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Relationship between Real Exchange Rate and Economic Growth: the case of South Africa

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Abstract: The objective of this study was to investigate the relationship between real exchange rate and economic growth in South Africa. Using time series data, the period from 1980 to 2015 was covered in the study. Data was collected from the South African Reserve Bank, the International Monetary Fund and International Financial Statistics. The Johansen cointegration and the Vector Error Correction Model estimation techniques were employed in the study, followed by VEC Granger causality test, variance decomposition and impulse response function. The long-run results revealed a negative and significant relationship between real exchange rate with export and economic growth. On the other hand, money supply and foreign direct investment have a positive and significant relationship with real exchange rate. Only export was significant and positively related to real exchange rate in the short-run. Results of granger causality showed that only export granger causes real exchange rate thus, a unidirectional causality exists between export and real exchange rate. Results of variance decomposition revealed that the real exchange rate is highly affected by shocks from economic growth. The impulse response functions showed that real exchange rate responds positively to shocks from real exchange rate and money supply. On the contrary, real exchange rate responds negatively to a shock from economic growth. There is, therefore, a need to increase exports, money supply, foreign direct investment and economic growth as these would lead to an increase in the Rand and consequently, appreciation of the Rand.

Keywords: *Real exchange rate, Economic growth, South Africa, VEC Granger Causality and VECM*

1. Introduction

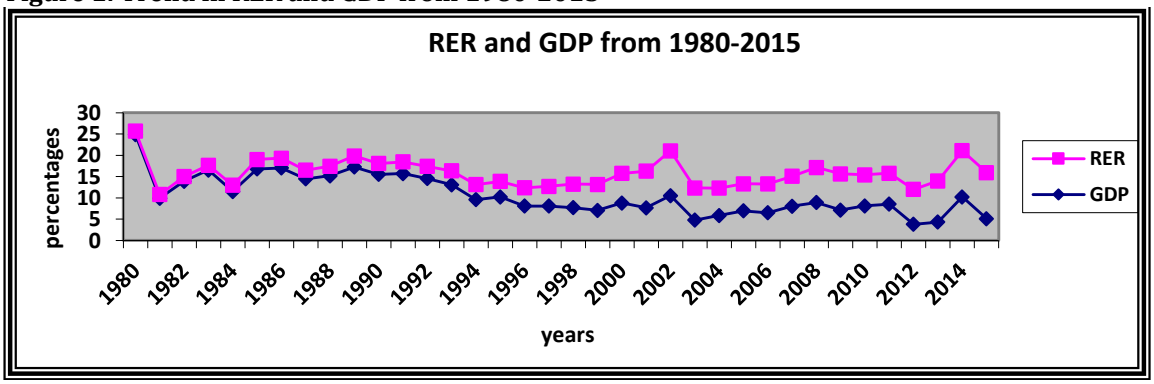
The relationship between exchange rate (ER) and economic growth (EG) has remained a controversial subject. A number of economists believe ER is an endogenous variable, whose influence on growth may be tough to separate (Habib, Mileva and Stracca, 2016). In terms of a country's level of trade, exchange rate plays an essential role. Thus, its importance allows exchange rate to be among the most observed, evaluated and governmentally influenced economic measures. Exchange rate fluctuations have been considered a problem in developing countries (Frankel, 2003). Fluctuations of exchange rate started occurring when most countries adopted the free float regime, after the change from global fixed exchange rate. South Africa is one of the countries that switched to a free floating system after 2000 (Van der Merwe, 1996). The value of the Rand has been going through a series of fluctuations recently. During the 2012 financial year, the Rand began to decrease against the United States Dollar; depreciating at 9 % average level rate of exchange (Census and Economic Information Centre Data, 2016). Moreover, in the 2015 financial year (between January and March), the decrease in the value of the currency was recorded at a rate of 12.45% (Trading Economics, 2015). In January 2016, it took a hard hit when it recorded its all-time high of R16.84 to the Dollar (Maepa,2015). This was mainly due to South Africa's political instability and the replacement of the Finance Minister, Nhlanhla Nene, with African National Congress (ANC) Member of Parliament, David Van Rooyen on 9thDecember 2015. Since South Africa is an open economy, real exchange rate (RER) is an essential factor and determines the development of a country. The exchange rate, therefore, has to maintain its stability for the economy to gain from international trade and also to increase the growth rate of the economy.

This study will add value to the current discussion on exchange and growth rates in South Africa as well as assist other students and researchers on information on the topic. It will also assist local policymakers in terms of formulating suitable policies. The study will also add value to available literature on the relationship between exchange and growth rates of the economy. This study is unique because of the chosen variables. Several studies have been conducted on the same topic; however, the variables chosen in this study are different from other studies. Furthermore, the methodology used in the study is very diverse. VEC Granger causality was employed in the study since most studies have only used the Vector Error Correction Model, variance decomposition and impulse response function.

2. Literature Review

Trend in RER and EG in the South African economy: A nation's currency value is considered to be an essential factor in determining growth (Walters and De Beer,1999). Thus, it is very important for a country to choose an appropriate exchange rate system since it offers a foundation for a nation to become competitive, especially in developing countries (Yagci, 2001).

