Can Investment Activities in the Form of Capital Formation Influence Economic Growth in South Africa?

T. Ncanywa
University of Limpopo

L. Makhenyane
University of Fort Hare

Abstract

The study examined the impact of investment activities as measured by gross fixed capital formation (GFCF) on economic growth of South Africa for the period from 1960 to 2014. The Johansen co-integration and the vector error correction model (VECM) were used to examine the impact. Results revealed that gross fixed capital formation has a positive relationship with economic growth both in the short and the long run. There is also bidirectional causality between the gross capital formation and economic growth. It is recommended that investment activities can be a tool both in the long and short run to boost the economy, and ultimately improve the citizen's livelihood.

Keywords: Gross fixed capital formation, Investment activities, Economic growth, South Africa.

1. Introduction

A few years ago South Africa decided to take upon the direction of adopting privatization polices, in an attempt to try to stimulate the improvement in investment activities in the form of capital formation of the country. Privatisation policies lead to expectations of efficiency, economic resources allocation efficiency, increase in aggregate supply, reduce unemployment and maintain a low inflation rate (Karim *et al.,* 2010). A development process that can be followed in achieving capital formation included three correlated conditions: existence of savings to be invested, existence of financial institutes to manage the channelling of funds, investing the return in savings into capital goods (Jhinghan, 2003). Capital formation can be defined as investment because the part of current income is saved and invested in returns for future incomes (Bakare, 2011). Capital formation can influence the country's economy by assisting citizens in maintaining and improving standards of living. Mathematically, it weighs the value of recently bought or existing assets (fixed) by businesses, government and households. This process involves the purchasing of productive capital goods, equipment, machinery as well as buildings. Capital formation may be in the form of a country increasing its tangible capital stock by inserting more money in the social and economic infrastructure. Two subclasses of gross fixed capital formation are gross private domestic investment and gross public domestic investment. Private domestic investment involves the investing of private enterprises such as Anglo-American, whilst the public domestic investment includes investments by public organizations like Mr Price Group and government (Bakare, 2011).

In the past few years, some studies showed that capital formation played an important role on growth of an economy in developing countries (Ghura and Hadji, 1996; Ghura, 1997; Beddies, 1999; Kumo, 2012; Ugochukwu and Chinyere, 2013). As the economic growth rate rises, it has been verified to be associated with an increase in capital formation in Nigeria (Ugochukwu and Chinyere, 2013; Adegboyega and Odusanya, 2014). Pathunia (2013) suggested that there are linkages between capital formation and exports growth in an economy. Therefore, through capital formation a country can increase its tangible capital stock by inserting more money in the social and economic infrastructure, and ultimately influence economic growth. However, Karim (2010) found no significant long run relationship between net investments and economic growth in Malaysia. South Africa experienced a gradual increase in gross fixed capital formation from 73 065 ZAR

Million in 1962 to 624 408 ZAR Million in last quarter of 2014 (Stats SA, 2015). This could be adhered to South Africa trending towards adopting privatization polices, in an attempt to try to stimulate the improvement in capital formation of the country (Perkins *et al.*, 2005). The intention is to allocate economic resources efficiently, increase in aggregate supply, reduce unemployment and maintain a low inflation rate. Based on the contradicting evidence shown by scholars above, and the trends shown by gross fixed capital formation (GFCF) in South Africa over the years, it was interesting to investigate if this increase in GFCF can increase economic growth. Therefore, the aim of this study is to examine the impact of GFCF on economic growth in South Africa in the period 1960-2014. The paper is structured as follows, section two deals with literature reviewed, section three methodology, section 4 results and discussions and the last section concludes.

2. Literature Review

In order to provide a conceptual framework and appropriate policy recommendations in this study, it is important to present a theoretical framework which underpins the study. This section examines some of the established theories on gross fixed capital formation and economic growth. In addition to the various theories that will be discussed in this section, empirical literature is also presented.

