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A PANEL OF EMPIRICAL APPROACH TO THE MAIN DETERMINANTS OF ECONOMIC GROWTH IN EAST AFRICA

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Three Essays On
A Panel of Empirical Approach to the Main Determinants of Economic Growth in East Africa

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By
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Dedication

This dissertation is dedicated to my family. With the help of the everlasting Almighty God, this work has come to the end. So, glory be to God.

Declaration

I, Urgaia Rissa Worku, the undersigned, declared that this dissertation is my original work and it has never been presented in any university. All sources of materials used for this study have been duly acknowledged. The title of dissertation is "A Panel of Empirical Approach to the Main Determinants of Economic Growth in the East Africa". The earlier version of the dissertation included in chapter II, III and IV were appeared in the article form in the journal of Applied Economics and Finance (2016) and journal of the China–U.S.A Business Review (2017) both are in U.S.A and another one on working paper of the Global Labor Organization in The Netherland (2018). These are the contribution of financial sector development to economic growth in East Africa, the impact of foreign direct investment on economic growth in East Africa and the role of human capital resources in East African Economies, respectively. Apart from these, there is no part of this thesis, presented anywhere at any university to award certificate, diploma or degree.

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Abbreviations

ADF	Augmented Dickey–Fuller
ARDL	Autoregressive Distributed lags
CADF	Cross sectional augmented Dickey–Fuller
EU	European Union
FDI	Foreign Direct Investment
FE	Fixed Effects
FMOLS	Fully Modified Ordinary Least Squares
FSD	Financial Sector Development
GMM	Generalized method of moments
HCR	Human Capital Resources
IID	Independently and identically distributed
ML	Maximum likelihood
NIPC	Gross National Income Per- capita
PCS	Physical Capital Stocks
RE	Random Effects
UNECA	United Nations Economic Commission for Africa
UNHD	United Nations Human Development
VAR	Vector Autoregressive
VECM	Vector Error Correction Model

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Abstract

This study investigates the main determinants of economic growth in East Africa using various types of econometric panel data models and wavelet time scaling analysis. The general objective of the study is to examine the contribution of financial sector development (FSD), the role of human capital resources (HCR) and the impact of foreign direct investment (FDI) on economic growth in the short–term, medium and long–term. The panel exercises comprise fully modified ordinary least squares FMOLS, dynamic ordinary least squares DOLS, transmission mechanism–channels in vector autoregressive VAR system and vector error correction model VECM, random effects RE and autoregressive distributed lags models ARDL. The results of the study indicate that FSD, HCR and FDI have positively significant effects on the GDP growth. The VAR short–term transmission mechanism-channels reveal that there is an important contribution of HCR to the development of physical capital stock through gross national income GNI. The GNI has also a positive impact on the accumulation of physical capital stock via HCR. The dynamic resources inflows of FDI into economy play a vital role in economic development by supplementing domestic savings in the process of capital accumulation, creating innovation and income growth. However, examining the correlation between FSD and GDP, HCR and GDP or FDI and GDP cannot identify the causes in different time horizons using traditional approaches such as ARDL and VAR methods. Thus, the time scaling wavelet decomposition method can help to recognize the dynamic causality. The panel Granger causality tests in wavelet time scaling analysis indicate that there are bi-directional dynamic relationships between FSD–GDP, HCR–GNI and FDI–GDP in the short–run, medium and long–run.

Keywords: *Economic Growth, FSD, HCR, FDI, Panel Data and Time Scaling Wavelet Analysis*

CHAPTER I: INTRODUCTION

Economic growth has been determined by the level of financial sector development (FSD), the involvement of human capital resources (HCR) and the inward flow of foreign direct investment (FDI). Indeed, these determinants are also being influenced by their own factors. For instance, the power engines behind economic growth of the functional financial intermediaries are determined by the growth rate of real GDP, gross capital formation, net official development assistance and aid received from abroad and the official exchange rates. In the meanwhile, gross national income per-capita GNIpc, total factor productivity TFP and physical capital stock PCS in a given country have been the main contributors for the development of the HCR. Lastly, the FDI activities take place in the economy are characterized by the amount of real GDP, official exchange rates, the level of index of openness and terms of trade, the volume of consumption expenditure and exports and imports.

Economic growth, an increase in the value added of goods and services produced over time at a fixed price adjusted to curb inflation, which is conventionally measured as a percentage rate of the real gross domestic product (IMF, 2012). The importance of long-run growth over time, even small rates of growth has large effects. For example, the United Kingdom experienced a 1.97 percent average annual increase over one hundred seventy-eight years, resulted in a 32–fold increase by 2008 according to the study by Officer (2011). For given per capita GDP and human capital, growth depends positively on the investment ratio (Barro, 1996) and thus, a small difference in economic growth rates among countries can result in very different living standards for the people if this small difference continues for many years. Many theoretical and empirical analyses of economic growth are credited to the level of human capital defined as skills of the workforce as indicated by Mankiw, Romer and Wei (1992).

There are several factors affecting economic growth in a given country. The study by Petrakos and Arvanitidis (2008) suggests that political and institutional aspects in given economy play an important role in advancing growth. Specifically, in this regard, Upreti (2015) identifies factors affecting economic growth in developing countries; Elkomy, Ingham and Read (2015) investigate the role of income in determining FDI growth effects in emerging and developing countries and Ghazanchyan, Stotsky and Zhang (2015) examine the growth drivers in Asian countries. In addition to these, Rahman and Salahuddin (2010) provide an empirical analysis of Pakistan economic growth; Leon-Gonzalez and Vinayagathasan (2013) investigate the determinants of growth in the Asian developing economies and Havi et al.(2013) explain the determinants of economic growth in Ghana. Furthermore, Gylfason and Hochreiter (2008) study and compare the economic growth performance of Estonia and Georgia; Paudel (2014) examines the determinants of economic growth in developing landlocked countries and Bassanini and Scarpetta (2001) argue that financial systems contribute to economic growth by providing funding for capital accumulation are among many studies, which we take into consideration.

The determinants influence economic growth at different levels, depending on the level of development achieved through various types of policies used. Since the statement of works by Adam Smith and Malthus to the present day, researchers have tried to find the most important determinates that influence growth by formulating new and improved theories and models (Boldeanu and Constantinescu, 2015). However, there is still no consensus on the key determinants of growth and an all-encompassing model (Boldeanu and Constantinescu, 2015). On top of these, Barro (2003) explains that growth rates vary enormously in different countries over long period due to economic policies, institutions and national characteristics. Likewise, Paudel (2014) suggests that land-lockedness hampers economic growth but good governance, trade-openness and coordinating infrastructure development with neighbors are significant aspects of the inter-country differences in growth rates among landlocked developing countries.

The empirical evidence of Leon-Gonzalez and Vinayagathasan (2013) recommends that investment ratio and trade openness are positively correlated to growth, whereas government consumption expenditure is negatively correlated in the determinants of growth in a panel of twenty seven Asian developing economies applied by Bayesian model averaging dynamic unbalanced panel data over the period 1980–2009. In addition, Abdi and Aragie (2012) argue that the Horn of African countries have poor economic growth as they have limited access to finance; low domestic savings, weak infrastructure and inadequate human capital. Those factors are the most significant constraints of economic growth.

Therefore, understanding and addressing the challenges of the financial sector development contribution, the role of human capital resources and the impact of foreign direct investment; we make crucial analyses for economic growth. Comprehensively, we study debates on inter-temporal causal relationship, whether a finance-led growth or a growth-led finance response to East African economic growth. The justification we provide for this study would be the stronger financial sector governed by wide-ranging expansionary monetary policy leads to the greater opportunity for the economy to be continuously growing and in return, the dynamic economy accelerates the financial sector development. In this study, we also examine the importance, empirical evidence and descriptive statistics of FSD, HCR and FDI. In the meantime, we explore whether HCR are of greater importance than physical capital accumulation needed to speed up economic growth. Since poor economies must concentrate first on technological progress generated and easily adopted by HCR, then they gradually accumulate physical capital achievement which can be done by relying on technological progress rather than physical capital.

The motivation of this study is to analyze the economic growth using different methods and stating that FSD, HCR and FDI as the main determinants of economic growth in East Africa. By carefully studying several related empirical literature, we have tried to make a unique approach to economic analysis started with demeaned data to ensuring the non–violating classical econometric assumptions such as autocorrelation and cross–sectional dependence among panel countries. We intend to make a methodological contribution to the economic analysis by designing a new approach, the time scaling wavelet, in addition to the unique specified models with own calculated indices. The time scaling wavelet decompositions combined with the standard methods of dynamic panel FMOLS, DOLS, VAR transmission channel, VECM, ARDL and random effect RE methods are applied in this discourse. This is to show the dynamic inter temporal causal effects of the main determinant and dependent variables in the short, medium and long–term.

By doing this, we add an important input to the stock of existing knowledge about economic analysis which makes our study different. The purpose in the study is to analyze empirically the main determinants of economic growth. The general objective is to examine the contribution of the FSD, the role of HCR and the impact of FDI on economic growth in the short–run, medium– and long–run. The region has been recently trying to take steps to enhance dynamic macroeconomic stability by considering the intense situations in the region and the importance of stability for poverty alleviation. Thus this kind of study conducted in this area is of vast significant. In this regards, this study helps to provide some tangible information for the policymakers to take some actions and serves as a foundation that can motivate other researchers to conduct further studies.

1.1. The Contribution of Financial Sector Development to Economic Growth

The relationship between financial sector development FSD and economic growth has increasingly attracted researchers across the globe because of institutional differences and variation in capital allocation between and within economies. Financial sectors can be considered as financial services and institutions that lead to effective financial markets and access to capital and financial services (World Economic Forum, 2012). Capital markets in the financial systems can also contribute to growth by raising long–term finance for productive investment, diversifying investors' risks and improving the allocation of funds according to the study by DFID (2004).

Nevertheless, in East Africa economies, there are underdeveloped capital markets, outdated legal frameworks constraints, lack of capacity and regulatory framework, poor supervision and weak market shares. There is also difficulty of accessing to the banking system, which constitutes the biggest component of the financial sector. Financial activities in the region are, by far infant and characterized by the monopolistic behavior of a few commercial banks, owned by governments. More importantly, the financial systems have remained highly exclusive. This exclusiveness is the result of market failures as proven by the empirical evidences mentioned in studies by Beck and Maimbo (2013) and Abdi and Aragie (2012).Bassanini and Scarpetta (2001) argue that financial systems contribute to economic growth by providing funding for capital accumulation and helping inventing new technologies. Ghazanchyan, Stotsky and Zhang (2015) indicate that private and public investments are strong drivers of growth. They also empirically noted that reduced financial risk and higher foreign direct investment support growth in Asian countries over the period 1980–2012.

1.2. The Role of Human Capital Resources in Economics Growth

Human capital endowment, the skills and capacities that take place in the productive sectors are important determinant of long–term economic success. For the individual, societies and economies, investing in human capital are critical, especially in the context of shifting population dynamics and utilizing limited resources (World Economic Forum, 2013). Better educated people are more likely to innovate, adopt new technology and better productivity than less educated ones (Lucas, 1993) and Romer, 1993)). Advances in technology, education and incomes hold ever-greater promise of long, health and more secure lives. Those advances are generated by human capital resources (UNHP, 2014). Recent empirical studies have shown that determinants on economic growth are of great importance. The study by Dewan and Hussein (2001) suggest that investment in both physical and human capital is necessary for economic growth in middle-income developing countries. While Gylfason and Hochreiter (2008) show that good governance, institutional reforms and improvements in the educational system can play a more important role in raising economic output and efficiency.

The level of human development in Africa is low, even though there has been a rapid growth of some aspects of human capital, particularly; the expansion of education in recent time. The expansion of the human capital stock itself has not been matched by a commensurate rise in physical capital due to the low level of income growth and the low returns to the education investment as the study shown by Simon and Francis (1998). Michael (2011) argues that in the 1950s and 1960s, most of Asian economies were destined for prolonged poverty, while Africa's independence encouraged great optimism. While East Asian economic performance has given rise to a large literature studying in growth 'miracle', the Sub-Saharan African has attracted attention for the opposite reason that the failure of many countries in the region to sustain per-capita income growth is a huge after the 1970s as showing by Robin (2011).

A sustained improvement in Sub–Saharan Africa human development is found to be the lowest level in the world according to the study of (UNDP, 1997 and 2013) and World Economic Forum, 2013)). Eastern African countries have shared low sustained income per capita with Sub-Saharan African, facing similar economic, social and environmental challenges in the development process such as inequality and equity concerns, high rates of poverty and unemployment and many others (United Nations, 2013). One of the effects is a conditional convergence term that the growth rate rises when the initial level of real per capita GDP is relatively low compared to the starting amount of human capital in the form of educational attainment and health. In this regard, Ndambiri et al. (2012) indicate that physical capital formation, a vibrant export sector and human capital formation are substantial contributors to the economic growth using panel GMM in a panel of nineteen Sub–Saharan countries from 1982–2000.

1.3. **The Impact of Foreign Direct Investment on Economic Growth**

The impact of foreign direct investment FDI on economic growth is one of other various dynamic resource inflows towards developing countries. It plays an important role in economic development by supplementing domestic savings, income growth and employment generation. It is also used to bring integration into the global economy, transfer of modern technologies, enhancement of efficiency and raising skills of domestic labor (see, Dupasquier and Osakwe, 2006); Anyanwu, 2006 and 2013). Attracting FDI has been given a high priority in the strategies of economic renewal as advocated by policy makers at national, regional and international levels. The experience of fast–growing East Asian countries and recently China has strengthened that the belief of attracting FDI is the key to bridging the gap in the resources of low–income countries (United Nation, 2005). This is one of the factors that make differences in economic growth across nations. In addition, Elkomy, Ingham and Read (2015) elaborate that the effects of FDI are found to be stronger in low income countries and negatively weaker in upper–middle income countries in panel of sixty one emerging and developing countries for the period of 1989–2013.

Growth differences across countries mentioned in studies conducted by Leon-Gonzalez and Vinayagathasan (2013), Koop et al. (2012), Leon–Gonzalez and Montolio (2012), Moral-Benito (2010, 2012), Sala–i–Martin et al. (2004) and Fernandez et al.

(2001) show that some countries maintain more sustainable economic growth than others. The differences came as a result of the different types of FDI activities in the economy. In Sub-Saharan Africa, as Michalowski (2012) indicates that the effects of FDI on economic growth have risen significantly over the last three decades, though the overall performance in attracting FDI seems to be disappointing. FDI inflows into Sub-Saharan Africa spread unevenly with a high degree of concentration in a few countries. Despite the fact that the existence of mixed evidences regarding the impact of FDI on economic growth, the states in Sub–Saharan Africa urgently need expanded and more dynamic private sectors. Furthermore, more efficient and effective infrastructure provision and increased investment from both domestic and foreign sources are required (John, 2005).

Since the East African economy is part of and has similar experiences with the Sub–Saharan African, the significant problems on the one hand and the great potential for sustained economic growth on the other hand, must be taken into consideration. There are many challenges to further development such as pervasive poverty, low level of human development, non–inclusive growth, poor infrastructure and regulatory environment for investment, weaknesses in governance and institutional capacity are the most common phenomena in the region.

Following an introduction in chapter I, the thesis is structured as follows. The contribution of financial sector development to economic growth, the role of human capital resources in economics growth and the impact of foreign direct investment on economic growth are set and their respective literature reviews, methodologies used for the analyses, discussions and empirical findings for each study are provided in chapter II, III and IV, respectively. Finally, the combined three researches and the main findings of the dissertation are summarized and concluded in chapter V and VI, respectively.

CHAPTER II: THE CONTRIBUTION OF FINANCIAL SECTOR DEVELOPMENT TO ECONOMIC GROWTH IN EAST AFRICA

Abstract

This study empirically analyses the effect of financial sector development on economic growth in East Africa from the year 1975 to 2015. The panel exercises comprise fully modified ordinary least squares (FMOLS) and dynamic least squares (DOLS) are used. These models are employed to estimate the short-run, medium-and long-run parameters with the help of time scaling wavelet analysis, in addition to the long term estimation parameters. The three variables are (i) financial sector development (FSD), (ii) gross capital formation and (iii) net official development assistance and aid received from abroad, which have positively significant contributions to economic growth as panel FMOLS and DOLS long–run empirical results. The Granger causality test of panel wavelet time scaling analysis shows that FSD is dynamically causing changes in economic growth, except in the short–term, while economic growth stimulates change in FSD in the short–term, medium and long–terms. From this, we suggest that financial sector accelerates and augments economic growth; in return, economic growth enhances the development of financial sector.

Keywords: Financial Sector Development, Economic Growth, Panel FMOLS and DOLS methods

2.1. Introduction to Financial Sector Development

The relationship between financial sector development FSD and economic growth has increasingly attracted several researchers across the globe because of institutional differences and variation in capital allocation between and within economies. Financial sectors can be considered as financial services and institutions that lead to effective financial markets and access to capital resources (World Economic Forum, 2012). A rapid economic growth must transform into sustained and inclusive development through development strategies that foster economic diversification, create jobs and reduce inequality and poverty (UN, 2014). However, Africa's recent growth remains below the potential that fails to translate into tangible job creation and its GDP growth rate decreases from 5.7 percent in 2012 to 4.0 percent in 2013, against developing economies' average of 4.6 percent (UNESCM, 2014).

Capital markets in the financial systems can also contribute to growth by raising long–term finance for productive investment, diversifying investors' risks and improving the allocation of funds (DFID, 2004). Nevertheless, in East Africa economies, capital markets are underdeveloped, constrained by out–dated legal frameworks, lack of capacity and regulatory framework, poor supervision and less market shares. East Africa has a difficulty to access the banking system, which ties the biggest component of financial sector. Financial activity in the region is by far infant and characterized by monopolistic behavior of a few commercial banks, owned by governments. More importantly; the financial systems have remained highly exclusive and this exclusiveness is a primarily result of market failures that make the provision of financial services to lower–income groups as it has been revealed empirical evidences by Beck, Demirgüç-Kunt and Levine (1999) and Abdi and Aragie (2012).

The contribution of financial sector development and capital market to economic growth are important tools because they promote economic growth, develop private sectors, increase liquidity to mobilize local savings, enhance bank competitions and develop diversity of financial institutions (Paul, 2004). Financial sector development and its services would expect to play an essential role in improving the livelihoods. However, this is not the case in East African region. For instance, there is an increase in the financial risk associated with growing stock of external debt and shortage of foreign exchange in Ethiopian economy (Kibret and Wakiaga, 2014), lack of export financing and long–term credit (Wolday and David, 2010) and very low level of financial inclusiveness and lack of physical access (Girma, 2012) and raising the paid–in capital about 566 percent for commercial banks and 900 percent for microfinance institutions by the national bank of Ethiopia (Genet, 2014).

The study by Susan (2014) indicates that even though the Kenyan mobile phone innovations undertaken in the system through Safaricom's M-Pesa, is a remarkable achievement of the microfinance institution for payments provider, the financial system in credit markets is volatile and macroeconomic performance is an instable. These issues and other related are common phenomena prevailing in the region. For instance; relatively high lending rates, extremely low insurance penetration and scarcity of long–term debt in Rwandan finance system; largely excessive government interference in the management of financial institutions in Tanzania and sharply curtailed and neglect of prudential regulation leads to mismanagement in Uganda are among others (see, United Nations, 2014) and Kessy, 2011)).

Many similar studies have also been conducted on financial sector and related issues in Africa. Particularly the study by Athenia and Alfred (2014) on banking sector development and economic growth, Ndlovu(2013) financial sector development and economic growth, Nicholas (2008) financial development in Kenya and Beck and Maimbo (2013) financial sector development in Africa could be mentioned among others. Ali and Emerta (2012) financial sector development in the IGAD Region, David (2012) policy innovations to improve access to financial services in developing countries, Ali (2012) banking sector development and economic growth, Paul (2004) capital market and financial sector development in Sub–Saharan Africa and Easterly and Levine (1997) Africa's growth tragedy, policies and ethnic divisions have been the most priorities we look into account.

This study extensively deals with many controversial empirical studies whether the FSD has a positive impact on economic growth. Evidences from empirical studies show that deeper, broader and better functional financial sector development can stimulate economic growth. This has been explained by Ugbaje and Edez(2014); Levine and Zervos(1996) and Pagano(1993). However, Lucas (1988) and Stern (1989) suggest there is no relationship between financial sector development and economic growth. Therefore, looking at mixed results and different views among evidences of the empirical studies, we explore the existing theory in organizing an analytical frame work to assess the effectiveness and importance of FSD to economic growth and vice versa.

According to the World Economic Forum (2012), financial sector development FSD has a great role as factors, policies and institutions that lead to effective financial intermediation and markets. It serves as a gateway as deep and broad access to capital and financial services. Financial services are the largest component of infrastructure services with expanded rapidly in facilitating transactions and making credit available, which is crucial building block for the private sector development. There is a great deal of evidence to suggest that FSD is important for growth and poverty reduction. Without FSD, development may be held back even if other conditions are met. It has an important role to play in mobilizing savings for productive investment and facilitating capital inflows and remittances from abroad and stimulating investment in both physical and human capital, thereby increasing productivity (DFID, 2004). The role of financial services can be used as instrument for growth and development through mobilize resources for efficient allocation and productive investment, including risk diversification (Mina, 2012).

Financial sector development can also be an important facilitator for the strength of capital market in the economic growth process. FSD has been an important role to promote economic growth and private sector development, increase liquidity and help to mobilize local savings and make resources available. It also enhances bank competition and develops a greater diversity of financial institutions in a given country or region. Further, it could increase remittances and facilitate in their use and lead to improved corporate governance as a result of necessitating the creation of legal and regulatory framework, increased transparency and information dissemination (Paul, 2004).

The current debates on the inter-temporal causal relationship between financial development and economic growth have motivated us to study by looking into other studies whether there is a finance-led growth or a growth-led finance response. This is because the relationship between financial sector development and economic growth has increasingly attracted a number of researchers across the globe in terms of institutional differences and variation in capital allocation between and within economies. However, some evidences suggest that financial market development is positively related to the growth rate of economy. However, in this regard, empirical research studies on the linkage between financial development and economic growth in the East Africa is very inadequate.

Therefore, looking at the mixed results and different views among the scholars, this paper explores the existing theory in organizing an analytical framework and then assesses the effects and quantitative importance of the FSD to economic growth. The purpose of the study is to examine the contribution of the FSD with specific reference to the short–run, medium and long–run in East African economic growth.

2. 2. An Overview of Financial Sector Development in East Africa

Capital markets can contribute to growth by raising long–term finance for productive investment, diversifying investors' risks and improving the allocation of funds. While these benefits are generally acknowledged, stock markets in Africa have so far not attracted a significant proportion of the global capital flows. In general, as Ajai and Renate (2007) clarify that in developed economies, financial cooperatives and their networks are well-developed and have large shares of the financial services market. However, in most developing countries, these financial cooperatives and their networks are underdeveloped, negligible market shares and are typically constrained by outdated legal frameworks, low capacity, lack of an appropriate regulatory framework and poor supervision. There are, however, a few promising stock exchanges in the countries such as Kenya, Namibia, Mauritius and Ghana (Andrea, Alfred and Ralph, 2000).

The study in United Nations Economic and Social Council Commission for Africa and African Union (2014) pronounces that Africa's recent growth remains below potential and has failed to translate into meaningful job creation. Moreover, the GDP growth rate in Africa slowed in 2012 than in 2013, against developing economies' average of 4.6 percent. Thus, the broad–based economic and social development needed to reduce high poverty and inequality rates in many countries. It is, therefore, essential that African countries embark on strategies to transform their economies through increased value addition in the primary commodity sector and diversify into higher–productivity and employment–generating sectors according to this study. Effectively to translate rapid economic growth into sustained and inclusive development, Africa must follow through on development strategies, which foster economic diversification, job creations, reduction in inequality and poverty and boost access to basic services (UN and African Union, 2014).

When someone considers financial sector development policy for any sector, "the subsequent principles should come into play. It is vital to engage the interest of the commercial banking system, commercial banks can leverage large balance sheets to support the level of growth required. It strengthens "the diversity in financial sector and front–line rural and cooperative banks, which are sufficiently strong and efficient that can expand the outreach of financial services to Africa's small firms. Improved capitalization has the effect of improving access to bank lending as a result and large businesses tend to have greater growth potential than micro–enterprises; these should be the primary target group" (Thorsten and Samuel, 2013, p.106–107). In this regard, however, the DFID (2004) estimates the unbanked population Africa–wide is between 80 and 90 per cent while specifically the Sub-Saharan African financial activity is characterized by the oligopolistic behavior of a few commercial banks, in most cases, government owned.

The evidence of empirical study in Thorsten and Samuel (2013) reveals that access to finance for private investment is essential for enterprise development and economic growth. It also argues that "regulatory and supervisory reforms are needed for Africa, but progress in recent years is a source for optimism. Regulatory capacity remains at the heart of the reform process and efforts for developing capacity are the biggest priority" (Thorsten and Samuel, 2013, p.220), however, the microfinance institution industry in Africa has grown significantly over the last several years, while it remains relatively small, as illustrated by its limited penetration rates.

Financial systems in Sub-Saharan Africa have remained highly exclusive. However, this exclusiveness is a primarily result of market failures that make the provision of financial services to lower–income groups. Ali and Emerta (2012) specifically, advocate that financial sector in the inter–governmental authority on development, IGAD region is greatly dominated by banking activities. However, non–bank financial institutions such as stock and corporate bond markets, insurance companies and pension funds exist at different stages of the development in the region.

2. 2.1. Financial Sector Development of Ethiopia

Financial services are expected to play an essential role in improving the livelihoods in Ethiopia. According to the study by Ruediger (2011), the Ethiopian economy has experienced good growth performance over the last decade noticeably successful in maintaining of macroeconomic stability without capital market. However, it faces some challenges that could impede on the growth and transformation processes. There has been no capital market taken place, since the abolition of the Addis Ababa share dealing group in 1974 by the military government ruling (Ruediger, 2011).There is also an increase in the financial risk associated with growing stock of external debt, shortage of foreign exchange, limited financing options for the growth and transformation plan, low level of domestic savings (Kibret and Wakiaga 2014), lack of export financing and long–term credit (Wolday and David, 2010).

Financial inclusion serves to ensuring access to appropriate financial products and services needed by low–income groups at an affordable cost. Some empirical evidences show that economic growth follows financial inclusion that boosts business opportunities and employment, thereby the gross domestic product enhancement. Inclusive growth acts as a source of empowerment which allows people to participate more effectively in the economic and social development process. In this way, financial inclusion is the road that Ethiopia needs to travel toward becoming a stimulant player in economic development (Girma, 2012). However, despite the fact that huge progress in the last ten years has been made, the financial inclusion is still very low. Lack of physical access, the framework of regulation and the inclusiveness of finance and economic growth in Ethiopia are not attracted as such. More importantly, the National Bank of Ethiopia has discouraged more financial institutions to join the financial sector by raising the paid–in capital about 566 percent for commercial banks and 900 percent for microfinance institutions (Genet, 2014).

Banks are generally expected to encourage mobilizing resources and raise efficiency by adopting improved practices and modernizing their capacities. "The requirements of more rigorously provision as per the revised directive and the tightened bank supervision are in respect of the level of non-performing loans. The bank managements are more become autonomous and accountable to the board" (MOFED, 2002, p.140). As a result, access to the existing banks has worsened by the recent financial regulation that led banks to operate through extremely conservative lending policy.

Furthermore, under current situation, the Ethiopian financial sector couldn't be able to offer adequate and competitive services on the scale required. "It also considers the private sector inadequate access to risk capital and credit. This is a major impediment to the expansion of productive activities and doing a business. For instance, the investment contribution of the formal private sector to the GDP in Ethiopia, according to recent studies, about 8.8 percent which is much lower that the Sub Saharan 18 percent on average and far lower than similarly fast growing economies on average of 25 percent (Triodos (2013, P.3)). Ethiopia has intentionally used tools such as low interest rates, targeted usage of credit, foreign exchange to support public enterprises and drive economic growth. This strategy has succeeded but led to the neglect of private sector development, a low national savings rate, a loss of international competitiveness and an increase in the trade deficit (Tom, 2014).

Finally, financial services in Ethiopia are characterized by high urban concentration (Triodos, 2013), out of which the commercial bank of Ethiopia, is the dominant one in the financial institution and owned by the government. It has 695 branches across the country and total assets of $ 9.8 billion, according to Annual Report (2013). The financial infrastructure in rural areas remains poor and farmers have virtually no access to financial services (Triodos, 2013). In addition, the Ethiopian national bank administers a strict foreign currency control regime and has a monopoly on all foreign currency transactions. The local currency is not freely convertible and it maintains restrictions on the payments and transfers for current international transactions (Triodos, 2013). Foreign investors and financial institutions are strongly discouraged by the restrictions on repayment.

2. 2.2. Financial Sector Development in Kenya

Financial sector development in Kenya is by far better than in Ethiopia. "The Kenyan financial system has grown tremendously backed by enhanced innovations over the last five years as a result of major reforms undertaken. The Kenyan banking system has opportunities in funding large corporate projects as more foreign companies intend to exploit natural resources and larger infrastructure projects get underway" according to the joint annual report by Financial Sector Regulators (2011, p.73). It recognizes the linkage between financial system stability and overall macroeconomic developments. The prevailing global macro–financial risks remain elevated and pose potential threats to Kenya's financial system stability. The sources of risks globally in Kenya in particular and developing countries in general, are small sized market and liquidity, volatility in credit markets and instability macroeconomic (Financial Sector Regulators, 2011)

David (2012) examines factors driving the increased financial inclusion in Kenya and discusses on innovations in financial access undertaken in the system to meet the principles for expanding financial access developed. The study includes two leading innovators, equity bank arguably Africa's most successful microfinance focused bank, and the M-Pesa Safaricom leading mobile phone based microfinance institution for payments provider in the world. Moreover, the study in Susan (2014) examines the empirical relationship between economic growth and financial development in Kenya over the period 1980–2011, using autoregressive distributed lag bounds testing approach for cointegration analysis. The empirical findings indicate that there is stable long–run relationship among, financial development, trade openness and economic growth. It also finds that financial development has a significant positive effect on economic growth.

Another study in Nicholas (2008) investigates the direction of causality between financial development and economic growth in Kenya using a dynamic Granger causality model. It concludes that the financial development unambiguously leads to economic growth can only be taken with a pinch of salt. The financial system in general, and the central bank in particular, have made headway in expanding financial inclusion in Kenya, small firms continue to face more constraints in access to finance compared to larger firms. In this sense, policy emphasis on financial inclusion, coupled with the widespread innovations in information and communications technology (James, 2014).

2. 2.3. Financial Sector Development of Rwanda

There must be recognized that when financial services reach out to the people efficiently, the economic growth may be accelerated. However, the key challenges to the economy in Rwandan is the low level of savings rates due to low savings culture, limited access to banking and inability to mobilize long–term stable financing because of small size and underdeveloped capital market (Minecofin,2012). The study of Monetary and Capital Markets Department (2011) also explains that mobilization of more long-term stable financing for the real economy continues to be another major challenge.

Rwanda is one of the most heavily aid–dependent countries, which remains highly dependent on official development assistance with over 80% of the population living in rural areas, growth in manufacturing is limited and productivity in agriculture value added is low. It needs a robust and supportive financial sector with suitable institutional and regulatory framework (Minecofin, 2012). The economy is overwhelmingly rural, heavily dependent on agriculture and agricultural production comprises approximately one–third of total GDP, although strong growth in the services sector (IMF, 2013).

Ministry of Finance and Economic Planning (2007) argues that for Rwanda to achieve accelerated economic growth driven by a high level of investment, it is essential that the financial market is widened and strengthened. Rwanda's financial sector is still relatively shallow and undiversified and characterized by relatively high lending rates. There is extremely low insurance penetration and a scarcity of long term debt. However, the national bank of Rwanda (2009) acquaint with the satisfactory performance of the sector as the entry of new bank into the financial sector that expects to foster more growth, improved access and increased competition.

According to the United Nations (2014) study, enhanced collaboration and communication between the private and public sectors, regarding business development and infrastructure development are key factors. It finds that lack of access to finance and skills continues to hinder the proactive participation of private sector in the development of the services economy in Rwanda. On top of these, Rwanda Sector Skills Survey (2012,) expresses well-functioning finance sector leads to rapid accumulation of physical and human capital, enhance technological innovation and ultimately lead to economic growth and poverty reduction.

2. 2.4. Financial Sector Development of Tanzania

The financial sector of Tanzania has undergone substantial structural change since 2003 and the financial sector assets have expanded rapidly, led by growth in private credit (IMF, 2010). This has enhanced financial intermediation, thereby increasingly supporting economic growth. Yet the banking system remains small and relatively inefficient and access to finance remains very low in which only one in six Tanzanians has access to financial services. African Development Fund (2000) informs that financial sector reform was introduced in 1991 and formed a major component of Tanzania's economic and financial program supported by the IMF and other donors. The reforms were necessitated by deterioration in the performance of the state controlled financial sector. The problems in the financial sector stemmed largely from excessive government interference in the management of financial institutions which was manifested in directed credit policies and regulated interest rates. The effects of these policies are to crowd out private economic agents and impair the loan portfolio and weak macroeconomic environment characterized by large budgetary deficits, high inflation and an overvalued exchange rate reinforced.

The SIDA (1997) task force from the performance of developing countries contends that a well-functioning financial system is an important element for achieving sustainable growth. Since efficient and secure financial market can contribute to raising the total savings in the economy in combination with appropriate economic policies. Moreover, efficient financial market can channel the savings into productive investments, thereby improving the efficiency of the capital stock. However, the recent trends seem to have further enhanced the function of efficient financial systems in developing countries in general and Tanzania in particular as a tool to improve growth prospects. The study in Kessy (2011) examines the extent to which financial sector reforms have affected the development and growth of financial institutions in Tanzania. Specifically, the paper focused on microfinance institutions with a premise that, in developing countries, the sector is an appropriate initiative in providing working capital for the poor people.

The study by Lunogelo, Mbilinyi and Hangi(2010) shows that at macro level, the crisis has reversed Tanzania's GDP growth projection from 8 percent to 5 percent for 2009/10 and this has negative implications in terms of investment, employment and income for various actors in the economy. This study also argues that trade in finance was becoming increasingly more risky as export commodity prices continued to lose value in the world markets, export orders reduced and tourism revenues declined.

Tanzanian government has come up with a number of policy responses to the global crisis, which has also provided some challenges lay in Tanzania's low domestic revenue generation capacity, productivity and weak infrastructure. There have been opportunities such as potential to diversify the country's large natural resources and the change to increase export income by expanding regional trade. On top of these, Anna (2004) emphases that a steady economic decline in the late 1970s and financial crisis in the early 1980s, Tanzania formally adopted an economic recovery program in 1986. It has since pursued reforms and made significant achievements in macroeconomic stability which has been achieved and a wide range of structural reforms have made. However, the remaining central challenge is making growth deliver more efficiently in terms of poverty reduction on pro–poor growth. To accomplish this, the focus should be on accelerating growth of agriculture and rural sector development, to stimulate economic opportunities in rural areas where poverty remains pervasive (Anna, 2004).

Tanzania could be a major food–exporting country but its dependence on rainfall, poor in transport and marketing infrastructures, as well as low access to technology which lead to persistent food security problems (Javier, 2008). The study in Nicholas and Odhiambo(2011) attempts to reveal the dynamic causal relationship between financial deepening and economic growth using multivariate model, ARDL-bounds testing procedure. It finds a distinct unidirectional causal flow from economic growth to financial depth and other results show that there is a bi-directional causality between financial development and foreign capital inflows. Niklaus (2005) pronounces of the donor–financed private sector development activities that internationally will recognize commitment of the Tanzanian government to enhancing the enabling environment for private sector development. This is a proposed strategy even though it is far below average, compared to high importance of economic growth for poverty reduction in Tanzania.

2.2.5. Financial Sector Development in Uganda

The departure of portfolio investors led to a sharp depreciation of the Uganda currency, reduction in export earnings of some sectors, lower FDI flows among others(Lamin ,2009) as one of the developing countries couldn't spared from the effects of the global economic recession. The study in (Friends Consult, 2008) overviews the overall national economic performance, financial sector dynamics and regulatory environment provide a vital context of understanding the state and the performance of microfinance industry.

