IMPACT OF BROADBAND SERVICES ON ECONOMIC GROWTH IN KENYA (1992-2019)

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DECLARATION

I hereby declare that this is my original work and it has not been presented to any other university or institution of higher learning for the award of any degree or diploma.

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This research paper has been submitted for examination with my approval as the university supervisor.

Approval

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DEDICATION

I wish to dedicate this M.A research project to my family, especially my husband Charles.

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ABSTRACT

The objective of this study sought to investigate the impact of ICT (with specific focus on broadband services) on Kenya's economic growth. Due to the nature of the variables that have been selected, this study employed reduced Vector Autoregressive (VAR) model informed by the identification challenges that exists when Ordinary Least Squares (OLS) estimates of a structural VAR result to inconsistent results. Additionally, autoregressive model, AR (2) was estimated for robust check. The study used annual time series data for the period 1992-2019 obtained from World Banks database and the Kenya National Bureau of Statistics (KNBS) publications. The findings showed that in the second lag growth in the broadband services was found to have a positive and significant effect on the economic growth in the current year. Other factors that were associated that caused significant growth in economy included the trade openness, inflation rate both at first and second lags and trade openness in the second lag. Apart from economic growth, increased performance in the broadband services was attributed to capital growth at first lag, trade openness at first lag as well as the flow of FDI stock in the country. On this basis, the study therefore proposes that the government should increase investments in the ICT sector and put measures in place to encourage the access to and use of broadband services and additionally ensuring policies towards ensuring macroeconomic stability are enforced in order to woo investors to invest in ICT sectors in Kenya.

CHAPTER ONE

INTRODUCTION

1. Background of the study

Over the past two decades, Information Communication and Technologies (ICT's) have become an integral part of societies. They have permeated all aspects of the global economy and society, and transformed the way in which people produce, consume, communicate, transact and interact. Indeed, access to and use of ICT's continues to be appreciated as a driving force for economic growth and development across the globe.

For developing economies, investments to enhance ICT usage provides: unique opportunities for innovative business solutions, enhanced service delivery both publicly and privately, access to a wealth of information and knowledge, and a general ease of doing things by society which has been buttressed by the proliferation of the "Internet of Things".

Digital technologies have the potential to transform traditional economies to digital economies, by among others, driving productivity gains through value addition. In the year 2019, Kenya launched the Digital Economy Blueprint. A digital economy affords Kenya the opportunity to leapfrog on economic development. The availability of accessible, reliable, affordable and resilient ICT broadband infrastructure is among the cross-cutting themes identified in Kenya realizing its digital economy aspirations. Furthermore, in 2019, Kenya launched the second National Broadband Strategy (NBS) 2018-2023, which spells out how the Government intends to ensure increased access to and use of broadband. The national broadband strategy describes broadband as connection that provides interactive, safe, quality and inexpensive services at a minimum speed of 2Mega bytes per second to every consumer in Kenya.

In the past decade, there has been a lot of interest in this study area the world over. However, in spite of this, there exists little empirical literature on the impact of use of broadband, on Kenya's GDP. Subsequently, this paper adds to the body of literature as well as assess whether the efforts to increase broadband coverage and use in the country by both the public and private sector are indeed key to ensure Kenya attains and maintains middle-income economy status.

There is no doubt that the rapid diffusion of ICT across most economies of the world (developing and developed in almost similar capacity) is as a result of increased infrastructure roll-out, availability of low-cost devices such as computers, cell phones and tablets. This has led to a fast and continuous substitution of information technology to other factor inputs including capital and labor in the production process of developing countries such as Kenya.

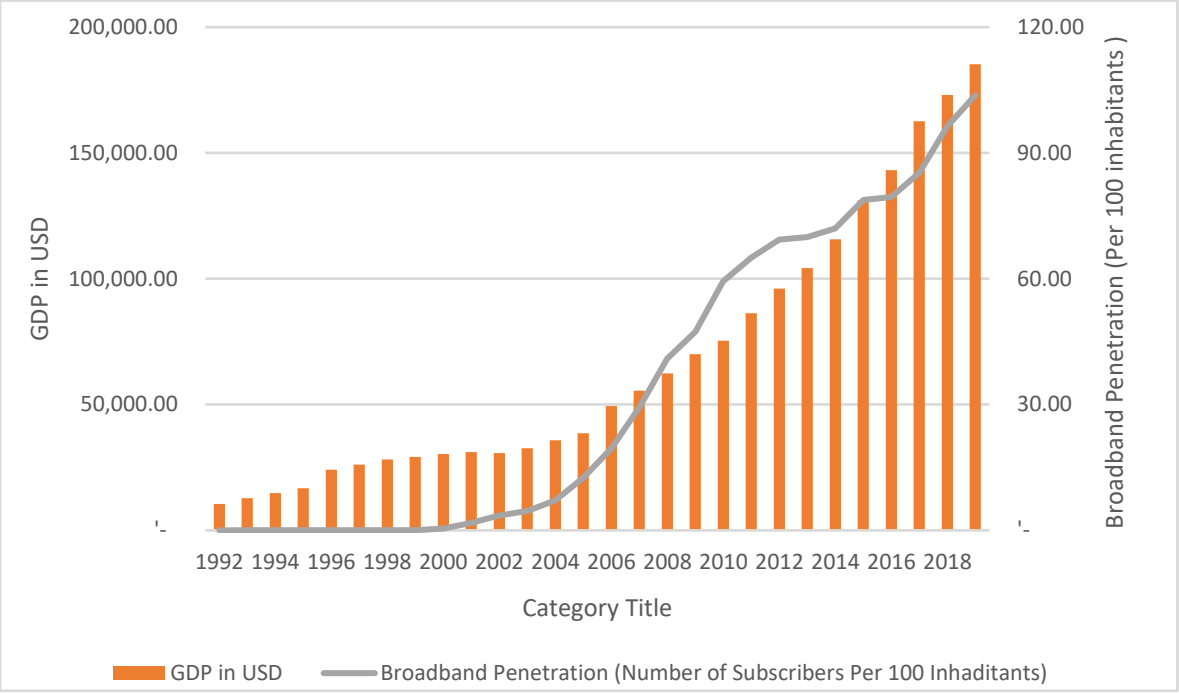
ICT has also been linked to firm's innovate capability. That is, it has assisted firms to respond better to both internal market and external market demand, to diversify their product range, to customize the services they offer to clients, and to provide different channels through which they can interact with their clients. Lastly, ICT has, in many occasions, reduced inefficiency in the firm's utilization of both capital and labour (Wang, Chen and Chen, 2012).

In the more recent time, ICT's role in promoting international trade, exports included cannot be underestimated. For instance, from the World Trade Organizations' trade facilitation agreement concluded in 2014, it was noted that there was dire need to bring clarity and improvement of relevant aspects of GATT Article V, VII and X. These articles emphasize the need for speeding up: good's movement, good's release and good's clearance including goods in transit. In response, most countries involved in international trade have established an electronic single window that uses ICT, resulting in high level of harmonization as well as sharing of relevant information across

systems of government, which results in beneficial gains to the involved parties in cross-border trade.

