Economic Growth and Trade Openness: Evidence from Zambia

Elias Muwau[1,*], Manenga Ndulo[2]
[1] University of Lusaka (Zambia)
[2] University of Zambia (Zambia)

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Summary: This paper sought to investigate the causal relationship between economic growth and trade openness using time series data of Zambia for the period 1978 to 2016. Two additional variables, Foreign Direct Investment (FDI) and physical capital were incorporated to form a multivariate framework. Autoregressive Distributed Lag (ARDL) bound approach was used to determine the presence of the long run relationship among the variables while the Vector Error Correction Model (VECM) was used to determine the direction of causality among the variables, both in the short run and long run.
The ARDL revealed a significant long run relationship among the variables. Physical capital was found to have a significant long run effect on economic growth but highly insignificant in the short run. Bi-directional granger causality was significant between economic growth and trade openness in the short run. The study also established a unidirectional short run causality flowing from physical capital to trade openness and from FDI to economic growth. Strong long run causality was found flowing from economic growth, FDI and physical capital to trade openness. The study further established a weak long run causality flowing from economic growth, trade openness and FDI to physical capital.

Keywords: Economic Growth; Trade Openness; Causality; Autoregressive Distributed Lag
Jel Classification Codes : F43, O56

I- Introduction :

There has been controversy amongst economists regarding the nature of the relationship between trade openness and economic growth. The standard neoclassical model of exogenous growth postulates that changes in trade openness can only affect the pattern of product specialization but not the long term rate of economic growth, while the new growth theory postulates that changes in trade openness can influence long term economic growth rate but the nature of the impact of trade openness on long term rate of economic growth when trading partners are structurally different in terms of innovation is ambiguous (Khobai and Mavikela, 2017). Almost every country trades with at least one other country for different commodities. Trade openness has different effects on the growth of different countries. Openness to trade is mostly related to exports and imports because the most used definition of openness is the ratio of the sum of export and import to GDP of a country (Semancikova, 2016).
The Zambian economy has been relatively open since colonial times. At independence in 1964, Zambia was heavily dependent on copper as its major export commodity. In 1970, copper accounted for over 90 percent of Zambia's foreign earnings, 40 percent of her gross domestic product (GDP) and 50 percent of the government earnings (Bostock and Harvey, 1972). The government adopted new economic policies that were aimed at diversifying the economy into agriculture and industrial development beginning in 1968 to increase the sources of foreign exchange.

* Corresponding author, e-mail: eliasmuwau@ymail.com

Non-traditional exports grew rapidly hitting 17 percent in 1995 from 8 percent recorded in 1990 (WTO, 1996). Zambia experienced a further increase in non-traditional exports beginning 2010. The Sixth National Development Plan which is prepared by the Government of the Republic of Zambia indicates that the share of non-traditional exports in Zambia's total exports reached 22.1 percent in 2011 from the 17.9 percent which was recorded in 2010. Statistics from the Bank of Zambia indicate that non-traditional exports contributed to more than 30 percent of merchandise exports in 2012 (The World Bank Group, 2014).

On the trading partners, Zambia's main partners for exports are Switzerland, China, Democratic Republic of Congo, Singapore, South Africa, United Arab Emirates, United Kingdom, India, Hong Kong, Zimbabwe, Malawi, Tanzania, Kenya, Luxembourg, and Rwanda. Zambia's major import partner is South Africa followed by Congo- Kinshasa and China from which she imports machinery, clothing and foodstuff.

Openness to trade is also affected by the intensity of trade restrictions imposed by the trading country. Zambia grants at least m.f.n. (most favoured nations) treatment to all its trading partners and after gaining her independence, Zambia applied the general agreement on tariffs and trade (GATT) based on a de facto until it became a contracting party in February 1982 (WTO, 1996). This helped to widen Zambia's openness degree.

I.1.Problem Statement

Zambia's growth has been fluctuating over time. For the past three decades, the growth performance of the Zambian economy was less satisfactory in the first of the three decades. The last two decades have seen an improvement in the growth rate of the nation. Apart from Copper, Zambia also export Cobalt, food, flowers, live animals, cotton and other tradable commodities. Trading with other countries has allowed Zambia to experience technological transfer, and a taste to other commodities which are produced abroad. Zambia import machineries, petroleum products, foodstuffs, chemicals, transport equipment among other importable commodities. Further, international trade is usually considered as one of the main sources of acquiring foreign exchange, and leads to competition in production as our local producers want to remain competitive and hence produce quality local products. However, this technological transfer, use of foreign produced goods, foreign exchange generation, and competition on local production, through opening to international trade, has not been clearly isolated to be an ingredient into Zambia's growth. The effect of trade openness on the growth of the Zambian economy still remains unclear. These uncertainties in the influence of trade openness pose a key question, as a pillar for this study; "Does trade openness influence economic growth of the Zambian economy?"

I.2.Research Objectives

The main objective of this study was to investigate the linkage between trade openness and economic growth.

Specific Objectives include:

1. To determine whether trade openness has a causal effect on economic growth in Zambia.
2. To determine whether economic growth has a causal effect on Trade openness in Zambia.
3. To determine whether the individual short run effect of trade openness, FDI and physical capital on economic growth differs from the individual long run effect of the same variables on economic growth.

