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# WHAT DRIVES LONG-RUN ECONOMIC GROWTH? EMPIRICAL EVIDENCE FROM SOUTH AFRICA

Themba Gilbert Chirwa<sup>1</sup> and Nicholas M. Odhiambo

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## Abstract

*In this study, we examine empirically the key determinants of economic growth in South Africa – using the ARDL bounds-testing approach. The paper has been motivated by the low and dwindling economic growth that South Africa has been experiencing in recent years. Our study finds that the key macroeconomic determinants that are significantly associated with economic growth in South Africa include, amongst others, investment, human capital development, population growth, government consumption, inflation, and international trade. The study finds that in the short run, investment is positively associated with economic growth, while population growth and government consumption are negatively associated with economic growth. However, in the long run, the study finds investment, human capital development and international trade to be positively associated with economic growth, while population growth, government consumption, and inflation are negatively associated with economic growth. These results have important policy implications. They imply that economic strategies pursued in the short run should include policies that attract investment, and reduce population growth and government consumption. However, long-run strategies to be adopted should include those that attract long-term investments, improve the quality of education, as well as trade liberalization; and ensure a reduction in population growth, government consumption and inflation.*

**Keywords:** Republic of South Africa; Autoregressive Distributed Lag Models; Economic Growth

**JEL Classification Code:** N17, F43, O47, O55

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## **1. Introduction**

The Republic of South Africa is one of the emerging economies in the world with a real per capita income of US\$6,086 at 2005 constant dollar prices registered in 2014 (World Bank, 2015). Since the mid-1990s, the Growth, Employment and Redistribution (GEAR) programme has been one of the main policy drivers that targeted a real GDP growth rate of 6% p.a.; and the creation of at least 400,000 new jobs p.a. The key drivers that were identified to facilitate the achievement of these goals included the promotion of both domestic and foreign investment; human capital development; inflation control; real exchange rate stabilization; and the promotion of international trade with a focus on non-gold exports (Republic of South Africa, 1996; Kearney and Odulosa, 2011). However, despite the implementation of numerous political and economic reforms during the post-apartheid era, the South African economy continues to experience social and economic challenges. The performance of the economy has been unimpressive, with real GDP growth rates averaging 3.1% p.a. during the 1994-2013 period. Even during the post-2008 global financial crisis, real GDP growth rates slowed down further, averaging 2.1% p.a. during the period 2008-2013 (World Bank, 2015).

In 2013, the South African government replaced the GEAR programme with the National Development Plan (NDP) of 2030. The aim of the NDP is to eliminate poverty and reduce inequality by 2030, with a focus on inclusive growth, strengthening state institutions, knowledge development, and promotion of good leadership and partnerships. Furthermore, 11 million jobs are expected to be created by 2030, and the economy is expected to grow at a rate of more than 5% p.a. (National Planning Commission, 2012, p. 28).

At the centre of each country's economic growth strategy is the need for achieving high and sustainable rates of economic growth. Economic policies, thus, play an important role in identifying the fundamental causes of economic growth and they can influence the direction in which key macroeconomic determinants such as physical and human capital are accumulated over time. They can also influence a country's economic growth trajectory by providing incentives to invest, to develop skills and even the absorption of technology (Barro and Sala-i-Martin, 2004). However, for effective policies to be formulated, policy makers are expected to base their judgement on sound empirical evidence that can guide policy makers in the formulation of economic strategies. At the heart of such a strategy is the need for policy makers to understand the specific macroeconomic determinants of growth in their country (Anyanwu, 2014).

Furthermore, for developing countries to be able to absorb technology from rich countries abroad, it is important that they create a conducive environment that would attract foreign investment. This requires creating a stable macroeconomic environment that reduces risks and uncertainty; which is fundamental in increasing productivity and attracting the necessary investment to influence economic growth. Numerous factors that would create an unstable macroeconomic environment have been identified in the economic growth literature, such as political instability, trade barriers, inadequate public infrastructure, low education quality, corruption, inflation, and fiscal and monetary policy (Easterly and Wetzell, 1989; World Bank, 1990).

The aim of this paper is, therefore, to examine the key macroeconomic determinants that lead to high rates of economic growth and those that hinder or slow growth in South Africa. The rest of this paper is organized as follows: Section 2 discusses the key macroeconomic drivers of growth in the Republic of South Africa. Section 3 discusses the empirical model specification and estimation

techniques. Section 4 presents the empirical estimation results. Lastly, section 5 present policy recommendations and concludes the study.

## **2. The Sources of Growth in South Africa**

The South African economy has gone through two distinct economic systems: an apartheid regime, 1948-1993, and the post-apartheid regime, 1994 to the present. Based on available data, the growth rate in real GDP during the apartheid era covering the period 1960-1993, was erratic and South Africa experienced declining growth rates. The structure of the South African economy was defined in the 1960s where more emphasis was placed on the promotion of industries or manufacturing and mining. The success of the South African economy relied on the availability of cheap labour and this motivated the development of regulations that focused on providing basic education to unskilled labour. However, with an expanding manufacturing/industrial sector, this created demand for skilled labour and the education policies that the Government had enacted created skills shortages (Lowenberg, 1997). Eventually the education laws in the 1960s, rather than creating an economic environment that would enhance economic opportunities, led to a system of constrained human capital development and inefficient and ineffective resource allocation and mobilization (Lowenberg, 1989).

The 1960s were also crucial years for the South African economy as they signify the advent of economic sanctions imposed by the international community to stop the South African government from implementing the apartheid policies. In August 1963, the United Nations General Assembly passed its first resolution to impose a voluntary arms embargo on South Africa. However, the implementation was not in full force as only a few states adhered to the resolution (Kreutz, 2005).

In November 1977, the United Nations Security Council passed a unanimous resolution that

imposed a firm and mandatory arms embargo on South Africa. The overall impact of this resolution was increased military spending as the South African Government resorted to producing some of the military equipment locally (McMillan, 1992). Perhaps the most influential sanctions imposed on the South African economy were the trade and financial sanctions of the 1980s. These were in the form of disinvestment and divestment. The former led to the imposition of restrictions on new foreign capital invested in South Africa. During the period 1948-1984, the South African economy was susceptible to foreign capital lending, which meant that the economy was heavily dependent on the willingness of foreigners to invest in South Africa (Levy, 1999).

