A TIME SERIES ANALYSIS OF AGRICULTURAL OUTPUT AND ECONOMIC GROWTH IN KENYA

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TO:

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DECLARATION

This project is my original work and has not been presented for a degree in any other University

25/09/2021

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This project was submitted for examination with my approval as University Supervisor

27/10/2021

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Signature Date

Dr. Fredrick Odhiambo Sule

DEDICATION

This paper is dedicated to my parents who through thick and thin, have been here for me. I hope this accomplishment will complete the aspiration you've had for me when you chose to give me the best education you could for all those years.

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Before all else, praises and thanks to God, for His favor all through my course.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lags
ASDS	Agricultural Sector Development Strategy
ASTGS	Agricultural Sector Transformation and Growth Strategy
CUSUM	Cumulative Sum
CUSUMSQ	Cumulative Sum of Squares
DF	Dickey Fuller
ECM	Error Correction Model
ERS	Economic Recovery Strategy
GDP	Gross Domestic Product
GoK	Government of Kenya
ILO	International Labor Organization
IRF	Impulse Response Function
KNBS	Kenya National Bureau of Statistics
MPL	Marginal Productivity of Labor
OLS	Ordinary Least Squares
SBC	Schwarz Bayesian Criterion
SRA	Strategy for Revitalizing Agriculture
VAR	Vector Auto Regression
VECM	Vector Error Correction Model

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ABSTRACT

Agricultural productivity in many countries in Africa is predicted to greatly impact economic growth since it is the mainstay of the majority of the people. Nevertheless, the effect of output from agriculture on growth of an economy has borne diverse research interests with different findings from one nation to another. In this research, we seek to determine how agricultural output influences economic growth in Kenya using the VECM employing data between 1970 and 2017. Results from the study established that generally, agriculture, industry, service output, and capital formation are relevant to predict changes in GDP. The study results also indicate that in the short run, agricultural production positively influences growth but has no long run effect. Hence, agriculture productivity is significant in the primary phases of economic development. From the findings of the study, it is evident that agriculture facilitates economic progression in the short run and ought to be reinforced by macro strategies in due course to be positively affecting the economy in the long run.

CHAPTER ONE: INTRODUCTION

1.1 Background

The supposed function of agricultural sector in regards to growth of an economy has long been comprehensively discussed and reviewed by several researchers. The agricultural sector is considered an engine and remedy to economic prosperity (Sertoğlu et al., 2017). It has the propensity to aid in the eradication of poverty, and expand food security for an estimated 9.7 billion individuals by 2050 (World Bank, 2019a). As compared to other sectors, the agricultural sector-led growth is two times more capable of boosting the earnings of the poorest who are residents of rural areas where agricultural activities are predominated (World Bank, 2019a). Also, the sector constitutes a third of the global GDP in 2014, hence its productivity is vital to economic growth.

The agricultural sector, being among the greatest promising sectors in Kenya, is regarded as the pillar of the Kenyan economy. Agriculture sector contribution to GDP is 24% directly and 27% indirectly through ties with the industry sector and services sector (FAO, 2019; GoK, 2019). Besides, more than 45% of the government earnings are generated from activities in the agricultural sector, and it is known for its enormous contribution of more than 75% of raw materials for industries and above 50% of income from exportation (GoK, 2019). Furthermore, approximately three-quarters of the population in Kenya is dependent on agriculture for their sustenance (FAO, 2019).

In 2017, the agricultural sector employed more than 9 million Kenyans which amount to 56% of total employment (KNBS, 2018). Knowing the significance of agriculture to growth of the economy and reducing poverty, the sector has been valued by the Government of Kenya as a high priority instrument for achieving a sustainable annual growth rate of 10 percent (GoK, 2019). The sector is also part of the government's medium-term inclusive growth agenda through the attainment of 100% nutritional and food security for all Kenyans by 2022 (World Bank, 2019b).

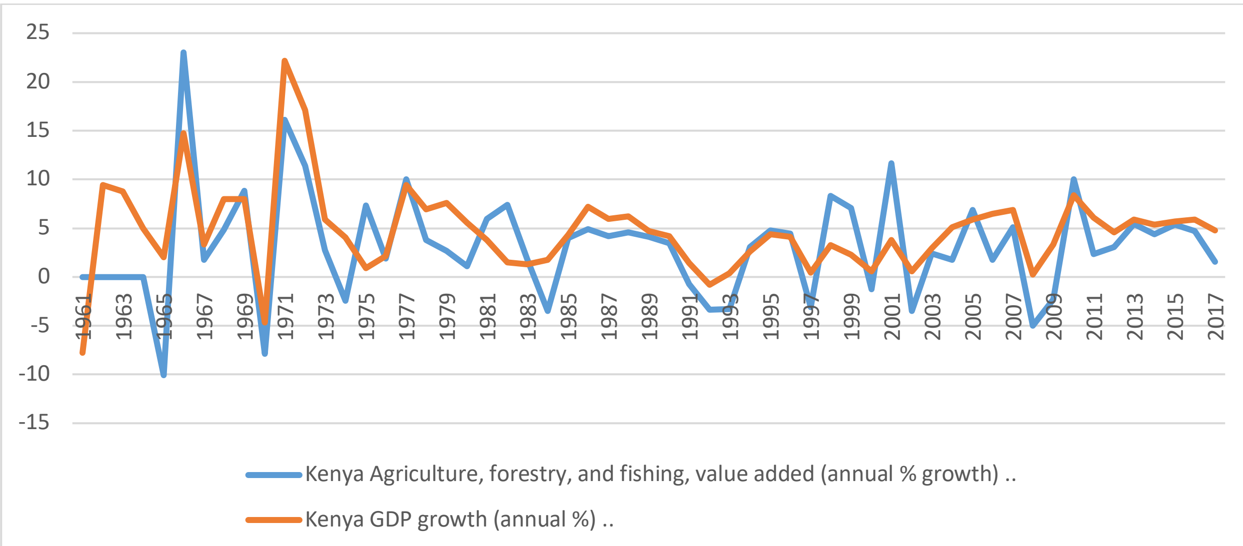
Several agricultural sector developments have been introduced and some are being instigated by the Government of Kenya. These reforms have been geared towards improving the agricultural sector performance that will lead to improvement in other economic sectors in Kenya. These reforms comprise of Economic Recovery Strategy for Wealth and Employment Creation, Strategy for Revitalizing Agriculture (SRA), Agricultural Sector Transformation and Growth Strategy (ASTGS), among others.

After years of stagnation and declining growth, the Kenyan Government established the ERS. The strategy emphasized the growth of the economy, generation of wealth, and employment as a way of achieving food security and elimination of poverty. The ERS strategy also identified that economic recovery is significantly influenced by agricultural sector productivity and pointed out that betterment of agricultural institutions and continuous investments in agricultural research as key for sustainable economic growth.

In addition to the ERS, the Strategy for Revitalizing Agriculture (SRA) was introduced to boost the performance of the agriculture sector (Poulton & Kanyinga, 2014; Muma, 2016). Although the sector attained a growth rate of 6.1% in 2007, the SRA was superseded by the Agricultural Sector Development Strategy (ASDS) which aimed at achieving a targeted annual growth of 10% (Muraya, 2017). As a result, it complements Vision 2030. In addition, the most recent Agricultural Sector Transformation and Growth Strategy (ASTGS) was launched with the expectation of guiding various programs over the next ten years. The ASTGS has three pillars:

increasing small-scale farmers, pastoralists, and fisher folks' income; improving agricultural productivity and value-added; and improving domestic food suppleness (World Bank, 2019).

1.1 Trend on Agricultural Sector Performance and GDP



Data Source: World Development Indicators 2019

From figure 1.1 above, it is evident that a high correlation between economic growth and agriculture sector performance exists.