Figure 1: Trend in RER and GDP from 1980-2015



In Figure 1 above, the graph shows the trend from 1980 to 2015, between real exchange rate and economic growth. The graph shows that from 1980 to 1995, economic growth was stable compared to the fluctuation in the real exchange rates. In 2001, the Rand was at its historical level of R13.84 to the dollar. However, in 2005, the currency softened and traded around R6.35 to the dollar. Nevertheless, South Africa, for the first time in 17 years, experienced a recession from 2008-2009, by going through three consecutive quarters of negative growth (Business live, 2017). In the fourth quarter of 2009, the weighted average exchange rate of the Rand increased by 1.2% (SA News, 2016). An appreciation in the exchange value of the Rand was due to improvement in the position of external trade, the constant increase in international commodity prices and positive sentiments towards the 2010 World Cup hosted by South Africa. However, since 2012, the Rand has been fluctuating, and lost its value for about 9.5% from December 2013 to December 2014 (Matlasedi, Zhanje and Iiorah, 2015). The Rand performed at its worst level in 2014 against the US dollar and decreased by 3.5% from the beginning of the year. However, the value increased by 2.5% by the end of the first quarter of 2014 (Twala and Mchunu, 2014). In 2015, the Rand hit to R15.38 (BusinessTech, 2016) and thenreached a level of R16.84 (Maepa, 2015), caused mainly to the political instability in the country. In 2015, GDP growth was 1.3%, an indication that economic performance remained challenging. By August 2015, the Rand dropped nearly 15% against the dollar due to South Africa's current deficit and slow growth. Since then, the Rand has been experiencing fluctuations, and concerns have been raised as the Rand may remain weak for at least the next five years (from 2014 to 2018) (Mittner, 2014).

Theoretical framework: This section is dedicated to theories on exchange rate. The Traditional approach implies that RER enhances EG, while the Structuralist approach implies that RER discourages EG. These two theories are applicable to the study as the main purpose is determine the relationship between RER and EG for South Africa.

The Traditional approach: The traditional approach holds that devaluation increases the growth rate of a country. This implies that when the exchange rate is devalued, domestic goods become inexpensive overseas, which in turn, raises their demand, thus resulting in a growth in exports (Salvatore, 2005). According to this method, aggregate demand determines output whereby, depreciation positively influences and encourages aggregate demand and output (Genye, 2011). Moreover, depreciation of a currency improves trade balance along with balance and expands output and employment (Acar, 2000). However, depreciation of a country's currency can only improve its trade balance and economic growth in the long-run when the Marshall-Lerner condition is satisfied. Thus, the traditional approach entails that real exchange rate enhances economic growth, implying a positive relationship (Sibanda, 2012).

The Structuralist approach: Contrary to the traditional approach, the structuralist approach maintains that currency devaluation may contain a contractionary outcome on output and employment. It shows that currency devaluation might cause a decrease in output. Krugman and Taylor (1978) state that devaluation encourages increase in returns share of gross domestic product thus, imposing a negative influence on aggregate demand if the saving propensity of firms and capital owners is greater than the wage of employees. In order for the structuralist approach to hold, a number of channels must be satisfied. The channels show that ER devaluation results in a decrease in aggregate demand and eventually general output. Furthermore, the contractionary effect is mainly caused by a rise in price levels. With this theory, a strategy to devalue money could result in challenging macro polices that strive to stabilize the macro-economy through a decrease in inflation (Sibanda,2012). Thus, a negative relationship exists between real exchange rate and economic growth. For the purpose of this study, the structuralist approach was considered more appropriate in terms of the situation in South Africa and thus, was adopted in the study; an indication that depreciation discourages economic growth.

Empirical literature: The purpose of this section is to examine studies conducted by other researchers with regard to exchange rates and economic growth, and to highlight the different methods of estimation employed by these researchers depending on their of country and period of study. Empirical evidence shows that results obtained differ from one study to another, thus, mixed results are found. Alawin, Sawaie, Al-Omar and Al-Hamdi (2013) examined the influence of real effective exchange rate (REER) in Jordon through the aggregate demand-supply theoretical framework. The researchers used the improved OLS method. Financial variables such as narrow monetary supply (M1) and broad money supply (M2) and GDP were employed. Data was obtained from the Central Bank of Jordon and the Department of Statistics. The theories are based on aggregate demand and aggregate supply to test the relationship. Considering the fact that the researchers used the traditional theory in their study, the results revealed that the appreciation of REER does not reflect international competitiveness of Jordanian goods, which is an indication that the Jordanian economy should maintain stability in RER. The empirical evidence showed that the impact of RER works through aggregate supply and a rise in REER enhances EG. In contrast, it was found that narrow money supply was more effective and because total price elasticity of exports and imports were found to be less than 1, the Marshall-Lerner condition was not obtained. It was recommended that real rate of exchange be used as one of the macroeconomic policies and maintain a fixed rate of exchange and as an active variable focus on narrow money supply in the Jordanian monetary policy.

Uddin, Rahman and Quaosar (2014) examined the relationship between ER and EG in Bangladesh. The study covered the period from 1973 to 2013 and employed a times series econometric technique, such as the Augmented Dickey-Fuller test (ADF), Granger causality test and Johansen cointegration model. Data was collected from the Bangladesh Bank, the Bangladesh Bureau of Statistics, the Asian Development Bank, the International Financial Statistics and World Development Indicators. The empirical results showed a significant positive relationship between ER and EG. The Granger's causality test proved that a bi-directional causality runs through exchange rate to economic growth and vice versa, which is an indication of the existence of a long-run equilibrium relationship between ER and EG. Aman, Ullah, Khan and Khan (2013) examined the link between exchange rate and growth rate of the Pakistan economy. The study covered the period from 1976 to 2010 and data was collected from the database of the World Bank and Pakistan economic surveys. An indirect approach was used in the study since theoretical literature is inadequate to clarify the correct link. Moreover, most academic literature emphasizes an indirect relationship since ER encourages growth through export, investment and internal trade. Hence, the simultaneous equation model with two and three stage least square techniques was employed in the study. A positive relationship between ER and EG was revealed in the study. Although a positive relationship was found, exchange rate cannot be applied as a strategy tool to boost growth with regard to Pakistan.

