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SOURCES OF ECONOMIC GROWTH IN ZAMBIA: AN EMPIRICAL INVESTIGATION

Themba Gilbert Chirwa[1] and Nicholas M. Odhiambo

Abstract

In this paper, the key macroeconomic determinants of economic growth in Zambia are investigated using the recently developed ARDL bounds-testing approach. The study has been motivated by the unsustainable growth trends that Zambia has been experiencing in recent years. Our study finds that the key macroeconomic determinants that are significantly associated with economic growth in Zambia include, amongst others, investment, human capital development, government consumption, international trade and foreign aid. The study's results reveal that in the short run, investment and human capital development are positively associated with economic growth, while government consumption, international trade and foreign aid are negatively associated with economic growth. However, in the long run, the study finds investment and human capital development to be positively associated with economic growth, while only foreign aid is negatively associated with economic growth. These results have significant policy implications. They imply that short-run economic policies should focus on creating incentives that attract investment and increase the quality of education, the effectiveness of government institutions, the promotion of international trade and the effectiveness of development aid. In the long run, development strategies should focus on attracting the accumulation of long-term investment, improving the quality of education and the effectiveness of development aid.

Keywords: Zambia; Autoregressive Distributed Lag Models; Economic Growth

JEL Classification Code: N17, F43, O47, O55

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1. Introduction

The achievement of high and sustainable rates of economic growth is a central theme in many economies in the world. One of the significant facts arising from empirical growth studies is that economic growth rates vary a great deal from country to country and over long periods of time (Mankiw *et al*., 1995). Different schools of thought on the factors that drive economic growth have emerged focusing on differences in the accumulation of physical and human capital (Solow, 1956; Mankiw *et al*., 1992); the adoption of technology (Romer, 1986; Lucas, 1988; Grossman and Helpman, 1991; Aghion and Howitt, 1992); and differences in factors that affect the efficiency of savings and investment (Easterly and Wetzel, 1989; World Bank, 1990).

The challenge that many policy makers face, particularly in individual countries, is the lack of country-specific empirical evidence that could guide their policy choices. Many empirical studies that are available are based on pooled data rather than country-specific analysis. As noted by Anyanwu (2014), the empirical evidence of most studies on Africa is based on the inclusion of an African dummy variable that provides evidence on the slow growth in Africa, compared to that in other regions. Although such empirical-growth studies are good for policy-making at the regional or global level, they may not be equally relevant at the country-specific level. In this study, therefore, we empirically investigate the key macroeconomic determinants of economic growth in Zambia during the period 1970-2013, using the recently developed Autoregressive Distributed Lag (ARDL) bounds-testing approach to cointegration, as developed by Pesaran *et al*. (2001).

In the 1960s, the Zambian economy was characterised as a dual economy that was highly capital intensive mainly driven by the mining and agricultural sectors. However, the dual economy could not absorb the needed employment that the economy desperately needed to improve the distribution

of wealth among Zambians. Smallholder agriculture, which was expected to be the solution, was underdeveloped due to the agricultural policies that the colonial Government had introduced to promote commercial agriculture. The major problems that the Government of Zambia faced at independence, therefore, revolved around the shortage of manpower and a segregated education system that did not favour the provision of high quality education to the local populace (Auty, 1991; Andersson *et al.*, 2000).

Since independence, Zambia has heavily relied on copper mining; and this has been the bedrock of the economy. However, the mining sector has gone through mineral booms and recessions because of fluctuations in the international copper prices, rendering the Zambian economy susceptible to external shocks. Furthermore, other equally important sectors, such as agriculture and manufacturing, have not been developed to their full potential; and these sectors become affected whenever there is a mineral recession (Auty, 1991, Chirwa and Odhiambo, 2015). In order to circumvent these problems, the Zambian authorities implemented a number of medium-term national development plans, and these were supported by reforms in the form of short-term or transitional national development plans. During the implementation of these plans, some of the key macroeconomic drivers that were identified to affect economic growth included, among others, the accumulation of physical capital, human capital development, international trade, real exchange rate, inflation, and fiscal policy (Chirwa and Odhiambo, 2015).

