Strathmore UNIVERSITY

The relationship between manufacturing and agriculture sectors in Kenya

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Submitted in partial fulfillment of the requirements for the Degree of Bachelor of Business Science in Finance at Strathmore University

Strathmore Institute of Mathematical Sciences

Strathmore University

Nairobi, Kenya

February 2021

DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.

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10th February 2021

This Research Project has been submitted for examination with my approval as the Supervisor.

Steve Anyona Makambi, PhD

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9th February 2021

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

GDP - Gross Domestic Product

KNBS – Kenya National Bureau of Statistics

VECM – Vector Error Correction Model

VAR – Vector Autoregression

USD – United States Dollar

ABSTRACT

Agriculture has the potential to transform the economy in a developing country and subsequently other key sectors through forward and backward linkages. Understanding the nature of the relationship that exists between manufacturing and agriculture is important as Kenya aims to transform its manufacturing sector. The aim of this study was to establish the nature of the relationship between the manufacturing and agricultural sector in Kenya and to identify how shocks in other factors determines changes in the two sectors. Manufacturing value added, agriculture value added, employment within the respective sectors and macroeconomic factors were considered for this study. To meet the first objective, this study employed the Granger causality test and a vector error correction model to establish the nature of the long-run relationship between the two sectors. Impulse response Functions were used to identify how shocks in employment determines changes in the two sectors. The results of the granger causality identified the presence of a forward linkage from agriculture to manufacturing. VECM results found the existence of a positive long-run effect of agriculture on manufacturing. The Impulse response functions further identified a negative long-run effect of manufacturing on agriculture. These results identified the need for government to intervene in both sectors as it pursues growth to prevent unforeseen results. Policies employed should encourage the forward linkage from agriculture to manufacturing.

1. INTRODUCTION

1.1. Background of the Study

Historically, manufacturing has been identified as the key sector for assured economic growth. Growth in manufacturing is characterised by growth in technology, economies of scale and integration to the global production networks. (Szirmai, 2012). Evidence shows that transforming manufacturing is essential in catapulting low-income countries towards middle income status. According to (Su & Yao, 2016), increased manufacturing promotes growth in the services sector, accelerates technological growth and increases demand in investment.

Manufacturing is considered key for the development of low-income countries; however, its importance has diminished over the past two decades. Development in the manufacturing sector value added in many developing countries has experienced decline. According to (Haraguchi, Cheng, & Smeets, 2017) this is because manufacturing has shifted and is concentrated in few developing countries. This has had a huge impact on the manufacturing outlook of many developing countries.

Most developed countries growth has been characterised by a large manufacturing sector. Agriculture is however a significant contributor to the economic growth of many developing countries. A productive agricultural sector and a vibrant economy in developing countries can co-exist for sustainable development. (Awokuse & Xie, 2015)

Developing countries ought to create favourable conditions to stimulate the growth of the industrial sector. The unbalanced growth model introduces the concept of inter-sectoral relationships through direct or indirect supply and demand within the sectors. (Degu, 2019). Developing countries are dominated by agriculture. This suggests that agriculture has the potential to transform the economy and subsequently other key sectors through forward and backward linkages established between the sectors.

Kenya is considered the economic, financial and transport hub in East Africa. Its nominal Gross Domestic Product, (GDP), as of 2019 was at Kenya shillings 9,740.4 billion (Economic Survey 2020, 2020) . GDP growth over the past decade has averaged at 5.5 percent and is now considered a lower middle-income country. The main sectors contributing to economic growth are Agriculture, manufacturing sector and the services sector. (Economic Survey 2020, 2020)

Year	Agriculture	Mining	Manufacturing	Electricity and water	Construction	Wholesale	Accomodation	Transport	ICT
2009	39%	1%	20%	4%	6%	12%	3%	12%	4%
2010	39%	1%	19%	4%	7%	12%	3%	11%	5%
2011	38%	1%	19%	4%	7%	12%	3%	12%	5%
2012	37%	2%	18%	4%	7%	12%	3%	11%	5%
2013	37%	1%	18%	4%	7%	13%	2%	11%	6%
2014	37%	2%	18%	4%	8%	13%	2%	11%	6%
2015	37%	2%	17%	4%	9%	13%	2%	11%	6%
2016	36%	2%	17%	4%	9%	12%	2%	11%	6%
2017	35%	2%	16%	4%	9%	13%	2%	12%	7%
2018	35%	2%	16%	4%	9%	13%	2%	12%	7%

Table 1.1. Percentage Real Gross Domestic Product by Activity

Sources. (Kenya National Bureau of Statistics–Third Quarter 2014 GDP Release, 2014) , (Quarterly Gross Domestic Product Report Third quarter 2019, 2019)

Table 1.1 considers the main sectors within the economy, mainly agriculture, manufacturing and key subsectors within services sector during the past decade. Agriculture is the highest contributor to GDP in comparison to other sectors within the table at an average of 37 percent. This is followed by manufacturing which has averaged at 19.5 percent. Wholesale and transport both within the services sector contributed to an average of 12.5 percent and 11.4 percent respectively.

Generally, economic evidence suggests that developing countries rely heavily on Agriculture as the main driver of economic growth. In most African countries, agriculture contributes to 20 percent of the growth in GDP. (Awokuse & Xie, 2015) About nine million Kenyans are employed in the sector. The sector employs 70 percent of the rural population and 40 percent of the total population in Kenya. (Agricultural Transformation and Growth Strategy, 2018)

Agriculture is a sector playing a pivotal role in the Economic growth of Kenya. (Stephen P. D'Alessandro, 2015). Agriculture in Kenya contributes to 26 percent GDP directly and up to 27 percent indirectly via other sectors hence it is considered a key economic driver for the country. (Wankuru, et al., 2019) . The main subsector contributing to the GDP from Agriculture is crop production which claims about 70 percent of agricultural output. Livestock contributes to 20 percent of output. Other subsectors include fishing, forestry and logging. (Wankuru, et al., 2019)

Agricultural productivity, especially food production, in Kenya during the past decade has been fluctuant. (Wankuru, et al., 2019) This has been attributed to factors such as insufficient access to credit, poor infrastructure and lack of integrated land hence increased cereal imports. (Wankuru, et al., 2019). This is a concern because food demand has not been met and has resulted to increased food imports to curb the deficit. (Wankuru, et al., 2019). Statistics indicate that food imports crossed the 100 million mark. (Munda, 2018)

Agricultural export value in Kenya is relatively low compared to that of other countries in Africa. Given the large percentage it contributes to the total export merchandise; it is important to take into consideration the value of the exports. Kenya exports only USD11 of processed agricultural products per capita, compared to USD83 in South Africa and USD77 in Côte D'Ivoire. (Wankuru, et al., 2019)