The apartheid regulatory economic regime can be summarised as a period characterised by political and economic suppression. This created an economic environment filled with uncertainties as a result of the political unrest and economic instability brought about by the punitive sanctions imposed on the economy since the 1960s. During this period, five key macroeconomic variables that were affected by the apartheid system were: investment (both domestic and foreign), which was affected by capital flight (divestment and disinvestment); human capital development suppressed by repressive education laws that were enacted even though demand for skilled labour was rising; real exchange rate instability, especially in the late 1970s when the South African government imposed a dual exchange rate system and exchange controls on debt repayment; inflation that moved from a single digit to double digits between the period 1973 and 1992; and trade restrictions imposed by arms embargos, trade and financial sanctions of the late 1970s and mid-1980s (Bayoumi, 1990; Lowenberg, 1997; Levy, 1999).

During the post-apartheid period, the economy lacked a number of social services such as education, housing, access to clean water, electrification, healthcare, public works and land reform.

Realizing the extent of the problems in 1994, the newly elected Government adopted a Reconstruction and Development Programme (RDP), whose first priority was to overcome poverty and deprivation faced by many South Africans (Republic of South Africa, 1994). Through the RDP, the approach towards achieving prosperity was to combine both growth and development. The key objectives of the RDP were to ensure that basic needs were met; human capital development was enhanced; to build on the existing economic infrastructure; and to promote democracy and equality of rights (Republic of South Africa, 1994). In 1996, the Government embarked on a Growth, Employment and Redistribution (GEAR) Macroeconomic Strategy that replaced the RDP. The GEAR supported fundamental economic reforms targeting sound monetary policy (inflation targeting), public budgeting and reduction of fiscal deficits to reduce debt service obligations; relaxation of exchange rate controls; tariff reforms; tax incentives; good governance; and security (Department of Finance, 1996).

Monetary policy reform during the post-apartheid era targeted financial stability as the main objective. At the heart of financial stability was the assurance of maintaining positive real interest rates to encourage national saving and investment, reduce inflation and minimise exchange rate fluctuations (Department of Finance, 1996). Exchange rate policy reform was important if South Africa was to increase domestic productivity by ensuring a sustained expansion of exports to boost trade and employment. The emphasis was, therefore, to ensure that the long-run real exchange rate growth was stable as a prerequisite for export growth and income redistribution (Department of Finance, 1996).

The importance of human capital development was also at the centre of the integrated strategy and central to the long-run economic performance and income redistribution policies. Education

reforms targeting decentralisation of school governance, quality education, teacher education, and private sector involvement in the provision of higher education were put on the agenda of transformation. The low provision of formal education, especially at the highest level, and the low quality of education have been the major factors isolated leading to low human capital development in South Africa (Department of Finance, 1996; Fedderke, 2005). Trade liberalisation was also identified as a key source of economic growth and employment creation. Trade reform focused on the removal of trade restrictions such as import surcharges that were abolished in October 1995; the rationalisation of tariff structures; and the redistribution and expansion of preferential trade arrangements with bilateral countries and regional integration institutions (Department of Finance, 1996).

In 2010, as a result of such economic vulnerability, the South African Government embarked on a new development plan called the ‘New Growth Path’ with an aim of reinvigorating the primary and secondary sectors of the South African economy. The New Growth Path specifically targeted six key sectors: infrastructure services by Government – transportation, energy and water, communications and housing; mining value chain; green economy; agriculture value chain; manufacturing; and tourism. These sectors are expected to create at least five million jobs which would reduce unemployment rate from 25% to 15% by the year 2020 (The Presidency of South Africa, 2010). To consolidate its development plans, the South African government embarked on a new long-term strategy called the National Development Plan of 2030 that focuses on inclusive growth, eliminating poverty and reducing inequality. The National Development Plan is expected to create 11 million jobs and the economy is expected to grow at a rate of more than 5% p.a. (National Planning Commission, 2012).

From the discussion, the key macroeconomic drivers that may be associated with economic growth in the South African economy include the accumulation of physical capital, human capital development, population growth, government consumption, inflation, real exchange rate stabilisation, and international trade.

### **3. Empirical Model Specification and Estimation Techniques**

#### **3.1 Empirical Model Specification**

The multivariate framework for determining growth is an extension to similar models used in the empirical growth literature (see, among others, Fischer, 1993; Chen and Feng, 2000; Anyanwu, 2014):

$$Y = f(INV, HC, POPG, GC, RER, INF, TRD) \quad (1)$$

In equation (1), *INV* represents investment (gross fixed capital formation as a share of real GDP); *HC* represents human capital; *POPG* is population growth; *GC* represents government consumption; *RER* is the real exchange rate; *INF* is the inflation rate; and *TRD* is international trade.

The accumulation of physical capital (investment) is one of the important and traditional determinants of economic growth supported by both exogenous and endogenous growth models (Solow 1956; Frankel, 1962). Though the findings are inconclusive, most of the empirical studies find a positive association between investment and growth (Dollar, 1992; Hamilton and Monteagudo, 1998; Bleaney *et al.*, 2001; Anyanwu, 2014). Thus, physical capital is expected to have a positive and statistically significant impact on economic growth.

Another traditional factor that affects economic growth is human capital development and has been supported by several endogenous growth models as well as extensions to the exogenous growth models (Romer, 1986; Lucas, 1988; Mankiw *et al.*, 1992; Islam, 1995). A large number of empirical growth studies have found evidence that an educated population is a key macroeconomic determinant of growth (Mankiw *et al.*, 1992; Barro, 1999, 2003; Radelet *et al.*, 2001). The relationship between human capital and growth is inconclusive. Some studies have found a positive relationship (Freire-Seren, 2002; Barro, 2003), while others have found an inverse relationship (Islam, 1995; Hamilton and Monteagudo, 1998). *A priori* expectation is, therefore, either a positive or negative association between human capital development and economic growth.

Population growth is another factor and has been found to affect the efficiency of savings and investment. However, empirical findings on the role of population growth are also inconclusive. In some cases, population growth has been found to be negatively associated with growth (Checherita-Westphal and Rother, 2012); while others find a positive association with growth (Sachs and Warner, 1997; Radelet *et al.*, 2001). *A priori* expectation is either a positive or negative relationship between population and economic growth.

