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AN EMPERICAL INVESTIGATION OF INTER SECTORAL LINKAGE IN ETHIOPIA: A CO-INTEGRATED VECM APPROACH

By:

FasikawAdimasuTechane

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FasikawAdimasuTechane

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This is to certify that the thesis prepared by FasikawAdimasu, entitled: *Inter sectoral linkages and their contribution for economic growth: the Case of Ethiopia*and submitted for the in partial fulfillment of the requirements for the degree of Master of Science (Economic Policy Analysis) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

The main objective of this paper was to examine the long run nature and direction of inter sectoral linkages between agriculture, industry and service sectors with a view to identifying the main growth stimulating sector in the economy in the case of Ethiopia. The study used time series data for the period between 1974 and 2016. The researcher estimated an econometric model that incorporates the linkages among the sectors using a Vector Error Correction Model. Johansen's co-integration test confirms the existence of one long-run relationship among the variables. Vector Error Correction Model (VECM) results indicated a strong long-run relationship between industry and service sector and also between agriculture and service sector. On the other hand, there is only a statistically significant association between industry and service sectors in the short run. Short run Granger causality test result also supports this outcome showing a strong unidirectional causality from industry to service sector. On the other hand, results of variance decomposition analysis and impulse response function suggest that service sector plays an important role in determining the growth of both the agriculture and industry through its positive innovative impact in medium to long-term perspective. The result of this paper suggests that government should be considered this directions and magnitudes of the inter-sectoral linkages before they set a policy and should focus on economic policies that promote multidimensional inter sectoral linkage.

Keywords: *Economic Growth, Intersectoral Linkage, Time Series data, Co-integration Analysis, Vector Error Correction Model, Granger causality, Impulse Response Function and Variance Decomposition Analysis.*

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List of Acronyms

ADF	Augmented Dickey Fuller
ADLI	Agricultural Development Led Industrialization
ARDL	Autoregressive Distributed lag
ECT	Error Correction Term
EEA	Ethiopian Economic Association
EPRDF	Ethiopian People Revolutionary Democratic Front
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GNP	Gross National Product
GTP	Growth and Transformation Plan
GVA	Gross Value Added
IMF	International Monetary Fund
IRF	Impulse Response Function
LDC	List Developed Countries
MoFEC	Ministry of Finance and Economic Cooperative
MoPED	Ministry of Planning and Economic Development
NBE	National Bank of Ethiopia
NPC	National planning commission
OLS	Ordinary Least Squares
PP	Phillips-Perron
RGDP	Real Gross Domestic Product
SAM	Social Accounting Matrix
SAP	Structural Adjustment Program
SDPRP	Sustainable Development and Poverty Reduction Program
TFP	Total Factor Productivity
TGE	Transitional Government of Ethiopia
WB	World Bank
UNDP	United Nation Development Program
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
VMPL	Value of Marginal Product of Labour

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The process of economic growth in an economy brings a structural change, which is manifested itself in terms of enormous changes in the composition of economic activities. According to Lewis (1954), Chenery (1979) and Kuznets (1966, 1979) economic development is a continuous gradual change and structural transformation from agriculture to industry and then from industry to service sectors. In due process, the contribution of agricultural activities to the growth of the economy declines and taken over by rising contribution of industrial and service sector activities. Neoclassical economists (such as Feder 1986; Dowrick and Gemmell 1991) consider structural transformation as the basis for achieving economic development. Hence, analysis of structural transformation between sectors becomes an important concern from a policy prospective.

The concept of sectoral linkage plays a vital role towards designing suitable strategies for rapid economic development. For the first time the idea of sectoral linkage was initiated in the 1950s by Hirschman. Hirschman (1958), in his 'unbalanced growth' theory, considers industries as the source of a large number of linkages to other firms and his theory points out that, the sector with the highest inter-linkages is likely to promote a more rapid growth of production, income and employment than alternative allocations of productive resources.

Assessing inter-sectoral linkage and the pattern of economic growth is an important research idea that provides crucial inputs for policy design so as to improve competitiveness in the international market and also enhance the pace of economic growth and development. Sectoral linkage describes as a sector's relationship with the rest of the economy through its direct and indirect intermediate input demands and supplies. Sectors are mutually interdependent for the supply of inputs and demand for output. In other words, the output of one sector serves as an intermediate input for other sectors and vice versa, thus the interdependence between firms or sectors found at different levels of production process is called linkages.According to Saikia (2011), there are two types of linkages. The supply or forward linkage, which is seen from the direction of an output supplier that is to be used as input in another firm or sector, which is found at higher degree of processing. On the other hand, the demand or backward linkage, which arises from the interdependence of one sector, found in a higher degree of processing or distributions stage seeking for the outputs of other sectors or firms to either use them as inputs or distribute it for final consumption desires.

