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Investigating the Causal Relationship between Education and Economic Growth in Zimbabwe

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INVESTIGATING THE CAUSAL RELATIONSHIP BETWEEN EDUCATION AND ECONOMIC GROWTH IN ZIMBABWE

Strictly as per the compliance and regulations of:

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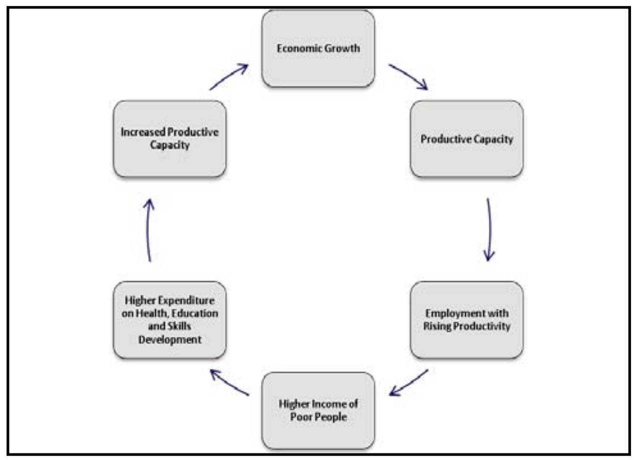
Keywords : Education, Economic Growth, Causality, F-Statistic Testing, VAR and Zimbabwe.

I. Introduction

Education can be viewed as both a consumer good and a capital good because it offers utility to a consumer and also serves as an input into the production of other goods and services. As a capital good, education can be used to develop the human resources necessary for economic and social transformation and thus leads to economic growth. The focus on education as a capital good relates to the concept of human capital, which emphasises that the development of skills is an important factor in production activities. Education is seen as contributing to economic growth in two ways. Firstly, education directly affects economic growth through making individual workers more productive. Secondly, education indirectly affects economic growth by leading to the creation of knowledge, ideas and technological innovation – either through the process of acquiring education itself or because education is a key input into the development of a research sector that produces new knowledge and ideas. Growth and human capital development can be mutually reinforcing. Growth promotes human capital development, and human development promotes growth (Jaoul, 2004). The following figure shows the relationship between education, physical capital investment and economic growth;

Figure 1 : Virtuous cycle of links between economic growth, human capital and physical capital



Source : Selim (2006: 8).

The virtuous cycle in figure 1 shows that education and economic growth reinforce each other and therefore depends upon each other. As the economy grows, it indicates that productive capacity has increased which comes with it an increase in employment. This increase in employment will result in higher incomes and thus a greater expenditure on education with more people getting access to education. As more people get education, their productive capacity increases and thus contribute to economic growth. This virtuous cycle will continue to repeat itself until the economy develops and as a result contributes to a significant reduction in poverty. Therefore, the objective of this paper is to investigate the causal relationship between economic growth and education with a link to physical capital so as to make informed policies related to education and economic growth.

The rest of the paper is structured as follows; section 2 gives the background to education and economic growth in Zimbabwe, section 3 reviews the literature on the relationship between education and economic growth, section 4 outlines the methodology used in the study, section 5 gives the results and their discussion while section 6 concludes by giving conclusions and policy recommendations.

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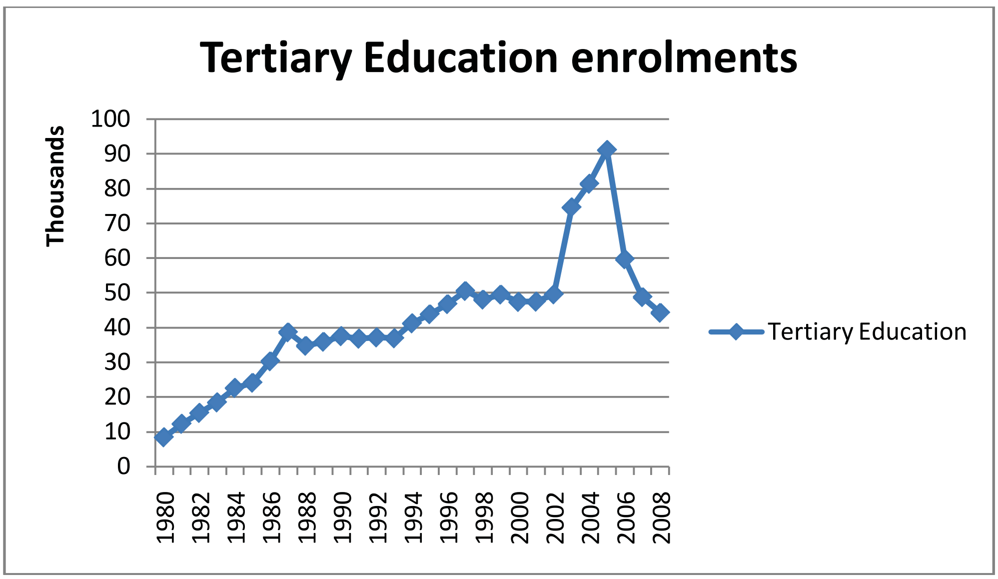
II. Background To Education And Economic Growth In Zimbabwe