Tarawalie (2010) investigated the impact of REER on EG in Sierra Leona. The author used quarterly data from 1990Q1 to 2006Q4. Data was obtained from the International Financial Statistics (2007), published by the IMF and the Bank of Sierra Leone Bulletin. The Johansen cointegration technique and bivariate Granger causality were used in the study. The empirical results obtained revealed a positive relationship between REER and EG supported by statistically significant coefficients. The results also showed that in the long-run, the monetary policy was somewhat more efficient than the fiscal policy, which is in line with the basic

Mundell-Fleming model. For policymakers, it was recommended that in order to obtain macroeconomic solidity, monetary and fiscal policies should be in consonance. Importantly, it is essential to keep ER stable by letting it to depreciate within a given band as well as maintain a stable political environment in order to recover investment. Ayodele (2014) studied the impact of exchange rate on the Nigerian economy from2000 to 2012. Inflation and exchange rates are factors measured in changes in GDP. Secondary data was collected from Annual Reports of the Central Bank of Nigeria, the Nigerian Stock Exchange and Nigeria Securities and Exchange Commission. The study used multiple regression models. It was found that as exchange rate increased, it negatively affected growth while inflation rate exerted a positive impact on growth. The negative effect of the rate of exchange did not allow the economy to boost as anticipated, although the economic growth rate increased every year in Nigeria. It was suggested that to accelerate economic growth through a favorable exchange rate and to decrease the pressure of the dollar, the government should make the investment climate friendly in the Nigerian economy by reinstating safety of lives and property, infrastructural growth and development in local production.

Wong (2013) examined RER misalignment and EG in Malaysia. The study focused on the period from 1971 to 2008. An Autoregressive Distributed Lag Model (ARDL) and Generalized Forecast Error Variance Decomposition (GFEVD) approach were applied. The results obtained revealed that in the long-run, a rise in real interest rate differential, productivity differential and real oil price or reserve differential will cause an increase in RER. It also showed that an increase in RER misalignment would cause a reduction in EG. Particularly, devaluation will promote economic growth while appreciation will hurt economic growth. The GFEVD outcome showed that variables are important in determining RER. According to the fundamentals, real exchange rate misalignment should be evaded in order to facilitate the allocation of resources in the economy. It was, therefore, concluded that government intervention is necessary during the short-run to minimize real exchange rate misalignment and to smooth down fluctuations, while in the long-run, markets and financial organizations should be strengthened.

Basirat, Nasirpour and Jorjorzadeh (2014) studied the effects of instability of the rate of exchange on economic growth, taking into account, the speed of growth of financial markets in developing countries. The authors analyzed panel data of 18countries from 1986 to 2010. The 5-year mean was used for each of the variables in order to eliminate the effects of short-term cycles as well as to avoid fluctuating annual data from denting the results. The World Development Indicator from the World Bank website was used to obtain statistics for all the variables. From the results revealed a negative and significant effect of financial development and exchange rate fluctuation on economic growth. Whereas, a positive effect was obtained from the mutual effect of exchange rate fluctuations and financial development on economic growth, although it was not statistically significant as the effect in the studied countries was small.

Bibi, Ahmad and Rashid (2014) investigated the role of exchange rate, trade openness, inflation, imports, exports, real exchange and foreign direct investment which improve economic growth. The period of study was from 1980 to 2011 using times series data. The methods used to determine stationarity were: ADF; Philips Peron (PP); Dickey-Fuller Generalized Least Square (DF-GLS); and cointegration and Dynamic Ordinary Least Square (DOLS) estimation techniques. The results of cointegration showed that a long-run relationship existed between the variables. On the contrary, inflation and trade openness imposed a negative impact on economic growth, which is supported by the results of DOLS and due to depreciation in the ER along with huge volume of importing resulting in trade deficit while FDI, imports, exports and exchange rate positively influenced EG. Although a positive relationship was shown between ER and EG, there was no significant relationship as the local economic performance of economic growth is much complex to the deviation in ER in the long period. It was recommended that policymakers should take the occurrence and amount of ER instability into account as well as the effects of changes on each macroeconomic factor of trade policy and foreign direct investment.

Kandil (2004) studied the outcomes of exchange rate fluctuations on real output growth along with price inflation for a sample of 22 developing countries. The author argues that a depreciation of a domestic currency all the way through initial rise in the price of foreign goods relative to home goods could stimulate economic activity. A theoretical model was employed, which decomposes the movements of ER into expected and unexpected mechanisms. The impact of expected exchange rate shifts in the long-run is assessed through

a significant decrease in output growth and a significant rise in price inflation. On the other hand, unexpected exchange rate shifts during the short-run, affect fluctuation in output growth and price inflation. Through the demand and supply channels, in the face of unanticipated currency depreciation, there is proof of a significant contraction of output growth as well as price inflation determined by demand expansion and supply contraction. It was, therefore, concluded that in a range of developing countries, exchange rate fluctuations generate unfavorable consequences on economic performance; these outcomes are clear by means of output contraction and price inflation during a phase of currency devaluation. There is a need for exchange rate policies to aim at minimizing unanticipated currency fluctuations in order to insulate economic performance from unfavorable outcomes of inconsistencies in developing countries. Moreover, evidence from empirical data suggests that the exchange rate should be stabilized at a level that is reliable with difference in macroeconomic fundamentals over time.