The most impressive progression of both the economy and agricultural sector was recorded after independence (1965-1972) because of the increase in smallholder cash crop production, land expansion (availability of ample land), and support from the government (Arne & Paul, 1987). Private investment in agriculture as well greatly weighed into the development of a policy environment which favored agricultural producers (Lofchie 1989).

The rapid growth was however not sustained. The average annual growth rate declined mainly due to low investment, mismanagement, and negligence of the agricultural sector, severe drought experienced in 1983 and 1984 hurt the agricultural sector productivity (GoK, 2011).

The government of Kenya identified agriculture as crucial to economic growth in the context of ERS and SRA and steadily invested more in the sector. Thus, there was a regain in growth in the 2000s. These gains were however affected in 2008 by post-election violence and various crises brought about by escalated fuel prices, and the economic crises of 2008/2009 (GoK, 2009).

1.2 Statement of Problem

Economic growth greatly depends on agricultural sector development which is a prerequisite for industrialization. This is because the agriculture sector has the potential to create sources of income and in turn, this leads to the betterment of living standards for rural dwellers, hence reducing poverty and also a provision of raw materials for the industrial sector. As a result of its importance, many governments in developing and developed countries have conducted several significant reforms to boost the growth of agriculture.

Like other governments, Kenya has introduced several reforms to increase agricultural output and its effect on the economy. However, despite the introduction of these reforms, the recent trend in agricultural output has been significantly volatile. According to the World Bank (2019), the sector contribution to real GDP growth has declined from 23.9 percent (2008-2012) to 21.9 percent over the last five years (2013-2017). Moreover, following the sector's robust rebound in 2010 when it attained a growth of 6.4 percent, its growth has decreased by approximately 1.6 percent in 2017 partly due to adverse weather conditions and the pervasiveness of pests and diseases. Therefore, this instability in agricultural output could weaken the capability of the sector in contributing to the Big Four agenda which is rightly pegged on the Kenya Vision 2030.

Given these depressing facts, this study will seek to inquire into what extent agricultural output contributes to enhancing economic growth in Kenya.

1.3 Research Questions

The paper aims to give solutions to the issues that follow:

- To what extent does agricultural output contribute to economic growth?
- Are agricultural output and economic growth cointegrated?

1.4 Research Objectives

The overall objective of the paper will be to examine how agricultural output affects economic growth in Kenya from 1970 to 2017. The specific objectives shall be:

- To establish the effect of agricultural output to growth Kenya's economy.
- To examine whether a long-run relationship exists between agricultural output and economic growth.
- Provide policy recommendations established by the outcomes of the study.

1.5 Justification of the Study

The function of agriculture in Kenya has long been suggested by economic policymakers. To keep using agriculture as a foundation for growth, it is crucial to understand the degree outputs from the sector contribute to economic growth and development.

The agricultural sector will continue being significant in the economy despite its relative decline in contribution to GDP. The sector is the main source of capital transfer to other economic sectors. Creation of employment opportunities and provision of food resulting from the progress of the agricultural sector is considered vital in the poverty reduction process as outlined in the Poverty Reduction Strategy Paper (PRSP) (GoK, 2004). Sustainable poverty reduction is linked to economic growth and poverty-reducing growth primarily begins from agriculture (Kimenyi, 2002).

The agricultural sector provides the basis for the non-agricultural sector, particularly for the industry sector. It provides raw material for industries and creates efficient demand for industrial goods. The agriculture sector produces raw and processed agricultural products which are exported and thus it plays a major role in earning foreign exchange. (Zubaidur and Hossain, 2015)

Knowing the role agricultural output plays in the overall economic growth and development, there are many efforts by the Government of Kenya to boost agricultural output. However, several challenges are still being faced in the agriculture sector and this implies appropriate strategies and policies need to be implemented.

Empirical evidence establishing the short-run and long-run relationship between output from agriculture and growth, as well as in what manner economic growth is affected by shocks from the agriculture sector is crucial for the formulation of policies. Therefore, this study shall be essential to authorities in making policies given that it will empirically evaluate how agricultural output contributes to economic growth.

Furthermore, the findings of this research could as well be used by other countries facing comparable challenges of striving to develop the agriculture performance similar to the case of Kenya. The study also aims to add to literature already existing on the function of agricultural output in the growth of economies.

1.6 Organization of the Study

The residual part of the paper consists of the following sections. Chapter two describes the review of literature related to this study. It covers the theoretical and empirical literature and an overview. The third chapterdescribes the framework and time-series properties of data that will be employed in the study. It also includes the data source and description of variables employed in the research. Chapter four involves the descriptive and empirical results of the analysis and discussions. Chapter five entails conclusion and policy suggestions based on the analysis results. It additionally covers the shortcomings of the study and provides ideas to research further.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This section presents studies that are associated and applicable to the study. It includes a review of theoretical and empirical literature as well as an overview that summarizes the various journal articles reviewed. The three sections are discussed below.

2.1 Theoretical Review

Several theories have been proposed to explain how agricultural output impacts economic development. Below are a few:

2.1.1 Lewis Model - Structural Change

Lewis (1954) focused on a dual economy that consists of a small urban industrialized sector and a large rural agricultural sector. Lewis argued that in the agriculture sector, there is an unlimited supply of labor since the labor supply surpasses labor demand at the subsistence wage implying there is zero MPL in the agriculture sector. Because of disguised unemployment, the agriculture sector does not derive any productivity from the surplus labor, and moving laborers to the industrial sector are likely to increase industrial output.

The industry sector employs labor from the surplus labor until a level where its marginal product is equal to wage. Industrial labor cost is minimized and supposing wages are constant, the industry sector employs more people, and thus profit in the industrial sector increases. After all the surplus labor in the agriculture sector moves to the industry sector, agriculture sector wages will start to rise. This in turn shifts the terms of trade in favor of agriculture. Accumulation of capital eventually catches up with the population and opportunity for development from unlimited labor supply ceases.

Once all surplus labor is used up, labor supplied to the industry sector turns out to be less than perfectly elastic. Producers in the agricultural sector are now obliged to compete for labor since the sector is now fully commercialized. Real wages is likely to increase hand in hand with rising productivity thus economy goes into a period of self-dependent development.

2.1.2 The Ranis-Fei Model

Ranis and Fei (1961) expanded Structural Change Theory by considering a case where there is a limited supply of labor such that the agricultural sector is commercialized. Ranis and Fei take into account the effect of changing terms of trade on the labor supply price in the industrial sector. They divide the process of economic development into 3 phases.

In Phase I, the marginal productivity of labor is zero and each worker is earning a wage equivalent to average product of labor. Some workers in the agriculture sector move to industry sector. In this stage, the average product is equal to the marginal product.

In Phase II, rising productivity in agriculture is the basis for industrial growth which is essential to sustain the third phase. Ranis and Fei argued that labor surplus may be existent as an average product which is greater than the marginal product and not equal to the subsistence level of wages but instead it is increasing. This is because the migration of workers progresses until a point where withdrawal of labor from the agricultural sector eventually causes a decline in agricultural output. The wage of industrial sector labor has to be increased to retain the similar purchasing power of industrial wage. An increase in real wages leads to reduced profits and lessens the surplus which could be reinvested to promote industrialization.

In Phase III, the MPL is greater than the wage rate. The economy is fully commercialized and disguised unemployment is exhausted. The supply curve of labor is now higher and both industry and agriculture begin to bid equally for labor. Hence the agricultural sector is commercialized because of the favorable terms of trade.

2.1.3 The Jorgenson Model

Jorgenson (1961) suggests an economy can only generate agricultural surplus based on the technological progress rate in agriculture, population growth rate, and elasticity of output in the agricultural sector in relation to variations in the labor force. Jorgenson uses a Cobb Douglas production function where the unknown constant is technical progress. The variation in growth rates of output and population is explained by the different values technical progress takes. An agricultural surplus occurs when the growth rate of output exceeds that of the population. In the early stages, the agricultural surplus is shifted to the industrial sector. The economy achieves balanced growth, at long last, with real wage rate rising at a similar rate to output per laborer and capital and output increasing at the same rate.