a) Trend in Tertiary education enrolments in Zimbabwe[1]

The enrolment in tertiary education showed an upward trend from 1980 to 1987. This shows an increase in gross enrolment of 364%. During this first period after independence, more tertiary institutions were constructed by the government which includes teacher training colleges, agricultural colleges, technical colleges and universities. After this the enrolment stabilised at around 35 000 per year from 1988 to 1993. Tertiary education enrolment enrolment picked up in 1994 and steadily increased by 37% to reach a peak in the year 1997. This was followed by a stable enrolment of around 48 000 between 1998 and 2002. This was a period affected by the drought in the history of Zimbabwe. Political tension also occurred during the same period as the Movement for Democratic Change (MDC), one of the main political parties in Zimbabwe came into being. Enrolment then increased sharply between 2002 and 2005 giving an increase by 84% before sharply dropping by 51.4% between 2005 and 2008. This was a period of economic and political crisis in Zimbabwe and this impacted negatively on gross tertiary enrolments. Figure 3 below shows the trend in tertiary education enrolment from 1980 to 2008.

Figure 3 : Tertiary Education Enrolments

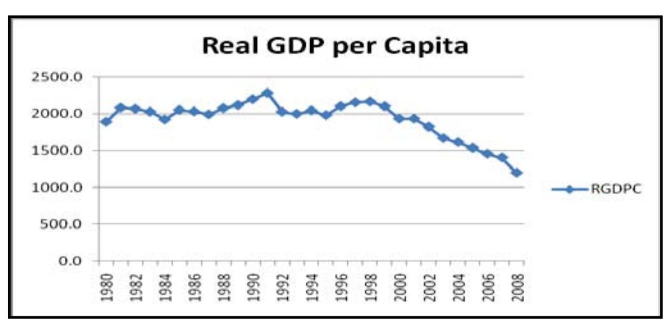


Source : Author's compilations from CSO various publications and Ministry of Higher and Tertiary Education.

b) Trend in real GDP per Capita[2]

Real GDP per capita shows an upward trend between 1980 and 1982. After this, real GDP per capita dropped during the period 1983 to 1984 as a result mainly of drought. The contribution of agriculture to GDP dropped from 17.8% in 1981 to 11.2% in 1984. Real GDP per capita followed an upward trend from 1985 to 1991 before declining in 1992 (CSO statistical Year Book, 2003). The sharp decline was also a result of the drought that hit the economy in 1992. The agriculture's contribution to GDP dropped to 7.4% in 1992. The GDP per capita followed a steady pattern between 1993 and 1996 before increasing from 1997 to a reach a peak in 1998. The economy dropped between 1999 and 2008.This could be explained by the controversial land reform that started in 2000, the drought that hit the economy in 2002 and the political and economic crises that occurred during the period. Figure 3 shows the trend in real GDP per capita in Zimbabwe from 1980 to 2008;

Figure 3 : Growth rate in real GDP per capita (in millions of Z$)



Source: Authour's compilations from various CSO publications

[1] The trend in Real GDP per Capita was established by the author using the Central Statistical Office data and data from the Ministry of Higher and Tertiary Education for the period 1980 to 2008.

[2] The trend in Real GDP per Capita was established by the author using the Central Statistical Office data from its Statistical Year Books for the period between 1980 and 2008.

The trends in both tertiary education enrolment and real GDP per capita in Zimbabwe displayed a common trend implying that either education contributed towards economic growth or economic growth contributed towards education. It is also possible that the two could be mutually reinforcing each other. The two could not be represented on one framework because of significant differences in their scales.

III. Literature Review

a) *Theoretical relationship on education and economic growth*

Following Lucas (1988) and Loening (2002), human capital is considered an independent factor of production and this is enshrined in endogenous growth models. This is presented by the Cobb-Douglas production function with constant returns to scale as follows: $Y_t = A.K^{\alpha} H^{\theta} L^{(1-\alpha-\theta)}$ where Y is defined as output: A is the total factor productivity or the technical change; K is physical capital, H is human capital and L is labour. This model can also be expressed as a per capita growth model.

