The Impact of Government Expenditure on Economic Growth in South Africa: A VECM Approach

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Abstract: Economists hold opposing views as to whether government expenditure is an effective way to stimulate the economy or not, while economic theory as well does not generate strong conclusions on the same issue. It is against this background that this paper aims to explore whether there exists a relationship between government expenditure and economic growth in South Africa. This paper employs the Johansen Cointegration analysis and Vector Error Correction Model on time series for the period 1997-2017 to examine the relationship. The paper further employs the Impulse Response Function to check for possible shocks among the variables. The empirical results strongly support the Keynesian view and the hypothesis that government expenditure is beneficial to economic growth in South Africa. Results revealed a long-run and short-run relationship amongst the variables. Moreover, the classification of government expenditure indicates that social infrastructure significantly contributes to a higher economic growth in the short-run then contract negatively in the long-run. However, economic infrastructure has no impact towards economic growth. The findings may provide an overview of policy suggestions to improve the effects that government expenditure has on economic growth.

Keywords: Government expenditure, Economic growth, VECM, Generalised impulse response function

1. Introduction

Policymakers' views contradict on whether government expansion helps or hinders economic growth. Those in favour of a bigger government maintain that government programs provide valuable public goods, i.e. education and infrastructure. They maintain that increased government expenditure may boost economic growth by injecting money into people's pockets (Mitchell, 2005). While supporters of a smaller government argue that more spending weakens economic growth by shifting additional resources from productive sectors of the economy to the government, which may use them ineffectively. Economists as well hold two diverse views: some believe that purchases by the government lead to a chain reaction of spending, while others suggest that government expenditure may "crowd out" economic activity in the private sector. These views contradict as to whether government expenditure may stimulate the economy or not. However, what they both agree on is that public expenditure in developing countries is an issue Economic theory, seemingly, does not generate strong evidence on the impact of government expenditure on economic performance. Two well-examined economic hypotheses, the Keynesian macroeconomic framework and the Classical view, have been a base to argue the impact of government spending on economic growth.

According to the Keynesians, public spending boosts economic activities (Ju-Haung, 2006). The Keynesian macroeconomic model supports the view of an active government intervention through an increase in government expenditure and money supply to stimulate the economy (Chipaumire *et al*., 2014). An increase in government expenditure will enhancement output and employment through the simple multiplier in the economy. The theory maintains that a long-run relationship between government expenditure and economic growth exist. As a result, the Keynesian economist argue that government spending increases national spending of a country However, the Classical economists' view is opposite of the Keynesian hypothesis.

The Classical view is based on the argument that increase in government spending will result in an increase in national output. Government spending is seen as the destabilising force in the development of the economy of a country rather the driving force of the economic growth. Therefore, according the Classical economists, the economy should be left to operate on its own and only prescribed a limited role for the government to play (Chipaumire *et al*., 2014). In addition to these two hypotheses, The Neo-classical model submits that fiscal policies cannot bring about changes in long-run growth output. Instead, the model identifies population growth, the rate of labour force growth, and the rate of technological progress to drive the growth rate in the long-run (Solow, 1956).

Barro (1989) maintained that GDP growth is negatively related to the government consumption expenditure. In his endogenous growth model, he argues that government consumption leads to misrepresentations, however does not provide an offsetting incentive to investment and growth. The remainder of the paper is organized as follows: The paper provides a review of the empirical evidence first, followed by a discussion of the methodology and the data set. Then the empirical test results are discussed. The study is concluded with some policy recommendations.

2. Literature Review

There have been a number of studies on the relationship between government expenditure and economic growth in both developing and developed countries. These studies have employed different theories and research methods to establish this relationship.

Chipaumire *et al.* (2014) using quarterly data from 1990-2010, investigates the validity of the Keynesian macroeconomic framework and the classical perspective of a long-run relationship and causality between government expenditure and economic growth in South Africa. The Granger causality test results indicated a negative causal relationship between government spending and economic growth. The study thus, found that increased government spending in South Africa has not led to a meaningful development of the economy which is inconsistent to the Keynesian stance. Ghura (1995), found similar results with Chipaumire *et al.* (2014), using pooled time-series and cross-section data for 33 countries in Sub-Saharan Africa for the period 1970-1990 indicated an existence of a negative relationship between government consumption and economic growth.

