



Macroeconomic Determinants of Economic Growth in South Africa (1994-2016): Cointegration Approach

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ABSTRACT

Priorities of developing countries include, obtaining sustained and positive economic growth. Before this can be achieved, however, determinants of positive economic growth need to be identified so that policy makers can make right decisions when allocating funds. The aim of this study was to analyse macroeconomic determinants of economic growth in South Africa for the period 1994-2016, using the cointegration approach. The study utilized both the Augmented Dickey Fuller and the Phillips Perron unit root tests to ensure that all variables involved were stationary; after the tests, all the variables were found to be stationary at first difference I(1). The study then employed the Johansen Cointegration Approach, which suggested that there is cointegration and a long-run relationship between real GDP per capita and the dependent variables. The Vector autoregressive (VAR) was also estimated; results showed that the residuals were robust and well behaved. The Vector Error Correction Model proved existence of a short-run relationship among the variables and that physical capital and inflation have positive impact on economic growth; labour force, government expenditure and FDI have negative impact on economic growth in South Africa. Findings should help in understanding the macroeconomic determinants of economic growth in South Africa.

Keywords: Economic Growth, Real GDP per Capita, Johansen Cointegration, South Africa

JEL Classifications: E52, E62, F43

1. INTRODUCTION

The transition from the apartheid era to a democracy in 1994 brought tremendous economic, social and political challenges to South Africa. The challenge was not only in the transition of political power, but the country was also faced with challenges in improving social conditions which would impact significantly on people's livelihoods and alleviate poverty. When the African National Congress came into power, the government designed an initial expansionary policy-the Reconstruction and Development Program (RDP)-that was aimed at improving the country's economic and social standing. The RDP was aimed at improving people's living standards by building houses, road construction, sewage, and water (ANC, 1994). The Growth, Employment and Redistribution Program (GEAR) which was established in 1996, due to the rand crisis, was established to help reduce inflation and

government deficits as well as improve the country's economic growth (South African National Treasury, 1996).

When the new government (ANC) came into power in 1994, the growth rates were sustainable, however between 1995 and 2004, South Africa's real economic growth rate averaged 3.1% (1.1% in terms of per capita). This was a significant improvement above the 0.8% average growth rate (-1.3% in terms of per capita) seen in the 10 years between 1985 and 1994. Even though this was a much-needed improvement, South Africa's growth performance was still somewhat low by international standards (Du Plessis and Smit, 2007). The GDP growth rate for South Africa was 2.74% between 1994 and 1998, and it grew to 3.19% and 4.8% between 1999 and 2003 and 2004 to 2008, respectively. It subsequently began to show a downward trend from 2009 to 2013; 2014 to 2018; and 2019 to 2021, with respective values of 1.91%, 1.21%, and -0.47.

Worrisome is the declining trend over the previous three periods. As a result, from 1994 to 2019 the overall GDP growth rate was 2.67%, and from 1994 to 2021 it was 2.42% (World Bank, 2022).

The country's total manufacturing output decreased by 6.8% in the first quarter of 2009 as compared to the last quarter of 2008. There was also a huge decrease in mining production by 12% in the first quarter of 2009 (SARB, 2007-2009). The real per capita GDP of South Africa's economy improved from the negative growth rate of -2.9% encountered in 2009 to a positive growth rate of 1.6 in 2010. The economy expanded by a growth rate of 1.8 in 2011, however, the growth rate started to dwindle from 2012 to 2016 when the real GDP growth rate was 0.7% and -1.3%, respectively (World Bank, 2017). Poor economic growth rates experienced in South Africa were mainly caused by depending on foreign investments that are unreliable, insufficient fixed capital and the inability of the state to initiate structural economic reform projects. Theoretical and empirical literature have identified and analysed different factors that have a relationship with economic growth.

Hatmanu et al. (2020) proved that exchange rate has a positive relationship with economic growth; a relationship was also proven by recent studies conducted by Hatoongo (2020) and Mekonnen (2021) who discovered a positive relationship between exchange rate and economic growth. Levine and Renelt (1992) proved that capital has a relationship with economic growth; a relationship was also proven by recent studies conducted by Zafar and Zahid (2013) who discovered a positive correlation between physical capital and economic growth, contrary to Pomi et al. (2021) who found that physical capital investment has a negative impact on economic growth in the short-run. Solow (1956) determined that labour force is positively correlated with economic growth; this has also been proven by studies Havi et al. (2013) and Agdew (2019). According to Uwakaeme (2022) together with the studies by Chang and Mendy (2012); Babalola et al. (2019) and Adam (2021), FDI is also one of the factors that affect economic growth. Onifade et al. (2020) and Barro (1991) also determined that government expenditure influences economic growth and Agdew (2019) and Antwi (2013) also confirmed that there is negative relationship between the two factors. Fischer (1993) discovered that inflation rate has an impact on the growth rate of the country. Ibrahim and Morad (2020) and Odo et al. (2016) found a positive relationship between economic growth and inflation, while Sendi et al. (2022); Ismaila and Imoughele (2015) and Thaddeus et al. (2021) found a negative relationship. It is, therefore, necessary to undertake the current study because the earlier empirical findings discussed above were not conclusive.