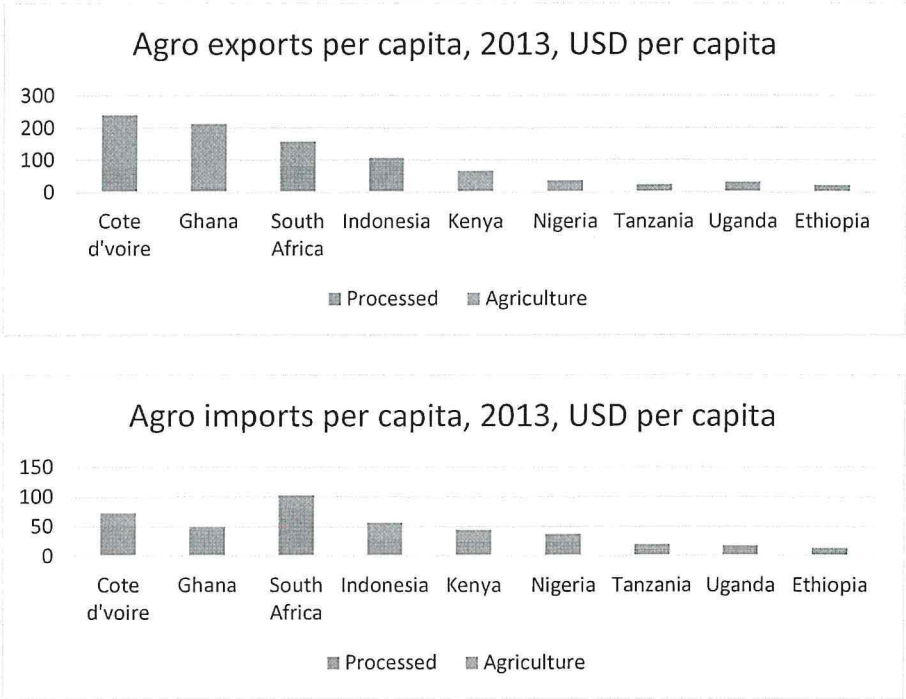


Figure 1.1. Agro-processing in Kenya relative to other regional peers.

Source: (Wankuru, et al., 2019)

It is evident that Kenya's share of its processed agro-exports is lower than that of other Eastern African countries. It stands at 16 percent while that of Tanzania and Uganda is 27 percent and 34 percent respectively. (Agricultural Transformation and Growth Strategy, 2018). Based on the figure above, Kenya is reliant on agricultural exports

therefore profits made within the sector are exported instead of being invested within the local industries.

Manufacturing industry in Kenya is composed of the following subsectors: Food production, Beverage and Tobacco, Rubber and plastic products, Metallic and non-metallic products, Industrial equipment, Machinery and equipment, Motor vehicle industry and Furniture industry. (Economic Survey 2020, 2020) The main subsector in the manufacturing industry is the food and beverage industry and it contributes to about 22 percent of the sector's income. (Wanjohi, Githuku, & Wambua, 2018) The pharmaceutical, furniture and wearing apparel subsectors have grown substantially over the past decade. (Wanjohi, Githuku, & Wambua, 2018)

Manufacturing in Kenya is still at its infancy stage and stagnated at 10 percent of GDP in the past decade. The country experienced a decline in the contribution to GDP by manufacturing in 2017 as GDP declined from 9.2 percent to 8.4 percent. (Manufacturing priority Agenda 2018: Sparking Kenya's Industrial Transformation for Job Creation, 2018). In 2019 manufacturing real value added grew by 3.2 percent compared to 4.3percent in 2018. This growth was attributed to increase in motor vehicle production, animal and vegetable oil production and the pharmaceutical sector. (Economic Survey 2020, 2020)

As a developing country, stagnation in manufacturing coupled with ill performance in agriculture raises the case of reduced industrialization opportunities sooner while at their low-income level states. (Wanjohi, Githuku, & Wambua, 2018). Manufacturing exports to neighbouring East African countries have reduced substantially over the past decade an indication of a suffering sector. (Wankuru, et al., 2019). One of the Big 4 Agenda's objective is to strengthen manufacturing in Kenya. This will mainly be achieved by strengthening the linkage between agriculture and manufacturing by stimulating supply from the agricultural sector towards the manufacturing sector. (Dr Miriam Omolo, 2019)

1.2. Problem Statement

Kenya consists of a dominant agricultural sector that contributes to the largest percentage share of Gross Domestic Product. Manufacturing sector is also a significant contributor towards Gross Domestic Product however, this sector has been stagnant at an average 10 percent of Gross Domestic Product over the past decade. The

government aims to improve the manufacturing sector as part of the Big 4 Agenda by stimulating supply linkages mainly through supply of raw materials. Agriculture also indirectly contributes towards the growth of other sectors and being the dominant sector spill over effects are inevitable. To best plan out policies that ensure a symbiotic relationship that improves manufacturing in Kenya and maintains the key role of agriculture within the economy, understanding the nature of the relationship that exists between manufacturing and agriculture is important.

1.3. Research Objectives

The general objective of this study is to establish the bidirectional relationship existing between the manufacturing and agricultural sectors in Kenya, hence the objectives are:

i. To establish the nature of relationship between the manufacturing and agricultural sector in Kenya.
ii. To identify how a shift in other factors determines changes in manufacturing and agriculture.

1.4. Significance of the study

Investigating the relationship between the manufacturing and agricultural sectors is important in formulating policies that will promote the growth of the two sectors. This will also aid in developing an appropriate strategy to better link the two sectors. This study will also contribute to the ongoing discussion on the Big 4 Agenda on how to improve the overall economic state through the increase of manufacturing output.

2. LITERATURE REVIEW

2.1. Theoretical Literature

2.1.1. Growth stage theories

Industrial fundamentalism theories on economic growth identified the process of growth as being characterised by occupational shifts and changes in the extent of integration within a sector in the economy. (Johnston & Bruce F Mellor, 1961)observed that agricultural led development consists of three stages. The first stage being the traditional approach to agriculture characterised by stagnated income, the second stage is institutional agriculture that adopts technology to increase output and the third stage refers to agriculture within industrialised societies.

List's work is desirable for developing countries that are heavily reliant on agriculture. (List, 1932) identified that growth takes place in five stages: The savage, pastoral, agricultural, industrial and commercial stages. List emphasized the importance of free trade in an agriculturally dependent economy. His study further identified that domestic industrial development is the generator of agricultural progress through an increased demand for farming sector, expanding non-agricultural sectors and development of more efficient methods of production.

List's theory is however limited as it does not address the conditions under which transformation from agriculture to manufacturing occur. (Rostow, 1964) provided the solution to how the economic transformation is met. Rostow identified that development starts with a traditional sector, followed by some preconditions to growth, growth, maturity and ends at a high consumption. This theory identified that in an open economy, agriculture plays a dominant role in developing countries through provision of food for the increasing population, providing market for domestic-industrial produced goods and by generating capital to be invested in other sectors.