In 2006, the Zambian authorities developed a long-term development strategy that aimed to transform Zambia from a low-income to a middle-income economy by the year 2030. For Zambia to achieve this goal, the economy was expected to grow at an average rate of 6% p.a. during 2006-2010; 8% p.a. during 2011-2015; 9% p.a. during 2016-2020; and 10% p.a. during 2021-2030

(Republic of Zambia, 2006). The success of the Vision 2030 development strategy could be well on track. The performance recorded by the medium-term strategies implemented after 2006 recorded considerable success. The economy grew at an average rate of 8.7% p.a. during the period of the Fifth National Development Plan (2006-2010) and at an average of 6.4% p.a. during the first four years of the Sixth National Development Plan (2011-2015). Overall, the Zambian economy has grown at an average rate of 7.7% p.a. during the period 2006-2014, which is in excess of the average growth rate forecast in the Vision 2030 strategy of an average of 7% p.a. for the period 2006-2015 (World Bank, 2015). However, in order to sustain such high growth rates, it is important for the Zambian authorities to understand the key macroeconomic determinants that have driven the Zambian economy, as well as those that hinder growth.

The rest of this paper is organized as follows: Section 2 highlights the empirical linkages between the selected key macroeconomic determinants and economic growth and discusses the empirical-model specification and estimation techniques. Section 3 presents the empirical analysis of the regression results. Lastly, section 4 discusses some policy implications and concludes the study.

2. Estimation Techniques and Empirical Analysis

2.1 Empirical Model Specification

The key macroeconomic determinants of economic growth in Zambia during the period 1970-2013 are investigated using a multivariate framework for determining growth (see, among others, Fischer, 1993; Chen and Feng, 2000; Anyanwu, 2014). The empirical equation is presented as follows:

$$Y = f\left(INV, HC, POPG, GC, RER, INF, TRD, AID\right) \qquad (1)$$

In equation (1), the variables of interest include investment (INV), human capital development (HC), population growth ($POPG$), government consumption as a share of real GDP (GC), real exchange rate depreciation (RER), inflation (INF), international trade (TRD), and foreign aid (AID).

Investment is one of the fundamental and traditional determinants of economic growth supported by both exogenous and endogenous growth models. However, the findings are inconclusive as some studies find a positive association between investment and growth (Dollar, 1992; Hamilton and Monteagudo, 1998; Bleaney *et al*., 2001; Anyanwu, 2014), while others have found a negative relationship (Most and Vann de Berg, 1996; Chang and Mendy, 2012).

The second important traditional determinant recommended by many empirical growth studies is human capital but the findings have also been inconclusive. Depending on the proxy used, human capital can either be positively associated with growth (Freire-Seren, 2002; Barro, 2003) or negatively associated with growth (Hamilton and Monteagudo, 1998).

The third traditional determinant of growth used by exogenous growth models is population growth, which is assumed to affect the efficiency of savings and investment. Just like investment and human capital, the findings are inconclusive. Some studies find a negative association (Checherita-Westphal and Rother, 2012), while others find a positive association (Sachs and Warner, 1997; Radelet *et al*., 2001). Another important factor that affects economic growth is Government expenditure (Barro, 1990; Barro and Sala-i-Martin, 1992).

Government spending has been found to crowd out private investment through high taxes, inefficient state programs, and controlled prices (Knight *et al*., 1993; Chen and Feng, 2000; Bleaney

et al., 2001). In other cases, government spending may be positively associated with growth if fiscal policy encourages investment (Barro, 1990; Barro and Sala-i-Martin, 1992; Anaman, 2004).

The real exchange rate is another important macroeconomic driver of growth, especially for countries that depend on international trade. The real exchange rate is regarded as a good indicator that measures the stability of capital markets (Dollar, 1992; Barro, 2003; Rodrik, 2008). Depending on the stability, an unstable real exchange rate can be negatively associated with growth, while a stable real exchange rate regime is positively associated with growth (Vieira *et al*., 2013).

Similarly, the inflation rate is an important macroeconomic determinant of growth and measures price stability. The level of the inflation rate, which represents macroeconomic stability, is a good indicator of how the government manages the economy (Fischer, 1992, 1993; Barro, 2003). However, the results are also inconclusive as inflation, just like other efficiency factors, exhibit threshold effects (Bruno and Easterly, 1998; Gylfason and Herbertsson, 2001; Burdekin *et al*., 2004).