The growth of the economy depends on the physical capital investment and human capital stock (education) that it has. Traditionally, investment is widely believed to be an important determinant of economic growth but recent research hinges on the importance of education. Human capital represents the investment people make in themselves that augment their economic productivity. The theoretical framework that looks at the adoption of education as a form of investment has become known as human capital theory. Based upon the work of Schultz (1971), Sakamota and Powers (1995), Psacharopoulos and Woodhall (1997), human capital theory rests on the assumption that formal education is highly instrumental and even necessary to improve the production capacity of a population, that is an educated population is a productive population.

Nelson and Phelps (1966) and Benhabib and Spiegal (1994) argued that a more educated labour force would innovate faster. Lucas (1988) and Mankiw, Romer, and Weil (1992) observed that the accumulation of human capital could increase the productivity of other factors and thereby raise growth of the economy. In the Lucas and Mankiw, Romer, and Weil models, a state's rate of growth depends on the rate of accumulation of human capital.

b) *Empirical literature review*

The early work on education and growth includes the work of Lucas (1988) which revealed that the growth rate of human capital, which is also dependent on the amount of time allocated by individuals to acquire skills, is critical for growth. The model was further extended by Rebelo (1991) by introducing physical capital as an additional input in the human capital accumulation function. The model of endogenous growth by Romer (1990) assumes that the creation of new ideas is a direct function of human capital, which manifests itself in the form of knowledge. As a result, investment in human capital leads to growth in physical capital which in turn leads to economic growth. Studies that supported the human capital accumulation as a source of economic growth also include (Benhabib and Spiegel, 1994). Some studies have examined different ways through which human capital can affect economic growth. Gupta and Chakraborty (2004) develop an endogenous growth model of a dual economy where human capital accumulation is the source of economic growth. They argued that the duality between the rich individual exists in the mechanism of human capital accumulation.

Bils and Klenow (2000) raise the issue of causality, suggesting that reverse causation running from higher economic growth to additional education may be at least as important as the causal effect of education on growth in the cross-country association.

De Meulemeester and Rochat (1995) tested for Granger causality between higher education enrolments and economic growth in six countries (Sweden, United Kingdom, Japan, France, Italy and Australia)[3] for different periods for each country ranging from 1885 to 1987. They found uni-directional short run causality running from higher education enrolments to economic growth in Sweden, the United Kingdom, Japan, and France and bi-directional causality between higher education enrolments and economic growth in Australia and Italy.

Using US annual data for the period 1949 to 1984, In and Doucouliagos (1997) found bi- directional causality between economic growth and human capital formation. Asteriou and Agiomirgianakis (2001) also found bi-directional causality between the same variables for Greece using annual data from 1960 to 1994.

During the period before the Second World War, Jaoul (2004) analysed causality between higher education and economic growth in France and Germany and obtained results which confirms that higher education has an influence on gross domestic product for France while no relationship was found for Germany.
Bo-nai and Xiong-Xiang (2006), using Chinese annual data from 1952 to 2003, showed that there is an evidence of a bi-directional causality between education investments and economic growth.

Kui (2006), using annual data for China from 1978 to 2004 established that economic growth was the cause of higher education.

[3] Sweden (1910–1986), United Kingdom (1919–1987), Japan (1885–1975), France (1899–1986), Italy (1885–1986), and Australia (1906–1986).

Hunang, Jin, and Sun (2009) analysed the causality between scale evolution of higher education and economic growth in China, for the period 1972 and 2007. The results confirm that there is a long-run steady relationship between higher education and GDP per capita.

Pradham (2009) employed the error correction modeling technique to show that there is uni-directional causality that runs from higher education to economic growth for India using annual data from 1951 to 2002.

The Johansen co-integration and Tod and Yamamoto causality approaches were used in VAR framework by Chaudhary, Iqbal and Gillani (2009) to analyse the relationship between higher education and economic growth for Pakistan for the period 1972 to 2005. The obtained results demonstrated that there was unidirectional causality running from economic growth to higher education.

For Northern Cyprus, Katircioglu (2009) demonstrated that long-run equilibrium relationship exists between higher education growth and economic growth. The results suggested uni-directional causality that runs from higher education to economic growth.