In line with the findings of Ghura (1995), Chude and Chude (2013) studied the impact of government expenditure on economic growth in Nigeria using Error Correction Model (ECM). The study employed Ex-post facto research design and applied time series econometrics technique to examine the long and short-run effects of the variables. The results showed that total expenditure on education has a positive relationship on economic growth in Nigeria in the long-run. Ramon, Vinod and Yan (2010) study the effect of fiscal policies on the quality of growth. Results point out that government spending on public goods is strongly associated with faster economic growth as well as with greater poverty reduction. Thus, linking more spending on public goods to accelerate economic growth and reduced poverty. However, government expenditure on private goods and subsidies to firms are associated with weaker economic growth and greater structural inequality.

Hasnul (2015), using OLS techniques on time-series data for the period 1970-2014, studied the relationship between government expenditure and economic growth in Malaysia. The results are similar with that of Ghura (1995), indicating a negative correlation between government and economic growth. However, classification of government expenditure indicates that only housing sector expenditure and development expenditure significantly contribute to a lower economic growth. Moreover, education, defence, healthcare and operating expenditure show no significate evidence of an impact on economic growth. On contrary, Hsieh and Lai (1994) developed a model based on Keynesian and Endogenous growth to investigate the nature of the relationship between government expenditure and economic growth in G-7 countries, namely Canada, France, Germany, Italy, Japan, UK and USA. The results suggested that the relationship between government spending and economic growth can vary significantly across time. However, there is no robust evidence of a positive or negative effect of government spending on growth.

Wu *et al*. (2010) found contrasting results to Hsieh and Lai (1994). The study conducted a panel Granger causality test using panel data set from 182 countries for the period 1950-2004 to re-examine the casual relationship between government expenditure and economic growth. The results strongly supported both Wagner's law and the hypothesis that government spending is helpful to the economic growth. Tang (2001), supporting the Wagner's law, applied Johansen's multivariate co-integration tests and found no co-integration between national income and government expenditure over the period 1960-1998.

Based on these literatures, it's clear that the effect of government spending on economic growth can be positive or negative. The literature either support the Keynesian hypothesis or the Classical view, whereas in the case of South Africa, the literature supports the Keynesian hypothesis, which indicate that there is a positive effect of government expenditure on economic growth.

3. Methodology

3.1 Data

This section details the nature of the methods and estimation techniques employed. In addition, several tests, including unit root, lag order selection criteria, Johansen co-integration, VECM, diagnostic tests, stability tests and forecast tests will be discussed. This paper used yearly time series data from the period 1997 to 2017, obtained from South African Reserve Bank (SARB).

3.2 Model Specification

The econometric model to be estimated in assessing the short-run and the long-run real effects of government expenditure upon economic growth is as follows:

$$GDPP_t = f\,(EINFR, SINFR, CONSG) \quad (1)$$

Where $GDPP$ denotes the measure of economic growth at market price, $CONSG$ denotes Government expenditure, $SINFR$ denotes social infrastructure and lastly $EINFR$ represents economic infrastructure.

The above selected variables in Equation 1 can be written in a linear form as follows:

$$LGDPP_t = \alpha + \beta_1 EINFR + \beta_2 SINFR + \beta_3 CONSG + \varepsilon_t \quad (2)$$

3.3 Estimation Techniques

To assess the short-run and long-run real effects of government expenditure upon economic growth, which is the primary objective of the paper, various estimation techniques and tests will be employed, which include the tests below.

3.4 Stationarity/Unit Root Test

This is the first step in the time series analysis is to check whether the data obtained is stationary or not (Brooks, 2008). According to Studenmund (2001), there is a criterion that must be met in order for a time series variable to be stationary. A time series variable, is stationary if: (i) the mean of the data is constant overtime (ii) the variance of the data is constant overtime (iii) the simple correlation coefficient between the mean and variance depends on the length of the lag but no other variable.