2.1 Theoretical Literature

The study applied the following theories to unfold the investment behaviour of organisations and government. In the Harrod-Domar model, stimulating investment would result to more growth of an economy. In order for a country to invest in capital formation, it should save some of its resources from current consumption. Diverting a proportion of current consumption is called savings. Bakare (2011) states that to replace a worn out capital good, an economy must save a proportion of its national income. However, Pettinger (2014) suggested that increasing the saving ratio may be inappropriate when you are struggling to get enough food to eat, hence increasing the saving ratio is mostly difficult for developing countries. Harrod-Domar model ignores factors such as labour productivity, technological innovation and levels of corruption. The Neo Classical Approach to investment had an objective to obviate the shortcomings of the Harrod-Domar model. In this approach capital stock is determined by the rental cost of capital and level of output (Uremadu, 2012). The cost of capital is endorsed by the Tobin Q investment theory published in 1968, which states that investments would still be made if the market value is not equal to the book value (Kanu and Ozurumba, 2014). In the Marginal efficiency of capital hypothesis, the level of investment is determined by the value of capital comparative to the interest rate (Kanu and Ozurumba, 2014). If marginal rate of capital is lower than interest rate, investment would be discouraged, if otherwise, investments would be stimulated. The rate of return over cost and the rate of interest rate determine the level of investment in any direction (Fisher, 1930).

2.2 Empirical Evidence

Studies on different aspects of capital formation and economic growth are reviewed. Some studies reviewed employed the ordinary least squares (OLS) and Vector Error Correction Model (VECM) to reveal a role played by capital formation on economic growth. For instance, Ugochukwu and Chinyere (2013) investigated the impact of capital formation on economic growth in Nigeria. Their results showed that capital formation is positively and significantly related to economic growth in Nigeria. Furthermore, capital formation showed a positive impact on stock market, on the other hand a negative impact for interest and inflation rates (Ugochukwu and Chinyere, 2013). The most important conclusion was that accumulation of capital formation in Nigeria would in the long run boost the economy and develop its state. Shuaib and Dania (2015) found a significant relationship between gross domestic capital formation and growth. Adegboyga and Odusanga (2014) investigated the nexus of FDI, trade openness, capital formation to growth in the economy of Nigeria, whether there was a positive correlation using time series data. According to Adegboyga & Odusanga (2014) the study indicated that capital formation can positively influence economic growth. It was further recommended that Nigeria should raise efficacy in its fiscal and monetary policies to increase its exports for economic growth. Moreover, government should look into its institutional framework due to positive but insignificant to the volume of FDI on growth in an economy.

Other studies investigated the capital formation growth nexus utilizing the Granger causality test. For example, Rajni (2013) investigated the causality between exports, imports and capital formation in India, using the Granger causality test. Data was

collected on the economic survey and handbook of India. Rajni (2013) found that there is bidirectional causality between gross domestic capital formation and export growth while on the other hand uni-directional causality between capital formation and import and export as resulted from the Granger causality test. Malawi (2005) examined the trends in gross fixed capital formation and money supply on economic activity in Algeria in the period from 1971 to 2003. The method to be followed was the Granger-causality test, the decomposition of variance, and the impulse response functions. Findings showed that both variables fixed capital formation and money supply according to Granger test can boost economic growth.

Kanu and Ozurumba (2014) investigated the impact of capital formation on economic growth of Nigeria using multiple regression techniques. The study used gross fixed capital formation, economic growth, total exports, total imports, total savings and inflation as variables. Findings ascertained that in the short run gross fixed capital formation had no significant impact on economic growth, however in the long run VAR model indicated that gross fixed capital formation and total exports and lagged values of GDP had a positive long run relationship with economic growth in Nigeria. Bakare (2011) determined the relationship between capital formation and economic growth using the Harrod-Domar model to test its application in reality on Nigeria' growth. The OLS was used to estimate the model. Bakare (2011) discovered that the Harrod-Domar model proved to work in Nigeria, which detect that national income is positively related with savings and capital formation.

An analysis of investment activities has been reviewed. For example, in South Africa Perkins and Fedderke (2005) revealed that the connection between economic infrastructure and economic growth appears to run in both directions. It was further stated that poor investment in infrastructure could create holdups in opportunities for promoting economic growth. Kumo (2012) studied infrastructure investment and economic growth in South Africa using the Granger Causality analysis. Findings showed that a strong connection exists between economic infrastructure investment and GDP growth. Nowbutsing (2012) was interested on whether Foreign Direct Investment (FDI) matters in capital formation and economic growth in Mauritius using the bounds testing method. Findings revealed that in the long run FDI has a positive and significant effect, furthermore states that a percentage increase in FDI contributes 0.17% economic growth as per Mauritius data.