2.1.2. Dual Economy Theory

Fisher-Clark models developed the idea of primary, secondary and tertiary forms of production. (Fisher, 1939) emphasized that for economic growth to occur there must be an evident shift in employment from primary activities to secondary activities. (Clark, 1940) also formulated the idea that for economic growth to be achieved, there must be increased output per worker within a given sector. Labour is eventually transferred from one sector with lower outputs to the sector with a higher output per

worker. The Fisher-Clark model identified that there must be transfer in labour from a primary sector to the secondary sector, however both theories fail to identify how traditional sector matures to achieve a transition to a secondary industrial sector. The model is also limited as it is only convenient for countries with a defined primary agricultural sector and secondary manufacturing sector. Advanced services sector in developing countries makes this model difficult to adopt because there is a possibility that the countries' industrial sector is by-passed as the economic progress does not have to follow the known agricultural-industrial path.

The Lewis model of economic development explained economic growth and transition in terms of labour transition between two sectors: a dual economy. The first sector is the traditional sector. It is characterised by fixed land, unlimited labour such that it is in surplus, subsistence wage and marginal productivity of labour is zero. The second sector is the modern sector that is expansionary in nature and charges a higher price than the wage hence it is profit making. While wages in both sectors are fixed, the wages in the modern sector are greater. This is incentive for labour to shift from the traditional sector to the modern sector. (Lewis, 1954)

Lewis model did not exclusively identify the traditional sector as the agricultural sector and the modern sector as the industrial sector. Dualism did not entirely focus on the rural-urban divide as in some cases, businesses that are entirely capitalist exist in rural areas. This theory is particularly relevant today and relates to the sectoral conditions within most developing countries. Many people in developing countries work in a low productive sector, the agricultural sector. (Gollin, 2014). The agricultural sector is dominant in rural areas while manufacturing is mainly in urban areas.

While the theory explained the shift in supply and demand for labour within a closed economic sector and how this contributes to growth among the different sectors, it has its own limitations. The theory does not consider an open economy and the factors that affect the two sectors within the open economy. (Matsuyama, 1992)suggested that in a closed economy agriculture is a precondition to industrialization while in an open economy it has a negative impact on the economic growth. Based on the assumption that all learning by doing occurs in the manufacturing sector, (Matsuyama, 1992)further suggested that when supply of labour is considered, a high production in agriculture has a negative impact on manufacturing.

2.1.3. Unbalanced growth Theory

This theory suggests that during the process of development, underdeveloped countries should focus their resources in developing few strategic sectors instead of all the economic sectors. According to (Hirschman, 1958), (Rostow, 1964) developing countries have scarce resources and should aim to invest within key sectors. Consequently, through sectoral linkages, the subsequent sectors and the general economy is expanded. These linkages are established through economic externalities and complementary. Unbalanced growth generates externalities hence growth in one sector subsequently encourages growth in other sectors. The theory also suggested that targeted investments within specific sectors promotes the growth of other sectors by generating demand of products or supply to other sectors. Hirschman suggested that for growth to take place the public agencies and private investors must work simultaneously due to limited resources. The theory assumed that government investment in social facilities would subsequently result to increased private investments within the sectors that benefit from the government investments. Relationships created between two sectors are established through forward and backward linkages. Backward linkages imply that dominant sectors lead to the growth of those that supply raw materials. Forward linkages are established because of the growth in supply of raw materials from the existing dominant sectors.

This theory is significant for this study as it places emphasis on an existing underlying sector as the trigger for growth. It is also realistic for a developing country as it considers and identifies the scarcity of resources in underdeveloped countries. This theory however does not consider other factors that affect the growth of a sector.

2.2. Empirical literature

(Evans, 2014) used the Kaldor's law of growth, that economic growth is positively related to manufacturing growth, to study the importance of manufacturing industry for the overall economic growth. The study performed a regression on data based on Kaldor's three growth laws. The study employed time series data on real GDP growth rate, manufacturing output growth rate, non-manufacturing output growth rate and manufacturing employment growth rate for the period 1971 to 2013. The study did not support Kaldor's laws in Kenya. It established that manufacturing is not the engine of growth in Kenya. Non-manufacturing sectors, agriculture and services, served as the engine for growth however they do not possess forward, and backward linkages

compared to manufacturing. This study further suggested that low growth in the manufacturing sector exhibits a negative relationship with the non-manufacturing sector. The study therefore established that growth in the agricultural sector is dependent on manufacturing.

(Olamade & Oni, 2016) did a study to examine the long run effects between economic sectors and effects of shocks on growth in Nigeria based on time series data from 1981 to 2014. The study employed data on value added within the manufacturing, agriculture, services and mineral sectors. The data on value added was regressed against the real value added on Gross Domestic Product. To investigate the long-run interdependence between the sectors, this study used bounds testing approach. Impulse response functions and variance decompositions were used to investigate the strength of the linkages between the sectors. The study used an autoregressive distributed lag model to perform a co-integration test on the data. The study identified an existing long run interdependence between the major sectors in Nigeria. The minerals sector is the most linked as it exhibited back and forth linkages with the other economic sectors however, this linkage did not account for the variations in agriculture and manufacturing. The study further identified that the existing forward and backward linkage between agriculture and manufacturing is extremely weak. The study highlighted concern that the expected structural shift from agriculture to manufacturing based on history has not been the case in Nigeria.

To understand how agricultural activities, contribute to the growth of manufacturing in African countries, (Kafando, 2018) did a regression analysis on cross-sectional data from 37 African countries for the period 1980 to 2009. Data on manufacturing value added, agriculture value added and control variables on investments capital, economic openness, human capital and governance quality were considered in the regression analysis. Based on value added from agriculture, the study was able to find out that agriculture contributes more to manufacturing in Central Africa and West Africa, followed by East Africa; however, this is affected negatively by the shocks in the agricultural sector. North and South African countries had a high level of manufacturing value added and agriculture value added however, very little contribution of agriculture towards manufacturing mainly because production is done exclusively for export or direct consumption.

(Uddin, 2019) studied the contribution of agriculture, industry and services sectors to economic growth in Bangladesh. The study used time series data on value added within the three sectors and real GDP from 1980 to 2013. The study employed a granger causality tests and vector error correction model. The Johansen co-integration test indicated positive linear relationships between each economic sectors and economic growth. The Granger causality tests identified a bidirectional relationship existing between both the manufacturing and agricultural sectors and between GDP and agriculture. The granger causality study further found a unidirectional relationship from the service sector to the agriculture sector and from the industry sector to the services sector. The vector error correction model revealed the existence of a long-run relationship between the sectors.

