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An Empirical Analysis of The Determinants of Economic Growth In Zambia: 1973-2013

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Abstract— **In this paper, we assess the key determinants of economic growth in Zambia between 1973 and 2013. In this view, a model is developed to assess investment, infrastructure development, economic diversification, and human development. Following the endogenous growth theories which postulate that policies play a substantial role in advancing growth on a long-run basis, we make use of exploratory data analysis techniques, multiple regression analysis and statistical tests to model economic growth as a function of foreign direct investment, construction, exports of goods and services and gross national income per capita power parity. We find that the real domestic product increased four times per unit increase in foreign direct investment, and the gross national income has a one-to-one correspondence with economic growth.**

Index Terms—Economic Growth, Multiple Regression.

I. INTRODUCTION

Zambia's vision is to become a prosperous middle income country by the year 2030, and the strategic pathways to this vision are significantly reducing hunger and poverty and fostering a competitive and export-oriented economy [1]. However, attaining the vision 2030 calls for national development plans that will increase the capacity of the Zambian economy to produce goods and services. The capacity for production of goods and services in an economy is simply referred to as "economic growth", which is determined or influenced by several factors. This paper assesses the determinants of economic growth in Zambia that should be taken into consideration in the process of national economic planning aimed at ensuring sustainable economic development. [2] argues that there is no more important issue challenging the research efforts of economists than to understand the determinants of economic growth since sustained economic growth is the most important determinant of living standards.

Zambia has, in recent years, had one of the world's fastest growing economies with a Real-Gross Domestic Product (GDP) averaging roughly 6.7% per annum [3]. However, the country's economic growth has not translated into significant poverty reduction as it is estimated that 60% of Zambians still live in poverty [4]. The country is further ranked among the world's poorest nations with low human development indices [5]. The [6] also observed that despite Zambia's strong economic growth and the status of a lower middle-income country, widespread, extreme rural poverty and high unemployment levels remain significant problems. Against the backdrop of high poverty and unemployment levels in Zambia, the national economic policy objectives for the country are focused on sustaining economic growth through accelerated infrastructure development, economic diversification, and enhanced investment and human development [5]. Thus, empirical analyses of the determinants of economic growth in Zambia are required to examine the correlation between economic growth and the factors influencing it and also to inform public policy development and implementation if the country is to sustain the desired economic growth.

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Poor understanding of the drivers of economic growth leads to formulation of ineffective policies and national development plans thereby undermining the attainment of sustainable economic growth and development. To this effect, there has been limited research on the key factors influencing economic growth in Zambia.

This paper contributes to the effective formulation of economic policy planning in the undeveloped regions of the world such as Sub-Saharan Africa through empirical investigations of the determinants of economic growth. [7] observed that Sub-Saharan African countries face major challenges like raising economic growth, reducing poverty and integrating into the world economy. Infact, [8] argues that the development community has traditionally paid relatively little attention to the long-term determinants of development; and as such researchers need to scale up their examination of the drivers and implications of economic transformation and productivity change in low-income countries. Therefore, this work identifies the key economic growth covariates with special reference to Zambia.

II. ECONOMIC GROWTH THEORIES

A review of literature on economic growth identified main theories including the Classical growth theory, Harrod–Domar model, Solow-Swan Model, Endogenous growth theory and Unified growth theories. The Classical growth theory is based on the law of variable proportions. It postulates that increasing the factors of production such as labour and capital, while holding other factors such as technological change constant will increase output, but at a diminishing rate that eventually will approach zero. [9] notes that the classical growth theory ignores the economies of scale and technology, which are the very important factors influencing economic growth.

[10] and [11], suggest another theory that the rate of economic growth depends on the quantity of labour and capital such that more investment leads to capital accumulation, which generates economic growth. According to this theory, the main constraint on development is the relatively low level of new capital formation in many poor countries. The main criticism of the model is that it is based on the belief that the relative price of labour and capital is fixed, and that they are used in equal proportions. Other economists [12] and [13] theorized that there are diminishing returns to capital and labour to the effect that economies eventually reach a steady state condition where technological progress and capital per worker remain constant, and economic growth ceases. The Solow-Swan model prescribes that the steady state condition can be overcome by investing in new technology that allows production with fewer resources. One important prediction of the model is the idea of "conditional convergence," suggesting that poor countries will grow faster and catch up with rich countries as long as they have similar saving rates and technology. However, the model is criticized for its inability to explain the sources of technological change.