2. LITERATURE REVIEW

The macroeconomic determinants of economic growth have been investigated by different studies, which include Mukit (2020) who analyzed the macroeconomic determinants impact of Gross Domestic in Bangladesh using the cointegration and the Vector Autoregressive Model (VAR) test annual secondary data for the period 1982-2019. The results obtained concluded that the series was present, and that the regression model was significant. Based on the results, exports had a positive but not significant relationship

to GDP. Imports, on the other hand, had an insignificant and negative relationship to GDP. Inflation is a significant and positive relationship to GDP. Using multiple regression analysis model, Hasan et al. (2022) investigated the impact of macroeconomic factors to Gross domestic product in Bangladesh. The study found that import and export are positively associated with GDP, while inflation rate is a negatively associated factor Pourshahabi et al. (2011) who made use of the panel data approach in conducting research on the relationship between FDI, economic freedom and economic growth in OECD countries from 1997 to 2007. They developed two models-one was used to find out which factors have positive impact on FDI, and the other to find the factors that contribute to economic growth in OECD countries. When researching on factors that stimulate FDI, the results were that human capital, the market size, inflation, and political stability are positively related to FDI showing a huge impact. Economic freedom has been found to have a positive impact on FDI, however, the impact is not significant. When they investigated on the growth factors using the second model, they found that FDI, government expenditure, economic freedom, human capital, and public investment are positively related to economic growth, while inflation and external debt are negatively related.

Pooled Mean Group (PMG) estimator on the panel data was used by Oyebowale and Algarhi (2020) to explore the macroeconomic factors influencing economic growth across 21 African economies. The study's findings showed that, at levels of 1%, 5%, and 1% respectively, the growth rates of exports, government spending, and gross capital formation have statistically significant positive long-run relationships on economic growth, whereas broad money is not statistically significant across the countries. The Dumitrescu-Hurlin Granger causality test indicates that there is a two-way causal relationship between economic growth in African countries and increases in gross capital formation, but not between general money growth, export growth, or increases in government spending. However, the evidence for heterogeneous causality varies amongst the nations (Lesotho, Algeria, Cameroun, and Benin). Jacob et al. (2021) analyzed the impact of key macroeconomic factors on economic growth of Bangladesh from the period of 1990 to 2020 using Auto Regressive Distributed Lag (ARDL) model. The result of the ARDL model shows that inflation rate, exchange rate and trade openness have positive and significant impact on Bangladesh economic growth while foreign direct investment has insignificant impact on economic growth of Bangladesh.

Antwi et al. (2013) used the error correction model to study the effect of macroeconomic factors on economic growth in Ghana; their study was based on the years 1980 to 2010. They found that physical capital, foreign direct investment, government expenditure and inflation had an impact on economic growth. They also made recommendations that for economic growth to be balanced in the country, the government should make positive changes on the budget balance and that foreign aid should be directed to public capital-intensive projects. Ullah and Rauf (2013) studied the effect of macroeconomic factors on economic growth. Their investigation was based on certain selected Asian countries, from the year 1990 to 2010. They discovered that foreign direct investment and savings rate have a positive relationship

with economic growth; the exports have a negative impact on economic growth while labour force, and tax rate have no effect on economic growth. Sharma et al. (2018) assessed the impact of foreign aid, government consumption expenditure, foreign direct investment, trade openness, exchange rate, human capital development, and inflation on economic growth in India by using yearly data and autoregressive distributed lag (ARDL) model for the period of 46 years, that is, from 1971 to 2016. The outcomes of the study find that in the long run, foreign aid, the government's final consumption expenditure and foreign direct investment have a positive and significant impact on economic growth, whereas economic growth has been negatively influenced by exchange rate and human capital development. Contrary to the long run, foreign aid has a negative and significant impact on economic growth in the short run. The short-run outcomes show that all the selected macroeconomic determinants have either negative or positive influence on economic growth.

Smith (2021) used annual data from 1987 to 2019 to investigate the causal relationship between inflation and economic growth in Bangladesh. Vector Error Correction Model and Vector Auto-regression Model concluded that inflation negatively affects the GDP in the short run and a positive association in the long run. Granger Causality test was also performed to calculate the bidirectional relationship and revealed that inflation does not granger cause GDP growth. However, it also shows that GDP growth does not cause granger to cause inflation as well. In Bangladesh, Chowdhury et al. (2019) investigated the impact of macroeconomic variables on economic growth using correlation and multiple regression analysis for the period of 1987-2015. In correlation analysis, it was found that GDP has positive correlation with all the variables except INT. furthermore, it was observed that the independent variables explained 75.60% of the variability of GDP and the relationship is also found statistically significant at 95% confidence level. Therefore, this study has concluded that macroeconomic variables have significant effect on the economic growth of Bangladesh. Urgaia (2019) investigated determinants of economic growth in East Africa using econometric panel data and wavelet time scaling analysis. The results of the study indicate that financial sector development (FSD), Human capital resources (HCR) and Foreign Direct Investment (FDI) have positively significant effects on the GDP growth. The VAR short term transmission mechanism-channels reveal that there is an important contribution of HCR to the development of physical capital stock through gross national income GNI. The GNI has also a positive impact on the accumulation of physical stock via HCR.

Zafar and Zahid (2013) used the multiple regression framework to study macroeconomic variables which affect economic growth. In their study, they used data from 1959 to 1960 and 1996 to 1997. Their collected data showed that human capital, in the form of education, is a necessary determinant for economic growth. They also found that openness to trade and increase in physical capital have a positive effect on economic growth, while external debt and budget deficit have a negative impact. They concluded that a country should try to rely more on domestic savings and resources in increasing growth in the country. Bhaskara-Rao and Hassan (2011) conducted a study on the macroeconomic variables which

determined economic growth in Bangladesh from 1970 to 2007 using the Autoregressive distribution Lag method. The results of the study show that foreign direct investment, money supply and openness to trade have a positive impact on economic growth, however, government expenditure and inflation had a negative relationship with economic growth.