2.1.4 Kuznets

Kuznet (1966) explains that the contribution of agriculture or any other sector is part of a mutually dependent system represented by the country's economy. He argued that what a sector does is not entirely attributable to it but is dependent upon what happens in the other sectors.

According to Kuznets, there are different ways in which agriculture boosts economic growth. He reasoned that the impact of agriculture to the growth is initiated by growth of products within the sector itself. A rise in the net agricultural output represents a rise in the product of the country since economic growth is the total rise in the net products of several economic sectors. The second type of contribution explains the agriculture sector contributes to the economy by providing opportunities for other sectors to arise or for the economy as a whole to take part in international trade. Thirdly, the type of contribution by the agriculture sector to economic growth occurs when resources are moved from agriculture to other sectors.

2.1.5 Neo-Classical Theory

Robert Solow and Trevor Swan (1956) initiated the neoclassical growth theory that stated economic growth comes from three factors of production; labor, capital, and technology. According to the them, the contribution of technology to growth is unlimited whereas the economy has limited capital and labor.

The Neoclassical Growth Model argues that capital accumulation in a country and the way it is made use of is vital in shaping the growth of the economy. The theory suggests that the link between capital and labor in an economy determines its total output. Technology enhances labor productivity by raising the total output levels by increasing labor efficiency.

2.2 Empirical Review

Several studies evaluating the association of output from agriculture and economic growth and development in many countries exist. However, they differ in terms of the methods used. A review of these empirical works is as follows:

Oyakhilomen and Zibah (2014) studied the link amongst produce from agriculture and the growth of the economy of Nigeria with an emphasis on the eradication of poverty. By adopting ARDL and time series data between 1981 to 2014, the author's findings implied growth of the economy was determined by agriculture sector productivity in the short and long run. However, despite GDP improvement, the poverty level in Nigeria was still rising.

Ismail and Kabuga (2016) employed the ARDL approach and time-series data between 1986 and 2015 for Nigeria to check the effect of agriculture output on growth of Nigerian Economy. Outcomes from their study revealed agricultural output and gross capital formation significantly influenced economic growth positively. Like Oyakhilomen and Zibah (2014), the short-run coefficient of output from agriculture positively affected economic growth. The CUSUM and CUSUMSQ showed stability.

Sertoğlu et al. (2017) reviewed how agriculture influenced economic growth in Nigeria using time series data for 1981 - 2013. The authors used the VECM approach. The results suggested economic growth represented by real GDP; output from the agriculture sector and oil leases showed a long-run relation. Outcomes of the research implicated that output from agriculture positively affects economic growth.

Enu (2014) adopted the OLS method and an annual time series from 1996-2006 to evaluate the effect of the agriculture productivity on Ghanaian economy. The findings showed output from agriculture positively impacts economic growth. In addition, both service output and the industrial sector were positively significant.

Duru et al. (2018) in a more recent analysis evaluated the role of agriculture output on growth of Nigeria and Ghana economies between 1985 and 2014. By use of the Johansen cointegration and VECM approach, they found that economic growth in Ghana was significantly influenced by agricultural output whereas its influence on Nigerian economy was insignificant. On the other hand, the sectoral findings showed that the industrial and service sectors contributed more to growth than agriculture in Nigeria as compared to Ghana.

Syed (2012) examined the function of agriculture in the Pakistani economy using secondary data across 1980-2010 and an OLS method. Results showed the growth of Pakistan's economy is significantly influenced by agriculture sub-sectors. However, forestry did not exhibit a significant relationship with GDP.

Awan and Alam (2015) examined the how agricultural sector influenced output on Pakistani economy by the use of secondary time series data between 1972 and 2012 and the OLS method. Variables used; agriculture value-added, labor force, trade openness, and gross capital formation resulted to be positively associated with economic growth. However, in the long run, the inflation rate negatively influenced economic growth. Labor forces, trade openness, and agriculture productivity implied a significantly positive relationship with GDP growth in the short run. CUSUM and CUSUMSQ suggested model stability for the study period.

Jatuporn et al. (2011) examined the causality between agriculture and the growth of Thai economy from 1961 to 2009 using the bivariate VAR approach. They acknowledged the presence of a long-run relationship and size effect from agriculture to economic growth, and conversely from economic growth to agriculture. Moreover, the generalized variance decomposition supported the Wald ($\chi 2$) coefficient statistic test that the main significant effect on agriculture is economic growth.

Katircioglu (2006) used cointegration and time-series data between 1975 and 2002 to investigate the relation output of agriculture has with growth of North Cyprus economy; a region known to experience drought and political instability. Similar to Jatuporn et al. (2011), the author examined the direction of causality employing the Granger causality test. The empirical outcomes showed a long-run equilibrium relation with the growth of agricultural output and the growth of the economy measured by real GDP. The author also found there was bidirectional causality among both variables in the long run. It was established that agriculture is key in terms of the growth of an economy.

Zubaidur Rahman and Elias Hossain (2014) examined the influence of Agriculture in the economic growth of Bangladesh using the VAR model by use of annual time series data between 1973 and 2011 to establish the causal relationship between agriculture sector productivity and growth of the economy. From the cointegration results, the authors established existence of a relation between agriculture and economic growth in the long run. The Granger causality test showed the relationship is unidirectional from agriculture to the growth of the economy with two periods lagged. The VAR results indicated that changes in economic growth significantly responded to changes in agricultural output.

Chebbi (2010) used Johansen's multivariate approach to determine the function of the agricultural sector in the growth and the interrelations with various economic sectors in Tunisia. Results from the study showed all economic sectors of Tunisia are cointegrated and have a tendency to move together. The short-run findings suggested agriculture partially drives the non-agricultural sectors. However, the agricultural growth is favorable for the agro-food industry sub-sector. They concluded that credit constraint remains a major issue for the agricultural sector and that development in the service sector and commerce sector does not quite contribute to the agricultural sector.

Trawina and Öztürk (2016) researched the influence of agricultural sector production on economic growth in Burkina Faso by use of annual data from 1970 to 2015 and the VAR approach including GDP per capita and added values of agricultural, industrial, and services sectors. They found that agriculture and economic growth proxy by GDP per capita did not have a causal relationship. Additionally, the findings indicated no positive relation between the agriculture output and economic development. A causal association existed between the industry sector and the agriculture sector.

Poonyth et al. (2001) utilized a simple growth model and an OLS estimation technique to find out the cross-sector effect of the agricultural sector on other sectors in South Africa. The findings suggested that an increment in growth by one percent in the agricultural sector will be met by a more than one percent rise in the other sectors. Hence, according to Poonyth findings, the other sectors are more efficient in regards to input used, implying that strategies advocating for agricultural-led growth is essential for the development of an economy.

Aballo (2012) reviewed the effect of agriculture output on Benin's economy. By use of VAR model with annual time series data from 1970 - 2010, outcomes showed agricultural sector performance positively affected the standards of living measured by GDP per capita and the service sector performance. On the contrary, agriculture was not affected by the performance of the other sectors. Furthermore, the study found total independence existed amid the agricultural sector performance and the industrial sector performance. Also, whenever there was a shock in the agricultural sector, it affected other sectors and the standard of livings.

Okonji (2019) studied the impact of agriculture sector performance on welfare of households in Kenya using OLS between 1985 and 2017. The outcomes of the research indicated that agriculture sector performance never had a significant contribution to neither human development nor households' welfare.