(Degu, 2019) did a study to determine the existence of a long-run and short run relationship, causal relationships and the effects of shocks within the manufacturing, agriculture and services sectors in the Ethiopian economy. The study used time series data on value added to the different sectors from 1975 to 2017. The study employed the Johansen co-integration tests, vector error correction model, granger causality tests and variance decompositions. The vector error correction model revealed an existing stable long-run relationship among the agricultural, services and industrial sectors. The granger causality test further revealed a bi-directional relationship existing between the industrial and agricultural sectors. Variance decomposition suggested that agricultural led industrialisation was inevitable as the results indicated that the agricultural sector development played a significant role in determining the overall economic growth.

(Osuagwu, 2020) conducted an empirical study to determine the long run relationship existing between the agriculture and manufacturing sectors in Nigeria. The study employed Granger causality tests, vector error correction models and co-integration techniques to estimate the relationship between manufacturing and agriculture using time series data from 1982 to 2017. Macroeconomic variables were also considered when estimating the model as control variables. The empirical analysis revealed that there is an existing relationship between manufacturing and agriculture in both the short run and long run. Results from the vector error correction model further revealed that changes in the agricultural production due to macroeconomic variables are not

corrected hence the existing link with the manufacturing industry is distorted over time.

These studies found that that manufacturing contributes towards a small portion of Gross Domestic Product in most developing countries. Agriculture contributes towards majority of Gross Domestic Product hence the dominant sector. Most studies further suggested the existence of sectoral linkages that subsequently resulted to increased economic growth. In addition to this, countries with a dominant agricultural sector exhibit a strong forward and backward relationship between the manufacturing and agricultural sectors. The studies identified that macroeconomic factors such as exports and inflation introduce shocks within the sectors hence negatively affect the long-run relationship between manufacturing and agriculture.

2.3. Summary of literature review

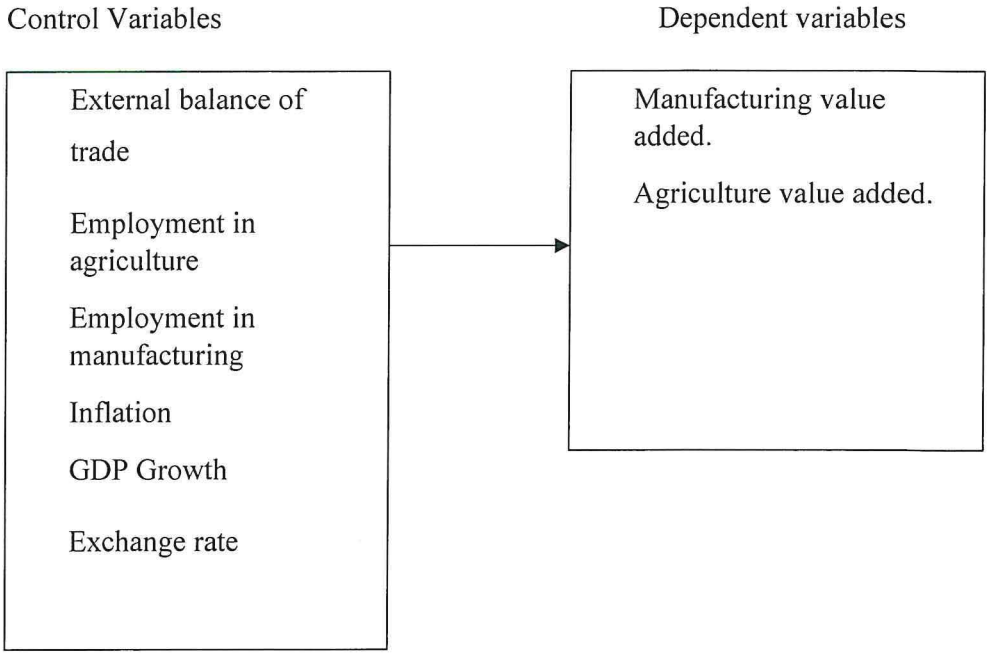
The growth stage theories, dual economy theories and unbalanced growth theories all concur with the fact that development of an economic sector is dependent on the dominant, already established sector. The dual-economy theory is relevant for this study as it is a depiction of the structural sectors in Kenya, one advanced sector that contributes to the largest percentage of GDP and a subordinate manufacturing sector. The theory identified that a key variable, employment, is necessary for the transformation of sectors from a primary activity, agriculture, to a secondary activity, manufacturing. Therefore, labour input is an important variable for this study based on the Lewis model of structural development and balance of trade variable is important to account for the open economy in Kenya.

Existing literature in Kenya put emphasis on the importance of individual economic sectors towards economic growth. Majority of the research done has placed its focus on the importance of manufacturing as the driver of the economy (Evans, 2014). There has been barely any research done to establish the relationship existing between manufacturing and agriculture in Kenya. This study therefore aims to identify any backward and forward linkages between manufacturing and agriculture.

2.4. Conceptual framework

The dependent variables are manufacturing and agriculture value added. Other control variables are Labour employed in both manufacturing and agriculture. This is done in line with the dual economy theories. The other independent control variables are

inflation, balance of goods and services, Gross Domestic Product and Exchange rate. These variables are included to consider the Matsuyama's critic on the dual economy to consider the open economy in Kenya.



3. METHODOLOGY

3.1. Introduction

This study aims to identify the bidirectional relationship existing between the manufacturing and agricultural sectors in Kenya by conducting a time series study. This study will take on a positivist approach given that the variables are quantifiable.

3.2. Research Design

The experimental research design is best served to meet the research objectives for this study. Experimental research design is suitable for a study that aims to examine a causal relationship. Independent variables and their effect on dependent variables are observed over a given time using past quantitative data to draw a reasonable conclusion for the study. (Mitchell, 2015)

3.3. Theoretical Foundation.

The model that will be used for this study is anchored by the dual-economy theory as suggested by (Lewis, 1954). The dual sector economy is depicted by the individual manufacturing and agriculture sector. The primary activity will be the dominant already established agricultural sector while the secondary activity will be represented by the manufacturing sector.

3.4. Model Specification

This study will adopt the Vector Autoregressive Model. This is because the study aims to identify the bidirectional relationship existing between two variables. Each model is therefore expected to be modelled as a linear combination of its past lags and the past lags of other variables within the model. This study expects to derive the following relationship:

$$M_t = \alpha_{1t} + \sum_{i=1}^{p} M_{1t-i} + \sum_{k=1}^{l} AG_{1t-k} + \sum_{j=1}^{q} X_{1t-j} + \varepsilon_{1t}$$

$$Ag_{2t} = \alpha_{2t} + \sum_{i=1}^{p} M_{2t-i} + \sum_{k=1}^{l} AG_{2t-k} + \sum_{j=1}^{q} X_{2t-j} + \varepsilon_{2t}$$

Where:

The dependent variables are M_t and Ag_{2t} which represent manufacturing value added and agriculture value added. The independent variables are the lagged values of the

dependent variables. The independent variables are therefore M_{1t-i} ,AG_{1t-k} , M_{2t-i} and AG_{2t-k}. The control variables are labour in manufacturing and agriculture, Gross Domestic Product, Inflation, External Balance of Trade and Exchange rate. The control variables are represented by X within the model.