The banking system in Uganda is among the weakest in Sub-Saharan Africa. A large government owned bank has been operated with very little regard for commercial principals and accumulated massive portfolio which resulted in bad debts. The role of foreign banks, which at least provided a basic, if limited, range of banking services, was sharply curtailed when they sold most of their branches to the public sector banks. In this regard, the neglect of prudential regulation has allowed mismanagement to become widespread (Martin, 1996).

The East Africa within Sub–Saharan African region has significant problems on the one hand and great potential for sustained economic growth on the other hand. There are number challenges to further development. These are persistent poverty, low level of human development, non-inclusive finance and economic growth, lack of infrastructures and weaknesses in governance are among others. Furthermore, the East African FSD is very infant one because there are almost no financial markets in the region.

The objective of this study is mainly an attempt to verify the effectiveness and contribution of FSD to dynamic economic growth and vice versa. We provide many related empirical literature studies, description of the variables, specification and estimation of the models that inspire the study in genuine options concerning methods for the analysis.

Several studies have been trying to explain the complementarities between financial sector and economic growth, even though the issue exists is quite sure known for many years. Theoretical explanations in the literature provide that FSD–led economic growth. This study adds an important unique contribution to the existing knowledge about the analyses of FSD–GDP growth and vice versa as a new approach applying wavelet time scaling analysis combined with panel fully modified ordinary least squares and dynamic panel least squares are used to estimate the short–run, medium and long–run parameters. As far as there has been known, there no such study an attempt to deal with this kind of analysis. Therefore, motivation of the study is to investigate whether there is a finance-led growth or a growth-led finance response in East African economic growth. That is, the stronger the financial sector governed by expansionary monetary policy, the greater opportunity for the economy to be fast growing and vice versa.

The paper is structured as follows: the next section highlights surveys of the related literature reviews; section three describes the data and methodology used. Section four discusses on empirical findings and the fifth section concludes the main findings of the study. The selected sample countries are Burundi, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Uganda and Zambia.

2.3. Review of the Related Literature for Financial Sector Development

Several empirical evidences show that FSD can make an important contribution to economic growth of the developing countries, where financial sectors are underdeveloped (DFID, 2004). Many studies such as Beck, Demirgüç–Kunt and Levine, (1999); Anthony and Tajudeen (2010); and Frank and Eric (2012) have indicated that finance and economic growths are positively interrelated. We also examine the empirical studies of economic growth by Levine and Zervos (1996) on stock market development and long–run growth, Levine (1997) on financial development and economic growth and Levine, Loayza and Beck (2000) on finance and growth in this study.

Substantial studies on the debate of the financial sector development contribution towards economic development, empirically in Levine and Zervos (1998) and King and Levine (1993) highlight the role and contribution of the financial sector in economic development in terms of output growth in cross–countries analysis. Stock market liquidity and banking sector development indicators also show positive correlation with economic growth in both short run and long run period in most countries according to the studies by Arestis et al., (2001), Shan et al., (2002) and Abu–Bader et al., (2005). There explore the link between financial sector development and economic growth bank–based model contributed more to output growth in long run than the stock market–based model. More importantly, causality results show that finance led growth, as Loayza and Ranciere (2002). The empirical studies by Ugbaje (2014), Montfort, et.al., (2013), Najia

(2013),Adusei (2013), Wampah (2013), Wafaa, et.al.(2013) and Frank and Eric (2012) have also been reviewed. Beck (2011), Anthony and Tajudeen(2010), Paul(2004), Levine(1997), Levine and Zervos (1996),and Pagano(1993) reveal that financial sector indicators significantly positive effect on economic growth. While others such as Athenia and Alfred (2014), Agnieszka (2013), Ndlovu (2013), Ali (2012) and Nicholas (2008) argue that financial development is unidirectional causality from economic growth to financial development.

On the other hand, Liang and Reichert (2006) reveal that mixed results while some scholars indicate a negative relationship between financial sector development and economic growth according to the analyses made by Stephen and Enisse (2015) and Rym et.al (2013). However, Lucas (1988) and Stern (1989), which suggest that there is no relationship between financial sector development and economic growth. Lucas (1988) expresses that finance is an over–stressed determinant of economic growth. Hence, any strategies aimed at promoting financial system development would be waste of resources and divert attention from more relevant policies. These policies include labor and productivity improvement programs, implementation of pro–investment tax reforms and encouragement of exports to the one which less relevant. In this regard, Africa must follow through on development strategies that foster economic diversification, jobs creation, and reduction in inequality and boost access to basic services (UN and African Union, 2014).

The studies by King and Levine (1993) and Levine and Zervos (1998) argue that deeply consider the role and contribution of the financial sector in economic development is an important component. These indicate that stock market liquidity and banking sector development have a positive correlation with economic growth. Evidences from recent empirical studies also suggest that deeper, broader and better functioning of FSD can stimulate economic growth (UNESCE, 2014); (World Economic Forum, 2012) and (World Economic Outlook, 2015).

Empirically, long–term financial deepening is related to faster economic growth and short–term credit booms are related to a higher probability of systemic banking distress (Beck, 2011), while Čihák et al. (2012) explain that recent revival of interest in the link between financial development and growth stems mainly from the insights and techniques of endogenous growth models, which have shown self–sustaining growth without exogenous technical progress. In addition to these, Demirgüç–Kunt (2009) also suggests that countries with better developed financial systems have experienced faster economic growth and enjoy lower levels of poverty as the governments play an important role in building effective and inclusive financial systems to make finance work for development.

The study by Cihák et al. (2012) expresses that financial institutions and financial markets exert has powerful influence on economic development, poverty alleviation and economic stability. Levine (2005) adds his views as when banks screen borrowers to identify firms with the most promising prospects as a key step to allocate resources efficiently, expand economic opportunities and foster growth. However, Agnieszka (2013) survey explains the effects of finance on productivity growth even though theoretical and empirical literature does not lead to consensus regarding the contribution of financial liberalization and financial development to growth.

The correlation between financial factors and economic growth in (Rousseau and Sylla, 2003) shows that domestic financial development promotes capital inflow from abroad, which are associated with emerging markets and capital–market globalization. Levine (1997) confirms the prevalence of theoretical reasoning and empirical evidence suggesting a positive in the first–order relationship between financial development and economic growth. However, Cecchetti and Kharroubi (2015) begin by showing disproportionately benefited high collateral; an exogenous increase in finance reduces total factor productivity growth. They find out the negative relationship between the rate of growth of financial sector and the rate of growth of total factor productivity. In addition, Caporale et al. (2009) examine the relationship between financial development and economic growth by estimating a dynamic panel model over the period of 1994–2007. The evidence suggests that the stock and credit markets are underdeveloped and the contribution to economic growth is limited owing to a lack of financial depth.

The impact of development and efficiency in financial sector on economic growth of a group of selected developing countries using a cross–country data averaged over the period of 2005–2009 in the empirical study of Najia (2013) shows that there are significantly positive. The long–run relationship between economic growth and banking sector development is an observed positive phenomenon (Athenia and Alfred, 2014). A complementary idea to these explanations is the analysis by Wafaa, Rafiq and Hanas (2013), which investigates whether financial sector development plays a role in economic growth in the Gulf Region. Accordingly, their empirical evidence reveals a positive relationship between financial sector development and economic growth. This also notes that the banking sector and the stock markets harmonize each other in providing financial services. United Nations (2006) expresses access to a well–functioning financial system can economically and socially empowers individuals and building inclusive financial sectors that improves live of the poor.

FSD enhances bank competition and develops a greater diversity of financial institutions (Paul, 2004) which increases liquidity in economic growth, increases number of firms and investors those participating in exchanges generates. Liquidity has a proven relationship with economic growth. Paul (2004) also stresses that FSD leads to improved corporate governance in capital market development enable to necessitate the creation of legal and regulatory framework, incorporating increased transparency and information dissemination. These monitoring systems heighten corporate governance, improve transparency and boost investor confidence. Governments should encourage competitions in financial sector and microfinance development as these will improve and increase outreach and access to credit at a lower cost (Bruce, 1991). These factors will boost private sector development and investments, which are the engine of growth and development.

The critical importance of financial system for economic growth by King and Levine (1993) provides the insights into channels through which finance fosters economic growth. More evidently, Beck (2012) has shown that finance has more important impact on growth through fostering productivity growth and resource allocation than through pure capital accumulation. Financial deepening is also a critical part of the overall development process of a country (Levine, 2005). FSD takes place when financial instruments, markets and intermediaries work together to reduce the costs of information, enforcement and transactions (Beck, Demirgüç–Kunt and Levine, 2009). Countries with larger banks and more active stock markets have an opportunity to grow faster over subsequent decades even after controlling for many other factors underlying economic growth (Levine, 1997). In this regard, countries with better developed financial systems tend to enjoy a sustained period of growth.

There are ample evidences suggesting that financial sector development plays a significant role in economic development. It promotes economic growth through capital accumulation and technological advancement by boosting savings rate, delivering information about investment, optimizing allocation of capital, mobilizing and pooling savings and facilitating and encouraging foreign capital inflows (Beck and Maimbo, 2013). Some studies confirm that the causal relation of financial development is not simply a result of economic growth and the driver for growth (Beck, Demirgüç–Kunt and Levine, 2009). Moreover, it reduces poverty and inequality by enabling and broadening access for the poor and vulnerable groups, facilitating risk management and raising investment and productivity that generates higher income (DFID, 2004).

Beck (2012) believes that by intermediating society's savings and allocating them to their best uses, financial systems have critical function for economic growth. However, financial sectors can also be a source of fragility. Reducing financial safety net subsidy, adjusting regulatory framework and strengthening incentives towards intermediation will not only make the financial system safer but also increase the growth benefits of finance for the real economy. Beck and Maimbo (2013) also find out that deepening financial markets and institutions, trend concentrated in high income countries and more pronounced for markets than for banks. Similarly, recent increase in cross–border lending and debt issues has been concentrated in high income countries, while low and middle income countries have experienced an increase in remittance flows (Beck, 2012).

A meta–analysis of sixty seven empirical studies finds that financial development is robustly associated with economic growth (Beck and Maimbo, 2013). The empirical study in Beck, Demirgüç–Kunt and Levine (2009) evaluates whether the exogenous component of financial intermediary development influences economic growth using the average data for seventy one countries over the period of 1960 to 1995. It also finds that financial intermediary development is positively associated with economic growth, which suggests legal and accounting reforms strengthen creditor rights, contract enforcement and accounting practices can boost financial development.

The Granger causality has shown mixed results about the causal relationship between changes in FSD and economic growth (Liang and Reichert, 2006). The empirical evidence suggests that development of stock markets in China, USA, United Kingdom, Japan and Hong Kong have independently a strong positive correlation with their economic growth. The result brings about an important theory to support for the proposition that stock market development is one of the key drivers of economic growth whatever the modes of their financial systems, stage of their economic development and types of economic system. King and Levine (1993) investigate the relationship between financial markets and output growth in a panel of twenty seven Asian countries from 1960 to 2009 using panel cointegration techniques. They conclude that financial market development has enhanced output growth and economic growth in turn has stimulated financial development. It has a significant policy implication that well–planned financial policy for promoting development of domestic financial markets which encompasses banking and securities sectors for crucial growth strategy in developing economies.

The study in Adusei (2013) examines the finance–growth nexus with panel data from 1981–2010 of twenty four African countries. It suggests that there is a positive relationship between finance and economic growth. Greater diversification, risk sharing and investment in higher productivity activities, financial development can facilitate resource allocation and ultimately economic transformation (Africa Wafaa, Rafiq and Hanas, 2013). In addition, capital market and FSD can be important facilitators for economic growth in sub-Saharan Africa (Paul, 2004). FSD should be recognized as a legitimate component of the development program in a given country. Anthony and Tajudeen (2010) investigate the long–run and causal relationship between financial development and economic growth for ten Sub–Saharan African countries by applying vector error correction model. The results show that financial development is cointegrated with economic growth and its Granger causes economic growth. Mlachila et al. (2013) indicate sustained growth in Sub–Saharan Africa has led to financial deepening yet, sub–Saharan African financial and banking systems remain underdeveloped.

Some findings reveal the existence of demand following financial development is a unidirectional causality from economic growth to financial development. The evidence on South African economy by Gondo (2009) is based on a time–series empirical growth model show that credit extension to private sector and stock market liquidity has complementary and statistically progressive impact on economic performance in the long–run.

Nature of the relationship between FSD and economic growth with specific reference to the Southern African development community in a panel of fourteen the Southern African states over the period of 1990–2012 empirically shows financial sector is an important tool for growth (Frank and Eric, 2012). In this concern, the effects of financial sector development on economic growth in Ghana using the Johansen Co–integration analysis within bi–variate VAR, statistically there is significant positive relationship between FSD and economic growth. Another study also examines the impact of FSD and economic growth in Nigeria by Adebola and Dahalan (2011) which describe a positive relationship among financial development bank, stock market and economic growth in the short–run. In the same way, an observed linkage among foreign direct investment, FSD and economic growth in a panel of four North African countries over the period of 1980–2011using generalized method of moment by (Mankiw, Romer, and Weil, 1992) find the existence of positive relations.

The Ethiopian economy according to the study by Kibret and Wakiaga(2014) has experienced impressive growth performance over the last decade. However, to become a middle–income country by 2025, it faces some challenges that could impede on growth and transformation agendas. These issues are financial risk associated with growing stock of external debt, shortage of foreign exchange and limited financing options for the growth and transformation plan and low level of domestic savings. Compared to Ethiopian, Kenyan economy has been considerable progress in terms of efficiency in the financial sector, especially through mobile money financial services (Francis, 2013) even though one–third of the population is still without access to financial services. Prior study by Nicholas (2008) examines the direction of causality between financial development and economic growth in Kenya concludes that the choice for measuring financial development, on the balance demand following response tends to predominate arguing financial development unambiguously leads to economic growth.

In summary, regarding an important contribution of financial sector development to economic growth, we deal with a number of controversial issues in the empirical studies. Some of them argue that financial development is unidirectional causality from economic growth to financial development while others show mixed results. Some others indicate that there has been a negative relationship between financial sector development and economic growth. However, Lucas (1988) and Stern (1989) suggest that there is no relationship between financial sector development and economic growth. The well–functioning financial sector development is the key and powerful engine to economic growth. It generates local savings, which in turn lead to productive investments in local business and enhances effectiveness of banking services as a channel for international streams of private remittances. The financial sector, therefore, provides the means for income–growth and job creation for the individual in addition to accelerates economic growth.

2.4. Data Sources and Methodology for Financial Sector Development

The methodological foundation of this study is Baltagi (2005) and (2008) econometric panel data. The panel data econometric analyses approach used by Baltagi (2006) on panel data econometrics is a theoretical contributions and empirical applications. Hahn (1999) explains how informative initial condition in dynamic panel model with fixed effects is essential. The study by Blundell and Bond (1998) on initial conditions and moment restrictions in dynamic panel data models is the most powerful one. Ahn and Schmidt (1995) for efficient estimation of models for dynamic panel data and Islam (1995) growth empirics from panel data approach are additional important empirical studies to be considered. Moreover, dynamic demand for natural gas in Baltagi and Levine (1986), dynamic wage equation of Arellano and Bond (1991) and dynamic model of company investment in Islam (1995) are the most top studies among others. The dynamic panel data models continue to exhibit the growth phenomenal. This means most of economic models are either implicitly or explicitly dynamic in nature Baltagi (2005 and 2008). Within this kind of methodology framework, we gather the appropriate and reliable data and transformed the original dataset into demeaned data for the study to be resulted in robust and effective outcomes.

2.4.1. Data Sources for Financial Sector Development, GDP and Others

The panel data of nine East African countries over the period of 1975–2015 are analyzed in this study. The annual data are obtained from the United Nations aggregates databases and world development indicators of the World Bank. These data are primary databases as officially recognized international sources.

2.4.2. Measuring Financial Sector Development

A good measurement of financial development is crucial in evaluating the progress of financial sector development and understanding the corresponding impact on economic growth (DFID, 2004). Financial sector is the set of institutions, instruments and regulatory framework that permit transactions to be made by incurring and settling debts and extending credit. However, in practice, it is difficult to measure the financial sector development given the complexity and dimensions it encompasses. Since financial sector in a country comprises varieties of financial institutions, markets and products, this measure only serves as a rough estimate and does not fully capture all aspects of financial development.

There has been very tough task for setting suitable indicators for measuring financial sector development. However, many alternative indicators have been suggested in various studies related to financial development and economic growth. Three indicators are recommended. The first indicator is the ratio of M2 minus currency in circulation to nominal GDP used as an indicator of banking sector development (Levine, 1997) and (Anwar, Shabir and Hussain, 2011). The second one is the ratio of domestic credit of private sector to nominal GDP. This indicator measures the quality and quantity of an investment financed by the banking sector. Many researchers use this indicator as a proxy for financial sector development (King and Levine, 1993). Third indicator is assets with central bank to GDP ratio. Average market capitalization to GDP ratio is used as an indicator for the development of stock exchange market. Thus, the ratio of total value of stock market to nominal GDP shows that financial and investment policy behavior depends on each other (Beck, Demirgüç–Kunt and Levine, 1999).

Unlike all indicators mentioned above, we use the ratio of total domestic credit to real gross domestic product as a proxy for the financial sector development FSD in this study. This is because; nominal GDP is subject to inflation, money two (M2) minus currency in economic circulation results in extensive use of liquid currency outside the banking system. Further, this also subject to inflation as large amount of money is not controlled under monetary authority. We don't also consider the ratio of domestic credit of private sector to nominal GDP because its limit in coverage. Credit provided to government and other sectors would be incorporated. Finally, we also do not consider the ratio of total value of stock market over nominal GDP as an indicator, since there is almost no stock market in developing economies in general and in East Africa in particular.

Well–made functional financial intermediaries are useful power engines behind economic growth. Accordingly, for this study we have designed the real gross domestic product GDP at 2005 constant price in USD is determined by major factors. These factors are the ratio of total domestic credit to real GDP as a proxy for financial sector development FSD, gross capital formation, net official development assistance and aid received from abroad and official exchange. Then we select a panel of nine East African countries such as Burundi, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Uganda and Zambia in the sample study.

2.4.3. Specifications of Dynamic Panel Econometric model for FSD–Economic Growth

The dynamic panel estimators based on the use of lagged observations of explanatory variables are designed to address the problems. The problems are unobserved country specific effects and joint endogeneity of explanatory variables. In dynamic panel estimators, we apply the differenced equation to remove any bias created by the unobserved country–specific effects and potential parameters inconsistency arising from simultaneity bias (see the studies in Easterly (1997) and Arellano and Bond (1991)). In the case where cross–sectional dimension is relatively small and time dimension is large, standard time series techniques is applied to system of equations and panel aspect of the data should not pose new technical difficulties (Breitung and Pesaram,2005).

Many economic relationships are dynamic in nature and thus panel data would allow researchers for better understanding about dynamics of adjustment. As we can see in some studies such as (Balestra and Nerlove, 1966) on dynamic demand for natural gas; (Baltagi and Levine, 1986) dynamic demand for an addictive commodity like cigarettes;

(Holtz–Eakin at al. ,1988) on dynamic wage equation; (Arellano and Bond ,1991) of dynamic model for employment and (Islam, 1995) on a dynamic model for growth convergence and (Ziliak, 1997) in dynamic life cycle for labor supply model, it is possible to get a key observed to panel data. These dynamic relationships are characterized by the presence of lagged dependent variable occurs as an independent with other regressors.

In terms of applications as Baltagi (2005) points out, panel data has an advantageous over pure time series or cross-section data in such a way that it controls for individual heterogeneities or differences; it gives more informative, variability, degrees of freedom and efficiency with less collinearity among the variables and it is better able to study the dynamics of adjustment. In addition, panel data is better able to identify and measure effects that are simply not detectable in pure cross-section or pure time-series data. It allows us to construct and test more complicated behavioral models than purely cross-section or time-series data.

Most empirical growth models estimated using panel data are based on the hypothesis of conditional convergence, containing some dynamics lagged variables in the regressors (Islam, 1995). The long–run estimation of dynamic panel econometric model explains macroeconomic events by specifying preferences, technology and institutions. It also predicts what is produced, traded and consumed and how these variables respond to various shocks (William, 2010). Consider a linear dynamic panel data involving lagged dependent variable by specifying as

$$\boldsymbol{Y_{it} = \sum_{j=1}^{p} p_j\, Y_{i,t-j} + X'_{it}\, \beta + \delta_{it} + \varepsilon_{it}} \qquad (2.4.3.1)$$

The dynamic panel described in eq. (2.4.3.1) is characterized by two sources of persistence over time. These are autocorrelation due to the presence of lagged dependent variable among the regressors and individual effects characterizing the heterogeneity among individuals. Thus, we cannot apply ordinary least squares OLS, generalized least squares GLS, Fixed and Random effects methods because $\boldsymbol{Y_{it-j}}$ is correlated with $\boldsymbol{\delta_{it}}$ and samples mean of $\boldsymbol{Y_{it-j}}$ is correlated with $\boldsymbol{\varepsilon_{it}}$ so that the results will be inconsistent (Baltagi, 2005).

The most widely used and efficient methods of estimation for the differenced equations are Arellano and Bover (1995) of generalized method of moments GMM; Pedroni (2000) of fully modified ordinary least squares FMOLS and Saikkonen (1992) and Stock-Watson (1993) of dynamic panel least squares DOLS. The GMM system form developed and studied by Arellano and Bover (1995) and discussed in Ahn and Schmidt (1995) and Hahn (1999) are not only lagged levels used as instruments for first differences but lagged first differences are used as instruments for levels which corresponds to extra set of moment conditions. There is an over–identified with GMM used y_{t-2} and y_{t-3} as instruments, however, this method requires large number of time variable sets which loses some time–series observations (Bruce, 2013).

First differencing eq. (2.4.3.1) specification eliminates individual effects and produces an equation in the form of

$$\Delta \boldsymbol{Y_{it}} = \sum_{\boldsymbol{j=1}}^{\boldsymbol{p}} \boldsymbol{p_j}\, \Delta \boldsymbol{Y_{i,t-j}} + \Delta \boldsymbol{X'_{it}} \boldsymbol{\beta} + \Delta \boldsymbol{\varepsilon_{it}} \qquad (2.4.3.2)$$

Phillips and Hansen (1990) propose fully modified ordinary least squares FMOLS and Pedroni (2000) and Mark and Sul (2003) improve and apply it for estimators. They employ semi–parametric to eliminate the problem caused by the long–run correlation between cointegrating equation and stochastic regressor innovations. It is asymptotically unbiased which directly comes from the differenced regressions given as

$$\Delta X'_{it} = \hat{\Gamma}'_{21} \Delta D_{1t} + \hat{\Gamma}'_{22} \Delta D_{2t} + \Delta \hat{u}_{it} \qquad (2.4.3.3)$$

According to the study by Phillips and Hansen (1990), fully modified ordinary lest squares FMOLS estimator is given by

$$\hat{\beta}_{FMOLS} = \left(\sum_{t=1}^{T} Z_{it}\, Z'_{it} \right)^{-1} \left(\sum_{t=1}^{T} Z_{it}\, Y^{*}_{it} - T \begin{bmatrix} \hat{\lambda}^{*}_{12} \\ 0 \end{bmatrix} \right) \qquad (2.4.3.4)$$

$\Delta \ln Y_t = 100(\ln Y_t - \ln Y_{t-1})$, $E(\Delta Y_{it-1} - \Delta \boldsymbol{\varepsilon_{it}}) = E((Y_{it-1} - Y_{it-2})(\boldsymbol{\varepsilon_{it}} - \boldsymbol{\varepsilon_{it-1}}) - E(Y_{it-1} - \boldsymbol{\varepsilon_{it-1}}) = -\sigma^2_{\varepsilon}$. The $\boldsymbol{\delta}$ are scalars, Y_{it} and X'_{it} are 1×K and β is K×K. We assume that the $\boldsymbol{\varepsilon_{it}}$ follow a one-way error component model and $\boldsymbol{\varepsilon_{it}} \sim$ iid $(0, \sigma^2_{\varepsilon it})$ and $\boldsymbol{\varepsilon_{it-1}} \sim$ iid $(0, \sigma^2_{\varepsilon it-1})$ independent of each other. We denote that D_{1t} and D_{2t} are deterministic trend regressors and $Z_{it} = (\mathbf{X'_{it}}, \mathbf{D'_{it}})'$, the modified data $Y^{*}_{it} = \hat{Y}_{it} - \hat{\omega}_{12}\hat{\Omega}_{22}\hat{u}_2$ and estimated biased correction term $\hat{\lambda}^{*}_{12} = \hat{\boldsymbol{\lambda}}_{\mathbf{12}} - \hat{\omega}_{12}\hat{\Omega}_{22}\hat{\Lambda}_{22}$. Assume that $\hat{\Omega}_{22}$ and $\hat{\Lambda}_{22}$ be the construction of long-run covariance matrix estimators using $\hat{u}_{it} = (\hat{u}_{1i,t}, \hat{u}_{2i,t})$.

Constructing the asymptotically efficient estimator of dynamic ordinary least squares DOLS to eliminate feedback in cointegrating system (Saikkonen, (1992) and (Stock-Watson, 1993). It involves augmenting the cointegrating regression with lags in ΔX_{it} so that the resulting cointegrating equation error terms become an orthogonal to the entire stochastic regressors' innovations. Thus, the efficient estimator of the DOLS can be as

$$\hat{Y}_{it} = X_{it}'\hat{\beta} + D_{it}'\hat{\gamma} + \sum_{j=-q}^{r} \Delta X_{i(t+j)}'\hat{\delta} \tag{2.4.3.5}$$

The assumption adding q and r leads of the differenced regressor steep up all the long–run correlation between innovations over–time and estimation based on the DOLS are efficient, have the same unbiased and mixture normal asymptotic as FMOLS (Saikkonen, 1992) and (Stock–Watson, 1993).

2.5 Discussions and Empirical Findings of FSD-Economic Growth

For the estimated parameters in this study, we employ the FMOLS and DOLS in the framework of panel cointegrating vector that characterizes long–run relationship among the variables. These are efficient estimation methods of the cointegration regression to address the correlation between the differenced lagged dependent variable and other explanatory variables.

2.5.1 Optimum Lag-length Determination for FSD-Economic Growth

The lag–length determination is the key point in the process of testing and estimation variables. The Akaike information and other criteria are often used to choose the optimal lag length distributed–lag models. To estimate lag length, we compute the log–likelihood function and various information criteria for each choice are used (Johansen, 1988).

There are three distinct situations that automatically the lag length parameters can be computed. The first situation occurs when we select the lag length parameter for the kernel–based estimators of using (Newey and West, 1994) data based automatic methods. The other two situations are when unit root test requires estimation of regression with a parametric correction for serial correlation as in augmented Dickey–Fuller ADF and Dickey-Fuller generalized least squares DFGLS test and autoregressive AR spectral estimator. The log–likelihood cannot decrease when additional regressors are included.

Table 2.5.1 Optimum Lag-length Determination in FSD-Economic Growth

Lag	LogL	LRIC	FPEIC	AIC	HQIC
0	-2914.7	NA	133.45	19.083	19.107
1	-512.52	4710.2	2.39e-05	3.5459	3.6919
2	-466.16	89.394*	2.07e-05*	3.4063*	3.6739*
3	-458.58	14.364	2.33e-05	3.5201	3.9094
4	-448.41	18.943	2.56e-05	3.6171	4.1281

* indicates lag order selected by the criterion of LRIC: sequential modified likelihood ratio LR test statistic, FPEIC: Final prediction error Information Criteria, AICIC: Akaike information criterion and HQIC: Hannan-Quinn information criterion (each test at 5% level). VAR Lag Order Selection Criteria of endogenous variables are lnGDP, FSD,lnGCF, lnDA and OER.

The test results from the lag length based on five–variable vector error correction VEC system with the optimum lag length of two has been reported in (Table 2.5.1). The lag orders chosen by modified likelihood ratio test statistic (LRIC), final prediction error information criteria (FPEIC), Akaike information criterion (AIC) and Hannan-Quinn information criterion (HQIC) have shown that the optimal lag–length is of two at conventionally the 5% level of significance. The optimum lag–length determination is the lowest value of each criterion assumes the most appropriate model. Thus, the two lag length will be used for the rest of analyses throughout the paper. Based on chosen the optimal lag length, now we can test for panel unit roots.

Recent literature suggests that panel–based unit root tests have higher power than individual unit root tests based on time series (Baltagi, 2005). Several panel unit root tests allow for the cross–sectional dependence that use orthogonalization type of procedures to asymptotically eliminate the cross–dependence of the series before standard panel unit root tests are applied. There are two natural assumptions one can assume the persistence parameters are common unit root process which are identical across cross-sections, included in Levin, Lin, and Chu and Breitung tests whereas the alternative one is to vary freely across cross–sections. Varying freely across cross–sections in the tests of Im, Pesaran, and Shin, Fisher–ADF and Fisher–PP allow for individual unit root processes. One major source of cross–section correlation in macroeconomic data is common shocks, such as oil price shocks and international financial crises (Baltagi, 2005). The cross–sectional dependence is a direct descendant of the cross–country on growth according to the study by King and Levine (1993); Levine and Zervos (1998) and Hurlin and Mignon (2007).

In order to check the cross–sectional independence in a panel, first we have to look at the correlation among independent variables. Accordingly, we observe that there is high correlation between gross capital formation ($lnGCF_{i,t}$) and total labor force ($lnLF_{i,t}$). So, we have to drop $lnLF_{i,t}$ from the model since its probability value is higher than that of $lnGCF_{i,t}$ which implies, it has less level of significant impacting on real GDP. Now we determine each variable has unit root in the presence of cross–sectional dependence across the panel in which the results have been reported in (Table 2.5.2) all five variables are non–stationary in the level, while become stationary after the first differencing. Hence, each of them has panel unit root. As you can see, the test for the cross–sectional dependence of the transformed demeaned data series from the original data in (Table 5.2.3), all five variables have also unit roots.

Table 2.5.2 Unit Root test in the presence of cross-section dependence in FSD-Economic Growth

Variable	Im- Pesaran &Shin		Fisher-chi squared		Fisher ADF PP	
	Level	1st Diff.	Level	1st Diff.	Level	1st Diff.
$lnGDP_{it}$	2.19706 (0.9860)	-4.16781 (0.0000)*	18.4764 (0.4247)	56.6891 (0.0000)*	15.2088 (0.6476)	104.023 (0.0000)**
FSD_{it}	1.54441 (0.9388)	-9.00403 (0.0000)*	11.6111 (0.8666)	107.489 (0.0000)*	11.1096 (0.8896)	193.959 (0.0000)*
$lnGCF_{it}$	0.83003 (0.7967)	-8.96295 (0.0000)*	12.4165 (0.8250)	105.245 (0.0000) *	18.6104 (0.4162)	223.307 (0.0000)*
$lnDA_{it}$	0.02876 (0.5115)	-7.69269 (0.0000)*	20.9716 (0.2808)	101.035 (0.0000) *	24.9586 (0.1261)	254.686 (0.0000)*
OER_{it}	1.11016 (0.8665)	-6.85127 (0.0000)*	12.3629 (0.8279)	78.8925 (0.0000)*	6.67812 (0.9926)	100.603 (0.0000)*

The test includes Individual Intercept & Trend and user-specified lags: of two. The null hypothesis assumes unit root process and * denotes rejection of the hypothesis at 1% level of significance.

2.5.3. **Stability, cross-sectional dependence and endogeneity tests for FSD-Economic Growth**

Before estimation, we conduct the stability diagnostics for individual countries using optimal lag–length of two and number of cointegrating equations of two by the cumulative sum test CUSUM under recursive estimates. The CUSUM plots statistics for equation (2.4.3.3) remain stays within the 5% critical bounds for each country. This confirms the existence of long–run relationships among variables and the coefficients of the variables are stable in the case of individual country (see Fig. A in Appendix), for the first country, Burundi. We also do for others in the same way as for the first one). This kind of test was used by Magnus and Fosu (2006) to test long–run coefficients stability. After conducting stability diagnostics for individual countries, we try to estimation.

We check our demeaned data generated from the original dataset (for detailed see (Walter, 2004)) whether there has been cross–sectional independence before estimation. Estimation in the presences of cross-sectional dependence causes bias and inconsistency as (Andrew, 2005) argues and hence, we consider the standard augmented Dickey–Fuller ADF regression with the cross-section averages of lagged levels and first-differences of the individual series (Pesaran, 2007) used for cross–sectional dependence test. The limited distribution of this test is different from the Dickey–Fuller distribution in such a way that the presence of cross–sectional lagged level in which (Pesaran, 2007) uses a truncated version of the Im,Pesaran and Shin test, avoiding the problem of moment calculation (Baltagi, 2005).

One major source of cross–section correlation in macroeconomic data is common stocks, such as oil price shocks and international financial crises (Baltagi, 2006). Cross–sectional dependence is a direct descendant of the cross-country growth (for detailed information (King and Levine, 1993) and (Levine and Zervos ,1998)).

Pesaran (2007) explains a simple test for error cross-sectional dependence (CD) that is applicable to a variety of panel models. His method is based on augmenting the usual ADF regression with lagged cross-sectional mean and its first difference, to capture cross-sectional dependence that arises through a single factor model. This is called cross-sectionally augmented Dickey–Fuller (CADF) tests (see Appendix–I). Therefore, we conduct the tests for both t-statistic and Pesaran cross–section dependence. They both confirm that there is no cross-sectional dependence in each series after transformation of the original data through demeaned method in Walter (2004) i.e., the difference between individual observation and common average of the series in which the tests outputs are reported in (Table 2.5.3).

Table 2.5.3 Test for Cross-sectional dependence in Demeaned Data series in FSD-Economic growth

Test for cross-sectional dependence for transformed Individual data series				
Variable	Coefficient	Std. Error	t-Statistic	P. Value
$\mathrm{FSD}_{\mathrm{i,t-1}}$	-0.0642	0.0234	-2.7491	0.0063 *
$\mathrm{lnGDP}_{\mathrm{i,t-1}}$	0.9989	0.0046	219.43	0.0000*
$\mathrm{lnGCF}_{\mathrm{i,t-1}}$	0.9784	0.0118	83.131	0.0000*
$\mathrm{lnDA}_{\mathrm{i,t-1}}$	0.9854	0.0126	78.479	0.0000*
$\mathrm{OER}_{\mathrm{i,t-1}}$	0.9963	0.0046	215.17	0.0000*
Test for Panel Equation: Pearson CD Normal			0.8330	0.4048

* Refer to rejection of the null hypothesis of the t-statistics for the individual data and the Cross-sectional Independence for Panel equation at 1% level of significance. The null hypothesis of Cross-sectional independence for a panel equation is not rejected. $lnGDP_{i,t}$ denotes GDP in log form. Regression of the dependent variable, $DGDP_{i,t} = lnGDP_{i,t} - lnGDP_{it-1}$, $depends\ on\ lnGDP_{it-1}$ then the calculated t-value is considered for the hypothesis of cross-sectional dependence of individual transformed data series.

The final test under this sub-topic is test for endogeneity. The endogeneity problem arises due to simultaneous equations of the real GDP-FSD model. In the presence of endogeneity, estimations become biased and inconsistent. Therefore, we must provide a solution with the help of instrumental variables IVs and two stages least squares 2SLS (see detailed in Wooldridge (2002), (1997a)).

Under instrumental variables, we run the regression of FSD on lnGCF, lnDA and OXR using OLS and obtain the estimated value of FSD-OSL. Then we estimate the real GDP using dynamic panel FMOLS by taking lnGDP as dependent and the estimated FSD-OSL, lnGCF and lnDA as explanatory variables. Lastly, we make the regression of lnGDP on lnGCF and OER as lnGCF is an IV-one for lnGDP or lnGDP on lnDA and OER as lnDA is another IV for lnGDP. However, these lead us to a non- unique solution, which depends on whether lnGCF or lnDA is considered as an IV for lnGDP. To estimate FSD equation by the FMOLS method, we consider the larger value coefficient of determination between these two regressions.