Government expenditure (or burden) has been modelled on growth, especially by endogenous growth theorists, and has been found to exhibit threshold effects (Barro and Sala-i-Martin, 1992). A number of growth studies find public spending crowds out private investment if high taxes are imposed, ineffective public programmes are implemented, prices are regulated, or the state takes up roles that may be implemented effectively by the private sector (Knight *et al.*, 1993; Chen and Feng, 2000; Bleaney *et al.*, 2001). Others, however, find that depending on the size of the government, public spending may be positively associated with growth if fiscal policy encourages

investment (Barro, 1990; Barro and Sala-i-Martin, 1992; Anaman, 2004). *A priori* expectation, therefore, is that government consumption is expected to have either a positive or negative relationship with economic growth.

The real exchange rate is another important macroeconomic driver of growth and measures the stability of capital markets and market distortions (Dollar, 1992; Barro, 2003; Rodrik, 2008). Depending on the level of real exchange rate variability, an unstable real exchange rate has been found to be negatively associated with growth, while a stable real exchange rate regime is positively associated with growth (Vieira *et al.*, 2013). *A priori* expectation is also either a positive or negative relationship depending on level of stability.

Inflation has also been identified as an important macroeconomic determinant of growth as a measure of price stability. Fischer (1992, 1993) argued that the inflation rate is a good indicator of how the government manages the economy, while Barro (2003) suggests that it is a good measure of macroeconomic stability. Inflation, just like other efficiency factors, exhibits threshold effects depending on its level (Bruno and Easterly, 1998). High inflation rate in excess of 10% per annum has been found to be negatively associated with economic growth (Gylfason and Herbertsson, 2001; Burdekin *et al.*, 2004).

International trade is another factor included in this study and has been found to affect economic growth through the diffusion of knowledge, transfer of advanced technology, economies of scale, promotion of competition, and increasing the efficiency of capital and productivity (Knight *et al.*, 1993; Sachs and Warner, 1997). *A priori* expectation, therefore, is that trade is expected to be positively associated with economic growth.

### 3.2 Estimation Techniques

In this study, the recently developed Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration developed by Pesaran and Shin (1999) and later extended by Pesaran *et al.* (2001), is used to examine the key macroeconomic determinants of growth in South Africa expressed in equation (1). The ARDL representation of the empirical model can be expressed as follows:

$$\begin{aligned}
 \ln Y_t = & \beta_0 + \beta_1 T_t + \sum_{i=1}^n \beta_{2i} \Delta \ln Y_{t-i} + \sum_{i=0}^n \beta_{3i} \Delta \ln INV_{t-i} + \sum_{i=0}^n \beta_{4i} \Delta \ln HC_{t-i} + \sum_{i=0}^n \beta_{5i} \Delta \ln POPG_{t-i} \\
 & + \sum_{i=0}^n \beta_{6i} \Delta \ln GC_{t-i} + \sum_{i=0}^n \beta_{7i} \Delta \ln RER_{t-i} + \sum_{i=0}^n \beta_{8i} \Delta \ln INF_{t-i} + \sum_{i=0}^n \beta_{9i} \Delta \ln TRD_{t-i} \\
 & + \alpha_1 \ln Y_{t-1} + \alpha_2 \ln INV_{t-1} + \alpha_3 \ln HC_{t-1} + \alpha_4 \ln POPG_{t-1} + \alpha_5 \ln GC_{t-1} + \alpha_6 \ln RER_{t-1} \\
 & + \alpha_7 \ln INF_{t-1} + \alpha_8 \ln TRD_{t-1} + \varepsilon_t \dots \dots \dots (2)
 \end{aligned}$$

In equation (2) the parameters  $\beta_2, \dots, \beta_9$  are the short-run multipliers (elasticities) and  $\alpha_1, \dots, \alpha_8$  are the long-run multipliers (elasticities). The white noise residual term is denoted by  $\varepsilon_t$ . The specification in equation (2) allows the growth rate during the transition to the steady state to be subject to short-run business cycle fluctuations driven by shocks to the economic environment (Collier and Goderis, 2012, p. 1243).

The ARDL modelling approach has got several advantages. First, the ARDL model is a powerful tool in investigating short- and long-run cointegrating relationships and it include lags of both the dependent and explanatory variables (Pesaran and Shin, 1999). Second, the Pesaran *et al.*, (2001) bounds test can be applied irrespective of whether the study variables are integrated of order zero or one (Odhiambo, 2013). Third, the ARDL model can take up a sufficient number of lags that capture the data-generating process in a general to specific modelling framework (Hirniisa *et al.*, 2009).

Fourth, the ARDL approach provides robust results in studies affected by small sample sizes and the parameter estimates exhibit desirable small sample properties (Narayan, 2005). Finally, the two-stage ARDL approach effectively corrects for any possible endogeneity in the explanatory variables (Pesaran and Shin, 1999; Acikgoz and Mert, 2014).

As suggested by Pesaran and Shin (1997, p. 22), the Schwarz-Bayesian Criteria (SBC) lag-length selection method can be used when estimating the country-specific ARDL model based on its superiority of being consistent in model selection compared to the Akaike Information Criterion (AIC). However, the SBC tends to select simpler or under-fit models compared to AIC, which tends to over-fit ARDL specifications. Burnham and Anderson (2004) argue that the AIC has theoretical advantages over the Schwarz-Bayesian Criterion (SBC). Furthermore, Yang (2005) argues that the AIC has an asymptotic optimal selection method in selecting a model with the least mean squared error whereas the SBC is not asymptotically optimal. However, the choice of the ARDL model based on either AIC or SBC will depend on the country model.