In terms of policy perspective, the development effort by way of for instance investment should concentrate on a sector which creates high backward and forward linkages. The expansion of the sector with higher linkage effect is likely to have a significant contribution for increasing output, per capita income and employment levels throughout the economy. A considerable change in inter-sectoral production and demand linkages brings a shift in the composition of GDP. For instance, Caselli (2005) and Chanda&Dalgaard (2008) provided evidence that shows the changes in the sectoral composition contribute not only to output growth, but also to productivity growth of the sectors.

Cristina (1997) and Laitner (2000) argued that variations in economic growth across countries are explained by the changes in sectoral composition which results different income elasticities for agriculture, manufacturing and service sectors. In this regard, experiences of the three economies have been varied. For instance, in some economies economic development process followed a sequence that started with agricultural transformation and industrialization and which subsequently led to the dominance of the services sector. On the contrary, some developing countries such as Ethiopia do not follow the above sequence. Service sector becomes the highest contributor to the GDP without a successful transition from an agricultural economy to an industrialized economy, which has been a key sector that would have stimulated larger multiplier effects on the growth of other sectors and thereby to the economyat large. Thus, this divergence in the growth process requires someone to pose a question on the issue of which one could be the right path. Therefore, a proper understanding of sectoral linkages is necessary for designing appropriate long-run strategies and for concentrating investment on appropriate sectors to achieve a sustainable growth rate in real GDP and to accelerate the process of economic development.

Studies on sectoral-inter linkages are very important for a developing country such as Ethiopia. Such studies help to identify linkage effects that may positively influence a strong relationship among sectors and promote and sustain the economic growth momentum.

Ethiopia has registered remarkable, rapid and stable economic performance with average annual growth rate of 10.9 per cent over the period between 2004 and 2014. This isabout double the average growth rate of Sub Sahara Africa and triples the world average growth rates over this period. This rate of growth has enabled Ethiopia to be one of the fastest growing economies in the world. The growth performance continued to be robust and broad based from the production side, due to all the major sectors registered positive and significant growth (UNDP 2014).

The Ethiopian economy has undergone a structural shift in terms of the changes in the shares of agricultural, industrial and services sector in the gross domestic product (GDP) over the last couple of years. From a primarily agro-based economy during the 1960s and 1970s, the Ethiopia has transited to an economy, whose services' sector tends to contribute almost equally with agricultural sector without having a robust growth in the industrial sector (Ibid).

In 2015/16, agriculture, industry and services sectors contributed 40%, 14% and 46% to the GDP respectively and the shares of agriculture, industry and service sectors in the GDP stood at 43%, 12% and 45% respectively in 2012/13. However, still agriculture continues to be the main source of employment than the service sector. In 2013, 72.7% of employment was generated in the agriculture sector, whereas the shares of service and industry sectors were 19.8% and 7.4 % respectively. This implies that the labourproductivity in service sector exceeds the agriculture sector, which employs the bulk of the people. That means the quality of jobs and incomes in the service sector are higher than those in the agriculture sector (NBE, 2015/16).

The shift in the economic composition probably causes considerable changes in the production and demand linkages among various sectors of the economy and it could have significant implications for the development process of the Ethiopian economy.Thus, the case for agriculture as a focus of economic growth strategies must rely on identifying a set of inter sectoral linkages through which agricultural growth contributes to the growth of other sectorsin the Ethiopian economy. The industrial sector has maintained modest increments over the years in terms of value added despite registering 18.5% annual growth rate, in 2012/13 which was buoyed by the construction boom and expansion in mining and manufacturing sub-sectors. Structurally, the service sector has been slowly taking over the lead from agriculture in terms of its contribution to the gross national product (UNDP, 2014).

1.2. Statements of Problem

A research on inter sectorallinkages plays a significant role in terms of assessing the degree of interdependence among sectors in an economy, the capacity of the growth of one sector in motivating the growth of other sectors and to guide policy makers to intervene that may enhance inter-sectoral linkages over time. In other words, it helps to provide inputs on inter-sectoral dynamics that could be useful to plan a favorable and suitable development strategy.

Lack of structural interdependence or inter linkages among sectors is one of the most distinctive characteristics of many developing countries such as Ethiopia. Ethiopia needs to determine whether linkages between sectors are converted into growth incite or not as the issue of inter sectoral linkage has serious short and long-term implications on development. The Ethiopian economy has been growing fast over the last years and makes it amongst the fastest growing non-oil economy as well as landlocked countries in the world. The Ethiopian economic history is changing from drought, famine and low economic growth to fast and sustainable economic growth (NBE, 2012/13).