The two stages least squares 2SLS is also applied for solving the problem of endogeneity that came out from simultaneous equations model in eq. (2.4.3.4a) is exact-identification and eq. (2.4.3.4b) is over-identification. We first estimate the reduced form equations by the OLS; that is, we make regression of FSD on lnGCF, lnDA and OER by the OLS method and obtain estimated FSD-OSL, and then we estimate lnGDP as a function of estimated FSD, lnGCF and lnDA by aping the FMOLS method in eq. (2.4.3.4a). Likewise, for eq. (2.4.3.4b), we run the regression of lnGDP on lnGCF, lnDA and OXR by the OLS method and obtain estimated lnGDP, then replace lnGDP by the estimated lnGDP and estimate FSD as a function of estimated lnGDP and OER by FMOLS method.

The main difference between IVs and 2SLS is that in the former case, the estimated values of the variables are used as instruments, while in the latter case they are used as regressors. However, in the case where there is exactly-identification, the results of IVs and 2SLS are the same (see specified equation in Appendix–I).

2.5.4. Johansen Cointegration tests for FSD-Economic Growth

Before the parameters estimation, we take into account about panel cointegration methodology analysis to see the long–run relationships among the variables undertaken using the techniques developed by Johansen (1991). Johansen highlights that one can a certain eigenvalues problem is solved and the eigenvectors calculated and then can conduct inference on the cointegrating rank using some nonstandard distribution and test the hypothesis about cointegrating relationship. When individual variables have a unit root (Engle and Granger, 1987) the cointegration can be an empirically useful method to model such relationship. The null hypothesis of a non-stationary behavior of the time series, admitting the possibility that the error terms are serially correlated with different serial correlation coefficients in cross-sectional units (Im, Pesaran, and Shin, 2002).

So, now the next step is to check the Johansen test of contegration. Johansen test of contegration determines number of cointegrated equations using Trace and Maximum Eigenvalue tests for unrestricted cointegration rank. In some cases where Trace and Maximum Eigenvalue statistics may yield different results we should prefer to take trace test (Alexander, 2001).

We consider panel cointegration methodology developed by Johansen (1988) and later applied by Saikonen (1992) for estimation and cointegration tests of the autoregressive approximation. Stock and Watson (1993) use for a simple estimator of cointegrating vectors in higher order integrated systems. Finally, inferences that can be conducted the test hypothesis for long-run relationship set up. Like panel unit root tests, panel cointegration tests can be motivated for their more powerful than individual time series cointegration tests. In the case of purchasing power parity and convergence in growth, economists use pool data on similar countries, in the hopes of adding cross-sectional variation to the data that will increase the power of panel cointegration tests (Baltagi, 2005).

The long run relationship tests for five-series multivariate for a panel and an individual country, we use the Johansen approach. First, we conduct the cointegration test for a panel of nine countries. Thus, we obtain two- and one-cointegrating equations at the 5% level of significance, according to the trace and the maximum-eigenvalue tests, respectively. The next will be test for individual country and the results are (5,2); (2,2); (1,1); (1,1); (1,0); (2,2); (1,0); (1,1) and (3,2). Numbers in the brackets are cointegrating equations obtained by the trace and maximum eigenvalue test. When the trace and the maximum eigenvalue statistically different, we should prefer to take trace test Alexander (2001), thus nine countries have passed with cointegrations. Finally, we conduct the test for a panel of nine countries, in which the test results are shown in (Table 2.5.4.1).

The results have shown in (Table 2.5.4.1) the Johansen test for unrestricted rank and number of cointegration equation. Both the trace and the maximum eigenvalue tests in the first column of (Table 2.5.4.1) indicate that number of cointegrating vectors in the hypotheses of the variables are not cointegrated($r = 0$) against the alternative of one or more are cointegrated vectors ($r > 0$). Since values of the trace statistic (0) and the maximum-eigenvalue statistic (0) exceed their respective critical values at the 5 % significance level, we reject the null hypothesis of zero cointegrating vectors (r=0) and accept the alternative hypothesis of more than zero cointegrating vectors (r>0). On the other hand, values of the trace statistic (1) and the maximum eigenvalue statistic (1) are greater and less than their respective critical values, respectively at the 5 % significance level, we reject the null hypothesis of one cointegrating vectors (r=1) of the trace test, but we don't reject the null hypothesis of one cointegrating vectors (r=1) of the maximum eigenvalue test. These suggest that the Johansen tests give number of cointegration vector within five series.

More explicitly, we don't reject the null hypothesis at the 5% level of significance that there are two-cointegrating equations according to the trace test as the critical value is larger than the trace statistic than while there is one cointegrating equation in the maximum eigenvalue test because the critical value is larger than the maximum eigenvalue statistic at the 5% level of significance. When the trace and the maximum eigenvalue tests statistically different, we prefer to take the trace test (Alexander, 2001) and thus a pane of nine countries have two cointegrating equations. Hence, the undertaken variables are integrated of the same order and they move together towards the long run equilibrium or they have long run relationship.

Table 2.5.4.1 Johansen test for Cointegration Equation in FSD-Economic Growth

Hypothesized No of CE(s)	Trace test				Maximum Eigenvalue test		
	Eigen value	Trace Statistic	5%Critical Value	Prob. Value	Max. Eigen Statistic	5%Critical Value	Prob Value
None	0.1325	93.907	69.819	0.0002*	44.780	33.877	0.0017*
At most 1	0.0826	49.126	47.856	0.0378*	27.154	27.584	0.0567
At most 2	0.0469	21.972	29.797	0.3000	15.120	21.132	0.2806
At most 3	0.0159	6.8523	15.495	0.5949	5.0789	14.264	0.7318
At most 4	0.0056	1.7734	3.8415	0.1830	1.7734	3.8415	0.1830

Both Trace and Max-eigenvalue tests of Johansen Unrestricted Rank(r) indicate there are two- cointegrating equations. The * denotes rejection of the hypothesis at the 5% level of significance. The trend assumption is linear deterministic with lag interval (in the first differences) is 1 to 2.

Table 2.5.4.2 Pedroni and Kao Residual Methods of Cointegration Test

Pedroni Method							
Common AR coefficients within-dimension					Individual AR coefficients between-dimension		
Panel-statics	Statistic	P. Value	Statistic	P. Value	Group statistics	Statist	P. Value
V	2.9505	0.0016**	1.5918	0.0557*			
Rho	1.4593	0.9278	1.7563	0.9605	Rho	2.1840	0.9855
PP	-1.6085	0.0539*	-1.6830	0.0462**	PP	-6.3459	0.0000**
ADF	-1.5233	0.0638*	-1.4054	0.0800*	ADF	-2.6231	0.0044**
Kao Method							
						Statistic	P. Value
ADF						-4.5445	0.0000**

H_0:The null hypothesis: No cointegration. Automatic lag length section is based on SIC with a maximum lag of 2.

** and * denotes 5% and 10% level of significance, respectively.

According to the Pedroni's method, on the basis of majority role, eight out of eleven outcomes confirm that the variables are integrated of the same order. The Kao method also shows there is long-run relationship among the variables. Therefore, (Table 2.5.4.2) indicates the variables move together in the long-run or they are cointegrated and have long-run relationship.

2.5.5. Panel FMOLS and Dynamic Panel DOLS Long-run Estimation for FSD-Economic Growth

Now we are able to estimate the long–run coefficients. Since number of cointegration within five series has been confirmed, we continue to the next step to estimate long-run parameters. The analysis of long-run cointegrating relationships has received a considerable attention by several researchers such as dynamic estimations of Pablo (2010); Pedroni (2000); Mark and Sul (2003) by applying the fully modified OLS and Barro (1998) which focuses on the determinants of economic growth a case where some cross-country empirical results are asymptotically unbiased.

Table 2.5.5 Panel FMOLS and DOLS estimation of long-run coefficients for FSD-Economic Growth

Variable	Fully Modified Least Squares FMOLS			Panel Dynamic Least Squares DOLS		
	Coeff.	t-Statistic	P. Value	Coefficient	t-Statistic	P. Value
$\mathrm{FSD2sls}_{it}$	0.0125	2.0688	0.0393*	0.0537	0.0021	0.0021*
LNGCF_{it}	0.4509	13.350	0.0000*	0.3843	0.0000	0.0000*
LNDA_{it}	0.0039	0.5689	0.5698	0.1706	0.0001	0.0001*
OXR_{it}	0.0003	3.8358	0.0001*	-0.0081	0.3663	0.3663

*Shows rejection the insignificance of the t-Statistic. lnGDP-2sls appears as dependent variable and long-run variances for cross sections of nine countries based on the HQIC automatic leads and lags specification of two optimum lag-length are used. The pooled estimation and the first-stage residuals use heterogeneous long-run coefficients in the panel fully modified least squares (PFMOLS). The grouped estimation in the panel dynamic least squares (DOLS) is used during estimation. Note that coefficient of determination; R-squared is taken from the estimation method of the panel fully modified least squares (FMOLS). R-squared 0.9536 indicates that about 95.4 % variations in real GDP is due to the facts that change in all variables mentioned in the model.

After diagnostic testing for the residual normality distribution and the serial correlation (the tests outputs are in the Appendix II, (Table 2.5.4.3)), we estimate long-run parameters. Thus, panel fully modified least squares PFMOLS and panel dynamic least squares PDOLS estimation results are reported in (Table 2.5.5) which indicate that as FSD increases by one unit, the real GDP growth increases by the one percent and five percent, respectively according to FMOLS and DOLS methods in a panel of nine East African over the period of 1975–2015. In addition, gross capital formation has a positively significant contribution to economic growth by both methods of estimation. The effect of net official development assistance and aid received from abroad on economic growth harmonizes with United Nations millennium development goals declaration that explicitly recognizes the role of official development assistance in the development process, committed the industrialized countries to grant more generous development assistance (UN, 2000).

On the other hand, however, the official exchange rates (OER) have significantly negative effect on economic growth (as it has been indicated by the method of panel FMOLS). The negative impact of OER may be due to that fact, high currency depreciation in the sample of countries under study. There are some evidences confirm the concern of official exchange rate OER negative impact on FSD performance. One of the evidences is in Gerardo and Felipe (2002) description of the G-3 exchange rate volatile impacting on developing countries, empirically shows a robust and significantly negative impact on developing countries' exports. Another evidence study comes from (Hua, 2011) estimation of twenty nine Chinese provinces in a panel data over the period from 1987 to 2008, by applying the generalized moment methods GMM system. The study result shows that the real exchange rate appreciation had a negative effect on economic growth and employment. Furthermore, Kandil, (2004) examines the effects of exchange rate fluctuations on real output growth and price inflation in a sample of twenty-two developing countries. Eventually, it concludes exchange rate depreciation that decreases real output growth.

Table 2.5.6 PFMOLS Granger causality test using wavelet analysis for FSD-Economic Growth

DependVar.	Indeped. Variable	Combined mean coefficients of time scale horizons		
		β_1	β_2	β_3
lnGDP-2SLS	FSD-2SLS	-1.3119	-0.3198	0.0358
		(14.89)	(23.32*)	(35.04*)
FSD-2SLS	lnGDP-2SLS	-0.0777	-0.0240	0.1818
		(16.49)	(20.75*)	(21.31*)

The lnGDP-2SLS and the FSD-2SLS denote the estimation of GDP in log form and FSD by 2SLS method to overcome the problem of endogeneity. Figures in parenthesis are Calculated χ^2-values and * denote rejection of the null hypothesis of the explanatory doesn't Granger cause of the dependent variable.

The optimal lag length of two in a heterogeneous panel FMOLS method is employed to calculate the probability value for each nine countries. Then we calculate the combined probability values for the time scale horizons using the formula, $\chi^2 = -2\sum_{i=1}^{L}\ln(P_i^2)$ where $-2\ln P_i$ has a chi-square χ^2distribution and i stands for country 1, 2, 3,.., L (see detailed in Dmitri et.al. ,2002 and Fisher ,1932). We compare these combined χ^2 with the conventional χ^2 of 16.92 which is available in (Brooks, 2008) at the 5% level of significance for 9 degrees of freedom which represents number of countries. We also use simple mean calculation for the combined mean coefficient of time scale horizons.

We use FMOLS method to calculate the probability value for each country. Then we calculate the combined probability values for time scale horizons which have chi-square distributions. We also use a simple mean calculation for the combined mean coefficient of the time scale. The Granger causality test of a panel wavelet analysis in the time scale horizon decompositions is based on equations (A and B in Appendix-I) with the help of FMOLS method. The combined mean coefficient values denoted by time scale by β_1, β_2 and β_3 represent the short, medium and long-term effects of FSD on real GDP and vice versa.

One unit increases in the FSD causes a 0.32 or 32 percent decreases in the medium-term but 3.6 percent increases in the long-term in real GDP growth. In the meantime, however, each unit increases in the real GDP growth leads to the FSD decreases by 2.4% in the medium-term and increases by 18 percent in the long-term in a panel nine East Africa. The indications of bi-directional dynamic causal relationship between FSD and economic growth exist in the range of time periods. Moreover, the combined mean coefficients increase over time. These mean that the strong FSD can produce more sufficient amount of real GDP for the nations and the reverse also holds true in the long-run. The possible justification for the unexpected negative sign of both FSD and economic growth in the medium and long term are volatile in the credit markets of the financial systems and unstable of money and macroeconomic performance cause delaying in responses of monetary policy in the region. The empirical results of this study related the study by Caporale et al. (2009) for EU economic growth, which shows the Granger causality runs from financial development to economic growth, but not in the opposite direction.

Moreover, by applying the Chlesky impulse-response functions, we examine how a 10-year interval of a panel of East African economies looks like. In this case, we employ the two-optimal lag for the endogenous variables and two-cointegrating equations with the help of standard error in Monte Carlo simulation in which the results are displayed in (Table 2.5.7).

Table 2.5.7 Homogeneous panel impulse response of estimated FSD and GDP

Period	Impulse–response of FSD to that of		I Impulse–response of GDP to that of	
Year	FSD	GDP	FSD	GDP
1974	0.0213	0.0000	0.0045	0.0570
1984	0.1617	-0.0026	0.1398	0.6257
1994	0.2324	-0.0047	0.4001	1.2522
2004	0.2626	-0.0063	0.7105	1.8727
2014	0.2753	-0.0076	1.0411	2.4876

The Cholesky Ordering are of FSD, lnGDP for the Standard Errors, which is the Monte Carlo (1000000 repetitions). FSD and lnGDP represents financial sector and the logarithmic representation of real GDP, respectively. Here in the cointegration environment, the Impulse Response Functions is generated (1,000,000 times of Monte Carlo Repletion).

The results in (Table 2.5.7) have shown the impulse innovation to the observed FSD and real GDP growth. The fluctuations of FSD and GDP are mainly explained by GDP and FSD shocks in the long run. The FSD shock accounts for 0.3 percent fluctuates in GDP while real GDP shock accounts for 14 percent fluctuates in FSD in the year 1984. The accumulated response fluctuation of GDP slightly decreases while that of the FSD increases over time and reaches 0.8 percent and 104 percent in the year 2014, respectively. We can also show graphically the accumulated response of real GDP to the FSD and vice versa (as shown in Fig. B, Appendix III on the upper to the right side and the bottom to the left side).

These empirical results are related to the previous studies by David (2012) and Susan (2014). The gain of this study, therefore, provides the supply and demand leading hypotheses by panel FMOLS and dynamic panel DOLS. These means FSD accelerates and augments economic growth and vice versa.

2. 6. Concluding Remarks for FSD-Economic Growth

This paper explores the contribution of financial sector development FSD to real GDP growth in a panel of nine East African economies over the period of four decades. It uses annual data obtained from the World Bank and the United Nations aggregated data base over the period 1975–2015. The general objective of the study is to examine the contribution of the FSD with specific reference to the short–run, medium– and long-run East African economic growth. The region is the Sub-Saharan Africa with significant problems on the one hand and great potential for sustained economic growth on the other hand. There are a number challenges to further development. Pervasive poverty, low level of human development, non- inclusive growth, vast infrastructure gap, relatively poor climate and regulatory environment for investment and weaknesses in governance and institutional capacity are among others.

Regarding an important contribution of financial sector development to economic growth, a number of controversial empirical studies have described. The issue has been extensively studied whether the FSD has a positive impact on economic growth, vice versa or not related at all. Evidences from recent empirical studies suggest that deeper, broader and better functioning of the FSD can stimulate economic growth of a given country.

Capital markets can also contribute to growth by raising long-term finance for productive investment, diversifying investors' risks, improving the allocation of funds and management of firms. While these benefits are generally acknowledged, stock markets in Africa have so far not attracted a significant proportion of the global capital flows. The United Kingdom's Department for International Development (DFID, 2004) estimates the unbanked population Africa–wide is between 80 percent and 90 percent.

The Sub-Saharan African financial activity can be characterized by the oligopolistic behavior of a few commercial banks, in most cases, government owned.

Some evidence suggests that financial market development is positively related to the growth rate of economy. In this regard, however, empirical research studies on the linkage between financial development and economic growth for the East Africa is very inadequate. Financial systems in the East African region have remained highly exclusive. The exclusiveness is a primarily result of market failures that make the provision of financial services to lower-income groups. More importantly, financial sector in the inter-governmental authority on development (IGAD) region is greatly dominated by banking activities (Ali and Emerta, 2012). However, non-bank financial institutions including stock and corporate bond markets, insurance companies and pension funds exist at different stages of development in the region. Therefore, looking at mixed results and different views among the scholars, this paper explores the existing theory in organizing an analytical framework and then assesses the effects and quantitative importance of the FSD to economic growth.

In this study, we empirically find that the observed FSD, gross capital formation, net official development assistance and aid received from abroad have positively significant contribution to economic growth, (labeled as GDP growth in panel countries) according to the FMOLS and DOLS methods of estimations. This means that the estimation of FMOLS method reveals that a one unit increases in FSD increases real GDP growth by 1.15 unit in the long-run for a given panel economies.

Finally, we employ a panel wavelet time scale analysis in the FMOLS method to investigate the Granger causality test for the effect of FSD on real GDP and vice versa. These show that the FSD has significantly negative impact in the medium–term, but has a long-term positive effect on GDP growth. In the meantime, GDP has significantly a negative impact on the FSD in the medium–term and positive significant influences in the long-term. Moreover, the combined mean coefficients increase over time. These mean that the strong FSD can produce more sufficient amount of real GDP for the nations .The reverse also holds true in the long–run.

The possible justification for the unexpected negative sign in both the FSD and economic growth in the medium-term are volatile in credit markets of the financial systems and weak monetary policy, probably unstable in monetary system in response to macroeconomic performance fluctuations. Accordingly, there has been a cause for delaying a response of monetary policy to the economy in the region. In addition, annual growth rate of FSD has negatively significant impact on the economic growth as a result of monetary policy in the region could unable to manage the rate of inflation. The high rate of inflation that makes more difficult for households and firms to make correct decisions in response to market signals. When prices rise, the economic agents may find it more difficult to distinguish between changes in relative prices and changes in the overall price level. This difficulty may interfere with the efficient operation of the price system so affects growth negatively (Howitt, 1990). Secondly, inflation may affect saving and investment decisions, thereby reducing the proportion of GDP causing the economy to accumulate less capital. The resulting reduced stocks of productive capital may, in turn, imply lower levels of future GDP (Motley, 1994).

Therefore, the conclusions we draw from this study can lay the foundation for reforming financial sector and enhancing inclusiveness of the financial system. These reforms and inclusiveness can leads to a comprehensive economy that makes beneficial to the East African countries. As far as the FSD accelerates and augments GDP growth and vice versa, effectively and vigorously pursued expansionary monetary policy, which directs the economy, could be a comprehensive beneficial gained from sustained growth, thereby development achievement by the region.

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Appendices for FSD-Economic Growth

I. Equation and Explanations

1. Cross sectional Dependence Test

For an AR(ρ) error specification, the relevant individual cross sectionally CADF statistics are computed from the ρ^{th} order cross- section/ time series augmented regression is given as

$$\Delta y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + c_i \bar{y}_{t-1} + \sum_{j=1}^{p} d_i \, \Delta \bar{y}_{t-j}$$

$$+ \sum_{j=1}^{p} \beta_{i,j} \, \Delta y_{i,t-1} + \varepsilon_{i,t},$$

Where $\varepsilon_{i,t}$ $is\ the\ idiosyncratic\ error\ term,$ $\bar{y}_{t-1} = \frac{\sum_{i=1}^{N} y_{i,t-1}}{N}$ and $\Delta \bar{y}_{i,t} = \frac{\sum_{i=1}^{N} y_{i,t}}{N}$.

With the transformed data, now we can test for the cross-sectional independence of individual data series (Pesatran, 2007) by constructing a test of null hypothesis $H_0 : \rho_i$ for all i, or the alternative one is $H_a : \rho_i < 0$.

2. Endogeneity test

Consider the following simultaneous equations of GDP-FSD model where lnGDP and FSD are endogenous variables whereas lnGCF, lnDA and OER are predetermined.

$$lnGDP = \beta_0 + \beta_1 FSD + \beta_2 lnGCF + \beta_3 \ln DA + u \qquad (2.3.3.4a)$$

$$FSD = \beta_{10} + \beta_{11} lnGDP + \beta_{12} OER + v \qquad (2.3.3.4b)$$

Here, we apply the methods of instrumental variables IVs and two stages least squares 2SLS for endogeneity arises from simultaneous equations model, before estimating the dynamic panel of long-run coefficients using FMOLS.

Where $lnGCF$ and $lnDA$are not correlated with u, Cov $(lnGCF, u) = 0$ Cov $(lnDA, u) = 0$ and Cov$(FDS, u) \neq 0$, Cov$(FDS, OXR) \neq 0$ and Cov$(OXR, u) = 0$. Thus, OER can be used as instrumental variable IV for FDS in eq(4a). Similarly, in eq(4b), lnGCF and lnDA are IVs for lnGDP, however, the solution is not unique, which depends on whether lnGCF or lnDA since the FDS function is over-identified whereas lnGDP is exact – identified. Note that FSD-OLS, FSD-2SLS, lnGDP-OSL and lnGDP-2SLS denote the estimated Financial Sector Development FSD and real lnGDP by -OLS and -2SLS methods, respectively.

3. Panel wavelet analysis for a Granger causality test

In order to investigate the casual relationship between the annual real Gross National Income per-capita and Human Capital Resources in the East Africa from 1980-2015, this study uses panel wavelet analysis for a Granger causality test. A multiresolutionary wavelet decomposition analysis for a Maximal Overlap Discrete Wavelet Transform MODWT which utilizes moving averages of the original data and moving averages of moving averages used for filtering the data. However, using moving averages, the MODWT loses the orthogonality which is the characteristic of basic discrete wavelet transformation (DWT). To maintain consistency in the transformation of the data series, the data is considered as a circular loop, with the observation following the last one simply being the first observation (Hacker, Karlsson and Mansson, 2012).

The segmentation of time series into different layers makes use of wavelet analysis become popular in economic analyses in the short-run, immediate and the long-run horizons according to studies by Ramsey and Lampart (1998); Hacker, Karlsson, and Månsson (2012); Reboredo and Rivera–Castro(2014). The supreme important of the time scale in a panel cointegrated methodology, where variables move together is a desirable. Since wavelets are local orthonormal bases consisting of small waves that dissect a function into layers of different scale. Given the Haar function with the domain [0,1], the wavelet transformation is

$$f(x) = C_0 + \sum_{\lambda=1}^{n} \sum_{k=0}^{n\,2^{\lambda-1}} C_{\lambda k\psi}\,(\lambda, k, \psi) \qquad (i)$$

where C_0 is the overall mean of the data and it along with the $C_{\lambda k\psi}$values are the wavelet coefficients.

Suppose there is a vector of actual time series observations y, with its elements ordered according to uniform units of time, as are the vectors with the level –λ smooth and detail series,S_λ and D_λ. Let the level-zero smooth series $s_0$is defined to be the same as the vector of actual observations y. The following two formulae describe how the smooth and detail series are calculated at scale levels of 1 and higher,

$$S_{\lambda,t} = \frac{S_{\lambda-1,t-2^{\lambda-1}} + 2S_{\lambda-1,t} + S_{\lambda-1,t+2^{\lambda-1}}}{4} \text{and } D_{\lambda,t} = \frac{-S_{\lambda-1,t-2^{\lambda-1}} + 2S_{\lambda-1,t} - S_{\lambda-1,t+2^{\lambda-1}}}{4}$$

It is always the case that the original series may be reconstructed by adding to the smooth series of the largest scale level consideredΛ, the sum of the detail series from level 1 to level Λ is given by

$$y = S_\Lambda + \sum_{\lambda=1}^{\Lambda} D_\lambda \qquad (ii)$$

Where below are demonstrated the patterns on how these equations work for three scale levels, keeping in mind that $S_{0,t} = y_t$ at scale level, 1 we have:

$S_{1,t} = \frac{y_{t-1}+2y_t+y_{t+1}}{4}$, $D_{1,t} = \frac{-y_{t-1}+2y_t-y_{t+1}}{4}$, $S_{2,t} = \frac{S_{1,t-2}+2S_{1,t}+S_{1,t+2}}{4}$, $D_{2,t} = \frac{-S_{1,t-2}+2S_{1,t}-S_{1,t+2}}{4}$,$S_{3,t} = \frac{S_{2,t-4}+2S_{2,t}+S_{2,t+4}}{4}$, $D_{3,t} = \frac{-S_{2,t-4}+2S_{2,t}-S_{1,t+4}}{4}$

& $S_{4,t} = \frac{S_{3,t-8}+2S_{3,t}+S_{3,t+8}}{4}$, $D_{4,t} = \frac{-S_{3,t-8}+2S_{3,t}-S_{3,t+8}}{4}$.

The associated wavelet details, D_1 to D_Λ are the decompositions of the two data at different timescales and S_Λ represents the long-term trend at scale levelΛ, which corresponds to zooming out the camera lens and looking at the broad land scape (Hacker, Karlsson, and Månsson, 2012)

II. Tables

Table 2.5.4.3 Serial Correlation and Normality Tests for FSD-Economic Growth

VAR Residual Serial Correlation LM Tests			VAR Residual Normality Tests using Cholesky Orthogonalization		
			Distribution	χ^2	P. value
Lags	LM-Stat	P. Value	Skewness	249.68	0.0000*
1	20.26458	0.7328	Kutrosis	55843.5	0.0000*
2	23.32022	0.5589	Jarque-Bera	56093.2	0.0000*

* Indicate rejection of the null hypotheses of No Serial-Correlation at lag order of two and multivariate normality distribution of the residuals in the model.

III. Graph

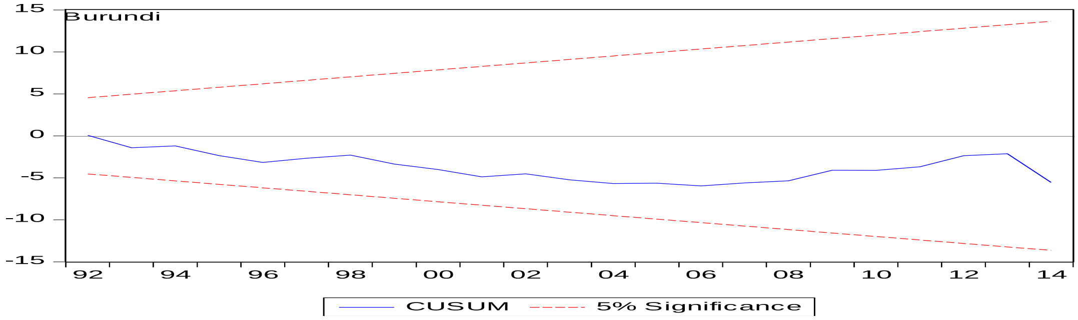

Fig-A. Stability CUSM test in the case of Burundi in FSD-Economic Growth

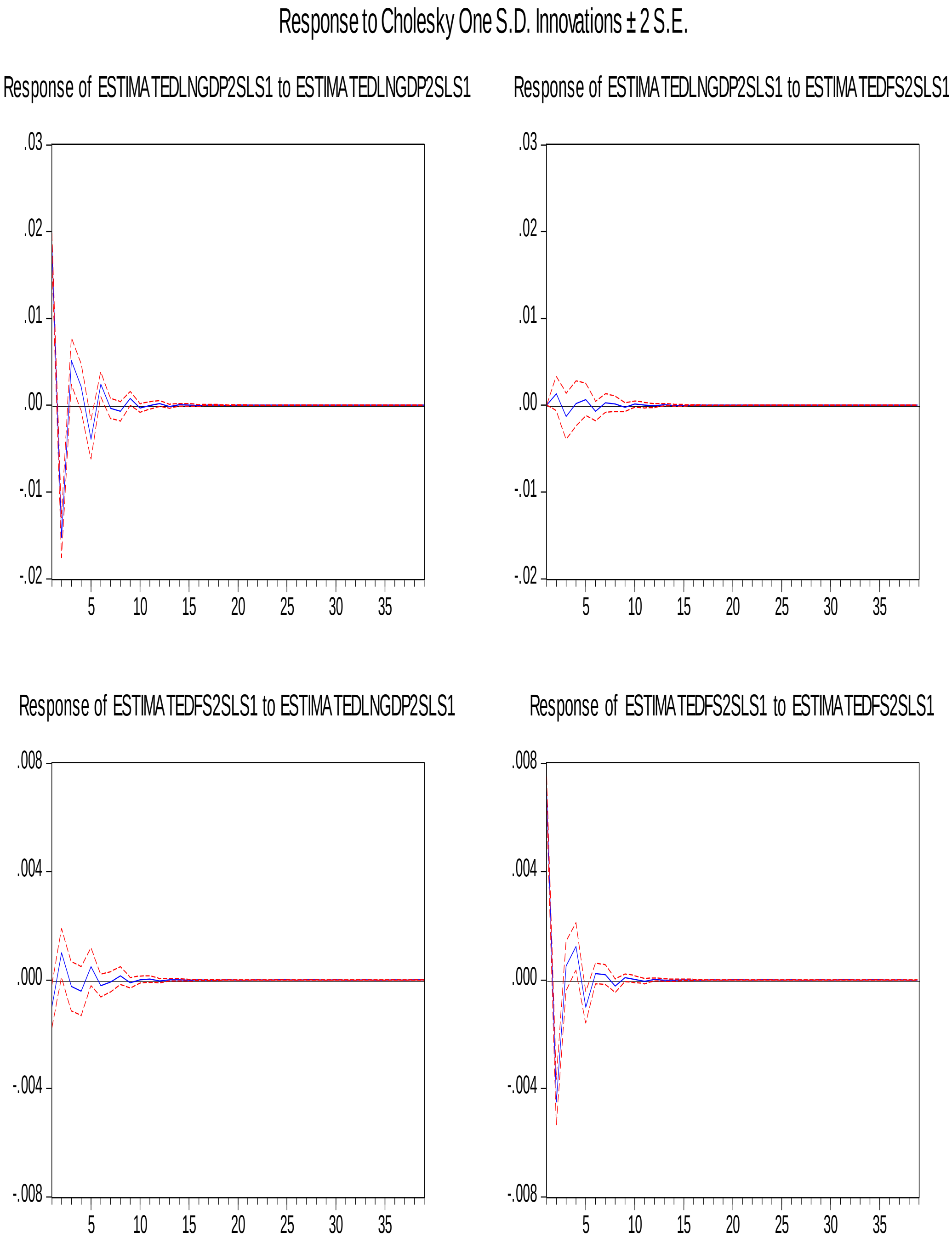

Fig . B Cumulated Responses of FDS to real GDP and real GDP to FDS

CHAPTER III: THE ROLE OF HUMAN CAPITAL RESOURCES IN EAST AFRICAN ECONOMIES

Abstract

This study deals with the role of human capital resources in economic growth. The skills, knowledge and innovation that people accumulate are the greatest assets in such countries which could bring income differences across the world. This is profoundly important for Africa today that smart and timely investments in human capital can play the central role in succeeding economic growth in East African for crucial reasons such as large youth populations and rapidly growing and changing skills demands for the technology. Most importantly, the quality of education of workers has been a major factor in creating high rate of economic growth and hence, without a greater supply of homegrown talent in areas of economic sector, it will be hard to build prosperous, inclusive and resilient economies that can compete and succeed globally. The empirical results of transmission mechanism channels in vector autoregressive model indicate that the observed human capital has a short–run effect on the national income in a panel of nine East African countries. The short–term transmission mechanism channels show that there is an important contribution of human capital resources HCR to the development of physical capital stock through GNI. The GNI has also a positive impact on the accumulation of physical capital stock via HCR. In addition, we also apply the time scaling decomposition of a panel wavelet analysis of the causality tests. The tests show that HCR and the GNI have a bi-directional causal relationship in the short–run, medium and long–run. Recent trend shows that East Africa has the lowest level of human capital development which raises the issues of employment challenges faced by women more than men although it has achieved a rapid growth in expanding education. We, therefore, suggest that more due attention should be given to human capital resources than any other in attempt to achieve sustainable development in the process of successful economic progress.

Keywords: *Dynamic Panel VAR, Transmission Channel, HCR, GNI and Granger Wavelet Analyses*

3.1. **Introduction to Human Capital Resources**

Human capital endowment, skills and capacities of the people in the productive sectors can be an important determinant of long term economic development. For the individual, societies and economies as a whole, investing in human capital is crucial; even more in the context of shifting population dynamics employing (World Economic Forum, 2013). Human capital is essential to economic growth since better educated people are more likely to innovate, adopt new technology and enhance productivity (Lucas, 1993; Romer, 1993 and Fishlow, 1966)).

Advance in technology, education and income hold ever-greater promises longer, healthier and more secure lives are generated by human capital resources according to the study by UNHD (2014). The gross domestic product GDP is said to be the measure of a country's overall economic output based on location while the gross national income GNI is the total value that is produced within a country, which comprises of the GDP along with the income obtained from other countries such dividends and interests.

The sources and patterns of economic growth, the factor flows and impact of national policies on economic growth are based on total factor productivity (TFP) other than capital accumulation. TFP is crucial for understanding the differences in economic growth and income across countries as suggested by Easterly and Levine (2002).

Capital stock in the process of adding to the stock of real productive resources, which refers to net additions of capital stock such as buildings and other intermediate goods(John,1997), is another important consideration. Increasing an economy's capital stock magnifies its capacity to producing more goods and services that can lead to an increase in sustainable economic growth. The replacement of physical capital by human capital accumulation as the prime engine of economic growth has changed the qualitative impact of inequality on the process of development.

In early stages of industrialization, physical capital accumulation is the principal source of economic growth, inequality enhances in the process of development by channeling resources towards individuals whose marginal propensity to save is higher. In later stages of development, however, human capital has become the main engine of economic growth; a more equal distribution of income, even in the presence of credit constraints can affect capital and economic growth in a positive way (Oded, 2011).

In recent time, however, there has been the lowest level of human development in Africa, despite the fact that rapid growth of some aspects of human capital, particularly; the expansion of education, notwithstanding starting from low level of income. The expansion of the human capital stock itself has not been matched by a commensurate rise in physical capital due to low level of income growth and low returns to the education investment according to the study by Simon and Francis (1998). Michael (2011) argues that in the 1950s and1960s, most Asia's economies were destined for prolonged poverty, while Africa's independence encouraged great optimism. While the East Asian economic performance has given rise to a large literature in studying the so-called growth 'miracle', the Sub–Saharan Africa has attracted attention for exactly the opposite reason. The failure of many countries in the region led to the failed in sustain per-capita income growth after the 1970s (Robin, 2011).

Sustained improvement in the Sub–Saharan Africa human development is found to be the lowest level in the world (UNDP, 1997 and 2013) and (World Economic Forum, 2013). The Easter African countries have shared equality difficulty with the Sub-Saharan African, facing similar economic, social and environmental challenges in the development process such as inequality, high poverty rates, unemployment and many others (UNEC, 2013). Therefore, understanding and addressing the challenges related to human capital is thus fundamental to the short term stability and the long term growth, providing prosperity and competitiveness of the nations. Thus, countries included in the sample study are Burundi, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Tanzania and Uganda which have undertaken in panel analyses.

The motivation of this study is to investigate the role of human capital resources in economic growth using dynamic panel transmission channels in vector autoregressive VAR model and wavelet time scale analysis. In this study, we look into the short-run, medium-and long-run empirical analyses genuinely generated for the application of growth rate. Thus this study adds unique key important contribution to the existing knowledge in growth accounting analyses. In this study, we examine the importance, the empirical evidence and descriptive statistics of HCR. In the meantime, we explore whether both human and physical capital accumulations are equally important or whether one of them is more significant than one another to economic growth. Most scholars argue that only considering physical capital is impossible for the poor countries to make sustained growth. Poor countries must concentrate first on technological progress generated and easily adopted by human capital and then gradually accumulate physical capital as the economies depend more on technological progress than physical capital.

