Africa are somehow similar to those found in other economies.

Juraj (2006) was interested in the volatility of exchange rate, the openness of the economy, the news factor and the exchange rate regime. He was also interested in how these factors may negatively have an effect in an economy. For instance, according to his findings, though there has been a confirmation that more opens economies have lower volatility of exchange rate, the news or news factor has an impact on the volatility of exchange rate and that the exchange rate regime has a little effect, which is not shown in the volatility.

According to Juraj (2006), the determinants of exchange rate volatility are discussed in terms of the establishment of the Economic Monetary Union (EMU), which has been established by the European Union. It seeks to stabilize the exchange rate among member countries and to encourage trade inside the European country. The EMU also rescued the European economies from the unsustainability of stabilizing the exchange rate that could have had a negative impact on investment and trade. The author further made some findings on other possible literature. The findings were that there are many determinants that result in the variation of the exchange rate. They include the openness of the economy, the domestic and foreign money supply, the exchange rate regime, interest rates, central bank independence, levels of output, inflation and unpredictable circumstances. The mentioned determinants are assumed to be the ones with the biggest impact on the variation of exchange rate, and that their effects differ according to different economic conditions in different economies.

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The above-identified determinants or factors are further-examined to analyse what effect they have on the volatility of exchange rate. It has been said that the exchange rate regime has not much of an effect on the volatility of exchange rate but only in the case of fixed exchange rate unlike floating ones. On the other hand, the openness of the economy does not have any effect in the volatility of exchange rate because of the relationship between the real exchange rate volatility and trade integration, with which they have a negative correlation. Their link is explained by the model with tradable and non-tradable sector to explain the effect of openness of economy on the volatility of exchange rate. The results are that the more open economies have a more flexible aggregate price level. This, therefore, reduces the effects of anticipated money shocks. It further results in low real exchange rate volatility in the countries with high economic openness. This is, therefore, why the European Union (EU) decided to establish the EMU in order to stabilize the exchange rate among the member economies.

Then there are unpredictable circumstances (news factor) that can also result in the volatility of exchange rate but can also have a small effect. The news factor might not even be valid but it might have an effect on exchange rate but only capture a small change in the real exchange rate volatility. The reason is that the news factor has more effect on the variety of interest rates for which interest rates have a negative effect on the volatility of exchange rate.

Out of the above various highlighted determinants, only few of those do have an effect on the volatility of exchange rate. On the other hand, factors such as the openness of the economy have been proven not to have any effect on the volatility of exchange rate.

MACROECONOMICS AND MONETARY ECONOMICS

Literature Review

Theoretical Review

Flexible Price Monetary Model (FPMM)

This model relies on the PPP condition and the stable money demand. It posits that the logarithm of money demand may be assumed to depend on the logarithm of real income, y, the price level, p, and the level of bond interest rate, r. The foreign demand for money is assumed to be the same. Therefore, in the domestic and the foreign country monetary equilibria are represented by the following equations:

$m^s = p + \phi\, y - \lambda\, r$

$$M^{s*} = p^* + \phi^*\, y^* - \lambda^*\, r^*$$

Foreign variables are starred, also the model assumes that the domestic interest rates are exogenous. This means that domestic interest rates are rigidly linked to the foreign world of the interest rates because of the assumption of capital mobility and zero expected change in the interest rates. Therefore, the model concentrates on the current account and assumes that the output is exogenously determined by the supply side of the economy.

Under the assumption of full employment level yield, the Mundell-Flemming model gives similar results to those of the FPMM model.

The problem about this model is that according to Keith (1996) this model failed adequately to explain the large variations in the real exchange rate that occurred in the number of small economies such as those of United Kingdom (UK), Netherlands and Italy in the second half of the 1970s.

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The Determinants of the Exchange Rate Variation in South Africa

Exchange Rate Trend in South Africa

Figure 1 is a graph for the South African exchange rate for the period 2003Q1-2014Q4. Between 2003 and 2008, there was a downward trend in the exchange rate variation. (Mimir & Enes Sune, 2015). There was a sharp upward fluctuation in the exchange rate between 2008 and 2009. From the third quarter of 2009 onwards, the South African economy started to experience a slightly downward trend in the exchange rate variation again. The exchange rate variation is presented in Figure 1 below.
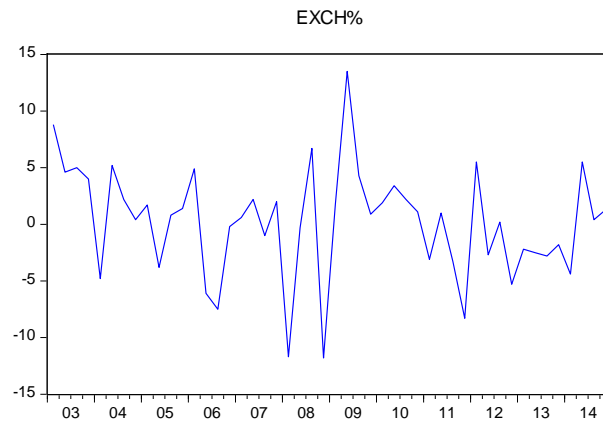
Figure 1. Exchange rate