Although the economy has been growing well in the last decade, the recent slowdown of the economy as witnessed in 2015/16 due to unfavorable world weather condition and drought indicates the existence of some problems in the Ethiopian development dynamics lead us to pose some issues for researchfordevelopment planning and strategies. Whether the existing growth continues over the years with existing structure of the country? Has there been strong sectoral interdependence? If there is; which sector contributes more to the overall growth dynamics and which sector determines or contributes positively or negatively to the growth of the other sector? How can the country attain a diversified and a more sustainable economic growth? This study aims to dealing with these and other similar questions. Addressing these issues may have some importance in providing inputs for designing appropriate long-term strategy to sustain, if possible boost further the current high growth performance in the next years ahead by way of, for instance, considering policy interventions, which are able to opening up faster growth potentials. This requires empirically identifying the existing sectoral linkages, establishingthe direction and the extent of the linkages and also how could they potentially be nurtured.

So far some studies such as Block (1999), Alemuetal (2003) and Fekadu et al (2007) have done on the relationships between agriculture and non-agricultural sectors and on agricultural growth linkages with other sectors. As far as the researcher knows, the effects of growth in industry and service on the growth of agriculture sector have not been addressed by the above studies. Having this gap as an entry point, this study will try to identify the impact of growth in any one of the three broad sectors on the growth of the remaining two other sectors. Specificallythis study tries to empirically assess the effects of growth in industry and services on the growth of agricultural sector or vice-versa.

As far as the researcher knows, most of the above intersectoral linkage studies were conducted before a decade and no research has been conducted recently in the case of Ethiopia. The contribution of sectors to economic growth is bound to change from time to time, as a result a recent literature is required to show which sector has a higher linkage effect and growth contribution to other sectors. This paper fills this gap of literature. Once linkages are identified, the information could be used to determine the likely impacts of policies adopted by the country. Government policies in LDCs are often aimed at boosting the output of particular sectors, for example by trade protection or provision of different incentives as against others. Feeding the results of this type of study into the policy formulation process may help to diminish unintended outcomes of such policy interventions.

Furthermore, the likely impact of the current higher contribution of the service sector to long-run economic growth has been ignored in the literature. This paper intends to fill this research gap and intends to provide policy implications that may potentially redress various socioeconomic problems such as poverty, unemployment and income inequality. In determining inter-sectoral relationship the use of appropriate econometricmodelshas a paramount importance.

This study also intends to measure the long-run and dynamic short-run relationship between the relevant variables. A dynamic multivariate econometric model is used to encompass the interactions of the various sectors in an economy, and identify the key sectors, and generate forecasts for policy simulations.

1.3. Research Question

(1) Are sectors of the Ethiopian economy interdependent in their growth process?
(2) If there is a causal relationship (interdependence) among the sectors of Ethiopian economy, how strong it is?
(3) Is there a long-run relationship among the sectors?
(4) Which sectors have a larger linkage with other sectors of the economy?

1.4. Hypotheses

(1) Service sector has a positive linkage with agriculture and industry by way of providing transport and market access in the process of buying inputs and to selling their outputs.

(2) Agriculture sector contributes to the growth of other sectors in terms of providing raw materials or inputs; therefore agriculture has had a positive linkage with other sectors.

(3) An increase in the growth of one sector will result in the growth of the other two sectors; (therefore there is a bi-directional relationship between sectors with each other in the long run).

1.5. Objectives of the Study

The main objective of this study is to measure inter sectoral linkages and thereby identify key sectors of the economy in terms of creating linkages and the effect of interdependence among sectors on economic growth in Ethiopia.

1.5.1. The Specific Objective of the Study

- To identify the existence of short and long-run growth relationships among agriculture, industry and service sectors

- To assess the magnitude and direction of the linkages among sectors
- To identify the key sectors that promotes growth in the other sectors in the economy over time.
- On the basis of empirical findings, to draw some policy implications.

1.6. Significance of the Study

Achieving economic growth with a proper structural transformation among sectors in the economy is one of the major objectives of countries. Ethiopia, as a developing country, recognizes the need to achieve a structural transformation for rapid and sustainable growth. To this effect, researchers may need to provide inputs for policy making, particularly in the areas of inter sectoral linkages between economic sectors to guide the potential intervention of the government.

This study tries to provide an evidence on the interaction of sectors to achieve economic growth in Ethiopia during the period of 1974/75 -2015/16 and provide some policy implications. It also contributes to the literature on structural transformation of the Ethiopian economy in general and provides evidence on the long run and short run relationship among sectors of the economy and serves as a spring board for further studies related to this area. The research also tries to indicate problems that need further investigations by other scholars.

1.7. Scope and Limitation of the Study

The study is restricted to use 42 years of annual time series data covering the period between 1974/75 and 2015/16 due to lack of data before 1974/75. This study focuses only on the broad three sectors (agricultural, industry and services) and does not go down to sub-sectors, due to shortages of data particularly, for the early periods. To avoid data inconsistency; attempt is made to stick only on two official data sources. Provided thatthemain aim of this study is to analyze the intersectoral linkages and their contribution to economic growth, other factors that contribute to economic growth like technology and resource availability are not addressed and might be considered as a limitation of this study.