In this study we also consider the impact of foreign aid on economic growth. Since independence, the Zambian government has benefitted from foreign assistance averaging 12.7% p.a. of real GDP during the period 1960-2013. Foreign aid has been found to supplement domestic savings in countries with a low savings rate (Chenery and Strout, 1966; Riddell, 1987). The empirical findings have also been inconclusive where in some cases foreign aid is positively associated with growth (Burnside and Dollar, 2000), while in some cases it has been found to be negatively associated with growth (Chang and Mendy, 2012; Anyanwu, 2014).

2.2   Estimation Techniques

The study employs the Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration developed by Pesaran and Shin (1999) and later extended by Pesaran *et al*. (2001) to examine the key macroeconomic determinants of growth in Zambia. The two-stage ARDL modelling framework has five distinct advantages. First, the two-stage ARDL approach effectively corrects for any possible endogeneity in the explanatory variables (Pesaran and Shin, 1999; Acikgoz and Mert, 2014). Second, the ARDL approach provides robust results in studies affected by small sample sizes where the parameter estimates have desirable small sample properties (Narayan, 2005). Third, the ARDL model can take up a sufficient number of lags that captures the data generating process in a general-to-specific modelling framework (Hirnissa *et al.*, 2009; Collier and Goderis, 2012). Fourth, the bounds test based on the unrestricted error correction model is applied, even when the study variables are integrated of order zero or one. Lastly, the ARDL model includes lags of both the dependent and explanatory variables and it is a powerful tool in investigating short- and long-run cointegrating relationships between variables of interest (Pesaran and Shin, 1999; Collier and Goderis, 2012).

The ARDL representation of the empirical model (equation 1) can be expressed as follows:

$$lnY_t = \beta_0 + \beta_1 T_t + \sum_{i=1}^{n} \beta_{2i} \Delta lnY_{t-i} + \sum_{i=0}^{n} \beta_{3i} \Delta lnINV_{t-i} + \sum_{i=0}^{n} \beta_{4i} \Delta lnHC_{t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta lnPOPG_{t-i}$$

$$+ \sum_{i=0}^{n} \beta_{6i} \Delta lnGC_{t-i} + \sum_{i=0}^{n} \beta_{7i} \Delta lnRER_{t-i} + \sum_{i=0}^{n} \beta_{8i} \Delta lnINF_{t-i} + \sum_{i=0}^{n} \beta_{9i} \Delta lnTRD_{t-i}$$

$$+ \sum_{i=0}^{n} \beta_{10i} \Delta lnAID_{t-i} + \alpha_1 lnY_{t-1} + \alpha_2 lnINV_{t-1} + \alpha_3 lnHC_{t-1} + \alpha_4 lnPOPG_{t-1}$$

$$+ \alpha_5 lnGC_{t-1} + \alpha_6 lnRER_{t-1} + \alpha_7 lnINF_{t-1} + \alpha_8 lnTRD_{t-1} + \alpha_9 lnAID_{t-1}$$

$$+ \varepsilon_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (2)$$

In equation (2) the short-run multipliers (elasticities) are the $\beta_2, \dots, \beta_{10}$ parameters, while the long-run multipliers (elasticities) are $\alpha_1, \dots, \alpha_9$. The white noise residual term is denoted by ε_t. Equation (2) is estimated using Ordinary Least Squares (OLS) to test the existence of a long-run equilibrium relationship between the dependent variable and its regressors. The second stage of the ARDL estimation involves estimating the error correction model associated with equation (2), which is expressed as follows:

$$ln\Delta Y_t = \beta_0 \Delta T_t + \sum_{i=1}^{n} \beta_{4i} \Delta lnY_{t-i} + \sum_{i=0}^{n} \beta_{5i} \Delta lnINV_{t-i} + \sum_{i=0}^{n} \beta_{6i} \Delta lnHC_{t-i} + \sum_{i=0}^{n} \beta_{7i} \Delta lnPOPG_{t-i}$$

$$+ \sum_{i=0}^{n} \beta_{8i} \Delta lnGC_{t-i} + \sum_{i=0}^{n} \beta_{9i} \Delta lnRER_{t-i} + \sum_{i=0}^{n} \beta_{10i} \Delta lnINF_{t-i} + \sum_{i=0}^{n} \beta_{10i} \Delta lnTRD_{t-i}$$

$$+ \sum_{i=0}^{n} \beta_{10i} \Delta lnAID_{t-i} + \rho ECM_{t-1} + \varepsilon_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (3)$$