The foregoing models of economic growth focusing on the factors of production are broadly classified as "Exogenous economic growth models." Another category of models is the "Endogenous economic growth models" which suggest that improvements in productivity can be linked directly to a faster pace of innovation and investment in human capital. Thus, endogenous economists argues that government policies can raise a country's growth rate if they lead to more intense competition in markets and help to stimulate product and process innovation [14]. The theory predicts increasing returns to investment especially in infrastructure and human development. Research and development is viewed as a key source of technical progress, and protection of property rights and patents is essential to providing incentives for businesses and entrepreneurs to engage in research and development. The theory recognises human capital as a key ingredient of growth, and that government policy should encourage entrepreneurship as a means of creating new businesses and jobs through investment and innovation. However, the theory is also criticized for its inability to explain key empirical regularities in the growth processes of individual economies and the world economy as a whole.

The inadequacies of the endogenous growth theory led to the development of the Unified growth theories [15], which sought to explain the empirical regularities that characterized the growth process over longer time horizons in both developed and less developed economies. The unified growth theories are consistent with the entire process of development, especially in the contemporary era of sustained economic growth.

III. DETERMINANTS OF ECONOMIC GROWTH

Several factors influence or drive economic growth. Various economic growth models identify human capital as a determinant of economic growth. In the main, human capital refers to the workers' acquisition of skills and know-how through education and training. The quality of human capital is measured by proxies of education such as school-enrolment rates, tests of mathematics and scientific skills among others. According to [2] an educated population is a key determinant of economic growth, and that human capital is a precondition for economic convergence between countries, stressing that those countries with highly skilled labour are relatively more productive. Technology has also been identified as a determinant of economic growth [16]. It plays a major role in economic progress by way of increasing productivity and growth since the increased use of technology enables introduction of new and superior products and processes. This role has been stressed by various endogenous growth models suggesting that there is a strong correlation between research and development, and economic growth. [17] also identifies the endowment of natural resources as a determinant of economic growth, while [18] believe in trade. [19] highlights population density as a key driver of economic growth. Other determinants of economic growth include innovation, initial conditions of development, investment and institutions [20].

IV. MEASURES OF ECONOMIC GROWTH

It is vital to note that many researchers have identified several measures or indicators of economic growth. The most commonly used indicator is the "Real Gross Domestic Product (GDP)" defined as: "an inflation-adjusted measure that reflects the value of all goods and services produced in a given year [21]." Other indicators include the Consumer Price Index (CPI) measuring changes in the prices paid for goods and services by urban consumers for the specified month; and Current Employment Statistics (CES). The Real GDP and other measures do not reflect the quality of economic growth. This aspect is reflected more in the Human Development Index (HDI), which is defined as a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living [22].

V. RESULTS AND DISCUSSION

A. *Exploratory Data Analysis*

In statistics, exploratory data analysis (EDA) is used to analyze data sets in order to summarize their main characteristics, often with visual methods. The objectives of EDA are mainly to suggest hypotheses about the causes of observed phenomena, assess assumptions on which statistical inference will be based, and support the selection of appropriate statistical tools and techniques [23]. In this paper, time series and principal components analysis (PCA) techniques are used to explore the data series on economic growth and its covariates in the Zambian context.

B. Time Series Plot

The time series plot of economic growth and its covariates in Zambia is depicted graphically in Figure 1 below.

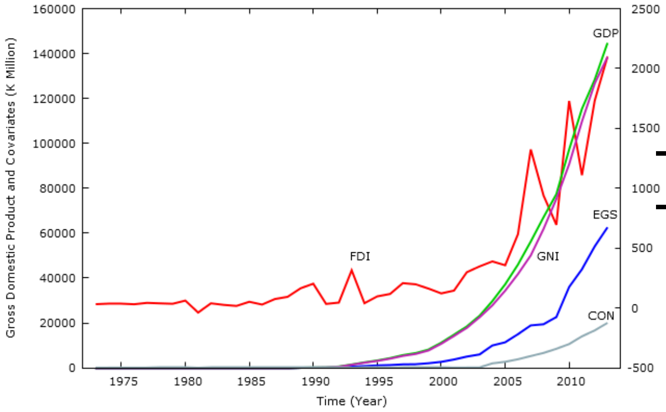

***Figure1**: Economic growth and its covariates in Zambia between 1973 and 2013*

Figure 1 shows increasing trends in the gross domestic product (GDP), gross national income (GNI), exports of goods and services (EGS), construction (CON) and foreign direct investment (FDI). The increasing trend appeared to correspond to the growing size of the Zambian economy in the 40 years' period. The FDI show significant variation over time as compared with the other variables. However, Principal component analysis is done to explore the pattern of similarity of the variables.