In Kenya, mobile broadband has continued to experience an upward trend. According to figure 1, there has been an upward trend in growth of both GDP and broadband penetration (per 100 inhabitants) in Kenya, from the year 1992 to 2019, although broadband penetration started experiencing higher growth rates from the year 2001. Proceeding to the year 2009, broadband penetration growth exceeded GDP growth and continued to be above until the year 2015 when GDP growth exceeded broadband penetration growth.

Figure 1: GDP and Broadband Penetration Growth in Kenya (1992-2019)



For a long period, the Internet has remained one of the telecommunication technologies responsible for the convergence, while devices such as desktops, laptops and mobile phones have assumed

a strategic role in connecting end-users. Subsequently, global uptake of telecommunications services is on an upward trajectory. In comparison between Internet and mobile phone connectivity, mobile phone subscription has surpassed Internet subscriptions according to statistics by the International Telecommunications Union [1]showing that as at the end of 2019, there were approximately 8.3 billion active mobile cellular subscriptions, representing a penetration rate of 108 percent. On the other hand, as at 2019, there approximately 4.1 billion Internet users representing a penetration rate of 53.6 per cent.

Despite all these understandings that ICT can enhance economic performance and its increased uptake and usage, there is inadequate empirical proof on the effect advanced ICT technologies, such and broadband usage on Kenya's economy. Thus, the study seeks to probe the effect of ICT with specific focus on broadband services on Kenya's economic growth.

2. Statement of the Problem

The Sustainable Development Goals 2017 recognized that ICT is helpful in the realization of the aspirations of the SDG's for the collective benefit of all. In addition, Kenya's Vision 2030 identified ICT's as a key component of all its pillars and anchored its aspirations on the availability and adoption of broadband technologies, in order to foster development across various sectors of the economy. Consequently, Government has promoted various initiatives, which have also complimented private sector investments, to ensure increased uptake and use of ICT's in the country. This includes massive investment in ICT aimed at improving connectivity by investing in underwater fiber optic cables, broadband infrastructure, and reforming the telecommunication sector's

[1] https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2019.pdf

legal and regulatory framework, allowing greater competition to improve services and reduce costs.

Increasing literature shows that mobile broadband, and ICT in general, stimulate economic development mostly in developed countries, especially in sectors of the economy such as increased investments, and job creation (Aghaei and Nasab, 2007; Zohra, 2012; Bahrini & Qaffas, 2019). These studies analyzed the impact of ICT on specific sectors (export, financial sector) and furthermore, many of the studies focused on developed countries, with limited studies on developing nations, yet broadband technology has the potential for improvement in their economic development. Additionally, there rigorous confirmation of the impact of broadband service on economic growth especially for developing nations is still somewhat limited, which forms the gap for this study.

3. Research question

I. What is the impact of broadband services on economic growth in Kenya?

4. Objectives of the Study

Generally, the study sought to establish the impact of broadband services on the economic growth in Kenya.

4.1. Specific Objectives

More specifically, the researcher aimed:

I. At establishing the effect of broadband services on economic growth in Kenya.

II. To recommend policies based on the findings of the study.

5. Significance of the Study

Kenya's big four agenda and digital economy blueprint are reliant on broadband services and infrastructure as a cross-cutting theme for achieving the aspirations of becoming more competitive at the global stage. Thus, the study is useful in informing policy makers on the role of broadband services on growth of the economy in Kenya. The results of this study will inform policy makers on where to focus on when making policies based on realistic assessments of what is possible with available finances and other resources.

To academic literature, the results of this study adds to existing body of literature, in addition to bring more rigorous evidence on the impact of broadband services on economic growth, especially for a developing nation.

Further, the results of this study provide a roadmap on economic analysis of impact of broadband services on economic growth, which will further inform investors on which sectors to invest on to enhance productivity.

6. Organization of the Study

Following the first chapter, is the second chapter which outlines the foundation theories of this study and reviewed literature in this area of study. Succeeding chapter's incudes chapter three which describes the methodology used to address the objectives of this study; fourth chapter which shows the results of the estimations methods and discussions. The study concludes by outlining the conclusions of the study, in addition to recommending policies in the fifth chapter.

CHAPTER TWO

LITERATURE REVIEW

1. Introduction

This section outlines the theoretical and empirical literature review as well as an overview of the two on the topic.

2. Theoretical Literature Review

2.1. Neoclassical models

Various theories have been put across to explain economic growth of various countries at different durations and they have found general acceptance in the economic world. The Solow (1956) is based on the assumption that various states of the economic growth do not depend on the savings and therefore its effect is exogenous in affecting economic growth. According to him economic growth depends on technology and capital accumulation which are exogenously determined. Improvement in technology leads to increased level of economic growth. The residual factor in the Solow includes factors that affect economic growth other than labour and capital accumulation and thus ICT can fit as one of the technological factors in this model which affect economic growth (Solow, 1956).

The endogenous economic growth model by Bailliu (2000) is an improvement of the Solow model but incorporating labour input and equating to zero. In this model, saving rate is linear in capital and hence there is no diminishing returns in relation to accumulation of capital and thus there is steady state. This implies that capital growth is affected by the investment which leads to increase

in economic growth in the long run. Implying from Solow model increase in capital accumulation implies better technology in the production process.

The Neoclassical model of economic growth is affected by labour endogenously while technology affects growth exogenously. This brings the idea of convergence in income given that each country experiences technological progress. This is however not the case in the endogenous model which explains that technology changes over. It is vital to note that in both cases the role of diminishing marginal returns on investment is appreciated. Ultimately, there is high returns by investing in low capital and labour stocks (Gottfries, 2013). The information Economy Report (2006) by the United Nations noted that investments in information technology play a key role in growth of the developing economies due to increased level of incomes.

2.2. Endogenous models

The endogenous growth theory appeared in trials to explain growth of countries in the long-term. Recently, several growth models have emerged mainly focusing on endogenous growth processes emanating from the usage of ICT (Romer, 1990; and Aghion and Howitt, 1992). According to Venturini (2007) the major determinants are innovation processes facilitated by ICT usage. Vourvachaki (2006) outlines that the main driver of growth is ICT- assisted spillovers through ICT usage.

Generally, endogenous theories commences the challenge to the determination of the deficiencies of the exogenous theories description of long-run growth based on the neoclassic models. Developing from microeconomic grounds, the growth models advanced by Romer (1990) and Aghion & Howitt (1992) defines approaches in which growth is motivated by changes in technology that is bolstered by Research and Development innovation and human capital. Contrary to neo-classist

models, technological changes are modeled exogenously and involves processes that generates growth, hence preventing the diminishing marginal products of physical and human capital.