Looking at how investment activities can influence employment, Iocovoiu (2012) focused on analyzing the correlation between the evolution of net capital investment and unemployment in Romania. The study used capital investments, net investments, investment rates, unemployment, and economic crisis as variables. Results of the research showed that a significant reduction in net investments, due to the global economic crisis has led increasing unemployment by lowering the number of employees. Malawi (2005) showed causality of gross fixed capital formation on economic activity in Algeria using Granger causality tests, the decomposition of variance and the impulse response functions. Bader and Malawi (2010) further investigated the effect of real interest rate on investment level in Jordan. Bader and Malawi (2010) witnessed that the findings were in line with economic theory, capturing that real interest rates have a negative impact on investment. A case of an increase of 1% in interest rate, decreases investment levels by 44%, while income level has a positive impact.

Karim, Karim and Ahmad (2010) aimed at testing the linkages between economic growth, fixed investment and household consumption in Malaysia. The study employed the structural vector error correction model. Findings were that household consumption and fixed investment were significantly affecting economic growth. It was stated that demand side policies affecting the household consumption and investment are ineffective to boost economic growth in the long run. Karim *et al.* (2010) concluded that fixed investments are significant only in the short run in Malaysia.

3. METHODOLOGY

In an attempt to examine the impact of gross fixed capital formation (GFCF) on economic growth, secondary quarterly data covering the period 1960 to 2014 was obtained from the South African Reserve Bank. The following linear model was estimated:

$$LGDP_t = \beta_0 + \beta_1 LGFCF_t + \beta_2 LGOVEXP_t + \beta_3 LCONS_t + \beta_4 LBOP_t + \beta_5 CPI_t + \varepsilon_t \quad (1)$$

Where β_0, is the intercept, β_1 to β_5 are slope coefficients of explanatory variables and ε is the error term. In this model, economic growth (LGDP) is regressed

against Gross Fixed Capital Formation (LGFCF), and control variables such as government expenditure (LGOVEXP), consumption expenditure (LCONS), net exports (LBOP), and consumer price index (CPI) are included. LGDP is logged real gross domestic product at market price used to measure economic growth. LGOVEXP is logged Gross fixed Capital Formation (Investment) at constant 2010 prices. LCONS represents logged final consumption expenditure by households and LGOVEXP logged final expenditure by general government. LBOP denotes logged balance of payments and CPI consumer price index used to measure inflation.

The analysis began by testing for stationarity in the time series. The formal tests conducted are the Augmented Dickey-Fuller (ADF) and the Phillips-Peron (PP) tests. According to Brooks (2008) these tests are the very key as they give understanding into the structural breaks, trends and stationarity of the data. The ADF test modifies the work done by Dickey and Fuller (1979 and 1976 respectively). The rejection of the null hypothesis under these tests means that the series does not have a unit root problem, meaning that they are stationary.

The weakness of the Dickey-Fuller test is that it does not take account of possible autocorrelation in error process, ε_t. If ε_t is auto-correlated, then the OLS estimates of coefficients will not be efficient and t-ratios will be biased. In view of the above mentioned weaknesses the Augmented Dickey-Fuller test was postulated and is preferred to the Dickey-Fuller test (Brooks, 2000). The calculated value of ADF is then compared with the critical value. If the calculated value is greater that the critical, we reject the null hypothesis that the series have unit root, thus confirming that the series are stationary.

The Phillips-Perron tests are a more comprehensive theory of unit root non-stationarity. The Phillips-Perron use non-parametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms. According to Brooks (2008) the tests are similar to Augmented Dickey Fuller test, but they incorporate an automatic correction to the DF procedure to allow for auto correlated residuals. The Phillips Perron test and the Augmented Dickey Fuller test have the same asymptotic distribution. The Phillips Perron tests often give the same conclusions as, and suffer from most of the same important limitations as, the Augmented Dickey Fuller tests (Brooks, 2008).