I.3.Research Hypotheses

H0: Trade openness has no causal effect on economic growth.
H1: Trade openness has a causal effect on economic growth.

H0: Economic growth has no causal effect on trade openness.
H1: Economic growth has a causal effect on trade openness.

H0: Individual short run effect of trade openness, FDI, and physical capital on economic growth is not significantly different from the individual long run effect of the same variables on economic growth.

H1: Individual short run effect of trade openness, FDI, and physical capital on economic growth is significantly different from the individual long run effect of the same variables on economic growth.

II. Literature Review

This section presents the theoretical and empirical literature in line with the study.

II.1. Theoretical Literature Review

Mercantilist View on Trade

The merchants, bankers, government officials and philosophers, wrote essays on international trade during the seventeenth and eighteenth centuries. They advocated for an economic philosophy known as mercantilism. In these essays, they demonstrated and maintained their view of trade, that for a nation to become rich and powerful, it needed to export more than it imported (Salvatore, 2013). In other words, the mercantilists maintained that a nation needed to maintain a positive trade balance for it to become rich and powerful. In their view, the economy would grow by restricting imports and encouraging exports. By so doing, government would stimulate national output and employment. Some of the propagandist of this theory is Thomas Munn (1571 - 1641) Jean Baptiste Colbert and Thomas Hobbes. In the times that the theory was established, the most important way in which a country could be rich was by acquiring precious metals such as gold. The more gold a nation acquired the more money it had in circulation and the greater business activities to allow for the continued growth of the nation. In the view of the mercantilists, openness was better measured using exports because the more exports a nation made, the wealthier the economy became and thus, the higher the growth rate for the nation.

Absolute Advantage as a Basis for Trade

This theory was established by Adam Smith (1776) and was presented in his popular writing on the wealth of the nation. In his writing on the view of trade, he criticized the view that the mercantilist had and argued that nations can only engage in trade if they all gain. Smith (1776) argued that if one nation gains, while the other doesn't (as implied in the mercantilist view) then the nation that does not benefit from trade will simply refuse to trade. In his view of trade, Smith argued that nations can trade based on absolute advantage. That is, when one nation is more efficient than another nation in the production of one commodity but is less efficient than the other nation in producing a second commodity, then both nations can gain by each specialize in the production of the commodity of its absolute advantage and exchange part of its output with the other nation for the commodity of its absolute disadvantage (Salvatore, 2013). The results from such trading were expected to lead to a utilization of resources in the most efficient way and a rise in the output of both commodities. In the view of Adam Smith, resources would be utilized in the most efficient way and world welfare would be maximized if there was free trade. Hence, he advocated for the policy of Laissez-faire and maintained that national economies would grow if the government has less interference with the movement of commodities between countries. Adam Smith highly advocated for the maximum degree of openness to international trade. This openness was viewed as one of the ways in which nations would grow and get the maximum possible share of the world's growth through trade.

Comparative Advantage as a Basis for Trade

This theory is a build up from the law of absolute advantage and it was brought forward by Ricardo (1817). This theory says that even if one nation is less efficient than the other nation in the production of both commodities, there is still a basis for mutually beneficial trade which can occur if the first nation specializes in the production and exportation of the commodity of comparative advantage and import the commodity in which its absolute disadvantage is greater (Salvatore,

2013). However, the assumption of the labor theory of value made it hard for the theory to be seen true. Haberler (1936) explained the law of comparative advantage using the opportunity cost theory which says that the cost of a commodity is the amount of a second commodity that must be given up to release just enough resources to produce one additional unit of the first commodity. The opportunity cost theory stresses that a nation will specialize in the production of a commodity with a lower opportunity cost and export part of the output and import the other commodity that has a higher opportunity cost of production. As nations trade freely, their economies grow since both nations gain from trade. Just like the law of absolute advantage, this theory also provides a basis for the link between trade and economic growth.

Heckscher – Ohlin Trade Theory

This theory was established by two Swedish economists, Eli Heckscher and Bertil Ohlin. The theory tries to highlight two things in the theory of comparative advantage. First, it highlights on what factors determine comparative advantage of countries and second, it also highlights on the effects of trade on factor income in the trading countries? The theory rests on a number of simplifying assumptions and Salvatore (2013) listed these assumptions.

The Heckscher-Ohlin theory built an explanation on the above two issues captured from the theory of comparative advantage and conclude that trade increase total world output, and that all countries gain from trade. The theory also helps to explain how trade enables countries to secure capital and consumption of goods from other parts of the world. With all this, it is clear from the theory that, trade stimulates economic growth. "Economic growth means the steady process by which the productive capacity of the economy is increased over time to bring about rising levels of national output and income" (Nageri et al, 2013). The 1970s economists looked at growth theories in the perspective of the Ricardian-Heckscher-Ohlin trade model drawn from Solow (1957) Model where it was pointed out that the country allocates its resources more efficiently after opening up to trade based on its comparative advantage and that trade openness will bring only a one time increase in output (Khobai and Mavikela, 2017). This one-off increase was observed to have no impact on the long run growth. Hence long run output growth is exogenous in this model.