The paper is structured as follows: it provides an introduction, a highlight about physical and human capital resources and their importance to economic growth. Section two describes the existing literature. The subsequent sections are intended to deal with methodological issues; empirical findings and discussions. Finally, the main findings of the study are summarized in a concluding section.

3.2. **Review of the Related Literature of Human Capital Resources**

There are a number of related studies on economic growth, human resources and capital stock. Carefully surveyed literature of human capital resources, physical capital stocks development and their relationship with economic growth have been observed from the studies by Kanu and Ozurumba (2014), Rakotoarisoa, Shapouri and Trueblood (2014), Orla et al. (2013) and Ndambiri et al. (2012). We also look into the empirical studies of Richard and Blessing (2010), Daniel and Marc (2004), Paula, John and Goddard (2001), Freddy et al. (2003) and Jess and Mark (1994).

Empirical studies of Arthur and Maxime (2014) tries to show the influence of macroeconomic volatile on physical capital accumulation in the Sub-Saharan economies. It indicates that a one-unit increase in the conditional standard deviation of the real effective exchange rate leads to a 0.011 percentage decrease in the stock of physical capital. In the decomposition of labor productivity growth, Oleg, Daniel and Romain (2012) argue that physical capital accumulation is the largest share in economic growth whereas the evidence suggested by Jeffrey and Andrew (1997) indicates that the slow growth in Africa as a result of poor economic policies due to lack of openness to international markets and geographical factors such as lack of access to the sea and the tropical climate.

Despite the economic theory which postulates, increases investment in human capital and physical capital that leads to increase in economic growth. However, in East African economy, specifically, the Kenyan case, this has not been true according to the study by Nelson and Fredrick (2006). Large decline in domestic savings over the years, while increasing the growth of fixed capital formation in Ethiopia, due to that fact that the low level of per capita income, potentially one major factor of the low level in savings (EEA,20003/04).

We also describe the empirical work of Khadharoo and Seetanah (2006) on the linkage between public capital and economic growth of the Mauritius economy over the period 1950–2000. This study uses vector error correction model in which to indicate that public capital has significantly contributed to the economic performance.

Furthermore, empirical evidence from the developed countries suggests the importance of human capital formation to economic growth has been the major driver of the development process; this notwithstanding, Nigeria has been a subject of debate (Kanayo, 2013). In addition, Bichaka and Christian (2008) also try to show the aggregate impact of remittances on economic growth using unbalanced panel data from1980 to 2004 for thirty seven African countries. It is found to be that remittances boosting growth in countries where financial systems are less developed, however, Valeriia (2009) investigates the impact of capital flight on economic growth from one hundred thirty nine countries in the year interval of 2002 to 2006 that displays a negative impact on GDP growth. Bangake and Eggoh (2010) study the international capital mobility of thrity seven African countries with panel cointegration methods over the period of 1979–2006. The findings indicate that the lowest being for non-oil producing compared to that of oil producing countries.

The role of education and human capital for the Egyptian economic growth (Khaled and Willi,2006) study from the year 1959 to 2002 using the Solow residual, has not been able to form a consensus of the causality between human capital and growth. While from the same region, the assessment on the labor outcomes in Algeria the study by Mohamed and Nassima (2003) has come up with the conclusion that the main problems behind the low contribution of labor market lies with inefficient labor market institutions, absence of economic diversification and low participation of the private sector in the economy.

The contribution of capital formation to economic growth has been described in many studies in addition to those we have tried to review above. Such empirical studies are Urélien and Yannick (2015), Sahbi and Jaleleddine (2015), Wendy and Umar (2013), Catia (2013), Edgar, Alexander and Axel (2012). We also add the reviews to this study the work done by Alexandra and Jacob (2011), Andrew, Robert and Fabio (2007), Verma, Wilson and Pahlavani (2007), Wang and Yao (2002) and Schultz (1998). Finally we have got the chance to look at some empirical studies such as Yasmina and Stephen (2004) which emphasis the cross-country patterns of economic growth in estimating stochastic frontier production function for the eighty developed and developing countries and Omolola(2013) that realizes the benefits from migration aspects. There is also one important work of Mohsen and Maysam (2013) which investigates the causal relationship between gross domestic investment and GDP for the Middle East and North African countries using panel cointegration analysis over the period of 1970–2010. The results show that there is strong causality from economic growth to investment.

In summary, the related empirical studies help us to identify the importance of human capital for the economic growth. Despite the fact that some of them describe negative relation, they provide key concepts to economic analyses. Hence, fundamentally based on these empirical literatures, this study looks into the analysis in depth for the role of human capital resources in economic growth with certain combined methods. The methods are dynamic panel transmission channels of the VAR system, the wavelet time scale decomposition and the impulse response models.

3.3. Data Sources and Methodology of the Study for Human Capital

3.3.1. Data Sources and Variables for Economic Growth, HCR and Others

A panel data set of nine selected East African countries over the period of 1980–2015 are obtained from the World Bank development indicators, the United Nations aggregate databases and International Monetary Fund Economic outlook. We consider data on gross national income per-capita at constant 2005 USD price as the dependent variable while other explanatory variables comprise total factor productivity TFP, human development index as a proxy for human capital resources HCR and physical capital stock PCS are calculated index. The indexed variables are based on own calculations.

3.3.2. **Measuring Physical Capital Stock and Human Capital Resources**

In economics, physical capital is factor of production consisting of machinery, buildings, computers and the like. Marshall and Mariam (2005) estimate fixed capital consumption as part of measurements for the net national income and multi-factor productivity changes. Physical capital is the difference between gross investment and fixed capital consumption (Berlemann and Wesselhoft, 2014).

Human capital resources, as (Kwon, 2009) argues that direct measurement is a difficult task and conventional measurement of human capital focuses on the monetary perspective, neglecting the importance of its non-monetary aspects such as creating added-values and social networks. Michael (2011) also claims that human capital measures are sensitive to alternative assumptions about income growth and discount rates, smoothing and imputation of labor force and school enrolment data. The study specifically in the (UN, 2008) emphasis that an accurate measure of labor and capital inputs based on the breakdown of aggregate hours worked and aggregate capital stock into various components are essential. The hours worked are cross–classified by educational attainment gender and age with the aim to proxy for differences in work experience. In all round, human capital is increasingly believed to play an important role in the growth process, even if adequate measuring of its stock remains controversial (Trinh et. al., 2002).

Human capital resource may be measured either by human capital index or human development index. Human capital index is a new measure for capturing and tracking the state of human capital development around the world while human development index is a summary measure for assessing long-term progress in three basic dimensions of human development such as long and healthy life, access to knowledge and decent standard of living (UNDP, 2013). The stock of human capital measurement has been developed to serve different analytic purposes. Notwithstanding these differences, many professionals have expressed common interest in developing monetary measures for human capital as useful complement of physical capital. For instance, Jorgenson and Fraumeni (1989 and 1992) present the most comprehensive study using income-based approach to measuring human capital for the US economy and Wei (2004) presents experimental measures of human capital formation for Australian economy, which is measured as lifetime labor income and gross human capital formation is measured as the sum of investment in education and training.

Despite the fact that various kinds of measures for human capital stocks have developed,(Kyriacou,1991) estimates the relationship between educational attainment and enrolment in primary, secondary and tertiary education of human capital investment past values and Mankiw, Romer and Weil(1992) also add the views to estimate the coefficients of production function using flows of investment as a proxy for capital stocks. The performance of human capital is measured with the help of macroeconomic indicators such as total number of years of schooling in the labor force, number of educational facilities, ratio of government expenditure on training to GDP and per capita expenditure on education according to the study by Barro and Lee (1993) and Wossmann (2003). Some studies take proxies such as school enrolment (Barro, 1991 and Mankiw, Romer and Weil, 1992); average years of schooling of workers in (Benhabib and Spiegel, 1994) and (Krueger and Lindahl, 2001) for human capital. The work carried out by Barro(1998) have analyzed that per capita wealth in various regions of the world by disaggregating several factors into human capital, physical capital and natural resources.

Human capital is more important and valuable than physical capital. As we cannot put the price on human life, the skills, knowledge and experiences of human being are more valuable than machines, production, computers etc. People can provide talent and services for a lifetime while most physical capital depreciates over time. Human capital accumulation is commonly cited as a precondition for development. It has long been considered as vital factor for economic development. We employ human development index, which is a composite statistic index of life expectancy, education and income per capita as a proxy for human capital stocks in our discourse.

3.3.3. Specification of Dynamic Panel Econometric Model for HCR

Countries endowed with large stock of human capital eventually emerge as technological leader in finite time and maintain the leadership as long as human capital advantage is sustained (Jess and Mark, 1994). Fairly strong positive association exists between the gross income and the life expectancy across developing countries, even though the associations do not reveal causality (Oded, 1993). Hence, human capital accumulation has been estimated using human development index in this study.

To calculate human development index used as a proxy for human capital stock, we consider the (UNDP, 2013) minimum and maximum values of the goalposts of the observed values in the time series interval 1980–2012.The values are set in order to transform indicators into indices between 0 and 1. The maximum value is set at 83.6 years for life expectancy of Japan in 2012, the world level for school life expectancy at 12 years, the expected years of schooling at 18 years. The combined education index of 0.971 from New Zealand in 2010 and the gross national income GNI of 87,478 USD in purchasing power parity of Qatar in 2012 are also considered. While the minimum values are set at 20 years for life expectancy, at 0 years for education variables and at $100 for the national income per capita NIPC (UNDP, 2013 and CIA, 2006 and 2015).

Therefore, by defining human capital resource (HCR) as human development index, the geometric mean of normalized indices of life expectancy index (LEI), school mean enrolment Index (SMEI), education index (EI) and income index (II) are calculated in the following way

$$HCR \equiv \mathrm{HDI} = (LEI \times EL \times II)^{\frac{2}{3}} \tag{3.3.3.1}$$

Where,

$$\mathrm{LEI} = \frac{\text{Life expectancy at brith(year)} - \text{Minimum value}}{\text{Maximum Value} - \text{Minimum value}},$$

$$\mathrm{SMEI} = \frac{\text{Mean of school enrolment} - \text{Minimum value}}{\text{Maximum value} - \text{Minimum value}},$$

$$\mathrm{EI} = \frac{\sqrt{(\mathrm{LEI})(\mathrm{MSEI})} - \text{Observed Minimum value}}{\text{Maximum value} - \text{Minimum value}} \quad \&$$

$$\mathrm{II} = \frac{\ln(\mathrm{GNI}) - \ln\ \text{Minimum value})}{\ln(\ \text{MaxximumValue}) - \ln(\text{Minimum value})}.$$

The school life expectancy is the total number of years of schooling from primary to tertiary that a child can expect to receive, assuming that the probability of his or her being enrolled in school at any particular future age is equal to the current enrolment ratio at that age (CIA, 2006 and 2015).

Under perpetual inventory method, the net physical capital stock at the beginning of the current period (PCS_t) can be expressed as the sum of one period lag in physical capital stock (PCS_{t-1}) and investment gross (IG_{t-1}) minus fixed capital consumption

($\mathrm{FCC_{t-1}}$) which causes depreciation (Berlemann and Wesselhoft, 2014). Thus we calculate the current physical capital stock as

$$PCS_t = PCS_{t-1} + \mathrm{IG_{t-1}} - \mathrm{FCC}_{t-1} \tag{3.3.3.2}$$

This implies that the change in physical capital stock (ΔPCS_t) is given by

$$\Delta PCS_t = PCS_t - PCS_{t-1} = \mathrm{IG_{t-1}} - \mathrm{FCC}_{t-1} \tag{3.3.3.3}$$

The initial capital stock based on (Harberger, 1978) approach employs the neoclassical growth theory, which relies on the assumption that the economy is in its steady state. As a consequence of output grows at the same rate as capital stock would be given as

$$g_{GDP} = g_{PCS} = \frac{\mathrm{IG_{t-1}}}{PCS_{t-1}} - \delta = \frac{PCS_t - PCS_{t-1}}{PCS_{t-1}} \tag{3.3.3.4}$$

Solving for PCS_{t-1} from (3.3.3.4) and plugging into (3.3.3.3) and (3.3.3.2), then we will have

$$PCS_t = \frac{\mathrm{IG_{t-1}} - \mathrm{FCC}_{t-1}}{g_{GDP}} + \mathrm{IG_{t-1}} - \mathrm{PCC}_{t-1} \tag{3.3.3.5}$$

In real environment, the production function tends to be increasing returns to scale with augmented the neoclassical model in accordance with the views of (Schmidt-Hebbel.1994) and (Easterly and Levine, 1994)). In the model specification of the classical theory, there exist technological spillovers and increasing returns to scale (Barro and Sala-i-Martin, 2003). Accordingly, we can express gross national income GNI as the combined contributions of technological level TFP, human capital resources HCR, and physical capital stock PCS and total labor forces TLF; following the Solow model specification in the Cobb-Douglas production function as

$$\mathrm{GNI}_t = \mathrm{A_t}(\mathrm{HCR_t})^{\alpha_t}(\mathrm{PCS})_{\mathrm{t}}^{\beta_t}(\mathrm{TLF})_{\mathrm{t}}^{\gamma_t}\mathrm{e}^{\varepsilon_t} \quad ,\alpha + \beta + \gamma > 1 \tag{3.3.3.6}$$

We take log differences of eq.(3.3.3.6) to set up the relationship for long-term growth from time t-1 to time t can be specified as

$$\begin{aligned}(\mathrm{lnGNI_t} - \mathrm{lnGNI_{t-1}}) = {} & \alpha_t \mathrm{lnA_t}(\mathrm{HCR_t}) - \mathrm{lnA_{t-1}}(\mathrm{HCR_{t-1}}) \\ & + \beta_t(\mathrm{lnPCS_t} - \mathrm{lnPCS_{t-1}}) \\ & + \gamma_t(\mathrm{lnTLF_t} - \mathrm{lnTLF_{t-1}}) + (\ln\varepsilon_t - \ln\varepsilon_{t-1})\end{aligned} \tag{3.3.3.7}$$

Specifying the first term in eq. (3.3.3.7), total factor productivity $\mathrm{TFP_t}$ depends on the level of human capital, reflecting the effect of domestic endogenous innovation. Take the expected value in both sides of eq. (3.3.3.7) and divide by $\frac{1}{\alpha_t}$ then we get the expected total factor productivity TFP_t depending on the level of human capital resources given by

$$
\begin{aligned}
&E[\ln A_t(HCR_t) - \ln A_{t-1}(HCR_{t-1})] \\
&\quad = E\left(\frac{\ln GDP_t - \ln GDP_{t-1}}{\alpha_t}\right) - E\left(\frac{\beta_t}{\alpha_t}(\ln PCS_t - \ln PCS_{t-1})\right) \\
&\quad\quad - E\left(\frac{\gamma_t}{\alpha_t}(nTLF_t - \ln TLF_{t-1})\right) - E\left(\frac{(\ln\varepsilon_t - \ln\varepsilon_{t-1})}{\alpha_t}\right)
\end{aligned}
$$

Since the expected value of error term $E(ln\varepsilon_t - ln\varepsilon_{t-1})$ is zero, TFP_t augmented with human capital can be, thus

$$
\begin{aligned}
TFP_t &= \left(\frac{\ln GNI_t - \ln GNI_{t-1}}{\alpha_t}\right) - \left(\frac{\beta_t}{\alpha_t}\right)(\ln PCS_t - \ln PCS_{t-1}) \\
&\quad - \left(\frac{\gamma_t}{\alpha_t}\right)(\ln TLF_t - \ln TLF_{t-1})
\end{aligned}
$$

$$
TFP_t = \left(\frac{\Delta \ln GNI_t}{\alpha_t}\right) - \left(\frac{\beta_t}{\alpha_t}\right)\Delta \ln PCS_t - \left(\frac{\gamma_t}{\alpha_t}\right)\Delta \ln TLF_t \qquad (3.3.3.8)
$$

Where $\frac{\alpha_t}{\alpha_t+\beta_t+\gamma_t}$, $\frac{\beta_t}{\alpha_t+\beta_t+\gamma_t}$ and $\frac{\gamma_t}{\alpha_t+\beta_t+\gamma_t}$ are the share of human capital resources, physical capital stock and total labour force in total costs. Their respective elasticity in continuous and discrete form in each are given as

$$
\alpha_t = \left(\frac{\partial lnGNI_t}{\partial lnHCR_t}\right)\left(\frac{lnHCR_t}{lnGNI_t}\right), \beta_t = \left(\frac{\partial lnGNI_t}{\partial lnPCS_t}\right)\left(\frac{lnPCS_t}{lnGNI_t}\right) \text{ and } \gamma_t = \left(\frac{\partial lnGNI_t}{\partial lnTLF_t}\right)\left(\frac{lnTLF_t}{lnGNI_t}\right) \ \&
$$

$$
\alpha_t = \left(\frac{\Delta lnGNI_t}{\Delta lnHCR_t}\right)\left(\frac{lnHCR_t}{lnGDP_t}\right), \beta_t = \left(\frac{\Delta lnGNI_t}{\Delta lnPCS_t}\right)\left(\frac{lnPCS_t}{lnGNI_t}\right) \text{ and } \gamma_t = \left(\frac{\Delta lnGNI_t}{\Delta lnTLF_t}\right)\left(\frac{lnTLF_t}{lnGNI_t}\right).
$$

Therefore, based on (Baltagi, 2005), we can express $\ln GNI_{it}$ as a function of total factor productivity TFP_{it}, human capital resources HCR_{it} and physical capital stock PCS_{it}. The dynamic panel form including lagged dependent variable can be expressed in terms of panel vector autoregressive VAR system contains a set of n variables plus error term is given by

$$
\begin{aligned}
\ln GNI_{it} &= \pi_0 + \pi_{1p}\sum_{l=1}^{P} \ln GNI_{i,t-l} + \pi_{2q}\sum_{l=0}^{q} TFP_{i,t-l} \\
&\quad + \pi_{3m}\sum_{m=0}^{r} HCR_{i,t-m} + \pi_{4n}\sum_{n=0}^{s} PCS_{i,t-n} + \varepsilon_{it} \qquad (3.3.3.9)
\end{aligned}
$$

Where π are parameters to be estimated and p, q, r and s denote optimal lag length. $\boldsymbol{\varepsilon}_{it}$ are white noise random disturbances. In dynamic panel data regression described in eq. (3.3.3.9), we cannot apply the OLS, GLS, Fixed and Random effects methods because $\ln GNI_{i,t-1}$ is correlated with $\boldsymbol{\varepsilon}_{it}$ so that the results will be inconsistent. If $\boldsymbol{\varepsilon}_{it}$ is independently identical distribution iid, it will be correlated with $\ln NIPC_{i,t-1}$. We suppose GNI_{it} be a p ×1 vector of cross-section i in period t, follows a non-stationary VAR (p) process.π_0 is a k ×1 vector with the j-th element representing the deterministic component of the model ϑ_{it} are a k ×1 vector of disturbances and are independent $N(0, \Omega_{i,t})$ for t=1,…,T (see Anderson et al. ,2006).

In recent time, panel data econometrics has been used for estimating and forecasting purposes as cited by Baltagi (2005) and dynamic panel estimators have increasingly been used in studies of growth theory (see, Baltagi, 2005); Easterly, 1997); Islam, 1995) and Arellano and Bond, 1991)). The dynamic relationships are characterized by the presence of lagged dependent variable appears as independent variable with other regressors. The long-run estimation under dynamic panel econometric models explains macroeconomic events by specifying preferences, technology and institutions and predicts what is actually produced, traded and consumed and how these variables respond to various shocks (William, 2010).

Based on lagged observations used as the explanatory variables, dynamic estimators are designed to address the problems of the unobserved specific effects and the joint endogeneity of explanatory variables (Alonso-Borrego and Arellano, 1996). In dynamic panel estimators, we apply the differenced equation to remove any bias and potential parameter inconsistency arising from simultaneity bias created by the unobserved country-specific effects and use lagged values of the original regressors. In cases where the cross sectional dimension is small and the time dimension is relatively large, the standard time series techniques are applied to the systems of equations and the panel aspect of the data should not pose new technical difficulties(Breitung and Pesaram ,2005).

In order to investigate the casual relationship between annual real gross national income per-capita and human capital resources in East Africa from the year 1980 to 2015, this discourse uses a panel wavelet analysis for Granger causality test. Multi-resolutionary wavelet decomposition analysis for a maximal overlap discrete wavelet transform which utilizes moving averages of the original data and moving averages of the moving averages used for filtering data. However, using moving averages, the maximal overlap discrete wavelet transform loses orthogonality which is the characteristic of basic discrete wavelet transformation. To maintain consistency in the transformation of the data series, the data is considered as a circular loop, with the observation following the last one simply being the first observation (Hacker, Karlsson and Mansson, 2012).

The segmentation of time series into different layers makes use of wavelet analysis become popular in economic analysis in the short-run, medium-and long-run horizons according to studies by Ramsey and Lampart(1998), Hacker, Karlsson and Mansson (20120) and Reboredo and Rivera-Castro (2014). The supreme important of the time scale in a panel cointegrated methodology where variables move together is desirable. Since wavelets are local orthonormal bases consisting of small waves that dissect a function into layers of different scale (see some important notes and formula in Appendix).

3.4. **Discussions and Empirical Findings for HCR- Economic Growth**

3.4.1. **Optimum Lag-length Determination for HCR model**

Lag-length determination is the key point in the process of testing and estimation. The Akakie information and other criteria are often used to choose the optimal lag length distributed-lag models. In the estimation of optimum lag-length, we compute log-likelihood function and various types of information criteria for each choice used in accordance with the analyses made in the studies by Johansen (1988, 1991, and 1995). The optimal lag length determination using order selection criteria is found to be three, since the lowest value of each criterion assumes the most appropriate model. Thus, this three optimal lag length will be used for the analysis throughout the paper. The test results have been accessed from the author.

3.4.2. **Panel and Individual Cointgration tests for HCR-Economic Growth**

We also take into account about panel cointegration methodology developed by Johansen (1988), (1991) and (1995). Johansen highlights that one can confident when eigenvalues problem is solved and inferences of the test hypothesis about cointegrating relationship among the variables are confirmed. Like panel unit root tests, panel cointegration tests can be interested for its more powerful than individual time series cointegration tests. The interactions of short-run dynamics between the cross-sections influence other members in a panel of the cross-section's temporary long-run equilibrium error. These differences make ranks in the cross-sectional cointegration (Anderson, Qian and Rasch, 2006).

Accordingly, first we conduct the Johansen cointegration tests for a panel of ten countries and we obtain that number of cointegration equation is found to be one. Then we also test for individual separately at the 5% level of significance using the trace and the maximum eigenvalue tests. Thus, Burundi, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Tanzania, Uganda and Zambia have shown number of equations as (3,1) ;(4,1) ;(1,0) ;(1,1) ;(1,1) ;(2,1) ;(2,0) ;(1,0) ;(1,1) and (0,0), respectively. Numbers in the brackets are the trace and the maximum eigenvalues. Out of ten countries, Zambia has been rejected since there is no cointegrating equation in both cases of tests. When the trace and the maximum eigenvalue statistically different, we should prefer to take trace test (Alexander, 2001) that is why nine countries have passed with cointegrations. Finally, we conduct test for a panel of nine countries, excluding Zambia, in which the test results are shown in (Table 3.4.2).

Table 3.4.2 Johansen test of Panel Cointegration for HCR- Economic Growth

Dependent Variable: lnGNI-OLS followed by estimated HCR-OLS and PCS							
Hypothesized No of CE(s)	Trace Test				Maximum Eigenvalue Tests		
	Eigenvalue	Statistic	5% C. Value	P. Value	Eigenvalue	5% C.V.	P. Value
None	0.2187	119.75	47.856	0.0000*	64.413	27.584	0.0000*
At most 1	0.1043	55.339	29.797	0.0000*	28.758	21.132	0.0035*
At most 2	0.0752	26.581	15.495	0.0007*	20.417	14.265	0.0047*
At most 3	0.0233	6.1638	3.8415	0.0130*	6.1638	3.8415	0.0130*

We perform the Johansen test of Panel Cointegration for unrestricted Rank(r). * denotes rejection of the null hypothesis at the 5% level of significance. The trend assumption is linear deterministic with optimum lag-length of 3.

The results in (Table 3.4.2) show that the Johansen test for cointegration for a panel of nine countries in the unrestricted rank multivariate analyses do exist. We reject the null hypothesis of no cointegration, at most one, two and three cointegrations. Since the trace and maximum eigenvalue statistics exceed their respective critical values conventionally at the 5% level of significance. Both tests indicate there are four cointegrating equations.

Both the trace and the maximum eigenvalue tests in the first column of (Table 3.4.2) indicate that number of cointegrating vectors, which are the hypotheses of the variables not cointegrated ($r = 0$) against the alternative of one or more cointegrating vectors($r > 0$). Since the values of trace statistic (0) and maximum eigenvalue statistic (0) exceed their respective critical values at the 5 % significance level, we reject the null hypothesis of zero cointegrating vectors (r=0) and accept the alternative hypothesis of more than zero cointegrating vectors (r>0). Likewise, the values of trace statistic (1) and maximum eigenvalue statistic (1) are also greater than their respective critical values at the 5 % significance level, we would reject the null hypotheses of $r \leq 1,\ r \leq 2\ and\ r\ \leq 3,$ cointegrating vectors (r=1, r=2 and r=3), however, we would fail to reject the alternative hypotheses of more than one, two and three cointegrating vectors (r>1, r>2 and r>3). From these tests we suggest that the Johansen test of trace and maximum eigenvalue reveal number of cointegration vectors is four within the series of lnNIPC, TFP, HCR and PCR. Hence, the undertaken variables are integrated of the same order; they move together towards the long run equilibrium or they have long run relationship.

3.4.3. **Cross-sectional dependence and Endogeneity tests for HCR-Economic Growth model**

Before estimating parameters, data must be cross-sectional independent by applying the demeaned method, i.e., the difference between actual observation and common mean of the panel since estimation in the presences of cross–sectional dependence causes bias and inconsistency as (Andrew, 2005) points out. We consider the standard augmented Dickey–Fuller ADF regression with the cross–section averages of lagged levels and first-differences of the individual series (Pesaran, 2007) for cross–sectional dependence test. The limiting distribution of this test is different from the Dickey–Fuller distribution due to the presence of cross–sectional lagged level in which (Pesaran, 2003) uses a truncated version of the Im-Pesaran and Shin (1997) test to avoid the problem of moment calculation(Baltagi,2005). Based on an AR(ρ) error specification, the relevant individual cross sectional augmented Dickey–Fuller CADF statistics are computed from the ρ^{th} order cross- section.

With the transformed data by the demeaned method (Walter, 2003), we make regression considering the differenced variable as dependent and its one period lagged as independent variables. Eventually after transformation of the original data, we test for the cross-sectional dependence of the individual explanatory variables (Pesaran, 2007). Consequently we confirm that there is no cross-section dependence among four explanatory variables. The output for the test has been accessed from the author. Finally before arriving at the process of estimation of the parameters, we have to check endogeneity problem that arises from simultaneous equations model with the help of two stages least squares 2SLS, (see Wooldridge, 2002), 1997a) for detailed)). In the presence of endogeneity problem, estimation becomes bias and inconsistent. Consider the following simultaneous equations of $\mathrm{lnGNI} - \mathrm{HCR}$ model where lnGNI and HCR are endogenous variables whereas others are predetermined.

$$\mathrm{lnGNI} = \beta_0 + \beta_1 \mathrm{HCR} + \beta_2 \mathrm{PCS} + \mathrm{u} \qquad (3.3.10\ \mathrm{a})$$

$$\mathrm{HCR} = \beta_{10} + \beta_{11} \mathrm{lnGNI} + \beta_{12} \mathrm{TFP} + \mathrm{v} \qquad (3.3.10\ \mathrm{b})$$

Equation (3.3.10 a) and (3.3.10 b) is exact–identified. Here, the two stages least squares 2SLS is applied for solving the problem of endogeneity as a result of simultaneous equations model. We first estimate the reduced form equations by OLS; that is, we make a regression of HCR on PCS and TFP by OLS method and obtain the estimated human capital resource HCR–OLS. Then we estimate lnGNI as a function of HCR–OLS and PCS using (3.3.9). We also make a regression of lnGNI on PCS and TFP by OLS method and obtain the estimated lnGNI. Finally we estimate HCR as a function of the estimated lnGNI and TFP by the OLS. These procedures are known as the two stages least square method 2SLS.

3.4.4 **Dynamic panel VAR estimation of short-run coefficients in HCR model**

Based on the three optimum lag–lengths found in section 3.4.1, now we can estimate the long–run parameters using panel VAR model and make use of other analyses. The analyses of long–run estimation parameters have received a remarkable attention in various forms such as dynamic OLS of Hayakawa and Kurozumi(2008); panel fully modified OLS estimators of Phillips and Moon(1999, 2000); panel fully modified OLS estimators of Kao and Chiang(2000) and panel vector error correction models of Anderson, Qian and Rasch (2006) in which the results are asymptotically unbiased and normally distributed estimated coefficients.

Table 3.4.4.1 Dynamic panel VAR estimation of short–term Coefficients for HCR model

Variable	Coefficient	t-Statistic	P. Value
$\mathrm{lnGNI2SSLS_{it-1}}$	1.1082	12.900	0.0000**
$\mathrm{lnGNI2SLS_{it-2}}$	-0.0769	-0.6141	0.5397
$\mathrm{lnGNI2SLS_{it-3}}$	-0.0668	-0.7934	0.4283
$\mathrm{HCR2SLS_{it-1}}$	-0.3518	-1.4555	0.1468
$\mathrm{HCR2SLS_{it-2}}$	0.8384	2.7136	0.0071**
$\mathrm{HCR2SLS_{it-3}}$	-0.5019	-2.1969	0.0289*
$\mathrm{TFP_{it-1}}$	-0.0003	-0.1512	0.8799
$\mathrm{TFP_{it-2}}$	0.0021	1.4118	0.1592
$\mathrm{TFP_{it-3}}$	-0.0029	-2.0019	0.0463*
$\mathrm{PCS_{it-1}}$	0.0575	6.1274	0.0000**
$\mathrm{PCS_{it-2}}$	-0.0011	-0.0926	0.9263
$\mathrm{PCS_{it-3}}$	-0.0183	-1.9972	0.0469*
Constant	-0.0028	-0.2865	0.7747

The Joint Wald Test

Joint Null Hypothesis	χ^2	P. Value
$\mathrm{lnGNI2SLS_{it-1}} = \mathrm{lnGNI2SLS_{it-2}} = \mathrm{lnGNI2SLS_{it-3}} = 0$	3080.7	0.0000**
$\mathrm{HCR2SLS_{it-1}} = \mathrm{HCR2SLS_{it-2}} = \mathrm{HCR2SLS_{it-3}} = 0$	7.6863	0.0430*
$\mathrm{PCS_{it-1}} = \mathrm{PCS_{it-2}} = \mathrm{PCS_{it-3}} = 0$	50.588	0.0000**

** and * denote the level of significance at 1% and 5% with the optimal lag length of three. In order to make free from endogeneity problem, we estimated data on GNI and HCR by 2SLS and denoted as GNI2SLS and HCR2SLS. Model Diagnostics: The residual error terms are normally distributed, free from the problem of Autocorrelation and heteroskedasticity. The test results have been accessed from the author.

R-squared	0.9653
F-statistic	596.56
Prob(F-statistic)	0.0000

By looking at the coefficient of determination (R–squared value), we claim that about 96.5 percent variation in lnGNI is due to the facts that change in TFP, HCR and PCS. The F-statistic value is statistically significant which indicates our model specification is adequate and fit to the data. The estimated one year lagged in the gross national income, two years lagged in human capital resources and one year lagged in physical capital stock have positively significant impact on the estimated GNI for a panel of nine East African countries over the period 1980–2015. The bottom portion in (Table 3.4.4.1) also indicates that the joint cumulative VAR Wald test up to three periods lagged of the estimated GNI, HCR and PCS have significantly impact on the current estimated GNI.

Table 3.4.4.2 Short–run panel VAR transmission mechanism channels by Wald test for HCR

Hypothesized	χ^2	P. Value
1. H_0: HCR causes lnGNI and lnGNI causes PCS		
lnGNI = F(HCR) and PCS = F(lnGNI)		
$HCR2SLS_{it-1} = HCR2SLS_{it-2} = HCR2SLS_{it-3} = 0$	8.1177	0.0333*
&		
$lnGNI2SLS_{it-1} = lnGNI2SLS_{it-2} = lnNGNI2SLS_{it-3} = 0$	7.9466	0.0471*
2. H_0: lnGNI causes HCR and HCR causes PCS		
HCR= F(lnGNI) and PCS= F(HCR)		
$lnGNI2SLLS_{it-1} = lnGNI2SLLS_{it-2} = lnGNI2SLLS_{it-3} = 0$,	20.695	0.0001**
&		
$HCR2SLS_{it-1} = HCR2SLS_{it-2} = HCR2SLS_{it-3} = 0$	7.1959	0.0659
3: PCS causes lnGNI and lnGNI causes HCR		
lnGNI = F(PCS) and HCR= F(lnGNI)		
$PCS_{it-1} = PCS_{it-2} = PCS_{it-3} = 0$,	51.971	0.0000**
&		
$lnGNI2SLS_{it-1} = lnGNI2SLS_{it-2} = lnGNI2SLS_{it-3} = 0$	20.695	0.0001**

** and * denotes rejection of the hypothesis at the 1%, and 5% level of significance using the optimal lag-length of three.

After excluding the insignificant TFP from the panel VAR system, we conduct the short-term transmission mechanism channels using the Wald test. As we can see the results from (Table 3.4.4.2), all hypotheses are significant, except HCR causes PCS. These imply that there is a significantly important contribution of human capital resource HCR to the development of physical capital stock PCS through gross national income per capita lnGNI. The growth of lnGNI has also a positive role towards the accumulation of PCS via HCR. Explicitly we can demonstrate the inter-temporal relationship between the estimated lnGNI and HCR using the wavelet time scale analyses.

Table 3.4.5 Impulse–response Granger causality test of wavelet time scales for HCR model

Accumulated Responses from	Short-term	Medium-term	Long-term
lnGNI to HCR	0.0044	0.0099	0.0697
Calculated χ^2–value	(12.10)	(20.27*)	(57.85*)
HCR to lnGNI	-0.0007	-0.0001	0.0117
Calculated χ^2–value	(28.06*)	(35.16*)	(52.66*)

* Denote rejection of the null hypothesis of the explanatory doesn't Granger cause of the dependent variable. We consider the optimal lag length found to be three in a VAR system in calculating the chi-square value for each country. Then we calculate the combined chi-square for the time scale horizons using the formula, $\chi^2 = -2\sum_{i=1}^{L}\ln(p_i^2)$ where $-2\ln p_i$ which has shown a chi-square distribution and i stands for country 1, 2, 3,.., L (see detailed in Dmitri et.al. ,2002 and Fisher ,1932). We compare these combined χ^2 (which is available is available in Brooks, 2008) with the conventional χ^2 of 16.92 at the 5% level of significance for 9 degrees of freedom which represents number of countries.

We extend the VAR analysis with the determined three optimum lag–lengths to the impulse-response functions. It is because impulse-response is more appropriate method for more than two optimal lag-lengths. We obtain the mean coefficients for the time scale decomposition of a panel wavelet analysis in the Granger causality test. Thus, the results in (Table 3.4.5) show that the accumulated responses of GNI to HCR are positive significant in the medium-and long-terms while that of HCR to GNI are significantly negative in the short-and medium-terms and significantly positive in the long-run for a panel of nine East African countries. These effects slightly increase over time which indicates that there are bi-directional inter-temporal causal relationships between HCR and GNI in the long-run. These mean that more educated and skilled human capital can produce sufficient amount of real gross national income for the countries and the reverse also holds true. For these, calculations are based on the Chlesky variance-response function with the help of the standard error of the Monte Carlo simulation.

The possible explanation for the unexpected negative accumulated response from HCR to GNI in the short-and medium-term may be the low level capacities that unable to accommodate more educated and skilled people in the economy the pane study. The empirical results of this study somehow related to some previous studies such as the link between human capital and labor market of the Pakistan economy by (Qadri and Waheed ,2014) and the critical unemployment high level in economic growth of the Spain and the Cyprus though the level of human capital, expressed as a percentage of tertiary educated in the study of (Cadil, Petkovováa and Blatnáb,2014). This idea may be also related to the studies by Sahbi and Jaleleddine (2015), Mohsen and Maysam (2013), Ndambiri et al., (2012), Anderson, Qian and Rasch (2006) and Freddy et al. (2003).