Consumer Price Index Trend (CPI) in South Africa

Whilst the exchange rate varies rapidly the consumer price index also continues to vary, but looking at the CPI graph South Africa has been facing slight changes in the consumer price indexes. From between 2003-2004 the second quarter the CPI has been fluctuating up and down, but from around zero. From 2005 onward the South African exchange rate has been fluctuating above zero. From within 2007Q1-2009 before the end of the fourth quarter, the CPI has been fluctuating upward, this means that the CPI has been fluctuating upward within this period of time, but then it has been increasing at an increasing rate and a decreasing rate. From the end of the fourth quarter onwards, the CPI has been depleting but not at a constant rate. This means that the CPI has been decreasing at an increasing rate and at a decreasing rate above zero, but close to zero. The consumer price index is supposed to rate at a range where prices are high enough to avoid high consumption to avoid high rate of inflation, but low enough for consumers to afford the market basket of goods.
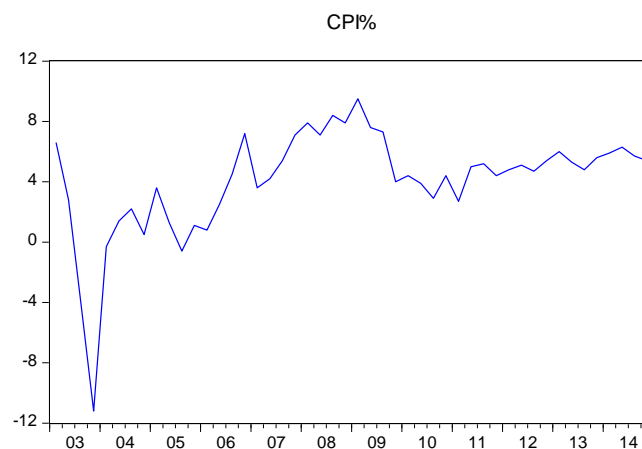
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Figure 2. Consumer price index vs Exchange rate

Foreign direct investment trend **(FDI)**

The data for foreign direct investment are only collected yearly (Fernandes & Paunov, 2012; Holmes et al., 2013); therefore, the investment variable does not have quarterly data. As it has been mentioned above

that the study uses quarterly data, so it was not possible to explain the trends for the foreign direct investment.

Commercial loans trend in South Africa

The graph below is an illustration of commercial loans trends in South Africa. In the graph, there is not much fluctuation as it has been fluctuating at a constant rate around zero, until the first quarter of December where there was a huge decrease in the commercial loans to 60%. The variable then adjusted between the beginning of the last quarter of 2012 and the end of the first quarter of 2014. Thereafter, a 100% large decrease in the commercial loans at the end of 2014 was experienced.
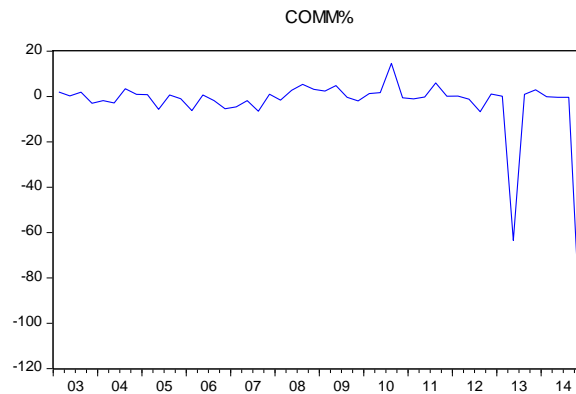

Figure 3. Commercial Loans

Gross domestic product (GDP) trend in South Africa

South African GDP has been fluctuating constantly during the past few years, looking at the graphs the variable has been fluctuating more than once in a single year. (McKay, 2013; Bhorat, Kanbur & Stanwix, 2014) But such fluctuations would not cause any shocks because looking at the graph the rate at which the GDP has been fluctuating is constant. (Christiano, Motto & Rostagno 2014), it is between 10% and -10%, not more or less than that. Analysing the trends, during the period 2003-2014 the GDP was fluctuating above 0% but less than 5%, like in most periods the GDP has been fluctuating above 0% which is a good thing, because that means there were positive balances no deficits. But during the last quarter of 2004 the GDP declined in that it went below 0%; the same thing happened in the first quarter of 2005 and in the first quarter of 2008 and so on. The question of whether these constant fluctuations on GDP can influence the fluctuation of the exchange rate at the rate at which it has been fluctuating during this period depends on how elastic the exchange rate is on GDP.
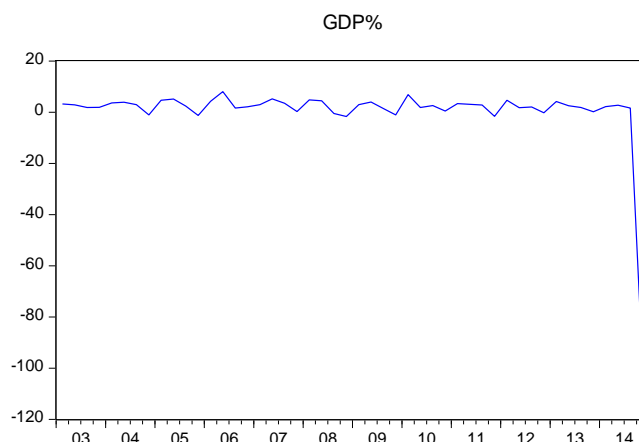
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Figure 4. GDP in South Africa