3. Empirical Literature Review

ICT depicts a vital role in the several sectors of the economy and this in turn contributes to growth of the economy in both short-run and long-run. Using a panel cointegration, the study in the Asian countries by Ahmed and Ridzuan (2017) established that ICT affected economic growth in the long run in the Asian nations. Further, the fixed effect model provided evidence that ICT among other variables included in the study such as labour and capital affects economic growth positively. Time series data for the period 1975 -2006 for Asian countries, from Asian Development Bank, International Labour Organization and World Development Indicator was used in the study.

The study by Utz (2017) on the influence of ICT to economic growth as well as other factors which include the government revenue and employment provides evidence that access to services such as the Internet immensely contributes to economic growth. The Utz's assessments provided evidence that ICTs would cause the potential growth in GDP to USD 1.8 billion in 2040 from USD 700 million in 2014. This emphasizes the potential gains of the adoption of ICTs. Moreover, the study estimated that 17,000 jobs would be created through ICT adoption and revenue generation from the ICT sector would increase from USD 200 million to 500 Million. This emphasizes on the potential benefits associated with the ICT related activities.

The empirical proof on the effect of the ICT on economic performance of the Organization of Petroleum Exporting Countries (OPEC) reveled a significant effect of ICT investments on economic growth (Aghaei and Nasab, 2007). Using the GMM for Panel data (1990-2007), the study findings show that ICT significantly, affect the economic growth of the eleven countries of the

OPEC from the fixed effects model. Thus, ICT leads to increase in the economic activities of the countries. Further, the study finding showed that the Foreign Direct Investment measured as technical and technological effects index also cause growth in the OPEC countries. Therefore, these two variables are key in the economic performance of the OPEC countries.

Zohra (2012) and Samimi and Ledari (2015) share similar sentiments that ICT affects growth in the third world nations positively and significantly. They provided evidence of a affirmative and substantial association between the two in both first world and third world nations. By the application of the Vector Error Correction Model for the period 1975-2011 (Shahbaz et al.,2014) confirmed that ICT and economic growth were related in the long run in United Arabs Emirates. The study findings also revealed that ICT leads to the increase in the level of energy consumption. There was a bi-directional causality between consumption of electricity and economic growth which implies that they both cause each other. Causal relationship between ICT and economic growth implied the importance of the investment in Research and Development to increase economic growth since this leads to improvement in technology.

One of the most recent studies in this area was carried out by Bahrini and Qaffas (2019) sought to investigate the influence of ICT on growth in the developing countries using the General Moments of Methods for the period 2007 to 2016. The study findings from the fixed effects model showed that measures of ICT such as mobile phones, use of the Internet and broadband are key in economic growth for both Sub-Saharan African Nations and Middle East as well as North Africa countries. It was however notable that the impact was high in the Middle East and North Africa where they used Internet and broadband as compared to Sub-Saharan Africa. In all these nations the ICT was measured by four variables; use of fixed telephones, mobile/cell phones, adoption of broadband and Internet use.

The independent study by Japan and in collaboration with the European Union (2015) revealed that based on the research findings by Lenkiewinc, Jora, Croll and Zantyliet (2015), ICT contributes up to a tune of 9 percent of the gross domestic product in Japan and 4 percent to the GDP growth rate in the European Union. In addition, the ICT sectors in the two nations are associated with at least 7% and 3% of the jobs in Japan and the European Union respectively. The assessment of the digital economy revealed that ICT plays a vital role in economic growth in the two nations. In addition, the study established that both Japan and EU have prioritized the ICT sector. Among the recommendation of this study on the ICT use include; the expansion of the Information and Technology Agreement; privatization of the copying levy system changes; ensuring openness and transparency in the Internet; liberalization on the ICT services; enabling environment; personal data protection; and innovation development.

By the application of the Autoregressive Distributive Lag (ARDL) model, the study in Japan by Ishida (2015) established that ICT affected economic growth in the long run. The study showed that in the short run that the ICT coefficient was insignificant and therefore the ICT investments in Japan did not affect economic development significantly. The study was based on the multivariate model for the time period 1980-2010.This study also showed that ICT investments causes a reduction the level of the energy consumption in Japan.

An earlier study by Mukarami (1997) established that the export of ICT related products reduced from the year 1990 due to the hollowing out which took place in Asia. Most of the ICT imports comprised of 4.5 percent of the equipment from Sarthe, balance of payment problem improved as a result of the increase in the total productivity. The reason for the increase in the total productivity due to applicability of ICT in all sector of the economy. This led to the growth experienced in the Asian nations, implying that ICT results in economic growth.

Using data for the time period 1998-2014 in Indonesia, the study by Hariani (2017) established that ICT had an affirmative and substantial effect on economic growth. In this study, ICT was measured by the Klassen typology mapping the inequality of the ICT sector in the country. The study showed that increase in internet use led to increase in economic growth. In addition, the study findings showed that internet use is high in the provinces in Indonesia with productive age as compared to those with high aged people.

4. Overview of the Literature

The review of majority of the studies indicate that Information and Communications Technologies plays an important role on economic growth. ICT use is measured by the following variables; use of fixed telephone; use of mobile phone; internet use; and broadband use (Ridzuan, 2017; Utz, 2017; Aghaei and Nasab, 2007). The general implication is that ICT plays a vital role in economic growth and development. The studies reviewed used various methods such as panel cointegration, Granger causality, OLS, ARDL and GMM due to their suitability for the analysis to achieve the study objective. Some studies showed that ICT significantly affected growth in the long run while other showed no significant relationship in the short-run. Further, we find limited studies carried on the impact of broadband services on economic growth for developing countries. Consequently, the existing literature has not given rigorous evidence of the impact of broadband services on economic growth, which forms the basis of this study.

CHAPTER THREE

METHODOLOGY

1. Introduction

This Chapter examines theoretical as well as empirical models. Following the introduction is the theoretical framework, empirical framework, model of estimation, variable definition table, pre-estimation tests, post-estimation tests and data types and sources.

2. Theoretical framework

Previous theories have recognized labor, technological development and capital, to be the core drivers of long run state of economic growth. According to Solow (1957); Romer (1990) and Gottfries (2013), technology has been considered to be a compliment to capital and labor since it brings about productivity gains in production process and also through new knowledge and innovations.

Neoclassical economists have considered technology to be exogenously determined which implied that income appear to converge between countries as time goes by due to different levels of accessibility to technological progress in different economies. Conversely, endogenous growth models fail to assume the convergence since it explains how technology adjusts between countries. Despite this, ICT investments have not been evident to affect economic growth as compared to investments in non - ICT sectors. This effect could not be realized until the 1990's upon massive increase in productivity in the United States as depicted in the model by Venturini, (2007). Despite this, Venturini (2007) has shortcomings since it is mainly based on capturing development in high-income countries which might to be the same case for low-income states. As noted by Avgerou (2003), development in ICT is effective in countries that place focus on implementing strategies

that aim at efficient use of assets, and that ICT affects different economies differently in terms of growth.