In Nigeria, Babalola et al. (2019) examined the impact of foreign direct investment, foreign aid and foreign trade on economic growth using Autoregressive Distributed Lag (ARDL) model bounds test and error Correction Model (ECM) and the annual time series data for the period 1980-2015. The Evidence from the study indicates that the variables are cointegrated. It also reveals that foreign direct investment, foreign aid and foreign trade have positive long-run impacts on economic growth in Nigeria. In the short-run, only foreign aid has positive impact on economic growth. The Granger causality results provide evidence of both short-run and long-run causality running from foreign aid and foreign trade to economic growth. Fiaz and Khurshid (2022) assessed the impact of macroeconomic variables on Pakistan's economic growth using the Markov Regime switching (MS) model and monthly data for 1981-2020. Each regime's mean and variance are highly significant and show a high growth regime with high volatility and a low growth regime with low volatility. Furthermore, the results show that inflation, interest rate, and trade openness negatively impact while real effective exchange rates positively affect development in both regimes. The negative effect of interest rate, exchange rate, inflation, and trade openness become more pronounced in low growth regimes. Chang and Mendy (2012) examined how openness to trade affects economic growth in thirty-six African countries, from 1980 to 2009. They applied a panel fixed-effects regression model to examine the relationship. The results were that openness to trade, foreign aid, exports, and imports have a significant positive impact on economic growth, but national savings rate, foreign direct investment, and domestic savings affect economic growth negatively. With regards to foreign aid, the study showed that it affects countries differently because it has had a positive impact on economic growth in Middle and North African countries while it has had a negative impact on West and East African countries.

Ibrahim and Morad (2020) investigated the determinants of economic growth in a sample of six countries from the Middle East and North Africa region. Two of which are from high-income countries, Bahrain and Saudi Arabia, and two of the highest middle-income countries, Jordan and Lebanon, and two from lower Middle income, Egypt and Morocco using panel data for the period 2001-2017. The results showed that the employment rate, foreign direct investment, gross national income, government expenditure, and inflation were among the most important in determining economic growth in the region during that period. All of them had a significant and positive impact on economic growth, except for the rate of growth in gross national income, which negatively affected the rate of economic growth. The pairwise Granger Causality showed that unidirectional causality is running from foreign direct investment Gross Domestic Product growth rates, from both Gross Capital Formation growth rates and Imports growth rates to Employment Ratio. Unidirectional causality also runs from both of Exports growth rates, Gross

Capital Formation growth rates, Imports growth rates to Foreign Direct Investment as a percent of Gross Domestic Product. There is also unidirectional causality from foreign direct investment and imports to unemployment. Thaddeus et al. (2021) investigated the impact of macroeconomic determinants on economic growth in Cameroon using the autoregressive distributed lag (ARDL) bounds model and time series data from 1970 to 2018. The results show that government expenditure, trade openness, gross capital formation and exchange rate positively and significantly impact economic growth in the short and long runs, while Human capital development, foreign aid, money supply, inflation and foreign direct investment negatively and significantly affected economic growth in the short and long-runs.

Anyanwu (2014) studied macroeconomic variables which have an impact on economic growth in Africa and China. For the African countries, cross country panel data was used from the years 1996 to 2010, while for China, time series data were used for the period, 1984-2010. From the results for the African countries, it was determined that domestic investment, net official aid, secondary school enrolment, metal price index, government effectiveness and urban population have a positive impact on economic growth. The results for China were that domestic investment and trade openness have a positive impact on economic growth, while official development aid, population growth, inflation, credit to the private sector, agricultural material price, and oil price have a negative impact on economic growth. Sakyi and Egyir (2017) examined the effects of trade and FDI on economic growth in Africa. Their focus was on testing the Bhagwati hypothesis by researching if trade exports and FDI have an impact on economic growth in 45 African countries between 1990 and 1994. To conduct this test, they estimated an augmented endogenous growth model using the generalised method of momentum estimation method. They concluded that exports and FDI have a positive impact on economic growth in Africa. Acikgoz and Mert (2014) collected data on the impact of investment on real GDP per capita in three Asian countries, namely, Hong Kong, Taiwan, and Republic of Korea. The autoregressive distributed lag and the fully modified ordinary least squares method were used for the period 1951-2007 for Taiwan, 1953-2007 for Republic of Korea, and 1960-2007 for Hong Kong. From the results, it was concluded that in the three countries investment has a positive impact on economic growth.

Prochniak (2011) employed the ordinary least squares estimation to analyse the determinants of economic growth in ten Eastern and Central European countries from the year 1993 to 2009. The results showed that the investment rate, human capital, population, economic freedom, communication, technology, and the financial sector have a positive effect on economic growth. It also showed that interest rate, public debt, budget deficit and inflation have a negative relationship with economic growth. Fetahi-Vehapi et al. (2015) analysed how openness to trade affects economic growth in ten South Eastern European countries, from the years 1996 to 2012 using a fixed-effects panel regression estimation method. The outcome demonstrated that human capital, trade openness, FDI and capital formation affect economic growth, positively while population size has a negative impact. Assefa and Mollick (2017) used the static and dynamic panel data methods to study the effects

of financial development in fifteen African countries for the period, 1995 to 2010. The results of the study were that flows of portfolio capital and foreign direct investment have a positive impact on the growth of all the fifteen countries. Salahuddin and Gow (2016) researched on how financial development, internet usage and openness to trade had affected economic growth in South Africa from the year 1991 to 2013. The structural unit root test and Johansen and ARDL cointegration were employed to analyse the relationship. The ARDL results revealed that financial development and internet usage are positively correlated with economic growth in South Africa and the Granger causality test also proved the same point.