Inflation Rate Trend in South Africa

The inflation rate, according to the diagram below, has been well controlled in South Africa. According to the South African inflation rate target, the inflation rate should vary between 3% and 6%. (Taylor, 2014) Figure 4 illustrates that in South Africa during the period 2003-2014, the inflation rate has been fluctuating around 5%. In the first two quarters of 2003, the inflation rate has been fluctuation above 5%, between 5.1% and 5.2%. After that the inflation started fluctuating below 5% until the last quarter when it started going back to 5% and then in the same quarter it went down again. The first quarter of 2007, last quarter of 2008 and so on, the inflation rate fluctuated very slightly above 5%.
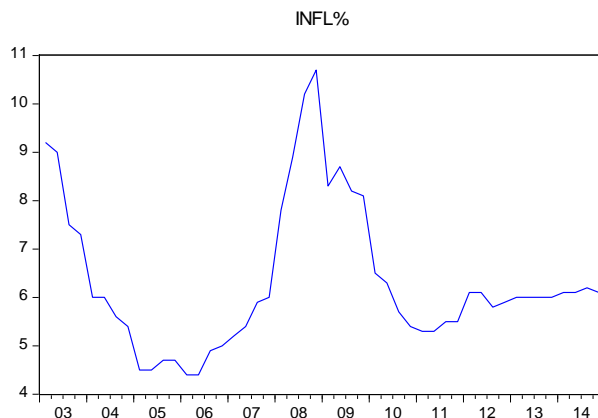
Figure 5. Inflation rate in South Africa

Interest Rates in South Africa

Like the inflation rate, interest rates in South Africa for the period 2003-2014, have been fluctuating at a constant rate, around 5% (South Africa Interest Rate 1998-2016). Therefore, if inflation rate hasn't been fluctuating at higher rates so there are not much of shocks it would've been created in the economy. According to figure 5 below, during the third quarter of 2007 and the first quarter of 2009 the interest rates slightly floated above 5%. There were other upward floatation on the interest rates during this period but they are unclear; for instance, from the first quarter of 2003, the first quarter of 2012. Then from the period 2005 until the first quarter of 2007 the interest rests were constant for a longer time but slightly

above 5%. Therefore, there haven't been much floatation in the South African domestic interest rates for a very long period of time.
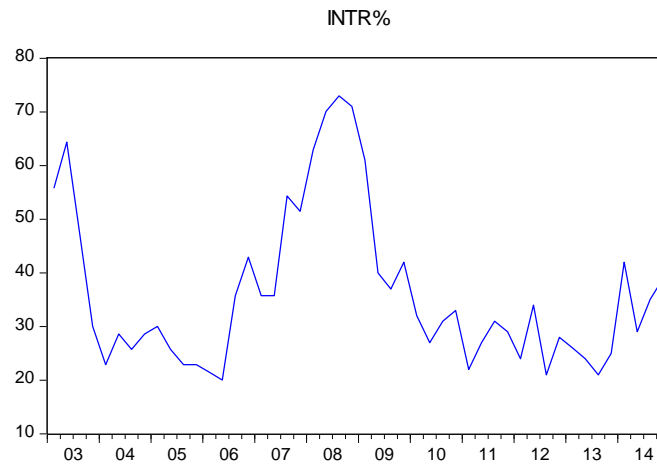

Figure 1. Interest rates

Objectives of the Study

- To empirically investigate the impact of the theoretically suggested variables (inflation, CPI, GDP and FDI) on exchange rate variation in South Africa. The study also aims at providing policy recommendations based on the empirical results;

- To provide a policy recommendation based on the results.

Hypotheses

- **Null hypothesis**

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ (Individual explanatory variables have no effect on the exchange rate variation).

- **Alternative hypothesis,**

H_1: $\beta_1 \neq 0$ $\beta_2 \neq 0$ $\beta_3 \neq 0$ $\beta_4 \neq 0$ $\beta_5 \neq 0$ (Individual explanatory variables have an effect on the exchange rate variation.

The regression will be as follows:

Exch Rate Variation = $\beta_0 + \beta_1 Infl + \beta_2 CPI + \beta_3 GDP + \beta_4 FDI + \beta_5 Int$ the hypothesis will therefore test for significance of each b (i.e., each coefficient).

Statement of the Problem

For the past two decades, the South African currency (Rand) compared to the United States (US) dollar has been steadily fluctuating. According to the South African Reserve Bank's report, the value of the South African rand compared to US dollar has gone down. The Rainbow Nation's records state that the current exchange rate is around R11.99 per US$1. These unfavourable conditions go back to 10 years when the Rand value was too weak, exchanged at R14 per $1. Therefore, if the value of the Rand

fluctuates as lower as that much, if it is not prevented, it could bring the South African economy at a trough.

Methodology

The study used the OLS estimation technique to achieve its objectives. As a point of departure, the study draws a number of variables from the existing empirical studies, including Stancik (2006), Ogun (2012), Mirchandani (2013) and Twarowska (2014). The most featured five explanatory variables of the exchange rate variation (Exchv) in the literature are as follows: Inflation Rate (Infl), Interest Rate (Intr), Gross domestic Product (GDP) and Foreign Direct Investment (FDI).