Using equation (2), we can test the existence of a long-run level cointegration relationship between the dependent variable and the set of regressors. This involves testing the joint null hypothesis of no-level relationship (co-movement) between the dependent variable, real GDP per capita, and the regressors using the Pesaran *et al.* (2001) bounds testing procedure. To carry out the test, equation (2) is estimated using the standard OLS estimation method and test for no-level relationships between real GDP per capita and the lagged terms of the dependent variable and the explanatory variables. Once a long-run cointegrating relationship has been confirmed, stage two of the ARDL model includes the estimation of the error correction model (ECM) associated with equation (2). The ECM is, therefore, expressed as follows:

$$\begin{aligned}
\ln\Delta Y_t = & \beta_0\Delta T_t + \sum_{i=1}^n \beta_{1i}\Delta\ln Y_{t-i} + \sum_{i=0}^n \beta_{2i}\Delta\ln INV_{t-i} + \sum_{i=0}^n \beta_{3i}\Delta\ln HC_{t-i} + \sum_{i=0}^n \beta_{4i}\Delta\ln POPG_{t-i} \\
& + \sum_{i=0}^n \beta_{5i}\Delta\ln GC_{t-i} + \sum_{i=0}^n \beta_{6i}\Delta\ln RER_{t-i} + \sum_{i=0}^n \beta_{7i}\Delta\ln INF_{t-i} + \sum_{i=0}^n \beta_{8i}\Delta\ln TRD_{t-i} \\
& + \rho ECM_{t-1} + \varepsilon_t \dots \dots \dots (3)
\end{aligned}$$

In equation (3), the term, ECM, is the error correction term, which measures the short-run speed of adjustment towards the long-run equilibrium path of the estimated ARDL model (Collier and Goderis, 2012). The error correction term captures the deviations of real output from the long-run equilibrium and gradually brings the economy back to its long-run growth path. Thus, the coefficient of the error correction term is expected to be negative and statistically significant; and the magnitude of this coefficient should be less than one (Collier and Goderis, 2012).

The bounds test procedure is applied only if the variables are stationary in levels or integrated of order zero,  $I(0)$ ; or are stationary at the first difference or integrated of order one,  $I(1)$ . If the variables are integrated of a higher order, then the bounds test cannot be applied (Odhiambo, 2013). Thus, it is important to determine the order of integration by conducting stationarity or unit root tests. In this study, three unit root tests are used as follows: the Augmented Dickey-Fuller (1979) unit root test that takes into account the presence of serial correlation in the time series data; the Elliott, Rothenberg and Stock (1996) Dickey Fuller Generalized Least Squares (DF-GLS) unit root test that detrends the time series data; and the Perron (1990) innovation outlier model that investigates the presence of a structural break in the time series data.

### **3.3 Data Sources**

The data for the macroeconomic determinants investigated have been obtained from the World Bank Development Indicators (World Bank, 2015), and the UNESCO Institute of Statistics (UNESCO, 2015). The period of analysis covers annual time series data for the years 1970-2013 and has a sample size of 44 observations. The following definitions of the variables are used: real GDP per capita (expressed in 2005 constant USD prices); investment (proxied by gross fixed capital formation as a share of real GDP in 2005 constant prices); human capital (proxied by total enrolment – primary, secondary and tertiary); population growth; government consumption share in real GDP; the real exchange rate (ratio of the nominal exchange rate and PPP conversion factor for GDP); inflation rate (growth of consumer price index); and international trade (proxied by the ratio of exports and imports as a share of real GDP expressed in 2005 constant USD prices). The study used Eviews 9 to conduct unit root tests and Microfit 5.0 for the estimation of the empirical results.

## **4. Empirical Estimation Results**

### **4.1 Stationarity Tests**

Table 1 reports the stationarity test results for the time-series used in this study. A preliminary graphical analysis of the time series data used was conducted and the data-generating processes for all variables in South Africa show that they are trend stationary, except for the trade variable. All unit root tests equations, therefore, include both an intercept and trend, except for the trade variable where only an intercept term is included. The unit root test results suggest that real GDP per capita, investment, and the real exchange rate are integrated of order one regardless of the unit root test used, while inflation and trade variables are integrated of order zero.

**Table 1: Stationarity Tests for all Variables**

Variable	Stationarity of all Variables in Levels						Stationarity of all Variables in 1 <sup>st</sup> Difference					
	ADF		DFGLS		Perron		ADF		DFGLS		Perron	
	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend
<i>Log(GDPPC)</i>		-1.12		-1.38		-3.57		-4.34***		-4.28***		-5.17***
<i>Log(INV)</i>		-1.95		-2.05		-4.34		-6.61***		-6.25***		-7.05***
<i>Log(HC)</i>		-0.77		-0.96		-6.77***		-5.61***		-5.65***		
<i>Log(POPG)</i>		-2.19		-1.98		-6.19***		-4.51***		-4.55***		
<i>Log(GC)</i>		-2.21		-2.13		-5.56**		-5.95***		-5.18***		
<i>Log(RER)</i>		-2.89		-2.83		-4.16		-5.70***		-5.73***		-6.64***
<i>Log(INF)</i>		-3.94**		-3.10*		-4.94*				-8.70***		-12.55***
<i>Log(TRD)</i>	-2.76*		-2.10**		-3.45		-6.37***				-7.74***	

Note: for all p-values: \*\*\* 1% significance level; \*\* 5% significance level; \* 10% significance level.

The results also show that human capital, population growth and government consumption are integrated of order one when the ADF and DFGLS tests are employed; and integrated of order zero when the Perron test is used. The unit root test results show that all variables are either integrated of order one or zero in South Africa. Therefore, the bounds testing procedure for cointegrating relationships suggested by Pesaran *et al.* (2001) can be employed.

#### 4.2 ARDL Bounds Test for Cointegration

In this section, the Schwarz-Bayesian Criteria is employed to determine the appropriate lag-length for the estimated an ARDL equation. The optimal lag length is chosen based on the number of regressors included in the growth model. For the South African growth equation, the growth equation is specified as  $ARDL(1, 0, 0, 0, 0, 0, 1, 1)$  model with an adjusted R-squared of 0.9703. Table 2 report the Pesaran *et al.* (2001) bounds test for level relationships for the South Africa growth equation.

**Table 2: ARDL Bounds Test Results**

Dependent Variable	Function		Value (F-statistic)	Cointegration Status	
Real GDP per capita	(GDPPC   INV, HC, POPG, GC, RER, INF, TRD)		5.67***	Cointegrated	
<b>Null Hypothesis: No long-run relationships exist</b>					
<b>Asymptotic Critical Values for <math>k = 7</math> (Pesaran <i>et al.</i>, 2001; Case I, p. 300)</b>					
1%		5%		10%	
$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
2.45	3.79	1.91	3.11	1.66	2.79

Note: \*\*\* 1% significance level; \*\* 5% significance level; \* 10% significance level.