In equation (3), the error correction term (ECM) measures the short-run speed of adjustment towards the long-run equilibrium path of the estimated ARDL model (Collier and Goderis, 2012). The real output responds to deviations from the long-run equilibrium, which is captured by the ECM by gradually bringing the economy back to its steady state level. The coefficient of the ECM is expected to be negative and statistically significant. The magnitude of this coefficient, which

covers the speed of adjustment towards the long-run equilibrium path, should be less than one (Collier and Goderis, 2012).

The bounds test procedure can only be useful if the variables are either integrated of order zero, $I(0)$ or integrated of order one, $I(1)$. For variables that are integrated of order two, $I(2)$, the bounds test cannot be applied (see also Odhiambo, 2013). Three unit root tests are employed in this study. They include the Augmented Dickey-Fuller (1979) unit root test that takes into account the presence of serial correlation in the time series data; the Perron (1990) innovation outlier model that investigates the presence of a structural break in the time series data; and the Elliott, Rothenberg and Stock (1996) Dickey Fuller Generalized Least Squares (DF-GLS) unit root test that detrends the time series data.

2.3   Data Sources and Definitions of Variables

The study covers annual time series data for the period 1970-2013 and has a sample size of 44 observations. The data for the variables of interest have been obtained from the World Bank Development Indicators (World Bank, 2015) and the UNESCO Institute of Statistics (UNESCO, 2015). The definition of the variables included is as follows: 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); foreign aid (net official development assistance and official aid received as a share in real GDP expressed in 2005 constant USD prices); and international trade (proxied by the ratio of exports and imports as a share of real GDP expressed in 2005 constant USD prices).

3. Empirical Results

3.1 Unit Root Tests

Table 1 below reports the stationarity test results for the variables used in this study. As illustrated in table 1, the results show that real GDP per capita, investment, human capital, population growth, real exchange rate, foreign aid and international trade are integrated of order one; while government consumption is integrated of order zero, irrespective of the unit root test used. On the other hand, the inflation variable is found to be integrated of order one when ADF and DFGLS tests are used and integrated of order zero when a structural break is included. Overall, all variables in Zambia are either integrated of order zero or one. Therefore, the Bounds testing procedure for cointegrating relationships suggested by Pesaran *et al*. (2001) can be employed.

3.2 ARDL Bounds Test for Cointegration

The Schwarz-Bayesian Criteria was employed to determine the appropriate optimum lag-length for the ARDL equation. The optimal lag-length selection criteria is based on the lowest SBC that is obtained. This method is chosen as it tends to under-fit the model of interest given that the optimal lag length chosen for the Zambian growth model is up to 2 lags and the sample size is small. Based on this setup, the optimal ARDL model selected for the Zambian growth equation is $ARDL(2, 0, 0, 0, 0, 0, 0, 2, 0)$ model with an adjusted R-squared of 0.9812. The optimal unrestricted ARDL representation selected is based on Case II: restricted intercept and no trend.

Table 1: Stationarity Tests for all Variables

	Stationarity of all Variables in Levels						Stationarity of all Variables in 1st Difference					
	ADF		DFGLS		Perron		ADF		DFGLS		Perron	
Variable	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend	Without Trend	With Trend
Log(GDPPC)		0.98		-0.94		-4.52		-7.26***		-7.42***		-9.86***
Log(INV)	-1.41		1.31		-2.79		-11.16***		-9.32***		-13.11***	
Log(HC)		-1.31		-1.52		-3.37		-3.91**		-3.95**		-6.45***
Log(POPG)	0.26		-0.82		-1.75		-1.91*		-1.65*		-4.23*	
Log(GC)	-4.18***		-3.14***		-5.04***							
Log(RER)		-0.79		-0.95		-4.69		-5.18***		-5.25***		-10.04***
Log(INF)		-1.82		-1.25		-5.41**		-6.15***		-5.99***		
Log(TRD)	-1.74		-1.62*		-3.39		-5.38***		-5.31***		-6.50***	
Log(AID)		-1.77		-1.99		-4.85		-10.03***		-10.01***		-10.69***