The study employed Johansen Co-integration test and the Vector error correction (VECM) to find long and short run relationship of the empirical model (Greene, 2000; Johansen and Julius, 1990). According to Greene (2000) the following steps are used when implementing the Johansen procedure. Step 1: Testing for the order of integration of the variables under examination. All the variables should be integrated of the same order before proceeding with the co-integration test. Step 2: This step involves setting the appropriate lag length of the model. Also in the step is the estimation of the model and the determination of the rank of Π. Step 3: With regards to the deterministic components in the multivariate system the choice of the appropriate model is made. An analysis of the normalised co-integrating vector(s) and speed of adjustment coefficients is made. Step 4: includes the determination of the number of co-integrating vectors. Causality tests on the error correction model to identify a structural model and determine whether the estimated model is reasonable is done in this last step.

Other econometric advances include the Granger causality tests to see the direction of causality. Also, variance decomposition is included to indicate the proportion of the movements in a sequence due to the dependent variable's own shocks versus shocks to the other variables (Green, 2000). Furthermore, impulse response functions are employed to trace out the response of the dependent variable in the Vector Auto Regressive (VAR) system to its own shocks and shocks to each of the variables (Gujarati, 2004).

To validate the outcomes achieved by the estimated model, diagnostic tests of serial correlation, heteroscedasticity and normality were checked. Diagnostic testing is very vital in the analysis of the impact of gross fixed capital formation on economic growth in South Africa because it validates the variables estimation outcomes achieved by the estimated model (Gujarati, 2004). Diagnostic checks test the stochastic properties of the model such as serial correlation, heteroscedasticity and normality.

Serial correlation happens when the error terms from different time periods (or cross-section observations) are correlated (Gujarati, 2004). In time series studies it occurs when the errors associated with observations in a given time period carry over into future time periods. Serial correlation (also called autocorrelation) in the residuals means that they contain information, which should itself be modeled. The Durbin-Watson statistic is used in the study to test for the presence

of first order serial correlation in the residuals. The null hypothesis is no serial correlation ($H_0 : \rho = 0$).

The assumption of normality is $\varepsilon_t \sim N(0, \sigma^2)$. The null is that the skewness (α_3) and kurtosis (α_4) coefficients of the conditional distribution of Y_t or, equivalently, of the distribution of are 0 and 3, respectively. The normality assumptions can be tested using the Jarque-Bera test (JB) (Gujarati, 2004). The JB test follows the null hypothesis that the distribution of the series is symmetric. The null hypothesis of normality would be rejected if the residuals from the model are either significantly skewed or leptokurtic or both. The Ordinary Least Squares makes the assumption that $V(\varepsilon_j) = \sigma^2$ for all j. The variance of the error term is constant a condition termed homoscedasticity (Gujarati, 2004). If the error terms do not have constant variance, they are said to be heteroscedastic.

4. Results and Discussions

This section presents results and discussions of the analysis of the impact of gross fixed capital formation (net investment) on economic growth in South Africa.

4.1 Unit Root Tests (Stationary Tests)

Table 1(a) shows the Augmented Dickey-Fuller (ADF) results.

Table 1(a): Stationarity results of the Augmented Dickey-Fuller test.

Variable	Intercept	Trend and intercept	Order of integration
LGDP	-2.052288	-3.033451	I(0)
DLGDP	-4.154147*	-4.419391*	I(1)
LGFCF	-1.612248	-2.536551	I(0)
DLGFCF	-4.994711*	-5.016505*	I(1)
LGOVEX	-3.51234	-2.872191	I(0)
DLGOVEX	-9.686113*	-10.35761*	I(1)
LCON	-1.761395	-2.877167	I(0)
DLCON	-4.512414*	-4.512414*	I(1)
LBOP	-1.309569	-1.306015	I(0)
DLPOP	-21.58229*	-21.60308*	I(1)
CPX	-3.015719*	-2.968273	I(0)
DCPX		-11.26469*	I(1)
Critical values: 1%	-3.461327	-4.002142	
5%	-2.875062	-3.431265	
10%	-2.574054	-3.139292	

Notes: The values marked with * signals stationarity significant at 1%, and ** represent stationarity and significant at 5%, and *** marked values signals stationarity and significant at 10%.

Source: Own compilation from SARB data

The test has a null hypothesis of unit root and the calculated value of ADF was compared with the critical value. If the calculated value is greater than the critical, we then reject the null hypothesis that the series have unit root, thus confirming that the series are stationary. The ADF tests reported variables in (i) intercepts and (ii) trends and intercepts. In levels, all variables were non-stationary except for CPI and were stationary after first differencing. Table 1(b) shows the Phillips-Peron (PP) results.