To test for stationarity, the paper made use of the Augmented Dickey Fuller unit root test of Dickey and Fuller (1979) as a test for stationarity and the Phillip-Perron test formulated by Phillips and Perron (1988) as a confirmatory test. The ADF is probably the most common procedure used in applied research to test for the presence of unit root. It allows the inclusion of the intercept or intercept plus trend coefficients in order to test for stationarity. Phillips (1987) and Phillips and Perron (1988) have developed a more comprehensive theory of unit root non-stationarity. The PP tests are similar to ADF tests, but they incorporate a correlation factor to the Dickey Fuller (DF) procedure to allow for autocorrelated residuals (Kocenda & Cerny, 2015).

3.5 Johansen Cointegration

Cointegration concerns long-run relationships between variables. Two variables possess an equilibrium relationship if, despite their univariate nonstationary behaviour, they move together in a manner that is stationary. Two variables that possess an equilibrium relationship defined in this way are said to be cointegrated (Sterwart, 2005). Because of the drawbacks of the Engle-Granger test, the Johansen (1988, 1995) cointegration test instead will be utilised to test the long-run behaviour among variables. The papers employ the use of the Maximum-Eigen value and the Trace test.

3.6 Vector Error Correction Model (VECM)

The Error Correction Model (ECM) is a single equation representing the speed of adjustment, whereas the Vector Error Correction Model (VECM) is a multiple equation model based on restricted Vector Auto regression (VAR) (Asari *et al*., 2011). An advantage of using the VECM is that it allows variables to evolve jointly overtime. However, the model is used when variables are integrated in order of I (1) and there is a cointegrating relationship among variables, if not then VAR would be employed instead (Brooks, 2008).

3.7 Diagnostic Tests

According to Michael (2003) heteroscedasticity usually arises from one of two causes. The first is that the average size of the dependent variable increases. The second is that a few outliers dominate the regression estimates. The simplest test is to correlate the residuals with each other. There are tests which can be undertaken to check the presence of heteroscedasticity such as the White test and Breusch-Pagan test. The White test (1980) is more general test than merely determining whether heteroscedasticity of the residuals is present. Under the assumptions of the linear model, heteroscedasticity will affect the standard errors and the goodness-of-fit statistics but not the parameter estimates. Breusch-Pagan test is a Lagrange multiplier test for heteroscedasticity. The main characteristics of Lagrange multipliers are that they do not require the model to be estimated under the alternative and that they are often simply computed from the R^2 of some auxiliary regression (Verbeek, 2008). Serial correlation is also tested and it occurs in time-series studies when the errors associated with a given time period carry over into future time periods. There are different types of serial correlation; one of them is first-order serial correlation. With first-order serial correlation, errors in one-time period are correlated directly with errors in the ensuing time period. Durbin-Watson statistic is a popular test which is used to test for serial correlation (Getmansky, Lo & Makarov, 2004).

3.8 Stability Tests

Stability tests of a regression model are tests designed to evaluate whether the performance of a model in a prediction period is compatible with its performance in the sample period used to fit it. There are two principles on which stability test can be constructed. One approach is to focus on the predictive performance of the model and; the other one is to evaluate whether there is any evidence of shifts in the parameters in the prediction period (Dougherty, 2007). We check for stability using tests such as the Chow test, CUSUM and CUSUM squares.

The Chow test is most commonly used in time series analysis to reveal the existence of a structural breakpoint. The total period is divided into two sub-periods (this is a simple case of the existence of one breakpoint). The CUSUM test is used to detect any systematic eventual movements where the coefficients values reflecting a possible structural instability whereas CUSUM squares test is used when we want to detect random movements (those that do not necessarily come from a structural change in coefficients) (Farhani, 2012).

3.9 Generalised Impulse Response Function

The generalised impulse response function (GIRF) is the revised technique given that the IRF has omissions which were spotted by previous researchers, so Persaran and Shin (1998) came up with the GIRF (Hurley, 2010). It does not need the orthogonalizing of shocks, because the response urge of the variables is the same to the sequences of the VAR and thus supplies relevant outcomes. The estimation is done by consistently taking one VAR equation to shock and utilise the spread of the decreased vector to work out the results of the other variables (Nazifi & Milunovich, 2010). The GIRF can be equated as follows:

$$GR_{\Delta p}(m,\theta_i, \Omega_{t-1}) = E(\Delta p_{t+m} \mid u_{it} = \theta_i, \Omega_{t-1}) - E(\Delta p_{t+m} \mid \Omega_{t-1}) \quad (3)$$

The Ω_{t-1} denotes the previous information of the variables which is transparent up to the lagged period shown by $t-1$ (Nazifi & Milunovich, 2010). θ_i is a subscript of the size of the shock of the variable i and the correlation of the decreased form of innovation represented by the vector u_{it}.