Tafirenyika (2017) employed the autoregressive distributed lag model to analyse the impact of FDI and economic growth in South Africa in the long run, then used the VECM to analyse the short run dynamics and lastly applied the Granger causality to examine the direction of causality. The results were that FDI, and exports have a positive relationship with economic growth, however the VECM Granger causality test showed that there was a unidirectional causality between economic growth and FDI but a bidirectional causality between economic growth and exports. Ismaila and Imoughele (2015) investigated the impact of macroeconomic determinants on economic growth in Nigeria using the ADF test for the unit root test and the Johansen cointegration test to analyse the short and long-run impact on economic growth in data from 1986 to 2012. From the results, it was concluded that foreign direct investment, capital formation and government expenditure are factors that affect growth positively, while inflation was proved to have a negative effect on the country's growth. Havi et al. (2013) made use of the Johansen method of cointegration and the vector error correction method to examine the macroeconomic determinants of economic growth in Ghana from 1970 to 2011. Physical capital and FDI affect economic growth positively while labour, consumer price index, military rule, foreign aid, and government expenditure affect economic growth negatively were proven to effect economic growth. Parviz (2011) examined factors of economic growth to determine if there were any time series support for FDI-led growth hypothesis in Canada for a period of 33 (33) years. The Beach-Mackinnon technique was used to estimate the model for the study. Findings were that factor productivity and domestic investment have a positive impact on economic growth and that there was no time-series support for FDI-led growth hypothesis in Canada.

Fedderke and Simkins (2012) analysed the economic growth of the South African economy by making use of the modern growth theory to structure a historical record. They concluded that financial deepening as well as the monetary and fiscal policies have a positive impact on economic growth. They concluded that political instability has affected economic growth negatively and that the country also needed to increase its human capital and technological progress. Doku (2017) investigated the quantitative effect and direction of Chinese Foreign Direct Investment (FDI) on economic growth in Africa using a sample of 20 African countries from 2003 to 2012; data was obtained from the United Nations Conference on Trade and Development and the World Bank. The study used panel least squares regression, specifically the fixed-effect model to examine these effects in Africa. The study also applied the Granger causality

test to examine whether a causal relationship exists between economic growth and China's FDI in Africa. The study established that a 1 per cent increase in China's FDI stock in Africa significantly increases Africa's gross domestic product (GDP) growth by 0.607 per cent, all things being equal. Furthermore, the study found that a causal link exists between GDP growth in Africa, China's FDI and the nature of causality is unidirectional.

Esso (2010) established a relationship between FDI and economic growth in 10 African countries, including South Africa; the time series data used in the study was for the period 1970-2007. The results showed that there is a long run relationship in South Africa, Kenya, Liberia, Cote d'Ivoire, Angola, and Senegal and the causality relationship in which FDI caused economic growth was found in Angola, Kenya, and Cote d'Ivoire. Mazenda (2014) applied the Johansen cointegration test and the VECM to study the effect of FDI on economic growth in South Africa, during the period 1980-2010 with the outcome that FDI was significant only in the short run, but not in the long run. The results also revealed that FDI crowded out domestic investment although domestic investment has a positive impact on economic growth. Ndambiri et al. (2012) examined the determinants of economic growth in Sub-Saharan Africa. They applied a panel data approach and the GMM for the period 1982-2000. The outcomes were that physical capital formation exports and human capital formation have a significant positive impact on economic growth while government expenditure, nominal discount rate and foreign aid affect economic growth negatively. Kumo (2012) investigated the impact of infrastructure investment and employment on economic growth in South Africa for the period 1960-2009. The bivariate vector auto regression and VECM were employed to analyse this relationship and the granger causality test was also applied to test for causation between the variables of interest. The outcome showed that there exists both short and long-run relationship between the variables and that economic growth and infrastructure investment have bidirectional causality.

Chirwa and Odhiambo (2016) in their study on the long run determinants of economic growth in South Africa made use of the ARDL bounds test approach for the period 1970-2013. The collected data from the study showed that investment, human capital, and international trade have a positive impact on economic growth and that population, government expenditure and inflation affect economic growth negatively. Odo et al. (2016) employed the causality approach to analyse the long run effect of public expenditure on economic growth in South Africa for the period 1980-2014; they also applied the cointegration test and VECM to estimate the variables. The results were that there is a positive relationship between inflation and economic growth while there is a negative relationship between government expenditure and economic growth.

3. METHODOLOGY

3.1. Sample Period and Variable Description

Secondary data were collected to conduct this study as they are more reliable, enhanced, easy to access and convenient to use. The time series data on real GDP per capita, government expenditure, inflation, labour force, physical capital and foreign direct investment were obtained from World development indicators (2017). Annual

data series from 1994 to 2016 were used to analyse the relationship between real per capita GDP growth and the selected determinants for this study. The sampling size of the study was 23. The study period (i.e., 1994-2016) was chosen due to the availability of data. The following factors were taken into consideration when selecting the period of the study: democracy, political stability, economic liberalisation and availability of the data needed to conduct the study.