Model specification

Based on the literature review and the availability of data, the empirical model of our study is, therefore, expressed as follows:

$EXCHV_t = \beta_0 + \beta_1 INFL_t + \beta_2 CPI_t + \beta_3 LGDP_t - \beta_4 LINTR_t + u_t$

Where, t – Quarterly period from 2003 – 2014

βs – the coefficients to be estimated

EXCHV – Exchange rate variation

INFL – Inflation Rate

CPI – Consumer Price Index

GDP – Gross Domestic Product

INTR – Interest rate

u - is the error term (disturbance term)

The study uses quarterly data for the period 2003 – 2014. The sources of the data are the South African Reserve Bank (SARB) for Inflation Rate, Interest rates, Consumer Price Index and for the Prime Overdraft Rate. Data for the interest rates were collected from Easy data. There were no quarterly data for the FDI in all sources. The variables are explained below.

EXCH – The exchange rate used is the foreign exchange rate of the rand per US dollar, where (R1 = 100cent). The exchange rate uses rands/dollar because the dollar is the world's commonly used currency for exchange. Economically, a rise in this variable means the domestic currency has depreciated.

INFL – The inflation rate is the percentage change in inflation.

CPI – The Consumer price index excludes beverages such as food and non-alcoholic beverages and petrol in all urban areas.

GDP – This is the quarterly Gross domestic product at market price, the GDP has been converted into percentages, since all other variables are in percentages. The selected GDP is the South African domestic GDP.

INTR – The variable is the money market interest rate. The variable taken is also on quarterly basis.

The inflation rate and Consumer price index are normally supposed to have a positive effect on the exchange rate. The interest rate exits a negative effect on the exchange rate; the higher the interest rate, the more the exchange rate appreciates. GDP is expected to have a positive effect on the movement of the exchange rate – that is, if GDP increases, the exchange rate will depreciate.

Findings and Discussion

The study used ordinary least squares (OLS) method to estimate the specified model. Our empirical analysis starts off by looking at the stationarity of the variables by using Augmented Dickey-Fuller tests. We present the analysis of the empirical results in the proceeding sections.

The results for stationarity test on the first group of variables reveal that most of all the variables are not stationary in level forms, except for the dependent variable.

Table 1. Augmented Dickey-Fuller test results for stationarity – First Group of Variables

		Augmentative Dickey Fuller test			
Variable		Intercept	Trend and intercept	None	Integration of order
EXCH		-6.830944***	-6.888211***	-6.910125***	I(0)
GDP		1.261654	-2.003942	2.037166	I(2)
DGDP		-2.745590*	-3.089895	-0.165854	I(1)
		-15.02882***	-14.86857***	-15.16991***	I(0)
INFL		-2.164773	-2.104369	-1.137921	I(1)
DINFL		-5.534345***	-5.564427***	-5.558017***	I(0)
INTR		-2.308780	-2.189378	-1.102751	I(1)
DINTR		-6.748437***	-6.796476***	-6.796476***	I(0)
CPI		-2.811929*	-3.618876**	-1.813062*	I(1)
DCPI		-6.931958***	-6.841585***	-7.009912***	I(0)
Critical values	1% level	-3.577723	-4.165756	-2.615093	
	5% level	-2.925169	-3.508508	-1.947975	
	10% level	-2.600658	-3.184230	-1.612408	
The three stars (***) mean that the statistic of the tested variable is significant at all levels of significance (1%, 5% and 10%). (**) mean that the test is significant at two levels of significance and one star (*) means that it is only significant at one level of significance.					