1.8. Outline of the Research

The remaining part of the paper is organized in five chapters. The second chapter deals with the review of theoretical and empirical literature related to the research topic. The third chapter presents and discusses the methodology,estimationtechniquesand also the sources and types of data.The fourth chapter presents an overview of the Ethiopia economic history and macroeconomic structure. Chapterfivepresents interprets and discusses empirical findings. Finally, chapter six provides conclusion and policy implications based on the findings of the study.

CHAPTER TWO

LITRATURE REVIEW

2.1. Theoretical Literature Review

2.1.1. Basic Concepts on Inter Sectoral Linkage

Sectoral linkage is the central issues of development economics. Modern economic growth processes not only involve significant increase in level of productivity but also require linkages in the distribution of inputs and outputs across sectors. According to Kuznets,(1979) without proportionate and considerable shifts in the shares of various sectors, achievement of high rates of growth per capita or per worker are impossible. Economic growth on a longer period cannot be achieved without the role and growth of different economic sectors. The economy is the collection of economic sectors, but composition and development level of economic sectors may be different. It is rather a new area of focus that deals with linkages and composition of economies; which is called “structural economics”(TomaLankauskienė, 2013).

2.1.2. The Lewis Theory of Development or Dual Economy Model

The theory of sectoral linkage is derived from classical models of a dual economy (Lewis, 1954) and it accounted in the growth literature as a central theory and an important source of growth and productivity improvement. The appropriate model of developing countries is the one that displays economic duality whereby both the technically advanced and primitive sector exists.Lewis (1954) developed pioneer theoretical pedestals on the dynamic interaction between agricultural sector growth and industrial sector growth of an economy. They state that growth in agriculture sector has a direct motivating impact on industrial growth through its forward and backward supply and demand linkages in terms of resource outflow, by providing inputs such as raw materials, capital, surplus labour and savings in order to improve the overall economic growth or output.

On the other hand, the growth in the industrial sector can promote agriculture production demand directly through its products related to agriculture production such as irrigation technology, chemical and biochemical technology and indirectly through its higher wages. These development theories stressed the positive relationship between agriculture's output growth and industry's output growth (Lewis, 1954 and Hirschman, 1958).

According to Dang, and Sui Pheng(2015)thesectoral linkage model developed by (Lewis (1954) may mislead policymakers, in terms of the pattern of development. Because the model implies, the reallocation of labour from the agricultural sector to the industrial sector is considered the engine of economic growth. Following this many developing countries implemented policies that often encourage the industry sector and overlook agricultural sector through the transfer of labour and other resources from agriculture to industry sector. The criticisms of these models were strengthened by the fact that in many developing countries, poverty was widespread. In the last two decades the negative effects of policies that twisted against that very important sector (agricultural sector) have come to be generally recognized (World Bank 2000).

According to new structural economists (Silverman, 1992)one of the key factors that differentiate successful countries from unsuccessful ones is considered as the natureofsectoral composition takes place. Therefore, they argue that the starting point for comparative economic analysis and the design of appropriate policies should be economic structures.Subramaniametal (2009) on the basis of the law of comparative advantage, the accumulation of capital and technology in the comparative advantage sectors are the engines for economic growth in the countries where trade and integration are the major development strategies. For comparative advantage sectors, the pattern of inter-sectoral linkages will be critical factors for the future course of the economy. If the sectors are strongly linked, the spillover effects could be significant.

However, the law of comparative advantage implies agricultural growth and industrial growth have negative link and their end result determine the direction of linkages and the magnitude of multipliers (Wright,1979). If the agricultural sector is negatively associated with the industrial sector, a technology and capital accumulation into the industrial sector will influence the agriculture sector negatively. As a result agricultural productivity lowered and this implies cheap labour supply which the industrial sector can utilize. This view indicates, the two sectors are competing for labour. Rising labour wages by industrial sector reduce labour force in agriculture sector. However, when the industrial sector competes with agricultural sector for scarce labour a harmful link emerged between agricultural and industrial productivity.

Hence, in order to repeal the harmful impact, increase the agricultural sector productivity through improved technology, skilled labour, better yielding seedlings, and among others. Two way feedback linkages or a bidirectional causal relationship between agriculture and industry sectors leads to greater productivity in the use of resources, and sustainable economic growth (Abdulkarim et al, 2012). Furthermore, if the agricultural sector has a greater multiplier effect than the industrial sector then diminishing the agricultural sector might have a harmful impact on the overall economy (Vogel, 1994). Therefore, policymakers in each county's economy should pay better concentration on the way of how agricultural sector resources transferred to the industrial sector and analyses the negative impacts on the agricultural sector before diminishing agricultural sector.

2.1.3. Structural Change and Patterns of Development

Structural changes in economic growth processrequiresthe change in consumer demand on food and basic necessities to desires for diverse manufactured goods and services, international trade and resource use. Following this, sustainable economic development requires transformation from agriculture sector to industrial sector and then structural change from industrial sector to service sector (Kuznets, 1961). The process involves the movement of labour from agriculture to industry and then to services sector. In this case, structural transformation follows two phases. In the first phase of development the majority of the labor force is engaged in food production. Labor shifts from agriculture in to industry and services when food output increases. In the second phase, labor moves from agriculture and industry sectors into the services sector. This process of structural transformation was followed only by developed countries.