Table 1 (b): Stationarity results of the Phillips-Perron test.

Variable	Intercept	Trend and intercept	Order of integration
LGDP	-2.351511	-3.176743**	I(0)
DLGDP	-22.43886*		I(1)
LGFCF	-1.142430	-2.011139	I(0)
DLGFCF	-16.95964*	-16.94317*	I(1)
LGOVEX	-1.896417	-5.235670*	I(0)
DLGOVEX	-49.79766*		I(1)
LCON	-0.952606	-7.349592*	I(0)
DLCON	-45.69107*		I(1)
LBOP	-1.239034	-1.720941	I(0)
DLBOP	-21.32013*	-21.39780*	I(1)
CPI	-5.125000*	-5.088392*	I(0)
Critical values			
1%	-3.460173	-4.000511	
5%	-2.874556	-3.430477	
10%	-2.573784	-3.138828	

Notes: The values marked with * signals stationarity significant at 1%, and ** represent stationarity and significant at 5%, and *** marked values signals stationarity and significant at 10%, if values are found significant at levels then no value is found after differencing.

Source: Own compilation from SARB data

According to Brooks (2008) PP tests are similar to ADF tests, but they incorporate an automatic correction to the ADF procedure to allow for auto correlated residuals. Both methods used to test for stationarity significantly revealed that the data series were non-stationary in levels and stationary when first differenced.

4.2 Johansen Co-Integration and VECM

The lag length used in the VECM estimation was determined, and the lag length selection criteria reported two as the optimum lag length as chosen by most criteria (see Table 2 on the next page).

The co-integration tests were employed and results showed that there are two co-integrating equations implying a long run relationship in the series exist (Table 3). This means in the long run, increasing capital formation could help in boosting economic growth.

TABLE 2: VAR Lag Order Selection.

Endogenous variables: LGDP LGFCF LCONS LGOVEXP LBOP CPI
Exogenous variables: C
Sample: 1960Q1 2014Q4
Included observations: 218

Lag	LogL	LR	FPE	AIC	SC	HQ
0	756.1773	NA	4.13e-11	-6.882360	-6.789209	-6.844735
1	2014.840	2436.493	5.56e-16	-18.09945	-17.44739	-17.83607
2	2204.380	356.4738*	1.36e-16*	-19.50807*	-18.29710*	-19.01894*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Own compilation from SARB data

TABLE 3: Johansen Co-integration results.

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.194411	124.7208	95.75366	0.0001
At most 1 *	0.165464	77.80929	69.81889	0.0100
At most 2	0.084655	38.55835	47.85613	0.2782
At most 3	0.057782	19.36388	29.79707	0.4670
At most 4	0.026117	6.448293	15.49471	0.6425
At most 5	0.003246	0.705555	3.841466	0.4009
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.194411	46.91152	40.07757	0.0073
At most 1 *	0.165464	39.25094	33.87687	0.0104
At most 2	0.084655	19.19447	27.58434	0.3997
At most 3	0.057782	12.91558	21.13162	0.4600
At most 4	0.026117	5.742737	14.26460	0.6464
At most 5	0.003246	0.705555	3.841466	0.4009
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Source: Own compilation from SARB data

The VECM estimate the effects of explanatory variables where economic growth is the function of gross fixed capital formation, government expenditure, consumption expenditure, balance of payment and consumer price index. The VECM corrects long run equation through short run adjustments leading the system to short run equation. Table 4, on the following page, confirms that the error term of the co-integrating equation is negative (-0.005147). This means that in the error correction model, variables adjust to long run shocks affecting the natural equilibrium and there is a short run relationship in the series.

Equation 2, derived from Table 5 the normalised co-integrating coefficients, indicates that there is a positive relationship between economic growth and gross fixed capital formation. A one unit increase in capital formation will lead to an increase in economic growth by 19,2 (equation 2). This is in accordance with the literature reviewed that gross capital formation can positively influence economic growth (Beddies, 1999); (Kumo, 2012); (Ugochukwu and Chinyere, 2013).

The estimated equation derived from the normalized co-integration coefficient is as follows (Table 5):

$$LGDP = 0.005174 + 0.192225LGFC - 0.1260267LCONS + 0.2291942LGOVEXP - 0.166804LBOP - 0.008857CPI \quad (2)$$

Equation 2, above, further reports a unit increase in con-sumption will lead to a decrease in economic growth by 12.6%. Government expenditure seems to

TABLE 4: Summary of the VECM estimates.