C. Principal Component Analysis

[24] describe **Principal component analysis (PCA)** as a multivariate technique that analyzes data in which observations are described by several inter-correlated quantitative dependent variables; and its goal is to extract the important information from the table, to represent it as a set of new orthogonal variables called **principal components**, and to display the pattern of similarity of the observations and of the variables as points in maps. In this paper, the GRETL software is used to determine the principal components (PCs) of the data series. In a multi-variate space, the correlation between the component and the original variables is called the **component loading**, which shows how much of the variation in a variable is explained by the component. The component loading of the PCA analysis is shown in Table 2.

***Table 1:** Component loading of PCA analysis of economic growth factors in Zambia, 1973-2013*

	PC1	PC2	PC3	PC4	PC5
GDP	0.450	0.134	0.536	0.150	-0.685
FDI	0.438	-0.887	-0.119	0.078	0.038
CON	0.447	0.351	-0.619	0.541	-0.003
EGS	0.450	0.186	-0.287	-0.822	-0.073
GNI	0.450	0.194	0.482	0.058	0.724

The sum of the squares of the component loadings in Table 2 are computed and presented in Table 3 to determine the amount of variance accounted for each variable. The results show that 100% of the variance is accounted for by each item across the principal components.

***Table 2**: Sum of squares of component loadings of the PCA of economic growth factors in Zambia*

Component	PC1	PC2	PC3	PC4	PC5	Total
GDP	0.202	0.017	0.287	0.022	0.469	0.999
FDI	0.191	0.786	0.014	0.006	0.001	1.000
CON	0.199	0.123	0.383	0.292	0.00009	0.9988
EGS	0.202	0.034	0.082	0.675	0.0053	1.0004
GNI	0.202	0.037	0.232	0.003	0.524	1.000

D. Empirical Model

Based on the Ordinary Least Squares (OLS) method, the regression analysis of economic growth measured as gross domestic product (GDP) and the explanatory variables including investment (Foreign direct investment, FDI), infrastructure development (construction, CON); economic diversification (Exports of goods and services, EGS); and human development (Gross national income per capita PPP, GNI) an empirical model is estimated using multiple regression to yield Equation 3, in which the numerical values in parentheses are the estimated errors of the regression.

$$\mathbf{GDP = -234 + 4.13*FDI - 0.0571*CON - 0.224*EGS + 1.09*GNI} \quad \textbf{[3]}$$

(188) (0.956) (0.273) (0.121) (0.0296)

The model shows that there is a positive correlation between economic growth and investment, and human development as can be seen from the coefficients of the proxy measures of FDI and GNI respectively. Infrastructure development and economic diversification have a negative correlation with economic growth. The statistics of the regression are presented in Table 4.

***Table 3:** Regression statistics for economic growth and its covariates in Zambia, 1973-2013*

	Coefficient	*Std. Error*	*t-statistic*	*p-value*
Constant	−233.829	188.168	−1.2427	0.2220
FDI	4.13184	0.956044	4.3218	0.0001
CON	−0.0571183	0.273366	−0.2089	0.8357
EGS	−0.223521	0.12145	−1.8404	0.0740
GNI	1.08826	0.0296348	36.7223	<0.0001

R-squared: 0.999497; Adjusted R-squared: 0.999441; Rho: −0.149321; Durbin-Watson: 2.277587

The regression statistics in Table 4 show that the coefficient of determination (R-squared and Adjusted R-squared) is 99.9 % indicating that the data fits very well to the regression line, and as such it can be inferred that all the variations in the dependent variable are predictable from the independent variables. The statistical significance test of the independent variables at 5% confidence level show that foreign direct investment and gross nation income per capita purchasing power parity has lower p-values than the critical value of 0.05. Therefore, we conclude that there is correlation between the variables. This suggests that these two explanatory variables are meaningful to the empirical model for predicting economic growth in Zambia. We validate the regression model by performing other statistical tests.

E. Unit Root Test of Stationarity

The Augmented Dickey-Fuller (ADF) test is performed to detect the presence of unit roots in the dependent and independent variables so as to establish stationarity. The results are presented in Tables 5 and 6.

***Table 4**: ADF test results for stationarity*

Variable	*Model*	*ADF Test (Level)*			
		t-statistic	*CV @ 5%*	*Decision*	*Conclusion*
GDP	None	-0.921	-1.951	Reject	Stationary
	Intercept	-0.623	-2.954	Reject	Stationary
	Intercept & trend	0.344	-3.553	Reject	Stationary
FDI	None	5.344	-1.950	Accept	Nonstationary
	Intercept	4.303	-2.941	Accept	Nonstationary
	Intercept & trend	1.973	-3.533	Reject	Stationary
CON	None	17.201	-1.949	Accept	Nonstationary
	Intercept	15.193	-2.937	Accept	Nonstationary
	Intercept & trend	5.337	-3.563	Accept	Nonstationary
EGS	None	1.996	-1.952	Accept	Nonstationary
	Intercept	3.153	-2.960	Accept	Nonstationary
	Intercept & trend	7.894	-3.563	Accept	Nonstationary
GNI	None	-4.671	-1.951	Accept	Nonstationary
	Intercept	-4.460	-2.954	Accept	Nonstationary
	Intercept & trend	-3.911	-3.553	Accept	Nonstationary

As in Table 5, we conclude at 5% level of significance for GDP that there is stationarity. However, for FDI, GNI and EGS the time series data is not stationary. Further results of differenced data are shown in (Table 6).