3. Methodology

The Structuralist approach, the Johansen (1995) cointegration technique, the Vector Error Correction Model (VECM), VEC granger causality, variance decomposition and impulse response function were adopted in this study. Different diagnostic and stability tests such as heteroscedasticity, serial correlation, normality and AR root graph were also used in the study.

Model specification: The dependent variable was real exchange rate (RER) and the explanatory variables were gross domestic product deflator (GDPD), foreign direct investment (FDI), export (EXP) and money supply (MS). The model according to Sibanda (2012) was adopted in the study.
The model was modified and estimated as follows:
$RER = \beta_0 + \beta_1 GDPD + \beta_2 FDI + \beta_3 MS + \beta_4 EXP + \varepsilon$ …… (1)
It is significant to change the regression equation into natural logarithm since it brings a stable trend and eliminates the tendency of fluctuations over time (Mah, 2012). Therefore, the regression equation now becomes:
$\ln(RER) = \beta_0 + \beta_1 \ln(GDPD) + \beta_2 \ln(FDI) + \beta_3 \ln(MS) + \beta_4 \ln(EXP) + \varepsilon$ …… (2)

Stationarity test: In order to avoid the generation of spurious regression and determine whether cointegration exists among the results of the variables, it is important to test for stationarity. Stationarity tests include both visual inspection and Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) unit root tests. Once the stationarity test has been done, the next step is to choose an appropriate lag length in order to see which lag fits the best.

Lag order selection criteria: It is important to have a good lag since variables that are omitted affect the lag length, which in turn, affects the behavior of the model. For the purpose of this study, FPE was chosen as the best criteria. Liew (2004) states that the FPE lag length is good for a small sample of 60 and below.

Johansen cointegration test: The Johansen technique applies the greatest likelihood evaluation towards VECM, together, they determine the short and long-run determinants of the dependent variable. There are two methods: The Maximum Eigenvalue test and the Trace test that determine the number of cointegrating vectors (Asteriou and Hall, 2006). In the Maximum Eigenvalue test, the null hypothesis (H_0) states that there are r cointegrating relations and the alternative hypothesis (H_1) states that there are r + 1 cointegrating relations.
$J_{\max Egen} = -T\ln(1-\lambda_{r+1})$ …… (3)
With regard to the trace test, theH_0isr cointegrating vectors and the$H_1$is n cointegrating vectors.
$J_{trace} = -T\sum_{i-t+1}^{n}\ln(1-\lambda_i)$ …… (4)
Lukephol (1993) suggests that the Trace test executes well than the Max-Eigen value. Once the existences of cointegrating relationships are determined, VECM could be applied. This is done by the vector auto regression (VAR) of order P (Sibanda, 2012):
$Y_t = A_1 Y_{t-1} + BX_t \ldots A_p Y_{t-p} + \varepsilon_t$ …… (5)
Where by, Y_t is a k- vector of I (1) variables, X_t is a d-vector deterministic variable and ε_t a vector of innovations. The equation above is rewritten into a VECM specification to employ the Johansen technique (Brooks, 2008). Thus, the VAR is rewritten as:

$\Delta Y_t = \prod Y_{t-1} + \sum_{i-1}^{p-1} i\Delta Y_{t-1} + BX_t + \varepsilon_t$ …… (6)
where: $\prod = \sum_{i-1}^{p} Ai$- I and i = - $\sum_{j=i+1}^{p} Aj$ …… (7)
When the coefficient matrix $\prod$ has reduced rank, then m × r matrices α andβ exist. Moreover, $\prod = \alpha\beta'$ and β' Y_t are stationary and r is the number of cointegration, each column of β is the number of cointegrating vector and α adjustment parameters in the VECM (Sibanda,2012).

Vector Error Correction Model: VECM is simply an idea when part of the disequilibrium from one phase to the next phase is corrected. This entails assessing the first differenced form (in equation 1) model by including an error correction term (ECT) as an explanatory variable. Thus, ECM is estimated as follows:
$\Delta\ln(RER_t) = \beta_0 + \sum_{i-n-1}^{n} \beta_1 \ln(GDPD_{t-1}) + \sum_{i-n-1}^{n} \beta_2 \Delta\ln(FDI_{t-1}) + \sum_{i-n-1}^{n} \beta_3 \Delta\ln(MS_{t-1}) + \sum_{i-n-1}^{n} \beta_4 \ln(EXP_{t-1}) + \beta_5 EC_{t-1} + v$ …… (8)
where n is the value selected using the Aikaike's Information Criteria (AIC) and Schward Information Criterion(SC). ECT represents the error correction term and V represents the Random error term. ECT is defined as the lagged values of the error term that has been developed from the regression mode. When the ECT is negative and statistically significant, it is an indication that part of the disequilibrium in RER is accurate in the next phase (Hassan, 2003).

Diagnostics and Stability tests: The diagnostic and stability tests help in electing whether or not a model has been correctly identified. The diagnostic test consists of Heteroscedasticity, Autocorrelation Lagrange Multiplier (LM) and Normality test. Under the stability test, the autoregressive (AR) root graph is employed, this test determines whether the model is stable or not.

VEC Granger causality test results: VEC granger causality is used to regulate whether present and lagged values of one variable affect one another. When X is said to Granger cause Y, then the historical and current values of X help to predict Y Granger (1969).