3.5. Data Analysis

The data on the variables necessary to conduct this study will be sourced from World bank. The study will use annual time series data from the year 1990 to 2019. The variables that will be used in this study are as follows. Data will be analysed using Stata.

This study requires the time series to be stationary, constant mean and variance, to estimate the models accurately. To test for stationary, this study will perform a unit root test. This was conducted using the Augmented Dickey Fuller test.

This study will further conduct a co-integration test to establish the presence of any statistically significant connection between the variables in the long run. The Johansen co-integration test will determine the number of co-integrating relationships using the maximum likelihood estimator. The Akaike Information Criterion will be used to identify an appropriate lag length. The Johansen test applies two likelihood ratio tests: The maximum Eigen value test and the trace statistic test. The null hypothesis on the Johansen test is the absence of co integrating relationships against the alternative to reject the null; presence of co integrating relationships. Rejection of the null hypothesis is at a 5% confidence interval. If the Johansen co-integration test proves the presence of co-integration, this will suggest that the time series has a statistically significant long-run relationship. A vector error correction model will be used if the Johansen test proves the presence of co-integration, otherwise a vector autoregressive model will be used.

Once the model is estimated this study will check for the serial correlation of the residuals. This is important as it ensures that the model fully explains the variables. In the case that the study identifies the presence of serial correlation, this is suggestion that the model needs more explanatory variables or the model is insufficient in explaining the relationship hence another model should be used.

To establish the nature of relationship between the manufacturing and agricultural sector in Kenya, this study will adopt a Granger causality model. The Granger

causality test suggests that one variable can be predicted by its own past variables and the past values of other variables within the model. In the case that the Johansen co-integration test proves the presence of co-integration, this study will further adopt the vector error correction model to identify the nature of the long-run relationship between the two sectors.

To identify how a shift in other factors determines changes in manufacturing and agriculture this study will use impulse response functions. Impulse response functions are important in describing the effect on a variable when other variables within the model experience economic shock. This will be useful within this study as it will better assess how policies or changes in the macroeconomic factors affect the two sectors.

3.6. Data Collection and Sources

The study will employ secondary archival annual time series data. Data on all the variables was collected from world bank from the period spanning 1991 to 2019. The starting period is constrained due to the unavailability of employment data within both sectors for the periods prior to 1991. This study will take industry employment as a proxy for employment in manufacturing due to unavailability of manufacturing employment data separately. Industry employment data comprises of data on mining, manufacturing, construction, electricity, water, and gas. Manufacturing is the largest subsector as seen in Table 3.1. as it contributes more to GDP hence it is valid to use industry employment data as a proxy.

Type	Variables	Measure	Description
Dependent variables	Manufacturing value added	Percentage	As a percentage of Gross Domestic Product.
	Agriculture value added	Percentage	Includes crop cultivation, livestock keeping, hunting, fishing and forestry.
Independent variables	External balance of goods and services	Percentage	As a percentage of Gross Domestic Product
	Inflation	Percentage	Annual Average inflation rate
	Employment in agriculture	Percentage	As a percentage of total employment
	Employment in industry	Percentage	Proxy for employment in manufacturing as a percentage of total employment
	Growth in Gross Domestic Product	Percentage	Annual percentage growth in Gross Domestic Product
	Exchange rate	Constant	Average annual per US Dollar

Table 3. 1. Definition and measurement of variables

4. EMPIRICAL FINDINGS

4.1. Introduction

This chapter presents the empirical findings of the study. The first section presented the descriptive analysis and the stationarity test. The second section presented results of the granger causality tests, cointegration analysis and impulse response functions.

4.2. Descriptive analysis and stationarity test

This section presents descriptive statistics and stationarity tests of all the variables. It also presents key trends on the dependent variables, employment in industry and employment in agricultural sectors. Average annual time series data was used for the period between 1991 to 2019 and the total number of observations for each variable was 29 hence no missing observations were made.

4.2.1. Descriptive Analysis

Descriptive analysis consists of descriptive statistics and graphs indicating trends followed by the variables over the period of the study.

	N	Mean	Std. dev.	min	max	skewness	kurtosis
Manufacturing value added	29	10.226	1.431	7.542	12.79	-.048	2.237
Agriculture value added	29	26.953	3.545	20.52	34.831	.486	3.223
External balance of goods and services	29	-8.296	4.915	-17.197	4.949	.949	3.943
Inflation	29	10.468	8.625	.933	41.989	1.935	7.403
Employment in agriculture	29	53.508	6.752	44.076	61.146	-.385	1.481
Employment in industry	29	9.749	3.991	6.159	16.646	.688	1.725
Gross domestic product	29	2.783	1.021	1.700	5.049	.796	2.396
Exchange rate	29	74.305	19.186	27.508	103.41	-.533	3.111

Table 4.1. Descriptive statistics

Table 4.1. includes the key measures of dispersion and key measures of a normality on all the variables. Manufacturing value added as a percentage of gross domestic product has averaged at 10.226 percent over the past 29 years. At its lowest peak, manufacturing was at 7.542 while at its highest the sector contributed to 12.79 percent. At -0.048, the skewness indicates a normally distributed curve. This is an indication that within the past 29 years the sector has stagnated at around 10 percent. This further suggests that the sector has not experienced significant shifts away from the average. Agriculture value added has averaged at 26.953 percent over the period of study. Its skewness is within the 0.5 range which suggests that the sector has also not suffered drastic shifts over the study period.

Employment in agriculture has averaged at 53.508 percent and 9.749 percent in industry as a percentage of total employment within the study period. At its peak employment in agriculture stood at 61.146 percent and 16.646 percent in industry. Employment in industry has been relatively low compared to that of the agricultural sector. Variations in employment have not been very significant within both sectors. The external balance of goods and services averaged at -8.936 percent an indication that the country's imports value is higher than the value in exports.