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As seen from the graphs below, the variables from the literature are not stationary as they do not vary around their means over time. It is only after first-differencing the variables that they become stationary around their means.
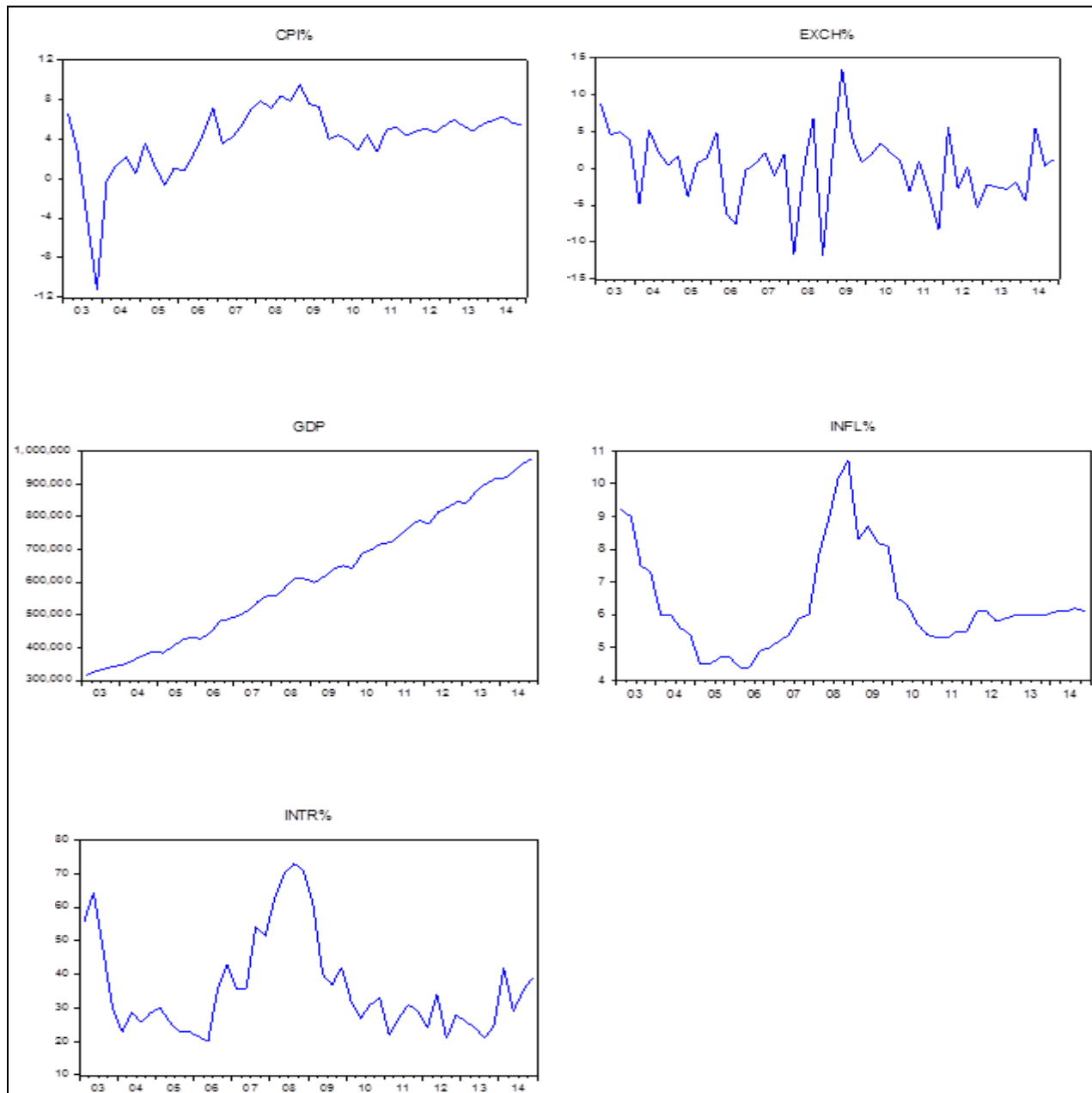
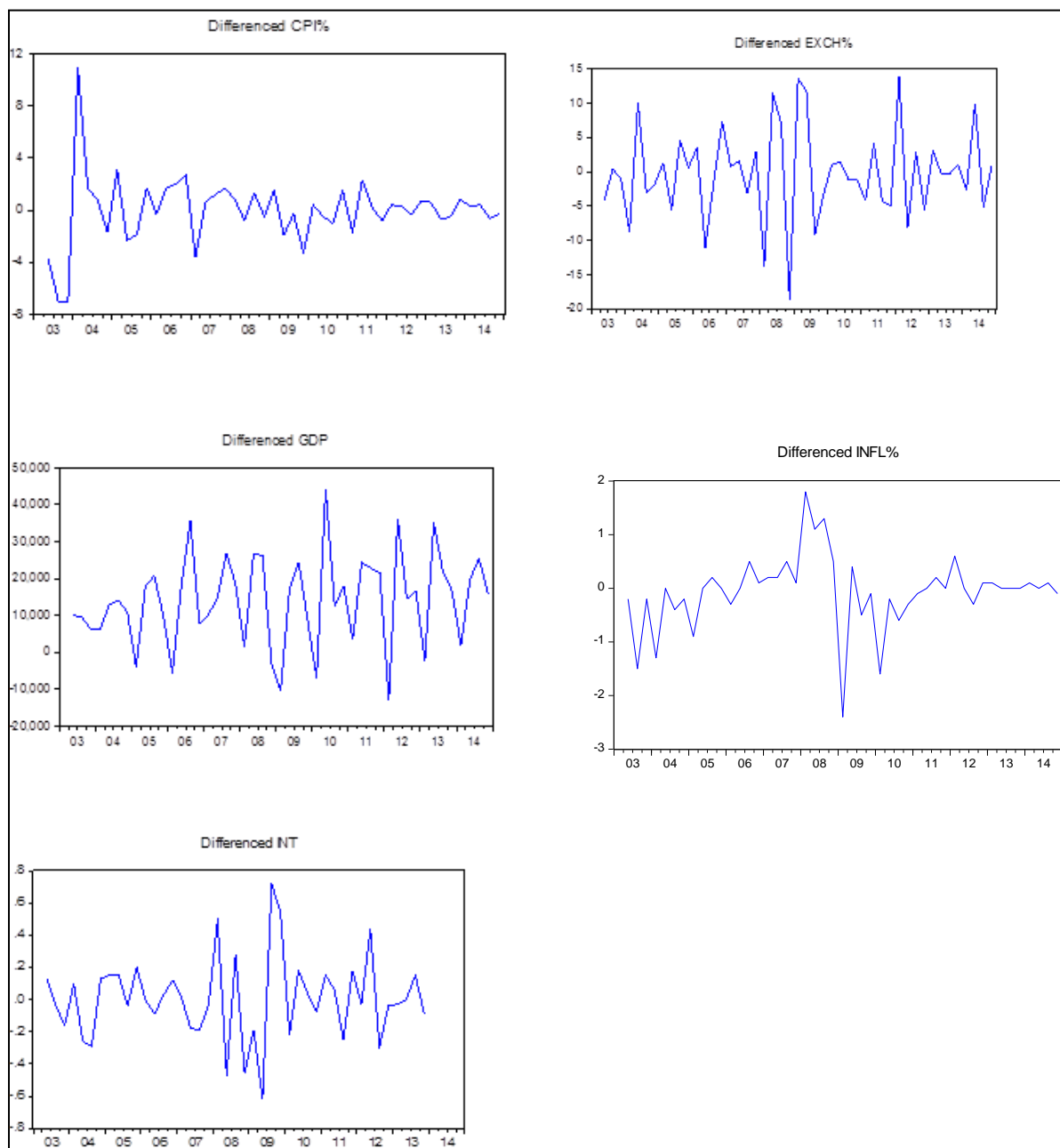**Figure 7. Before-differencing graphs – First Group of Variables**