Variance decomposition results: Andren (2007) explained the significance of variance decomposition by maintaining that it offers a way of defining the comparative significance of shocks in enlightening differences in the variable of interest. Henceforth, it provides ways of defining comparative significant of shocks to RERs with the intention of explaining variations in economic growth.

Impulse Response Analysis: This technique traces the responsiveness of the dependent variable to shocks in each of the other variables in a study. It is normally related to VECM, given that shocks related to VECM slowly deter away after a while (Brooks, 2014).

4. Results and Interpretation

Stationarity: Figure 2 shows graphical representations of all the variables at first difference, indicating that both mean and variance are constant over time, thus stationarity has been achieved at first difference. A formal method to present results of unit root (ADF and PP unit root tests) has been conducted in order to support the graphical findings in Table 2.

Table 1: Unit root at intercept

Variables	ADF test t-statistic	Probability	PP test t-statistic	Probability	Order of integration
LNGDPD	-8.298	0.000***	-3.014	0.043**	I(1)
LNRER	-4.370	0.002***	-4.194	0.002***	I(1)
LNFDI	-4.732	0.001***	-4.633	0.001***	I(1)
LNMS	-5.007	0.000***	-9.439	0.000***	I(2)
LNEXPO	-5.603	0.000***	-6.344	0.000***	I(1)

***stationary at 1%, **stationary at 5%, *stationary at 10%

From the Table above presented reveals the unit root test for all the variables at first difference and second difference. Based on the probability values LNGDPD, LNRER, LNFDI and LNEXPO are stationary at first difference while LNMS is stationary at second difference.

Table 2: Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ	Conclusion
0	-15.14	NA	2.25e-06	1.185	1.409	1.261	Not good
1	169.4	304.0*	1.92e-10*	-8.202	-6.856*	-7.743*	Good
2	194.9	34.42	2.07e-10	-8.228*	-5.759	-7.386	Not good

Lag order selection criteria: Table 2 presents the lag length selection criteria. Lag one is found to be the best lag for the data with regard to the case of South Africa as indicated by FPE, majority of the criteria also suggest lag 1.

Table 3: Trace test and Max-Eigen test

		Trace test			Max-Eigen test			
Hypothesized no. of CE(s)	Eigen value	Trace statistics	0.05 critical value	Prob.**	Max-Eigen statistics	0.05 critical value	Prob**	Conclusion
None*	0.682	82.09	69.82	0.004	38.98	33.88	0.011	Reject H_0
At most 1	0.466	43.11	47.86	0.120	21.35	27.58	0.256	Do not reject H_0
At most 2	0.308	21.76	29.70	0.312	12.40	21.13	0.499	Do not reject H_0
At most 3	0.172	9.264	15.49	0.342	6.421	14.26	0.550	Do not reject H_0
At most 4	0.080	2.844	3.841	0.092	2.842	3.841	0.092	Do not reject H_0

Results of Johansen Cointegration test: Table 3 presents the results of the Trace and Max-Eigen tests. The trace statistics at none is 82.09; it is more than the 5% critical value of 69.82. The$H_0$of no cointegrating vectors is, therefore, not accepted at none and suggests that there is cointegration at none. The Max-Eigen test at none is 38.98, which is more than the 5% critical value of 33. 88. This implies that there is cointegration and, therefore, theH_0 is rejected. Both Trace and Max-Eigen indicate 1 cointegration equation at none.

Table 4: Results of Long-run relationship

Variables	Coefficient	t- statistics	Standard error	Conclusion
Constant	-1.538	-	-	
LNRER	1.000	-	-	
LNGDPD	0.878	5.523	0.159	Negative and significant
LNFDI	-0.518	-3.032	0.518	Positive and significant
LNMS	-0.868	-2.326	0.373	Positive and significant
LNEXPO	1.266	2.909	0.435	Negative and significant

The long run equation is presented as follows:

LNRER = 1.538 – 0.878 LNGDPD + 0.518 LNFDI + 0.868 LNMS – 1.266 LNEXPO…… (9)

Results of Vector Error Correction Model: The results of the long-run relationship of VECM show that if all the independent variables are held constant, LNRER will rise by 1.538 unit. A negative and significant relationship between LNRER and LNGDPD exists in the long-run. A 1 unit increase in LNGDPD will cause LNRER to decrease by 0.878 unit. These results are in line with those obtained by Ayodele (2014) and Wong

(2013) who also found a negative relationship between real exchange rate and economic growth. Therefore, it could be concluded that if LNGDPD increases, then it leads to a depreciation of the Rand. Also, LNFDI shows a positive and significant relationship on LNRER in the long-run. A 1 unit increase in LNFDI will cause LNRER to increase by 0.518 unit. These results are similar to those of Bibi et al. (2014) who found that foreign direct investment is positively related to economic growth. However, there is no significant evidence. This implies that if LNFDI increases, then the Rand will appreciate. An increase in foreign direct investment attracts more investors to invest in the country and boosts business confidence in the market thus, encouraging economic growth and has a positive influence on the Rand.

A positive and significant relationship was also found between LNMS and LNRER. A 1 unit increase in LNMS will cause LNRER to increase by 0.868 unit. Also, with LNMS, if increased, then the Rand will appreciate. Contrary to this, Sibanda (2012) found a negative relationship between money supply and economic growth. Finally, a negative and significant relationship exists between LNEXPO and LNRER. A 1 unit increase in LNEXPO will cause LNRER to decrease by 1.266 unit. LNEXPO is negative, an indication that a decrease depreciates the Rand. Bibi et al. (2014) found a positive relationship between real exports and economic growth. The results are contrary maybe due to effects of international financial instability.