Karimou (2018) adopted the VEC model and a dataset which covers 1961 to 2014 to analyze the effect of output from agriculture on Benin economy. Empirical findings suggested a long-run relationship was present amongst output from the industry sector and agriculture sector, capital, and GDP. The ECM results demonstrate that 21.6% of inconsistency in the long and short-run GDP was improved in one year while variance decomposition indicates when there is a shock in GDP, agricultural output will contribute to GDP fewer than 2% for the first three-year period as well as around 6% for the ten years. The author concluded that excluding feedback and capital shocks, agricultural output is greatly influenced by GDP.

2.3 Overview of Literature

Taking into account the significance of the agricultural sector, many researchers have researched the relation between the output from agriculture and economic growth and development. As per the reviews, several different approaches have been used in explaining the linkages between the output from agriculture and the growth of the economy. Additionally, many papers have concentrated on the effect of agriculture on the growth of economies but only a few of them emphasized the inter-sectoral spillover effect.

Most of the related literature reviewed employed time-series estimation techniques to carry out their analysis. The Vector Error Correction Model and Vector Autoregressive model are the most frequently used approaches. Notwithstanding, there is no estimation done on data with structural breaks presence.

Many studies focusing on the linkage between agricultural output and growth and development of economies have been done in various countries but a few have been done in the case of Kenya. This paper will add to the existing literature by examining the causal link amid agriculture output and growth of Kenyan economy using either the Vector Error Correction model. The paper will provide an insight on the issue of whether or not the agricultural sector acts as the main engine of economic growth.

CHAPTER THREE: METHODOLOGY

3.0 Introduction

Various techniques have been adopted to establish the role of agriculture productivity on growth in developing as well as developed countries. This chapter describes the methods that will be adopted for this study. It also explains the variables to be used and their source.

3.1 Theoretical Framework

The Structural Change Theory established by Lewis (1954) will be adopted as our framework in this study. As a systematic theory of economic development, the Structural Change Theory outlines development starting as a large traditional economy to a small modern one. Lewis (1954) suggests an economy comprises of two sectors each using different technologies (combination of capital and labor); the small modern (industrial or manufacturing) sector and the large traditional (agricultural or subsistence) sector with surplus labor[1]. Capital is immobile whereas unskilled labor, manufactured goods, and food are mobile between both sectors.

The agricultural and institutional wage rates are presumed to be equivalent. Lewis refers to it as institutional wage because each laborer gets this wage as a result of an institutional course of action. Suppose market forces were let to operate in the subsistence sector, laborers with zero or very low marginal productivity would not receive this wage. The industrial sector has more capital and resources as compared to labor. Labor in the industrial sector is employed at a higher wage rate than that of the agriculture sector by around 30 percent (Lewis, 1954).

[1]Surplus labor is also known as disguised unemployment means there exist a huge number of laborers in agriculture sector such that MPL is equal to zero. Therefore, the withdrawal of some laborers from agriculture will not change the total product.

The theory suggests the surplus labor in the agricultural sector which has no value to production should be transferred to the industry sector where they will generate surplus output. This surplus will then be used to achieve growth and development. Therefore, economic growth is dependent on progress of agriculture and industry sectors.

$$Y = f(AGRI, IND) \quad (1)$$

Where Y represents Economic growth, AGRI is the Agricultural sector, and IND denotes the Industrial sector. Hence, both sectors are interconnected in that the agricultural sector utilizes capital inputs, labor expertise, and consumes final output from the industry sector. Also, the industries use labor and output from agriculture.

3.2 Empirical Model

To observe the effect of output from agriculture on the economic growth, the study adopts Karimou's (2018) model which took on Lewis Structural Change Theory. We use this model to determine how the link between the agriculture and industry sector affects economic growth in Kenya with inclusion of service output and labor which plays a big role in contributing to Kenya's GDP.

$$GDP = f(AGROUT, INDOUT, SVOUT, CAP, LAB) \quad (2)$$

The stochastic form of the model is given as:

$$GDP_t = \beta_0 + \beta_1 AGROUT_t + \beta_2 INDOUT_t + \beta_3 CAP + \beta_4 SVOUT + \beta_5 LAB + \mu_t \quad (3)$$

Where β_0 is the intercept, β_1, β_2, β_3, β_4, and β_5 are the coefficients for estimation, t represents time trend, GDP indicates Gross Domestic Product, AGROUT represents Agricultural output (% GDP), INDOUT denote Industry output (% GDP), SVOUT , Service output (%GDP), CAP represents capital, LAB represents labor and μis the stochastic error terms.

3.2.1 Variables Definitions, Descriptions, and Expected Behaviors

Gross Domestic Product (GDP): In this paper, GDP will be used as a measure for the growth of the economy. It denotes the summation of value added by its entire producers. We use GDP to capture economic growth since it reports the entire output produced within one year. It entails agriculture, industry, and services sectors.

Agricultural Value Added (AGROUT): This is the net output on summing up total outputs less intermediary inputs. It includes value-added in forestry, hunting, fishing, and also cultivation of crops and livestock production. Agricultural Value added is used by World Bank to measure agricultural productivity (Ismail and Kabuga, 2016). Following Lewis' theory that uses agriculture as the basis of a nation's economic development, agriculture output was used in the regression model to illustrate the growth of Kenya's economy. Agricultural output is anticipated to positively impact the growth of the economy.

Industrial Value Added (INDOUT): This includes value-added in manufacturing, construction, mining, electricity, gas as well as water. It is the total disposable outputs of each sector upon totaling all outputs less intermediate inputs. Its calculation excludes asset depreciation and deterioration of natural resources. For the purpose of this study, it will be denoted by INDOUT. From Lewis's theory, the industrial sector is an indisputable foundation for growth in a developing country's economy. As a result, we include it in the study as an explanatory variable of growth of the economy, and it is predicted to positively influence GDP.

Service Value Added (SVOUT): This entails value-added in retail and wholesale trade, services comprising transportation, public as well as personal services. Value-added service output entails the disposable output of the sector on summing up total output less intermediate inputs. This is included in the model as it plays a major part in the contribution to the economic growth of Kenya. It is anticipated to positively impact GDP.

Gross Capital Formation (CAP): It entails spending on accumulations to fixed assets of the economy together with net variations in stock levels. It is denoted by CAP. Capital is added in the model as a basis of economic growth. It is expected to positively influence economic growth.

Labor Force (LAB): It comprises individuals 15 years or older who provide labor for making goods and provision of services for a certain spell of time. It comprises of the employed and the unemployed as well. Labor contribute to growth of an economy. It is represented by LAB and it is anticipated to positively affect Kenya's economic growth.

3.3 Pre-estimation Tests

To ensure consistent variables, we will examine the time-series features of macroeconomic variables involved in our study. This will be done by conducting several tests including: normality test, unit root test, unit root test in existence of structural breaks.

3.3.1 Normality Test

A normality test will be used to ascertain if the sample data has been extracted from a population with normal distribution. The Jarque-Bera test will be adopted to examine normality of our series.

3.3.2 Unit Root Test

To determine if our time series variables are stationary and possess a unit root, we will employ the ADF unit root test. The ADF includes several lags to deal with the problem of autocorrelation, a problem not detected by the standard Dickey-Fuller (DF) test. The optimal lag length or k will be examined using Schwarz Bayesian Criterion (SBC) and Akaike Information Criterion (AIC). When no unit root is spotted, we will difference correctly until the series became stationary.

3.3.3 Unit Root Test in the Presence of Structural Break

A structural break occurs when there is a sudden change in the series at a certain time (Gujarati and Porter, 2009). These changes are accounted for to avoid forecasting errors and the unreliability of the model. When a structural break is present, the outcomes of the unit root tests might be affected by the break (Perron, 1989). Given this reason, we will adopt the Gregory and Hansen model to test for the structural break.