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

Table 2 reports the Pesaran *et al.* (2001) bounds test for level relationships for the Zambia 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, AID)		6.17***	Cointegrated
Null Hypothesis: No long-run relationships exist				
Asymptotic Critical Values for $k = 8$ (Pesaran *et al.*, 2001; Case II, p. 300)				
1%		5%		10%
$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
2.62	3.77	2.11	3.15	1.85	2.85

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

As illustrated in table 2, the computed $F-$statistic is 6.17 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 a long-run level relationship between the dependent variable, real GDP per capita, and the set of covariates.

3.3 Empirical Analysis of ARDL-Based Error Correction Model

Table 3 below presents the short- and long-run multipliers for the Zambian growth equation. Panel 1 of table 3 presents estimated results of the long-run coefficients, while panel 2 presents the estimated short-run coefficients for the Zambian growth equation. The results in panel 2 reveal that in the short-run, the adjustment process measured by the Error Correction Term (ECM) is between 0 and -1 and is statistically significant at the 5% significance level. This implies that the growth of real GDP per capita in Zambia converges monotonically towards its long-run equilibrium path at a rate of -0.20%, and confirms the long-run equilibrium relationship

between real GDP per capita and the regressors being studied. The underlying ARDL model reveals a good fit represented by an estimated R−squared value estimated at 0.77 and an adjusted R−squared value of 0.67.

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

Panel 1 – Estimated Long-Run Coefficients (Elasticities) [Dependent Variable: Log of Real GDP per capita, $\log(GDPPC)_t$]				
Regressor	**Coefficient**	**Standard Error**	**t-statistic**	**Probability**
$\log(INV)_t$	0.2933**	0.13	2.26	0.032
$\log(HC)_t$	0.2987***	0.09	3.09	0.004
$\log(POPG)_t$	0.1957	0.54	0.36	0.718
$\log(GC)_t$	-0.2149	0.16	-1.37	0.181
$\log(RER)_t$	-0.0777	0.07	-1.12	0.270
$\log(INF)_t$	0.0145	0.06	0.24	0.815
$\log(TRD)_t$	-0.0163	0.14	-0.11	0.910
$\log(AID)_t$	-0.1485*	0.09	-1.72	0.097
C_t	3.4908	2.70	1.29	0.206
Panel 2 – Estimated Short-Run Coefficients (Elasticities) [Dependent Variable: change in log of Real GDP per capita, $\Delta\log(GDPPC)_t$]				
Regressor	**Coefficient**	**Standard Error**	**t-statistic**	**Probability**
$\Delta\log(GDPPC)_{t-1}$	-0.3345**	0.13	-2.51	0.018
$\Delta\log(INV)_t$	0.0596***	0.02	3.63	0.001
$\Delta\log(HC)_t$	0.0607***	0.02	3.02	0.005
$\Delta\log(POPG)_t$	0.0397	0.12	0.33	0.741
$\Delta\log(GC)_t$	-0.0436*	0.03	-1.74	0.092
$\Delta\log(RER)_t$	-0.0158	0.02	-0.92	0.366
$\Delta\log(INF)_t$	0.0029	0.01	0.23	0.822
$\Delta\log(TRD)_t$	0.0270	0.03	0.93	0.358
$\Delta\log(TRD)_{t-1}$	-0.0537*	0.03	-2.01	0.054
$\Delta\log(AID)_t$	-0.0301*	0.02	-1.80	0.082
ECM_{t-1}	-0.2031**	0.08	-2.42	0.022
R-Squared	0.7690	R-Bar Squared		0.6735
S.E. of Regression	0.0248	F-Stat (11,30)		8.78[0.000]
Residual Sum of Squares	0.0179	DW-statistic		2.15
Akaike Info. Criterion	-90.319	Schwarz-Bayesian Criterion		-79.024

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

The long-run results in panel 1 show that the key macroeconomic determinants that are associated with the long-run level of real GDP per capita include the accumulation of physical

capital (investment), human capital development and foreign aid. The results reveal that there is a positive and significant association between investment and the level of real GDP per capita and the result is statistically significant at the 5% significance level. A 1% increase in the level of investment leads to a 0.29% increase in the level of real GDP per capita. The result supports similar growth studies conducted in developing countries that found a positive association between investment and growth (see, among others, Bleaney *et al*., 2001; Anaman, 2004; Asheghian, 2009).