Table 5: Results of Short-run error correction model

Variables	Coefficient	T-statistics	Standard error	Conclusion
CointEq1	-0.305	-4.051	0.075	Negative and Significant
D(LNEXPO(-1))	0.591	2.404	0.246	Positive and Significant
R-square	0.557			
Adj R-square	0.459			

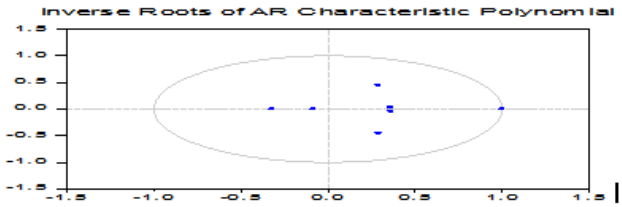
The error correction term is negative (-0.305) with an absolute t-statistics of 4.051. This proves that only 30% equilibrium is corrected in the next period as it moves towards restoring equilibrium. D (LNEXPO (-1)) has a positive relationship and is statistically significant in determining LNRER. This means that an increase in export leads to an increase in real exchange rate or vice versa. The R-square value is 0.56, which suggests that only 56% of the deviation in LNRER is explained by the independent variables. Also, the Adjusted R-square is 0.46, which provides evidence that 46% of the independent variables explain the variation of the dependent variable.

Diagnostics and stability tests: This section focuses on the results of the diagnostics and stability tests. The probability value of 0.05 or 5% level of significance was used to decide whether the null hypothesis should be accepted or rejected.

Table 6: Summary of all diagnostic tests

Test	Null hypothesis	Chi-square/ LM statistic	Probability	Conclusion
Heteroscedasticity	No heteroscedasticity	169.4	0.703	No evidence of heteroscedasticity.
Serial correlation LM	No serial correlation	21.04	0.690	No evidence of serial correlation
Normality	Residuals are normally distributed	7.695	0.659	Normally distributed

Figure 3: AR autoregressive root graph



Stability test: The AR root graph in Figure 3 is used to detect whether the model is stable for South Africa or not. All the unit root points lie inside the unit circle which implies that the model is stable.

Table 7: VEC Granger Causality test

Dependent variable: D(LNRER)				
Excluded	**Chi-square**	**Degree of freedom**	**Prob.**	**Conclusion**
D(LNGDPD)	0.013	1	0.908	Do not Reject H_0
D(LNFDI)	0.489	1	0.484	Do not Reject H_0
D(LNMS)	0.741	1	0.389	Do not Reject H_0
D(LNEXPO)	5.781	1	0.016	Reject H_0
ALL	8.719	4	0.069	Do not Reject H_0
Dependent variable: D(LNGDPD)				
Excluded	Chi-square	Degree of freedom	Prob.	Conclusion
D(LNRER)	0.479	1	0.489	Do not Reject H_0
D(LNFDI)	0.395	1	0.520	Do not Reject H_0
D(LNMS)	0.576	1	0.448	Do not Reject H_0
D(LNEXPO)	0.000	1	0.987	Do not Reject H_0
ALL	1.421	4	0.841	Do not Reject H_0
Dependent variable: D(LNFDI)				
Excluded	Chi-square	Degree of freedom	Prob.	Conclusion
D(LNRER)	0.773	1	0.379	Do not Reject H_0
D(LNGDPD)	0.607	1	0.436	Do not Reject H_0
D(LNMS)	2.950	1	0.086	Do not Reject H_0
D(LNEXPO)	0.114	1	0.736	Do not Reject H_0
ALL	4.614	4	0.329	Do not Reject H_0
Dependent variable: D(LNMS)				
Excluded	Chi-square	Degree of freedom	Prob.	Conclusion
D(LNRER)	2.073	1	0.140	Do not Reject H_0
D(LNGDPD)	0.853	1	0.356	Do not Reject H_0
D(LNFDI)	3.084	1	0.079	Do not Reject H_0
D(LNEXPO)	1.101	1	0.294	Do not Reject H_0
ALL	7.370	4	0.117	Do not Reject H_0
Dependent variable: D(LNEXPO)				
Excluded	Chi-square	Degree of freedom	Prob.	Conclusion
D(LNRER)	0.437	1	0.509	Do not Reject H_0
D(LNGDPD)	0.159	1	0.680	Do not Reject H_0
D(LNFDI)	0.573	1	0.449	Do not Reject H_0
D(LNMS)	0.170	1	0.670	Do not Reject H_0
ALL	1.667	4	0.797	Do not Reject H_0

Results of VEC Granger causality test: The probability values are used to evaluate the casual relationship among variables. The results are evaluated at 5% level of significance. When the probability value is more than 5%, then H_0 is accepted and if it is less than 5%, then H_0 is not accepted instead,$H_1$is accepted. From the

results obtained, only LNEXPO granger causes LNRER since the probability value is less than 5%, an indication that changes in LNEXPO do affect LNRER. LNGDPD, LNMS and LNFDI do not granger cause LNRER. On the contrary, Tarawalie (2010) performed a bivariate granger causality test and found that REER does granger cause real GDP in the case of Sierra Leone.