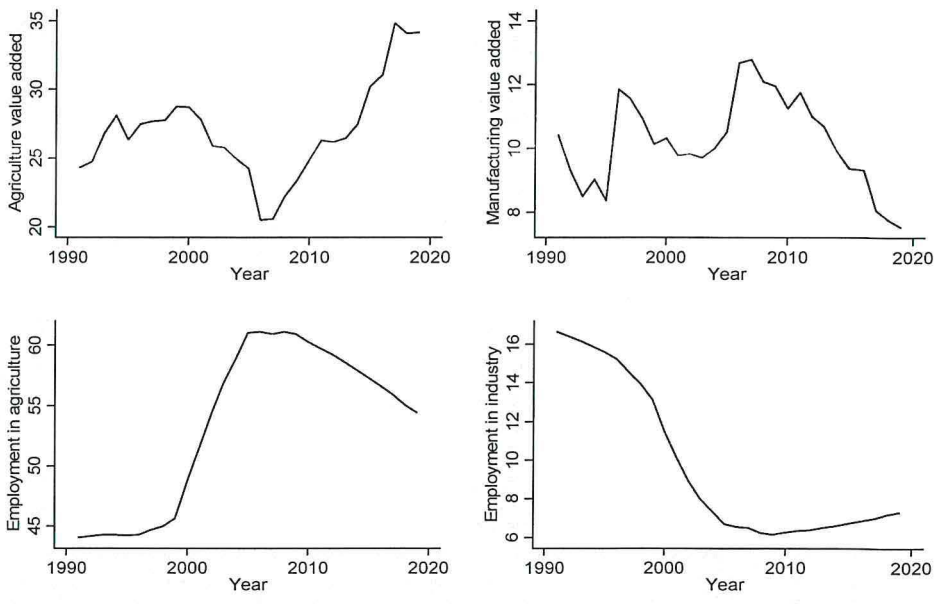


Figure 4.1. Key variable trends

Figure 4.1. depicts the trend followed by manufacturing value added, agriculture value added, agriculture employment and employment in industry over the study period.

Manufacturing value added as a percentage of Gross Domestic Product has constantly fluctuated over the study period between 8 percent and 12 percent. 2007 was the highest peak at 12.79 percent. Starting 2008 value added to GDP from manufacturing has consistently declined. The manufacturing sector began experiencing significant setbacks in 2008 as it suffered distribution setbacks because of limited supply in raw materials and heavy man hours losses. As a result of the distribution setbacks, the sector experienced reduced capacity utilization and productivity. From 2008, the sector's contribution to GDP has declined significantly with no sign of recovery. According to the Kenya Association of manufacturers, the sector has been affected by skill gaps, lack of predictable and stable policies and lack of incentives on exports.

Agricultural sector has always been the highest contributor to GDP in Kenya. Based on Figure 4.1. The sector's value added to GDP stood at around 26 percent between 1991 and 2004. The sector however experienced a sudden drop in 2005 due to drought, floods and the Rift valley fever outbreak. Productivity within the sector was further affected by the 2007 post-election violence and the commodity price shock in 2008 followed by an onset of drought in 2009. From 2010 the sector's value added significantly increased and this is mainly attributed to government intervention. Given that major challenges are climate related the government set out drought management and climate change mitigation and adaptation strategies within its agricultural and economic development strategies.

Employment in agriculture was relatively low in 1990s and significantly increased from the 2000s and further remained stagnant at 60 percent between 2005 and 2010. The high growth in agriculture sector contributed towards the growth in employment within this sector. 2010 onwards saw a significant decline in the percentage of employment in agriculture. This could be attributed to the changing employment structure as manufacturing sectors and services sectors have higher wages compared to the agricultural sector. The industrial sector trend curve is the inverse of the agricultural sector trend. Preliminary findings observed from the trends suggests that employment shifts between the manufacturing and agricultural sector is inevitable.

4.2.2. Stationarity test

To test for stationary of the variables included within the models, the augmented Dickey Fuller were employed. The tests were run at the 1%, 5% and 10% levels of significance. The results are presented in the table below.

Results of augmented dickey-Fuller unit root test					
Variables	Statistic		Critical value		P-value
		1%	5%	10%	
Level Form and post differencing					
Manufacturing value added *(1)*	**-3.306**	-2.492	-1.711	-1.318	0.0015
Agriculture value added *(1)*	**-2.961**	-2.492	-1.711	-1.318	0.0034
External balance of goods and services *(1)*	**-2.147**	-2.492	-1.711	-1.318	0.0210
Inflation *(1)*	**-2.482**	-2.492	-1.711	-1.318	0.0102
Employment in agriculture *(2)*	**-2.275**	-2.508	-1.717	-1.321	0.0165
Employment in industry *(2)*	**-2.537**	-2.508	-1.717	-1.321	0.0094
Gross Domestic Product *(1)*	**-5.038**	-4.362	-3.592	-3.235	0.0021
Exchange rate *(1)*	**-3.838**	-4.362	-3.592	-3.235	0.0147

Table 4.1. Augmented Dickey Fuller test results.

Table 4.2 presents the results of the Augmented dickey fuller test. Using the 5 percent critical value, the test statistics are greater than the 5 percent significance level. The null hypothesis that each variable has a unit root is rejected because all the variables are stationary at level. Prior to the test, the Akaike Information Criteria was used on each variable to specify the maximum lags necessary to test for stationarity. Maximum lags for the variables were one besides employment in industry and employment in agriculture which had two maximum lags.

4.3.Results and interpretation

This section presents the results on the analysis related to individual objectives. The first part discusses the nature of the relationship between the manufacturing and

agricultural sectors. The second part discusses how key factors determine changes in manufacturing and agriculture.

4.3.1. To establish the nature of relationship between the manufacturing and agricultural sector in Kenya

To meet this objective, the study employed the granger causality test which was used to determine the presence of a causal relationship and the direction of causality between the manufacturing sector and agricultural sectors. The Johansen cointegration test was then employed to test for the existence of any long-run relationship between the variables. The vector error correction model was then run to determine the nature of the long-run relationship.

Granger causality Wald tests			
	chi2	df	Prob>Chi2
Manufacturing value added			
Agriculture value added	5.181	2	0.075
External Balance of goods and services	8.365	2	0.015
Inflation	1.183	2	0.554
Employment in Agriculture	5.562	2	0.062
Employment in industry	4.620	2	0.099
Growth in Gross Domestic product	2.121	2	0.346
Exchange rate	1.642	2	0.440
ALL	35.661	14	0.001
Agriculture value added			
Manufacturing value added	0.570	2	0.752
External balance of goods and services	0.685	2	0.710
Inflation	0.738	2	0.692
Employment in agriculture	11.955	2	0.003
Employment in industry	8.696	2	0.013
Growth in GDP	0.519	2	0.771
Exchange rate	9.641	2	0.008
ALL	46.709	14	0.000

Table 4.3. Granger causality results

Table 4.3. indicates the results of the Granger causality test. The null hypothesis of the first equation is lagged values of agriculture value added and other control variables do not cause manufacturing value added. The null hypothesis of the second

equation is lagged values of manufacturing value added and other control variables do not cause agriculture value added.

In the first equation, at 5 percent p-value, lagged values of agriculture do not cause manufacturing value added however, lagged values of external balance of goods and services cause manufacturing. Taking into consideration other variables within the model at 10 percent p-value, lagged values of agriculture value added, employment in agriculture and employment in industry cause value added in manufacturing. The direction of causality from agriculture value added to manufacturing value added is therefore present at 10 percent p-value. In the second equation, at 5 percent p-value, lagged values of employment in agriculture, employment in industry and exchange rate cause value added in agriculture. However, manufacturing value added does not cause agriculture value added.