According to Bah (2009), many developing countries are following processes that are very different from the above process. The share of services in output is high at relatively low income per capita in many developing countries in Africa, Latin America and some Asian countries. In these countries, the service sector grows rapidly without proper transformation from agriculture to industrial sector and at low level of development in the manufacturing sector. The traditional economic development path presented by Kuznets and Rostow from agriculture to manufacturing and then to service is not the only path for economic growth and progress. A country with a large pool of cheap labor could attract more labor intensive manufacturing industries, and highly skilled labour could attract a number of activities in the service sectors. Therefore, developing countries do not have to follow the traditional steps (Rostow's model of development) of sectoral economic progress.

Silverman (1992)explainedat the early stages of development agriculture plays an important role by provides important resource as inputs to the industrial sector. Since wage rate in the industry sector will be higher than that of the agriculture. The value marginal product of labour (VMPL) in industrial sector is higher than in agriculture because productivity in the industrial sector is higher than the agricultural sector. Consequently, resources are transferred from the agriculture sector to the industry sector (Rural agricultural workers will migrate to urban areas) to earn higher wage. This is recognized a forward linkage in the growth theory.However, according to Subramaniam (2010), during VMPL is equated among sectors the performance of agriculture in the latter stages of development could be mixed.

Subramaniam (2010) points out another factor that affects sectoral linkage in terms of changes in the demand for goods. As the economy grows, the consumption patterns of people changed, and these changes might lead to structural changes in the economy. The Neo-Classical economic theory suggests that the demand for normal goods increases as income increased; it further suggests that the magnitude of demands of normal goods depend largely on the income elasticities of goods as a result of shift in demand. Several studies explain that (Onakoya, AdegbemiBabatunde, 2013) the income elasticities of agricultural products are smaller than industrial goods because agricultural products directly depend upon uncertain natural climatic conditions. Unfavorable weather condition may lead to low agricultural yield and considerable increase in the price of agricultural products. However, the industrial sector performance depends mainly on installed machinery; therefore, their price may be stable. Consequently, people are willing to spend a larger amount of their additional income on industrial goods due to increase price of agricultural products, this leads to the industrial sector will grow faster than the agricultural sector. Accordingly, further structural adjustment between sectors of the economy are necessitating in the economy. However, the agricultural sector will be benefit from the increased income in the industry sector, therefore, a positive linkage is expected.

Similar to the industrial sector, the service sector could negatively influence to the growth of the agricultural sector due to changes in productivity and differences in income elasticities. As the given economy come into a higher level of development, income elasticities of service goods become greater than those of agriculture and industrial goods (Jacoby, 2013 and Rostow, 1960). In most industrial economies, the service sector replaced the place of the manufacturing sector as the leading sector. This indicates that after the manufacturing and agricultural sectors productivity has increased to the maximum possible; the service sector will accelerate economic growth. At a highest level of economic development, the demand for jobs in the service sector increases more and more resources will transfer from the manufacturing and agricultural sectors to service sector. As a result, this condition creates a negative linkage to the other sectors.

The alternative argument implies that the growth in the service sectors allow other sectors to take advantage of the benefits of economies of scale. Growth in the service sector like banking, telecommunication and transport could make a positive linkage to rest of the economy. Unlike the agricultural and industrial jobs, most of the service jobs cannot be fully replaced by machines. As a result the greater proportion of human intervention and quality service personnel are required in most of the service sector jobs which further strengthen positive externalities to the rest of the economy(Rostow, 1960). Growth rate of labor productivity in the service sector cannot be the same as those of the agricultural and manufacturing sectors, because most of the service sector jobs cannot be performed by machines. This will lead to a continuous growth in the service sector and an increase in labor productivity, while employment in other sectors slows due to technological progress. Consequently, the service sector becomes more important, expensive and have continually increasing share of GDP as compared to other sectors.

Furthermore, according toSubramaniam (2010)specialization and free-trade encouraged labor intensive industry sectors into countries, agriculture was the major economic sector. The economies of most of high and middle-income countries focused mostly on service oriented industrial sectors and less dependent on manufacturing. On the other hand, least developed countries focused on the transfer of resources from less efficient agricultural sector to more efficient industrial sectors. However, countries with vast agricultural resources end up with an inefficient agricultural sector for longer periods, while countries with limited agricultural resources may achieve faster economic growth through investment in efficient manufacturing and service sectors.This trend indicates that the manufacturing and service sectors are progressing, while agricultural sector appears to be losing in the current economy. The share of service sector to GDP growth increase due to the difficulty in outsourcing, however, modern technological information such as internet, telecommunication, and transportation facilities, have made feasible outsourcing some of service sectors.