Solow Growth Model

The Solow model puts a focus on four things namely; output, capital (through savings and investment), labour (through population growth and education) and knowledge (through technological progress). Solow (1956) replaced the existing production function with the neoclassical production function. To understand the growth process, Solow assumed diminishing returns to capital and constant returns to scale in the production process. Solow's model included a 'sources of growth analysis' procedure which was intended to determine the magnitude of the effect each of his inputs had on the growth of the economy (Waithaka, 2012). The model brought up by Solow predicts that countries with high investment rates, low population growth rates and low rates of depreciation are likely to have more output per worker; and that countries with a larger population are likely to have larger economies ceteris paribus. This model postulates that output growth occurs because of increases in labour quantity and quality, increases in capital, or improvements in technology or a combination of two or all of these factors.

This theory, however, is not sufficient in providing an explanation for the relationship between trade openness and economic growth in that it does not sufficiently explain the determinants of the change in technology. Therefore, the next section covers the new growth theory which seeks to explain the linkage between trade openness and economic growth, and also explain what determines the changes in technology.

The New Growth Theory

This theory stands on the ground that investments and technology are the two linkages between trade openness and economic growth. In the line of investment, the theory highlights that since the traded sector is more capital intensive than is the non-traded sector and the low price of capital due to competition in the international market of machinery and capital equipment, trade

openness tends to promote economic growth (Khobai and Mavikela, 2017). In the technology link, trade openness is argued to possibly increase technology due to technology spill-over, economies of scale in research and development and high profits to innovators, which can be provided by a large international market (Grossman and Helpman (1990); Romer (1990); Rivera-Batiz and Romer (1991); Coe and Helpman (1995)) cited by Khobai and Mavikela (2017).

Rivera-Batiz and Romer (1991), and Grossman and Helpman (1990) points out four distinct opportunities through which trade openness may lead to long run economic growth:

1. Communication effect: A nation that opens up to international trade tends to have an opportunity to communicate with foreign counterparts. The communication then facilitates the transmission of technology (Grossman and Helpman, 1990).
2. Duplication effect: Some new ideas and technology get to be invented due to trade openness and eventually, this prevents duplication of research and development efforts (Rivera and Romer, 1990). More new ideas are likely to lead to a long run economic growth (Grossman and Helpman, 1990).
3. Integration effect: This effect argues that openness to international trade increases the size of the market that firms can access. A larger market size of research and development sector increases R&D activities and as a results economic growth in this sector also increases because of the presence of increasing returns to scale in the sector (Grossman and Helpman, 1990).
4. Allocation effect: Openness to international trade allows countries to specialize in the production of the commodities of their comparative advantages that are determined by factor endowment. Upon opening to international trade, relative factor prices are subject to change (Grossman and Helpman, 1990).

II.2. Empirical Literature Review

Zombe (2014) conducted a study which aimed at investigating the causal relationship among financial development, trade openness, and economic growth in Zambia from 1965 to 2011. He used the Johansen co-integration test to establish the long run relationship among the variables and the VECM for the granger causality test. The Johansen co-integration tests validated the existence of a long run relationship among the variables. Trade openness was found to significantly cause economic growth when broad money was used as a measure of financial development. However, trade openness and economic growth caused financial development when domestic credit to private sector was used to measure financial development. The author highlighted on the importance for policy makers in Zambia to pursue policies that further open up the economy to international trade with caution because trade openness was found to hinder the growth of domestic credit to the private sector in the short run.

Malefane and Odhiambo (2018) examined the impact of trade openness on economic growth in South Africa using annual time series data covering the period 1975 to 2014. The authors used the autoregressive distributed lag (ARDL) bounds testing approach to investigate the dynamic impact of trade openness on economic growth. Four trade openness proxies were used to arrive at robust results. The first proxy was the ratio of total trade to GDP. The second proxy was the ratio of exports to GDP. The third proxy was the ratio of imports to GDP, and the last proxy is an index of trade openness, which captures the effects of residual openness, resulting from taking the country's size and geography into account. The results of their study indicated a positive and significant long run impact of trade openness on economic growth when the ratio of total trade to GDP is used as a proxy, but not when the other three proxies were employed. The short run results, however, indicated a significant positive impact of trade openness on economic growth when the first three trade openness proxies are employed, but not so when the trade openness index is employed. The authors, therefore, suggested that the promotion of policies that support international trade were relevant for the South African economy.

Keho (2015) conducted a study which analysed the relationship among foreign direct investment, exports, and economic growth in 12 selected Sub-Saharan African countries over the

period 1970 to 2013. The study employed the multivariate co-integration approach of Johansen and the results showed that the three variables were co-integrated in ten countries. Economic growth was found to have a long run effect on FDI in five countries. The results also reviewed a short run bidirectional causality between FDI and the economic growth proxy (GDP).

Zahonongo (2017) took evidence from Sub-Saharan Africa and conducted a study on trade and economic growth in developing countries. The main objective of the study was to investigate how trade openness affects economic growth in developing countries, with a focus on the Sub-Saharan Africa. The study used data from 42 Sub-Saharan African countries, covering the period 1980 to 2012, and employed the pooled mean group estimation techniques. It was found in this study that trade openness had a positive and significant effect on economic growth.