Table 8: Variance Decomposition of LNRER

Period	S.E.	LNRER	LNGDPD	LNFDI	LNMS	LNEXPO
1	0.100	100.0	0.000	0.000	0.000	0.000
2	0.156	76.17	19.42	0.152	3.320	0.919
3	0.198	53.16	41.78	0.097	4.373	0.592
4	0.237	38.10	56.23	0.192	3.754	1.735
5	0.260	30.02	63.20	0.335	3.128	3.326
6	0.296	25.52	66.96	0.411	2.75	4.365
7	0.320	22.69	69.44	0.437	2.535	4.898
8	0.342	20.61	71.34	0.445	2.411	5.193
9	0.363	18.952	72.87	0.449	2.321	5.409
10	0.383	17.59	74.11	0.454	2.245	5.597
11	0.40	16.47	75.13	0.459	2.179	5.761
12	0.419	15.54	75.97	0.463	2.123	5.899
13	0.437	14.77	76.68	0.466	2.077	6.015
14	0.453	14.10	77.28	0.469	2.037	6.113
15	0.469	13.52	77.81	0.472	2.004	6.197

Results of Variance decomposition: Table8 shows the forecast error variance for LNRER is 100%, an indication that in the first period, to explicate its own shocks, 100% of RER variance is explicated through its individual innovations. While it moves on to the 5th period, it decreases to 30.02 % and 17.59% in the 10th period. After the 5th period onwards, variations in real exchange rate are more influenced by LNGDPD and accounts for 77.81% in the changes contrary to 13.52% in LNRER itself. This is an indication that LNGDPD is the highest variable in explaining variations in LNRER for the South African economy. On the contrary, Sibanda (2012) revealed that EG describes most of its variations along with real interest rates while exchange rate does not explain much variation in economic growth.

Impulse response analysis: Figure 4 shows the response of LNRER to LNRER at an increasing positive effect to a decreasing positive effect on itself. This suggests that a shock to LNRER will cause an increase in LNRER in the South African economy. Also, a positive response of LNRER to LNMS means that a shock to LNMS causes LNRER to increase. If the response of LNRER to LNGDPD is negative, it is an indication that a shock to LNGDPD causes LNRER to decrease. If the response of LNRER to LNFDI is negative than positive, this is an indication that a shock to LNFDI will cause LNRER to decrease than increase. On the contrary, if the response of LNRER to LNEXPO is positive than negative, this shows that a shock to LNEXPO will result in LNRER to increase than decrease. If the response of LNGDPD to LNRER, LNFDI to LNRER and LNMS to LNRER are negative, this implies that a shock to LNRER will cause LNGDPD, LNMS and LNFDI to decrease. If the response of LNEXPO to LNRER is positive than negative, it is an indication that a shock to LNRER will cause LNEXPO to increase than decrease. These results are different from those obtained by Sibanda (2012), who found that all variables are significant even though they are not tenacious. Since REER shock encourages growth, however, from 8 quarters, it has a negative impact.

5. Conclusion

The results obtained in this study revealed a negative and significant relationship between RER and EG. Also, RER does not granger cause EG or vice versa, instead, EXPO was one variable that granger causes RER. This is confirmed by the results of VEC granger causality test. Meanwhile, the results of variance decomposition and impulse response function showed that RER does respond to shocks from EG as well as from FDI, MS and EXPO. It is, therefore, concluded that an increase in growth will strengthen the Rand. Variance decomposition

confirmed the results, an indication that variations in real exchange rate are highly explained by shocks from economic growth. On the other hand, there is a need to attract foreign investors and increase business confidence in the markets. There is need for government and individuals to promote investment and to create a peaceful environment for investment which will enhance the Rand to appreciate. Furthermore, if money supply increases, then interest rates are likely to decline thus, increasing investment and economic growth and hence, an appreciation of the Rand. There is need for South Africa to diversify its products in order to increase international trade and to encourage export promotion. This will expand the market and economic growth will be achieved. Reducing its imports will go a long way in expanding and developing a trade balance.

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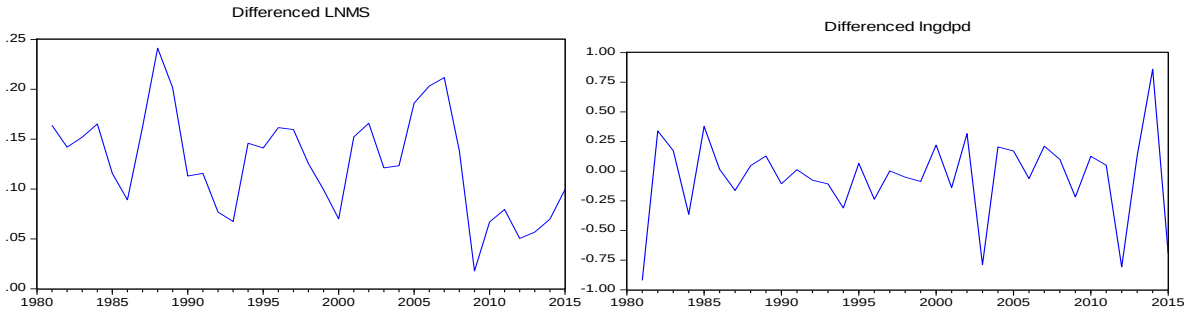
Appendices