Variables	Coefficients	Standard error	t-statistics
Co-integrating equation	-0.005147	(0.01139)	[-0.45172]
Constants	0.005174	(0.00081)	[6.42625]

Source: Own compilation from SARB data

TABLE 5: Estimates of the Normalised Cointegration Coefficients.

Normalized cointegrating coefficients (standard error in parentheses)					
LGDP	LGFCF	LCONS	LGOVEXP	LBOP	CPI
1.000000	-0.192225	0.1260267	-0.2291942	0.166804	0.008857
	(0.15555)	(0.39540)	(0.31660)	(0.07299)	(0.00255)

Source: Own compilation from SARB data

TABLE 6: Pairwise Granger Causality Tests.

Sample: 1960Q1 2014Q4 Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
LGFCF does not Granger Cause LGDP	218	10.9131	3.E-05
LGDP does not Granger Cause LGFCF		4.10278	0.0179
LCONS does not Granger Cause LGDP	218	89.9185	5.E-29
LGDP does not Granger Cause LCONS		55.2041	5.E-20
LGOVEXP does not Granger Cause LGDP	218	2.17757	0.1158
LGDP does not Granger Cause LGOVEXP		13.9623	2.E-06
LBOP does not Granger Cause LGDP	218	0.19554	0.8225
LGDP does not Granger Cause LBOP		4.11104	0.0177
CPI does not Granger Cause LGDP	218	2.83723	0.0608
LGDP does not Granger Cause CPI		0.57890	0.5614

Source: Own compilation from SARB data

be influencing the economic growth positively. A unit increase in balance of payment will lead to a decrease of 16.7% in economic growth. Lastly, in this model inflation is negatively related to economic growth, meaning that when an increase in investment is expected to boost economic growth inflation should be taken care of.

4.3 Granger Causality Results

Granger causality is based on the prediction that if a signal on one variable can 'Granger cause' a signal on another variable, then the past values of that variable should contain information that helps predict the other variable above and beyond the information contained in the past values of the other variable alone (Gujarati, 2004). Table 6 above indicates a significant bidirectional causal relationship between economic growth and capital formation. This means gross fixed capital formation can predict information contained in the past values of GDP.

4.4 Impulse Response Functions

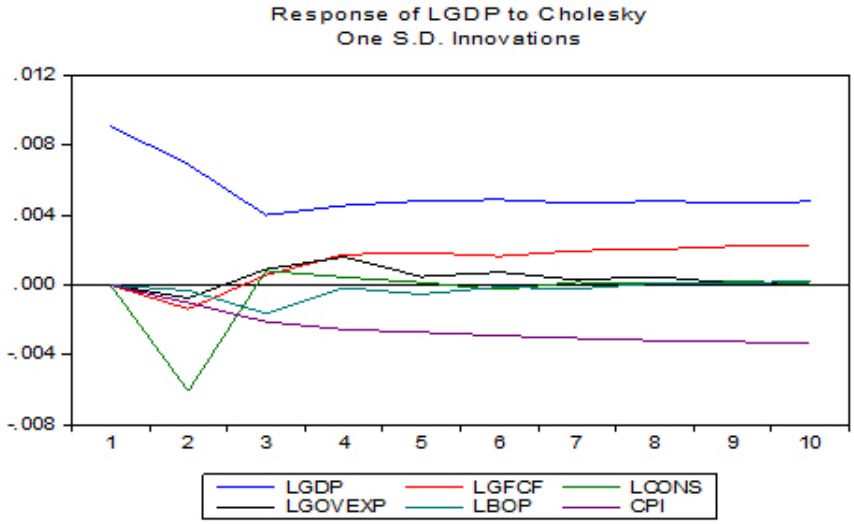
The impulse response functions illustrate the shocks or reactions of LGDP to a one standard deviation of changes on the explanatory variables (Gujarati, 2004). They further indicate the directions and persistence of the response to each of the shocks over a particular period of 10 months. Figure 1 on the next page shows trending downwards towards the third period and thereafter the shock shows some trend of improvement. The impulse responses further indicate the same direction response of gross fixed capital formation to GDP from the second quarter.