The benefit we provide from this study is that the combined analyses of different methods. The methods are dynamic panel transmission mechanism channels in VAR model of multivariate panel and wavelet time scaling of bivariate impulse-response bi-directional dynamic causal relationship. This is the new approach for the economic analysis which adds to the existing knowledge. We also argue that due attention should be given to the human capital resources more than any other for the economy to progress successful.

3.5. **Conclusion for HCR-Economic Growth**

Human capital resource is the basic foundation for economic growth. Human capital endowments allocated to the productive sectors can be an important determinant of economic growth. The skills, knowledge, and innovation that people accumulate are the greatest assets in such countries and this shows that human capital brings income differences across the world. This is profoundly important for the East African today that smart and timely investments in human capital can play the central role in creating sustainable and successful economic growth in couples of decades, for a number of reasons such as large youth population's growth and rapidly growing and changing skills demands for the technology (Keith, Fred and Lutz, 2017).

Importantly, the quality of education of workers has been a major factor in succeeding high rate of economic growth and hence, without a greater supply of homegrown talent in areas of economic sector, it will be hard to build prosperous, inclusive, and resilient economies that can compete and succeed globally. However, East Africa has the lowest level of human capital development nevertheless; it displays a rapid growth in the expansion of education. This highlights the issue of employment challenges that women are going through more than men. Instead of attending school, they are being forced to marry at an early age, due to financial constraints and traditional cultures that curb their education opportunities.

In fact, labor theories and policies do not usually include a gender approach to labor challenges in modern economic theory. Thus, physical policy is an important element in addressing the development of human capital in East African region. This physical policy is all about the effective system of taxation on revenue generation for the governments and other resources of mobilization as well as inequality and equity concerns. However, in East Africa, this policy would be in effective when it comes narrowing the gap in societies in terms of income and wealth inequalities in addition to the lack of inclusiveness in economic growth for all beneficiaries. The expansion of human capital stock itself has not been matched by a proportionate rise in physical capital due to the low level of income growth and the low returns to educational investments (Simon and Francis, 1998) caused by the low levels of accommodation in the economy.

In this study, we conduct the tests for non-stationary and others, before ultimately estimate the coefficients. Our estimation indicates that the growth rates of human capital resources and the physical capital stock have long-run effects on the growth rate of gross national income in a panel of nine East African countries over the period of 1980 to 2015. The short–term transmission mechanism of the VAR system applied in accordance with the Wald test which indicates that HCR growth contributes hugely to the development of PCS through GNI. The GNI growth has also a positive role in accumulating PCS via HCR.

We explicitly demonstrate the dynamic inter–temporal relationship between gross national income and human capital growth using a panel wavelet analysis in time scaling decomposition. The test shows that the accumulated responses of GNI to HCR are positively significant in the medium–and long–term, while that of HCR to GNI are significantly negative in the short- and medium–run but positive in the long-run. These effects slightly increase over time which indicates that there are bi–directional inter–temporal causal relationships between HCR and GNI in the long–run. This leads us to say that more educated and skilled human capital can produce sufficient amount of real gross national income for the countries and vice versa. The possible explanation for the unexpected negative accumulated response from HCR to GNI in the short– and medium–term may be the low level capacity to accommodate more educated and skilled people by the panel countries.

This study, therefore, employs the analyses of short–run dynamic panel transmission channels in a VAR model and the causality test of wavelet analyses. We use the combined analyses of different methods such as the short–run dynamic panel transmission mechanism channels in VAR model of the multivariate panel and wavelet time scaling of the bivariate impulse–response bi–directional dynamic causal relationship. We, therefore, suggest that the analyses of dynamic panel transmission channels in the VAR model for the short-run effect and the wavelet time scaling in causality tests for the short–medium–and long–run effects in a panel dataset are essential. This is the new approach for the economic analysis which adds to the existing stock of knowledge. We also argue that more due attention should be given to HCR than any other in attempt to achieve sustainable development in the process of successful economic progress.

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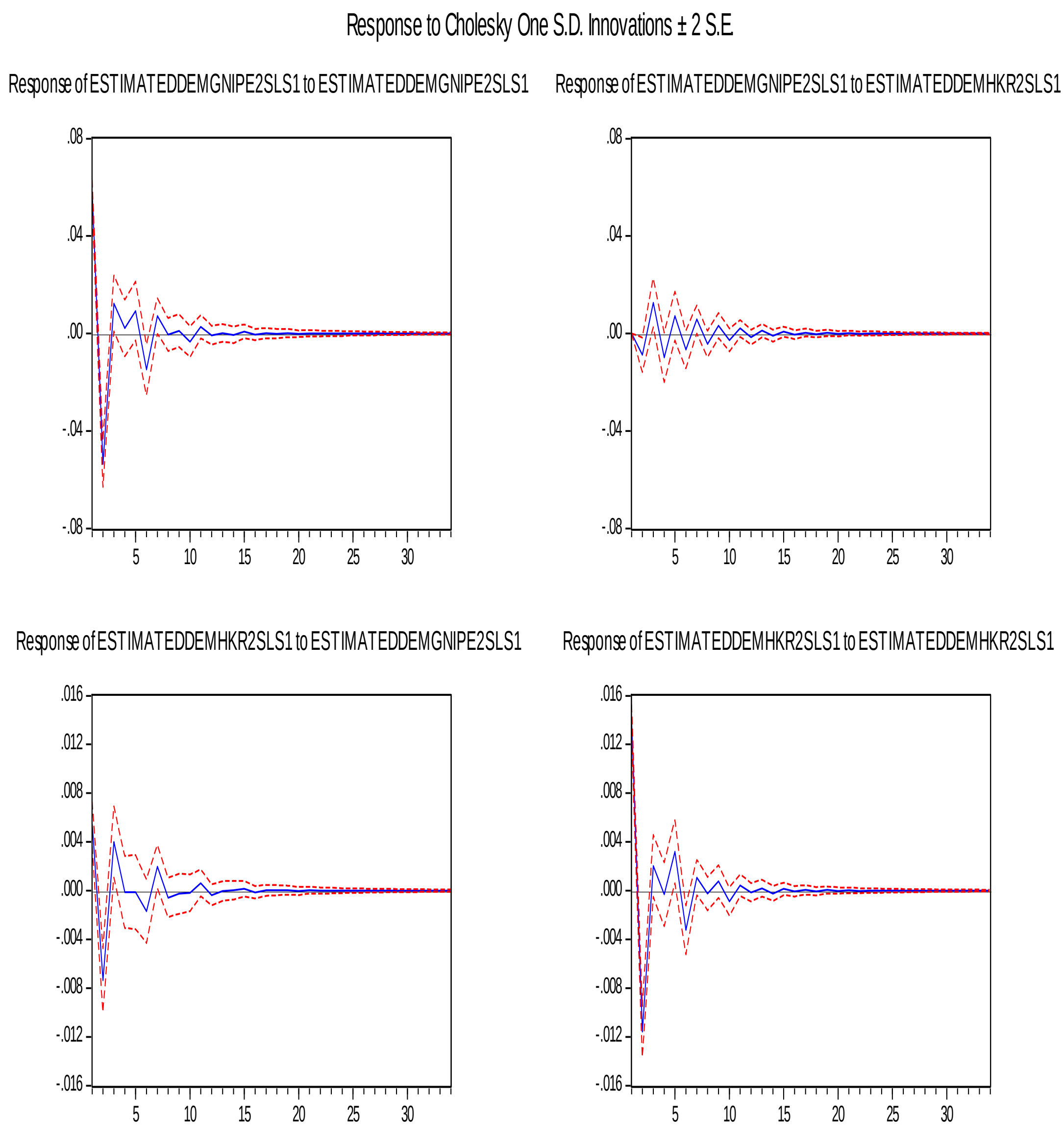
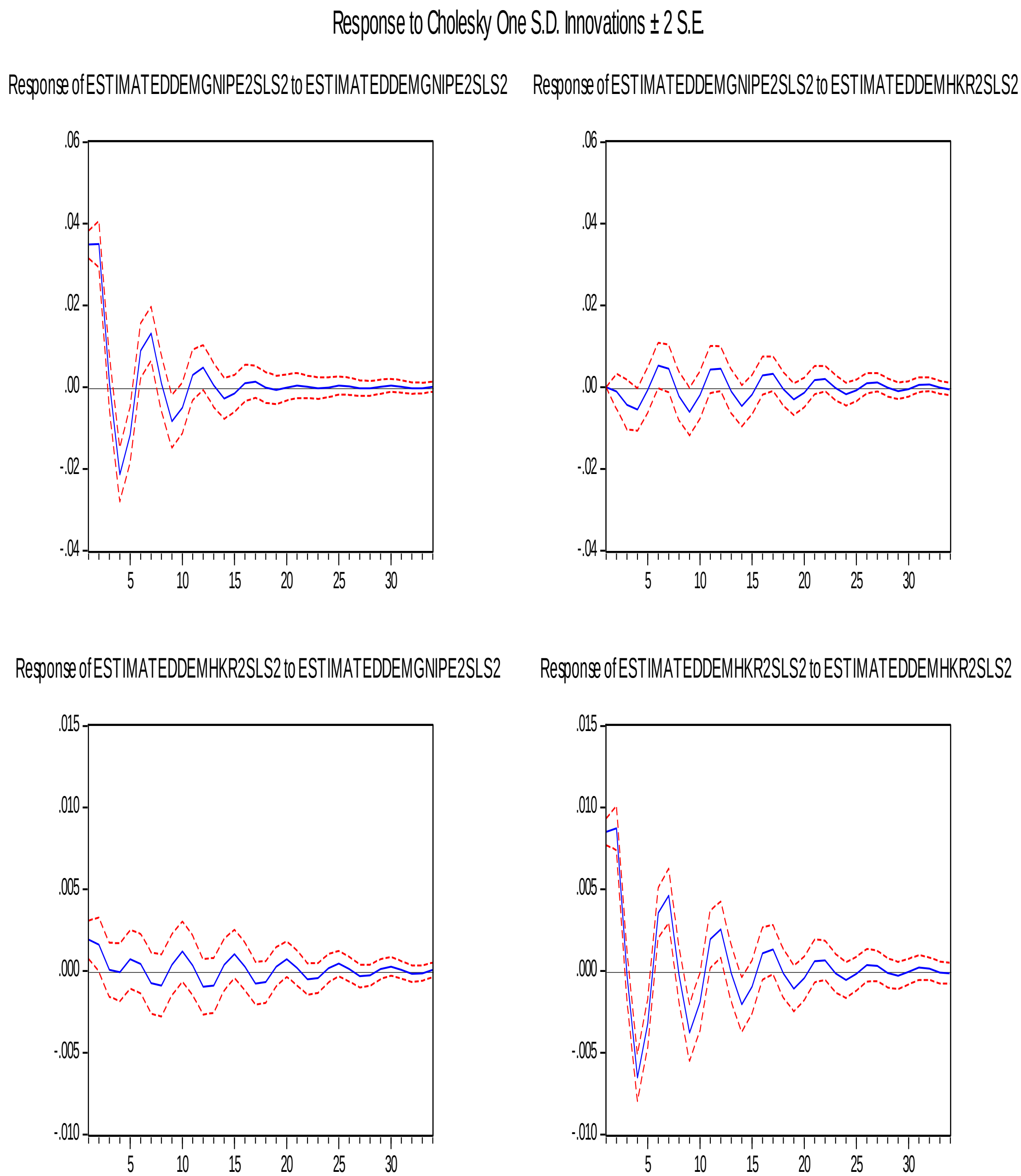
Appendix for Economic Growth and HCR: Graph

1. Short- term Time Scaling Horizon



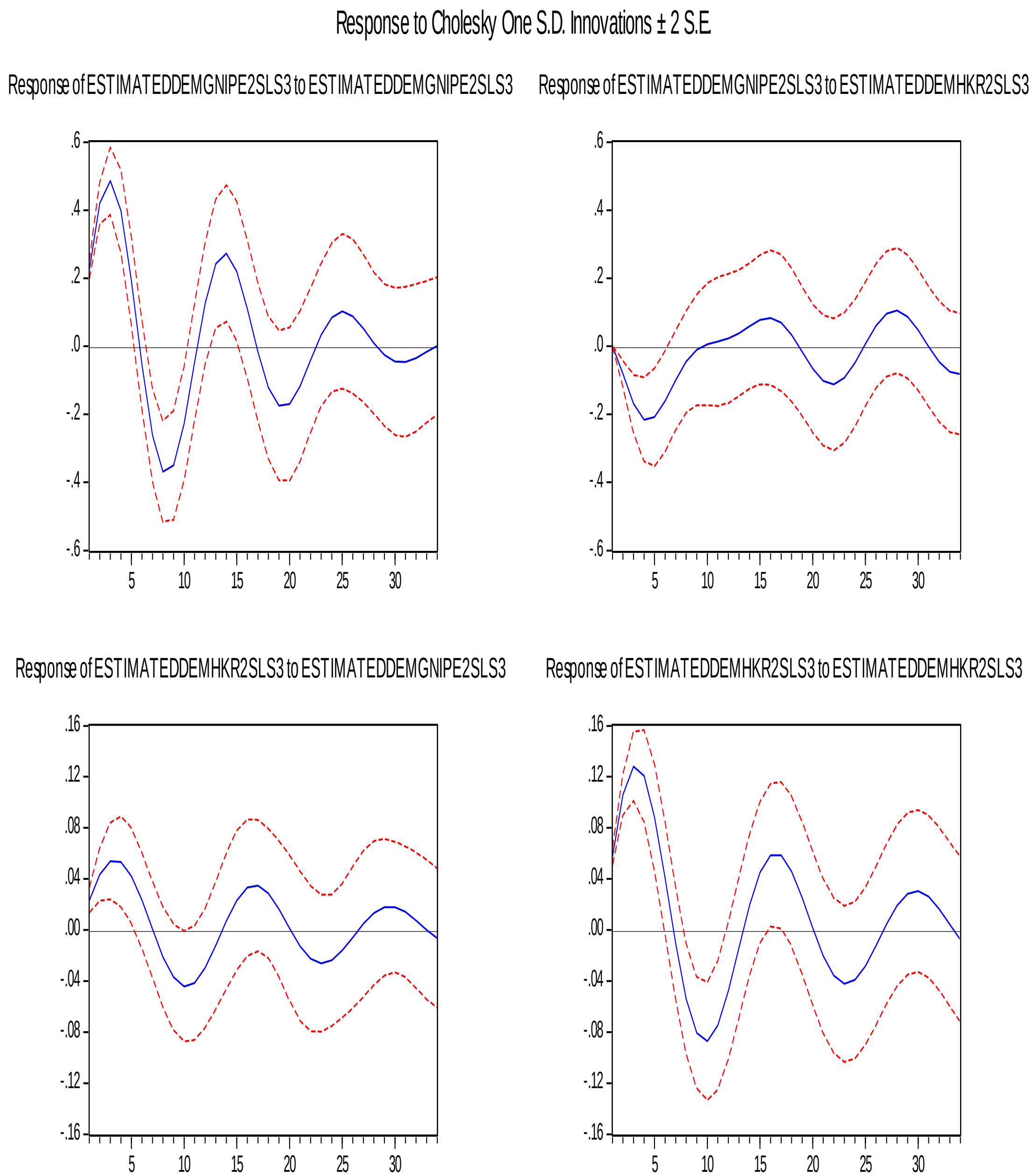
1000,000 times simulations using Monte Carols

2. Medium-- term Time Scale Horizon



1000,000 times simulations using Monte Carols

3. Long-term Time Scale Horizon



1000,000 times simulations using Monte Carols

Fig. C Time Scales Decomposition of the Wavelet Analyses for Economic Growth and HCR

CHAPTER IV: THE IMPACT OF FOREIGN DIRECT INVESTMENT ON GDP GROWTH IN EAST AFRICA

Abstract

This study empirically investigates the impact of foreign direct investment (FDI) on GDP growth in East Africa. The study employs annual panel data, obtained from the United Nations aggregate database for the selected countries in the region over the period 1970-2015. Unlike time series and cross–sectional, panel dataset reduces the identification problems in the presence of endogenous variables and estimates more robust and efficient parameters. This discourse uses methods of panel autoregressive distributed lag and random effect models combined with time scaling wavelet decomposition analysis in order to show the short, medium and long–run effects for the entire region and the individual countries. Flowing FDI into developing countries is one of the most dynamic resources which play an important role in economic development by supplementing domestic savings in capital accumulation, creating innovation and income growth, transferring modern technology and employment generation, and providing a means for creating stable and long–lasting economic growth. Examining the correlation between FDI and economic growth, cannot identify the specified direction of causation by one variable to another one using traditional approaches such as dynamic panel ARDL. However, the time scaling wavelet decomposition method can help to recognize the dynamic causality in time horizons. Thus the Granger causality of wavelet analysis in a panel indicates that there are bi-directional dynamic relationships between real GDP and FDI in the short, medium, and long–run. According to the empirical evidence, the long-run estimated coefficients reveal that a one percentage increase in FDI significantly increases the real GDP by approximately 0.16 percent in a panel of seven East African countries.

Keywords: *FDI, economic growth, dynamic panel ARDL, time scales wavelet decompositions*

4.1. Introduction to Foreign Direct Investment on GDP Growth

Empirical investigation of the impact of foreign direct investment (FDI) on economic growth is essential for developed and developing economies. The inflow of FDI is a key element in providing a means for creating stable and long-lasting real GDP or economic growth (OECD, 2008). It improves the competitive position of a given economy, encourages transfer of modern technology, and provides an opportunity for the host economy to promote its products more widely in international markets, positive effect on the development of international trade and an important source for capital accumulation.

FDI is one of the most dynamic resource inflows into developing countries which play an important role in economic development such as transferring modern technology and creating employment generation. It is helpful in supplementing domestic savings in capital accumulation, creating innovation and income growth. It is also used to bring integration into the global economy, enhance efficiency and raise the skills of domestic labor (Dupasquier and Osakwe, 2006; Anyanwu, 2006; 2012). An increase in FDI may be associated with improving economic growth due to the inflow of capital and increase tax revenues for the host country. These make a channel of FDI into new infrastructure and other projects to boost development endeavors. Furthermore, FDI can result in the transfer of soft skills through training, availability of more advanced technology for the domestic economy and access to research and development resources (UNCTAD, 2010).

Attracting FDI has been assigned a prominent place in the strategies of economic renewal supported by policy makers at national, regional, and international levels. The experience of fast-growing East Asian and recently China has strengthened the belief that attracting FDI is a key to bridging the resource gap of the low-income countries (UN, 2005). This is one of the factors that make differences in economic growth across nations. Explaining growth differences across countries by Leon-Gonzalez and Vinayagathasan (2013), Koop, Leon-Gonzalez and Strachan (2012), Leon-Gonzalez and Montolio (2012), Moral-Benito (2010; 2012), Sala-i-Martin, Doppelhofer, and Miller (2004), lead to a conclusion that some countries can keep on sustainable economic growth while others cannot. The difference results from the activities of FDI would make the variation in economic growth in a given region. The study by Lee, Pesaran, and Smith (1997) explains that international per capita output and its growth empirically reflect the nature of steady state growth rates which differ significantly across countries.

One of the most important parameters that encourage FDI towards the economy is openness to international trade. In fact, trade liberalization enhances the competition and efficiency in production allowing for technology transfer and increased TFP as (Nachega and Fontaine, 2006) indicate. The support for regional economic integration in Africa, in terms of trade is high among the continent's international development partners (Peter, 2010). For successful integration, various forms of measures have been taken such as lifting up of tariffs, quantitative restrictions, and exchange controls. However, Andrew (2000) points out that Africa has not embraced trade liberalization in the manner that other developing regions have. This implies that export performance in Africa over recent decades is typically found to be poor and has shown stagnation (Oliver and Andrew, 2006). The composition of Africa's exports is essentially remained unchanged with smaller shares in the world trade. Africa will not be able to set itself on sustainable path to growth and poverty reduction, without increased trade (Economic Commission for Africa Report, 2005). Africa has generally been slow and reluctant for private sector development as a multiple effect from FDI (Booth and Golooba-Mutebi, 2009).

In the Sub-Saharan Africa, the study of (Michalowski,2012) indicates that FDI and its effects on economic growth have risen significantly over the last three decades, though the overall performance of the region in attracting FDI seems to be disappointing. FDI inflows into Sub-Saharan Africa spread unevenly across the region with a high degree of concentration in a few countries. Although there is mixed evidence regarding the impact of FDI on economic growth in Sub-Saharan Africa, African states urgently need expanded and more dynamic private sectors, more efficient and effective infrastructure provision and increased investment from both domestic and foreign sources (Nellis, 2005). Brixiová and Ndikumana (2011) also indicate that macroeconomic policies would help the low income countries in Africa, profoundly important to the East African economy, which has similar experiences with the Sub Saharan Africa.

This study is being proposed to make contribution to the stock of existing knowledge by designing a new econometric model approach, time scaling wavelet decompositions in addition to the traditional dynamic panel ARDL and random effect RF methods. The purpose of this study is empirically to analyze the impact of FDI on economic growth. We review a number of related empirical studies, followed by specification of the appropriate model for estimating macroeconomic data, which inspires our study to be genuine option. The general objective is to investigate the impact of FDI on economic growth in the short, medium, and long–term in East Africa. The region has been recently trying to take steps to enhance dynamic macroeconomic stabile by considering intense situations in the region and importance of stability for poverty alleviation; the associated studies conducted in this area have prime worth. This study helps to provide with tangible information about how FDI inflows is well managed and fully utilized for the basic foundation of economic program implementation. Moreover, it may motivate other researchers to conduct further study on this area. It can be also used as a reference for governments' policymakers and non-governmental organizations to take some actions.

The structure of the paper begins with introduction section followed by describing an overview of related empirical literature. The subsequent sections are intended to reveal the type of data and methodology used and empirical findings with discussions. Finally, main findings of the study are summarized and concluded in the last section. The selected sample countries are Burundi, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Tanzania, Uganda, and Zambia.

4.2. Review of the Related Literature of Foreign Direct Investment

The empirical relationship between FDI and economic growth has been given due to attention in the economic literature. Tsikata (2012) examines the relationship between foreign exchange regime and macroeconomic performance in Eastern Africa that finds the determinant of growth, investment, and real exchange rates. Kamaludin, Sheikh, and Mohamed (2013) assess that the suitability of monetary union among East African community members based on aggregate demand and aggregate supply framework with a structural vector auto-regression model to identify shocks. Such shocks are global supply, domestic supply, monetary supply, and domestic demand shocks using variance and impulse response analyses. Their results reveal that domestic demand shocks and external supply shocks are influential.

The investigation on FDI in Kenya as the main drivers for real GDP growth and those factor driver by the study findings in (Abala, 2014) show that FDI is mainly market-seeking, which requires growing GDP, political stability, good infrastructure, market size as well as reduction in corruption levels. Ngeny and Mutuku (2014) explore the FDI volatility on growth in Kenya, using time series data scanning from 1970 to 2011.The results from this study suggest that FDI has a positive effect on growth whereas FDI volatility has a negative impact on growth. Notably, trade openness is not FDI inducing, thus affecting growth negatively. Basemera, et al., (2012) analyze the role of institutions in determining FDI inflows to East Africa between the year 1987 and 2008 and their findings show that institutional variables, particularly economic risk and financial risk rating and corruption, have significantly influenced the FDI inflows to East Africa. More specifically, the study by Brixiová and Ndikumana (2011) shows that favorable external environment, domestic factors such as reduced conflict, greater political stability and prudent macroeconomic policies underpinned growth and structural reforms that improved the business environment of Rwanda and Ethiopia.

According to the study in Sun (2002), in this era of increasingly globalized world economy, FDI is particularly significant driving force behind the interdependence of national economies. Even though most of the FDI flows have concentrated on the developed countries, its importance is undeniable for developing countries as well. Aggregate wealth and total trade volumes of the developing world rise over time because, FDI flows into developing countries grow up and their participating is more than ever before in the global production network (Anyanwu, 2012). As a result, there is a positive relationship between market size and FDI inflows, openness to trade has a positive impact on FDI inflows, but increase financial activities have negative effect on FDI.

The new endogenous growth models allow that the FDI has to impact on economic growth in the long–run through knowledge transfers to the host country. The finding of Lund(2010) suggests that the impact of FDI on economic growth is not obviously thought. FDI may potentially influence economic growth positively but is dependent of many factors such as host country characteristics, FDI policy and the FDI kind (Lund, 2010). A high level of economic growth attracts FDI which causes economic growth primarily in the manufacturing sector. FDI is generally seen as a composite bundle of capital stock and technology that can augment the existing stock of knowledge in the host economy through labor training, skill acquisition and diffusion (Lund, 2010).

The FDI inflows and effects on economic growth in absolute terms in Sub-Saharan Africa according to the study by Michalowski (2012), have risen considerably over the recent three decades while the overall performance of the region in attracting FDI seems to be disappointing. FDI inflows into Sub-Saharan Africa spread unevenly across the region showing a high degree of concentration in a few countries. There is mixed evidence regarding FDI impact on economic growth in the region such as the empirical perspectives. Anyanwu and Yameogo (2013) examine factors driving FDI inflows to African countries which have both policy and non-policy factors. These are alternatively viewed as basic economic factors, trade and exchange market policies. Other aspects of the investment climate as presented in Anyanwu (2012) that drives FDI to West Africa, indicating the real per capita GDP, domestic investment, trade openness and exports, have positive and significant effect on FDI inflows.

In East Africa, however, according to the study by (Abala,2014) investigates that FDI in Kenya is mainly market-seeking, which means it requires growing GDP, political stability, good infrastructure, market size, and reduction of the level of corruption. In addition, Basemera et al. (2012) analyze the role of institutions in determining FDI inflows to East Africa over the period over 1987–2008 using fixed effect model. The findings they draw from the study show that institutional variables, particularly economic risk and financial risk rating and corruption, have significantly influence the FDI inflows to East African region. There is also an investigation of the impact of FDI volatility on growth in Kenya using time series data scanning from the year 1970 to 2011, by applying the bound testing approach. Ngeny and Mutuku (2014) suggest that FDI has positive effect on growth whereas the FDI volatility has a negative impact on growth.

Substantial importance of the FDI to economic growth and development by complementing domestic investment, facilitating trade and transferring knowledge and technology must be taken into account. As (OEOD,2002) argues to make FDI is an effective integral part in the open international economic system and major catalyst to development, the primarily challenges of host countries such as the need to establish transparent, broad and effective enabling policy environment for investment and to build the human and institutional capacities to implement should be addressed. There have been insignificant inflows of the FDI into African economies, despite the fact that (Ogalo, 2011) FDI is a fundamental instrument to solving Africa's economic problems. However, AERC (2006) shows average annual inflows of FDI into Africa doubled in the 1980s compared with the 1970s and it also increases a remarkable in the period 2000-2003. The study in (Van der Lugt et al., 2011) tells us an automatic link between the FDI inflows to economic development has been a certain notion that increased in prominence with the rise of neo-liberal thinking in the 1980s. The notion encourages the success of the so-called the Asian tigers achieving high growth rates, which coupled with poverty reduction through an outward market-policy orientation.

The empirical relationship between economic openness and economic performance such as income growth and export performance has been much debated in recent economic literature. However, in this case, the trade and growth relationship is not yet fully established according to the study by Rodriguez and Rodrik (2001) and Halit (2003) which demonstrates that trade liberalization does not have a straightforward relationship with growth. Pritchett (1991) also describes that there is no reliable and robust estimate of economic openness and economic performance. Thus, it is likely to be possible from cross-country data in which the empirical results of Halit (2003) indicates that trade barriers are positively and significantly associated with growth in the developing countries. In contrary, Lloyd and MacLaren (2002) argue that fair trade has spread in developing countries as initiative aimed at lifting poor smallholder farmers out of poverty by providing them with premium prices, availability of credit, and improved community development.

On the other hand, the new growth theory argues that there is indeed a demonstrable positive relationship between economic openness and economic performance (see Edwards, 1998); Srinivasan and Bhagwati, 1999); Frankel and Romer, 1999)). The documentation of positive relationship received support from the work by Billmeier and Nannicini (2007) using matching estimators and synthetic control methods. Further developments include the construction of multi-dimensional openness indicators known as globalization indicators used by De Lombaerde and Iapadre (2008), which is another important key element. Measures of trade openness based on the transformed uniform tariff equivalents derived from the computable general equilibrium (CGE) analysis in Lloyd and MacLaren (2002) are some among others. Regarding terms of trade, the most advanced model building on the "new open-economy macroeconomics that synthesizes the Keynesian nominal rigidities with inter-temporal approaches to open-economic dynamics, is an important effects of market structure on international trade" (Obstfeld, 2001, pp.109).

Index of openness with multi commodity-countries model as a mathematical expression of the sum amount of exports and imports of the country to its GDP ratio has been indicated by Kotcherlakota and Sack-Rittenhouse (2000). In this review specifically, the measurement of trade openness by Lloyd and MacLaren (2002);the relationship between trade openness and economic growth by Halit (2003) and the dnamic measurement of economic openness by De Lombaerde (2009) are very crucial to be considered in the literature review of this kind of study. The two relative prices are price of exports in terms of imports or the difference between price on commodities in foreign and domestic markets is known as terms of trade (Obstfled and Rogoff, 1996). These observations are some sources for the calculation of index of openness. De Lombaerde (2009) proposes a new method to measure economic openness that empirically investigates the openness-growth nexus as a new tool for policy-makers. Further, De Lombaerde (2009) examines the empirical relationship between economic openness and economic performance which concludes that no definitive conclusions seem to be reached yet, part of the problem being the very measurement of economic openness of a national economy.

There are certain empirical studies show that macroeconomic effects both domestically and internationally, out of which one is the effect of wealth on consumption and the other important one is the effect on investment, which are the issues of long-standing interest to economists. Cooper and Dynan (2016) suggest fluctuations in household wealth have driven major swings in economic activity. Individual economies in the global economy are interlinked through many different channels in a complex way. These are scarce resources including oil and other commodities, political and technological developments, labor and capital movements across countries, cross-border trade in the financial assets as well as trade in goods and services are the most common onces. Even after allowing for such effects, there might still be residual interdependencies due to unobserved interactions and spill-over effects not taken properly into account by using the common channels of interactions (Alexander and Pesaran, 2016).

The macroeconomic effects of large exchange rate appreciations have indicated in a sample of one hundred twenty eight countries (Kappler, Reisen, Schularick and Turkisch, 2011), an exchange rate appreciation has strong effects on current account balances. The empirical results of this study explicitly reveal that within three years after appreciation event, the current account balance on average deteriorates by three percentage points of GDP. This effect occurs through reduction of savings without reduction in investment. Chirinos-Leañez and Pagliacci (2015) try to associate macroeconomic fluctuations and the reactions of monetary authority in order to evaluate how macroeconomics shocks affect domestic and foreign debt markets in Venezuela, where monetary policy is not the main source for macroeconomic fluctuations. The new-Keynesian macroeconomic model for the small open economy of Peru that uses Bayesian techniques and quarterly data to estimate parameters (Salas, 2010) describes that the empirical findings provide support to the weights on forward-looking components in the aggregate demand. Proano,et al.,(2006) formulate the disequilibrium aggregate supply and aggregate demand model based on the sticky wages and prices and the adaptive expectations concerning inflation climate in which the economy operates. Through instrumental variables in GMM-system estimation with aggregate time series data for the U.S. and the Eurozone economies, (Proano,et al., 2006) obtain structural parameter estimates which support the specification of theoretical model.

An observable statistical adverse impact on macroeconomy caused by natural disasters has costlier events which lead to more pronounced slowdowns in production in the short run (Noy, 2009). Interestingly, developing countries face much larger output declines following the disaster of similar relative magnitude than developed countries. Furthermore, countries with higher literacy rate, better institutions, higher per capita income, and higher degree of openness to trade and higher levels of government spending are better able to withstand the initial disaster shock and prevent further spill-over.

The study investigated by Brixiová and Ndikumana (2011), has clearly shown that an average of 5.7 percent a year during 2001–2008, Africa has experienced the highest growth as a whole. This is due to favorable external environment, domestic factors such as reduced conflict, greater political stability and prudent macroeconomic policies underpinned growth and structural reforms that improved business environment in the countries (e.g., Rwanda and Ethiopia). The increase in trade and investment flows between Africa and China, India and the Gulf countries are becoming an important driver of growth and fundamental shift in macroeconomic policy thinking (Hailu and Weeks, 2011) which explains that the shift in opens space for implementing policies to promote growth and reduce poverty.

After carefully examining the empirical studies mentioned above in related literature, which have brought mixed notions of FDI and economic growth relation, the study has looked for the appropriate model. This new approach model can reveal the inter-temporal causal effects in different time horizons, in addition to the classical estimation between dependent and explanatory variables. We also examine whether the results of the classical estimation methods such as dynamic ARDL and RF are harmonized.

4.3. **Methodology of the Study for the Impact of FDI on GDP growth rate**

4.3.1**. Data Sources and Variable Descriptions for FDI, GDP and Others**

According to the study by Lane (2001), many scholars have introduced open-economy dynamic models that incorporate imperfect competition and nominal rigidities since 1990s. A consistent framework for understanding dynamic macroeconomic models requires the key concepts in a discrete time setting and develops recursive approach in the dynamic stochastic environment. The research methodology is based on systematic use of techniques for conducting empirical research comprised of research hypotheses, methods of data selection, model specification and variable descriptions. To this aim, the study employs annual panel data of 11 selected East African countries for the period of 1970-2015.

The sources of data for this study are FDI net inflow in absolute term (in the current price USD) is obtained from the United Nations Conference on Trade and Development and real GDP (at 2005 constant USD), official exchange rates OER and data related to index of openness IO and terms of trade TOT are from the United Nations aggregate database. The real GDP, FDI, IO, TOT, and OER are macroeconomic variables to be used. IO and TOT are indexed by own calculations based on real GDP at constant 2005 USD, while consumption expenditure, exports and imports are directly obtained from the sources.

Therefore, in this study we employ the methodology of panel dataset because it allows us to identify certain parameters, without the need to make restrictive assumptions and produce more efficient estimation of parameters. This methodology is helpful to reduce the identification problems in the presence of endogenous variables and measurement errors. It produces much more quality of outcomes in terms of robustness to omitted variables and identification of individual dynamics as compare to the time series and the cross-sectional datasets (Verbeek, 2004 and Baltagi, 2005). The selection of panel countries is based on availability of data on the series and a common economic nature in the sample study.

4.3.2. **Framework of the Model for the Impact of FDI on GDP growth rate**

This section tries to specify the appropriate methods in the estimations of economic growth which are explained by FDI and other control variables. The methods we use in this study will be panel autoregressive distributed lag and random effect models combined with time scaling wavelet decomposition analysis. Reasons for choosing these kinds of models are to undertake a panel of short, medium and long–run analyses for the entire region and the individual countries. FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host economy. Some scholars argue that growth in modeling an economy with a continuum of agents is indexed by their level of ability. For instance, as a benchmark for modeling, we follow the Solow growth model specification, further developed by (Borensztein et al., 1998), Alfaro et al., 2000), and Carkovic and Rosse, 2004).

We assume the standard panel of open macroeconomic models in the Cob-Douglas form by scaling variables in such a way that population equals unity. In addition, agents life for last one period in foreign production sector, Y^{FDI}. The foreign production sector is assumed to be owned entirely by foreign investors that use foreign capital and domestically supplied labor of perfectly competitive and technology of the Cobb-Douglas constant returns to scale as

$$Y_{it}^{FDI} = AL_{it}^{\beta}\left(K_{it}^{fdi}\right)^{1-\beta} \qquad (4.3.2.1)$$

where $0 < \beta < 1$ is the stock of foreign capital, L_{it} denotes the domestic labor and A is a productivity parameter.