Solow (1957) growth theory has been a commonly used model by previous studies in explaining the impact of ICT on output growth. According to this model technological factor, or commonly referred to as Solow residual, is a very important parameter since it considers all other components of production which are not described by capital and labor alone.

The choice of the Solow residual model in this study is informed by the fact that economic growth can be affected by technological innovations through such factors as investment decisions and human capital improvements. Due to this, there is a likelihood of positive association between technology and economic growth, which justifies the use of neoclassical model in this study.

The production function by Solow is stated as follows:

$$Y = AK^{\alpha}L^{1-\alpha} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where Y represents the output stock (GDP), K represents capital stock while L is labor stock. A represents the technological component which influences productivity of capital and labor. The function assumes constant returns to scale, which implies that a unit rise in both K and L leads to a unit growth in output level. The sum of the values α and $(1 - \alpha)$ equals to one. The variable technological growth in the production function is incorporated as exogenous as per the Solow model hence written as follows:

$$Y = K^{\alpha}(AL)^{1-\alpha} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Considering that the above functions are not linear, and this study linearizes the relationship, we transform the equation by taking natural logarithm, and hence represented as follows:

$$ln\,Y = \alpha\,ln\,K + (1-\alpha)(ln\,A + ln\,L) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

3. Empirical framework

The analytical approach for this study is solely built on the Solow residual model as shown in the above section. Analytically, the study adopts the approaches by Niebel (2014), and Yousefi (2011). According to the studies, GDP is the dependent variable while the predictor variables are capital, labor and technology. Technology variable was measured using mobile broadband subscriptions (per 100 inhabitants) in this study. Additionally, the study is augmented by including other control variables which according to literature are considered to affect output growth. The resulting production function is represented as follows:

$$ln\,Y_t = \beta_0 + \beta_1 lnK_t + \beta_2 lnL_t + \beta_3 lnA_t + \beta_i X_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where t is the time subscript, X represents the control variables such as real effective exchange rate, trade openness, inflation rate and foreign direct investments stocks, which all affect GDP growth. The study uses fixed and mobile broadband subscription per 100 people as the ICT (technology variables). The following equation was estimated:

$$ln\,Y_t = \beta_0 + \beta_1 lnK_t + \beta_2 lnL_t + \beta_3 lnM_t + \beta_4 lnREER_t + \beta_5 lnIR_t + \beta_6 lnTO_t + \beta_7 lnFDI_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5$$

Where, M represents the number of broadband subscriptions (per 100 people) that includes both fixed and mobile broadband. Y, K and L is defined as above. REER is exchange rate, IR is inflation rate, TO is trade openness, and FDI is foreign direct investments stocks in Kenya.

4. Model of estimation

Asteriou & Hall (2007), claims that it is a common problem when modelling economic problems especially when we encounter the explanatory and independent variables explaining one another, which the variables in this study seem to depict. Such relationship cannot be modeled in simple regressions as the results may be biased.

To solve these problems of simultaneity among the variables, Sims (1980) stipulated that the variables should be modeled in such a way that all of them are treated as endogenous variables. these suggestions led to development of vector autoregressive models (VAR).

The variables in this study appears to have a similar relationship (simultaneity). Hence, we adopt the VAR model in our analysis. This model is appropriate because it is superior to OLS estimations which may lead to unreliable estimates. The general VAR model is shown in the equation below:

$$X_t = A_0 + \sum_{i=1}^{d} A_i X_{t-i} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .6$$

Where;

X_t = represents the variables under study.

A_0= is a column vector of constant terms.

A_i = is an $m \times m$ matrix of coefficients.

u_t = is the error term.

In the VAR equation shown above, respective variable is linearized in terms of its preceding values as well as a past values of all the other variables.

5. Variable definition table

Table 1: Description and Measurement of Variables

Variable Name	Notation	Measurement	Expected Sign	Source
Dependent Variable				
GDP growth per capita	Y	Kenya's Real GDP per Capita, measured in US dollars	+Ve	World Bank data
Independent Variables				
Gross Domestic Fixed Capital Formation	K	This is represented as the total value of the gross fixed capital formation. Measured in US dollars.	±Ve	World Bank
Labor	L	The total number of the population that is actively engaged in production, measured as a percentage of people aged 15+, of the total population	±Ve	World Bank

Variable Name	Notation	Measurement	Expected Sign	Source
Broadband Services penetration	M	The variable is measured as the number of total broadband subscriptions that includes both fixed and mobile broadband (per 100 inhabitants in Kenya)	±Ve	World Bank
Real Effective Exchange Rate	REER	This is a measure of the trade-weighted average of a respective country currency against a basket of other currencies after adjusting for inflation. It is expressed in terms of an index relatively to a base year. It is used to measure the strength of currency	±Ve	Kenya National Bureau of Statistics (KNBS)
Inflation Rate	IR	This is the annual consumer price index	±Ve	World Bank
Trade Openness	TO	It is represented as the ratio of the sum of trade imports and exports to Gross Domestic Product.	+Ve	World Bank

Variable Name	Notation	Measurement	Expected Sign	Source
Foreign Direct Investments	FDI	FDI stocks is measured as the total level of direct foreign investment in Kenya at a specified time, basically annually.	±Ve	World Bank

6. Pre- Estimation tests

6.1. Stationarity test

It is important to know the statistical properties of data, especially when dealing with time series data sets. Stationarity implies that the joint statistical distribution of any collection of the time series varieties does not depend on time. Estimations done while the data is non-stationary may lead to biased estimations. Due to this, the study carried out an Augmented Dickey Fuller (ADF) defining the null hypothesis as the data having a unit root. If the ADF test statistic is found to be higher than the critical value, then we fail to reject the null hypothesis. Stationarity for all the variables was achieved through differencing.

6.2. Cointegration test

Before determining on the type of model to estimate, it is important to ascertain the order of cointegration or sometimes referred to as long run relationships. Cointegrated variables are usually

considered as having relationship that yield equilibrium interactions. Cointegration among the variables was determined using the Johansen test, defining a null hypothesis of no cointegration. Prior to this test, optimal lag length for the variables was established using the Bayesian Information Criterion/ Schwarz Information Criterion (SBIC) and Akaike Information Criterion (AIC) lag selection criteria. This test guides on the kind of VAR model to estimate.

7. Post estimation tests

Multicollinearity test

Multicollinearity occurs certain predictor variables in a regression model are correlated. Presence of multicollinearity leads to problems in analysis and thereby limiting the conclusions drawn from the research. In testing for multicollinearity, the study used the Variance Inflation Factor (VIF) test. If any of the predictor variable has a VIF exceeding value of 20, then it may be collinear with another variable in the model. Furthermore, if the mean VIF across all predictors exceeds value of 10, then multicollinearity is present across all the predictors.