3.3.4 Test for Cointegration

Our decision to employ a VEC or VAR model will be determined by the cointegration level. Two variables are cointegrated if a long run or an equilibrium relationship is present. The cointegration test is considered a pre-test because it is used to avoid the problem of autocorrelation (Granger, 1986).

To examine the long-run relation on output from agriculture and growth of the economy, the ARDL-Bound test for cointegration which can be used for time series with mixed order of cointegration will be adopted in this study. If a long-run relation is detected, we will adopt the VEC model whereas the detection of no long-run association calls for the use of the VAR model. Once the long-run relation is found, ECM will be employed to offset short-run disequilibrium.

3.4 Model Estimation

Gujarati and Porter (2009) suggest that because the individual results produced by the VAR are difficult to explain, the Impulse Response Function (IRF) is used to interpret the results. In a VAR system, the IRF tracks the response of the dependent variable to shocks in the error term. For instance, the IRF will trace the response of economic growth to shocks in agricultural output. Hence, this will be done for the other variables in the model.

3.5 Post-estimation Tests

Inconsistent post-estimation test results suggest the findings from the estimation are not reliable. To validate our empirical results, several post-estimation tests will be conducted. We will adopt the LM test for residual autocorrelation and to ensure the model is stable, we will use the inverse root test.

3.6 Data Types and Sources

The study will use secondary annual data sourced from the World Development Indicator. Our variables under study include GDP, agricultural value-added, industrial value-added, service value-added, gross capital formation, and labor force. The series covers 47 years spanning from 1970 to 2017 and the time lag was selected based on the availability of key variables.

CHAPTER FOUR: DATA ANALYSIS, RESULTS, AND DISCUSSIONS

4.0 Introduction

The section discusses both descriptive and empirical resultss of the analysis carried out. The second section (4.2) of the chapter discusses the results of descriptive statistics. The descriptive results provide the general distribution aspects of the data. Further, the section also discusses the correlation aspect of the data to verify the nature of the relationship of the data, specifically if the variables move in the same direction or not. Section three (4.3) and four (4.4) of the chapter discusses inferential statistics, where exploration is done in-depth to verify the statistical relationship of the variables under study. The inferential begins by exploring complex dimensions of the distribution of the data, particularly the nature of the mean and variance of the data series over time. Having data with a constant mean and variance over time is preferred for most analyses since future projections could easily be inferred by observing past behaviors of the data.

4.1 Descriptive Statistics and Correlation analysis

4.1.1 Summary statistics

The analysis of this study used 48 observations (1970-2017) as shown in table 1. The standard deviation of all the observations apart from that of INDOUT had a small standard deviation implying that most of the observations were close to the mean, thus, the spread was not very high.

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP	48	27.81789	3.315969	20.51969	37.00683
AGROUT	48	16.94016	1.380732	13.55652	19.38411
INDOUT	48	165.499	24.56926	105.8583	233.2316
SVOUT	48	20.68457	3.369993	15.00382	29.78929
CAP	48	74.74375	1.756529	70.36	78.57
LAB	48	4.556556	4.191636	-4.65545	22.17389

The maximum and minimum values for each variable are seen to be close to each other, except LAB, which confirms the closeness of the data series to their mean values.

4.1.2 Correlation matrix

Correlation analysis indicates a positive correlation amongst GDP, AGROUT, INDOUT, and CAP, however, the correlation level is weak. There is a negative correlation between GDP and SVOUT together with LAB. All these correlations are however weak.

Table 2: Correlation Matrix

	GDP	AGROUT	INDOUT	SVOUT	CAP	LAB
GDP	1					
AGROUT	0.1375	1				
INDOUT	0.3399	-0.1426	1			
SVOUT	-0.0749	0.8362	-0.656	1		
CAP	0.3256	0.2635	0.3356	0.0098	1	
LAB	-0.1376	0.3401	-0.2976	0.4086	-0.0288	1

There is a high correlation between Service output and agricultural output, an implication to this is that the two variables seem to be reinforcing each other. Such that, as service output increases, agricultural output moves in a similar direction. A high correlation is also observed between service output and industrial output. Moderate correlation is observed between service output and labor, meaning the two variables reinforce each other, such that, as labor increases, more service output is observed in the country. Correlations do not however imply causation, thus there was a need to carry out other analytical tests to verify the relationships between these variables.

4.2 Inferential statistics

4.2.1 Test for Stationarity

Before using time series variables for analysis, it is vital to observe whether these variables have a constant mean and variance. This is to avoid running a spurious regression. To do this, an ADF test was conducted. In interpreting the ADF test results, the absolute statistic of calculated ADF is compared with the critical statistic. In the event the calculated value is found to be lower than the critical value then the null hypothesis of the presence of a unit root cannot be rejected, otherwise null is rejected. The ADF outcomes are as below:

Table 3: ADF test results

Variables	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
GDP	-5.493	-3.6	-2.938	-2.604
AGROUT	-1.379	-3.6	-2.938	-2.604
1st difference AGROUT	-5.719	-3.607	-2.941	-2.605
INDOUT	-2.152	-3.6	-2.938	-2.604
1st difference INDOUT	-6.808	-3.607	-2.941	-2.605
SVOUT	-2.027	-3.6	-2.938	-2.604
1st difference SVOUT	-5.691	-3.607	-2.941	-2.605
CAP	-3.808	-3.6	-2.938	-2.604

LAB	-0.411	-3.6	-2.938	-2.604
1st difference LAB	-4.445	-3.607	-2.941	-2.605

Results in table 3 show that all the variables except GDP and CAP were non stationary in their levels since the absolute statistic of calculated ADF was less than the critical values at 1%, 5%, and 10% confidence intervals. Their first differences were however stationary since all the absolute calculated ADF values were greater than the critical values at all the confidence intervals. Variables being non stationary on levels but stationary at first difference inferred that all were integrated of order one I (1). Consequently, it is viable to examine if they are cointegrated. The reason to test if they are cointegrated is to confirm the presence of a linear combination among these variables. Because some variables are I (0) while some are I(1), a bound test proposed by Pesaran, Shin, and Smith (2001) will be used to test for cointegrations.

4.2.2 Bound Test of Cointegration

The null hypothesis for the bound test is the absence of a cointegrating equation. The test is executed on the level form of the variables. To make a decision, if the calculated F-Statistic is higher than the critical value for the upper bound I (1), we conclude cointegration is present. This is an implication that a long-run relationship exists. Thus the null hypothesis is rejected the long-run model is estimated, particularly the Error Correction Model. However, if the calculated F-statistic is lower than the critical value for the lower bound I (0), then there is no cointegration thus no long-run relation amongst the variables. If it falls between I(0) and I(1), the test is not conclusive. The bound test results are exhibited in Table 4 below:

Table 4: Bound test of cointegration

```
H0: no levels relationship              F =  8.510
                                        t = -6.860

Critical Values (0.1-0.01), F-statistic, Case 3
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	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_5	2.26	3.35	2.62	3.79	2.96	4.18	3.41	4.68

The results show that the F-statistics is greater than the upper bound at all critical levels, implying that there is cointegration among the variables. Particularly these variables have a long-run relationship. Thus, need to run an ECM model. In the event there are structural breaks in the model, the bound tests would yield inconsistent results. Thus to test for cointegration in the presence of structural breaks, a Gregory-Hansen cointegration test for structural breaks was conducted. The hypotheses for the test are:

Ho: No cointegration at the structural breakpoint

Ha: There is cointegration at the breaking point

The results for the test are shown in appendix 1. For each of the models, the absolute value of the test statistics Zt was higher than the critical value at a 5% level of significance, thus the null hypothesis was rejected. An ECM model which takes into effect the structural break of 1993 was estimated. The stability of the model was compared with an ECM model without the structural break using the CUSUMSQ test. The graphs for the two models are shown in appendix 2. The model which includes structural breaks in appendix 2A showed instability since the red line at some point in the years, goes beyond the lower bound. However, the model without the structural breaks showed high levels of stability since the red line was between the lower and upper bounds. The implication for this was that an ECM model without the inclusion of structural breaks was more stable and correctly specified for this study.

4.2.3 Vector Error Correction Model (VECM)

From section 4.3, all the variables for the study were observed to be cointegrated, an implication that all of them had a long run association; particularly all of them were endogenous. Thus, the following error correction models were estimated:

$$\Delta \mathrm{gdp_t} = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\Delta \mathrm{gdp_{t-1}} + \sum_{i=1}^{p} \beta_{2i}\Delta \mathrm{agrout_{t-1}} + \sum_{i=1}^{p} \beta_{3i}\Delta \mathrm{indout_{t-1}} + \sum_{i=1}^{p} \beta_{4i}\Delta cap_{t-1} + \sum_{i=1}^{p} \beta_{5i}\, \Delta SVOUT_{t-1} + \sum_{i=1}^{p} \beta_{6i}\, \Delta LAB_{t-1} + \boldsymbol{\gamma}\mathbf{ECT_{t-1}} + \mu_t \qquad (1)$$

$$\Delta \mathrm{agrout} = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\Delta \mathrm{gdp_{t-1}} + \sum_{i=1}^{p} \beta_{2i}\Delta \mathrm{agrout_{t-1}} + \sum_{i=1}^{p} \beta_{3i}\Delta \mathrm{indout_{t-1}} + \sum_{i=1}^{p} \beta_{4i}\Delta cap_{t-1} + \sum_{i=1}^{p} \beta_{5i}\, \Delta SVOUT_{t-1} + \sum_{i=1}^{p} \beta_{6i}\, \Delta LAB_{t-1} + \boldsymbol{\delta}\mathbf{ECT_{t-1}} + \mu_t \qquad (2)$$

$$\Delta \mathrm{indout_t} = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\Delta \mathrm{gdp_{t-1}} + \sum_{i=1}^{p} \beta_{2i}\Delta \mathrm{agrout_{t-1}} + \sum_{i=1}^{p} \beta_{3i}\Delta \mathrm{indout_{t-1}} + \sum_{i=1}^{p} \beta_{4i}\Delta cap_{t-1} + \sum_{i=1}^{p} \beta_{5i}\, \Delta SVOUT_{t-1} + \sum_{i=1}^{p} \beta_{6i}\, \Delta LAB_{t-1} + \boldsymbol{\alpha}\mathbf{ECT_{t-1}} + \mu_t \qquad (3)$$

$$\Delta SVOUT_\mathrm{t} = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\Delta \mathrm{gdp_{t-1}} + \sum_{i=1}^{p} \beta_{2i}\Delta \mathrm{agrout_{t-1}} + \sum_{i=1}^{p} \beta_{3i}\Delta \mathrm{indout_{t-1}} + \sum_{i=1}^{p} \beta_{4i}\Delta cap_{t-1} + \sum_{i=1}^{p} \beta_{5i}\, \Delta SVOUT_{t-1} + \sum_{i=1}^{p} \beta_{6i}\, \Delta LAB_{t-1} + \boldsymbol{\vartheta}\mathbf{ECT_{t-1}} + \mu_t \qquad (4)$$

$$\Delta CAP_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\Delta gdp_{t-1} + \sum_{i=1}^{p} \beta_{2i}\Delta agrout_{t-1} + \sum_{i=1}^{p} \beta_{3i}\Delta indout_{t-1} + \sum_{i=1}^{p} \beta_{4i}\Delta cap_{t-1} + \sum_{i=1}^{p} \beta_{5i}\, \Delta SVOUT_{t-1} + \sum_{i=1}^{p} \beta_{6i}\, \Delta LAB_{t-1} + \boldsymbol{\theta} \mathbf{ECT_{t-1}} + \mu_t \quad (5)$$

$$\Delta lab_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\Delta gdp_{t-1} + \sum_{i=1}^{p} \beta_{2i}\Delta agrout_{t-1} + \sum_{i=1}^{p} \beta_{3i}\Delta indout_{t-1} + \sum_{i=1}^{p} \beta_{4i}\Delta cap_{t-1} + \sum_{i=1}^{p} \beta_{5i}\, \Delta SVOUT_{t-1} + \sum_{i=1}^{p} \beta_{6i}\, \Delta LAB_{t-1} + \boldsymbol{\rho} \mathbf{ECT_{t-1}} + \mu_t \quad (6)$$

Where, in all the models, the dependent variables are all endogenous variables. The β_i coefficients for each model represent the short-run dynamics, p is the lag length. The coefficients $\gamma, \delta, \alpha, \theta, \vartheta, \rho$ are the speeds of adjustments for each model.. The models were estimated with 2 lags each and the outcomes are in table 5 below:

Table 5: Short-run dynamics and speed of adjustments

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	D_gdg	D_agrout	D_indout	D_svout	D_cap	D_lab
L._ce1	-0.860***	-0.159	0.0603	-1.363	0.247	0.0350
	(0.214)	(0.170)	(0.0757)	(1.426)	(0.270)	(0.0735)
LD.gdggrowth	0.318**	-0.0143	0.0441	-0.649	0.0839	-0.0141
	(0.131)	(0.104)	(0.0465)	(0.875)	(0.165)	(0.0451)
L2D.gdggrowth	0.0963	0.0115	0.0236	-0.254	0.0248	-0.0183
	(0.100)	(0.0798)	(0.0356)	(0.669)	(0.127)	(0.0345)
LD.agrout	0.770	0.117	-0.0561	1.559	-2.372*	-0.380
	(1.051)	(0.836)	(0.372)	(7.010)	(1.326)	(0.362)
L2D.agrout	3.489***	-0.769	0.707*	-11.42	-0.0101	-0.178
	(1.080)	(0.859)	(0.383)	(7.206)	(1.363)	(0.372)
LD.indout	-1.490	-0.0755	-0.279	2.144	4.804**	0.756
	(1.848)	(1.470)	(0.655)	(12.33)	(2.332)	(0.636)
L2D.indout	-5.878***	1.259	-1.195*	18.61	-0.0164	0.411
	(1.987)	(1.580)	(0.704)	(13.26)	(2.508)	(0.684)
LD.svout	-0.155	-0.00504	0.00211	-0.0990	0.510**	0.0671
	(0.174)	(0.139)	(0.0618)	(1.163)	(0.220)	(0.0600)

L2D.svout	-0.587***	0.116	-0.117*	1.801	0.00679	0.0343
	(0.194)	(0.154)	(0.0687)	(1.293)	(0.245)	(0.0667)
LD.cap	0.0110	-0.129	0.0869*	-1.726*	-0.506***	0.0180
	(0.138)	(0.110)	(0.0490)	(0.922)	(0.174)	(0.0476)
L2D.cap	-0.160	-0.181*	0.0776*	-1.994**	-0.275*	0.0175
	(0.119)	(0.0949)	(0.0423)	(0.796)	(0.151)	(0.0411)
LD.lab	-0.906*	0.380	-0.182	3.064	-0.616	0.328*
	(0.520)	(0.414)	(0.184)	(3.469)	(0.656)	(0.179)
L2D.lab	-0.0135	0.487	-0.334	6.712*	-0.0472	0.270
	(0.576)	(0.458)	(0.204)	(3.840)	(0.726)	(0.198)
Constant	0.180	-0.00356	0.00781	-0.145	-0.180	0.0427
	(0.329)	(0.261)	(0.117)	(2.193)	(0.415)	(0.113)
Observations	45	45	45	45	45	45