The study results also show that human capital development is positively 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 reveal that a 1% increase in school enrolment leads to a 0.30% increase in the level of real GDP per capita. These results support similar studies that found a significant positive association between education and economic growth in developing countries (see, among others, Knight *et al*., 1993; Chen and Feng, 2000; Anyanwu, 2014).

The study results also reveal a negative and significant relationship between foreign aid and 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 foreign aid leads to a -0.15% decrease in the long-run level of real GDP per capita. These results support similar studies that found a negative relationship between foreign aid and economic growth, particularly in Zambia (Most and Vann de Berg, 1996), and other studies that found a negative relationship between foreign aid and economic growth in Sub-Sahara African countries (Chang and Mendy, 2012; Anyanwu, 2014). The long-run results also revealed no significant relationship between population growth,

government consumption, real exchange rate depreciation, inflation, international trade and the long-run level of real GDP per capita.

The short-run results in panel 2 of table 3 reveal that the key macroeconomic determinants that had a significant association with the growth of real GDP per capita include investment, human capital development, government consumption, international trade and foreign aid. The results reveal that the relationship between the growth rate of investment and the growth rate of real GDP per capita is positive and statistically significant at the 1% significance level. They show that a 1% increase in the growth rate of investment led to a 0.06% increase in the growth rate of real GDP per capita. These results are consistent with existing empirical growth studies that found a positive relationship between investment and economic growth (see, among others, Freire-Seren, 2002).

The study also reports a positive association between the growth of human capital development and the growth of real per capita GDP and the results are statistically significant at the 1% significance level. The results show that a 1% increase in the growth of total enrolment led to a 0.06% increase in the growth rate of real GDP per capita. These results are consistent with most of the theoretical and empirical underpinnings that postulate a positive relationship between human capital development and economic growth, particularly in developing countries (Mankiw *et al*., 1992; Chen and Feng, 2000; Anyanwu, 2014).

The relationship between the growth in government consumption and real GDP per capita growth is found to be negative and significantly associated at the 10% significance level. The results show that a 1% increase in the growth of government consumption led to a -0.04%
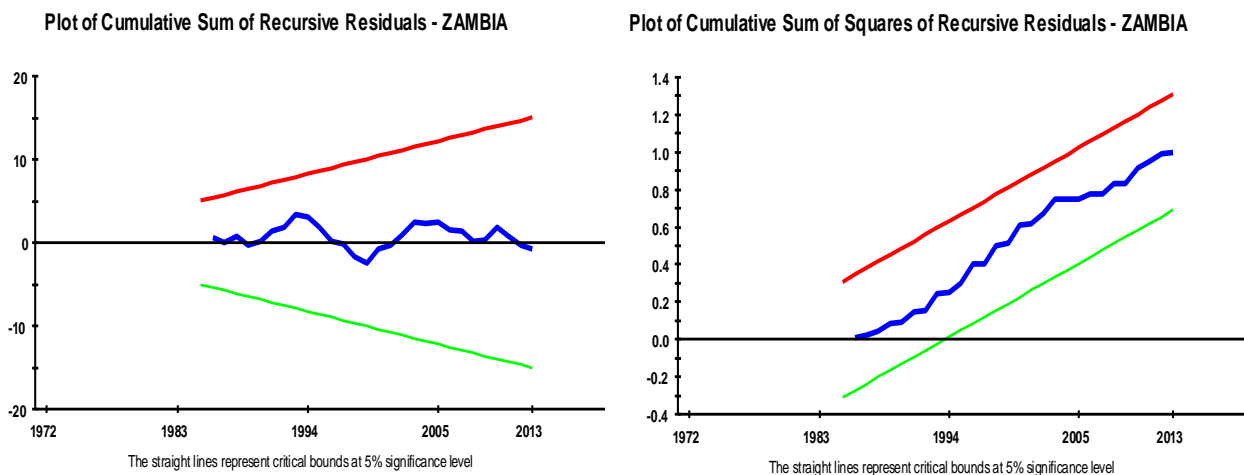
decline in the growth of real GDP per capita in the short-run. These results are consistent with a number of empirical studies that found a negative relationship between government consumption and economic growth (see, among others, Barro, 1999, 2003; Bhaskara-Rao and Hassan, 2011).