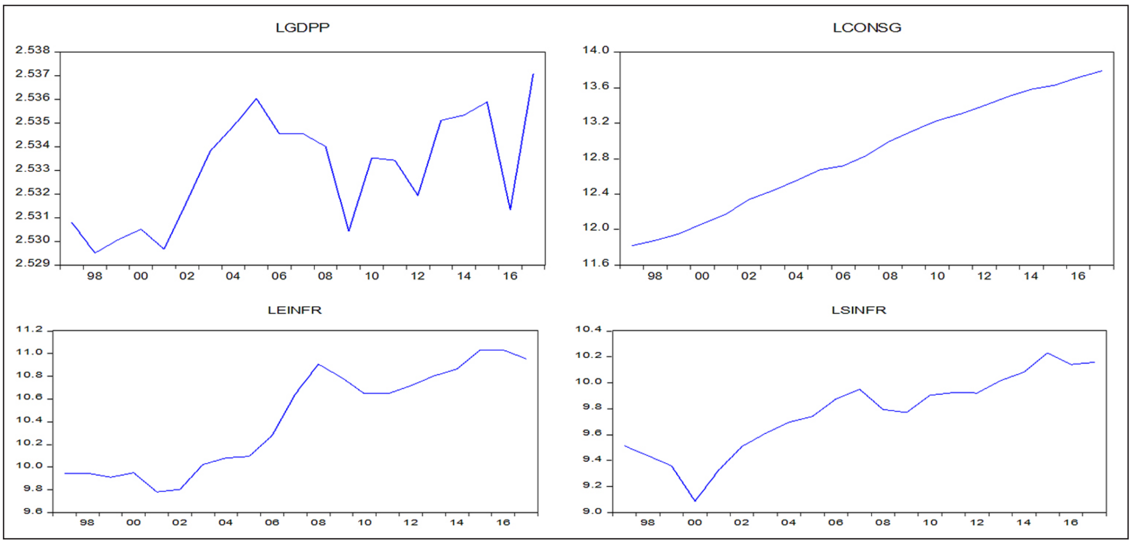
3.10 Variance Decomposition

Powers and Yun (2009) describe how the variance decomposition analysis emphasises on the rates that react to the volatility in sole and structural components with more than one variable. This approach is what is called the multivariate decomposition technique and is mostly used in social findings to distribute the inputs in different groups in average forecasts from the multivariate models. The approach uses the outcome of the regression analysis to issue parcels characteristics of a varying group in statistics like the mean. In a linear regression model, the main thing is decomposing the variance of the reaction of the dependent variable Y into parts resulting from the dependent variables together with their errors (Grömping, 2007), which can be as follows:

$$Y = \beta_0 + X_1\beta_1 + \ldots + X_i\beta_i + \varepsilon_t \quad (4)$$

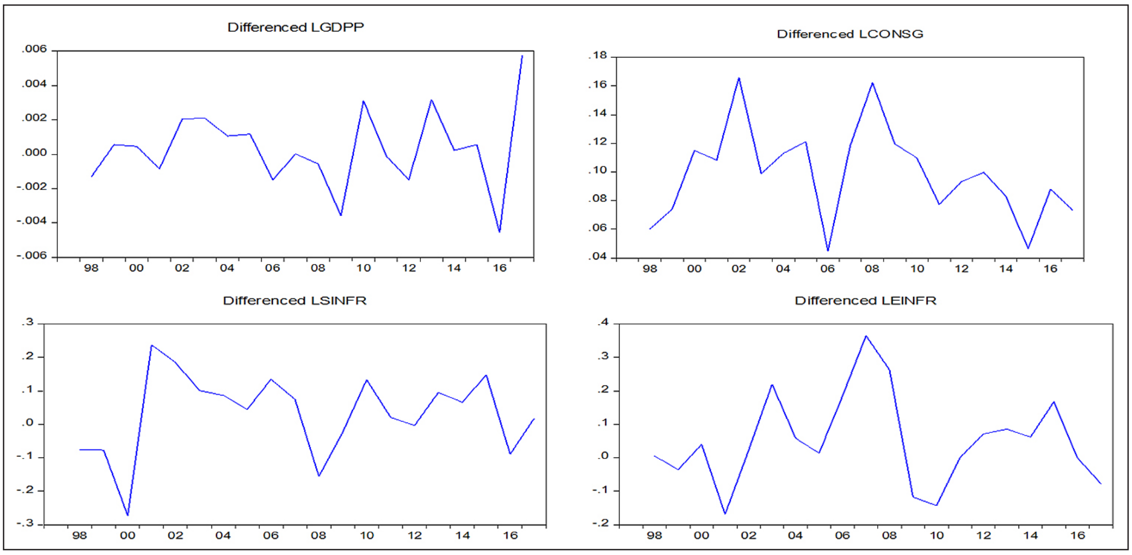
With the Equation 4 above, the y β_s are the unknown constant, also the dependent variables are random with equals $1\ldots i$ (Grömping, 2007). The i denotes the random variables and the ε_t is the error term. The ε_t is assumed to be zero and the variance to be greater than zero. On the matrix side, the inter-regression of the correlations ijk and the i x i is the correlation

Figure 1: Time Series in Levels



Source: Author's calculation

Figure 2: Time Series in 1st Difference



Source: Author's calculation

matrix. The relationship between the two is assumed to be positive, meaning that any sample regression of the matrix with $n > i$ rows is a full column order.

4. Empirical Results and Discussions

This section provides a summary of the results of all the tests undertaken to estimate the model. The results are interpreted in details and recommendations based on the findings are made in the last part of the paper. Existing literature has shown that estimating time series variables without testing for unit root may lead to spurious results. Hence, to avoid such, the ADF and PP unit root tests were conducted to check for stationarity.

4.1 Unit Root Test

Figure 1 depicts LGDPP, LCONSG, LEINFR and LSINFR in levels. Since the line graphs of all the variables display an upward trend, it implies that the time series may not be stationary at level. Eventually, when variables are transformed to their first difference status in Figure 2, all the line graphs appear to be hovering around their mean which suggest the possibility of stationarity after first differencing. But the graphical approach cannot be used to make conclusive statements about stationarity therefore, formal tests in the form of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were applied to the data for efficient and robust unit root

Table 1: Unit Root Test Results

Variables	Test	T-statistic at intercept	Critical value at 5%	Probability	Results
LGDPP	ADF	-6.023981	-3.029970	0.0001	I(1)
	PP	-6.167452	-3.029970	0.0001	I(1)
LEINFR	ADF	-3.796714	-3.040391	0.0113	I(1)
	PP	-10.93600	-3.029970	0.0000	I(1)
LSINFR	ADF	-3.901330	-3.029970	0.0087	I(1)
	PP	-4.653352	-3.029970	0.0018	I(1)
LCONSG	ADF	-3.476719:	-3.029970	0.0207	I(1)
	PP	-3.457402	-3.029970	0.0215	I(1)

Source: Author's calculation

Table 2: Johansen Cointegration Test Results

Maximum - Eigen Value				Trace Test			
Null hypothesis	Alternative hypothesis	Test statistic	0.05 Critical value	Null hypothesis	Alternative hypothesis	Test statistic	0.05 Critical value
r = 0	r = 1	43.79247*	27.58432	r = 0	r ≥ 1	79.22301*	47.85613
r = 1	r = 2	17.07291	11.13162	r = 1	r ≥ 2	35.43054	39.79707
r = 2	r = 3	13.57060	12.26460	r = 2	r ≥ 3	18.35763	19.49471
r = 3	r = 4	4.787031	2.841466	r = 3	r ≥ 4	4.787031	5.841466
*denotes a rejection of the hypothesis at 0.05 level							

Source: Author's calculation

Table 3: Normalised Coefficient Test Results

LGDPP	LEINFR	LSINFR	LCONSG
1.000000	0.061857	0.072751	-0.342824
	(0.01554)	(0.01857)	(0.02922)

Source: Author's calculation

testing and the results are presented in Table 1. The unit root results revealed that all variables were not stationary in levels hence they contained a unit root. When variables are transformed to first difference, they all become stationary at 5% level of significance and thus allows this paper to further determine a long-run relationship through cointegration.