Olufemi (2004) conducted a study on trade openness and economic growth in Nigeria. This study took further evidence on the causality issues. The main aim of the study was to investigate the causality between trade openness and economic growth using data from the Nigerian economy. The study used the Johansen co-integration technique and the VECM to arrive at its findings. The author found that there was a long run relationship between economic growth and trade openness in Nigeria and that economic growth causes trade openness. The later observation was a unidirectional causality.

Moyo et al (2018) conducted a study on the relationship between trade openness and economic growth in Ghana and Nigeria for the period 1980 to 2016. The study employed the ARDL approach to examine the long run relationship between variables. The study found the existence of a long run relationship among variables for both countries. In addition, the results showed that while trade openness had a positive impact on economic growth of Ghana at 1% level of significance, it had a negative and insignificant effect on economic growth of Nigeria.

Belloumi (2014) conducted a study which sought to examine the relationship between foreign direct investment (FDI), trade openness and economic growth in Tunisia using the Autoregressive Distributed Lag Bounds approach to co-integration for the period 1970 to 2008. The results showed that the variables in the model were co-integrated when FDI is the dependent variable. The results also indicated that there was no significant short run Granger causality from FDI to economic growth, from economic growth to FDI, from trade openness to economic growth, and from economic growth to trade openness.

A study was conducted on Cote d'Ivoire by **Keho (2017)**. The main aim of the study was to examine the impact of trade openness on economic growth for Cote d'Ivoire over the period 1965 to 2014 in a multivariate framework including capital stock, labour and trade openness as regressors. The study used two techniques of the Autoregressive Distributed Lag bounds test and the Toda and Yamamoto Granger causality test to arrive at the results. In this study, trade openness was found to have a positive effect on economic growth both in the short run and long run. The study also identified a strong complementary relationship between trade openness and capital in promoting economic growth.

Khobai and Mavikela (2017) conducted a study in Argentina which aimed at investigating the causal relationship between economic growth and trade openness using data covering the period 1970 to 2016. They used the Autoregressive distributed lag (ARDL) model and the vector error correction model (VECM) to investigate the relationship. In addition to economic growth and trade openness, the authors used FDI and physical capital as additional variables to form a multivariate framework. The ARDL results validated the existence of a long run relationship between economic growth, trade openness, FDI and capital. They further observed a long run causality flowing from trade openness, foreign direct investment and capital to economic growth.

Muhammad et al (2012) conducted a study on the causal relationship between trade openness and economic growth and took the empirical evidence in the case of Pakistan. The authors employed the Johansen co-integration test and the error correction model to examine the

long run relationship and used annual data from 1970 to 2012. The results indicated that a significant relationship between openness and economic growth existed.

Dutta et al (2017) took evidence from Bangladesh to investigate the causal relationship among economic growth, domestic investment, foreign direct investment and trade openness over the period 1976 to 2014. The authors employed the Phillips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests of unit root to test for the stationarity of the variables employed in the study. The Johansen co-integration test was employed to test for the long run relationship among the variables and the Granger Causality test based on the vector error correction model (VECM) was used to test for any existence of the causal relationship among the variables. The findings of the study revealed that all variables were non-stationary in their level form but became stationary after taking the first difference of each variable. The Johansen co-integration test validated the existence of a long run relationship among the variables and the VECM established some causal relationships. A unidirectional causality was found flowing from FDI to economic growth, domestic investment to trade openness, and from economic growth to trade openness. Further, the authors found bidirectional causality between domestic investment and economic growth, and between domestic investment and FDI. The authors recommended for an FDI led growth.

Adhikary (2011) conducted a linkage analysis on FDI, trade openness, capital formation, and economic growth in Bangladesh using time series data for the period 1986 to 2008. The author employed the VECM to determine the causal linkage among the variables. A unidirectional causality was observed from trade openness, FDI and capital to economic growth. Following the results from the short run model, trade openness was found to have a significant negative but diminishing effect on economic growth while FDI and capital had a significant positive effect on economic growth. FDI led policies became the main recommendation from these findings.

Idris et al (2016) conducted a study which aimed at investigating the relationship between trade openness and economic growth in 87 selected countries which included both Organizations for Economic Co-operation and Development (OECD) countries and developing countries for the period 1977 to 2011. The authors adopted two measures of trade openness. The first measure considered the ratio of the sum of export and import in their nominal values to nominal GDP. The second measure considered trade openness in real values and this method takes the ratio of export and import in US$ to real GDP. The authors adopted the General Method of Moment (GMM) technique and observed a significant bidirectional causal relationship for both developing countries and OECD countries. That is, trade openness was found to cause economic growth and then economic growth further caused trade openness.

II– Methods and Materials:

II.1. Model Specification

The model which was used in this study states that real GDP per capita is a function of trade openness, foreign direct investment (FDI) and physical capital. FDI and physical capital are control variables. The authors of this paper were fully aware of the contributions which human capital makes to economic growth according to literature such as the Solow model; however, there was incomplete data for human capital to cover the study period. The author used physical capital as used in most studies such as those conducted by Adhikary (2011), and Khobai and Mavikela (2017). The model of this study took the following general form;

$$GDP_t = f(OPEN_t, FDI_t, K_t)$$

Where,

GDP_t = Real Gross Domestic Product per capita over time
$OPEN_t$ = Trade openness over time
FDI_t = Foreign direct investment over time
K_t= Physical capital over time

Specifically, the econometric model that was used in this study is in logarithmic form.

$$LGDP_t = \beta_0 + \beta_1 LOPEN_t + \beta_2 LFDI_t + \beta_3 LK_t + \epsilon_t$$

Where,

$LGDP_t$ is the natural log of per capita real GDP using 2010 as base year (proxy for economic growth)

$LOPEN_t$ is the natural log of trade openness,

$LFDI_t$ is the natural log of foreign direct investment, and

LK_t is the natural log of gross fixed capital formation (proxy for physical capital)

ϵ_t = error term

The a priori expected signs for the parameters of the model are $\beta_1>0$, $\beta_2>0$ and $\beta_3>0$.