*** p<0.01, ** p<0.05, * p<0.1						

On row one of table 5, term L._ce1, represents the speeds of adjustments for each model, particularly γ, $\delta, \alpha, \theta, \vartheta$, ρ. For the first model, the speed of adjustment for GDP growth has the expected sign and is statistically significant at a 1% level of significance. The coefficient -0.860, implies preceding year's errors, or the deviation from GDP growth rate long-run equilibrium, are corrected for within the present year, at a convergence speed of 86%.

For short-run coefficients, one lag of GDP is statistically significant, which implies 1 previous year can statistically predict the current period's GDP growth rate in the short run. The first lag of output from agriculture is not statistically significant; however, the second one is positively statistically significant. The implication for this is that in the short run, two-year previous years' agricultural output can positively influence GDP growth in the current year. This is expected, as much of the agricultural produce consumed in the country takes a short period to be cultivated and processed for consumption.

In the short run, industry output, service output, and labor are negatively statistically significant to GDP growth after the second lag. The negative coefficient implies that these sectors are taking up huge investments and therefore negatively impacting GDP in the short run. However, this is expected, as most of these sectors like industries and the service sectors require heavy investments in technologies which might take longer periods for their positive influence on GDP growth to be observed. The influence of labor productivity might also take longer periods to be observed as it involves periods of learning and adapting to new technologies.

Model 2, where agricultural output is the dependent variable, no coefficient is statistically significant except the second lag of capital formation. The coefficient is negative, implying investments do not generally influence growth of agricultural output significantly in the short run. A reflection that agriculture investments in the Kenya are low or do not produce any meaningful impact in the short run.

Model 3, where industry output is the dependent variable, agricultural output, and capital formation are positively and statistically significant. The implication to this is that in the short run, agricultural output together with capital formation (investments) in Kenya are observed to foster industrial output. The lags of industry and service outputs negatively impacts industry output in the current period. For industry lag, the implication is that in the short run, the output of a previous year exerts negative pressure on the output of the current year perhaps because production processes in industries take longer periods, and investments are usually made in the previous years. The influence of service output is negative also because of the longer periods involved in production processes while investments are made on initial periods.

For model 4, where service output is the dependent variable, labor is observed to greatly influence service output in the short run positively. This is expected, as much of the services are provided by labor. Notably, the significance is on lag two, implying the positive impact is usually observed after a short period of engaging labor in the service sector. Capital formation has a negative impact on the short run, perhaps because it takes some time for the productivity of the labor services to be observed after initial periods of investments.

Model 5, where the capital formation is the dependent variable, agricultural output has a negative statistically significant influence on capital formation. The implication for this is that in the short run, the agricultural sector uses up a lot of capital in the country but does not contribute much to its formation. The sectors which are observed to increase the levels of capital in the country are industries and service sectors.

For the last model where labor is the dependent variable, no coefficient is statistically significant. The implication to this is that these economic sectors together with GDP growth rates are not influencing demand for labor. The growth exhibited in the sectors is not enough to spur growth in labor demand. A possible reason for the continued increase of unemployment rates in the country. The long-run effects of these variables on GDP growth are observed in table 6 below:

Table 6: Long run impact (Johansen normalization restriction imposed)

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1						
gdggrowth	1	.	.	.	.	.
agrout	2.566187	.9895438	2.59	0.010	.6267165	4.505657
indout	-5.00956	1.686675	-2.97	0.003	-8.315381	-1.703738
svout	-.4708591	.1724061	-2.73	0.006	-.8087688	-.1329495
cap	-.3435387	.1341281	-2.56	0.010	-.6064251	-.0806524
lab	-.1767774	.2182981	-0.81	0.418	-.6046337	.2510789
_cons	107.6003	.	.	.	.	.

The coefficients are statistically significant at a 5% level excluding labor. To interpret the results of the Johansen normalization restrictions, the signs of the coefficients are usually reversed. Thus agricultural output, in the long run, has a negative influence on GDP growth in Kenya. However, industry output, service output, and capital formation positively impact GDP growth in the long run. Therefore, in conclusion, everything else held constant, agricultural output and the other control variables except labor have an asymmetry effect on gross domestic product growth in Kenya in the long run.

In terms of magnitude, industry output is observed as the highest contributor to GDP growth in Kenya in the long run, followed by service output and finally capital formation (investments). The long-run negative effect of agriculture output on GDP in Kenya is a reflection of how performance of agriculture has been since 1970. This can generally be attributed to poor climatic conditions, low productivity levels, and perhaps minimal investments in the agricultural sector in the country. Generally from the results, agricultural, industry, and service output together with capital formation are statistically relevant to predict movements or changes in GDP growth in Kenya.

4.3 Diagnostic tests

4.3.1 Autocorrelation

The first diagnostic test that was carried out was the autocorrelation test. A lagrangian multiplier test was conducted; the outcomes are as below:

Table 7: Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	31.4775	36	0.68352
2	37.6845	36	0.39209

The null hypothesis is that there is no autocorrelation at lag order. The results above show that the p values are greater than a 5% level of significance implying that the null hypothesis cannot be rejected. Thus variables did not suffer from autocorrelation.

4.3.2 Normality test

A Jarque-Bera test is conducted to determine if the errors are normally distributed for the models. Since there were 6 equations for all the endogenous variables, the Jarque-Bera test is conducted for each one of them. The results are as in Table 8 below:

Table 8: Jarque-Bera test

Equation	chi2	df	Prob > chi2
D_gdggrowth	0.005	2	0.99745
D_agrout	0.042	2	0.97912
D_indout	29.076	2	0.00000
D_svout	84.144	2	0.00000
D_cap	0.398	2	0.81974
D_lab	471.920	2	0.00000
ALL	585.585	12	0.00000

The results show that for the first model where GDP growth rate is the dependent variable, the errors are normally distributed. The same is observed for the equations of agricultural output and capital formation. For the other models, the errors are not normally distributed.

CHAPTER FIVE: SUMMARY, CONCLUSION, AND POLICY RECOMMENDATIONS

5.0 Introduction

The chapter comprises of summary of findings as well as provision of policy recommendations. Furthermore, it includes limitations and suggestions for future studies. The chapter is subdivided into five sections which are discussed as follows:

5.1 Summary

This paper set out to identify and analyze how agricultural output affects economic growth in Kenya using data from 1970 - 2017. The findings generally show that GDP and Capital formation are the only variables that are stationary at their levels. The other variables are stationary in their first differences. Having such a series warranted conducting a bound test of cointegration rather than the Johansen test of cointegration. Since structural breaks were suspected within the variables, a Gregory-Hansen cointegration test was also conducted. Generally, it was observed that the variables were cointegrated but the stable model was the one that did not include the structural breaks. An ECM model was estimated.

In the long run, agricultural output is observed to negatively impact GDP growth in the country. However, industry output, service output, and capital formation impact growth positively in the long run. GDP is observed to have a speed of adjustment of 86% in the long run. Implying GDP quickly adjusts to its long-run equilibrium levels. In the short run, agricultural output is observed to positively influence GDP growth in the country while industry output, service output, and labor have a negative influence.

For the model of agricultural output, no variable is observed to influence agriculture in the short run, except capital formation. For the industry output model; agricultural output and capital formation are observed to statistically influence industry output in the short run. Labor and capital is observed to have a very significant impact on service output on the service model. For the capital formation model, agricultural output is observed to significantly affect capital formation in the country in the short run. Finally, for the labor model, no variable is observed to have a positive impact in the short run.

On the diagnostic tests, the variables do not exhibit any form of autocorrelation. GDP growth, Agricultural output, and capital formation equations show a normal distribution of the errors terms. However, the other equations show that the error terms are not normally distributed.

5.2 Conclusion

From the outcomes of the study, it is apparent that generally agriculture, industry, and service output together with capital formation are statistically relevant to predict movements or changes in GDP in Kenya.

The long-run negative impact of agricultural output on GDP growth in Kenya however, is a reflection of how the agriculture performance has been. This can be attributed to poor climatic conditions, low productivity levels, and perhaps minimal investments in the agricultural sector in the country.

Agricultural output positively influences GDP in the short run. This is anticipated, as much of the agricultural produce consumed in the country takes a short period to be cultivated and processed for consumption.

5.3 Policy Implications

The following policy recommendations are therefore suggested:

The government should increase investment in agriculture since the findings imply that investments in the agricultural sector in Kenya are low and do not produce any meaningful impact in the short run. This could be done through increasing both public and private resources apportioned to research based on agriculture for instance research on high yielding and drought-resistant seed varieties and infrastructure development; and providing agricultural subsidies to encourage production and foster good agricultural practices.

Government should urge financial organizations to create a certain amount of credit facilities accessible to activities for the agricultural sector to boost food supply, create employment opportunities and reduce poverty.

Efforts should continually be made to promote modern agriculture by expanding, encouraging mechanization, and modernizing existing irrigation schemes, and start new schemes to ensure the country does not over-rely on rain-fed agriculture.

5.4 Study Limitations

Data availability being a limitation of the study especially labor output for the period before 1990 which called for interpolation of the data from 1990 backward to 1970, which is an estimate of the real data. This may sometimes result in some inconsistencies. The result of the study was nevertheless informative and identifies many issues that are of concern.

5.5 Areas of Further Research

The agricultural sector is very broad. It is, therefore, necessary to conduct other studies to analyze agricultural growth opportunities among the various agricultural sub-sectors which can be used as a basis to establish investment opportunities in the sector and the whole economy also.

Appendix 1

Gregory-Hansen Test for Cointegration with Regime Shifts
Model: Change in Level — Number of obs = 48
Lags = 1 chosen by Bayesian criterion — Maximum Lags = 2

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-8.12	16	1985	-6.05	-5.56	-5.31
Zt	-8.55	24	1993	-6.05	-5.56	-5.31
Za	-53.77	24	1993	-70.18	-59.40	-54.38

Model: Change in Level and Trend — Number of obs = 48
Lags = 1 chosen by Bayesian criterion — Maximum Lags = 2

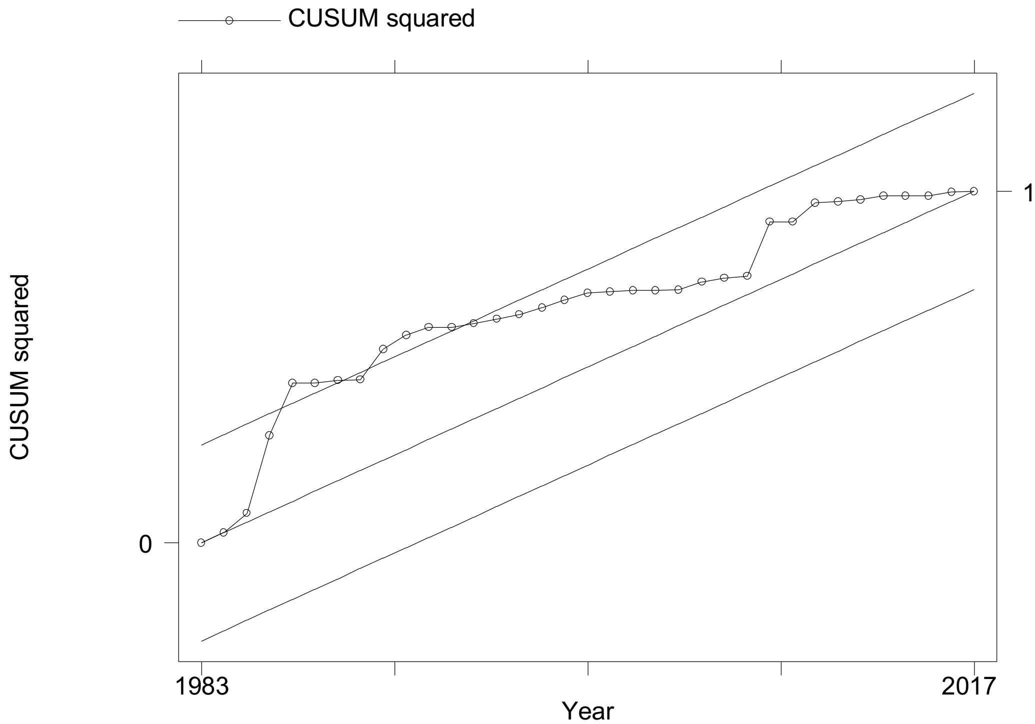
	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-8.21	36	2005	-6.36	-5.83	-5.59
Zt	-8.84	24	1993	-6.36	-5.83	-5.59
Za	-54.85	24	1993	-76.95	-65.44	-60.12

Gregory-Hansen Test for Cointegration with Regime Shifts
Model: Change in Regime — Number of obs = 48
Lags = 1 chosen by Bayesian criterion — Maximum Lags = 2

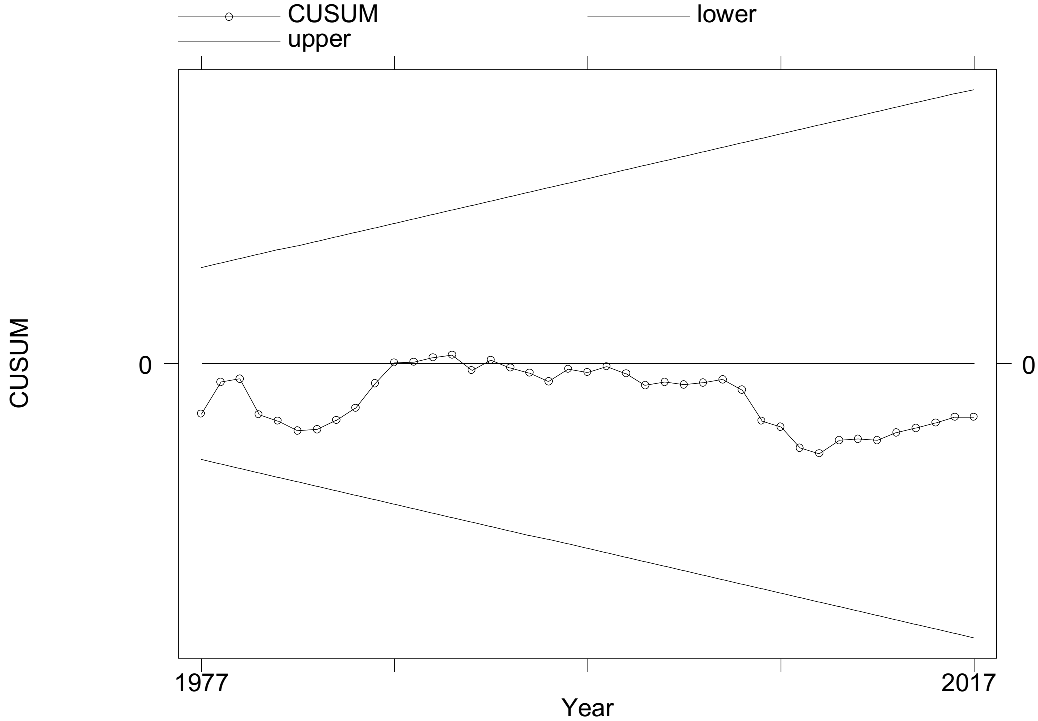
	Test Statistic	Breakpoint	Date	Asymptotic Critical Values 1%	5%	10%
ADF	-8.09	38	2007	-6.92	-6.41	-6.17
Zt	-8.79	8	1977	-6.92	-6.41	-6.17
Za	-55.33	8	1977	-90.35	-78.52	-75.56

Appendix : Stability test

Appendix 2A: Model with structural breaks dummy



Appendix 2B: Model without structural breaks dummy



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