4.2 Johansen Cointegration Test

The Johansen cointegration test is calculated to determine whether the variables in the paper have a long-run relationship amongst each other and in Table 3 the normalised coefficient equation is presented.

In Table 2 above, the calculation suggests that there is one cointegration equation from both tests. The hypothesis of stating that there is no cointegration is rejected, since the test statistics are greater than the critical values. This suggests a long-run relationship.

$$LGDPP + LEINFR + LSINFR - LCONSG = 0 \quad (5)$$

The displayed signs above indicate the signs that are found in the normalised equation which are equated to zero. For accurate results the signs will have to be reversed.

$$LGDPP = -LEINFR - LSINFR + LCONSG \quad (6)$$

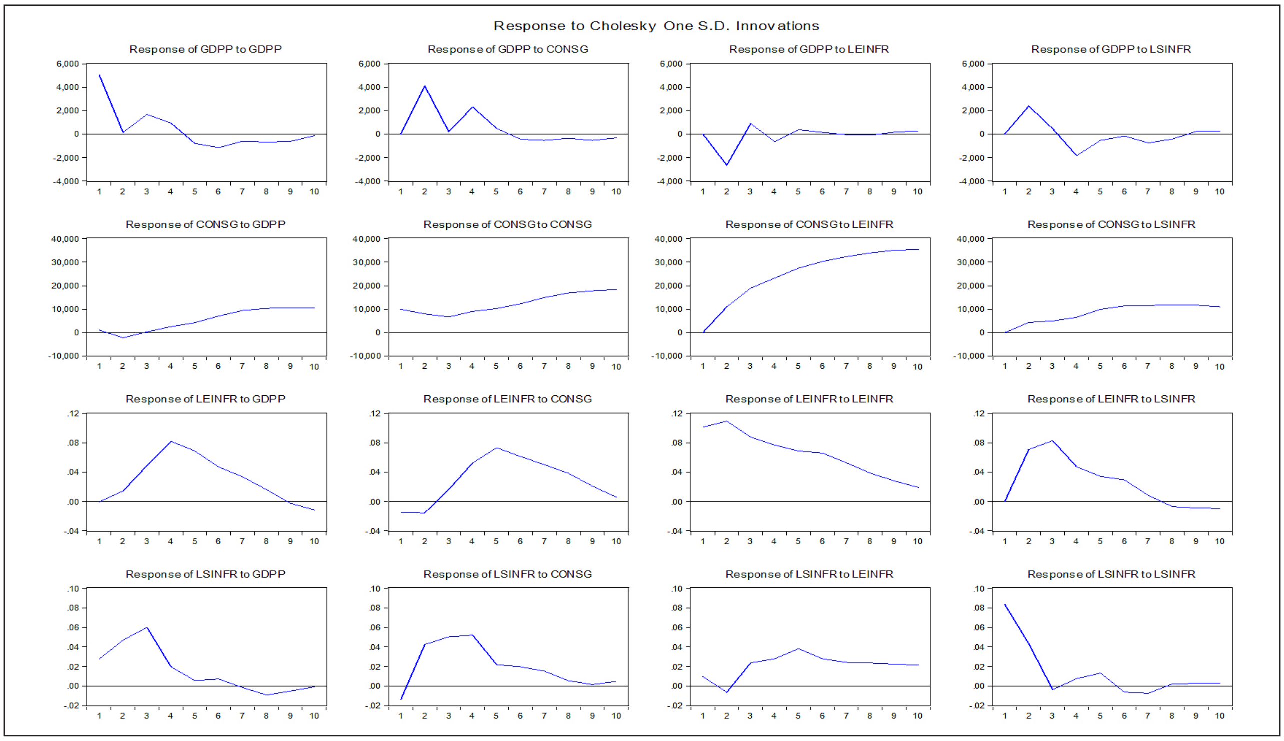
Equation 6 above assumes that in the long-run the government expenditure's influence on the GDP is economically and statistically significant. This is shown by the positive sign above.