4.5 Variance Decomposition

Variance decompositions indicate the fraction of the forecast error variance for each variable that is attributable to its innovations and to innovations in the other variables in the system (Brooks, 2008). The variance decomposition results are presented in Table 7 using Choleski decomposition method to identify the most effective instrument to use in targeting each variable of interest. This helps in separating innovations of the endogenous variables into portions that can be attributed to their own innovations and to innovations from other variables.

Table 7 notes variance decomposition for 10 periods and it also illustrates an effect of each variable towards economic growth fluctuation in the short and the long run. If the second quarter is considered,

FIGURE 1: Impulse response functions.



Source: Own compilation from SARB data

TABLE 7: Variance decomposition of LOGGDP.

Period	S.E.	LOGGDP	LOGGFCF	LOGCON	LOGGOVE	LOGNTEX	INFLA
1	0.009107	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.013082	76.32018	1.081961	21.60413	0.330503	0.057679	0.605539
3	0.014004	74.79546	1.113980	19.19877	0.712397	1.399138	2.780253
4	0.015137	73.05031	2.280586	16.52125	1.729217	1.208499	5.210134
5	0.016239	72.29817	3.289147	14.36256	1.591049	1.153963	7.305115
6	0.017303	71.67872	3.812434	12.67393	1.583421	1.020335	9.231154
7	0.018297	70.67967	4.572041	11.34402	1.443228	0.926276	11.03476
8	0.019294	69.73940	5.235945	10.20293	1.359398	0.835732	12.62659
9	0.020253	68.74427	5.959095	9.268722	1.237275	0.759816	14.03083
10	0.021197	67.83725	6.583410	8.464819	1.138639	0.709798	15.26608

Source: Authors

TABLE 8: Diagnostic checks results.

Test	Null Hypothesis	Probability	Conclusion
Jarque-Bera (JB)	No normal distribution	0.961315 > 0.05	We fail to reject H0, there is no normality
White (CH-sq)	No heteroscedasticity	0.1770 > 0.05	We fail to reject the H0, there is no heteroscedasticity
Breusch-Godfrey Serial Correlation LM Test	No serial correlation	0.257461 > 0.05	We fail to reject H0, there is no serial correlation

Source: Own compilation from SARB data

the impulse or innovation shock, economic growth accounts to 76.3% of its own shock or fluctuation. However, with shocks for the independent variables, the fluctuations for economic growth are 1.08% for investment, 21.6% for consumption, 0.33% for government expenditure, 0.057% for balance of payment and 0.6% for inflation. In the long run that is for period 10, economic growth accounts to 67.8% of the fluctuation. Investment in the long run accounts for 6.6% and inflation 15.2%. This implies that throughout the whole period of forecast economic growth is influenced by its own shocks in the short run and in the long run.

4.6 Diagnostic and Stability Checks

The diagnostic tests in the model are done so that the chosen model is checked for robustness (Engle and Granger, 1991). For heteroscedasticity the p value of 0.1770 was found indicating that there is no Heteroscedasticity in the residuals (Table 8). The Jarque Bera normality test indicated a probability value of 0.961315 meaning that we do not reject the hypothesis and the residuals are normally distributed. The Breusch-Godfrey LM test had a probability value of 0.257461 which is more than 0.05 and therefore we do not reject the hypothesis

and conclude that there is no serial correlation within the model.

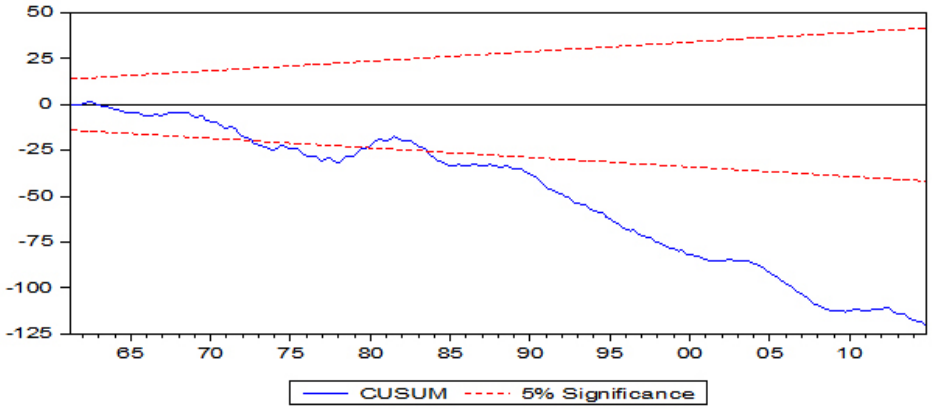
Stability tests performed include the CUSUM, CUSUM square test, and the Inverse Roots of AR Characteristic Polynomial. In Figure 2, the CUSUM test indicates a positive feedback in that the cumulative sum moves inside the critical line, however with exception to the period beyond 1990. At Figure 3, the CUSUM of square indicates stability as the cumulative sum moves inside the critical line throughout the period covered, therefore indicates stability of the model. The Inverse Roots of AR Characteristic Polynomial confirm the stability of the model as all the points are inside the circle.