The total output in the economy is mainly explained by GDP. In addition to FDI, there are also some other factors affecting domestic economic sector such as IO, TOT, and OER. With multi-commodity countries, IO can be expressed mathematically as the total sum of exports and imports of the country to its GDP ratio according to the study by (Kotcherlakota and Sack-Rittenhouse, 2000). We take into account of measuring trade openness (Lloyd and MacLaren, 2002), trade openness and economic growth in which a cross-country empirical investigation in (Halit, 2003) and dynamic measurement of economic openness (De Lombaerde, 2009) which can be used as the foundation for the calculation of IO index. The two relative prices are price of exports in terms of imports known as terms of trade TOT which are discussed by Obstfled and Rogoff (1996). We obtain terms of trade as the difference between price on commodities in foreign and domestic markets. Trade is the difference between monetary value of exports and imports of output in an economy over a certain period.

Let the net export be defined as $\mathrm{NX_{it}} \equiv \left(\frac{1}{\mathrm{Y_{it}}}\right)\left(\mathrm{Y_{it}} - \frac{\mathrm{P_{it}^F}}{\mathrm{P_{it}^H}}\mathrm{C_{it}}\right)$ in terms of domestic output, which expressed as a fraction of steady state output Y. Then the first order approximation in the form of logarithmic function as ln terms (Gali and Monacelli, 2005) leads to

$$\ln(Y_{it}.NX_{it}) \equiv \ln\left[Y_{it}\left(\frac{1}{Y_{it}}\right)\left(Y_{it} - \frac{P_{it}^F}{P_{it}^H}C_{it}\right)\right] = lnY_{it} - ln\left(\frac{P_{it}^F}{P_{it}^H}C_{it}.Y_{it}\right) \Rightarrow lnY_{it} + lnNX_{it}$$

$$= lnY_{it} - lnC_{it} - lnY_{it} + lnP_{it}^H - lnP_{it}^F$$

$$\Rightarrow \mathrm{lnNX_{it}} = -\mathrm{lnY_{it}} - \mathrm{lnC_{it}} - \left(\mathrm{p_{it}^F} - \mathrm{p_{it}^H}\right) \Rightarrow \mathrm{lnNX_{it}} = -\mathrm{lnY_{it}} - \mathrm{lnC_{it}} - \mathrm{TOT_{it}}$$

$$\mathrm{TOT_{it}} = -(\mathrm{lnY_{it}} + \mathrm{lnC_{it}} + \mathrm{lnNX_{it}}) \qquad (4.3.2.2)$$

Under multi-commodity and multi-country model, TOT is the difference between the real GDP and both the sum of domestic consumption and net exports (Reinsdorf, 2010). In the process of dynamic output production if export price over import price times 100 exceeds over 100 percent, then the economy is doing net capital accumulation since more money coming in than going out from the economy (Reinsdorf, 2009). Random effects model approach assumes intercepts of the individuals are different and independent of explanatory variables but they can be treated as drawings from the distribution with mean and variance. Therefore, we specify panel macroeconomic model for the East Africa, including TOT as follows

$$\mathrm{lnY_{it}} = \mathrm{f(lnFDI_{it}\,, IO_{it}, ToT_{it}, OER_{it}, e^{U_{it}})}$$

$$\mathrm{lnY_{it}} = \mu + \psi_1 \mathrm{lnFDI_{it}} + \psi_2 \mathrm{IO_{it}} + \psi_3 \mathrm{ToT_{it}} + \psi_4 \mathrm{OER_{it}} + \mathrm{U_{it}}$$

$$\mathrm{y_{it}} = \mu + \psi_1 \mathrm{x_{1,it}} + \psi_2 \mathrm{x_{2,it}} + \psi_3 \mathrm{x_{3,it}} + \psi_4 \mathrm{x_{4,it}} + \alpha_\mathrm{i} + \varepsilon_\mathrm{it}$$

The compact matrix form as

$$\mathrm{Y_{it}} = \mu + \psi \mathrm{X'_{it}} + \alpha_\mathrm{i} + \varepsilon_{\mathrm{it},} \alpha_\mathrm{i} \sim \mathrm{IID}(0, \sigma_\alpha^2) \text{ and } \varepsilon_\mathrm{it} \sim \mathrm{IID}(0, \sigma_\varepsilon^2) \qquad (4.3.2.3)$$

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where μ denotes constant intercept, $\mathrm{U_{it}} = \alpha_\mathrm{i} + \varepsilon_\mathrm{it}$ is treated as an error terms which are independently and identically distributed over individuals. It consists of two components: an individual specific component considered as random factors, which does not vary over time or time invariant, while the remain component which is assumed to be uncorrelated over time. Where ψ is estimable parameters, $\mathrm{lnY_{it}} = \mathrm{y_{it}}$, $\mathrm{lnFDI_{it}} = \mathrm{x_{1,it}}$, $\mathrm{IO_{it}} = \mathrm{x_{2,it}}$, $\mathrm{ToT_{it}} = \mathrm{x_{3,it}}$, and $\mathrm{OER_{it}} = \mathrm{x_{4,it}}$ denote real GDP in logarithm form, foreign direct investment in (log) form, index of openness, terms of trade and official exchange rates, respectively as well as i and t denotes individual country and time variant.

Autoregressive distributed lag ARDL model has gained popularity as a method of examining in the long run in which the cointegrating relationships among the variables exist. It has been given as ARDL (p, q_1, …, q_k) where p is the number of lags of the dependent variable, q_1 is the number of lags of the first explanatory variable, and q_k is the number of lags of the k^{th} explanatory variable (Pesaran, Shin and Smith, 1999). Thus we can rewrite (4.3.2.3) in dynamic panel autoregressive distributed lag models ARDL as

$$y_{it} = \eta + \prod\nolimits_0 y_{it-1} + \prod\nolimits_1 x_{1,it-1} + \prod\nolimits_2 x_{2,it-1} + \prod\nolimits_3 x_{3,it-1} + \prod\nolimits_4 x_{4,it-1}$$
$$+ \sum_{j=1}^{p-1} \prod\nolimits_{oj} \Delta y_{i,t-j} + \sum_{j=1}^{q_1-1} \prod\nolimits_{1j} \Delta x_{1,i,t-j} + \sum_{j=1}^{q_2-1} \prod\nolimits_{2j} \Delta x_{2,i,t-j} + \sum_{j=1}^{q_3-1} \prod\nolimits_{3j} \Delta x_{3,i,t-j}$$
$$+ \sum_{j=1}^{q_4-1} \prod\nolimits_{4j} \Delta x_{4,i,t-j} + \lambda ECT_{it-1} + \varepsilon_{it} \qquad (4.3.2.4)$$

Where η is constant intercept, Δ is the first-difference operator, $\prod_0, \ldots, \prod_4$ indicate long-run coefficients, $\prod_{0j}, \ldots, \prod_{4j}$ denote short-run coefficients, ECT_{it-1} and ε_{it} represent the correction error terms and the independently identically distributed iid terms, respectively.

Using the cointegrating relationship form in equation (4.3.2.4), Pesaran, Shin, and Smith (2001) describe a kind of methodology to test whether ARDL model contains long–run relationship between dependent and regressors variables. The model selection procedures are available for determining the lag lengths for ARDL model. Since ARDL model can be estimated by applying the least squares regression, standard Akaike, Schwarz and Hannan-Quinn information criteria are used. The ARDL model estimates the dynamic relationship between dependent variable and explanatory variables in the short run.

In the cointegration methodology, (Johansen,1991 and 1995) uses the single equation methods such as fully modified OLS and dynamic ordinary least squared OLS either require all variables to be integrated order of one I(1) or require prior knowledge and specification of which variables are integrated order of zero I(0). In order to overcome this problem, (Pesaran, Shin and Smith ,1999) uses the cointegrating systems that can be estimated by the ARDL models, with the variables in the cointegrating relationship either I(0) or I(1), without pre-specifying for the integrated order of I(0) or I(1). The study of Haug (2002) explains that ARDL bounds testing approach is more suitable which provides better results for small sample size and the short–term and long–run parameters are estimated simultaneously. VAR is commonly used for estimating and forecasting the systems of interrelated time series and it is also used for analyzing the dynamic impact of random disturbances of the variables on the system.

The important of time scale wavelet analysis in the VAR framework, is desirable local orthonormal bases consisting of small waves that dissect a function into layers of different scale (Schleicher, 2002). The segmentation of time series into different layers makes a very powerful wavelet analysis in the short, medium and long-run. Now days, it has become popular and increasingly used in economic literature (Gallegati et al. (2015); Reboredo and Rivera-Castro (2014); Hacker, Karlsson and Månsson (2012); Almasri and Shukur(2003) and Ramsey and Lampart(1998)). The maximal overlap discrete wavelet decomposition in the methodology we use allows for moving averages at every scale level and avoids the problems of calculating the moving averages consistently throughout the series by reusing observations in a circular loop. The last value of the original series is simply the first value of that series (Hacker, Karlsson and Månsson, 2012).

Suppose the real GDP, FDI and other explanatory variables for a panel of eleven East African countries over the period of 1970-2015 are jointly determined by the VAR system, from equation (4.3.2.4) as

$$y_{it}^{D_{j,t}} = \Gamma_0 + \sum_{k=1}^{K} \Gamma_{10}^{(k)} y_{i,t-k}^{D_{j,t}} + \sum_{k=1}^{K} \Gamma_{11}^{(k)} x_{1i,t-k}^{D_{j,t}} + \sum_{k=1}^{K} \Gamma_{21}^{(k)} x_{2i,t-k}^{D_{j,t}} + \sum_{k=1}^{K} \Gamma_{31}^{(k)} x_{3i,t-k}^{D_{j,t}} + \sum_{k=1}^{K} \Gamma_{41}^{(k)} x_{4i,t-k}^{D_{j,t}} + \varepsilon_{it} \tag{4.3.2.5}$$

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where D stands for the differences, K for the number of lag length, i for the cross sectional dimension, and t for time dimension, are respectively. j=1, …, T denotes time scale decomposition into different layers of the entire panel datasets.

4.4. **Discussions and Empirical Findings for the Impact of FDI on GDP growth**

In the section, we try to make useful analyses and discussions for the empirical findings generated the impact of FDI on GDP growth.

4.4.1. **Autoregressive distributed lags for the impact of FDI on GDP growth rate**

We need the specification of optimal lag length for the ARDL models considering lags of the dependent variable as autoregressive and of the independent variables as distributed lags in the regressors. To test for the cointegration, there must be specified how many lags to be included in the model. There has been shown the determination of lag order for the vector autoregressive VAR model with integrated order one I(1) variables. The order of the corresponding vector error correction model VECM is always one less than the VAR because VECM makes adjustment automatically. So we always refer to the order of the underlying VAR (Tsay(1984), Paulsen(1984) and Nielsen(2001)) and the optimal number of lags for the regression models can be decided by Akaike(1971) information criteria AIC, Schwartz(1978) information criteria SBIC and Hannan and Quinn(1979) information criteria HQIC and others. These are often used to choose optimal lag length of the distributed lag models to compute the log-likelihood function according to the study by Johansen (1988), (1991) and (1995).

There has been assumed that all the undertaken variables are integrated order of one, I(1). Then we can develop the standard ARDL model based on equation (4.3.2.4), by using the chosen optimal lag length. In order to determine the optimum lag-length, we take up to 20 lags. Thus, according to the criteria of final prediction error FPE, AIC, SIC, and HQIC in each test at the 5% level of significance reported in (Table 4.4.1) which indicate that the optimum lag-length is one because each criterion assumes the lowest points are chosen as an appropriate lag-length.

Table 4.4.1 Optimum Lag-length Selection for FDI-Economic Growth model

Lag	LogL	FPE	AIC	SIC	HQIC
0	-3,355.81	0.4068	24.803	24.869	24.829
1	-1,692.79	0.2288*	12.714*	13.113*	12.874*
2	-1,669.09	0.2310	12.724	13.455	13.017
.					
.					
20	-1,302.25	0.5152	13.338	20.050	16.034

Notes. * indicates lag order selected by the criterion in the VAR lag order selection criteria; Endogenous variables: lnGDP, lnFDI, TOT, IO, and OER for the sample period the year 1970 and 2015 and the included observations are 271.

4.4.2. **Test of Cointegration for the impact of FDI on GDP growth rate**

After determining the optimum lag-length, we look for cointegration test. In the process of cointegration test, first we observe the trace and the maximum eigenvalues tests both indicate that there are two panel cointegrating equations at the 5% level of significance for a panel of eleven countries in East Africa. Then we conduct test for the individual countries in which eight out of eleven countries, each shows there is cointegration relationship among variables. Finally, by excluding countries which do not have cointegration such as Madagascar, Malawi, and Seychelles, the panel cointegration results are reported in (Table 4.4.2.1).

The analyses of long–run cointegrating relationships have received a remarkable attention in various methods. These methods include dynamic OLS estimation of Pablo(2010), panel fully modified OLS estimators of Phillips and Moon(1999 and(2000) and Kao and Chiang(2000), panel vector error correction models of Anderson, Qian, and Rasch(2006), fully modified OLS estimators of Pedroni(2000) and Mark and Sul(2003). Further, we look into the determinants of economic growth for cross–country of (Barro, 1998). The resultant estimated coefficients obtained by these methods are asymptotically unbiased and normally distributed. We mean cointegration refers to the condition when linear combinations of nonstationary time–series are stationary which suggests that there is an existence of long–run equilibrium between the undertaken variables.

Table 4.4.2.1 Test for Panel Cointegration for FDI-GDP growth model

Hypothesized No. of CE(s)	Eigenvalue	Trace Test			Maximum Eigenvalue Test		
		Statistic	C. Value	P .Value	Statistic	C. Value	P .Value
None	0.1356	99.189	69.819	0.0000*	49.681	33.877	0.0003*
At most 1	0.0776	49.508	47.856	0.0347*	27.581	27.584	0.0500
At most 2	0.0318	21.926	29.797	0.3026	11.004	21.132	0.6470
At most 3	0.0251	10.923	15.495	0.2163	8.6810	14.265	0.3137
At most 4	0.0065	2.2416	3.8415	0.1343	2.2416	3.8415	0.1343

. * Denotes rejection of the hypothesis at the 0.05 level and **MacKinnon-Haug-Michelis (1999) p-values. According to Johansen and Juselius (1990), the trace and maximum eigenvalues statistics are calculated as $\lambda_{Tr}(r) = -T\sum_{i=r+1}^{n}\ln(1-\lambda_i)$ and $\lambda_{max}(r, r+1) = -T\log(1-\lambda_{T+1})$, where n is the number of variables in the system for r = 0,1,2…n–1, and T is the sample size and λ are the estimates of the eigenvalues, respectively.

We determine number of cointegrating vectors using the trace and the maximum eigenvalues statistics in Johansen (1991) methodology. In this sense for more specific description, we go back to (Johansen and Juselius, 1990) study which advises us the trace statistic tests in the null hypothesis of r cointegrating relations against the alternative of n cointegrating relations. While the maximum eigenvalue tests in the null hypothesis of r cointegrating relations are against the alternative of r + 1 cointegrating relations. The tests follow that when the trace and the eigenvalues are all zero, the rank of the matrix will be zero, implying non-cointegration.

We conduct the Johansen test for unrestricted rank and number of cointegrating equations in multivariate analyses. The first column of (Table 4.4.2.1) indicates that there are hypothesized number cointegating equations and eigenvalues of the undertaken variables. In the test, we strongly reject the null hypothesis of no cointegration $(r = 0)$ against the alternative of one or more cointegrating vectors$(r > 0)$ in which at most one against the alternative. Since the values of trace statistic (0) and (1) exceed their respective critical values at the 5% significance level, we reject the null hypotheses of zero and at most one cointegrating vectors (r = 0) and (r = 1) in the trace test and accept the alternative hypotheses of more than zero (r > 0) and one cointegrating vectors (r > 1). However, we would reject null hypothesis of no cointegration vector but we would fail to reject the null hypothesis of at most one vector using maximum eigenvalue test.

On the other hand, the trace statistic (2) and the maximum eigenvalue statistic (1) in the first and second columns of (Table 4.4.2.1) are less than their respective critical values at the 5 % significance level, we wouldn't reject the null hypothesis of $r \leq 2$, the cointegrating vectors (r =2) and the null hypothesis of $r \leq 1$ consist of the cointegrating vector (r=1) respectively. These mean the trace test indicates that there are two cointegrating equations while the maximum eigenvalue test shows that there is one cointegrating equation.

Therefore, we conclude that the system has two cointegrating equations because when the trace and the maximum eigenvalue statistics generate different results, we should rely on the value of the trace test (Alexander, 2001). This suggests the Johansen test gives number of cointegration vector which is two within five series. Hence, the variables are integrated of the same order and they move together towards the long-run equilibrium or have long-run relationship.Since we have dealt with ARDL models, the cointegration tests are not sufficient to prove the existence of long-run relationship among the variables. Thus we need additional one, the bound test.

Table 4.4.2.2 ARDL(1,1,1,1,1) Bound test for the Existence of Long-Run Relationship of FDI model

Upper bound values at significant level of 1%	5%	Wald F-statistic	Probability value
5.06	4.01	35.28	0.0000**

Notes. Bounds test for the sets of the null hypothesis: C(1) = C(2) = C(3) = C(4) = 0 using the Wald test and ** denotes rejection of the null hypothesis. The upper bound value for each country and the average are 5.06 and 4.01, respectively.

As we can see the results in (Table 4.4.2.2), the calculated Wald F-statistic value exceeds the Peasaran upper bound critical value at the 1 percent and 5 percent level of significances; we would reject the null hypothesis of jointly zero. This implies that all variables have long–run association or they move together in the long run and hence, cointegration exists. Since the calculated probability values of 0.23 percent, 2.35 percent, and 0.25 percent all are less than the 5 percent level of significance shown in (Table 4.4.2.3), we wouldn't reject the null hypothesis of stable and non-autocorrelation or non-serial correlation. Note that individual country has the existence of cointegration. Hence, the data are free from the problems of serial auto-correlation of all countries, except Tanzania, now we can estimate the model. The test for stability was done by Magnus and Fosu (2006) prior to our study.

Table 4.4.2.3 Stability Condition and Serial-Autocorrelation Diagnostics for FDI model

Country	Stability Ramsey RESET test		Autocorrelation ML test	
	F-statistic value	*P* value	LM-statistic	*P* value
Burundi	0.0113	0.9159	25.642	0.4269
Ethiopia	0.7028	0.4074	17.425	0.8658
Kenya	0.0004	0.9850	21.579	0.6599
Mauritius	0.6764	0.4167	19.433	0.7759
Rwanda	10.721	0.0023*	30.757	0.1972
Tanzania	5.6009	0.0235*	49.428	0.0025*
Uganda	1.7046	0.2005	32.843	0.1350
Zambia	1.6999	0.2005	18.077	0.8391

Notes. * Denotes rejection of the null hypothesis at the 5% level of significance. Ramsey RESET is Regression Equation Specification Error Test. Number of fitted terms is one or omitted variables are squares of fitted values.

The results in (Table 4.4.2.3) indicate that the null hypothesis of Ramsey RESET is stable except the case of Tanzania economy while that of VEC residual serial correlation of the null hypothesis indicate that there is no serial correlation at lag-order of one. Test for autocorrelation LM is based on the optimum lag-length of one and coitegrating equations of two.

4.4.3. **Parametric estimations using ARDL and time scaling wavelet analysis for FDI model**

Once we conduct the tests for long–run equilibrium relationship, stability condition and serial-autocorrelation diagnostics for the undertaken variables, our next step will be the estimation of long- and short-run coefficients including the first-order autoregressive coefficient of the error term by using equation (4.3.2.4) and dynamic panel ARDL (1, 1, 1, 1, 1) model. Now being based on the cointegrating number of equation which is found to be one, now we can estimate the short-run and the long-run parameters and make use of other analyses.

Table 4.4.3.1 ARDL (1, 1, 1, 1, 1) Panel Estimation and Cross-sectional dependence test for FDI

Long-run estimation			
Variable	Coefficient	t-statistic	P value
$\ln FDI_{it}$	0.1617	3.7003	0.0003**
TOT_{it}	0.4729	0.9188	0.3590
IO_{it}	2.0492	0.3232	0.7468
OER_{it}	0.0028	4.1433	0.0000**
Short-run estimation			
Variable	Coefficient	t-statistic	*P* value
$D(\ln FDI_{it})$	0.0006	28.498	0.0001**
$D(TOT_{it})$	-0.0583	-16.999	0.0004**
$D(IO_{it})$	0.1153	0.9088	0.4304
$D(OER_{it}$	-0.0003	-2875.6	0.0000**
$ECT_{i,t-1}$	-0.0584	-174.24	0.0000**
Constant	0.9029	1.3865	0.2596
Cross-sectional dependence test			
Type of Test	Statistic value (prob. value)	Type of test	Statistic value (prob. value)
Pearson LM	10.1193 (0.0063*)	Friedman $-\chi^2$	56.608 (0.0963)
Pearson CD	12.2972 (0.0016*)	Frees normal	0.0574 (0.5782)

The first order partial derivative of lnGDP with respect to lnFDI, $\frac{\partial \ln GDP}{\partial \ln FDI} = \beta_1 \frac{GDP}{FDI}$ which implies $\beta_1 = \left(\frac{\partial \ln GDP}{\partial \ln FDI}\right) \cdot \left(\frac{FDI}{GDP}\right)$ and the first order partial derivative of lnGDP w.r.to OER, $\frac{\partial GDP}{\partial OER} = \beta_4 GDP$, which would result in $\beta_4 = \left(\frac{\partial GDP}{\partial OER}\right) \cdot \frac{1}{GDP}$. Dependent variable for the long run and short run are $\ln GDP_{it}$ and D ($\ln GDP_{it}$). * and ** denote rejection the insignificance values for the null hypothesis of cross-section independence at the 1% and 5% level of significances.

According to the results in (Table 4.4.3.1), both the Pearson LM and Pearson CD tests show that no cross–sectional dependence or there is a cross-sectional independence at the one percent level of significances. The purpose of logarithmic transforming variables in the model is the common way to handle the non–linear relationship exists between the independent and dependent variables and to capture the outliers. The panel ARDL (1, 1, 1, 1, 1) has been selected from 16 evaluated models in which one is found to be the optimal lag length for dependent and explanatory variables of seven countries, excluding Madagascar, Malawi, Seychelles, and Tanzania.

The long–run estimation results reported in (Table 4.4.3.1) empirically reveal that there is a significantly positive relationship between the real GDP and the FDI (both in natural logarithm form (ln)). This implies that a 1percent increase in FDL leads to a 0.16 percent increases in real GDP for a panel of seven East African countries during the study period. In the meantime, a 1 percent increase in the official exchange rate OER leads to a 0. 28 percent increases in real GDP over time. In the short run, the growth rate of FDI has a positive impact whereas of terms of trade TOT and OER each of them has a negative impact on the real GDP growth rate for the panel countries. The error correction term which is denoted by $\mathrm{ECT}_{i,t-1}$ for panel countries also reported in (Table 5.3.3.3) is negative and significant. It measures the seed of adjustment towards the long–run equilibrium, in which the system is getting adjusted towards long–run equilibrium at the seed of 5.8 percent. The economy in the panel has a corrected disequilibrium approximately after 17 years, i.e. 1/0.0584 = 17.12.

Finally we investigate the time scale decompositions wavelet analyses using equation (4.3.2.5) to show the inter-temporal causality between FDI and real GDP (in natural logarithms form (ln)) in different time periods. In order to investigate the casual relationship between the real GDP and the FDI in East Africa over the period of 1970–2015, we use heterogeneous panel wavelet analysis of Granger causality test. A multi-resolutionary wavelet decomposition analysis for a maximal overlap discrete wavelet transform which utilizes moving averages of the original data and moving averages of the moving averages are used for filtering data. For the purpose of maintaining consistency in the transformation of the data series, data are considered as a circular loop, with the observation following the last one simply being the first observation (Hacker, Karlsson and Månsson (2012). The segmentation of time series into different layers makes use of wavelet analysis become popular in economic analyses in the short, immediate and long–run horizons according to studies by Ramsey and Lampart (1998), Almasri and Shukur (2003), Hacker, Karlsson and Månsson (2012) and Reboredo and Rivera–Castro (2014).

Table 4.4.3.2 Panel ARDL (1, 1) Time Scale Wavelet Causality Test for FDI model

Dependent variable	Independent variable	Combined mean coefficients in time scale horizons		
		β_1	β_2	β_3
Real lnGDP	lnFDI	0.0106 (37.28*)	0.0122 (41.12*)	0.3584 (54.32*)
lnFDI	Real lnGDP	4.9957 (23.64*)	5.8258 (29.05*)	0.4538 (53.15*)

Notes. Figures in the parenthesis are the calculated χ^2 and the * denotes rejection of the null hypothesis of the explanatory that doesn't Granger cause for the dependent variable. The optimal lag length of one in an ARDL method is employed to calculate the probability value for each country. Then we calculate the combined chi-square for the time scale horizons using the formula, $\chi^2 = -2\sum_{i=1}^{L}\ln(\chi_i^2)$ where $-2\ln p_i$ has a chi-square distribution and i stands for country 1, 2, 3, .., L (see detailed in Zaykin, Zhivotovsky, Westfall, & Weir, 2002; Fisher ,1932). We compare these combined χ^2 (which is available in Brooks, 2008) with the conventional χ^2 of 14.07 at the 5% level of significance for 7 degrees of freedom which represents number of countries as heterogeneous panel.

We use the optimal lag length that found to be one in the ARDL method to calculate the probability value for each country. Then we calculate the combined chi-square for the time scale horizons. We also use a simple mean calculation for the combined mean coefficient of the time scale horizons. As it has been shown in (Table 4.4.3.2), we use the ARDL (1, 1) to determine the wavelet time scaling Granger causality test for a panel of East African economies. The combined mean coefficient values denoted by the time scale by β_1 , β_2, and β_3 represent the short-, medium-, and long-run effects of FDI on GDP and vice versa, respectively. These indicate that there are bi-directional inter-temporal causal relationships between FDI and GDP growth rates.

As you can see the results reported in (Table 4.4.3.2), both FDI and GDP cause changes significantly each other in the short, medium and long–terms. FDI and GDP growth rate has significantly positive contribution to each other in the short, medium, and long terms in the panel of seven East African countries. As FDI increases by one unit, GDP growth also increases by 0.011 in the short term, 0.022 in the medium, and 0.36 in the long term, in the meantime, as GDP growth increases by one unit, FDI also increases by 0.4.99, 5.83, and 0.45 in the short, medium, and long terms, respectively. Moreover, the combined mean coefficients increase over time scaling horizons in general. The calculations are based on the Chlesky variance-response function with the help of standard error in the Monte Carlo simulation (see Fig.E in Appendix).

4.5. **Conclusion for the Impact of FDI on GDP growth rate**

We estimate empirically the impact of FDI on real GDP in a panel of seven East African countries for the sample period of 1970–2015. FDI is one of the most dynamic resources flowing into developing countries that can be an important component for economic development, in terms of domestic savings in capital accumulation, employment generation and growth. It can also be used as a tool for integrating domestic economy into global one, transferring modern technologies, enhancing efficiency and rising skills of manpower. An increase in FDI may be associated with improved economic growth due to the inflow of capital for the host country which makes a channel into new infrastructure and other projects to boost development. Attracting FDI has assumed a prominent place in the strategies of economic renewal being advocated by policy makers at national, regional, and international levels. The experience of fast-growing East Asian and recently China has strengthened the belief that attracting FDI is the key to bridging the resource gap in the low income countries (UN, 2005).

The Granger causality test of a panel wavelet analysis in the time scale horizon decompositions is calculated using an ARDL (1, 1) method revealing the short, medium and long-term effects of the FDI on GDP and vice versa. These effects show that bi-directional dynamic causal relationships have made the changes to each other. Both FDI and GDP have significantly positive contributions to one another in the short, medium, and long run. Moreover, the combined mean coefficients increase over time in general.

This study contributes to the economic analysis on the long, medium and short run by applying dynamic causality, designing a new econometric approach (using the time scaling wavelet decomposition in the framework of dynamic panel ARDL). It divides up the time in a more detail way rather than the traditional one. It also brings information within the time range of the impulse and the consequence of the FDI on growth effects. The general objective of this study is to investigate the contribution of FDI to the economic growth in the short, medium, and long term in the trend time horizons for East African economy.

In this study we only focus on the impact of FDI on economic growth of East African region. It may help to provide vital information which serve as a guide for policymakers to deal with. Further studies are required to conduct on this area by considering some approaches which can potentially affect growth such as the impact of corruption, the economic policy in each country and the interaction among each country when it comes to trade and other factors.

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Appendices for the impact of FDI on GDP growth rate

I. Formula and Important Notes

For an AR (**ρ**) error specification, the relevant individual cross sectionally CADF statistics are computed from the **ρ**th order cross- section/ time series augmented regression is given as

$$\Delta y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + c_i \bar{y}_{t-1} + \sum_{j=1}^{p} d_i \, \Delta\bar{y}_{t-j} + \sum_{j=1}^{p} \beta_{i,j} \, \Delta y_{i,t-1} + \varepsilon_{i,t},$$

Where $\varepsilon_{i,t}$ is the idiosyncratic error term, $\bar{y}_{t-1} = \frac{\sum_{i=1}^{N} y_{i,t-1}}{N}$ and $\Delta\bar{y}_{i,t} = \frac{\sum_{i=1}^{N} y_{i,t}}{N}$.

With the transformed data, now we can test for the cross-sectional independence of individual data series (Pesearan, 2007) by constructing a test of the null hypothesis $H_0 : \rho_I$ for all i, or the alternative one is $H_a : \rho_i < 0$.

II. Graph

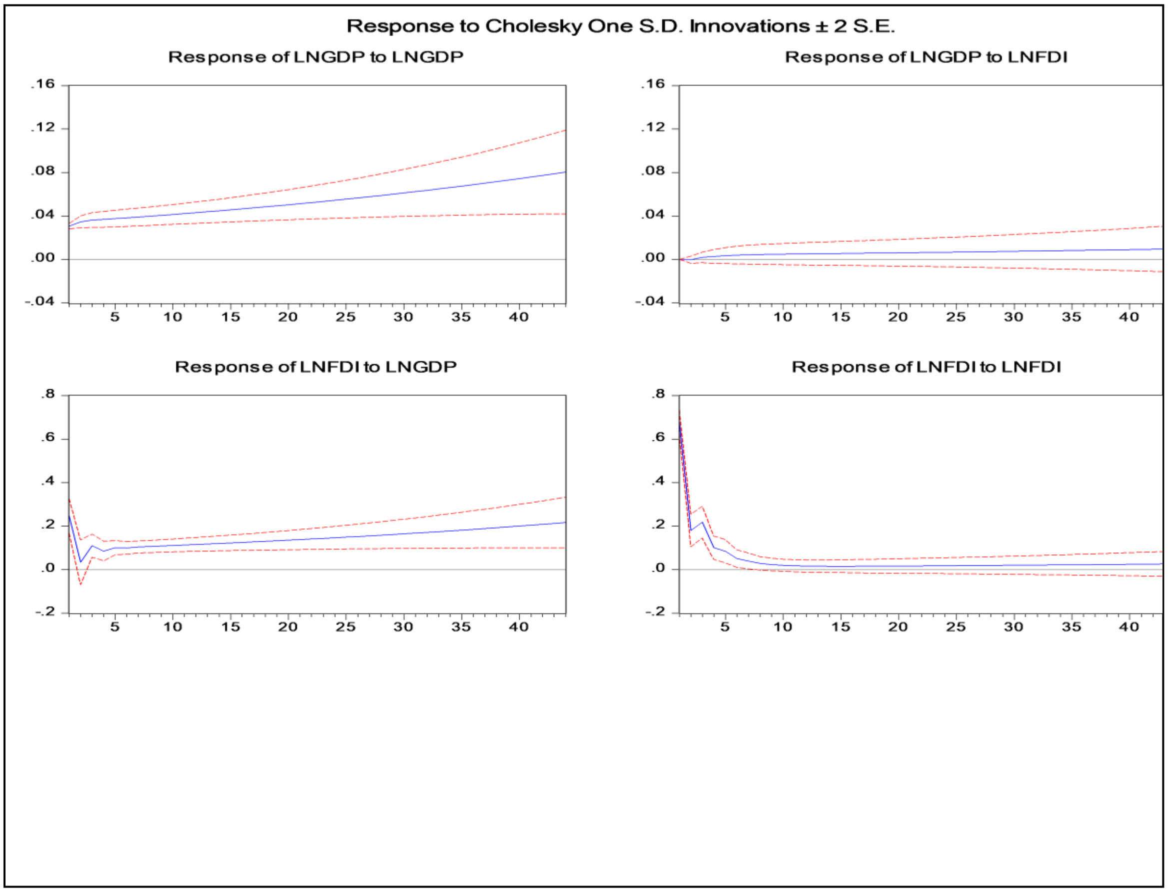
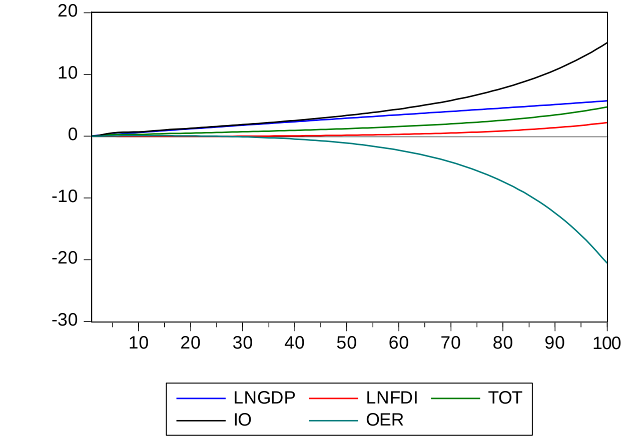
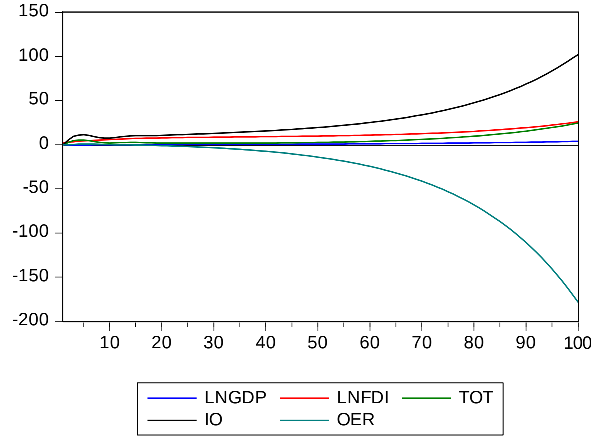


Figure D. Impulse responses combined graphs for real GDP and FDI using Monte Carlo analysis.