Most studies done were from the developed world and no study of this nature has been done for the case of Zimbabwe. The studies done have continued to provide mixed results with some showing uni-directional causality while others show bi-directional causality. Therefore, this paper contributes to the existing literature by employing granger causality testing to test the causal relationship between human capital stock and real income using annual data for Zimbabwe (a developing country) from 1980 to 2008. An understanding of the nature of the relationship will aid in policy making and implementation.

IV. Methodology And Data Descriptions

Clearly, the education-growth relationship is not so simple that one can compute average years of education and confidently predict growth. I believe my model clarifies matters. The methodology employed in this study is a quantitative one that involves first performing unit root tests before running the main model of Granger Causality Tests and VAR.

a) Unit Root Tests

The variables to be used in this study are time series variables which are usually non-stationary. These variables should be tested for stationarity before they are used in the model. If the variables are stationary in levels, that is, without differencing, they are said to be integrated of order 0. If they become stationary after first differencing they are said to be non stationary in levels and require to be differenced once to become stationary and thus are integrated of order 1. Differencing a variable twice to achieve stationarity means the variable is integrated of order 2.

b) Granger Causality Tests

The Granger Causality test as proposed by Granger (1969) and Sims (1972) is used to test whether one variable is useful in forecasting another variable and vice-versa. In general, a time series X is said to Granger cause another time series Y if it can be shown that the series X values provide statistically significant information about the future values of series Y, if not, X does not Granger cause Y. This is confirmed by a probability value that falls within the range of 1% and 10% or an F-statistic that takes an absolute value of at least 2. The larger the value, the more significant it becomes. The F-Statistic is constructed as follows;

i. The F statistic Testing

We use the F-statistics to test the validity of causality. It depends upon the restricted residual sum squares (RSS_1) and unrestricted residual sum squares (RSS_2). F is calculated as follows;

$$F = \frac{(RSS_1 - RSS_2)/m}{(RSS_2)/(n-k)}$$

and F follows a normal distribution, $(m, n-k)$.

Where, m is the number of lags; k is the number of parameters involved in the model; and n is the sample size. The test is to reject the null hypothesis of non-causality between education and economic growth against an alternative hypothesis of causality between the two. If the realisation of the above statistic is significant, then we reject the non-causality hypothesis and conclude that education causes economic growth and vice versa. If it is not significant, then the non-causality hypothesis is accepted and concludes that education does not cause economic growth and vice versa.

Causality can either be uni-directional or bi-directional. The null hypothesis of no causality is tested against the alternative hypothesis of causality between two variables. In a two variable model X and Y, the following two equations are estimated;

$$Y_t = \sum_{i=1}^{m} \alpha_i X_{t-1} + \sum_{i=1}^{m} \beta_i Y_{t-1} + u_{1t} \quad (1)$$

$$X_t = \sum_{i=1}^{m} \delta_i Y_{t-1} + \sum_{i=1}^{m} \theta_i X_{t-1} + u_{2t} \quad (2)$$

Where u_{1i} and u_{2i} are serially uncorrelated random disturbances with zero mean. If X Granger causes Y; $H_0 : \alpha_1 = \alpha_2 = \alpha_3 = ---\alpha_m = 0$ is rejected against the alternative hypothesis. This means that there is statistical evidence to accept the alternative hypothesis, H_1. Similarly, if Y Granger causes X; $H_0 : \theta_1 = \theta_2 = \theta_3 = ---\theta_m = 0$ is rejected against the alternative hypothesis. This means that there is statistical evidence to accept the alternative hypothesis, H_1.

c) The Vector Autoregressive (VAR) model

The study also uses a VAR framework to establish the direction of causality between education and economic growth. This should be done after testing the variables of the model for unit root tests using ADF test. The VAR methodology, although it does not have a sound theoretical framework, it can be used to test inter-dependent relationships among variables. In a VAR framework all variables are treated as endogenous variables and is a substitute methodology to simultaneous equations. The methodology will also employ innovation accounting and impulse response functions which are superior approaches to the traditional granger causality tests.

i. *The VAR Model Specification*

The VAR model to be used in our analysis is as follows;

$$X_t = \sum_{i=1}^{n} \beta_i X_{t-i} + \mu_t$$

where

$X_t = (PCRGDP_t, INVESTMENT_t, EDUCATION_t)$

which is a 3x3 vector of variables and $\beta_1 - \beta_n$ are 3x3 matrices of coefficients while μ_t is a vector of error terms.