This study used the Augmented Dickey Fuller test developed by Dickey (1979) to test for stationarity of both exogenous and endogenous variables of the model. It was necessary to perform the test because it helped to prevent spurious regression which has a high possibility of occurring in an estimation of a regression line where the data follows a time trend. The equation required by the ADF test is:

$$\Delta y_t = B_0 + B_1 y_{t-1} + B_2 t + \sum_{i=1}^p A_i \Delta y_{t-i} + z_t; H_0 : B_1 = 0; H_1 : B_1 > 0 \quad (1)$$

y_t represents the vector for the time series variables included in the study

t represents the time

Δ represents the first difference operator

The study also applied the Phillips-Perron (PP) unit root test developed by Phillips (1988). The error term in a PP test has to be statistically independent and should contain a constant variance (Asteriou, 2011).

The test was however modified in order to correct standard errors and also for it to be in line with its proposed assumptions. The advantage of this test is that, it can be applied to a wide number of problems.

The Johansen Cointegration estimation method was employed to study the data and determine the factors which have a relationship with economic growth in South Africa. For this study, real GDP per capita is the dependent variable and the explanatory variables are-foreign direct investment, inflation, government expenditure, physical capital, and labour force. The time series properties of all the variables included in this study were explored to eliminate trends that could lead to spurious parameter estimates. The Johansen maximum likelihood cointegration test was used to determine long-term relationships between the variables.

The error correction model integrates short-run dynamics in the following long-run growth function:

$$\begin{aligned} \Delta RPCGDPG_t = & \alpha_1 + \sum_{i=1}^p b_{2i} \Delta RPCGDP_{t-i} + \sum_{i=0}^p c_{3i} \Delta K_{t-i} + \sum_{i=0}^p d_{4i} \Delta L_{t-i} \\ & + \sum_{i=0}^p e_{5i} \Delta FDI_{t-i} + \sum_{i=0}^p f_{6i} \Delta \Delta GE_{t-i} + \sum_{i=0}^p g_{7i} I_{t-i} + \lambda_9 ECM_{t-i} + \varepsilon_{2t} \end{aligned} \quad (2)$$

ECM_{t-i} represents the error correction model in which the residuals are found from equation 2. The ECM is the result that shows the amount of disequilibrium being corrected. It also shows how stable

a relationship is in the long run through its statistical significance (Bannerjee, 1998).

3.2. Model Specification

Many theories of economic growth, such as-Classical, Endogenous, Keynesian, and Neoclassical - have tried to explain the variables which affect or determine economic growth in different countries. These variables include-the savings rate, technological progress, human capital, foreign direct investment, physical capital, natural resources, government expenditure, geographical areas, openness to trade and other variables; some of these are included in this study.

Real GDP per capita is a function of foreign direct investment, inflation, government expenditure, labour force and physical capital.

Following the approach employed by Lucas (1988) as adopted by Havi et al., (2013), South Africa's economic growth (GDP) function is mathematically expressed as follows:

$$RPCGDP = f(K, L, FDI, GE, I) \tag{3}$$

Thus, the function of economic growth becomes,

$$RPCGDP = \beta_0 + \beta_1K + \beta_2L + \beta_3FDI + \beta_4GE + \beta_5I + \varepsilon_t \tag{4}$$

Where:

RPCGDP represents Real GDP Per Capita growth rate,
K represents physical capital measured as gross fixed capital formation as a % of GDP,

L represents Labour Force measured as a % of total population aged 15–64,

FDI represents foreign direct investment measured as foreign direct investment as a % of GDP,

GE represents government expenditure measured as government expenditure as % of GDP,

I represents inflation measured by consumer price index,

ε_t represents the error term which is assumed to be normally and independently distributed with zero mean and constant variance.

$\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 are the partial elasticity of real GDP per capita.

4. ANALYSIS AND INTERPRETATION

Unit root theory is the cornerstone to the methodology used for testing the stationarity or nonstationarity of a time series (Abdullah, 2022). The Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests were used to test the stationarity of each variable, and the results are shown in Tables 1 and 2, respectively.

Table 1: Augmented Dickey Fuller test (ADF)

Variable	None		Constant		Constant and trend		Conclusion
	Level	1 st difference	Level	1 st difference	Level	1 st difference	
RPCGDP	-1.972646*	-5.229486**	-2.472180	-5.114421**	-2.599054	-5.105937**	I (1)
K	0.434500	-3.248848**	-1.826032	-3.164758**	-2.599054	-3.080972*	I (1)
L	2.679504	-1.722327*	0.136149	-2.799892*	-6.180242**	-3.883182**	I (1)
FDI	-0.560861	-6.131947**	-4.821864**	-5.923021**	-4.671096**	-5.823688**	I (1)
GE	0.454114	-4.064745**	-1.593213	-3.990784**	-2.155552	-4.236270**	I (1)
I	-0.790683	-5.002743**	-3.922508**	-4.884500**	-3.911116**	-4.906650**	I (1)

*Significant at 10% **Significant at 5%

Because the null hypothesis of non-stationarity is rejected at the first difference, the ADF unit root test findings demonstrate that the variables are integrated of the first order I(1). The Phillips-Perron (PP) test results shown in Table 2, which demonstrate that the variables are integrated of the first order I(1) because the null hypothesis of non-stationarity is rejected at first difference, also confirm the findings of the Augmented Dickey Fuller test.