II.2. Data Sources

This study used annual time series data of Zambia for the period 1978 to 2016. Due to some discontinuities in the data sourced from local sources, the study made use of the data from the World development indicators through the World Bank data bank.

II.3. Variable Measurement

In this study, gross domestic product (GDP) per capita using 2010 constant prices was used to indicate economic growth. Using per capital real GDP to measure economic growth was used by several researchers in their studies such as Khobai and Mavikela (2017), and Malefane and Odhiambo (2018).

The study used net inflows (BoP, current US$) to measure foreign direct investment. The authors were aware that FDI is a smaller component of total BoP current inflows, however, the problem of data availability for the study period led the author to use net inflows (BoP, current US$) to measure FDI.

Physical capital was measured using gross fixed capital formation using 2010 as the base year. The use of gross fixed capital formation is evident from other studies such as Hye and Lau (2015).

The ratio of exports plus imports to GDP was used to measure trade openness. It was noted in this study that measuring trade openness as the ratio of exports plus imports to GDP has many weaknesses such as those spotted by Lloyd and Maclaren (2000). The two authors identified two limitations of this measure. The first limitation they stated was that figures in the numerator and denominator are in current prices and these prices may change over time for internationally traded goods and services, and for domestic goods and services these prices may diverge due to changes in exchange rate or other relative price movements. The second limitation is that the measure depends on two quit distinct sets of factors; (i) resource endowments, country size, tastes, technology and other determinants of comparative advantage. (ii) level of trade restrictions. There are however, some other measures which are used in literature to measure trade openness. These include; the ratio of exports to GDP, the ratio of imports to GDP, and the index of openness which captures the effects of residual openness resulting from taking the country's size and geography into account. However, due to data limitations on the third measure of trade openness, this study went ahead and used the total trade to GDP ratio as a measure of trade openness because it has been extensively used in literature. This measure has been used by many researchers in literature such as Zombe (2014) and Daniels and Vanhoose (2009).

II.4. Estimation Techniques

The software used to analyze the data was E-views 10. This study used the autoregressive distributed lag (ARDL) model to depict the long run and short run relationship between economic growth, trade openness, foreign direct investment, and physical capital.

The dataset was logged, and the unit root tests was conducted to test the stationarity of the data before analysis. To conduct the unit root test, the Augmented Dickey-Fuller test and the Phillips-Perron unit root test were used. Upon obtaining the order of integration of the series,

ARDL bound test to co-integration was used to check for the existence of any long-run or equilibrium relationship between economic growth, trade openness, foreign direct investment, and physical capital. Further, the Granger causality tests was conducted based on the VECM to determine the direction of causality relationships among the variables of the model.

II.5. Co-integration test

In order to determine the long run relationship between economic growth, trade openness, foreign direct investment and physical capital, this study employed the Autoregressive Distributed Lag bound approach. This model was developed by Pesaran et al (2001). Harris and Sollis (2003) highlights three major advantages of the ARDL approach; (i) it does not need all variables under study to be integrated of the same order and it can be applied when the underlying variables are integrated of order one, order zero, or fractionally integrated. (ii) The ARDL test is relatively more efficient in the case of small and finite sample data size. (iii) By applying the ARDL technique we obtain unbiased estimates of the long run model. However, it is important to also note one of the limitations of the ARDL technique that it cannot be applied if we have variables stationary at second difference. The ARDL test involves estimating the following conditional error correction models:

$$\Delta LGDP_t = \alpha_1 + \alpha_T T + \alpha_{GDP} LGDP_{t-1} + \alpha_{OPEN} LOPEN_{t-1} + \alpha_{FDI} LFDI_{t-1} + \alpha_K K_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LGDP_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta LOPEN_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta LFDI_{t-k} + \sum_{m=0}^{t} \alpha_m \Delta LK_{t-m} + \varepsilon_{1t}$$

$$\Delta LOPEN_t = \alpha_2 + \alpha_T T + \alpha_{GDP} LGDP_{t-1} + \alpha_{OPEN} LOPEN_{t-1} + \alpha_{FDI} LFDI_{t-1} + \alpha_K K_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LGDP_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta LOPEN_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta LFDI_{t-k} + \sum_{m=0}^{t} \alpha_m \Delta LK_{t-m} + \varepsilon_{2t}$$

$$\Delta LFDI_t = \alpha_3 + \alpha_T T + \alpha_{GDP} LGDP_{t-1} + \alpha_{OPEN} LOPEN_{t-1} + \alpha_{FDI} LFDI_{t-1} + \alpha_K K_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LGDP_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta LOPEN_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta LFDI_{t-k} + \sum_{m=0}^{t} \alpha_m \Delta LK_{t-m} + \varepsilon_{3t}$$

$$\Delta LK_t = \alpha_4 + \alpha_T T + \alpha_{GDP} LGDP_{t-1} + \alpha_{OPEN} LOPEN_{t-1} + \alpha_{FDI} LFDI_{t-1} + \alpha_K K_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LGDP_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta LOPEN_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta LFDI_{t-k} + \sum_{m=0}^{t} \alpha_m \Delta LK_{t-m} + \varepsilon_{4t}$$