If all the variables of the model are integrated of the same order, that is, I (1), then a VECM can be constructed in which all variables enters the above model in their first differences.

ii. *Cointegration within VAR*

Cointegration refers to the situation where two or more non stationary series of the same order are found to have a long run relationship. Suppose a series Y_t and X_t are individually non-stationary and integrated of order one, I (1), we say they are integrated if their linear combination is integrated of order zero, I (0). If the variables are integrated of the same order, cointegration tests will be performed. If the variables are integrated of different orders, then the unrestricted VAR framework will be employed.

iii. *Variance Decomposition*

Variance decomposition permits inferences to be drawn regarding the proportion of the movement in a particular time-series due to its own earlier "shocks" vis-à-vis "shocks" arising from other variables in the VAR. After estimating the VAR, the impact of a "shock" in a particular variable is traced through the system of equations to determine the effect on all of the variables, including future values of the "shocked" variable. The technique breaks down the variance of the forecast errors for each variable following a "shock" to a particular variable and in this way it is possible to identify which variables are strongly affected and those that are not.

iv. *Impulse Response Functions*

The impulse response function analysis traces the time path of the effects of "shocks" of other variables contained in the VAR on a particular variable. In other words, this approach is designed to determine how each variable responds over time to an earlier "shock" in that variable and to "shocks" in other variables. If the impulse response function shows a stronger and longer reaction of economic growth to a "shock" in education than "shocks" in other variables, we would find support for the hypothesis that education causes economic growth. Similarly, if the impulse response function shows a stronger and longer reaction of education to a "shock" in economic growth than "shocks" in other variables, we would find support for the hypothesis that economic growth "causes" education.

In this study causality on the following three variables will be tested, that is on, Economic Growth, Education and Investment. The variables are transformed to logarithms so as to improve on their statistical properties. However, the variable for economic growth was not expressed in logarithms since some values of this series are negative and thus there is no logarithm of a negative number. Therefore, the overall model is a semi-log model.

d) Variables of the model

In this model three variables will be used that is Economic growth, Education investment and aggregate investment. This is so because of their interrelatedness in growth in endogenous growth models. The number of variables has been limited to only 3 to ensure a sufficient number of observations. This is because of a small sample size used.

i. *Economic growth measured by per capita Real GDP (PCRGDP)*

Economic growth is defined as the increase in a nation's ability to produce goods and services over time as is shown by increased production levels in the economy. A growth in this per capita RGDP indicates an improvement in standards of living for citizens and hence leads to poverty reduction. This is the commonly used measure of economic growth as also used by Romer (1990), Rebelo (1991), Gupta and Chakraborty (2004) and Huang etal (2009). Economic growth is expected to relate positively and significantly with education and physical capital investment.

ii. *Human capital (Education)*

This refers to investment in education. New technological developments are futile if skills are in short supply, implying that there are significant synergies between new knowledge and human capital. It has been shown that education is an important empowering tool for gender equity and thus is assumed to significantly contribute to economic growth and poverty reduction (Ministry of Education, Sport, Arts and Culture, 2007). In this study education is proxied by time series variable of tertiary education enrolments (Huang et al, 2009) which sums university enrolment, teacher training colleges enrolment, agricultural training colleges enrolment and technical colleges enrolment for the period under study. This variable was chosen as it contributes directly to skilled human capital. This is a quantity measure of education which closely relates to the quality of education in the country. Secondary school enrolment used in some studies (such as by Musibau, 2005) suffers from the fact that not all students from secondary schools will constitute skilled human capital in the economy. In addition, secondary education only contributes to economic growth after a considerably long period as compared to tertiary education. Education expenditure is another variable that could be used as a proxy for education but it also fails to reflect the quality of education in the economy. The variable chosen is expected to positively and significantly relate with economic growth and physical capital investment.

iii. *Physical capital Investment (LINV)*

Physical capital (investment) refers to an increase in capital stock in the economy and is one of the traditional determinants of economic growth. Gross Fixed Capital Formation is used as a proxy for physical capital investment. This variable is used in this model as a control variable and also because investment has a bearing on both economic growth and human capital development. Chakraborty (1994) and Msibau(2005) also included physical capital (investment) as an important determinant in their growth models. This variable is expected to have a significant relationship with economic growth and education and vice versa.

e) *Data sources*

The annual data for the study is secondary data obtained from the Central Statistical Office and the Ministry of Higher and Tertiary Education. Only these sources of data were used for consistency. The time series data for the study span from 1980 to 2008. The period is fairly long enough to get accurate relationship between education investment and economic growth in Zimbabwe.