The computed statistic for the bounds test is based on Case I: no intercept and no trend as the included deterministic components. The computed  $F$  – statistic is 5.67 and is statistically significant at the 1% upper critical bound. In summary, the bounds test to cointegrating

relationships using the Pesaran *et al.* (2001) approach confirms the existence of long-run level relationships between the dependent variable, real GDP per capita, and the set of covariates studied in South Africa.

### 4.3 Empirical Analysis of ARDL-based Error Correction Model

Table 3 below presents the short- and long-run multipliers for the growth equation in South Africa.

**Table 3: Estimated Results (Short- and Long-run Coefficients)**

<b>South Africa: Panel 1 – Estimated Long-Run Coefficients (Elasticities) [Dependent Variable: Log of Real GDP per capita <math>\log(GDPPC)_t</math>]</b>				
<b>Regressor</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>t-statistic</b>	<b>Probability</b>
$\log(INV)_t$	1.0413***	0.38	2.77	0.009
$\log(HC)_t$	0.3622***	0.12	3.06	0.004
$\log(POPG)_t$	-0.4372*	0.24	-1.79	0.082
$\log(GC)_t$	-0.8754**	0.41	-2.12	0.042
$\log(RER)_t$	0.1114	0.20	0.55	0.586
$\log(INF)_t$	-0.4216*	0.21	-1.97	0.058
$\log(TRD)_t$	1.3527**	0.55	2.48	0.019
<b>South Africa: Panel 2 – Estimated Short-Run Coefficients (Elasticities) [Dependent Variable: change in log of Real GDP per capita <math>\Delta\log(GDPPC)_t</math>]</b>				
<b>Regressor</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>t-statistic</b>	<b>Probability</b>
$\Delta\log(INV)_t$	0.0684**	0.03	2.26	0.030
$\Delta\log(HC)_t$	0.0238	0.02	1.59	0.122
$\Delta\log(POPG)_t$	-0.0287*	0.01	-2.02	0.051
$\Delta\log(GC)_t$	-0.0575**	0.03	-2.27	0.030
$\Delta\log(RER)_t$	0.0073	0.01	0.55	0.583
$\Delta\log(INF)_t$	-0.0071	0.01	-1.25	0.219
$\Delta\log(TRD)_t$	-0.0371	0.04	-1.06	0.297
$ECM_{t-1}$	-0.0657**	0.02	-2.65	0.012
R-Squared	0.7559	R-Bar Squared	0.6873	
S.E. of Regression	0.1323	F-Stat (7,34)	14.16[0.000]	
Residual Sum of Squares	0.0056	DW-statistic	2.07	
Akaike Info. Criterion	-117.77	Schwarz-Bayesian Criterion	-109.08	

Note: \*\*\* 1% significance level; \*\* 5% significance level; \* 10% significance level.

Panel 1 of Table 3 reports the long-run coefficients; while Panel 2 reports the short-run coefficients of the estimated growth equation. The short-run results in Panel 2 show that the equilibrium error correction coefficient is estimated as -0.07% and statistically significant at the 5% significance level. The ECM value is within the 0 to -1 range and implies that the real GDP per capita in South Africa converges monotonically towards its long-run equilibrium path. This confirms the long-run equilibrium relationship between real GDP per capita and the regressors. The regression results for the underlying ARDL model reveals a good fit represented by an  $R$  –squared value of 0.76 and an adjusted  $R$  –squared value of 0.69.

Panel 1 of table 3 present the long-run coefficient estimates for the South Africa growth equation. The results show that the key macroeconomic determinants that revealed a significant relationship with long-run economic growth include the accumulation of physical capital (investment), human capital development, population growth, government consumption, inflation, and international trade. The results reveal that the level of investment is positive and significantly associated with the long-run level of real GDP per capita; and the results are statistically significant at the 1% significance level. The results show that a 1% increase in the level of investment leads to a 1.04% increase in the level of real GDP per capita in the long run. These results are consistent with empirical findings in the economic growth literature, where investment is positively associated with economic growth in the long run (Acikgoz and Mert, 2005).

Human capital development, reveals a positive and statistically significant association with the long-run level of real GDP per capita at the 1% significance level. The results reveal that a 1% increase in human capital development leads to a 0.36% decrease in the level of real GDP per

capita in the long-run. These results are supported by both theoretical and empirical underpinnings where education increases economic growth (see, among others, Fischer, 1992; Chen and Feng, 2000; Anyanwu, 2014). The results have also revealed that population growth is negatively and significantly associated with the long-run level of real GDP per capita; and the results are statistically significant at the 10% significance level. The results show that a 1% increase in the growth of population leads to a -0.44% decrease in the level of real GDP per capita in the long-run. These results are consistent with empirical growth studies that found a negative association between population growth and economic growth in developing countries (see, among others, Most and Vann de Berg, 1996; Checherita-Westphal and Rother, 2012; Anyanwu, 2014).

The study has also found that government consumption is negatively associated with the long-run level of real GDP per capita; and the results are statistically significant at the 5% significance level. The results show that a 1% increase in government consumption leads to a -0.88% decrease in the level of real GDP per capita in the long-run. These results are also consistent with empirical growth results where government consumption is a burden to economic growth (see, among others, Barro, 1999, 2003; Bhaskara-Rao and Hassan, 2011).

The results also reveal that inflation is negatively and significantly associated with the long-run level of real GDP per capita at the 10% significance level. The results reveal that a 1% increase in the inflation rate leads to a -0.42% decline in the level of real GDP per capita in the long run. These results are consistent with empirical growth studies that also found a negative association between inflation and economic growth in developing countries (see, Fischer, 1992; Burnside

and Dollar, 2000; Chen and Feng, 2000; Bhaskara-Rao and Hassan, 2011; Anyanwu, 2014, among others).

Finally, international trade plays a significant role in the South African economy as the results reveal a positive and significant association; and is statistically significant at the 5% significance level. The results show that a 1% increase in international trade leads to a 1.35% increase of the long-run level of real GDP per capita. These results are also consistent with the growth literature where trade is found to be positively associated with economic growth especially in developing countries (see, among others, Burnside and Dollar, 2000; Chen and Feng, 2000; Radelet *et al.*, 2001; Chang and Mendy, 2012).