Generally, the relationships or linkages among the different sectors is complicated and multi-directional. Assuming free flow of resources, this complicated cycle of linkage will continue until the VMP (value of marginal product) of resources is equalized among the sectors and reaches at equilibrium. The average wage rates and the productivity of resources will be increased across the sectors and the economy will have experienced higher growth at the higher equilibrium level. With this equilibrium condition in the short run the technological changes will lead to higher profits, whereas the consumers will enjoy lower prices in the long run. As a result demand for better production technologies (machineries) and skilled man power should increase in the agricultural sector. The number of farm workers will have decreased which replaced by the skilled labour force, but the significant change in output level depends on adaptation of efficient technologies and the transfer of resource from the agriculture to other sectors in the economy. Finally both the industrial and service sectors must be responsible to respond the farmers need by providing machineries and skilled labors to establish strong backward linkages to the agricultural sector. The resulting economy will record higher growth rateJacoby (2013).

2.2.EmpiricalLiterature Review

Duarte and Restuccia (2007) built a general equilibrium model to capture the process of structural transformation for Portugal. The structural change pattern indicates that a shift of employment and production from agriculture to industry and then to services, as a result the share of output of the agriculture sector declined and the shares of output of industry and services increased with the dominance of the service latter. Differences in the level of competition between sectors may be accountable for their diverse productivity performance. One possible source for differences in the level of competition across sectors is the degree of foreign competition.

Accordingly economists have become interested to analyze the relationship between structural change and economic growth and how different sectors interact with each other in the process. However, the direction of causality between changes in sectoral composition and economic growth and the linkages between agriculture, industry and services cannot be assumed to be unique and should thus be established empirically. Different plentiful empirical studies should be explaining sectoral linkage in the literature. The use of SAM and input-output framework are common in the literature.

Using the input-output framework, Saikia, (2011) investigates the inter-sectoral linkages among agriculture, industry and service sectors in the Indian economy. The findings show strong inter-connectivity among sectors and structural changes over the study period.Both the production and demand linkages from agriculture to industry have increasedduring both the pre- reform and post-reform periods. Pre-reform period is the period before 1991 and post reform period is a period after 1991 due to the change in policy environment in the Indian economy during 1991as a result of the economic reform process. Both the production and demand linkages were primarily from industry to agriculture in the pre-reform period and which changed from agriculture to industry in the post-reform period. On the other hand, both the production and demand linkages from agriculture to service is very weak, even it has declined in the post-reform period, while industry and service has very strong production and demand linkages and it has improved in the post-reform period.

A similar study by Kaur et al. (2009) using both input-output approach and econometric co-integration and state-space modelsshows that agriculture, industry and service sectors exhibit strong long-run equilibrium relationship amongst each other in the case of India. The analysis of I-O tables from the production side reveals that input demand of the services sector is industry intensive rather than being agriculture intensive. In addition, the agriculture sector is significantly dependent on industry sector for inputs. Conversely the demand linkage examination displays that the agricultural sector exhibits strong connection with the industrial sector, while the reverse connection of industry with the agricultural sector have weakened recently. Demand linkages of the services sector with the industrial sector were observed to have strong association, the reverse connection also strengthenedovertime.The co-integration analysis indicates that the three broad sectors demonstrate strong long-run equilibrium amongst themselves. In bivariate framework also, these sectors confirm robust long-term equilibrium relationship with one another. Author analysis based on state-space model using Kalman filter also support the outcome of the co-integration analysis, as the results capture variations in one sector influencing the other sector's performance over time.

Using a Social Accounting Matrix, Vogel, (1994) investigated whether agriculture holds the strong linkages that drive industrialization in developing countries. The author compared agricultural production multipliers (forward and backward) linkages of different levels of development. The possible relationship between agriculture and manufacturing in developing countries also is examined. The result reports that agriculture create strong backward linkages to nonagricultural production at lower levels of development, due to rural household expenditures on nonagricultural commodities come from increases in agricultural income. As a result at this, the agricultural backward linkages (agricultural expenditures on nonagricultural sector) dominated its forward linkages (nonagricultural production expenditures on agricultural inputs).

Furthermore a number of studies have followed an alternative econometric approach to examine the mutual relationship and linkages among sectors(Sastry, Singh, Bhattacharya and Unnikrishnan, 2003).Of these approaches, the time-series econometric approach is the one which encompasses the time dimensions of the variablesin the model, and it is useful to take in to account all the indirect linkages among sectors.The indirect linkages across sectors could be judged through various channels including the productivity spillovers and scale-economies channels. In order to obtain reliable estimates, different problems occur in time series data. Neither theory nor econometric practice has satisfactorily dealt with problems of endogeneity of the variables involved; and it has not been possible to separate short-run from long run structural change effects. To treat each of these problemsmodern time-series econometric techniques provide the appropriate methodology that allows us to explore the linkages between sectoral GDP and productivity for agriculture, manufacturing and services in a more satisfactory manner.Studies conducted using econometric techniques during1980s or before 1990s largely focused on the use of single equation and simultaneous-equation regression models. After the late 1980s there has been a paradigm shift in the use of econometric methodologies including the introduction of more efficient cointegration and vector error-correction models (VECMs) to examine the linkages among sectors.