Table 4: VECM Test Results

Dependent variable: D(LGDPP)			
Variable	**Coefficient**	**Standard error**	**T-statistics**
EC (-1)	0.308219	(0.26526)	[-1.16195]
C	-0.018517	(0.02167)	[-0.85457]
D(LGDPP(-1))	-0.430378	(0.31985)	[-1.34557]
D(LCONSG(-1)	0.293438	(0.21221)	[1.38278]
D(LEINFR(-1)) -	0.094745	(0.04692)	[-2.01937]
D(LSINFR(-1)) -	0.005754	(0.07203)	[-0.07988]
R-squared 0.471659, Adj. R-squared 0.268451			

Source: Author's calculation

Figure 3: Generalised Impulse Response Function Table



Source: Author's calculation

4.3 VECM Test Results

The VECM test is calculated to determine the short-run relationship among variables, which will determine the level of speed adjustment.

The error correction term (ECT) from the regression assumes the expected negative sign which is also statistically and economically significant. The strong significance entails the fact that the variables in the model are cointegrated in the short-run. The results of the short-run dynamics indicate that a positive linear relationship exist between economic growth and the variables (Government expenditure and Social infrastructure). The measured speed of adjustment confirms that economic growth has an automatic adjustment mechanism. The value of -0.308 for Error Correction Term (ECT) suggests a fast speed of adjustment of roughly 31 percent. The adjusted R-squared looks at the goodness of fit, therefore, the model explains a significant proportion of the variability of the series. The coefficient of determination (R^2) indicates that the model explains about 47 percent of the systematic variations in the economic growth.

4.4 Generalised Impulse Response Function

This methodology approach is employed to track the time area of how GDP respond to government expenditure in the action of the function's shocks

Table 5: Variance Decomposition

Period	S.E.	GDPP	CONSG
1	5045.063	100.0000	0.000000
2	7412.970	46.35885	30.50054
3	7670.085	48.09160	28.56825
4	8293.598	42.42930	32.14977
5	8371.947	42.55130	31.88207
6	8465.512	43.4865243	31.43883
7	8536.210	43.25657	31.43883
8	8581.421	43.43687	31.31101
9	8624.461	43.50646	31.14630
10	8639.683	43.37351	31.22718

Source: Author's calculation

Table 6: Summary of Diagnostic Test Results

Test	Null hypothesis	t-statistic	P-value	Conclusion
Jarque-Bera	Residuals are normally distributed	0.6487	0.7229	Do not reject Ho since PV is >5% L.O.S
Breusch-Godfrey	No serial correlation	0.5479	0.7604	Do not reject Ho since PV is >5% L.O.S
AutoCorrelation	No Autocorrelation	4.4511	0.974	Do not reject Ho since PV is >5% L.O.S
ARCH	No Heteroskedasticity	0.1308	0.7175	Do not reject Ho since PV is >5% L.O.S
Breusch-Pagan-Godfrey	No Heteroskedasticity	3.1994	0.4090	Do not reject Ho since PV is >5% L.O.S

Source: Author's calculation

and it assists in providing both the short and long-term relationship amongst the variables, using the decomposition method.

The response of GDP to government expenditure shocks implies a positive display and declines towards the end of the forecast. On the other hand, the response of government expenditure to GDP starts of negatively then after 3 years strengthens and maintains being positive. These results suggest that in the first two years the standard deviation shock to GDP marginally decreased the level of government expenditure, but after that increased until the end of the forecast. After the second period the results indicate that an increase in GDP reveals an increase in the level of government expenditure.