8. Data types and sources

The study used secondary time series data from the World Bank data bank and Kenya National Bureau of Statistics. The data is based on annual observations for the period 1992 to 2019.

CHAPTER FOUR

EMPIRICAL FINDINGS AND DISCUSSION

1. Introduction

This chapter presents the estimation results and discussion. Following the introduction is the descriptive statistics, estimation tests and finally the model results.

2. Descriptive statistics

Table 2 shows various statistical properties of the variables included in this study such as mean, standard deviation, minima and maxima. The mean is a measure of central tendency that shows the average value for the variables. Standard deviation indicates how the variable observations vary from the mean of the study variables. The minima show the lowest achievable value of the observations while the maxima indicate the highest attainable values.

Table 2: Description Statistics

Variable	Mean	Std. Dev.	Min	Max
Y	48505.9	52141.31	3283.752	185269.6
M	33.80887	36.451	.0043433	103.769
K	4.725552	9.685166	-20.1736	31.74717
L	71.40533	2.757181	65.12	75.03
REER	60.87554	36.42496	7.420187	139.3288

IR	10.17207	7.396963	.9332055	41.98877
TO	3.322219	1.222206	1.523994	5.244755
FDI	3.15e+08	4.94e+08	394430.6	1.63e+09

FDI stocks is measured as the total level of direct foreign investment in Kenya at a specified time, basically annually was found to have the highest mean value of 3.15e+08 followed by GDP Growth per capita which had a mean value of 48505.9. Other variables that had high values included L having a mean value of 71.40533 and REER with 60. 87554.Trade openness which was the ratio of the sum of trade imports and exports to Gross Domestic Product recorded the least mean value of 3.322219.

The variable with the highest standard variation was the FDI of 4.94e+08 a showing the variable observations varied greatly from the mean values from one year to another. It is notable that the standard deviation of the FDI and the Y (which had the second largest standard deviation value) are greater than their mean values. Other variables that reported a higher standard deviation values than their mean were capital and broadband services of with values of 9.685166 and 36.451 respectively compared to their means of 4.725552 and 33.80887 respectively. Trade openness had the least standard deviation of 1.222206.

This study also presented the minimum and maximum values attainable by the variable observations. Capital stock had the least value of -20.1736 closely followed by the mobile broadband services and inflation rate with 0.0043433 and 0.9332055 respectively.

3. Pre- Estimation Tests

One of the pretests carried out in this study was the correlation matrix to show how the variables were related to one another. Table 3 below shows the tabulated correlation matrix

3.1. Correlation matrix

Table 3: Correlation Matrix

	Y	M	K	L	REER	IR	TO	FDI
Y	1.0000							
M	0.9685	1.0000						
K	-0.0857	-0.0356	1.0000					
L	0.4972	0.4671	-0.4013	1.0000				
REER	0.9259	0.8406	-0.0964	0.3546	1.0000			
IR	-0.3273	-0.3003	0.1845	0.0562	-0.4411	1.0000		
TO	-0.7462	-0.8230	-0.2499	-0.0193	-0.6247	0.2927	1.0000	
FDI	0.8414	0.8585	-0.1385	0.4879	0.7415	-0.2365	-0.6610	1.0000

The rule of interpreting the coefficients is that -1 shows a perfectly negative linear correlation between two variables, 0 indicates no linear correlation between two variables while 1 shows the existence of perfect positive linear correlation between two variables. In this case large positive values shows a higher positive relationship between variables and thus they are correlated in the positive direction. The negatives signs show a that changes in one variable cause a negative change in other variables and thus they are moving in different directions. Very small values in magnitude whether positive or negative values shows a weak relationship.

3.2. Stationarity test

As noted earlier, estimations done while the data is non-stationary may lead to biased estimations. To avoid this, the study carried out an Augmented Dickey Fuller (ADF) test, and the results presented in table 4.

Table 4: Unit Root Test for Stationarity

Variable	Levels		Differencing Order	Difference	
	Statistic	Comment		Statistic	Comment
Y	-0.366	Non-stationary	1	-4.719 ***	Stationary
M	-0.577	Non-stationary	1	-5.068 ***	Stationary
K	-4.554***	Stationary	0	-4.554***	Stationary
L	-0.591	Non-stationary	1	-6.164***	Stationary
REER	0.662	Non-stationary	1	-5.125***	Stationary
IR	-3.913***	Stationary	0	-3.913***	Stationary
TO	-0.635	Non-stationary	1	-5.419***	Stationary
FDI	-2.864	Non-stationary	1	-9.955***	Stationary

The study first carried out the unit root test when all the variables were at level, and most of them were found to be non-stationary at level including the growth per capita, broadband services, labour, real effective exchange rate, trade openness and foreign direct investments. Only capital and inflation rate were found to be stationary at level, which is indicated as zero differencing in table 4. The rest of the variables that were non-stationary at level became stationary after the first difference.

3.3. Lag selection

Before proceeding to carry out the Johansen cointegration test, this study determined the optimal lag selection using FPE, AIC, HQIC and SBIC. The selection of the optimal is by the rule of the thumb. The study determined the optimal lag length to be 4.

Table 5: Lag Selection Criterion

Selection-order criteria
Sample: 1994 - 2019 Number of obs = 26

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-350.329				129.164	27.5638	27.6753	27.9509
1	-119.496	461.67	64	0.000	.000438	14.7305	15.7337	18.2144
2	71.5655	382.12	64	0.000	1.5e-07	4.9565	6.85153	11.5373
3	3583.51	7023.9	64	0.000	1.e-116*	-260.27	-257.483	-250.592
4	5979.16	4791.3*	64	0.000	.	-443.935*	-441.037*	-433.871*

Selection of the optimal lag informed testing for cointegration using the Johansen cointegration test and the results are presented in section 4.3.4 table 6.

3.4. Cointegration test

In the interpretation of the Johansen cointegration test, the rule is that trace statistics are compared with the critical values. If the trace statistic is greater than critical value, it indicates the existence of cointegration.

Table 6: Johansen Test for Cointegration

Trend: Constant	Johansen Test for Cointegration.				No of Observations =26
Sample 1994-2019					Lags=4
Maximum Rank	Parms	LL	Eigen Value	Trace Statistic.	5% Critical Value.
0	8	-550.15162		215.8474	156.00
1	47	-471.99401	0.63534	59.5322*	68.52
2	56	-459.95668	0.46060	35.4575	47.21
3	63	-450.9985	0.36833	17.5411	29.68
4	68	-445.98459	0.22673	7.5133	15.41
5	71	-442.70057	0.15499	0.9453	3.76
6	72	-442.22793	0.02395		

The findings show that the trace statistic is 215.8474 which is greater than the critical value 156.00 and this is an indication that there is cointegration between dependent and independent variables.