4.1. The Vector Autoregressive (VAR) Lag Order Selection Criteria

Table 3 above presents the lag lengths selected by different information criteria. Akaike, Schwarz and Hannan-Quinn information criteria are used for the selection of the optimal number of lags in the study. The optimal lag length is important because VAR and VECM are sensitive to the lag length. The Akaike information criterion (AIC) measures the quality of the models on a particular set of data. The AIC measures the data for all the models individually, also provides the model selection. The Schwarz criterion (SC) which is also known as Bayesian information criterion (BIC) is based on a finite set of models and it prefers the model with the lowest BIC. The VAR determines the optimal lag length for the Johansen cointegration test based on the AIC. From Table 3, the optimal lag length recommended for this study, by the Akaike information criterion (AIC) is 1, where AIC (13.47291) is less than SC (15.55581).

4.2. The Johansen Cointegration Approach

Tables 4 and 5 show Trace and Maximum-Eigen results. The Johansen's maximum likelihood approach was employed to test for cointegration. This cointegration test analyses the short and long-run relationship between the variables of the study. All the variables have to be integrated of the same order, in this case all the variables differenced and were found to be integrated of order I(1).

In Table 4, the trace test is conducted to determine and analyse if there is a cointegration relationship between RPCGDP, K, L, FDI, GE and I in South Africa. The results of the cointegration test showed that there are 6 cointegrating equations in the trace statistic, therefore this study rejects the null hypothesis that states that there is no cointegration. The null hypothesis is rejected at 179.63 because it is >95.75 at 5%, therefore, the results prove the existence of short and long-run relationship.

In Table 5, the Max-Eigen test is conducted to determine and analyse if there is a cointegration relationship between RPCGDP, K, L, FDI, GE and I in South Africa. The Max-Eigen test results showed that there is one cointegrating equation, therefore the null hypothesis that states that there is no cointegration, is rejected.

Table 2: Phillips perron test (PP)

Variable	None		Constant		Constant and trend		Conclusion
	Level	1 st difference	Level	1 st difference	Level	1 st difference	
RPCGDP	-1.972646**	-5.229486**	-2.472180	-5.114421**	-2.599059	-5.105937**	I (1)
K	0.336498	-3.248848**	-1.624609	-3.164758**	-2.019675	-3.080972*	I (1)
L	7.353923	-1.758323*	0.611921	-3.077182**	-1.551508	-3.367552*	I (1)
FDI	-2.365456**	-7.467049**	-4.821864	-7.271314**	-4.671096**	-7.170641**	I (1)
GE	0.150963	-5.469948**	-1.705722	-5.514651**	-3.191243	-5.245024**	I (1)
I	-1.097281	-4.422419**	-3.140049**	-4.316816**	-3.112827	-4.234469**	I (1)

*Significant at 10% **Significant at 5%

Table 3: The vector autoregressive lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-215.8774	NA	23.19158	20.17068	20.46823	2024077
1	-106.2020	149.5574	0.032809*	13.47291*	15.55581*	13.96358*

*Indicates lag order selected by the criterion

Table 4: Trace test

Hypothesized No. of CE (s)	Eigenvalue	Trace statistic	0.05 critical value	Prob.**
None*	0.985087	179.6302	95.75366	0.0000
At most 1*	0.790242	91.31447	69.81889	0.0004
At most 2*	0.736793	58.51662	47.85613	0.0037
At most 3*	0.492238	30.48552	29.79707	0.0416
At most 4*	0.399781	16.25296	15.49471	0.0384
At most 5*	0.231635	5.533303	3.841466	0.0187

*Standard error in parentheses. Trace test indicates 6 cointegrating eqn (s) at the 0.05 level, *Denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) P-values

Table 5: Max-eigen test

Hypothesized No. of CE (s)	Eigenvalue	Max-eigen statistic	0.05 critical value	Prob.**
None*	0.985087	88.31572	40.07757	0.0000
At most 1	0.790242	32.79785	33.87687	0.0668
At most 2*	0.736793	28.03108	27.58434	0.0438
At most 3	0.492238	14.23258	21.13162	0.3463
At most 4	0.399781	10.71966	14.26460	0.1688
At most 5*	0.231635	5.533303	3.841466	0.0187

Max-eigenvalue test indicates 1 cointegrating eqn (s) at the 0.05 level. *Denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) P-values

Table 6: Normalized cointegrating equation

Normalised cointegrating coefficients					
RPCGDP	K	L	FDI	GE	I
1	-0.570649 (0.07711)	0.664542 (0.13479)	0.128570 (0.10160)	2.014495 (0.14442)	-0.172637 (0.06405)

*Standard error in parentheses

The null hypothesis is rejected at 88.32 because it is >40.07 at 5% level, therefore, the results prove the existence of short and long-run relationship.

4.3. The Vector Error Correction Model (VECM)

The existence of cointegration means that VECM can be used. VECM techniques allow long run and short run impacts of variables to establish the macroeconomic determinants of economic growth. Using the results from the cointegration test, the VECM was specified. The VECM results are presented in Tables 6 and 7, below.