In terms of the role of international trade, the study results reveal a negative association between the growth of international trade and real GDP per capita growth in the short-run and the results are statistically significant at the 10% significance level. They reveal that a 1% increase in the growth of international trade in the previous period led to a -0.05% decline in the growth of real per capita GDP. These results are consistent with similar empirical growth results that found a negative relationship between variability in the terms of trade and economic growth (see, among others, Mendoza, 1997). However, these results are contrary to other findings where trade is beneficial for growth (see, among others, Barro, 1999, 2003; Burnside and Dollar, 2000; Radelet *et al*., 2001; Bhaskara-Rao and Hassan, 2011).

The results also show that foreign aid is negative and significantly associated with the growth of real GDP per capita and the results are significant at the 10% significance level. The results show that a 1% increase in foreign aid led to a -0.03% decrease in the growth of real GDP per capita. These results are synonymous with growth studies conducted in developing economies where foreign aid was found to be negatively associated with economic growth (see, among others, Most and Vann de Berg, 1996; Chang and Mendy, 2012; Anyanwu, 2014). The study also found no significant relationship between population growth, real exchange rate depreciation, inflation and the growth of real GDP per capita in the short-run.

Lastly, we report post-diagnostic tests based on the 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 results for the Zambian growth equation.

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. The results are suggestive of coefficient stability whereby the CUSUM test reveals parameter instability, while the results of the CUSUMQ test reveal variance stability.

Table 4 reports post-estimation diagnostic results for the Zambian growth equation.

Table 4: Post-Estimation Diagnostic Tests

Test Statistic	Results
Breusch-Godfrey Test: No Serial Correlation F(1,28)	0.54 [0.469]
Breusch-Pagan-Godfrey Test: No Heteroskedasticity F(1,40)	0.00 [0.981]
Ramsey RESET Test: Functional Form F(1,28)	1.51 [0.230]
Normality: CHSQ (2)	1.36 [0.506]
ARCH Test: Heteroskedasticity (no ARCH terms) F(1,28)	0.70 [0.409]

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 selected ARDL model for Zambia is correctly specified and the parameter estimates are not biased.

4. Conclusion

In this paper, we have examined the key macroeconomic determinants of economic growth in Zambia during the period 1970-2013. The determinants investigated include the accumulation of physical capital, human capital development, population growth, government consumption, real exchange rate depreciation, inflation rate, foreign aid and international trade. The study used the recently developed Autoregressive Distributed Lag (ARDL) approach to cointegration, in order to estimate both the short- and the long-run elasticities of the selected macroeconomic determinants. The results reveal that the key macroeconomic determinants that are significantly associated with growth in Zambia include investment, human capital development, government consumption, international trade and foreign aid. The short-run results reveal that the accumulation of physical capital and human capital development were positively associated, while government consumption, international trade and foreign aid were negatively associated with economic growth. The long-run results reveal that the accumulation of physical capital and

human capital development are positively associated, while foreign aid is negatively associated with the long-run level of real GDP per capita.

The study results have significant policy implications for Zambia. They show that investment, human capital development and foreign aid are significantly associated with economic growth both in the short and in the long run. Thus, it is recommended that the economic strategies adopted should include those that create incentives to attract investment – with an emphasis on the adoption of labour-intensive technologies, on quality-based human capital development, and on ensuring the effectiveness of developmental aid. In terms of education, the focus of the Zambian authorities during the study period shows that more emphasis was on improving primary education than secondary or tertiary education. Thus, future education policies should focus more on increasing enrolment at secondary and tertiary education levels, as well as improving the quality of education in all its forms. The results also show that the growth of government consumption and international trade in the short run are negatively associated with economic growth. Thus, the short run strategies to be advocated should aim at improving the efficiency and effectiveness of government institutions, as well as implementing trade liberalization and reforms.

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