Yao (1996; 2000) examine the inter-sectoral linkages of the China economy based on a multivariate co-integration analysis conducted using the VAR model and time-series data for sectoral GDP indices. The author divided the economy in five sectors, agriculture, industry, transportation, construction and services, and estimated with VAR model using annual data on the real gross domestic product (GDP) originating from these five sectors for theperiodbetween 1952 and 1992 in Yao (1996) and between 1952 and 1996 in Yao (2000). In both studies the result shows that the agricultural sector has positive effects on all the other sectors, while the non-agricultural sectors have little effect on agricultural sector.

In Yao (1996), the model was estimated with structural break to account for the effects of economic reforms of post-1978 and the result indicated that the agriculture sector has strong and positive effects; the effects of transportation, construction and services on other sectors are mostly positive; conversely industry has negative effects,. This result applies only to the period between 1952 and 1978. After 1979, significant economic reforms were taken that allowed large-scale rural to urban migration and influenced the organization and trading of agricultural goods, so that these sectors' GDP become endogenous and agriculture is shown to have a strong and positive effect on all the other sectors. A comparison of economic performance before and after the economic reforms in China indicates that rapid capital transfer from agriculture to other sectors does not necessarily result in higher growth in the rest of the economy.

The finding of Yao (2000) suggests that agricultural growth could cause other sectors to grow; any increase in agricultural output had a positive and sizeable effect on the rest of the economy. On the whole, agriculture has a significantly positive effect on all the other sectors in terms of product, factor and market contributions. On the other hand, it suggests that the growth in other sectors has little impact on agriculture to grow fast. Industry provides necessary inputs to the expansion of the agricultural sector like machinery, fertilizers and increases demand for agricultural goods as inputs. The expansion of certain services sub-sectors (transport and communications, storage, financial services, etc.) can allow the other sectors to take advantage of the benefits of economies of scale, and thus make positive linkages to the rest of the economy. On the other hand, there is little inter-sectoral impact between the non-agricultural sectors. Some industry and services sub-sectors (construction, hotels and restaurants, etc.) are more labour-intensive and will thus compete with the other sectors for labour, resulting in negative sectoral linkages.

Gemmell, et al, (2000) employ a trivariate VAR model to test for the short and long-run sectoral relationships and to determine the direction of causality; by using annual data on output (1965 - 1991) and on productivity (1970-1991). The authors divided the Malaysian economy into three broad sectors, agriculture, manufacturing, and services and also examine the long-run and short-run linkages amongst them using output, and productivity. Output data contains sectoral value added at constant prices. Output growth in the different sectors can be either mutually reinforcing or mutually inhibiting. The results suggest that the expansion of manufacturing output react negatively in the short run and positively in the long-run with agricultural growth. In contrast, the expansion of agricultural sector does not affect other sectors of the economy. The increase in services sector has negative effects on agriculture in both short run and long run.

On the other hand, increases in productivity,(the ratio of real GDP to employment), in one sector tends to spill over to the other sectors in the long run. Increases in productivity of both industry and service sectors impact positively on agriculture productivity in the long run. For instance, industry and services provide agriculture with modern productive inputs, technology, and skilled managerial power that allow this sector to modernize its production techniques and thus increase its productivity. The findings also show that an increase in labour productivity in agriculture does not lead to an increase in labour productivity other sectors of the economy.

Kanwar (2000) uses a multivariate VAR model to identify the sectoral relationships and test the existence of co-integration between five sectors: agriculture, manufacturing industry, construction, infrastructure, and servicesinIndia. The sectors are associated with real GDP at factor cost over the period 1950/51 to 1992/93. The result indicated that the agriculture, infrastructure and service sectors are softly exogenous in the long-run and significantly affect the process of income generation and output expansion in the manufacturing and construction sectors but the reverse did not apply. Agricultural sector is a driving force for the other sectors and similarly, infrastructure development as well as the development of services significantly influences the development of manufacturing and construction sectors as well as encouraged the Indian economy as a whole. On the contrary, the growth process in the manufacturing sector and construction sector does not significantly impact the income generation in agricultural, infrastructure and service sectors.

Fiess and Verner (2001) Use the multivariate VAR model with Johansen approach to analyze cointegration relationships and sectoral growth in Ecuador using quarterly data for real GDP of sectors from 1965 to 1998. The result of the paper reveals a large degree of interdependence in sectoral growth. The agricultural sector is identified as a major driving force in economic growth of Ecuador. The authors also point out that the agricultural sector appears to play a major role in determining growth in the other two sectors. In overall, the agricultural sector co-integrates with manufacturing, commerce, transport and public services.