Figure 8. After-differencing graphs – First Group of Variables

Model estimation – First Group of Variables

Table 2 shows that the variables are not individually and jointly significant.

Table 1. Regression results

Ordinary Least Squares regression with DExch (Exchange rate) as the dependent variable of the sample from 2003Q1-2014Q4			
Variable	Coefficient	t-statistic	Probability
DGDP	-7.44E-06	-1.622362	0.1120
DCPI	1.855963	0.363553	0.1185
DINFL	-0.174074	2.448188	0.0657
DINTR	-1.083658	-1.888958	0.7180
R-squared 0.158424		Jarque–Bera 17.75701	
Adjusted R-squared 0.080138			
S.E. of regression 4.675802			
F-statistic 2.023657			
Durbin-Watson stat 2.769457			

Diagnostic tests – First Group of Variables

The t-value for normality test (Jacque–Bera test) is 17.75701, with a p value of 0.000139. Given that the p value is lower than 0.05, the conclusion would be that we reject the hypothesis that the variables are normally distributed. When comparing the p value with 0.05, if the p value is high we suppose to accept that there is normality in the distribution. (Gujarati, 2004) With a p-value of 0.2199, we do not reject the null hypothesis that there is heteroscedasticity in the error term at 5% significance level. The test for serial correlation (LM test) suggests that, with a p-value of 0.1010, we do not reject the null hypothesis of no serial correlation. The last diagnostic test is the Ramsey reset test; with a p-value of 0.82, at 5% significance level, we fail to reject the null hypothesis. This, therefore, means that the test proves that the model is not mis-specified.

Empirical Results from Second Regression

The augmented Dickey-Fuller test results show that all the variables are not stationary in their level forms. The differences of these variables, however, are stationary.

Table 3. Augmented Dickey-Fuller test results for stationarity

Augmented Dickey-Fuller test					
Variable		Intercept	Trend and intercept	None	Integration of order
EXCH		-0.420596**	-2.400254***	0.727341***	I(0)
LSM		-1.535731***	-1.667008***	3.593282***	I(0)
USINTR		-1.104137***	-3.893474**	-1.007491***	I(0)
POR		-3.153121*	-3.378607**	-1.357824***	I(0)
LR		-0.405215***	-3.340589**	1.390098***	I(0)
LOIL PRICES		-2.272218***	-2.400254***	-0.627140***	I(0)
CPI		1.332491***	-2.866295***	5.250135***	I(0)
Critical values	1% level	-3.477144	-4.024452	-2.581466	
	5% level	-2.881978	-3.442006	-1.943107	
	10% level	-2.577747	-3.145608	-1.615210	
The three stars (***) mean that the stationarity test for the variable is significant at all levels (1%, 5% and 10%). The two stars (**) means that the test is significant at two levels of significance and one star (*) means that it is only significant at one level of significance.					