***Table 5**: ADF test results for stationarity at first difference*

	Model	*ADF Test (First difference)*			
		t-statistic	*CV @ 5%*	**Decision*	*Conclusion*
GDP	None	-0.403	-1.951	Reject	Stationary
	Intercept	-0.036	-2.954	Reject	Stationary
	Intercept & trend	0.574	-3.553	Reject	Stationary
FDI	None	0.563	-1.951	Reject	Stationary
	Intercept	-0.082	-2.951	Reject	Stationary
	Intercept & trend	-9.295	-3.533	Accept	Nonstationary
CON	None	4.426	-1.952	Accept	Nonstationary
	Intercept	4.480	-2.964	Accept	Nonstationary
	Intercept & trend	4.439	-3.568	Accept	Nonstationary
EGS	None	6.511	-1.952	Accept	Nonstationary
	Intercept	6.443	-2.964	Accept	Nonstationary
	Intercept & trend	5.859	-3.568	Accept	Nonstationary
GNI	None	-2.883	-1.952	Accept	Nonstationary
	Intercept	-2.571	-2.960	Reject	Stationary
	Intercept & trend	-0.730	-3.544	Reject	Stationary

F. Co-integration

We further use the Johansen co-integration test to detect the number of co-integrating vectors that are present among the variables. "Co-integration" is the property of two-time series data where both share common stochastic change in the average value of the random or stochastic process. This test is performed in the GRETL software using the **trace and maximum eigen value statistics** [25]. The model outputs for the test are summarized and presented in Tables 7 and 8.

***Table 6**: Johansen test results for co-integration (Trace statistics)*

Hypothesized No. of CE (s)	*Eigen Value*	*Trace Statistic*	*Critical Value at 5%*	*P-Value**
None	0.899	226.791	69.819	5.902
At most 1	0.802	137.570	47.856	2.522
At most 2	0.602	74.485	29.797	7.425
At most 3	0.545	38.575	15.494	6.100
At most 4	0.182	7.851	3.841	0.005

****Decision rule**: reject H_o if t-statistic < critical value at 5% level of significance*

Table 7: Johansen test results for co-integration (Maximum Eigen statistic)

Hypothesized No. of CE (s)	***Eigen Value***	***Max-Eigen Statistic***	***Critical Value at 5%***	***P-Value***
None	0.899	89.221	33.877	2.830
At most 1	0.802	63.085	27.584	1.546
At most 2	0.601	35.909	21.132	0.000230
At most 3	0.545	30.724	14.264	6.233
At most 4	0.182	7.852	3.841	0.00508

****Decision rule**: reject H_o if t-statistic < critical value at 5% level of significance*

The null hypothesis for the trace test was that there were no co-integrating vectors present among the variables. Upon examination under the scenarios of none, at most 1, at most 2, at most 3 and at most 4 for the input variables, the trace statistics are greater than the computed critical values as can be seen in Table 7. This shows that there is at least one possible linear combination for the input variables to yield a stationary process.

The maximum eigen value test carried out in Table 8 under the same scenarios for the input variables as in the trace test show that the maximum eigen value statistics are greater than the critical values at the 5% level of significance. This confirms that the number of linear combinations is not equal to the number of input variables. Thus, the co-integration test is relevant and so it can be established that there is a long-run equilibrium relationship among the variables. Therefore, the OLS regression model derived for GDP as a function of FDI, CON, EGS and GNI is valid. Our results are similar to those obtained in [2], [5], [13], [20], [21], and [26].

CONCLUSION

Investment and human development are significant determinants of economic growth in Zambia in the long-run. In view of this empirical evidence, we recommend that the central focus of economic policy in Zambia should be directed towards providing an enabling environment for investment in the various sectors of the economy, and enhancing human development. It may be interesting in future to assess the real impact of infrastructure development and economic diversification given the policy emphasis on these drivers.

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- George M. Mukupa, Elias R. Offen, Douglas Kunda and Edward M Lungu (2016) "A comparative study of Equilibrium Equity Premium Under Discrete Distributions of Jump Amplitudes" Journal for Mathematical Finance (JMF). Vol. 6; no.1, pp 232-246.

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