5. Conclusion

The objective of the study was to examine the impact of investment activities as measured by gross fixed capital formation on economic growth in South Africa for the period 1960 to 2014. The relationship between gross fixed capital formation and economic growth was justified by the significant role indicated in developing countries such as Nigeria. The Johansen co-integration, Vector Error Correction Model and Granger causality were used to examine the relationship. The results indicated that there is a long and short run relationship between economic growth and gross fixed capital formation. It has also been found that the causal relationship is bidirectional implying that gross fixed capital formation can Granger cause economic growth and vice versa.

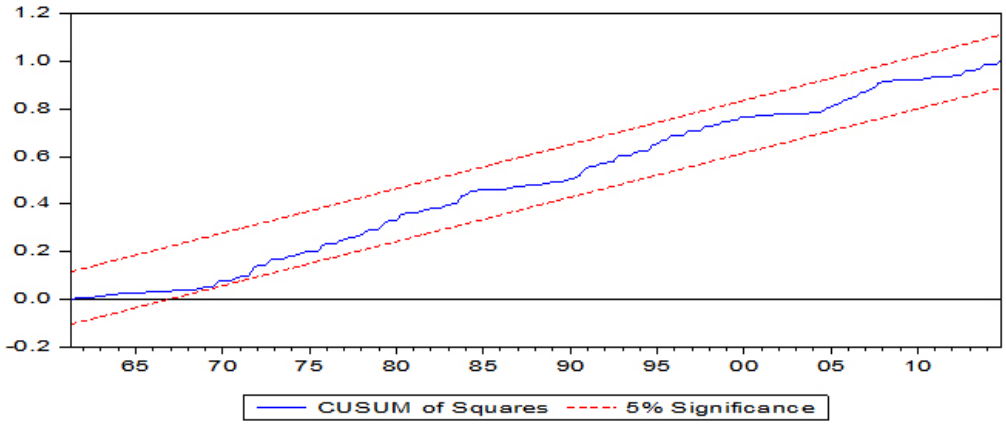
The study recommends that gross fixed capital formation can be used as one of the tools to boost economic growth. Growth in the economy can influence many macro-economic variables such as production and household income which can ultimately positively influence the citizen's livelihood. Government should encourage savings by providing incentives to create an investment climate that boost capital formation and hence promote sustainable growth.

Figure 2: CUSUM test.



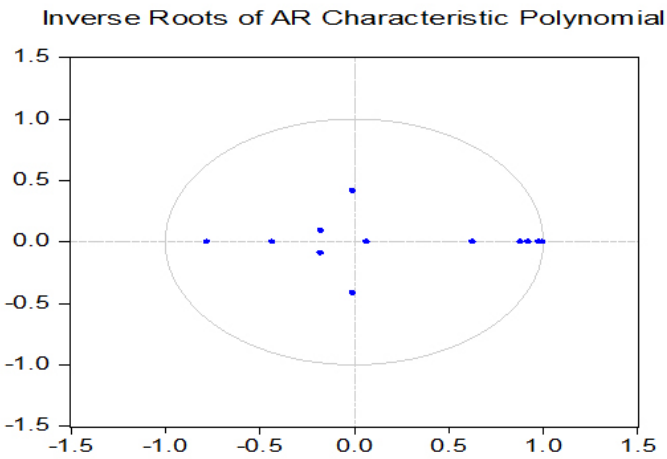
Source: Authors

Figure 3: Custom of squares.



Source: Authors

FIGURE 4: The Inverse Roots of AR Characteristic Polynomial.



Source: Own compilation from SARB data

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