The study results did not find any significant association between the depreciation of the local currency and the long-run level of real GDP per capita in the long-run.

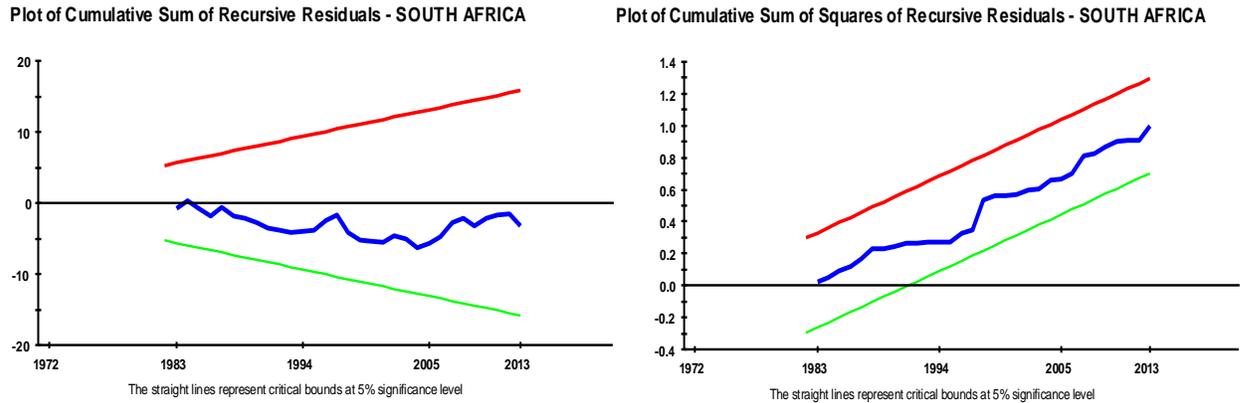
The short-run results in Panel 2 of Table 3 reveal that the key macroeconomic determinants that were significantly associated with the growth of real GDP per capita include investment, population growth, and government consumption. The results show that growth of investment in the current period is positively and significantly associated with the growth of real GDP per capita at the 5% significance level. The results show that a 1% increase in the growth of the investment in the current period led to a 0.07% increase in the growth of real GDP per capita. These results are consistent with the findings in the empirical growth literature that found a positive association between investment and economic growth in developing countries (Freire-Seren, 2002).

The study results also reveal that population growth is negatively and significantly associated with real GDP growth in the short-run; and the results are statistically significant at the 10% significance level. The results show that a 1% increase in population growth leads to a -0.03% decrease in the growth of real GDP per capita in the short-run. These results are consistent with the empirical growth literature where population growth has been found to be negatively associated with economic growth in developing countries (see, among others, Most and Vann de Berg, 1996; Anyanwu, 2014). The growth of government consumption was also found to be negative and significantly associated with economic growth in the short-run; and the results are statistically significant at the 5% significance level. The results show that a 1% increase in the growth of government consumption led to a -0.06% decline in the growth of real GDP per capita in the short-run. These results are consistent with the empirical growth literature that found a negative relationship between government consumption and economic growth (see, among others, Barro, 1999, 2003; Bhaskara-Rao and Hassan, 2011).

The study did not find any significant association between human capital development, depreciation of the local currency, inflation, and international trade on real GDP per capita growth in the short-run.

Lastly, the following post-diagnostic tests are reported – CUSUM and CUSUMSQ test; Breusch-Godfrey serial correlation test; Breusch-Pagan-Godfrey test for heteroskedasticity; Ramsey RESET test; Normality test; and ARCH test. Figure 1 illustrates the CUSUM and CUSUMSQ test results for the estimated growth equation in South Africa.

**Figure 1: CUSUM and CUSUMQ Tests**



As illustrated in Figure 1, the cumulative sum of recursive residuals as well as the squares of the recursive residuals are within the 5% critical lines and the results are suggestive of parameter and variance stability. Table 4 reports post-estimation diagnostic results for the South African growth equation.

**Table 4: ARDL-VECM Post-Estimation Diagnostic Tests**

Test Statistic	Results
Breusch-Godfrey Test: No Serial Correlation F(1,31)	0.18 [0.672]
Breusch-Pagan-Godfrey Test: No Heteroskedasticity F(1,40)	0.02 [0.882]
Ramsey RESET Test: Functional Form F(1,31)	0.00 [0.949]
Normality: CHSQ (2)	0.90 [0.636]
ARCH Test: Heteroskedasticity (no ARCH terms) F(1,31)	0.11 [0.743]

*Note: for all p-values: \*\*\* 1% significance level; \*\* 5% significance level; \* 10% significance level.*

The results reveal that we cannot reject the null hypotheses for all post-diagnostic tests at the 5% significance level. This implies that the final ARDL model for the South African growth equation is correctly specified and the parameter estimates are not biased.

## 5. Conclusion

In this paper, we have empirically examined the key macroeconomic determinants of the real sector growth in South Africa during the period 1970-2013. These include the accumulation of physical capital, human capital development, population growth, real exchange rate depreciation, inflation rate, and international trade. The study has employed the recently developed Autoregressive Distributed Lag (ARDL) modelling approach to estimate both the short- and long-run elasticities of the selected macroeconomic determinants. Using the ARDL bounds testing approach to co-integrating relationships, the study results reveal that the key macroeconomic determinants that have a significant relationship with economic growth include investment, human capital development, population growth, government consumption, inflation, and international trade. The results show that in the short run, investment was positively associated with economic growth; while population growth and government consumption revealed a significant negative association with economic growth. In the long run, the results reveal that real per capita GDP is positively and significantly associated with the accumulation of physical capital, human capital development, and international trade; and negatively and significantly associated with population growth, government consumption, and inflation. These results have important policy implications both in the short and in the long run. In the short run, it is recommended that economic strategies that would attract the accumulation of physical capital, reduce population growth and government consumption share in real GDP should be adopted. In the medium to long term, it is recommended that policy makers should focus on implementing long-term strategies that aim at attracting the accumulation of physical capital, with a focus on advanced labour-intensive technologies; the promotion of high quality education;

creating a conducive environment for international trade; and reducing population growth, government consumption, as well as inflation.