Figure 4: Visual inspection at differenced form



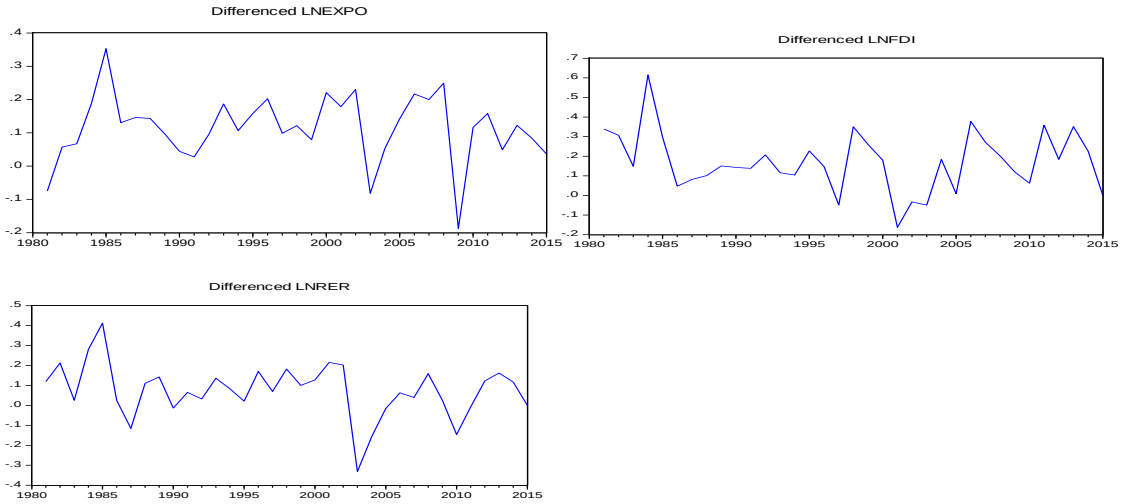
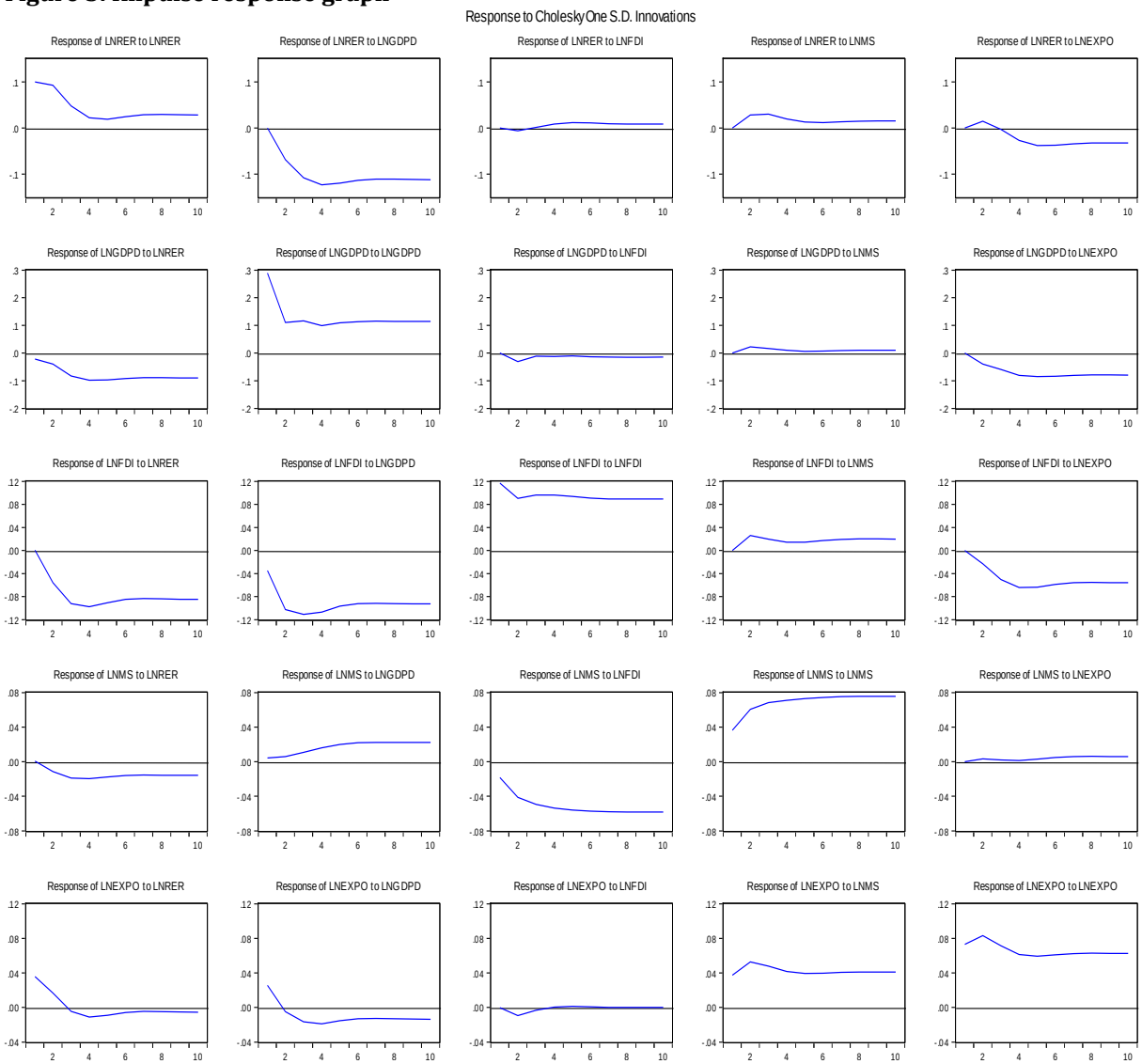



Figure 5: Impulse response graph