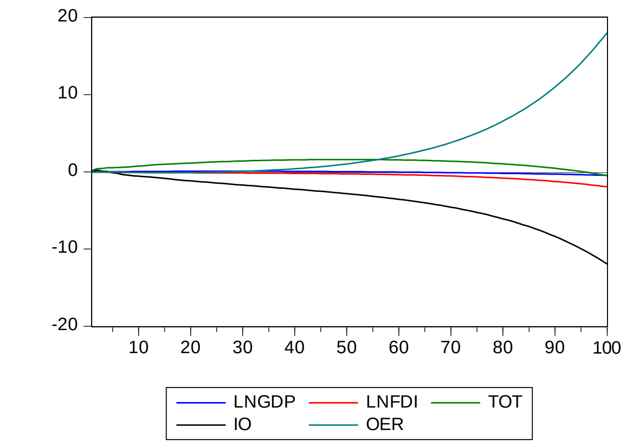
Accumulated Response of LNGDP to Cholesky
One S.D. Innovations



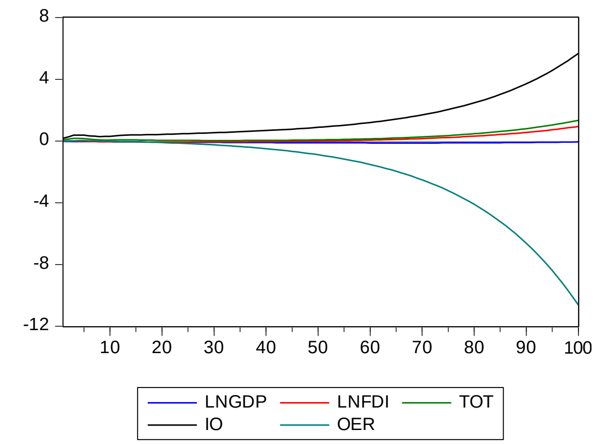
Accumulated Response of LNFDI to Cholesky
One S.D. Innovations



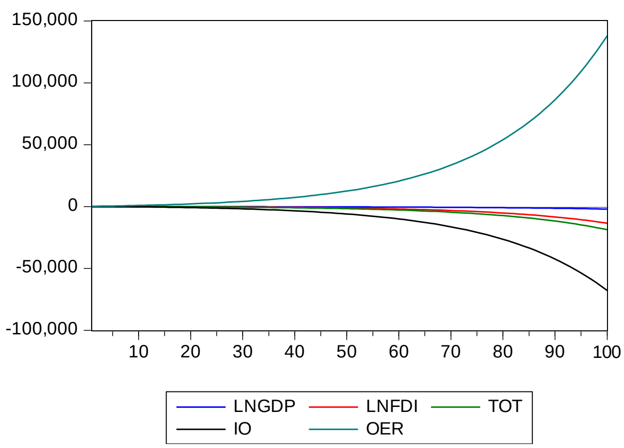
Accumulated Response of TOT to Cholesky
One S.D. Innovations



Accumulated Response of IO to Cholesky
One S.D. Innovations



Accumulated Response of OER to Cholesky
One S.D. Innovations



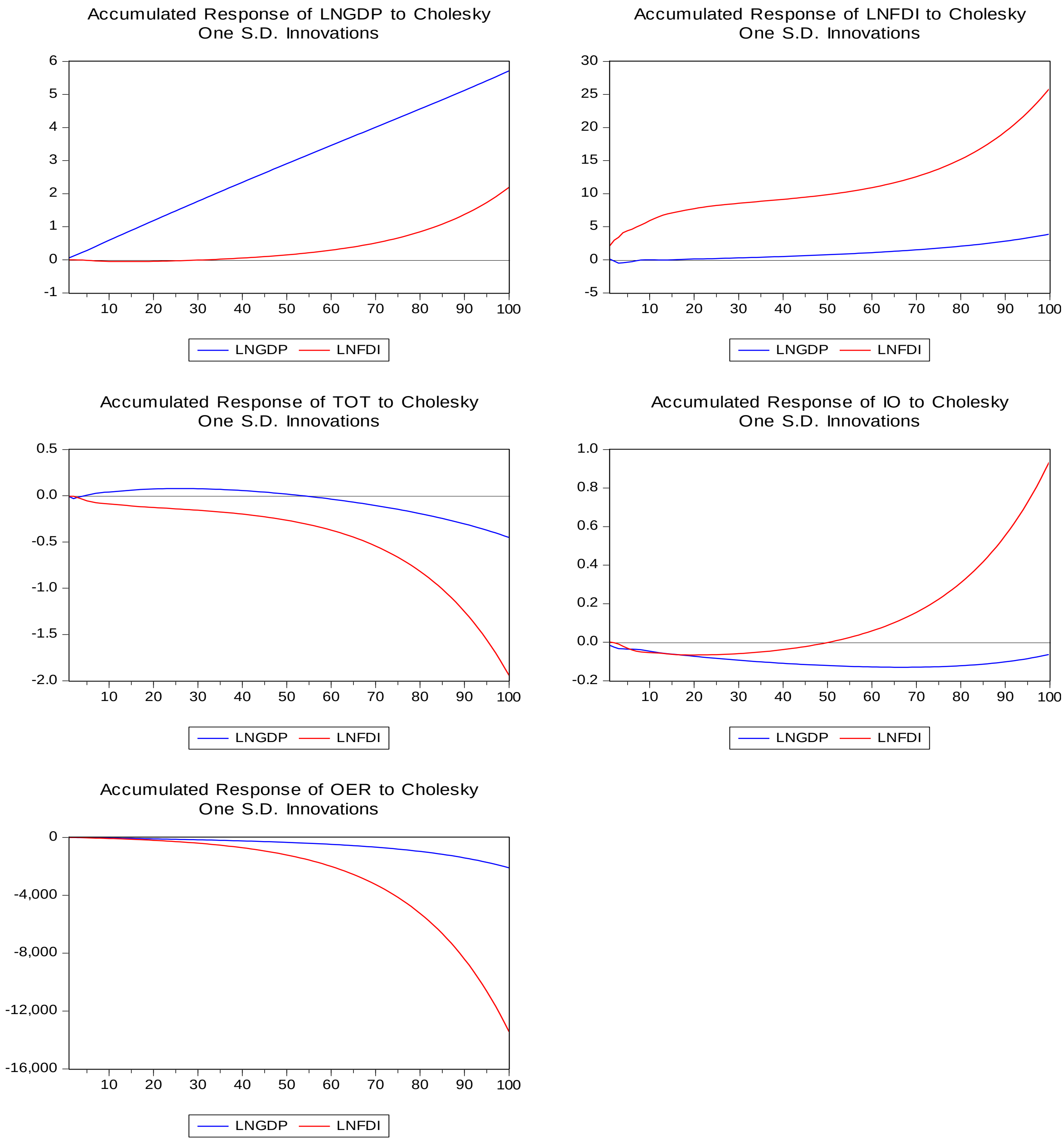


Fig. E. Accumulated Responses of variables once at time and one by one on each other

CHAPTER V: THE THREE COMBINED PAPERS

Now we want to make the combined analyze of the three research papers by taking their main variables as explanatory variables and the real GDP as dependent one. The three combined researches are the contribution of financial sector development to economic growth, the role of human capital resources to economic growth and the impact of foreign direct investment on economic growth. The literatures review has been remained as it is in each research.

5.1 Model specifications for the three combined research papers

This section tries to describe the methods that we make use of estimation for economic growth in East Africa. FSD, HCR and FDI can contribute to economic growth only when sufficient absorptive capability of advanced technologies is available and an economic growth modeling with a continuum of agents indexed by their level of ability (Alfaro, et al., 2000). In real environment, the production function tends to be increasing returns to scale with augmented neoclassical model (Schmidt-Hebbel, 1994) and (Easterly and Levine, 1994). There exist technological spillovers and increasing returns to scale (Barro and Sala-i-Martin, 2003).

We assume a standard panel of open macroeconomy modeling in Cob–Douglas form; following the Solow growth model specification, further developed by Borensztein et al., 1998); Alfaro et al.(2000) and Carkovic and Levine (2004) as a benchmark for our study. A continuum agents of total mass in which one agent who lives for one period in foreign–production sector is given as Y^{FDI}. This is assumed to be owned entirely by foreign investors which uses foreign capital, domestically supplied labor of perfectly competitive and technology of the Cobb-Douglas constant returns to scale is given by

$$GDP_{it}^{FDI}=AL_{it}^{\beta}\left(K_{it}^{fdi}\right)^{1-\beta} \qquad (5.1.1)$$

Where $0 < \beta < 1$ is the stock of foreign capital, L_{it} denotes the domestic labour and A is a productivity parameter. Optimality conditions in the FDI sector imply that foreign capital is paid at its marginal product which is given by the international rate of interest, r, after rearranging, we get an expression for the stock of foreign capital,

$$K_{it}^{fdi} = \left(\frac{(1-\beta)}{r}\right)^{\frac{1}{\beta}} AL_{it} \qquad (5.1.2)$$

The second sector, $GDP_{it}^{Domestic}$ is composed of a number of firms, GDP_{it}^{n}, each of which is owned by a local entrepreneur. Potential entrepreneurs can take the advantage of better managerial practices, networks, access to markets and other spill-overs from the foreign firms located in the domestic country. These positive effects are not internalized by the foreign firm. Output in this sector is given by

$$GDP_{it}^{Domestic} = \int_{\in_{nit}^{*}}^{1} Y_{it}^{n}\, d \in = \int_{\in_{nit}^{*}}^{1} \left[\in_{n,it} B\left(K_{it}^{fdi}\right)^{\theta} S^{\gamma}\right] d \in$$

$where$ $0 < \theta < 1, 0 < \gamma < 1$ and n is associated with an entrepreneur ability of level $\in_n$ and S is the fixed capital investment. The total number of labor employed in the FDI sector will be,

$$L_{it} = \int_{0}^{\in^{*}} \in_{n,it} dn = \in^{*} \qquad (5.1.3)$$

From (5.1.2) and (5.1.3), we can rewrite the amount of foreign capital as

$$K_{it}^{fdi} = \left(\frac{(1-\beta)A}{r}\right)^{1/\beta} \in_{it}^{*}$$

The total output in the economy is given by

$$GDP_{it} = GDP_{it}^{DFI} + \int_{\in_{it}^{*}}^{1} GDP_{it}^{n}\ d \in$$

$$\Rightarrow GDP_{it} = GDP_{it}^{DFI} + (1 - \in_{it}^{*}) B\left(K_{it}^{fdi}\right)^{\theta} S^{\gamma} \qquad (5.1.4)$$

The total effect of FDI on real GDP is, therefore, the sum of the private marginal product of FDI in its own sector plus the difference between the social and the private marginal product,

$$\frac{\partial GDP_{it}}{\partial K_{it}^{fdi}} = \frac{\partial Y_{it}^{FDI}}{K_{it}^{fdi}} + \frac{\partial(1 - \in_{it}^{*}) B\left(K_{it}^{fdi}\right)^{\theta} S^{\gamma}}{K_{it}^{fdi}} \Rightarrow \frac{\partial GDP_{it}}{\partial K_{it}^{fdi}} = r + (1 - \in_{it}^{*}) B\theta\left(K_{it}^{fdi}\right)^{\theta-1} S^{\gamma} > 0$$

The total output in the economy is mainly explained by gross domestic product GDP, which has been dominantly determined and modeled by FDI, FSD and HCR for a panel of East African macroeconomic growth as

$$\text{lnGDP}_{\text{it}} = f(lnFDI_{it}, FSD_{it}, HCR_{it}, e^{\varepsilon_{it}})$$

$$\text{lnGDP}_{\text{it}} = \psi_0 + \psi_1 lnFDI_{it} + \psi_2 FSD_{it} + \psi_3 HCR_{it} + \varepsilon_{it} \qquad (5.1.5)$$

Where ψ are estimable parameters, , $lnGDP_{it}$ is real GDP in (log) form, $lnFDI_{it}$ *is* Foreign Direct Investment in (log) form, FSD_{it} is Financial Sector Development, HCR_{it} is Human Capital Resecourse and $U_{it} = \varepsilon_{it}$ denote the Error Terms, respectively. The error term ε_{it} is independently and identical distribution, iid as well as i and t denotes individual country and time variant.

Autoregressive distributed lag ARDL model has gained popularity as a method of examining long-run in which the cointegrating relationships among the variables exist given as ARDL (p, $q_1,\ldots,q_k$) where p is number of lags of the dependent variable, q_1 is number of lags of the first explanatory variable and q_k is number of lags of the k^{th} explanatory variable (Pesaran and Shin,1999). The model selection procedures are available for determining these lag lengths. We can rewrite (5.1.5) in dynamic panel autoregressive distributed lag ARDL model as,

$$\begin{aligned}\Delta lnGDP_{it} &= \eta + \textstyle\prod_0 lnGDP_{it-1} + \prod_1 FSD_{i,t-1} + \prod_2 HCR_{i,t-1} + \prod_3 lnFDI_{i,t-1} \\ &+ \sum_{j=1}^{p-1} \textstyle\prod_{oj} \Delta lnGDP_{i,t-j} + \sum_{j=1}^{q_1-1} \prod_{1j} \Delta FSD_{i,t-j} + \sum_{j=1}^{q_2-1} \prod_{2j} \Delta HCR_{i,t-j} \\ &+ \sum_{j=1}^{q_3-1} \textstyle\prod_{3j} \Delta lnFDI_{i,t-j} + \lambda ECT_{it-1} + \varepsilon_{it} \qquad (5.1.6)\end{aligned}$$

Suppose the long-run matrix $\prod$ coefficients has reduced rank decomposition and the compact vector matrix form can be expressed in the following way as

$$\textstyle\prod = \alpha\beta',$$

$$\Delta Z_t = \beta_0 + \Gamma Z_{i,t-1} + \textstyle\prod \Delta Z_{i,t-1} + \varepsilon_{i,t} \qquad \text{for } i = 1,2 \ldots, N \text{ and } t = 1,2 \ldots, T.$$

$$where\ \Delta Z_t = \begin{bmatrix}\Delta Z_{1t}\\ \Delta Z_{2t}\\ \vdots \\ \Delta Z_{Nt}\end{bmatrix}, \beta_0 = \begin{bmatrix}\beta_0'\\ \beta_1'\\ \vdots \\ \beta_N'\end{bmatrix}, \ \Gamma = \begin{bmatrix}\Gamma_{11} & \Gamma_{12} \ldots & \Gamma_{1N}\\ \Gamma_{21} & \Gamma_{22} \ldots & \Gamma_{2N}\\ \vdots & \vdots & \vdots \\ \Gamma_{N1} & \Gamma_{N2} & \Gamma_{NN}\end{bmatrix}, Z_{t-1} = \begin{bmatrix}Z_{1t-1}\\ Z_{2t-1}\\ \vdots \\ Z_{Nt}\end{bmatrix}, \Delta Z_{t-1} = \begin{bmatrix}\Delta Z_{1t-1}\\ \Delta Z_{2t-1}\\ \vdots \\ \Delta Z_{Nt}\end{bmatrix}\ \alpha =$$

$$\begin{bmatrix}\alpha_{11} & \alpha_{12} \ldots & \alpha_{1N}\\ \alpha_{21} & \alpha_{22} \ldots & \alpha_{2N}\\ \vdots & \vdots & \vdots \\ \alpha_{N1} & \alpha_{N2} & \alpha_{NN}\end{bmatrix}, \beta' = \begin{bmatrix}\beta_{11} & \beta_{12} \ldots & \beta_{1N}\\ \beta_{21} & \beta_{22} \ldots & \beta_{2N}\\ \vdots & \vdots & \vdots \\ \beta_{N1} & \beta_{N2} & \beta_{NN}\end{bmatrix}, \textstyle\prod = \begin{bmatrix}\prod_{11} & \prod_{12} \ldots & \prod_{1N}\\ \prod_{21} & \prod_{22} \ldots & \prod_{2N}\\ \vdots & \vdots & \vdots \\ \prod_{N1} & \prod_{N2} & \prod_{NN}\end{bmatrix} \text{and} \varepsilon_t = \begin{bmatrix}\varepsilon_{1t}\\ \varepsilon_{2t}\\ \vdots \\ \varepsilon_{Nt}\end{bmatrix},$$

and $\Delta Z_t = \Delta lnGDP_{it}, \beta_0 = \boldsymbol{\lambda_0} = \delta_i d_{it},\ Z_{t-1} = \ lnGDP_{i,t-1} + FSD_{i,t-1} + HCR_{i,t-1}\ + lnFDI_{i,t-1}$.Matrices α and β are of dimension $N_p\ \times$ r, with$rank\ \ r\ \equiv\ r_1 +\ r_2\ +\ \ + r_N < N_p$and the value of r determines the number of cointegration.Γ denotes short-run coefficients. Where η is constant intercept, Δ is the first-difference operator and $FSD_{it}, HCR_{it} and\ FDI_{it}$ is a 1 × k vector of strictly exogenous covariates in each, ∏ is a k × 1 vector of parameters to be estimated, $\prod_0, \dots \prod_4$ parameters to be estimated which indicate long run coefficients and $\prod_{0j}, \dots \prod_{4j}$ denote short-run coefficients, ECT_{it-1} and ε_{it} are the representations error correction terms and independent identically distributed iid term which comes from a low-order moving-average process, with variance σ_ε^2, respectively and $\mathrm{i} = 1, \dots \mathrm{N}$ and $\mathrm{t} = 1, \dots \mathrm{T_i}$.

Using the cointegrating relationship form in Equation (5.1.6), (Pesaran, Shin and Smith, 2001) describes a methodology for testing whether the ARDL model contains a long-run relationship of the variables. Finally, we estimate the dynamic relationship between the dependent variable and the regressors. In dynamic panel data regression described in eq. (5.1.6), we cannot apply the OLS, GLS, fixed effects (FE) and random effects (RE) methods because $lnGDP_{i,t-1}$ is correlated with λ and the samples mean of $lnGDP_{i,t-1}$is correlated with that of $\boldsymbol{\varepsilon_{it}}$so that the results will be inconsistent (Baltagi,2005).

If we assume ε_{it} are uncorrelated with the other covariates, we can fit a random-effects model, is known as variance-components or error-components model. Since variance components are unknown, consistent estimates are required to implement feasible GLS, offers two choices such as the Swamy–Arora method and simple consistent estimators (Baltagi and Chang, 2000) use variance-components estimators. These are based on the ideas of Amemiya (1971) and Swamy and Arora(1972). Baltagi and Chang (1994) derived the Swamy–Arora estimators of the variance components for unbalanced panels. The default of the Swamy–Arora method contains a degree-of-freedom correction to improve its performance in small samples.

Since an ARDL model can be estimated via least squares regression, the standard Akaike, Schwarz and Hannan–Quinn information criteria are used for model selection. The standard error of the long–run coefficients can be calculated from the standard errors of the original regression. The methods such as Fully modified OLS, or dynamic OLS either require all variables to be I(1)or require prior knowledge and specification of which variables are I(0) Johansen (1991 and 1995). To alleviate this problem, Pesaran and Shin (1999) show that cointegrating systems can be estimated as ARDL models, with the variables in the cointegrating relationship that can be either I(0) or I(1), without pre-specify which are I(0) or I(1).

We can also express eq.(5.1.6) in terms of panel vector autoregressive VAR system contains a set of n variables, each of which is expressed as a linear function of the order-p lags of itself and of all others $n-1$ variables, plus an error term is given by

$$lnGDP_{it} = \eta_0 + \eta_1 lnGDP_{i,t-1} + \cdots + \eta_p lnGDP_{i,t-p} + \eta_2 FSD_{i,t-1} + \cdots + \eta_p FSD_{i,t-p} + \eta_3 HCR_{i,t-1} + \cdots + \eta_p HCR_{i,t-p} + \cdots + \eta_3 lnFDI_{i,t-1} + \cdots + \eta_p lnFDI_{i,t-p} + \cdots + e_{i,t} \qquad (5.1.7)$$

If the undertaken variables are cointegrated, we use the system of panel vector error correction model VECM instead of VAR models to estimate the long-run and short-run relationship between dependent and explanatory variables as follows

$$\Delta lnGDP_{it} = \boldsymbol{\lambda_0} + \boldsymbol{\lambda_{it}}\left(lnGDP_{i,t-1} - \Phi_1\, FSD_{i,t-1} - \Phi_2\, HCR_{i,t-1} - \Phi_3\, lnFDI_{i,t-1}\right) + \sum_{l=0}^{q} \alpha_l\, \Delta FSD_{i,t-l} + \sum_{m=0}^{r} \gamma_m\, \Delta HCR_{i,t-m} + \sum_{n=0}^{s} \delta_n\, \Delta lnFDI_{i,t-n} + \vartheta_{i,t} \qquad (5.1.8)$$

where λ_{it} are parameters of the error correction terms which estimate the speed of adjustment or error-correction towards the long- run equilibrium for country i over time t. If the parameter of the error correction term is negative in sign and significant, there is a long-run association, or integrated of the same order among $lnGDP_{it}$, FSD_{it}, HCR_{it} and ln FDI_{it}; otherwise, no long-run relationship. ϑ_{it} are white noise random disturbances. α, γ and δ are parameters to be estimated and p, q, r and s denote the optimal lag length. The model is flexible which provides both the short-run and long-run elasticities, in addition to being consistent in dealing with non-stationary data at level.

We suppose GDP_{it} be a p ×1 vector of cross-section i in period t, follows a non-stationary VAR (p) process. $\boldsymbol{\lambda_0} = \delta_i d_{it}$ is a p ×1 vector with the j-th element representing the deterministic component of the model and d_{it} is vector of deterministic components and δ_i is a p ×1 matrix of parameters. ϑ_{it} are a p ×1 vector of disturbances and are independent *t N(0, $\Omega_{i,t}$) for t=1,…,T.* Further, we assume that the number of cross-sections N is fixed and the number of time periods T is relatively large (see: Anderson et al. (2006)).

Now days panel data econometrics have been used for estimating and forecasting purposes Baltagi (2005).Dynamic panel estimators has increasingly been used in studies of growth according to the studies by Baltagi, (2005); Easterly (1997); Islam(1995) and Arellano and Bond(1991). These dynamic relationships are characterized by the presence of a lagged dependent variable appears as an independent with other regressors. The long–run estimation under dynamic panel econometric models explains macroeconomic events by specifying preferences, technologies and institutions and predicts what is actually produced, traded and consumed and how these variables respond to various shocks (William, 2010).

Based on the lagged observations used as explanatory variables, the dynamic estimators are designed to address the econometric problems of the unobserved specific effects and the joint endogeneity of explanatory variables (Alonso–Borrego and Arellano, 1996). In the dynamic panel estimators, we apply the differenced equation to remove any bias and potential parameter inconsistency arising from the simultaneity bias created by the unobserved country–specific effects and the use lagged values of the original regressors. In cases where the cross sectional dimension is small and the time dimension is relatively large, the standard time series techniques are applied to the systems of equations and the panel aspect of the data should not pose new technical difficulties (Breitung and Pesaram ,2005).

If the variables are non–stationary in their levels, but stationary in differences, we take the differences and estimate short–run and long–run coefficients using VEC model that allows consistent estimation of the relationships among the series. More precisely, under the specification of restricted matrices Γ, α and β, the panel VECM allows the interactions of short–run dynamics between cross–sections; influence of one cross–section's temporary long–run equilibrium error on other members of the panel; the difference in cointegration ranks across cross–sections and cross–sectional cointegration (Anderson et al., 2006).

5.3. **Empirical Results and Discussions of the three combined researches**

In the section, we have tried to show the empirical results and discussions from the study using different methods for the analysis. Here are the following.

5.3.1. **Transmission Mechanism Channels in panel VECM**

After taking the significant independent variables along with the dependent real GDP and dropping FSD, we run the model. The results for the transmission mechanism channels in panel VECM or the causal channels reported are in (Table 5.3.1.1). The error correction terms–1 and–2, here in (Table 5.3.1.1) which indicate that there are robust long–run relationship among the gross rate of real GDP, human capital recourses HCR and foreign direct investment FDI. The three years lagged in the gross rate of real GDP have significantly negative impact on the real gross rate of the current real GDP whereas that of one year lagged in human capital resources HCR has significantly positive contribution to the gross rate of real GDP. However, the first period lagged in the gross rate of FDI causes the adverse effect to the real GDP gross rate.

The results have been checked and reported in ((Table 5.3.1.2), which is available in Appendix-B) which show that the joint cumulative three years lagged in real GDP, HCR and FDI has significantly negative, positive and negative effects on real GDP gross rate, respectively. As you can see the diagnostic checking for the model, F–statistic (9.3501) with the probability of (0.0000) is quite significant indicates the data is well fitted to the model. The model is also free from the problem of autocorrelation, heteroskedasticity and cross-sectional dependence in which the results are reported in ((Table 5.3.1.3) in Appendix–B).

Table 5.3.1.1 Transmission Mechanism Channel in Panel VEC Model using eq. (5.1.8)

Dep. Var. is $D(\ln GDP_{i,t})$	Coefficient	Std. Error	t-Statistic	P. Value
α_1ECT-1	-0.0084	0.0031	-2.6811	0.0088**
α_2ECT-2	-0.0251	0.0036	-6.8933	0.0000**
$\Gamma_1 D(\ln GDP_{i,t-1})$	-0.2198	0.0347	-6.3377	0.0000**
$\Gamma_2 D(\ln GDP_{i,t-2})$	-0.1058	0.0341	-3.0995	0.0026**
$\Gamma_3 D(\ln GDP_{i,t-3})$	-0.0825	0.0339	-2.4336	0.0170*
$\Gamma_4 D(HCR_{i,t-1})$	0.0629	0.0176	3.5758	0.0006**
$\Gamma_5 D(HCR_{i,t-2})$	0.0157	0.0186	0.8425	0.4018
$\Gamma_6 D(HCR_{i,t-3})$	0.0167	0.0206	0.8083	0.4211
$\Gamma_7 D(\ln FDI_{i,t-1})$	-0.0082	0.0026	-3.1225	0.0024**
$\Gamma_8 D(\ln FDI_{i,t-2})$	-0.0029	0.0029	-0.9630	0.3382
$\Gamma_9 D(\ln FDI_{i,t-3})$	-0.0003	0.0028	-0.0918	0.9271
Constant	0.0947	0.0055	17.1366	0.0000**

F-statistic 9.3501, Prob.(F-statistic) 0.0000

5.3.2. **Variance Decomposition and Impulse Response**

Here we assume that the variables are non–stationary at level in the nature of VECM environment. According the results reported in ((Table 5.3.2.1) in Appendices–B and–C), in period 2(in the year 1991), the short run–impulse innovation or shock to real GDP accounts for about 95.35 percent variation of fluctuates in real GDP (own shock), while in the long run period 25(in 2014), the own fluctuates decline to 9.50 percent. The shock to HCR accounts for 4.60 percent variation of fluctuates in real GDP whereas in the long–run (in the year 2014) the own fluctuates increase to 11.19 percent. However, there has been very huge fluctuation variations in real GDP for the last 25 years is because of the shock to FDI for about 0.045 percent in the year 1991, which becomes 79.31 percent in the year 2014. For this reason, the graphs in (Appendix –C) also indicate that the accumulated responses of the real GDP to the FDI is more immediate than to HCR for the period 1990 to 2014. As you can see in ((Table 5.3.2.2), in Appendix–B), the accumulated response of $\ln GDP_{it}$ to $HCR_{i,t}$ and $lnFDI_{i,t}$ has not been this much varied since 1990 to 2014.

5.3.3. **Random effects and ARDL models long-run estimation coefficients**

As we can see in (Table 5.3.3.1), three different redundant fixed effects tests are employed, each in both χ^2 and F–test versions. For restricting the cross-section fixed effects to zero; the period fixed effects to zero and restricting both types of fixed effects to zero. In all three cases, the *p*-values related with the test statistics are zero or the χ^2 and F-tests are statistically significant at the 5 percent level, indicating that the restrictions are not supported by the data. Hence, a pooled sample data could not be employed. It is of interest to determine whether the random effects model passes the Hausman test for the random effects being uncorrelated with the explanatory variables. We also conduct the Housman test in order to distinguish whether RE is an appropriate model and fit for the data or not. The chi–squared statistic χ^2 value of 0.1540 with the p–value of 0.9846, which is greater than 1percent for the test summary of the cross–section random. This leading us to fell the rejection at the 1 percent level of significance that the null hypothesis of the appropriate model is random effect, against the alternative fixed effects FE. Thus this shows the random effects model specification is to be preferred.

In order to determine the relationship between dependent and independent variables, we choose a panel random effect RE, over both fixed effect FE and pooled OLS regression models. We employ the model specified in eq.(5.1.5) and make the regression. Accordingly, the outputs reported in (Table 5.3.3.1), display basic information about the specification, including the method used to compute the component variances, the coefficient estimates and associated statistics. We estimate the specification using cross-section SUR standard errors to allow for general contemporaneous correlation between the panel residuals. The cross–section designation is used to indicate a non–zero covariance, allowing across cross-sections. This portion exhibits the best–linear unbiased predictor estimates of the random effects.

Table 5.3.3.1 Redundant FE and the Hausman correlated Random Effects tests using eq. (5.1.5)

Effects Test	Statistic	P. Value
Cross-section- F	1014.8	0.0000
Cross-section $-\chi^2$	1061.5	0.0000
Period- F	18.291	0.0000
Period $-\chi^2$	366.51	0.0000
Cross-Section and Period - F	212.03	0.0000
Cross-Section and Period $-\chi^2$	1081.8	0.0000
Hausman test summary for cross-section random-χ^2	0.1540	0.9846

Table 5.3.3.2 Random Effects and ARDL models long-run estimation coefficients

Random effects estimation using eq. (5.1.5)				ARDL(2,1,1,1)estimation using eq. (5.1.6)		
Variable	Coefficient	t-Statistic	P. Value	Coefficient	t-Statistic	P. Value
FSD_{it}	0.5181	0.4970	0.6196	1.4759	0.7953	0.4272
HCR_{it}	1.4276	3.3935	0.0008*	2.4803	2.7346	0.0067*
$lnFDI_{it}$	0.0589	2.8428	0.0048*	0.3891	3.3650	0.0009*
Constant	20.427	53.503	0.0000*	0.3658	3.9351	0.0001*
F-statistic	98.943		0.0000*	$E_{i,t-1}$= -.024	-3.5273	0.0005*

**and * denotes level of significance conventionally 1%. Dependent Variable: lnGDP, Panel EGLS (Cross-section random effects) for a Sample period 1980 -2015 which includes 9 cross-countries.

The Swamy and Arora estimator of the component variances and the cross–section SUR standard errors and covariance (no d.f. correction) are in the procedures. Note that SUR refers to seemingly unrelated regressions, a generalization of linear regression model that consists of several regression equations, each having its own dependent variable and potentially different sets of exogenous explanatory variables (Zellner, 1962). The model selection method includes Akaike information criterion. The dynamic regressors with 2 lags automatic, FSD, HCR, lnFDI and number of models evaluated is 4 for the selected model, which is resulted in ARDL (2, 1, 1, 1). Data on all series were demeaned to be cross-section independent and lnGDP, FSD and HCR were estimated by 2SLS to get rid of endogeneity.

The long-run estimations reported in (Table 5.3.3.2) of the random effects RE and the autoregressive distributed lags ARDL (2, 1, 1, 1) models indicate that human capital resource HCR and foreign direct investment FDI both have positively significant effects on economic growth (denoted by real GDP growth) for a panel of the East African countries over the period 1980–2015. More technically, a one percentage point increases in HCR and FDI that increases about 142.8 percent and 0.06 percent in economic growth for the panel.

The error correction terms, denoted by $E_{i,t-1}$for a panel of nine countries and for individual countries reported in (Table 5.3.3.3, in Appendix–II) are negative and significant. The error correction terms measure the seed of adjustment towards long-run equilibrium, at the seed of 2.40 percent, 5.56 percent and 5.23 percent for a panel countries, Mauritius and Zambia economies, respectively. The absolute value of the coefficient of the error correction term for Mauritian's economy is 0.0556. This indicates about 5.56 percent of the short run disequilibrium will be adjusted within a year, which has the fastest speed among countries in the sample study.

The short-run estimated growth rates of human capital resources HCR and foreign direct investment FDI, have positive and negative significant impact on economic growth rate of Burundi; negative and positive of Ethiopia; both negative of Kenya and Madagascar; negative and positive of Malawi; both positive of Mauritius; both negative of Rwanda; negative FDI and financial sector development FSD of Uganda and Zambia, respectively, see (Table 5.3.3.3, in Appendix–II).

CHAPTER VI: CONCLUSION

In this study, we investigate the main determinants of economic growth in East Africa using various types of panel or longitudinal data econometric modeling. The general objective of this study is to examine the contribution of FDI, the role of HCR and the impact of FDI on economic growth in the short-term, medium-and long-term trends. In examining the correlation between economic growth and its determinants, it is difficult to easily identify the direction of causation using traditional approaches such as dynamic panel ARDL. This study, however, contributes the new knowledge to the existing stock one about the economic analysis in the long-run, medium- and short-run by applying dynamic causality, designing a new econometric approach, the time scaling wavelet decomposition in dynamic panel framework, in addition to specifying unique model with indices calculations. The time scaling wavelet decomposition method can help to recognize the dynamic causality in time horizons. It divides up the time in a more details. It also brings information within the time range of the impact and the consequence effects in trend time horizons.

The two error correction terms which show that there are robust long–run relationships among the gross rate of real GDP, human capital recourses HCR and foreign direct investment FDI after dropping the insignificant FSD. The three years lagged in the gross rate of real GDP have significantly negative impact on the real gross rate of the current real GDP whereas that of one year lagged in human capital resources HCR has significantly positive contribution to the gross rate of real GDP. However, the first period lagged in the gross rate of FDI causes the adverse effect to the real GDP gross rate. The joint cumulative three years lagged in real GDP, HCR and FDI has significantly negative, positive and negative effects on real GDP gross rate, respectively.

In the variance decomposition and impulse response cases under the nature of VECM environment, in period 2(in the year 1991), the short run–impulse innovation or shock to real GDP accounts for about 95.35 percent variation of fluctuates in real GDP (own shock), while in the long run period 25(in 2014), the own fluctuates decline to 9.50 percent. The shock to HCR accounts for 4.60 percent variation of fluctuates in real GDP whereas in the long–run (in the year 2014) the own fluctuates increase to 11.19 percent. However, there has been very huge fluctuation variations in real GDP for the last 25 years is because of the shock to FDI for about 0.045 percent in the year 1991, which becomes 79.31 percent in the year 2014. For this reason, the accumulated responses of the real GDP to the FDI is more immediate than to HCR for the period 1990 through 2014.

We also conduct the Housman test in order to distinguish whether RE is an appropriate model and fit for the data or not. The test summary of the cross section random, leading us to choose the appropriate model, panel random effect, which against the alternative fixed effects. The long-run estimations of the random effects RE and the autoregressive distributed lags ARDL (2, 1, 1, 1) models indicate that human capital resource HCR and foreign direct investment FDI both have positively significant effects on economic growth for a panel of the East African countries over the period 1980–2015. More technically, a 1 percent point increases in HCR and FDI that increases about 142.8 percent and 0.06 percent in economic growth for the panel. In this regard, the error correction terms for a panel of nine countries and for individual countries are negative and significant, which measure the seed of adjustment towards long-run equilibrium, at the seed of 2.40 percent, 5.56 percent and 5.23 percent for a panel countries, Mauritius and Zambia economies, respectively. The absolute value of the coefficient of the error correction term for Mauritian's economy is 0.0556. This indicates about 5.56 percent of the short run disequilibrium will be adjusted within a year, which has the fastest speed among countries in the sample study.

Regarding short-run estimation coefficients, the short–run estimated growth rates of human capital resources HCR and foreign direct investment FDI, have positive and negative significant impact on economic growth rate of Burundi; negative and positive of Ethiopia; both negative of Kenya and Madagascar; negative and positive of Malawi; both positive of Mauritius; both negative of Rwanda; negative FDI and financial sector development FSD of Uganda and Zambia, respectively.

We also estimate the long-run parameters using panel fully modified least squares FMOLS and panel dynamic least squares DOLS methods to examine the effect of FSD on GDP growth. Thus, estimation results indicate that as FSD increases by one unit, GDP growth increases by one percent according to panel FMOLS method of estimation.

However, gross capital formation has positively significant contribution to economic growth in East Africa over the period of 1975–2015 by both methods.

Human capital resource is a crucial component for economic growth. Specially, well-educated and skilled persons in productive sectors are important determinants of economic growth. Nevertheless East Africa has the lowest level of human capital development regardless of rapid growth in the expansion of education, the issue of employment challenges that women have faced more than men. Instead of going to school, women are being forced to marry at an early age due to financial difficulties and strict society rules that curb their education opportunities. In fact, labor theories and policies do not usually include a gender approach to labor challenges in modern economic theory. Thus, physical policy is an important element for addressing the development of human capital in the region. Physical policy is all about the effective system of taxation on revenue generation for the governments and other resources mobilization mechanisms in addition to inequality and equity concerns. However, the East African policy is inadequate when it comes to bridging the gap between the societies in terms of income and wealth inequalities, in addition to the lack of inclusiveness in economic growth for all beneficiaries. The expansion of human capital stock itself has not been matched by a proportionate rise in physical capital due to the low level of income growth and low returns to the educational investment (Simon and Francis, 1998).

We observe that the growth rate of human capital resources and physical capital stock have long-run effects on gross national income. The short–term transmission mechanism-channels using the Wald test indicates that growth of HCR has a significant important contribution to the development of physical capital stock through GNI. The GNI plays also a positive role in accumulating physical capital stock via HCR. We demonstrate explicitly the dynamic inter-temporal relationship between GNI and HCR growth by using panel wavelet time scaling decomposition analysis. The accumulated responses of GNI to HCR are positively significant in the medium and long–terms while the responses of HCR to GNI are significantly negative in the short-and medium-term. They are also significantly positive in the long–run. The estimated growth of HCR and GNI has a bi-directional dynamic causal relation.