V. Estimation Of Results And Interpretation

a) *Stationarity tests*

Unit root tests are performed on the following variables, Economic growth (PCRGDP), Human Capital as measured by Tertiary Education Enrolment (LTEDU) and Physical Capital Investment (LINV). The results show that PCRGDP is stationary in levels while the other two variables become stationary after second differencing. This shows that the variables cannot be co-integrated and only an unrestricted VAR model can be estimated. Therefore, the variables will be used to test for Pairwise Granger causality and VAR according to their levels of stationarity. PCRGDP will not be differenced while LTEDU and LINV will be differenced twice. Table 1 summarises the unit root tests;

Table 1 : Unit Root Tests

Variable	ADF test Statistic	1% critical Value	5% critical Value	10% Critical Value	Result
PCRGDP	-4.169580**	-4.3382	-3.5867	-3.2279	Stationary (0)
LTEDU	-4.033913***	-4.3738	-3.6027	-3.2367	Stationary(2)
LINV	-5.119735***	-2.6603	-1.9552	-1.6228	Stationary(2)

****Significant at 1%, ** significant at 5% and *significant at 10%.*

Note : A constant and a trend option were used for levels and first differences while no trend and constant option was used for 2nd differencing.

b) *Pairwise Granger Causality Tests*[4]

Table 2 : Pairwise Granger Causality Tests

Null Hypothesis	Observations	F-Statistic	Probability
DDLINV does not Granger Cause PCRGDP	23	2.49972*	0.0900
PCRGDP does not Granger Cause DDLINV		0.74958	0.5745
DDLTEDU does not Granger Cause PCRGDP	23	3.28621**	0.0426
PCRGDP does not Granger Cause DDLTEDU		0.59217	0.6740
DDLTEDU does not Granger Cause DDLINV	23	2.41605*	0.0979
DDLINV does not Granger Cause DDLTEDU		0.81387	0.5371

****Significant at 1%, ** significant at 5% and *significant at 10%.*

The results in table 2 indicate that there is a uni-directional causality between economic growth and education. This is so because the null hypothesis of education does not cause economic growth was rejected at the 5% levels of significant. This clearly indicates that education causes economic growth. However, the reverse causality that economic growth causes education was found to be insignificant. This means that as education enrolment improves more skills are contributing to the growth of the economy, holding other factors constant. There is also a uni-directional causality running from investment to economic growth as the null hypothesis of no causality is rejected at the 10% level of significance. This is supported by theory which states that investment is a major determinant of economic growth. Investment also has a significant impact on education as the null hypothesis of no causality is rejected at the 10% level of significance. This shows that investment is an important variable in determining education in Zimbabwe.

c) *Estimation Results for VAR*

Before the VAR model is estimated, the optimal lag length was chosen using the Akaike Information Criteria (AIC). As Enders (1995) suggested, the optima lag is selected based on the lowest values of AIC. A VAR with the least AIC[5] was selected and this was found to be 4.

i. *Variance Decomposition*

Therefore 4 lags were used in the VAR model. Tables 3, 4 and 5 give the variance decompositions for the three variables included in the model. It can be noted that own series shocks explain most of the error variance even though the shock will also affect the other variables in the system.

Appendix 1 shows the variance decomposition tables for the 3 variables used in the analysis. Table 3 shows the variance decomposition for tertiary education. The results show that less than 5% of the shocks in tertiary education is explained by economic growth and physical capital investment throughout the period chosen. This confirms that either investment or economic growth do not cause education.

Deviations in investment are a result of tertiary education starting from the second period. The effect of tertiary education on investment significantly increases over time suggesting that investment significantly causes tertiary education. Economic growth only explains a maximum of 13% of deviations in tertiary education confirming that economic growth is not a significant cause of investment.

Lastly, much of the deviations in economic growth are caused by investment, starting to contribute 11% in the first period which gradually increases to a maximum of 33% in the 4th period. This shows that investment is an important driver of economic growth as also confirmed by theory. Tertiary education is another important variable that significantly explains deviations in economic growth. It started off by contributing 11% in the second period before rising to a maximum of 47% in the 5th period which stabilises at that rate throughout the entire period. This result suggests that tertiary education causes economic growth.

ii. *Impulse Response Functions*

Appendix 2 shows the impulse response functions for tertiary education, investment and economic growth. The response of a variable to itself is highly significant in the initial periods before other variables become influential. The response of economic growth (PCRGDP) to tertiary education is positive and significant. The response of tertiary education to economic growth is insignificant. This shows that tertiary education is an important variable that influences economic growth. The response of economic growth to investment is also positive and significant. The response of investment to economic growth is insignificant. This shows that investment causes economic growth and not vice versa. The response of investment to tertiary education is significant while the response of tertiary education to investment is insignificant. This shows that tertiary education causes investment and not vice versa.