The graphs of the variables illustrates that all variables are stationary at level form. In contradiction with the graphs below, they illustrates that all variables are stationary after differencing.
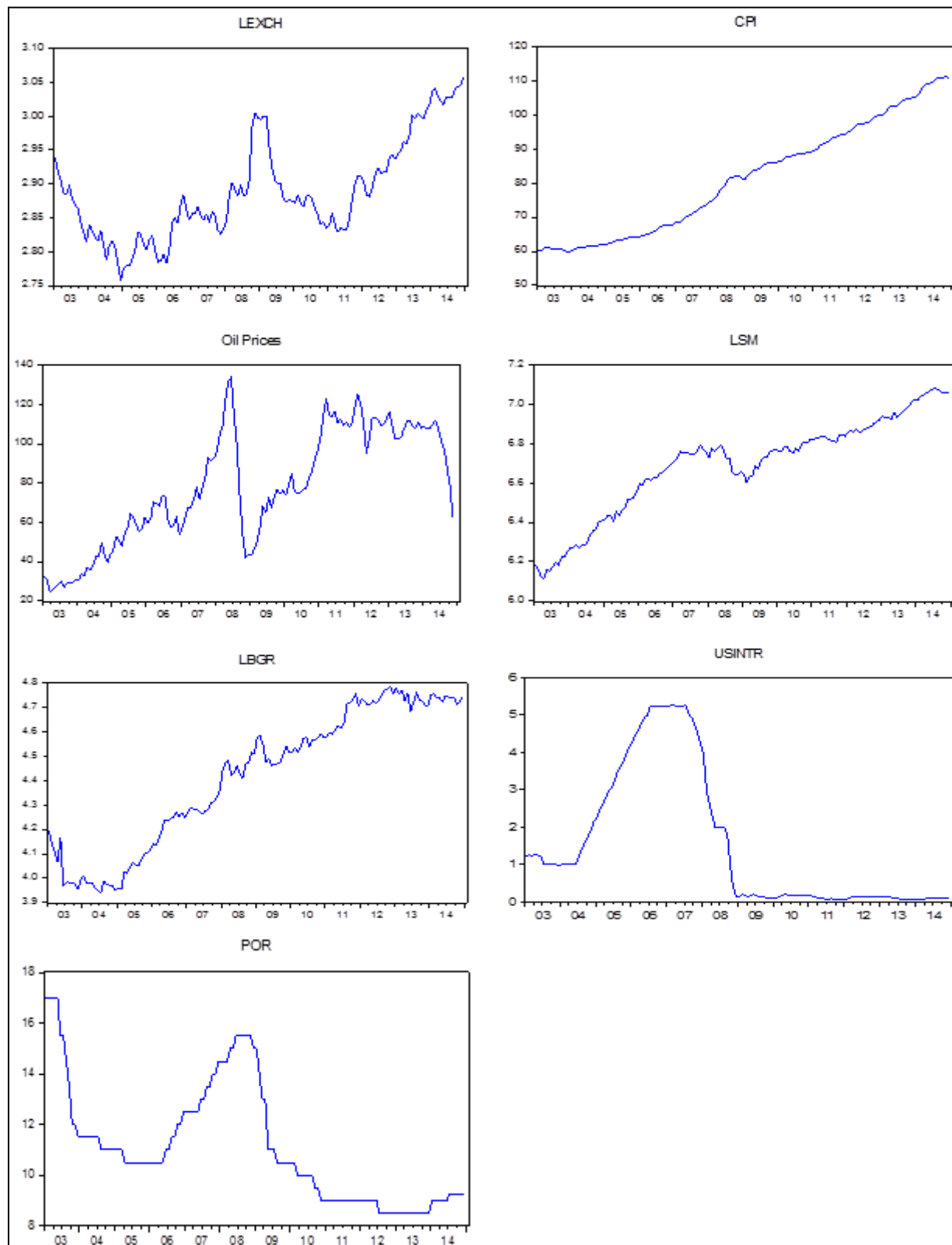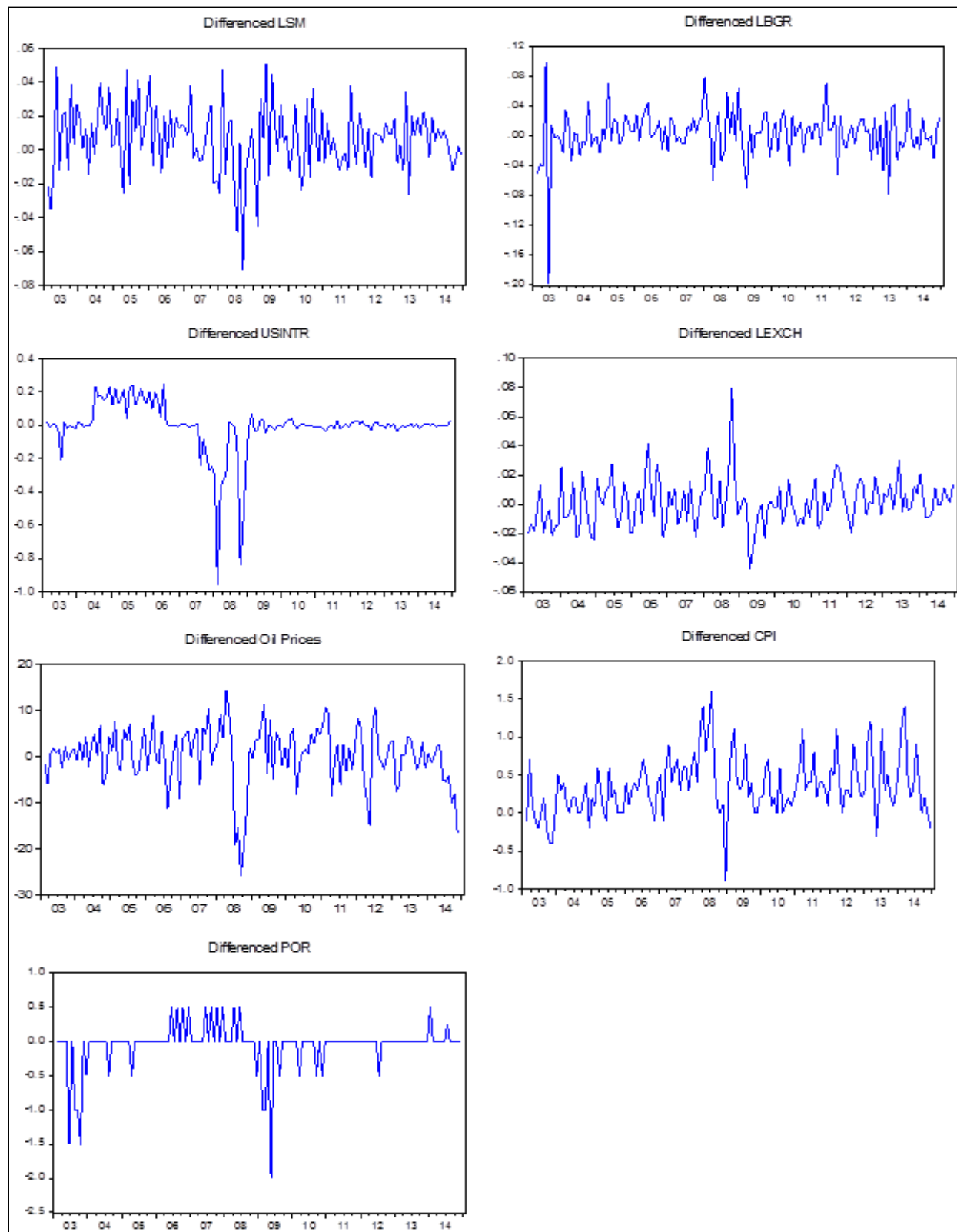
Figure 9. Before-differencing graphs