4. VAR Model Results

Table 7: VAR Model Results

	VAR Results		AR (2) Regression Results	
	Model One	**Model Two**	**Model One**	**Model Two**
	Y	M	Y	M
Lag 1 (Y)	0.763**	-2.915	0.527***	4.641*
	(0.262)	(3.449)	(0.0563)	(0.422)
Lag 2 (Y)	0.172	3.955	0.311*	1.701*
	(0.255)	(3.348)	(0.0451)	(0.339)
Lag 1 (M)	-0.0268*	0.428**	-0.0272**	0.272**
	(0.0110)	(0.145)	(0.00263)	(0.0198)
Lag 2 (M)	0.0293***	-0.00964	0.0347***	0.0627***
	(0.00871)	(0.114)	(0.00184)	(0.0138)
Lag 1 (K)	0.000932	0.0120	0.00186	0.00835*
	(0.00105)	(0.0138)	(0.000226)	(0.00170)
Lag 2 (K)	0.000653	-0.000703	0.00122*	-0.00115
	(0.00106)	(0.0139)	(0.000229)	(0.00172)
Lag 1 (L)	0.000176	-0.00195	-0.0264***	-0.325***
	(0.000719)	(0.00945)	(0.00432)	(0.0324)
Lag 2 (L)	0.000726	-0.0516***	0.0445***	-0.0979**
	(0.000850)	(0.0112)	(0.00458)	(0.0344)
Lag 1 (REER)	0.00168	0.0294	0.00435*	-0.0127

	(0.00173)	(0.0228)	(0.000414)	(0.00311)
Lag 2 (REER)	-0.00114	-0.00812	-0.00392*	-0.0511
	(0.00167)	(0.0220)	(0.000333)	(0.00250)
Lag 1 (IR)	0.00840	0.0170	0.0141***	-0.312***
	(0.0231)	(0.304)	(0.00389)	(0.0292)
Lag 2 (IR)	0.0170	-0.367*	0.0174***	-0.240***
	(0.0136)	(0.178)	(0.00248)	(0.0186)
Lag 1 (TO)	-0.0951*	-0.840	-0.228	0.123*
	(0.0324)	(0.426)	(0.00785)	(0.0589)
Lag 2 (TO)	0.0603*	-0.164	0.0990*	1.475*
	(0.0283)	(0.373)	(0.0106)	(0.0793)
Lag 1 (FDI)	0.00527	-0.126	0.00305	0.0619*
	(0.00760)	(0.0999)	(0.00189)	(0.0142)
Lag 2 (FDI)	-0.0152*	-0.198*	-0.0311*	0.0261
	(0.00713)	(0.0937)	(0.00223)	(0.0167)
Constant	0.928*	1.791	1.334***	-37.47***
	(0.438)	(5.753)	(0.241)	(1.808)
Observations	26	26	26	26
AIC	23.95189	23.95189	--	--
HQIC	25.56182	25.56182	--	--
SBIC	28.4768	28.4768	--	--
Adjusted R^2	--	--	0.898	0.794

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.1. VAR model results

This study carried out VAR model when variables are in the first lag. The results are presented in Table 7. The constant shows the values of the dependent variables when model is empty without inclusion of the independent variables for both models.

Economic growth at first lag positively and significantly leads to an increase in economic growth by 0.763 while it has a negative and significant effect on the broadband service by 2.915. The implication is that the performance of the economic growth plays an important role in the growth of the economic performance on the following year. The effect of the economic growth at the second lag was found to have a positive and insignificant effect on economic growth and broadband services by 0.172 and 3.955 respectively. This implies that the performance of the economy two years in the past does not affect economic growth and broadband services in the current year.

The findings showed that broadband services at first lag in the economy led to a negative and a significant decrease in economic growth in the country by 0.0268 while the effect of the broadband at first lag positively and significantly affected broadband service and led to its growth by 0.428. At second lag, the effect of the broadband services on broadband services is negative and insignificant by 0.00964 and thus it does play a significant role.

Capital in this case was found to have an insignificant effect on both economic growth and broadband services. A unit change in capital at first lag and second was found to increase economic growth by 0.000932 and 0.000653 respectively. Similarly, the effect on broadband services by a

change in capital was found to be positive at first lag and negative in the second lag. Particularly, a unit change in capital leads to an increase in broadband services by 0.0120 at first lag and reduction of the same by 0. 00070. Thus, capital stock does not play any significant role on economic growth and broadband services in Kenya.

Labour as a factor of production was found to have a positive and insignificant effect on economic growth and broadband services in Kenya. A unit change in labour at first and second lag leads to growth in economic growth by 0.000176 and 0.000726 respectively. At first lag, change in labour negatively and insignificantly reduces broadband services by 0. 00195. Interestingly, unit changes in the labour at the second lag significantly reduces broadband services by 0. 0516. Thus, the current performance of the broadband services in the country are negatively affected by the performance of labour two years ago.

A unit change in the real effective exchange rate insignificantly increases economic growth by 0.00168 at first lag and insignificantly reduces economic growth by 0.00114 in the second lag. Similarly, an increase in the real effective exchange rate positively and insignificantly increases performance of the broadband services by 0.0294 at first lag and causes insignificant reduction by 0.00812. Subsequently, we can conclude that real effective rate does not have any significant effect on economic growth and broadband services.

Inflation rate as one of the macroeconomic factors was found to play an insignificant role on economic growth both at first and second lag. A unit change in the first and second lags insignificantly increase economic growth by 0.00840 and 0.0170 respectively. A unit change in the rate of inflation in Kenya insignificantly increases performance in the broadband services by 0.0170 and thus minimal role while in the second, inflation rate significantly reduces the performance of broadband services by 0.367. Therefore, inflation has a negative effect on broadband services.

Trade openness leads to the reduction of not only economic growth but also the performance of broad services in Kenya at the first lag. Improvement in trade openness significantly reduced the rate of economic growth and growth in broadband services by 0.0951 and 0.840 respectively. This is possibly due to exposure of the local firms to the internationally competitive firms. However, trade openness significantly leads to growth in the economy by 0.0603 when it is lagged twice. The effect of trade openness is negative and insignificant on the broadband services by 0.164 on the second lag.

Foreign direct investment does not have any significant effect on both economic growth and broadband as it insignificantly increases economic performance by 0.00527 while causing a reduction in broadband services in the economy by 0. 126. When lagged twice, the effect was negative and significant on both the economic growth and broadband services. It causes a reduction in economic growth and broadband performance by 0.0152 and 0.198 respectively.

4.2. AR (2) regression results

To confirm the findings of this study and also be able to carry out the post-estimation tests, the study carried out the AR (2). This helps in affirming the results of the VAR model. Economic growth at the first lag is found to have a positively and significantly increase the in economic growth in the current year and broadband services. A unit change in the economic growth in both first and second lags caused the economy and broadband services to significantly grow by 0.527 and 0.311 for economic growth and broadband services to grow by 4.641 and 1.701 both at first lag and second lag respectively.