Where:

$LGDP_t$ is the natural log of real GDP per capita using 2010 as the base year

$LOPEN_t$ is the natural log of Trade openness

$LFDI_t$ is the natural log of foreign direct investment

LK_t is the natural log of gross fixed capital formation

T is the time period under consideration

Δ is the first difference operator

ε_{it} , i = 1, 2, 3, 4 are the residuals and ε_{it} are normally distributed

This test is based on the F-test. The hypothesis here is that;

$H_0: \alpha_{GDP} = \alpha_{OPEN} = \alpha_{FDI} = \alpha_K = 0$

$H_1: \alpha_{GDP} \neq \alpha_{OPEN} \neq \alpha_{FDI} \neq \alpha_K \neq 0$

The null hypothesis is formulated to indicate no co-integration while the alternative hypothesis is formulated to indicate the presence of co-integration. This implies that the rejection of the null hypothesis would indicate the presence of co-integration at a given level of significance under consideration. This would occur if the calculated F-statistic exceeds the upper critical bound value. If the F-statistic falls below the lower critical bound value, the null hypothesis would not be

rejected, and this would indicate nonexistence of co-integration. Inconclusive results about co-integration would be arrived at if the F-statistic fall between the two critical bound values.

III- Results and discussion :

The normality test of data points for each variable was followed by the selection of an optimal lag. In Table 1 the VAR approach chose an optimal lag of 1. The unit root results obtained from the Augmented Dickey Fuller and Philips-Peron results both indicated a mixture of the I(0) and I(1) variables. This necessitated the use of the ARDL model as it is suitable for such a mixture of integration. Results from the bounds test of integration in Table 3 indicated a significant long run relationship between economic growth, trade openness, FDI, and physical capital. These results are consistent with Khobai and Mavikela (2017).

The study found that in the long run, trade openness and foreign direct investment have an insignificant long run effect on economic growth. Physical capital on the other hand was found to have a significant long run effect on economic growth and this is consistent with the finding of Adhikary (2011). Specifically, Table 4 shows that a 1 percent increase in physical capital would increase economic growth by 0.284 percent in the long run, ceteris paribus.

Results from the short run estimations showed a different picture. The results indicate that trade openness has a negative and significant short run effect on economic growth at 5 percent level of significance. FDI has a significant positive short run effect on economic growth at all conversional levels of significance (i.e. 1 percent, 5 percent and 10 percent levels of significance). These results are consistent with Adhikary (2011) who conducted a study in Bangladesh and recommended for the FDI led policy formulation, but contrary to the findings of Keho (2017) who observed a positive effect of trade openness on economic growth. Physical capital was dropped from the short run model by the specified ARDL (1, 1, 1, 0). Specifically, Table 5 shows that a 1 percent increase in trade openness would reduce economic growth by 0.075 percent in the short run, ceteris paribus. Similarly, all things equal, a 1 percent increase in FDI would increase economic growth by 0.032 percent in the short run. Lastly, the -0.099619 ECM (-1) coefficient supports the existence of the long run relationship among the variables in the model at 5 percent and all other conversional levels of significance. The results indicate further that the departure from the long run growth path due to a certain shock is adjusted by 9.96 percent every period.

Table 6 presents the Granger causality results from the VECM. The results indicate that there is no significant long run causality moving from trade openness, FDI and capital to economic growth. However, significant long run causality is observed at 1 percent level of significance flowing from economic growth, foreign direct investment and physical capital to trade openness.

Bi-directional short run causality was observed between trade openness and economic growth. Unidirectional short run causality was observed flowing from FDI to economic growth and from physical capital to trade openness. No short run causality was observed flowing from economic growth, trade openness and FDI to physical capital or from economic growth, trade openness and physical capital to FDI.

IV- Conclusion:

This study sought to investigate the causal relationship between economic growth and trade openness using time series data of Zambia for the period 1978 to 2016. Two additional variables (FDI, and physical capital) were incorporated to form a multivariate framework. The study employed the autoregressive distributed lag bound approach to co-integration to determine the presence of the long run relationship, and Granger causality test by use of the VECM to determine the direction of causality among the variables both in the short run and long run.

The Augmented Dickey-Fuller and the Phillips-Perron unit root test results indicated that trade openness and FDI were stationary at their levels meaning they are I(0), while economic growth and capital were stationary at their first difference meaning they are I(1). This provided basis for employing the ARDL bound approach to co-integration. A lag of one was adopted based on the Schwarz Information Criterion and the long run relationship was significant among economic growth, trade openness, FDI and physical capital. Physical capital was found to have a significant positive effect on economic growth in the long run. Trade openness and FDI was found

to have an insignificant long run effect on economic growth. The study also found a significant negative effect of trade openness on economic growth and a significant positive effect of FDI on economic growth in the short run.