Figure 10. After-differencing graph

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Analysis of results – Second Group of Variables

As we can see from Table 4 below, the coefficient of determination is sufficiently high (59%). Prime Overdraft Rate and Money Stock have a positive effect on Exchange Rate Variation in South Africa. On the other hand, Reserves and the USA Interest Rate affect Exchange Rate Variation negatively. However, the coefficient on Reserves is statistically insignificant at 5% significance level, as shown by the t-statistic. The rest of the coefficients are statistically significant at 5% significance level.

Table 4. OLS Regression results – second Group of Variables

Ordinary Least Squares regression with Exchange (Exchange rate) as the dependent variable of the sample from 2003M1-2014M12			
Variables	Coefficients	t-statistic	P-Value
DLR	-0.019354	-0.589126	0.5568
DLSM	-0.207262	-4.201974	0.0000
DUSINTR	0.018681	5.361937	0.0000
DPOR	0.014207	10.62392	0.0000
DOIL PRICES	-0.001117	-7.227547	0.0000
DCPI	0.010646	12.27607	0.0000
R-squared 0.870952 Jarque – Bera 2.751930 Adjusted R-squared 0.865259 S.E. of regression 0.026473 F-statistic 152.9792 Durbin-Watson stat 0.524690			

Diagnostic tests – Second Group of Variables

The t-value for normality test (Jarque – Bera) is 2.751930, with a p value of 0.252596. Given the p value greater than 0.05 the conclusion would be that we fail to reject the null hypothesis that the residuals are normally distributed. The results for the Heteroskedasticity test reveal that the p-value is 0.0000. Thus, we reject the null hypothesis that there's heteroscedasticity.

The test results for serial correlation (LM test) show a p-value of 0.0000 and an F- statistics 87.66433, we reject the null hypothesis of serial correlation, also shows an observed R-square 81.05294, with a chi-square 0.0000. The results from Ramsey reset test reveal a p-value of 0.0198 and a likelihood value 5.432083, therefore, we reject the null hypothesis no misspecification in the model.

Conclusion

This study carried out OLS estimation to analyse the factors that determine exchange rate variation in South Africa. The regression involved first differences of the variables of interest; since, according to the Augmented Dickey-Fuller test, the variables were found to be non-stationary in their level forms. The first group of explanatory variables from extant empirical literature was found to be individually and jointly insignificant, and the coefficient of determination from the regression was too low (approximately, 10%). The explanatory variables used in the regression include Gross Domestic Product, Consumer Price Index and Inflation Rate. Quarterly data for these variables were used in the estimation. However, it should be noted that quarterly data for Foreign Direct Investment, a widely used variable in the empirical literature on exchange rate variation, were not available.

The second regression used the following explanatory variables: South Africa's Foreign Reserves, South Africa's Total Money Stock, South Africa's Prime Overdraft Rate, South Africa's consumer price index, Oil prices and the USA Interest rate. The Prime Overdraft Rate was used as a proxy for the interest rate in South Africa. One of these explanatory variables, Money Stock, was used in the research on the same topic for the European developed countries. However, the regression on these variables used monthly data. The Augmented Dickey-fuller test showed that all the variables, in this group, were stationary in their level forms. According to the results, all the variables but one (South Africa's Foreign Reserves) were found to be significant at the 5% level of significance. The coefficient of determination (87%) was remarkably higher than the one obtained from the first regression.

It would be interesting to carry out a further empirical exercise, in this regard, that uses the combined explanatory variables of the two groups.

Recommendation

Policy Recommendations

The study has established that the CPI, US interest rates and prime overdraft rate have a positive relationship with the South African exchange rate. This means that the South African policymakers should keep the above-mentioned variables at high levels because a strong domestic exchange rate attracts foreign investors and the foreign direct inflows will help maintain a health capital account of South Africa.

For the past three quarters or so, the South African economy has been experiencing a steep depreciation in its currency. This is a worrying development as it implies that imports will become much more expensive; especially so for oil imports and other production inputs used in South Africa. The higher import costs will push inflation higher in the South African economy. This calls for the South African policymakers to increase the interest rate in order to reverse the adverse effects. Of course, the use of the interest rate comes with its own cost; notably, the economy will likely stagnate in the face of low levels of investment.

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