## References

- Acikgoz, S., and M. Mert. 2014. "Sources of Growth Revisited: The importance of the nature of technological progress." *Journal of Applied Economics*, Vol. 17, No. 1, pp. 31-62.
- Anaman, K. A. 2004. "Determinants of Economic Growth in Brunei Darussalam." *Journal of Asian Economics*, Vol. 15, No. 4, pp. 777-796.
- Anyanwu, J. C. 2014. "Factors Affecting Economic Growth in Africa: Are there any lessons from China?" *African Development Review*, Vol. 26, No. 3, pp. 468-493.
- Banerjee, A., S. Galiani, J. Levinsohn, Z. McLaren and I. Woolard. 2007. "Why Has Unemployment Risen in the New South Africa?" *NBER Working Paper Series 13167*, June. Retrieved from [www.nber.org/papers/w13167.pdf](http://www.nber.org/papers/w13167.pdf).
- Barro, R. J. 1990. "Government Spending in a Simple Model of Endogenous Growth." *Journal of Political Economy*, Vol. 98, No. 5, pp. S103-S125.
- Barro, R. J. 1999. "Determinants of Economic Growth: Implications of the Global Evidence for Chile." *Cuadernos de Economía*, Vol. 36, No. 107, pp. 443-478.
- Barro, R. J. 2003. "Determinants of Economic Growth in a Panel of Countries." *Annals of Economics and Finance*, Vol. 4, No. 2, pp. 231-274.
- Barro, R. J., and X. Sala-i-Martin. 1992. "Public Finance in Models of Economic Growth." *The Review of Economic Studies*, Vol. 59, No. 4 pp. 645-661.
- Barro, R. J. and X. Sala-i-Martin. 2004. *Economic Growth*. New York. McGraw-Hill.
- Bayoumi, T. 1990. "Output, Employment and Financial Sanctions in South Africa." *IMF Working Paper WP/90/113*, European Department.
- Bhaskara-Rao, R., and G. Hassan. 2011. "Determinants of the Long-Run Growth Rate of Bangladesh." *Applied Economics Letters*, Vol. 18, No. 7, pp. 655-658.

- Bleaney, M., N. Gemmell and R. Kneller. 2001. "Testing the Endogenous Growth Model: Public expenditure, taxation, and growth over the long-run." *Canadian Journal of Economics*, Vol. 34, No. 1, pp. 36-57.
- Bruno, M., and W. Easterly. 1998. "Inflation Crises and Long-Run Growth." *Journal of Monetary Economics*, Vol. 41, No. 1, pp. 3-26.
- Burdekin, R.C.K., A.T. Denzau, M.W. Keil, T. Sitthiyot and T.D. Willett. 2004. "When does Inflation hurt Economic Growth? Different Nonlinearities for Different Economies". *Journal of Macroeconomics*, Vol. 26, No. 3, pp. 519-532.
- Burnham, K. P., and D. R. Anderson. 2004. "Multimodel Inference: Understanding the AIC and BIC in model selection." *Sociological Methods and Research*, Vol. 33, No. 2, pp 261-304.
- Checherita-Westphal, C., and P. Rother. 2012. "The Impact of High Government Debt on Economic Growth and its Channels: An empirical investigation for the Euro area." *European Economic Review*, Vol. 56, No. 7, pp. 1392-1405.
- Chen, B. and Y. Feng. 2000. "Determinants of Economic Growth in China: Private enterprise, education, and openness." *China Economic Review*, Vol. 11, No. 1, pp. 1-15.
- Collier, P., and B. Goderis. 2012. "Commodity Prices and Growth: An empirical investigation." *European Economic Review*, Vol. 56, No. 6, pp. 1241-1260.
- Department of Finance. 1996. *Growth, Employment and Redistribution. A Macroeconomic Strategy*. Pretoria: Republic of South Africa. Retrieved from <http://www.treasury.gov.za/publications/other/gear/chapters.pdf>.
- Dickey, D. A., and W. A. Fuller. 1979. "Distribution of the Estimators for Autoregressive Time Series with a Unit Root." *Journal of the American Statistical Association*, Vol. 74, No. 366, pp. 427-431.
- Dollar, D. 1992. "Outward-Oriented Developing Economies Really do Grow more rapidly: Evidence form 95 LDCs, 1976-1985." *Economic Development and Cultural Change*, Vol. 40, No. 3, pp. 523-544.

- Easterly, W. R., and D. L. Wetzel. 1989. "Policy Determinants of Growth: Survey of theory and evidence." *Policy, Planning and Research Working Papers Series No. 343*, Washington D. C., World Bank, pp. 1-41.
- Easterly, W. R., and R. Levine. 1997. "Africa's Growth Tragedy: Policies and ethnic divisions." *The Quarterly Journal of Economics*, Vol. 112, No. 4, pp. 1203-1250.
- Elliott, G., T. J. Rothenberg, and J. H. Stock. 1996. "Efficient Tests for an Autoregressive Unit Root." *Econometrica*, Vol. 64, No. 4, pp. 813-836.
- Frankel, M. 1962. "The Production Function in Allocation and Growth: A synthesis." *The American Economic Review*, Vol. 52, No. 5, pp. 996-1022.
- Fedderke, J. W. 2005. "South Africa: Sources and constraints of long-term growth 1970-2000." Working Paper Series No. 94, Africa Region. Retrieved from [www.worldbank.org/afr/wps/wp94.pdf](http://www.worldbank.org/afr/wps/wp94.pdf).
- Fischer, S. 1992. "Macroeconomic Stability and Growth." *Cuadernos de Economía*, Vol. 29, No. 87, pp. 171-186.
- Fischer, S. 1993. "The Role of Macroeconomic Factors in Growth." *Journal of Monetary Economics*, Vol. 32, No. 3, pp. 485-512.
- Freire-Seren, M. J. 2002. "On the Relationship between Human Capital Accumulation and Economic Growth." *Applied Economic Letters*, Vol. 9, No. 12, pp. 805-808.
- Gylfason, T. and T.T. Herbertsson. 2001. "Does Inflation matter for Growth?" *Japan and the World Economy*, Vol. 13, No. 4, pp. 405-428.
- Hamilton, J. D. and J. Monteagudo. 1998. "The Augmented Solow Model and the Productivity Slowdown." *Journal of Monetary Economics*, Vol. 42, No. 3, pp. 495-509.
- Hirnissa, M., M. Habibullah and A. Baharom. 2009. "Military Expenditure and Economic Growth in 5 Asian Countries". *Journal of Sustainable Development*, Vol. 2, No. 2, pp. 192-202.