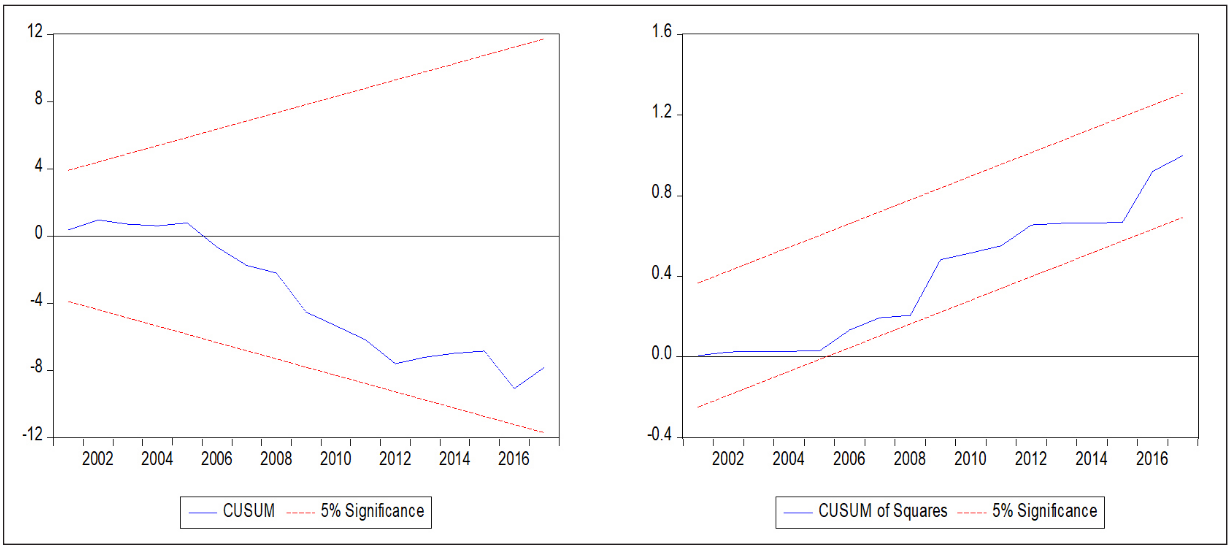
4.5 Variance Decomposition

The variance decomposition results are shown in Table 5 which are used to forecast these shocks to be able to analyse and predict the variation of the fluctuation of GDP and government expenditure since they are from a single regression equation.

Table 5 above suggests that government expenditure suggests a significant influence of more than 30 percent in the fourth year and a further escalation of more than 31 percent in the tenth year. Variance decomposition suggests that government expenditure's shocks do have influence on GDP. Thus GDP implies its own innovations significantly by more than 42 percent in the fourth year and more than 43% in the tenth year.

Table 6 shows the diagnostic test for serial correlation, heteroscedasticity and normality of residuals using the Breush-Godfrey Serial correlation LM test, Autocorrelation, Breusch-Pagan-Godfrey heteroscedasticity Test and the Jarque-Bera normality test. All the probability values of the tests are above 5% level of significance. Therefore, all the null hypotheses

Figure 4: Plot of CUSUM and CUSUMSQ Tests



Source: Author's calculation

cannot be rejected. This means that the model is free from serial correlation, autocorrelation, heteroscedasticity and residuals are normally distributed as shown by the absence of asterisks in the table above. Such an outcome reinforces the reliability and robustness of the research results.

Figure 4 shows that the plots of the CUSUM and CUSUMSQ residuals remained within the critical bounds of 5% level of significance throughout the period of study which imply that, the model was stable (Mohapatra *et al.*, 2016). Therefore, it can be concluded that both the short-run and long-run coefficients in the VECM models are stable.

5. Conclusion

This research study investigated the impact of government expenditure on economic growth by incorporating into the model, economic infrastructure and social infrastructure as control variables covering the period 1997 and 2017. Both the Augmented Dickey Fuller and the Phillips Perron unit root test results show that economic growth, government expenditure, economic infrastructure and social infrastructure are I(1) variables. The Johansen Cointegration test results confirmed an existence of a cointegration among variables. The test indicated that government expenditure is significant and positively related to economic performance, while economic infrastructure and social infrastructure are significant and negatively related to economic performance. The VECM test results reported a positive shot-run relationship between economic growth and the independent variables. The results equally indicated 31% automatic fast speed of adjustment mechanism if the model deviated from equilibrium in a balancing manner. The diagnostic tests revealed that the model is bereft of the problems of serial correlation, autocorrelation, heteroscedasticity and residuals are normally distributed. The stability test confirmed that the long-run coefficients in the short-run coefficients and the long-run coefficients in the VECM models are stable.

6. Recommendations

The suggestion of the direction of policy formulation is based on the robust research study outcomes. The South African government needs to increase expenditure aimed at shaping the general efficiency of the economy and shrink the allocation towards social and economic infrastructure. This may lead to a higher economic growth rate which tends to increase government revenue and thus fund government spending.

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