Based on the results above, manufacturing value added and agriculture value added only display a unidirectional relationship. These results suggest the existence of forward linkages from agriculture value added to manufacturing value added. This implies that agriculture contributes directly towards the growth of manufacturing through the supply of factors such as raw materials. The lagged values of employment in both industry and agriculture cause both manufacturing value added and agriculture value added. This implies that employment in both sectors influences productivity within the sectors.

These results suggest that agriculture is an integral factor within the manufacturing sector in Kenya. Therefore, for the manufacturing sector to grow, the linkage between the agriculture and manufacturing sectors must be maintained. The causal relationship between employment in both sectors suggest that employment within both sectors should also be a factor of consideration when developing policies around these sectors.

Prior to the cointegration test, the study established the appropriate lag length based on the Akaike Information criteria. The results suggested that there should be two lags in the underlying VAR hence one lag in the VECM analysis. The study further conducted the Johansen cointegration test. Based on the results in Appendix A, the null hypothesis of no cointegration is rejected strongly as the trace statistics indicate the presence of six cointegrating relationships.

Johansen normalization restrictions imposed				
beta.	*Coef*	*Std. Err.*	*z*	*P>z*
Manufacturing value added	1	.	.	.
Agriculture value added	-2.78e-17	.	.	.
Balance of goods and services	-3.33e-16	.	.	.
Inflation	-1.39e-17	.	.	.
Employment in agriculture	0	(omitted)		
Employment in industry	-3.55e-15			.
Growth in GDP	-3.200399	.645967	-4.95	0.000
Exchange rate	.4088433	.0822493	4.97	0.000
_cons	-18.48563			.
_ce2				
Manufacturing value added	1.56e-17			.
Agriculture value added	1			.
Balance of goods and services	1.67e-16			.
Inflation	3.30e-17			.
Employment in agriculture	-1.11e-16			.
Employment in industry	-2.22e-16			.
Growth in GDP	.1249841	.3449672	0.36	0.717
Exchange rate	-.0933713	.0439238	-2.13	0.034
_cons.	6.155063			.

Table 4.4. Vector error correction results

Table 4.4 shows the Johansen normalization report. The coefficient signs are reversed in the long run. The results indicate that a unit increase in agriculture value added has a positive effect on manufacturing value added. Increase in agriculture value added increases manufacturing value added by 2.7 percent. The results omitted the p-value hence it is difficult to ascertain the level of statistical significance in this case. For agriculture value added, a unit increase in manufacturing value added has a negative effect on agriculture value added. Increase in manufacturing value added decreases agriculture value added by 1.56 percent. These results also omitted the p-value hence it is difficult to ascertain the level of statistical significance.

Taking into consideration other macroeconomic variables within the model, the external balance of goods and services, inflation, employment in industry and growth

in the gross domestic product have positive effects on manufacturing value added in the long run. The exchange rate however has a negative effect on manufacturing value added in the long run. For agriculture value added, balance of goods and services, inflation, and growth in GDP have a negative relationship with agriculture in the long run. Employment in agriculture, employment in industry and exchange rate have a positive long-run relationship with agriculture value added.

These results suggest that in Kenya increase in agriculture value added has a positive long-run effect on the manufacturing sector. The effect of manufacturing value added on agriculture value added in the long run is negative. Employment in both industry and agriculture positively impact the two sectors. This is consistent with the dual economy, that a shift in employment towards a particular sector is a prerequisite for growth in the corresponding sector within the country.

4.3.2. To identify how a shift in other factors determines changes in manufacturing and agriculture.

This section presents the results of the second objective, to identify how a shift in other factors determines changes in manufacturing and agriculture. To meet this objective the study employed impulse response functions. Macroeconomic factors considered were employment in industry and employment in agriculture as this study adopted the dual economy theory, that identified these variables as key to explain changes in both sectors.

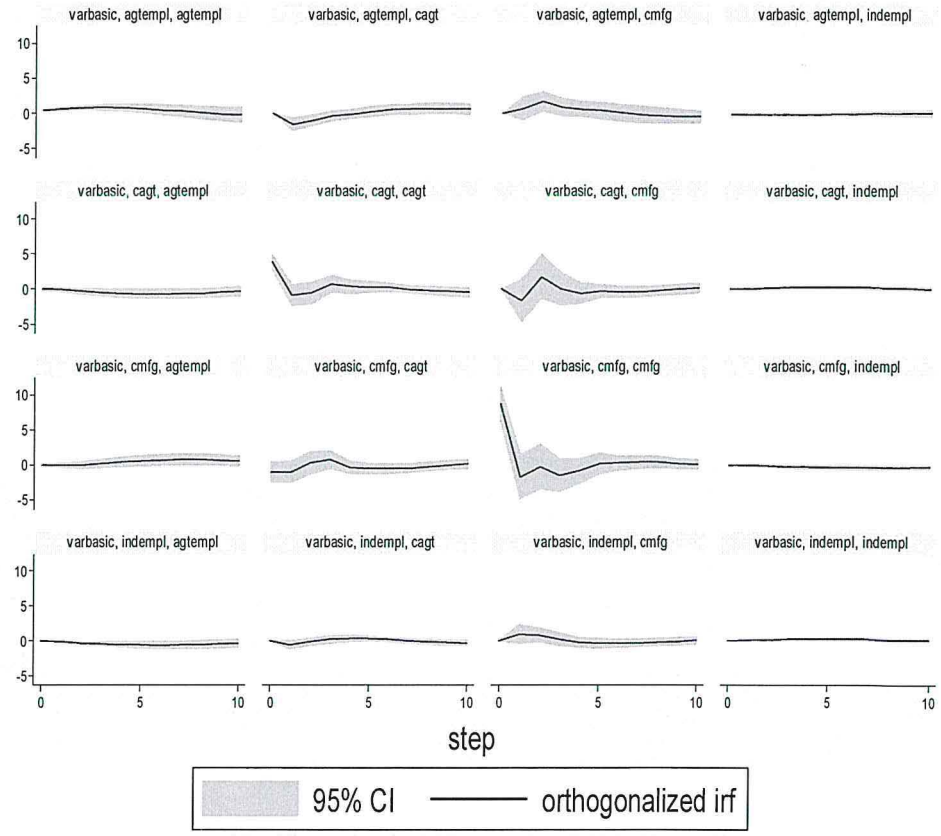


Figure 4.2. Impulse response functions

Figure 4.2. illustrates the results of Impulse response functions. *Indempl* represents employment in industry, *agtempl* represents employment in agriculture, *cagt* represents agriculture value added and *cmfg* represents manufacturing value added.