Real per capita GDP, as denoted by RPCGP, represents the economic growth rate proxy and it is normalised to unity as an endogenous variable of the regression model. Table 6 shows the long-run and normalised coefficients for the model generated from the cointegrating vector. The equation is as follows:

$$RPCGDP = 0.570649K + 0.664542L + 0.128570FDI + 2.014495GE - 0.172637I \quad (5)$$

The long run equation is derived to make RPCGDP the endogenous variable. The derived equation is as follows:

$$RPCGDP = 0.570649K - 0.664542L - 0.128570FDI - 2.014495GE + 0.172637I \quad (6)$$

Equation 6 shows that K and I have a positive impact on economic growth while L, FDI and GE have a negative impact. According to the results, capital, as denoted by K, has a positive impact on economic growth. The coefficient of K is 0.570649, therefore a 1% increase in capital will result in a 0.570649% increase in economic growth (RPCGDP). The result of this relationship is inconsistent with the results gathered by Zafar and Zahid (2013), who found that physical capital has a positive impact on economic growth. The results for labour force, as denoted by L, showed that labour force has a negative impact on economic growth in South Africa. The coefficient of L suggests that a 1% increase in L will result in a 0.664542 decrease in economic growth (RPCGDP). The results of this relationship are similar to those found by Havi et al. (2013), who also found a negative relationship between labour force and economic growth. Foreign direct investment, as represented by FDI, has a negative impact on economic growth. According to the results, a 1% increase in foreign direct investment will lead to a 0.128570% increase in economic growth as denoted by RPCGDP. The negative relationship outcome is similar to the results found by Mazenda (2014). The results also show that government expenditure as denoted by GE has a negative impact on economic growth. Given the coefficient of GE as -2.014495, this means that a 1% increase in government expenditure will result in 2.014495 decrease in economic growth (RPCGDP). The negative relationship between government expenditure and economic growth is consistent with the relationship found by

Odo and Chukwu (2016). According to these results, consumer price index or inflation, as denoted by I, has a positive effect on economic growth and since the coefficient of I is 0.172637, it means that a 1% increase in consumer price index will lead to a 0.0172637 increase in economic growth (RPCGDP). The positive relationship between inflation and economic growth is similar to the results found by Odo and Chukwu (2016).

The vector error correction model estimates the short-run effects of the coefficients of the model. The short run effect is denoted by the speed of adjustment and for the model is -0.060414 as shown in Table 7 below and it is significant at 5%. The system must converge to equilibrium, therefore the negative sign of the speed of adjustment is justified. The results suggest that 6.0414% disequilibria in economic growth of previous years are corrected in the current year. The significance of the results also confirms that there is a long-run equilibrium relationship between all the variables and economic growth. R squared indicates that 78.2687% of the total variations in South Africa's economic growth are explained by the independent variables of the model, therefore, the model represents a good measure of fit.

4.4. Diagnostic Test

Diagnostic tests were carried out to test for normality, serial correlation autocorrelation and heteroskedasticity in the model. The diagnostic test results presented in Table 8 are at 5% level of significance.

The first diagnostic test is the Jarque-Bera test for normality; the results show that the residuals of the regression are normally distributed as the P-value of 0.363220 is >0.05 (5%) level of significance. The Breusch-Godfrey test is for serial correlation;

the results show that there is no serial correlation because the $P = 0.9961$ is $>5\%$ level of significance. The autocorrelation test was performed by Ljung-Box Q; the results show that there is no autocorrelation in the model because the $P = 0.881$ is $>5\%$ level of significance. The Breusch Pagan Godfrey is one of the tests used to test for heteroskedasticity; the result for this test proved that there is no heteroskedasticity in the model because the $P = 0.3883$ is $>5\%$ level of significance. The Harvey test was also used to test for heteroskedasticity; the test shows that there is no heteroskedasticity because the $P = 0.4961$ is $>5\%$ level of significance. The Glejser test was also used to test for heteroskedasticity; the test indicates that there is no heteroskedasticity in the model because the $P = 0.4060$ is $>5\%$ level of significance. The ARCH test also indicated that there is no heteroskedasticity in the model because the $P = 0.9074$ was $>5\%$ level of significance. The White test was also conducted to check for heteroskedasticity in the model; the results indicate that there is no heteroskedasticity since the $P = 0.2940$ is $>5\%$ level of significance.

4.5. Stability Test

Figure 1 above show that the model is stable throughout the period of the study because the cumulative sums move within the 5% critical lines, and this suggests that the model is stable and suitable for analysis.

The cumulative sums line in Figure 2 above moves within the 5% critical lines; this indicates that the model is stable and suitable to be used for analysis.

Table 9 shows the Ramsey RESET test results. The Ramsey RESET test is performed to check the stability of the model as to whether the model is correctly specified or not. The results

Table 7: Error correction results

Variables	D (RPCGDP)	D (K)	D (L)	D (FDI)	D (GE)	D (I)
ECT coefficients	-0.060414	0.176340	0.023856	0.012134	-0.165482	0.522481
Standard Errors	0.13835	0.13635	0.01109	0.22887	0.06782	0.25345
T-Statistics	-0.43667	1.29326	2.15030	0.05302	-2.43991	2.06148

$R^2=0.782687$

Table 8: Diagnostic test results

Test	Null hypothesis	Test statistic	P-values	Conclusion
Jarque-Bera	Residuals are normally distributed	2.025493	0.363220	Do not reject H_0 $PV > LOS$ at 5% The residuals are normally distributed
Breusch-Godfrey	No Serial correlation	2.39E-05	0.9961	Do not reject H_0 $PV > LOS$ at 5% There is no serial correlation
Ljung-Box Q	No Autocorrelation	5.1514	0.881	Do not reject H_0 $PV > LOS$ at 5% There is no autocorrelation
Breusch Pagan Godfrey	No Heteroskedasticity	5.231607	0.3883	Do not reject H_0 $PV > LOS$ at 5% There is no heteroskedasticity
Harvey	No Heteroskedasticity	4.380257	0.4961	Do not reject H_0 $PV > LOS$ at 5% There is no heteroskedasticity
Glejser	No Heteroskedasticity	5.081915	0.4060	Do not reject H_0 $PV > LOS$ at 5% There is no heteroskedasticity
ARCH	No Heteroskedasticity	0.013527	0.9074	Do not reject H_0 $PV > LOS$ at 5% There is no heteroskedasticity
White	No Heteroskedasticity	22.89448	0.2940	Do not reject H_0 $PV > LOS$ at 5% There is no heteroskedasticity