Broadband services significantly reduced the rate of economic growth by 0.0272 due to a unit change in the performance at first lag. On the contrary, broadband services in the second lag significantly increase the current broadband services by 0. 272. At second lag, a unit change in the broadband services positively increases economic growth and broadband services by 0.0347 and 0.0627 respectively. This emphasizes on the role of broadband services on economic growth in Kenya. Similarly, using data for the time period 1998-2014 in Indonesia, Hariani (2017) established that ICT had a positive and statistically significant effect on economic growth. Further, the study in Japan by Ishida (2015) established that ICT affected economic growth in the long run.

Capital was found to positively and significantly affect economic growth and broadband services in Kenya. A unit change in capital significantly increase growth by 0.00186 and broadband services by 0. 00835. At the second lag, a unit change in capital significantly increases economic growth by 0.00122 while the effect on broadband is negative and insignificant by 0.00115. A unit change in labour at the first lag significantly reduces the economic growth by 0.0264 but at the second lag, the effect is positive and significant with a coefficient of 0.0445. Labour increase reduces the economic performance at first lag and second lag by 0.0264 and 0.0445 respectively. Ahmed and Ridzuan (2017) provided evidence that ICT among other variables included in the study such as labour and capital affects economic growth positively.

Real effective exchange rate at first lag significantly increases economic growth by 0.00435 while it reduces broadband services significantly by 0.00392 at the second lag. The effect of the real effective exchange rate is negative and significant on broadband services by 0.00435 at first lag and 0.00392 in the second lag. Contrary to the priori expectations, changes in the inflation rate on economic growth at first and second lags leads to the significant growth of the economy by 0.0141 and broad band services by 0.0174. On the other hand, a unit change in inflation rate significantly

reduces the performance of the broadband services at first lag and second lag by 0.312 and 0.240 respectively.

Trade openness which measures the ability of the country to do business with other nations in the world causes a significant reduction in the economic growth by 0.228 at first lag and a significant increase in economic growth by 0.0990 at the second lag. At the first and second lag, trade openness significantly increases the performance of the broadband services in Kenya by 0.123 and 1.475 respectively. The flow of foreign direct investments positively and insignificantly increases economic growth in Kenya by 0.00305 at first lag while the effect on economic growth is negative and significant by 0.0311 at the second lag.

Foreign direct investments significantly and positively affect economic growth in the first lag by 0.0619 due to a unit change in the FDI stocks. The effect of FDI in the second lag and first lag is positive and insignificant at the second lag by 0.0261. Aghaei and Nasab(2007) using the General Methods of Moments (GMM) for Panel data (1990-2007) showed that the Foreign Direct Investment measured as technical and technological effects index also cause growth in the OPEC countries.

5. Post Estimation Tests

5.1. VAR Stability Test

In testing for the stability of a VAR model, the decision rule is that the modulus of each Eigen value of the matrix of variables under study should be strictly less than one for the model to be stable. The results (**See Appendix II**) indicate that VAR stability condition is satisfied since all the Eigen values lie inside the unit circle. The modulus of each eigenvalue is less than one.

5.2. Multicollinearity Test

The Variance Inflation Factor (VIF) (**See Appendix III**) results shows there is no multicollinearity problem in both the models, since we have the mean VIF of 6.07 and 9.00 respectively, which is less than 10.

CHAPTER FIVE

CONCLUSION AND POLICY RECOMMENDATION

1. Introduction

This section consists of the summary of the study findings, policy recommendations, and proposes further areas of research based on the findings of the study.

2. Summary and Conclusion

The first objective of this study was to find out the effect of broadband services on economic growth in Kenya. To achieve this, this study used secondary annual time series data from the World Bank data bank and Kenya National Bureau of Statistics over the period 1992 to 2019. Using VAR model, the study provides significant results showing that at first lag broadband services significantly led to reduction in economic growth. This implied that the economic performance was affected negatively by the performance of the previous year. This negative effect was confirmed by the AR (2) regression results as the second model which was carried out as the confirmation for the VAR results.

However, in the second lag growth in the broadband services was found to have a positive and significant effect on the economic growth in the current year. The effect of the broadband services two years back was found to significantly affect the economic performance in the current year. The AR (2) confirmed the VAR results were actually factual by providing evidence that the indeed that broadband services in the second lag plays a significant important role on the economic performance in the current year.

Other factors that were associated that caused significant growth in economy included the trade openness, inflation rate both at first and second lags and trade openness in the second lag. Factors

such as labour at first lag, real effective exchange rate, trade openness and FDI at first lags led to the reduction in the rate of economic growth significantly. Apart from economic growth, increased performance in the broadband services was attributed to capital growth at first lag, trade openness at first lag as well as the flow of FDI stock in the country. Variable such as labour and real effective exchange rate at first lag as well as inflation rate led to the reduction in broadband performance in Kenya.

3. Policy Recommendation

One of the objectives of this study was to propose appropriate policies based on the study findings. First, the growth in the broadband services was found to have a positive and significant effect on the economic growth in the current year. This is an indication of that access to the internet through broadband services plays an important role in the growth of Kenya's economy. This study therefore proposes that the government should increase investments in this sector and put measures in place to enhance access to and use of broadband services.

Secondly, the role the trade openness which is associated with positive changes in economic growth in the country was found to be key and thus this study proposes improvement on the country's level of trade openness. This allows the country to leverage on the benefits of openness in the economy. This is not only beneficial to economic growth but also to the also to significant growth in the broadband services.

Thirdly increased performance in the broadband services was associated with capital growth which is an indication that capital accumulation is an important factor and thus there is need for the country to invest in capital accumulation so as to be able to harness the benefits associated with broadband services. This can be achieved through encouraging/ creating avenues for investments, and savings.

Finally, the study proposes on that the country should put measures in place to ensure that there is macroeconomic stability on inflation and real effective exchange rate so as to ensure that there is conducive environment to woo investors to the ICT sector.

4. Further areas of research

This study sought to find out the effect of broadband services on economic growth on a national level, not considering its accessibility and adoption by different user groups classified by region or other demographics. Therefore, this study proposes further studies that will factor in accessibility and adoption of broadband service by different user groups, using other methods.