VI. Conclusions And Policy Recommendations

a) *Conclusions*

The empirical results from granger causality tests, variance decomposition and impulse response functions confirm a uni-directional causality between education and economic growth in Zimbabwe. While education matters for growth, the reverse is not equally true. This confirms that investing more resources in human capital development is vital for labour productivity and growth of the economy. This in turn will lead to poverty reduction. The results also confirm that education can lead to economic growth through its impact on physical investment. Investing in human capital will lead to improvement in physical capital productivity which in turn leads to economic growth. A rise in human capital boosts the return on physical capital. Therefore, more resources should be put to the education sector, both public and private.

b) *Policy Recommendations*

The results from this study confirm that the education-economic growth relationship is a one way relationship. While education matters for economic growth, the reverse is not equally true. This result has a number of policy implications. The first one is that they support the role of human capital development in

[4] A lag length of 4 was chosen using the Akaike Information Criteria.

[5] With a lag of 1, AIC=7.4675, with a lag of 2, AIC=7.5007, with a lag of 3, AIC=7.5698 and with a lag of 4, AIC is 7.4120.

investment, economic growth and development. Therefore there is need to increase not only the quantity of resources but also the quality of resources into the education sector. This is in line with the Nziramasanga (1999) commission of inquiry into the education system in Zimbabwe which also recommends the need to increase resources into the education sector for it to contribute meaningfully to economic development. A more educated labour force will have a higher marginal productivity of labour and thus contributes more to national output. Investment in education should also be demand-driven as this will make it meet the demands of the industry in light of the dynamic nature of production methods. There is also need for adequate training even after tertiary education to ensure that education skills are more relevant for economic growth. Students at tertiary institutions also need a lot of mentoring well before they finish their education as this ensures that they adequately prepare themselves for their chosen fields and thus contribute to economic growth and poverty reduction.

Emphasis should also be put on enlarging the participation of women in education as this is perceived to contribute more to economic growth through reduced fertility, late marriages and leads to a more educated future generation through the encouragement of children. This will significantly contribute to poverty reduction.

Secondly, there is need for a shared responsibility in educating our population. This means that the private sector should also play a major role in the education sector through paying fees for students particularly the more vulnerable ones, like the girl-child and the orphans. They can also assist with infrastructure on education and that which is closely linked to education, food and education materials provision. This will enhance the impact of education on economic growth and poverty reduction. The private sector can also assist with the remunerations for staff since this has a bearing on their performance and the ultimate performance of the students.

However, future studies can focus on using other measures of education such as those that focus on the quality of education rather than on the quantity. This study failed to do that due to data unavailability. Such measures include cognitive skills which show attainment rates for particular grades especially in mathematics and science, individuals' average years of schooling of population aged 25 and 64 and experience at work places. A strong rise in the years of education of a high quality is particularly relevant for economic growth but the challenge is that it is difficult to measure especially in developing countries such as Zimbabwe. To this end, high enrolment rates together with efficient use of financial resources are necessary but not exhaustive conditions for economic growth.

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Appendices

Appendix 1 : Variance Decomposition Tables

Table 3 : Variance Decomposition for DDLTEDU

Period	S.E.	DDLTEDU	DDLINV	PCRGDP
1	0.132953	100	0	0
2	0.147674	98.6401	1.358669	0.001228
3	0.149766	95.92398	3.893755	0.182262
4	0.1962	93.76735	4.148887	2.083766
5	0.201138	91.57234	4.159214	4.268446
6	0.20353	91.01019	4.821066	4.168742
7	0.23524	93.11555	3.62191	3.262544
8	0.243455	93.35292	3.415165	3.231912
9	0.243838	93.23465	3.437663	3.327687
10	0.265576	93.9999	3.014176	2.985922