*L.O.S means "level of significance", *PV means "probability value"

Figure 1: CUSUM test results

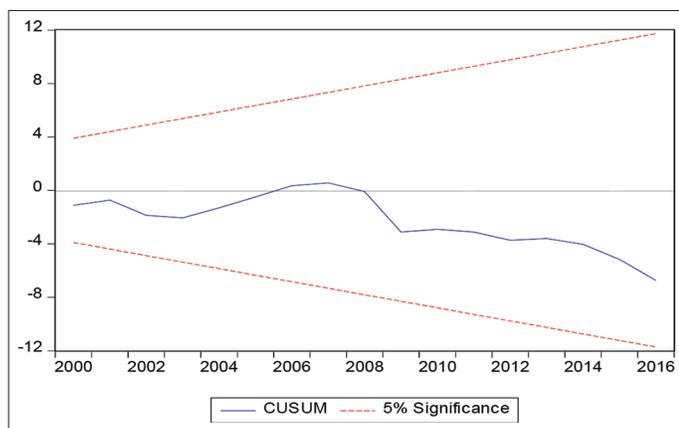


Figure 2: CUSUM of squares test results

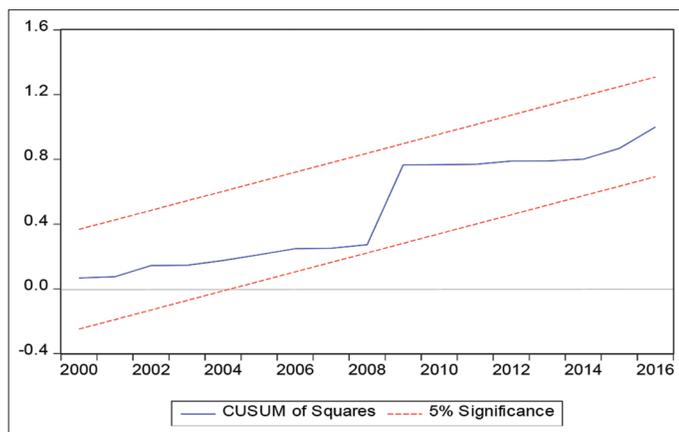


Table 9: Ramsey RESET test

Test	Ho	Test statistic	P-value	Conclusion
Ramsey RESET	The model is correctly specified	0.529659	0.6036	Do not reject Ho PV>LOS at 5% The model is correctly specified

indicate that the model is correctly specified, therefore the null hypothesis is not rejected because the probability value of 0.6036 is >5% level of significance.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study was aimed at determining and analysing macroeconomic determinants of economic growth in South Africa for the period 1994-2016. The study focused on five determinants of economic growth-physical capital, labour force, foreign direct investment, government expenditure and inflation. The study analysed how these factors affect real GDP per capita growth rate in South Africa. The rationale for conducting this study was because South Africa has been experiencing low economic growth rates, hence, the need to find out how economic growth rate can be stimulated. The study made use of both ADF unit root test and Phillips-Peron unit root test for stationarity of all the variables.

The variables were not stationary at level, they were found to be stationary at first difference. The Johansen cointegration test was applied to check for cointegration amongst the variables. The results showed that there is cointegration and proved that a long-run relationship exists among the variables. Following the cointegration results, the VECM was applied for short and long-run estimates. This data indicated that physical capital and inflation have a positive relationship with economic growth, while labour force, FDI and government expenditure have a negative relationship with economic growth. The diagnostic tests showed that the model is stable and correctly specified, also that there is no serial correlation, auto correlation nor heteroskedasticity.

The study found that physical capital has a positive impact on economic growth; this implies that investments in the construction of roads and buildings, machinery, plants, and other physical capital stock should be a priority for the government. Physical capital investment increases production in a country, which has a positive impact on economic growth. Labour force was found to have a negative impact on economic growth; this may be caused by high increasing population growth rate or a mismatch between jobs available and skills acquired. Educational institutions and companies, therefore, should educate people on the skills that are mostly needed, in the workplace, to reduce the mismatch between skills acquired and jobs available. The results also showed that FDI has a negative impact on economic growth. The government, therefore, should depend less on foreign direct investment as this leads to volatility of investment funds; they should rather encourage domestic savings through taxation, compulsory lending to the government and a finance-credit mechanism to also collect savings from different sources. Government expenditure was found to have a negative relationship with economic growth; hence, the government should try not to exceed its expenditure budget at any given period. The government should also try to spend on expenses that will have higher benefits for the economy, such as agriculture, health, physical capital, and education. According to the results, inflation has a positive impact on economic growth and even though the inflation rate has been higher than the 6% target, it has always been below 10% with the exception of 2008 (World Bank, 2017). Inflation rates lower than 10% affect economic growth positively, therefore the government should keep inflation at a lower rate so that the commercial banks' lending rate can be lower, consequently, attract more investors.

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