From the figure, the title varbasic *agtempl, cagt* represents the response of agriculture value added to a standard deviation shock in employment in agriculture. Therefore, in the short term, a standard deviation shock in employment in agriculture temporarily reduces agriculture value added. The response is negative in the short term however, in the long run this dies out as agriculture value added gradually increases to a positive response. The effect of employment in agriculture is however the opposite on manufacturing value added. The title varbasic *agtempl, cmfg* represents the response of manufacturing value added to a standard deviation shock in employment in agriculture. In the short term, a standard deviation shock in employment in agriculture temporarily increases manufacturing value added. The response is positive however in

the long run this dies out as manufacturing value added gradually decreases to a negative response.

The title varbasic *cagt, cmfg* represents the response of manufacturing value added to a standard deviation shock in agriculture value added. In the short term, a standard deviation shock in agriculture value added reduces then increases manufacturing value added in the short run. The response is positive and its effect in the long run slightly reduces but persists as manufacturing value added increases. The title varbasic *cmfg, cagt* represents the response of agriculture value added to a standard deviation shock in manufacturing value added. In the short term, a standard deviation shock in manufacturing value added increases agriculture value added. This positive response persists in the long-run as agriculture value added increases in the long-run.

The title varbasic *indempl, cagt* represents the response of agriculture value added to a standard deviation shock in employment in industry. In the short term, a standard deviation shock in employment in industry slightly increases agriculture value added. This response does not persist in the long run as it eventually decreases. The title varbasic *indempl, cmfg* represents the response of manufacturing value added to a standard deviation shock in employment in industry. In the short term, a standard deviation shock in employment in industry temporarily increases manufacturing value added. This response gradually reduces in the midterm; however, the positive response slightly increases manufacturing value added in the long-term.

These results suggest that for the government to boost growth within both sectors employment within the respective sectors must be considered. This concurs with the dual -economic theory that a shift in employment towards a particular sector is a pre-condition for the growth of the respective sector. These results further suggest that growth within the sectors is dependent on the productivity rate within the sectors which is subsequently dependent on the employment rate within the sector. The results also indicate that in the long run, both sectors are interdependent and have positive effects on each other.

To check for the suitability of the model, the study employed the LaGrange-multiplier test for autocorrelation and the Jarque-Bera normality test. The null hypothesis of the autocorrelation test is no autocorrelation against the alternative of presence of autocorrelation. The results indicate that the study cannot reject the null hypothesis of

no autocorrelation at both 1 and 2 lags as the probability lags exceed 5 percent critical value. Results from the Jarque-Bera test indicated that the error terms of the model are normally distributed. Refer Appendix B and Appendix C.

5. SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

The first objective of this study was to investigate the nature of the relationship between agriculture and manufacturing sectors in Kenya. This was done to promote better understanding of the linkage between the two sectors to enable better policy interventions. The analysis employed the granger causality tests and vector error-correction specification. Other time series data on macroeconomic variables, which includes employment in industry and agriculture, inflation, exchange rate and growth in gross domestic product for the period 1991 to 2019. The second objective was to identify how the sectors react to a shift in the variables. Employment variables were considered to meet this objective and impulse response functions were employed.

5.2. Conclusion

Trends on key variables indicated that the manufacturing sector has been suffering within the past decade as the value added within the sector has stagnated. Agriculture value added within the past decade has increased significantly and has been the dominant sector within the country. Employment trends suggested the existence of an inverse relationship between the employment within the two sectors.

To establish the nature of the relationship between the manufacturing and agricultural sectors, the granger causality test was employed. Results from the Granger causality test indicate a unidirectional relationship between agriculture value added and manufacturing value added. This implies a forward linkage from the agricultural sector to the manufacturing sector. These results persist in the long-term as the vector error correction model with a negative coefficient implies that there is an existing long run positive effects of agriculture on manufacturing value added. The results of the granger causality further indicated that manufacturing value added does not cause agriculture meaning that in the short-term manufacturing value added has no effect on agriculture. The vector-error correction model however indicated a negative long-run relationship between manufacturing and agriculture value added. This implies that in the long run, an increase in manufacturing activity has a negative impact on agriculture.

To determine how other factors determine changes in manufacturing value added and agriculture value added, impulse response functions were employed. Employment in agriculture and industry were the only variables considered. The results suggested that

to boost sectoral growth employment growth within the respective sectors is a key factor of consideration.

5.3. Recommendations

To establish the nature of the relationship between the manufacturing and agricultural sectors, the granger causality test and vector error correction model was employed. The results implied that government investment in agriculture is necessary in boosting manufacturing. A major policy implication arising from this study is the need for increased government intervention in the agricultural sector to boost yield in agricultural productivity. The aim of this would be to subsequently trigger growth within the manufacturing sector. There is also need for the government to encourage the forward linkage between agriculture and manufacturing through policy interventions that promote local processing of agricultural produce. Results of the VECM suggested that the government must intervene in the case of a successful manufacturing sector. This should be done to prevent the negative impact of the manufacturing sector on the agricultural sector.

To identify how other factors determine changes in manufacturing and agriculture, Impulse response functions were used, these conquered with the dual economy theory that shifting employment patterns results to increased output within the corresponding sector. Based on these results, the government should create employment opportunities within the respective sectors and in turn boost productivity resulting to growth in the sectors.

5.4. Areas of further research

A recommendation for further research is the understanding of the link between the agricultural, manufacturing sectors and other fast-growing sectors such as the services sector. This will be suitable to as it will help gain insight into the direction of growth to be taken by Kenya given the struggling manufacturing sector. Studies on employment patterns between various sectors within the economy in Kenya should also be conducted.

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APPENDIX

Appendix A.

Results of the Johansen cointegration test.

Johansen cointegration test				
rank	Max statistic	5% critical value	Trace statistic	5% critical value
0	75.4164	51.42	274.6239	156.00
1	54.1456	45.28	199.2075	124.24
2	48.4073	39.37	145.0619	94.15
3	38.3698	33.46	96.6545	68.52
4	27.4868	27.07	58.2847	47.21
5	23.9064	20.97	30.7979	29.68
6	5.0425	14.07	6.8915*	15.41
7	1.8490	3.76	1.8490	3.76

Appendix B

Results of the Lagrange multiplier test for auto correlation.

Lagrange-multiplier test

lag	chi2	df	Prob>Chi2
1	18.526	16	0.294
2	18.616	16	0.289

Appendix C

Results from the Jacque Bera test for normality.

Jarque-Bera test

Equation	chi2	df	Prob>Chi2
Manufacturing value added	0.892	2	0.640
Agriculture value added	5.360	2	0.069
External balance of goods and services	0.451	2	0.798
Inflation	6.888	2	0.032
Employment in agriculture	0.194	2	0.908
Employment in industry	0.414	2	0.813
Growth in gross domestic product	1.452	2	0.484
Exchange rate	8.253	2	0.016
ALL	23.903	16	0.092