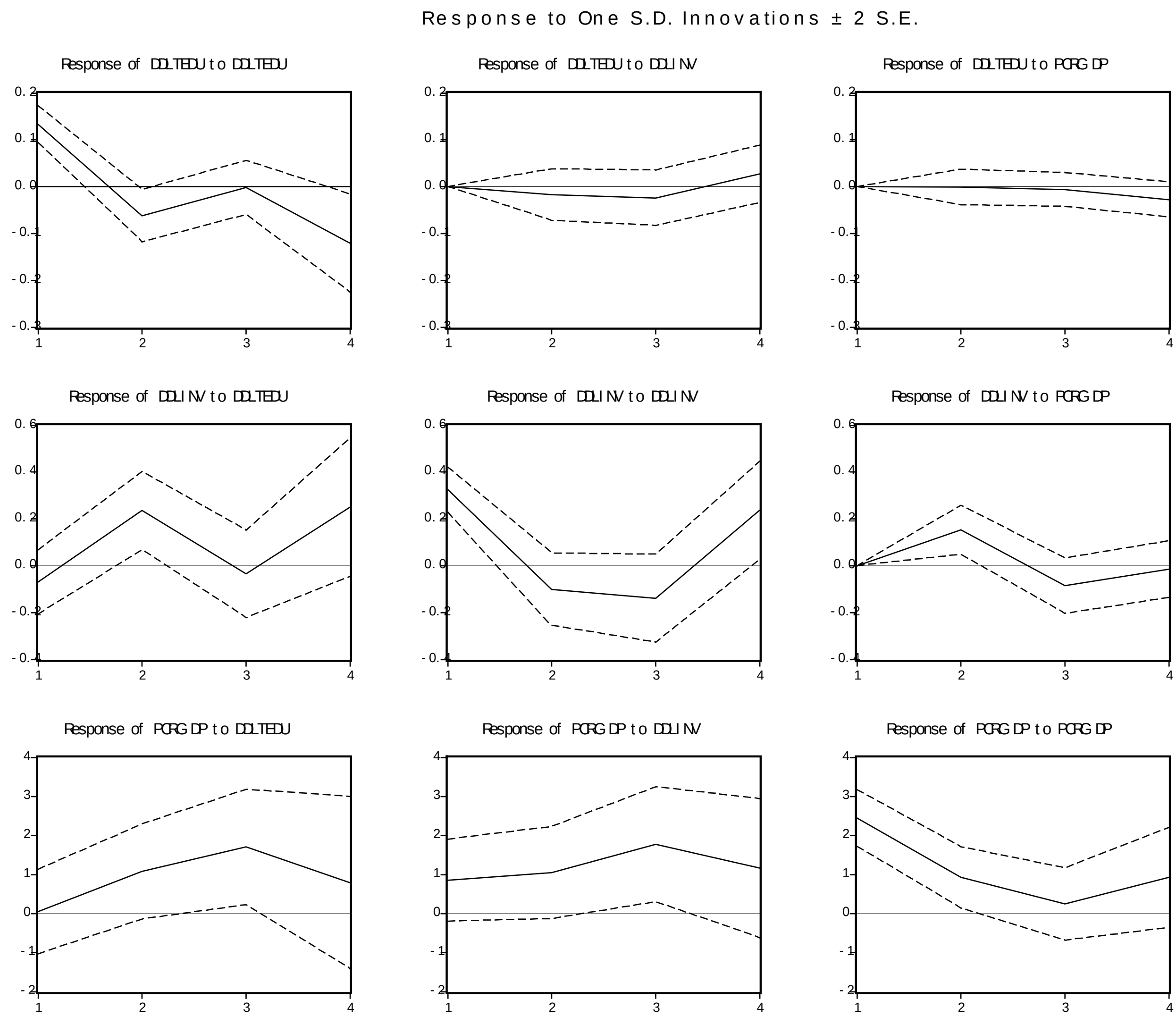
Table 4 : Variance Decomposition for DDLINV

Period	S.E.	DDLTEDU	DDLINV	PCRGDP
1	0.332286	4.237047	95.76295	0
2	0.446605	30.18003	58.10556	11.71442
3	0.476901	27.01032	59.48867	13.50101
4	0.588477	35.89705	55.17643	8.926515
5	0.701082	54.43792	38.90116	6.660927
6	0.752623	54.9954	39.21613	5.788476
7	0.787784	55.70925	38.1143	6.176446
8	0.827345	56.9001	35.57585	7.524051
9	0.845874	55.57762	36.90615	7.51623
10	0.864496	57.43756	35.3354	7.227039

Table 5 : Variance Decomposition for PCRGDP

Period	S.E.	DDLTEDU	DDLINV	PCRGDP
1	2.592462	0.040953	10.96689	88.99216
2	3.137341	11.8007	18.71127	69.48803
3	3.994078	25.50605	31.25105	43.2429
4	4.334513	24.9317	33.76839	41.29991
5	5.417441	47.36118	25.5491	27.08972
6	5.460858	47.06743	26.03614	26.89643
7	5.478846	47.39748	25.87483	26.72769
8	5.655308	46.83071	27.44988	25.71941
9	5.704444	46.03264	27.844	26.12337
10	5.826616	47.25036	27.60707	25.14257

Appendix 2 : Impulse Response Functions



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