- Islam, N. 1995. "Growth Empirics: A panel data approach". *The Quarterly Journal of Economics*, Vol. 110, No. 4, pp. 1127–1170.
- Kearney, M. and A. Odusola. 2011. *Assessing Development Strategies to achieve the MDGs in the Republic of South Africa*. United Nations Department for Social and Economic Affairs, March.
- Knight, M., N. Loayza and D. Villanueva. 1993. "Testing the Neoclassical Theory of Economic Growth: A panel data approach." *Staff Papers (International Monetary Fund)*, Vol. 40, No. 3, pp. 512-541.
- Kreutz, J. 2005. *Hard Measures by a Soft Power? Sanctions Policy of the European Union 1981-2004*. Bonn: Bonn International Centre for Conversion. Retrieved from [www.bicc.de](http://www.bicc.de).
- Levy, P. I. 1999. "Sanctions on South Africa: What Did They Do?" *Center Discussion Paper No. 796*, Connecticut: Yale University. Retrieved from [http://www.econ.yale.edu/growth\\_pdf/cdp796.pdf](http://www.econ.yale.edu/growth_pdf/cdp796.pdf).
- Lowenberg, A. D. 1989. "An Economic Theory of Apartheid." *Economic Inquiry*, Vol. 27, No. 1, pp. 57-74.
- Lowenberg, A. D. 1997. "Why South Africa's Apartheid Economy Failed." *Contemporary Economic Policy*, Vol. 15, No. 3, pp. 62-72.
- Lucas, R.E. Jr. 1988. "On the Mechanics of Economic Development". *Journal of Monetary Economics*, Vol. 22, pp. 3-42.
- Mankiw, N. G., D. Romer, and D. N. Weil. 1992. "A Contribution to the Empirics of Economic Growth". *The Quarterly Journal of Economics*, Vol. 107, No. 2, pp. 407–437.
- McMillan, S. M. 1992. "Economic Growth and Military Spending in South Africa." *International Interactions*, Vol. 18, No. 1, pp. 35-50.
- Most, S. J., and H. Vann de Berg. 1996. "Growth in Africa: Does the source of investment financing matter?" *Applied Economics*, Vol. 28, No. 11, pp. 1427-1433.
- Narayan, P. K. 2005. "The Savings and Investment Nexus from China: Evidence from cointegration tests." *Applied Economics*, Vol. 37, No. 17, pp. 1979-1990.

- National Planning Commission. 2012. *National Development Plan 2030: Our future – make it work*. Department: The Presidency, Sherino Printers.
- Odhiambo, N.M. 2013. “Financial systems and economic growth in South Africa: A dynamic complementarity test.” *International Review of Applied Economics*, Vol. 28, No. 1, pp. 83-101.
- Perron, P. 1990. “Testing for a Unit-root in a Time Series with a Changing Mean.” *Journal of Business and Economic Statistics*, Vol. 8, No. 2, pp. 153-162.
- Pesaran, M. and Y. Shin. 1999. “An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis” Chapter 11 in *Econometrics and Economic Theory in the 20<sup>th</sup> Century: The Ragnar Frisch centennial symposium*, S. Strom (ed.). Cambridge University Press: Cambridge.
- Pesaran, M. H., Y. Shin and R. J. Smith. 2001. “Bounds Testing Approaches to the Analysis of Level Relationships”. *Journal of Applied Econometrics*, Vol. 16, No. 3, pp. 289-326.
- Radelet, S., J. Sachs, and J. Lee. 2001. “The Determinants and Prospects of Economic Growth in Asia.” *International Economic Journal*, Vol. 15, No. 3, pp. 1-29.
- Republic of South Africa. 1994. *The Reconstruction and Development Programme*. Pretoria: The Presidency of South Africa. Retrieved from [www.info.gov.za](http://www.info.gov.za).
- Republic of South Africa. 1996. *Growth, Employment and Redistribution. A Macroeconomic Strategy*. Pretoria: Department of Finance. Retrieved from <http://www.treasury.gov.za/publications/other/gear/chapters.pdf>
- Rodrik, D. 2008. “The Real Exchange Rate and Economic Growth”. *Brookings Papers on Economic Activity*. Brookings Institute Press.
- Romer, P.M. 1986. “Increasing Returns and Long-Run Growth”. *Journal of Political Economy*, Vol. 94, No. 5, pp. 1002-1037.
- Sachs, J. D., and A. M. Warner. 1997. “Fundamental Sources of Long-Run Growth.” *The American Economic Review*, Vol. 87, No. 2, pp. 184-188.

- Solow, R. M. 1956. A Contribution to the Theory of Economic Growth.” *Quarterly Journal of Economics*, Vol. 70, No. 1, pp. 65–94.
- The Presidency of South Africa. 2010. *The New Growth Path*. Pretoria: Republic of South Africa. Retrieved from [www.info.gov.za](http://www.info.gov.za).
- UNESCO Institute of Statistics, Education (full dataset), retrieved from [http://data.uis.unesco.org/Index.aspx?DataSetCode=EDULIT\\_DS&lang=en#](http://data.uis.unesco.org/Index.aspx?DataSetCode=EDULIT_DS&lang=en#) on May 05, 2015.
- Vieira, F.V., M. Holland, C. G. da Silva, and L. C. Bottecchia. 2013. “Growth and Exchange Rate Volatility: A panel data analysis.” *Applied Economics*, Vol. 45, No. 26, pp. 3733–3741.
- World Bank. 1990. *Adjustment Lending Policies for Sustainable Growth*. Policy and Research Series, Washington D. C., World Bank.
- World Bank. 2015. *World Development Indicators 2015*. Retrieved from [www.worldbank.org](http://www.worldbank.org) on May 5, 2015.
- Yang, Y. 2005. “Can the Strengths of AIC and BIC be shared? A conflict between model identification and regression estimation.” *Biometrika*, Vol. 92, No. 4, pp. 937-950.