Foreign direct investment FDI is one of the most dynamic resources flowing into developing countries. It can play an important role in economic development efforts, in terms of domestic savings, employment generation and growth. It can be also used in integrating global economies with domestic ones, transferring modern technologies, enhancing efficiency and rising skills of manpower. An increase in FDI inflows may be associated with improved economic growth for the host country that functions as a channel for new infrastructure and other projects to boost development. Attracting FDI has assumed a prominent place in the strategies of economic renewal being advocated by policy makers at national, regional and international levels. The experience of fast–growing East Asian and recently China has strengthened the belief that attracting FDI is the key to bridging the resource gap of low-income courtiers (United Nation, 2005). Accordingly, we apply the correlation between FDI and GDP growth in our discourse. The Granger causality test of panel wavelet analysis decompositions reveals that the short-run, medium-and long-run effects of the FDI on GDP and vice versa exist. The bi-directional dynamic causal effects of FDI and GDP contribute immensely to each other in short, medium and long terms.

We can conclude that the reforms in the financial sector and the inclusiveness of financial system which directs the economy could be beneficial to the countries in our sample study. We also argue that much attention should be given to HCR more than any other to make economic growth that can lead to sustained development. Furthermore, as FDI and GDP have significantly positive contributions to one another in the short, medium, and long run, favorable environment conditions and conducive economic policies need to be designed. In this study, we only focus on the contribution of FSD, the role of HCR and the impact of FDI on economic growth in East African. However, further studies are required to be conducted on this area by considering some topics which can potentially affect the growth such as corruption, economic policy in each country, the interaction among each country with trade and others. They may help providing very crucial information which serves as a foundation for policymakers to deal with.

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Appendices for combined researches

Appendix–I

5.2 Optimal lag length, test for panel units and cointegration and other specifications

5.2.1 Optimum lag-length determinations

The lag-length determination is the key point in the process of testing and estimation variables (Mark, 2000) and if we want choose the lag-length to maximize the normal likelihood; we just choose p to minimize $ln|\widehat{\Sigma_p}|$, where $\widehat{\Sigma_p} = \frac{1}{T-P}\sum_{t=p+1}^{T} \widehat{\varepsilon_t}\, \widehat{\varepsilon_t}'$. The Akaike information criterion, Schwartz-Bayesian information criterion and other criteria are often used to choose the optimal lag length distributed-lag models. To estimate the lag length, we compute the log-likelihood function and various information criteria for each choice are used. Another way of deciding on lag length is to use the standard Wald test statistics (Johansen, 1995).

There are three distinct situations that automatically the lag length parameter can be computed. The first situation occurs when we select the lag length parameter for the kernel- based estimators (Newey–West, 1994) data-based automatic methods. The other two situations occur when the unit root test requires estimation of a regression with a parametric correction for serial correlation as in the augmented Dickey–Fuller ADF and Dickey-Fuller generalized least squares DFGLS test equation regressions and the autoregressive AR spectral estimator. In all cases, lagged difference terms are added to a regression equation. The automatic selection methods choose to the minimum value of Akaike, Schwarz, Hannan–Quinn, modified Akaike, modified Schwarz and modified Hannan-Quinn information criteria that can be defined as,

$$-2\left(\frac{l}{T}\right)+\frac{2k}{T}, -2\left(\frac{l}{T}\right)+\frac{klog(T)}{T}, -2\left(\frac{l}{T}\right)+2klog(\frac{\log(T)}{T}, -2\left(\frac{l}{T}\right)+\frac{2(k+\tau)}{T},$$

$$-2(l/T)+(k+\tau)\log(T)/T, \text{and} -2(l/T)+2(k+\tau)\log(T))/T, \text{respectively.}$$

The modification factor τ is computed as: $\tau = \alpha^2 \sum \tilde{y}_{t-1}^2 / \hat{\alpha}_u^2$, for $\tilde{y}_t = y_t$, when computing the ADF test equation, and for $\tilde{y}_t$ as defined in "autoregressive spectral density estimator", we use the modified criteria to estimate the model (Ng and Perron,2001).

The log-likelihood cannot decrease when additional regressors are included. The calculated panel unit roots are based on an original approach of the recent econometric literatures. The null hypothesis is a non-stationary behaviour of the time series, admitting the possibility that the error terms are serially correlated with different serial correlation of the in cross-sectional units (Im, Pesaran, and Shin, 1998). The lag-length determination is the key point in the process of testing and estimation variables.

5.2.2. Panel Unit Root Tests

Recent literature suggests that panel-based unit root tests have higher power than unit root tests based on individual time series (Baltagi, 2005) and "a regression is technically called a spurious regression when its stochastic error is unit-root nonstationary"(Pablo, 2010, p.4). The simple test of error cross-section dependence applicable to a variety of panel models including stationary and unit root dynamic heterogeneous panels with short T and large N (Pesaran, 2004). There has been suggest that the simpler way of getting rid of cross-sectional dependence than estimating the factor loading is augmenting the usual ADF regression with the lagged cross-sectional mean and its first difference to capture the cross-sectional dependence that arises through a single factor model. This is called the cross-sectionally augmented Dickey–Fuller (CADF) test. This simple CADF regression is

$$\Delta y_{i,t} = \alpha_i + \rho_i^* y_{i,t-1} + d_0 \bar{y}_{t-1} + d_1 \Delta \bar{y}_t + \varepsilon_{i,t}$$

Where $\bar{y}_t$ is the average at time t of all N observations. The presence of the lagged cross-sectional average and its first difference accounts for the cross-sectional dependence through a factor structure. If there is serial correlation in the error term, the regression must be augmented as usual in the univariate case, but lagged first-differences of both $y_{i,t}$ and $\bar{y}_t$ must be added, which leads to

$$\Delta y_{i,t} = \alpha_i + \widehat{\rho_i} y_{i,t-1} + d_0 \bar{y}_{t-1} + \sum d_{1+j} \Delta \bar{y}_{t-j} + \sum_{k=1}^{p} c_k \Delta y_{i,t-k} + \varepsilon_{i,t}$$

where the degree of augmentation can be chosen by an information criterion or sequential testing. According to Pesaran(2004), after running the CADF regression for each unit i in the panel, the t-statistics on the lagged value, called $CADF_k$ is used to obtain the CIPS statistic

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_k$$

The joint asymptotic limit of the CIPS statistic is nonstandard and critical values are provided for various choices of N and T. The t-tests are free of cross-sectional dependence and the limiting distribution of this test is different from the Dickey–Fuller distribution due to the presence of the cross-sectional average of the lagged level. Pesaran uses a truncated version of the IPS test that avoids the problem of moment calculation.

We consider the following five types of panel unit root tests such as Levin, Lin and Chu (2002); Im, Pesaran and Shin (2003); Breitung(2000); Hadri (2000); Fisher-type tests using ADF and PP tests in Maddala and Wu (1999) and Choi(2001). Panel unit root tests are similar, but not identical. We begin by classifying the unit root tests on the basis of whether there are restrictions on the autoregressive process across cross-sections or series. Consider a following AR (1) process for panel data:

$$y_{it} = \rho_i y_{it-1} + X_{it}\delta_i + \varepsilon_{it}$$

where $i = 1,2, \ldots N$ cross-section units that are observed over periods $t = 1,2, \ldots, T$. The X_{it} represent the exogenous variables in the model, including any fixed effects or individual trends, ρ_i are the autoregressive coefficients, and the errors ε_{it} are assumed to be mutually independent idiosyncratic disturbance if $|\rho_i| < 1, y_i$ is said to be weakly trend- stationary. On the other hand, if $|\rho_i| = 1$ then y_i contains a unit root.

For purposes of testing, there are two natural assumptions that we can make about the ρ_i. First, one can assume that the persistence parameters are common across cross-sections so that $\rho_i = \rho$ for all i. The Levin, Lin, and Chu (LLC), Breitung, and Hadri tests all employ this assumption. Alternatively, one can allow ρ_i to vary freely across cross-sections then the Im, Pesaran, and Shin (IPS), and Fisher-ADF and Fisher-PP tests are of this form.

Levin, Lin, and Chu (LLC), Breitung, and Hadri tests all assume that there is a common unit root process so that is identical across cross-sections. The first two tests employ a null hypothesis of a unit root while the Hadri test uses a null of no unit root. LLC and Breitung both consider the following basic ADF specification,

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{\rho_i} \beta_{ij}\, \Delta y_{it-1} + X'_{it}\delta + \varepsilon_{it}$$

Where we assume a common$= \rho - 1$, but allow the lag order for the difference terms, ρ_i, to vary across cross-sections. The null and alternative hypotheses for the tests may be written as

$$H_0 = \alpha = 0$$

$$H_a = \alpha < 0$$

Under the null hypothesis, there is a unit root, while under the alternative, there is no unit root.

The Im, Pesaran and Shin, and the Fisher-ADF and PP tests all allow for individual unit root processes so that it may vary across cross-sections. The tests are all characterized by the combining of individual unit root tests to derive a panel-specific result. The Im, Pesaran-Shin begins by specifying a separate ADF regression for each cross section,

$$\Delta y_{it} = \alpha y_{it-1} + \sum_{j=1}^{\rho_i} \beta_{ij}\, \Delta y_{it-1} + X'_{it}\delta + \varepsilon_{it}$$

The null hypothesis may be written as $H_0 = \alpha_i = 0$ for all i while the alternative hypothesis is given by $H_a = \alpha_i = 0$ for $i = 1,2 \dots . N_1$ or $\alpha_i < 0$ for $i = N + 1, N + 2, \dots, N$.

The calculated panel unit root test, based on an original approach of the recent econometric literature is essential for non-stationarity. The null hypothesis is a non-stationary behaviour of the time series, admitting the possibility that the error terms are serially correlated with different serial correlation coefficients in cross-sectional units (Pesaran, 2003).

5.2.3. Panel Cointegration test

Before proceeding to estimate the model, we should test for cointegration. Richard et al.,(2006) examine the canonical correlation method as an alternative to likelihood-based inferences for vector error-correction models. The testing statistic based on Box-Tiao's canonical correlations shows promise as an alternative to cointegration ranks based on Johansen (1995) the ML–based approach for testing of integration rank in VECM models.

The most common tests to determine the number of cointegrating relationships among the series are due to (Johansen, 1995).The analysis of long-run cointegrating relationships has received considerable attention in various forms of the residual-based such as Panel fully modified OLS and Dynamic OLS estimators of Phillips and Moon (1999); Pedroni, (2000) and (2001); Kao and Chiang (2000); Mark and Sul(2003) that produce asymptotically unbiased, normally distributed coefficient estimates.

We must to determine the order of integration of the series in given data. Testing for unit root is performed using the panel unit root test of (Im, Pesaran and Shin ,2003); hereafter the IPS test, which is appropriate for balanced panels(Catia, 2013),

$$\Delta x_{it} = \alpha_i + \tau_i t + \rho_i x_{i,t-1} + \sum_{j=1}^{l} \Delta\beta_{ij} x_{i,t-1} + \epsilon_{it}$$

$$for\ 1 = 1,2,..,\mathrm{N}\ \mathrm{t} = 1,2,..,\mathrm{T}.$$

$x = y, x_1, \ldots, x_n$ and i, t, l and ρ_i denote cross − sectional unit, time, number of lags and autoregressive root, respectively. The null hypothesis test for non-stationary process in panel series allowing for a heterogeneous coefficient of $x_{i,t-1}$ and its alternative one are respectively given as $H_0: \rho_i = 0, for\ all\ i$ and $H_a: \rho_i < 0, for\ at\ leat\ one\ i$.The total variation $\bar{x} = \frac{1}{NT}\sum_i \sum_t x_{it}$ can be decomposed into within variation over time for each individual country $x_i = \frac{1}{NT}\sum x_{it}$ and the between variation across countries (Catia Cialani2013).

Like the panel unit root tests, panel cointegration tests can be motivated by the search for more powerful tests than those obtained by applying individual time series cointegration tests. The latter tests are known to have low power, especially for short time dimension and short span of the data. In the case of purchasing power parity and convergence in growth, economists use pool data on similar countries, in the hopes of adding cross-sectional variation to the data that will increase the power of unit root tests or panel cointegration tests (Baltagi, 2005).

Consider a panel structure for the $n+1$ dimensional time series vector process (y_{it}, X'_{it}) with cointegrating equation,

$$y_{it} = \alpha + X'_{it}\,\beta + \delta_i + \gamma_i + \epsilon_{it}$$

where y_{it} is the dependent variable, X_{it} is a k–vector of regressors and ϵ_{it} are the error terms for $i = 1,2,\dots,n$ cross-sectional units observed for dated periods $t = 1,2,\dots,T$. The α parameter represents the overall constant in the model, while δ_i and γ_i represent cross-section or random effects and period specific or fixed effects, respectively. The cointegrating relationship between y and X is assumed to be homogeneous across cross-sections, and that specification allows for cross-section specific deterministic effects for cross-sections i, period t.

Pedroni (1999) developed a number of statistics based on the residuals of the Engle and Granger (1987) cointegration regression. Assuming a panel of N countries each with m regressors (Xm) and T observations, the long run model is written as:

$$\mathrm{Y_{it}} = \alpha_{\mathrm{i}} + \lambda_{\mathrm{it}} + \sum_{\mathrm{j=1}}^{\mathrm{m}} \beta_{\mathrm{j,i}}\, \mathrm{X_{j,it}} + \epsilon_{\mathrm{it}}\,, \mathrm{t} = 1,2,\dots,\mathrm{T} \text{ and } \mathrm{i} = 1,2,\dots,\mathrm{N}.$$

Where $\mathrm{Y_{it}}$ and $\mathrm{X_{j,it}}$ integrated of order one in levels, I(1). Pedroni (1999) proposed seven panel cointegration statistics. Four of these statistics, called panel cointegration statistics, are within-dimension based statistics. The other three statistics, called Group mean panel cointegration statistics, are between-dimension based statistics. Under the null hypothesis, the seven tests are based on the absence of cointegraton (Sahbi and Jaleleddine, 2015).

$$H_0: \rho_i = 0, \text{for } i = 1,2, \ldots, N$$

Where ρ_i is the autoregressive term of the estimate residuals under the alternative hypothesis of the equation,

$$\hat{\varepsilon}_{it} = \rho_i \varepsilon_{it-1} + u_{it}$$

The residual based DF and ADF of Kao test, consider the panel regression model

$$y_{it} = x'_{it}\beta + z'_{it}\gamma + \epsilon_{it}$$

Where $y_{it} and\ x'_{it}$ are I(1) and non-cointegrated. Kao (1999) proposed DF and ADF type unit root tests for ϵ_{it} as a test for the null no cointegration. In order to test the null hypothesis of no cointegration, the null can be written as $H_O: \rho = 1$.

According to (Baltagi ,2005, p.251-253), the OLS estimate of ρ and the t-statistic are given as $\hat{\rho} = \frac{\sum_{i=1}^{n}\sum_{t=2}^{T}\hat{e}_{i,t}\hat{e}_{i,t-1}}{\sum_{i=1}^{n}\sum_{t=2}^{T}\hat{e}^2{}_{i,t}}$ & $t_\rho = \frac{(\hat{\rho}-1)\sqrt{\sum_{i=1}^{n}\sum_{t=2}^{T}\hat{e}^2{}_{i,t-1}}}{S_e}$, Where $S_e{}^2 = \frac{1}{NT}\sum_{i=1}^{N}\sum_{t=2}^{T}\left(\hat{e}_{i,t} - \hat{\rho}\hat{e}_{i,t-1}\right)^2$

5.2.4 **Check for Cross sectional Dependence**

As Andrews (2005) argues the cross-sectional dependence causes bias and inconsistency estimation. The cross-sectional independence is a convenient but difficult to justify assumption in panel cointegration analysis. One major source of cross-section correlation in macroeconomic data is common shocks, such as oil price shocks and international financial crises (Baltagi, 2006). Panel data models with correlated cross-sectional units are important due to increasing availability of large panel data sets and increasing inter-connectedness of the economies (Baltagi, 2006).

We have to test for panel unit roots, account of heterogeneous cross-sectional dependence. The cross-sectional dependence is a direct descendant of the cross-country on growth (King and Levine, 1993); Levine and Zervos, 1998)) and it is used as a consistency check on the panel findings.

Appendix–II: Tables

Table.5.3.1.2. Joint cumulative channels via real GDP using Wald Test

Hypothesized, H_0:	χ^2 value	P. Value
1. $\Gamma_1 = \Gamma_2 = \Gamma_3 = 0$	48.58982	0.0000*
2. $\Gamma_4 = \Gamma_5 = \Gamma_6 = 0$	16.12213	0.00021**
3. $\Gamma_7 = \Gamma_8 = \Gamma_9 = 0$	10.44713	0.0151**

** and * denotes rejection of the hypothesis at the 1% and 5% level of significance. Restrictions are linear in coefficients. $Dependent\ variable$: $D(lnRGDP_{it})$.

Table 5.3.1.3.VEC Residual Serial Correlation LM and Heteroskedasticity tests

Serial Correlation LM Test			Heteroskedasticity Test			
			No Cross Terms		Include Cross Terms	
Lags	LM-Statistic	P. Value	Joint- χ^2	P. Value	Joint- χ^2	P. Value
1	18.52546	0.0295	148.3936	0.1561	512.7841	0.0510
2	7.522866	0.5828				
3	6.390804	0.7003				

Null Hypotheses: no serial correlation and no Heteroskedasticity.at lag order 3 for each. * denotes rejection of the hypothesis at the 5% level of significance, Hence, Here we do not reject both null hypotheses and hence, the model is free from the problem of serial correlation and Heteroskedasticity.

Table 5.3.2.1 Variance Decompositions

	Variance Decomposition of $lnRGDP_{it}$				Variance Decomposition of HCR_{it}			
Period	S.E.	$lnRGDP_{it}$	HCR_{it}	$lnFDI_{it}$	S.E.	$lnRGDP_{it}$	HCR_{it}	$lnFDI_{it}$
1	0.02836	100.000	0.00000	0.0000	1.57851	1.36553	14.3085	84.3259
2	0.03731	95.3515	4.60350	0.0449	1.79848	1.34433	13.1814	85.4742
3	0.04437	91.1412	6.58417	2.2745	2.04552	1.43752	19.6740	78.8884
4	0.05182	83.3214	8.02720	8.6513	2.35028	1.42417	22.1119	76.4639
5	0.06044	74.3269	7.09294	18.580	2.54558	1.49140	23.6194	74.8892
6	0.06964	66.0972	6.23534	27.667	2.75374	1.47913	24.5723	73.9485
7	0.08007	57.8508	5.69750	36.451	2.93166	1.48087	25.1669	73.3521
8	0.09150	50.5868	5.48392	43.929	3.08943	1.48978	26.0214	72.4888
9	0.10417	44.0718	5.44668	50.481	3.23959	1.50069	26.8459	71.6533
10	0.11804	38.4058	5.46820	56.125	3.37529	1.51449	27.6193	70.8661
11	0.13297	33.5911	5.55159	60.857	3.50115	1.52600	28.3245	70.1494
12	0.14891	29.5339	5.71258	64.753	3.61707	1.53696	28.9611	69.5018
13	0.16577	26.1333	5.95164	67.914	3.72353	1.54828	29.5688	68.8828
14	0.18352	23.2759	6.25562	70.468	3.82197	1.55997	30.1525	68.2874
15	0.20210	20.8653	6.60642	72.528	3.91277	1.57214	30.7114	67.7163
16	0.22144	18.8234	6.99157	74.184	3.99657	1.58450	31.2441	67.1713
17	0.24148	17.0863	7.4039	75.509	4.07386	1.59695	31.7492	66.6538
18	0.26217	15.6015	7.83882	76.559	4.14505	1.60953	32.2288	66.1615
19	0.28344	14.3260	8.29189	77.382	4.21061	1.62225	32.6850	65.6927
20	0.30525	13.2248	8.75890	78.016	4.27093	1.63512	33.1186	65.2461
21	0.32754	12.2692	9.23599	78.494	4.32639	1.64810	33.5304	64.8214
22	0.35025	11.4360	9.72007	78.843	4.37732	1.66118	33.9206	64.4181
23	0.37333	10.7062	10.2086	79.085	4.42406	1.67434	34.2898	64.0358

24	0.39674	10.0641	10.6997	79.236	4.46690	1.68755	34.6384	63.6739
25	0.42043	9.49709	11.1916	79.311	4.50613	1.70080	34.9672	63.3319

Variance Decomposition of LNFDI

Period	S.E.	$\ln RGDP_{it}$	$\ln EE_{it}$	$\ln FDI_{it}$
1	1.578510	1.365531	14.30854	84.32593
2	1.798488	1.344330	13.18145	85.47422
3	2.045524	1.437523	19.67405	78.88843
4	2.350289	1.424171	22.11193	76.46390
5	2.545589	1.491400	23.61940	74.88920
6	2.753742	1.479133	24.57234	73.94852
7	2.931660	1.480878	25.16696	73.35217
8	3.089439	1.489789	26.02141	72.48880
9	3.239596	1.500694	26.84594	71.65336
10	3.375290	1.514495	27.61935	70.86615
11	3.501158	1.526001	28.32452	70.14948
12	3.617078	1.536966	28.96119	69.50184
13	3.723538	1.548280	29.56884	68.88288
14	3.821973	1.559978	30.15253	68.28749
15	3.912773	1.572149	30.71149	67.71636
16	3.996573	1.584503	31.24417	67.17132
17	4.073864	1.596957	31.74924	66.65381
18	4.145059	1.609538	32.22889	66.16157
19	4.210618	1.622256	32.68502	65.69272
20	4.270939	1.635120	33.11869	65.24619
21	4.326394	1.648106	33.53047	64.82142
22	4.377329	1.661187	33.92069	64.41813
23	4.424064	1.674341	34.28982	64.03584
24	4.466905	1.687553	34.63847	63.67398
25	4.506138	1.700807	34.96722	63.33198

Cholesky Ordering: $\ln RGDP_{it}$, HCR_{it}, $\ln FDI_{it}$.

Table 5.3.2.2 Impulse Response

Period	Accumulated Response of $lnRGDP_{it}$			Accumulated Response of HCR_{it}			Accumulated Response of LNFDI		
	$lnRGDP_{it}$	HCR_{it}	$LNFDI_{it}$	$lnRGDP_{it}$	HCR_{it}	$LNFDI_{it}$	$lnRGDP_{it}$	HCR_{it}	$LNFDI_{it}$
1	0.0283	0.0000	0.0000	0.0229	0.1835	0.0000	0.1844	0.5970	1.4495
2	0.0512	0.0080	0.0008	0.0456	0.3719	-0.0307	0.2817	0.8613	2.2641
3	0.0728	0.0161	0.0074	0.0717	0.5540	-0.0713	0.4108	1.4913	2.9963
4	0.0939	0.0253	0.0211	0.0898	0.6930	-0.0749	0.5468	2.1223	3.9570
5	0.1157	0.0319	0.0422	0.1031	0.7965	-0.1023	0.6809	2.6783	4.7501
6	0.1378	0.0385	0.0680	0.1146	0.8953	-0.1418	0.8055	3.2552	5.6189
7	0.1603	0.0464	0.0995	0.1269	0.9887	-0.1958	0.9284	3.8026	6.4536
8	0.1832	0.0561	0.1361	0.1388	1.0754	-0.2616	1.0506	4.3689	7.2375
9	0.2066	0.0676	0.1786	0.1496	1.1505	-0.3310	1.1743	4.9466	8.0128
10	0.2305	0.0807	0.2270	0.1588	1.2121	-0.4059	1.2969	5.5203	8.7568
11	0.2547	0.0955	0.2812	0.1667	1.2626	-0.4862	1.4174	6.0908	9.4817
12	0.2794	0.1124	0.3412	0.1737	1.3038	-0.5717	1.5358	6.6539	10.184
13	0.3046	0.1316	0.4068	0.1801	1.3366	-0.6619	1.6524	7.2111	10.860
14	0.3302	0.1533	0.4780	0.1858	1.3612	-0.7552	1.7673	7.7633	11.512
15	0.3563	0.1776	0.5578	0.1908	1.3779	-0.8509	1.8805	8.3086	12.138
16	0.3829	0.2046	0.6369	0.1952	1.3869	-0.9482	1.9919	8.8458	12.740
17	0.4100	0.2345	0.7244	0.1990	1.3890	-1.0465	2.1012	9.3738	13.317
18	0.4376	0.2672	0.8171	0.2024	1.3847	-1.1453	2.2084	9.8917	13.870
19	0.4656	0.3029	0.9148	0.2055	1.3747	-1.2439	2.3137	10.399	14.398
20	0.4942	0.3416	1.0174	0.2082	1.3595	-1.3416	2.4168	10.895	14.903
21	0.5231	0.3834	1.1247	0.2107	1.3394	-1.4381	2.5180	11.380	15.384
22	0.5526	0.4283	1.2366	0.2130	1.3150	-1.5326	2.6170	11.852	15.842
23	0.5824	0.4763	1.3528	0.2152	1.2869	-1.6248	2.7140	12.312	16.278
24	0.6128	0.5274	1.4732	0.2173	1.2554	-1.7142	2.8090	12.760	16.693
25	0.6435	0.5816	1.5976	0.2194	1.2211	-1.8004	2.9019	13.194	17.086

Cholesky Ordering: $lnRGDP_{it}$, $lnEE_{it}$,$lnFDI_{it}$

Table 5.3.3.3 Cross–section short-run ARDL (2, 1, 1, 1) coefficient estimation using eq.(5.1.6)

Country	Variable	Coefficient	t-Statistic	P. Value
1.Burundi	$E_{i,t-1}$	-0.0042	-134.47	0.0000*
	$D(LNGDP)_{i,t-1}$	0.3436	15.615	0.0006*
	$D(FSD)_{it}$	-0.2267	-0.5034	0.6493
	$D(HCR)_{it}$	1.5186	8.6069	0.0033*
	$D(lnFDI)_{it}$	-0.0024	-680.42	0.0000*
	Constant	0.0659	7.9935	0.0041
2.Ethiopia	$E_{i,t-1}$	-0.0236	-121.60	0.0000*
	$D(LNGDP)_{i,t-1}$	0.0563	1.6340	0.2008
	$D(FSD)_{it}$	-0.4991	-0.3903	0.7224
	$D(HCR)_{it}$	-0.1209	-4.8785	0.0165*
	$D(lnFDI)_{it}$	0.0073	157.39	0.0000*
	Constant	0.4057	6.7949	0.0065
3.Kenya	$E_{i,t-1}$	-0.0149	-186.41	0.0000*
	$D(LNGDP)_{i,t-1}$	0.2550	7.9768	0.0041*
	$D(FSD)_{it}$	0.0506	0.2322	0.8313
	$D(HCR)_{it}$	-0.1627	-7.4745	0.0050*
	$D(lnFDI)_{it}$	-0.0033	-450.53	0.0000*
	Constant	0.2571	10.535	0.0018
4.Madagascar	$E_{i,t-1}$	-0.0203	-192.72	0.0000*
	$D(LNGDP)_{i,t-1}$	-0.2783	-13.081	0.0010*
	$D(FSD)_{it}$	1.4027	2.8260	0.0664
	$D(HCR)_{it}$	-0.0321	-7.1764	0.0056*
	$D(lnFDI)_{it}$	-0.0015	-124.36	0.0000*
	Constant	0.3242	11.063	0.0016
5.Malawi	$E_{i,t-1}$	-0.0019	-33.910	0.0001*
	$D(LNGDP)_{i,t-1}$	0.3498	10.743	0.0017*
	$D(FSD)_{it}$	3.32E-06	1.43E-05	1.0000
	$D(HCR)_{it}$	-0.0202	-16.379	0.0005*
	$D(lnFDI)_{it}$	0.0054	272.80	0.0000*
	Constant	0.0573	4.9381	0.0159

6.Mauritius	$E_{i,t-1}$	-0.0556	-51.052	0.0000*
	$D(LNGDP)_{i,t-1}$	0.1070	7.9089	0.0042*
	$D(FSD)_{it}$	0.4403	3.0778	0.0542
	$D(HCR)_{it}$	0.3426	8.0388	0.0040*
	$D(lnFDI)_{it}$	0.0425	439.52	0.0000*
	Constant	0.7663	2.7759	0.0692
7.Rwanda	$E_{i,t-1}$	-0.0053	-45.793	0.0000*
	$D(LNGDP)_{i,t-1}$	0.2098	7.8061	0.0044*
	$D(FSD)_{it}$	-1.8181	-1.7188	0.1841
	$D(HCR)_{it}$	-0.2758	-4.5458	0.0199*
	$D(lnFDI)_{it}$	-0.0024	-69.023	0.0000*
	Constant	0.1045	5.3992	0.0125
8.Uganda	$E_{i,t-1}$	-0.0356	-41.306	0.0000*
	$D(LNGDP)_{i,t-1}$	0.3887	13.322	0.0009*
	$D(FSD)_{it}$	0.0608	6.6433	0.0069*
	$D(HCR)_{it}$	-0.0722	-1.3379	0.2733
	$D(lnFDI)_{it}$	-0.0054	-91.037	0.0000*
	Constant	0.5436	2.4925	0.0883
9.Zambia	$E_{i,t-1}$	-0.0523	-91.419	0.0000*
	$D(LNGDP)_{i,t-1}$	0.0848	3.1310	0.0520
	$D(FSD)_{it}$	0.7184	4.8375	0.0168*
	$D(HCR)_{it}$	-0.0458	-1.4279	0.2486
	$D(lnFDI)_{it}$	0.0101	207.51	0.0000*
	Constant	0.7680	4.0775	0.0266

Appendix–III: Graphs

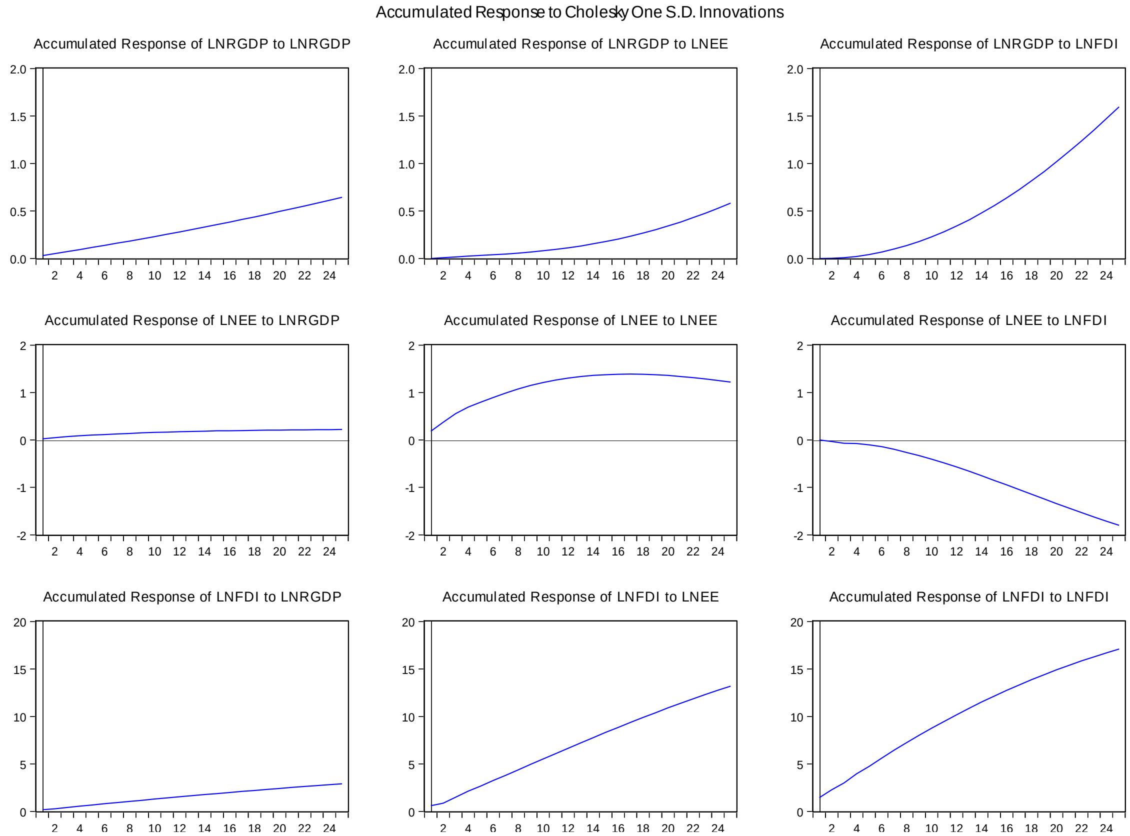
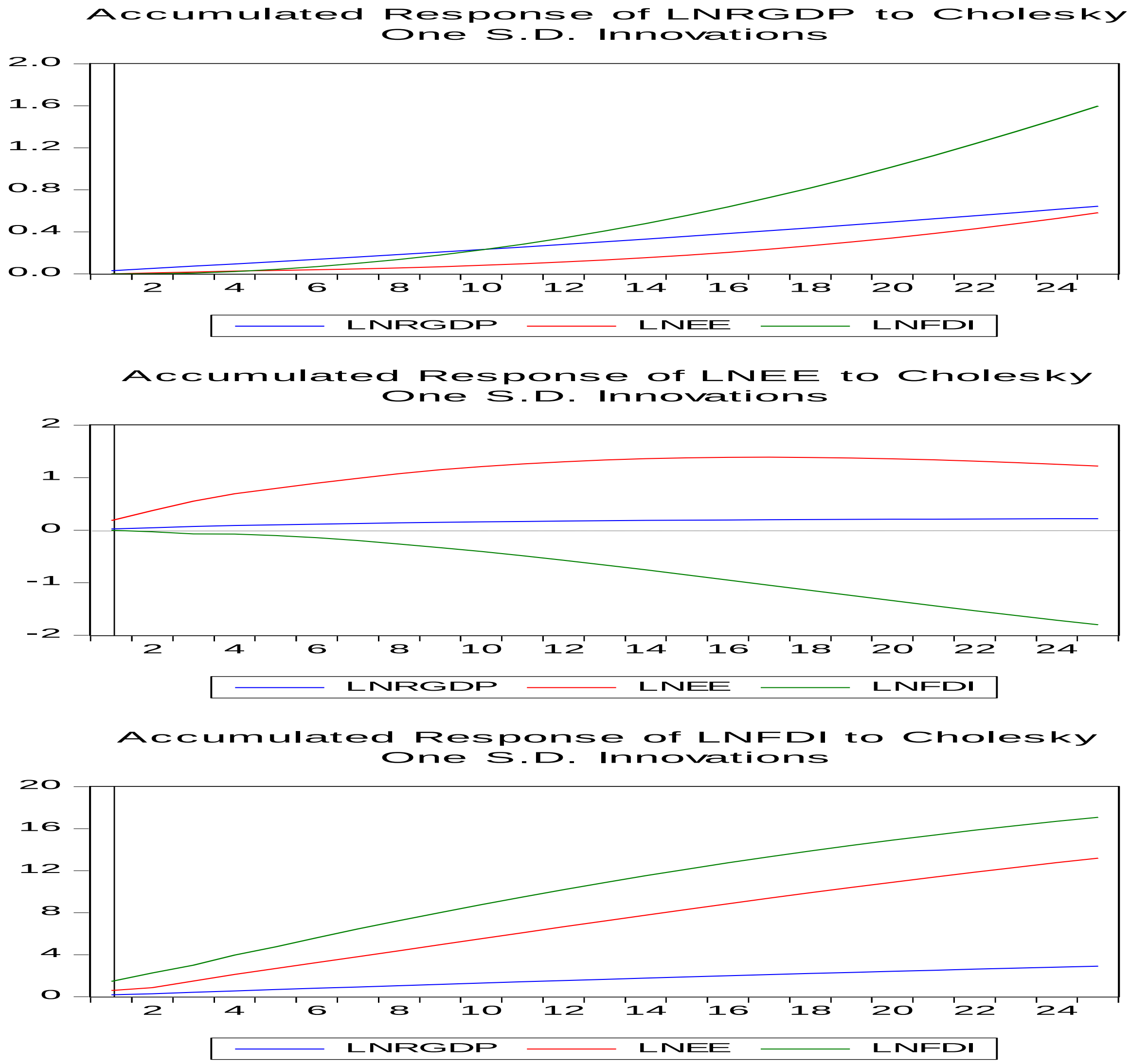


Fig. F. Combined Graphs of $\ln RGDP_{it}$, HCR_{it} ,$\ln FDI_{it}$



Impose response standard errors are not available for VECs and BVARs.

Fig. G. Accumulated responses