The Granger causality test results based on the VECM indicated that there is no significant long run causality flowing from trade openness, FDI and physical capital to economic growth on the Zambian economy. However, significant long run causality was observed flowing from economic growth, FDI and capital to trade openness. Additionally, weak long run causality was found flowing from economic growth, trade openness and FDI to physical capital. The short run results of the VECM indicated the presence of a significant bi-directional causality between trade openness and economic growth. Further, unidirectional causality was observed flowing from FDI to economic growth, and from capital to trade openness.

The policy implications in this study are direct. Zambia needs growth policies that are directed to boosting gross fixed capital formation. The higher the gross fixed capital formation, the greater the rate of economic growth in the long run. This is evident from the long run effect of physical capital on economic growth in the findings. For short term growth, trade openness led growth policies can be formulated to boost the economy. Policy makers may consider new trade policies that improve economic growth. That is, tight short run trade openness policies are necessary for the growth of the economy. This implies that a substantial portion of the economic expansion of Zambia is internal. This is evident from the negative short run effect of trade openness on economic growth and the insignificant long run effect of trade openness on economic growth. Policy makers need to increase trade restrictions if the nation is to achieve short run growth.

Since there is unidirectional causal relationship running from FDI to economic growth, any FDI expansionary policy might bring higher economic growth. This unidirectional relationship perhaps comes because Zambia became more attractive for foreign investors for multiple prospects (labour availability, cheap wage rate, etc.) especially after the 1991 economic liberalization.

In addition, there is need for further studies that focus on trade openness and economic growth on the Zambian economy using local data sources and adding other variables which may affect economic growth.

- Appendices:

Table 1: VAR Lag Selection Criteria

Endogenous variables: LGDP LOPEN LFDI LK
Exogenous Variables: C
Sample: 1978 - 2016
Included observations: 31

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	-17.99491	NA	0.0000486	1.419027	1.604057	1.479342
1	103.7816	204.2703	0.0000000534	-5.405266	-4.480113*	-5.103689
2	118.6597	21.11727	0.0000000608	-5.332884	-3.667608	-4.790046
3	150.2550	36.69130*	0.0000000259*	-6.339031	-3.933634	-5.554932
4	170.1244	17.94653	0.0000000278	-6.588668*	-3.443148	-5.563307*

Note:
** Indicates lag order selected by criterion,*
LR: Sequential modified LR test statistic (each test at 5 percent level)
LPE: Final prediction criterion
AIC: Akaike information criterion
SIC Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 2: Unit Root Test

Variable	ADF Statistics	ADF Order of Integration	PP Statistics	PP Order of Integration
LGDP	-1.151922	I(1)	-1.153557	I(1)
LOPEN	-3.651494**	I(0)	-3.634513**	I(0)
LFDI	-4.551797*	I(0)	-4.537896*	I(0)
LK	-1.799083	I(1)	-1.758875	I(1)

*Notes: (i) McKinnon critical values are used for rejection of hypothesis of a unit root. (ii) Critical values for ADF and PP statistics are -4.219126, -3.533083 and -3.198312 at 1 percent, 5 percent and 10 percent Significance level respectively. (Where *** mean significant at 10 percent, ** significant at 5 percent and * significant at 1 percent).*

Table 3: Cointegration Bounds Test

Critical Value bound of the F-statistic								
	10 percent level		5 percent level		2.5 percent level		1 percent level	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
K = 3	2.72	3.77	3.23	4.35	3.69	4.89	4.29	5.61

Dependent Variable	F-Statistic	Co-integration
$LGDP_t$	$F_{LGDP} = 13.97537$	Yes
$LOPEN_t$	$F_{LOPEN} = 5.611809$	Yes
$LFDI_t$	$F_{LFDI} = 10.580000$	Yes
LK_t	$F_{LK} = 8.034396$	Yes

Source: Authors' own computation

Table 4: Long Run Estimations

Dependent Variable: LGDP
Method: ARDL (1,1,1,0) : SIC
Sample: 1978 - 2016
Included observations: 36 after adjustment

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	-1.175957	1.936738	-0.607184	0.5485
LOPEN	-0.012474	0.455819	-0.027366	0.9784
LFDI	0.114316	0.067792	1.686282	0.1025
LK	0.284392*	0.089251	3.186437	0.0034
R-squared	0.988801		Akaike info criterion	-4.621669
Adjusted R-squared	0.986484		Schwarz criterion	-4.313763
Durbin-Watson stat	1.996252		F-statistic	426.7510
			Prob(F-statistic)	0.000000

*Where *** mean significant at 10 percent, ** significant at 5 percent and * significant at 1 percent*
Source: Authors' own computation

Table 5: Short Run Estimations

Dependent Variable: D(LGDP)
Method: ARDL : SIC (1,1,1,0)
Sample : 1978 - 2016
Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOPEN)	-0.074657**	0.027843	-0.681354	0.0120
D(LFDI)	0.032161*	0.004909	6.551045	0.0000
ECM(-1)	-0.099619**	0.012367	-8.055121	0.0000
R-squared	0.752705	Akaike info criterion		-4.843892
Adjusted R-squared	0.737718	Schwarz criterion		-4.711932
Durbin-Watson stat	1.996252			