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APPENDICES

Appendix 1: VAR Model Results for all the Variables

	Model 1	**Model 2**	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Y	**M**	K	L	REER	IR	TO	FDI
Lag 1 (Y)	**0.763****	**-2.915**	-35.01	-1.104	-11.21	1.335	-1.584	8.934
	(0.262)	**(3.449)**	(46.70)	(48.26)	(23.86)	(3.086)	(1.538)	(5.089)
Lag 2 (Y)	**0.172**	**3.955**	46.41	26.34	23.47	-1.979	1.406	-7.189

	(0.255)	**(3.348)**	(45.34)	(46.85)	(23.16)	(2.995)	(1.493)	(4.940)
Lag 1 (M)	**-0.0268***	**0.428****	-0.622	-0.200	-4.500***	-0.196	-0.147*	-0.626**
	(0.0110)	**(0.145)**	(1.966)	(2.031)	(1.004)	(0.130)	(0.0647)	(0.214)
Lag 2 (M)	**0.0293*****	**-0.00964**	1.001	0.173	3.399***	0.248*	0.0678	0.529**
	(0.00871)	**(0.114)**	(1.550)	(1.602)	(0.792)	(0.102)	(0.0511)	(0.169)
Lag 1 (K)	**0.000932**	**0.0120**	0.126	0.0571	-0.0306	-0.0116	0.00164	-0.0345
	(0.00105)	**(0.0138)**	(0.187)	(0.193)	(0.0956)	(0.0124)	(0.00616)	(0.0204)
Lag 2 (K)	**0.000653**	**-0.000703**	-0.111	-0.210	-0.0899	0.00763	-0.000153	-0.0135
	(0.00106)	**(0.0139)**	(0.188)	(0.195)	(0.0962)	(0.0124)	(0.00620)	(0.0205)
Lag 1 (L)	**0.000176**	**-0.00195**	-0.0502	0.848***	0.0265	0.00551	0.00528	-0.00439
	(0.000719)	**(0.00945)**	(0.128)	(0.132)	(0.0654)	(0.00845)	(0.00421)	(0.0139)
Lag 2 (L)	**0.000726**	**-0.0516*****	0.0144	-0.154	-0.0958	0.0100	-0.00884	-0.0235
	(0.000850)	**(0.0112)**	(0.151)	(0.156)	(0.0773)	(0.00999)	(0.00498)	(0.0165)
Lag 1 (REER)	**0.00168**	**0.0294**	0.0695	-0.330	0.812***	0.00794	0.000358	0.00608
	(0.00173)	**(0.0228)**	(0.309)	(0.319)	(0.158)	(0.0204)	(0.0102)	(0.0336)
Lag 2 (REER)	**-0.00114**	**-0.00812**	-0.218	-0.0331	-0.0406	-0.0184	-0.00345	-0.00754
	(0.00167)	**(0.0220)**	(0.298)	(0.308)	(0.152)	(0.0197)	(0.00981)	(0.0325)
Lag 1 (IR)	**0.00840**	**0.0170**	3.433	2.324	-0.0820	-0.0880	-0.0243	-0.440

	(0.0231)	**(0.304)**	(4.115)	(4.252)	(2.103)	(0.272)	(0.136)	(0.448)
Lag 2 (IR)	**0.0170**	**-0.367***	2.162	2.186	-0.0523	0.138	-0.0955	0.0857
	(0.0136)	**(0.178)**	(2.413)	(2.494)	(1.233)	(0.159)	(0.0795)	(0.263)
Lag 1 (TO)	**-0.0951****	**-0.840***	-8.900	0.625	3.835	-0.897*	0.758***	-1.448*
	(0.0324)	**(0.426)**	(5.763)	(5.955)	(2.945)	(0.381)	(0.190)	(0.628)
Lag 2 (TO)	**0.0603***	**-0.164**	11.87*	4.236	-3.448	0.540	-0.139	0.521
	(0.0283)	**(0.373)**	(5.045)	(5.213)	(2.578)	(0.333)	(0.166)	(0.550)
Lag 1 (FDI)	**0.00527**	**-0.126**	-0.204	0.750	-0.691	0.0966	-0.0180	-0.206
	(0.00760)	**(0.0999)**	(1.353)	(1.398)	(0.691)	(0.0894)	(0.0446)	(0.147)
Lag 2 (FDI)	**-0.0152***	**-0.198***	-1.804	-5.853***	0.484	-0.110	0.0994*	-0.207
	(0.00713)	**(0.0937)**	(1.269)	(1.311)	(0.648)	(0.0838)	(0.0418)	(0.138)
Constant	**0.928***	**1.791**	-81.94	-146.5	-96.64*	9.466	2.397	12.94
	(0.438)	**(5.753)**	(77.91)	(80.51)	(39.81)	(5.148)	(2.565)	(8.489)
Observations	26	26	26	26	26	26	26	26
AIC	23.95189	23.95189	23.9519	23.95189	23.95189	23.95189	23.95189	23.95189
HQIC	25.56182	25.56182	25.5182	25.56182	25.56182	25.56182	25.56182	25.56182
SBIC	28.4768	28.4768	28.4768	28.4768	28.4768	28.4768	28.4768	28.4768

Appendix II: VAR Stability Test

step	(1) oirf	(1) Lower	(1) Upper	(1) fevd	(1) Lower	(1) Upper	(2) oirf	(2) Lower	(2) Upper
0	-.100412	-.189361	-.011463	0	0	0	-.100412	-.189361	-.011463
1	-.036023	-.144869	.072823	.16078	-.088502	.410062	-.036023	-.144869	.072823
2	-.07854	-.209291	.052212	.107039	-.09692	.310998	-.07854	-.209291	.052212
3	-.050898	-.185447	.083651	.110067	-.11165	.331784	-.050898	-.185447	.083651
4	-.064772	-.207956	.078412	.097322	-.113673	.308316	-.064772	-.207956	.078412
5	-.010969	-.152525	.130586	.094626	-.121412	.310663	-.010969	-.152525	.130586
6	.01422	-.123772	.152212	.082527	-.113758	.278812	.01422	-.123772	.152212
7	.073381	-.060628	.207391	.07496	-.099234	.249155	.073381	-.060628	.207391
8	.10947	-.023488	.242428	.082221	-.072741	.237183	.10947	-.023488	.242428

step	(2) fevd	(2) Lower	(2) Upper
0	0	0	0
1	.16078	-.088502	.410062
2	.107039	-.09692	.310998
3	.110067	-.11165	.331784
4	.097322	-.113673	.308316
5	.094626	-.121412	.310663
6	.082527	-.113758	.278812
7	.07496	-.099234	.249155
8	.082221	-.072741	.237183

Appendix III: Multicollinearity Test results

Model One: Y Dependent Variable

Variable	VIF	1/VIF
M	19.04	0.052514
TO	8.40	0.119015
REER	4.67	0.214105
FDI	4.08	0.245023
L	3.31	0.302192
K	1.52	0.659255
IR	1.47	0.679671
Mean VIF	6.07	

Model two: M Dependent Variable

Variable	VIF	1/VIF
Y	31.66	0.031585
REER	14.16	0.070642
TO	6.62	0.151057
FDI	3.80	0.263026
L	3.73	0.268259
K	1.52	0.657028
IR	1.52	0.657700
Mean VIF	9.00	