*Where *** mean significant at 10 percent, ** significant at 5 percent and * significant at 1 percent*
Source: Authors' own computation

Table 6: Heteroscedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.906595	Prob. F(6,29)	0.1135
Obs*R-squared	10.18370	Prob. Chi-Square(6)	0.1171
Scaled explained SS	6.377156	Prob. Chi-Square(6)	0.3823

Source: Authors' own computation

Table 7: Autocorrelations Tests

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 1 lag

F-statistic	0.005154	Prob. F(1,28)	0.9433
Obs*R-squared	0.006625	Prob. Chi-Square(1)	0.9351

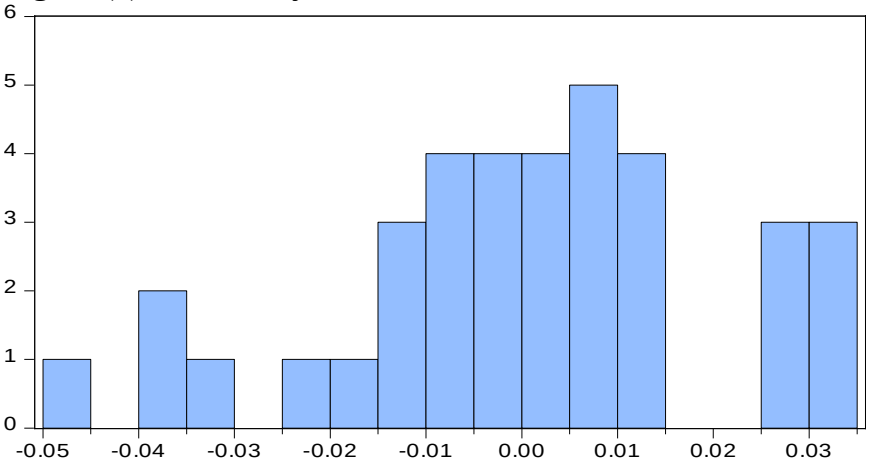
Source: Authors' own computation

Table 8: Vector Error Correction Model Results

Dependent Variable	**Type of Causality**				
	Short run				Long run
	$\Delta LGDP$	$\Delta OPEN$	$\Delta LFDI$	ΔLK	ECT_{t-1}
$\Delta LGDP$	.....	0.087610***	-0.018570***	0.006446	-0.021695
$\Delta LOPEN$	-1.709212**	.....	0.038889	-0.546750*	-0.175884*
$\Delta LFDI$	1.740103	-0.244016	.....	-0.888281	0.016859
ΔLK	-1.573482	-0.137052	-0.008355	.....	-0.117938***

*Where *** mean significant at 10%, ** significant at 5% and * significant at 1%*
Source: Authors' own computation

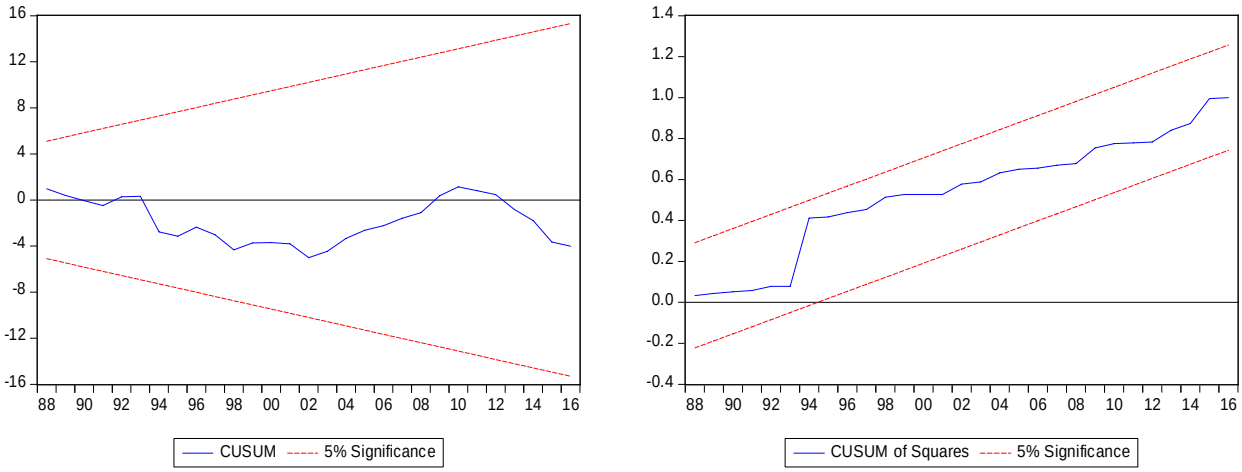
Figure (1) : Normality Test



Series: Residuals	
Sample 1979 2016	
Observations 36	
Mean	-7.93e-17
Median	0.000958
Maximum	0.033578
Minimum	-0.048428
Std. Dev.	0.020038
Skewness	-0.374170
Kurtosis	2.930014
Jarque-Bera	0.847368
Probability	0.654631

Source: Author's own computation

Figure (2): Stability Test using CUSUM and CUSUM of Squares



Source: Author's own computation

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