The strong positive growth effect of agriculture on the industrial sector indicates direct Grangercausality from agriculture to industry. The agricultural growth exert a direct impact on industrial growth, while the industrial sector affects the growth of the agricultural sector only indirectly through the error correction term and the growth equation of the service sector. Growth in the agricultural sector also appears to positively influence growth in the service sector.These indicate an increase in commerce of service sector with agricultural products.

Withvector autoregressive (VAR) framework,Norman et al (2007) presented an account of the patterns of sectoral interdependence in Malaysia's economy. This method facilitates the investigation of related concepts of exogenity and temporal precedence or basically Granger-causality and offers a natural framework for the study of structural change. The authors analyzed sectoral value added and labor productivity data.The study indicated that manufacturing and services sectors value added Granger-causes growth in the agricultural value added, while, growth in agricultural output does not Granger-cause the manufacturing or service sectors outputs. The result also suggest that, manufacturing and service GDPs are 'weakly exogenous' in the sense that changes in the outputs of these sectors appear to affect changes in agricultural value added but not vice versa. The rapid expansion of manufacturing value added has significant influences on the expansion of agricultural value added over the long-run. On the other hand the growth of value added of the service sector adversely influence to growth of agricultural value added in both the short- and long-runs. The results also revealed that increases in labourproductivity of both manufacturing and service sector positively impact on agriculturelabour productivity in the long-run. This is consistent with neoclassical arguments that higher productivity techniques in manufacturing will tend to spill over to agriculture.

Subramaniam et al. (2009) applied a Vector Error-Correction Model (VECM) to estimate the inter-linkages among economic sectors such as agriculture sector, manufacturing sector, services sector, and trade sector on two former command economy countries, Poland and Romania by using annual time series data from 1989 to 2007. This method was employed to identify the existence of long-run and short-run relationships among these sectors. The findings showed that the four different sectors moved together over the sample periodinboth economies. The study establishes the existence of a long-run relationship of industrial, service, trade and the agricultural sector. In Poland the industrial sector plays a positive role for the growth of the agricultural sector, however, the growing service sectors negatively influence the growth of the agricultural sector in the long run. On the other hand the Romanian agriculture is negatively affected by the rising industries, and positively influenced by the growing service sectors. In Poland, the role of agriculture in the short-run was found to be insignificant on other sectors, but it has a positive impact on the industrial sector in Romania.

Subramaniam (2010) investigates the inter-sectoral linkages among the agricultural, industrial and service sectors of former communist countries, Poland, Romania, Bulgaria and Hungary using endogenous growth model and estimated VECMandannual time series data from 1985 to 2007. This study mainly focuses on the impacts of transition on the agricultural sector and how the agricultural sector affects other sectors of these countries. The result reveals that different sectors in the economies moved together over the sample period, and consequently their growth was interdependent. This suggests that if one of the sectors deviates from the long-run equilibrium, path there is a tendency that it would return back to the same equilibrium path. All four countries were economically and socially similar during the communist era. However, the differences in the inter-sectoral linkages are caused by difference in available resources and the adopted transition policies of each country.

Sepehrdoust and Qazi (2012) use autoregressive distributed lag (ARDL) approach to cointegration to examine the long-run relationship and variance decomposition method to test the strength of causal relationship among GDP, agriculture, industry, service and oil and gas growth using data for the period between 1959 and2010 in the case of Iran. The structural changes of an economy entail that the long run co-integration and the dynamics of sector shares of the industrial, agricultural, services and oil and gas sector value added are positively related to each other and to economic growth as well and this long run relationship exists when the gross domestic product, industrial value added, agricultural value added, services, and oil and gas value added are dependent variables. Moreover, the long run elasticity indicates that one percent increase in value added of industry, agriculture, services and Oil and Gas, results an increase in gross domestic product by 0.216, 0.091, 0.431 and 0.156 percent respectively.

On the other hand, economic growth and agricultural growth positively influence the growth of industrial and other sectors. One percent increase in agricultural sector growth increases industrial sector growth by 0.164 percent. One percent increase in economic growth will result in industrial, agricultural and oil sector growth by 1.989, 0.021 and 5.321 percent respectively. While the growth of service and oil and gas sectors are negatively associated to industrial sector growth, and the growth of service sector and oil and gas sector are also negatively correlated to agricultural growth. The variance decomposition results reveal that the shock in GDP Y is explained by the service sector, the shock in industrial and Oil and Gas sectors are first explained by the innovation of GDP and then gradually shift on the service sector and the shock in agriculture is explained by the growth in GDP.

In Africa, the research by, Blunch and Verner (2006) apply the econometric framework of the vector auto-regression (VAR) co-integration to examine relationship among agriculture, industry and services sector growth in Côte d'Ivoire, Ghana, and Zimbabwe in terms of real GDP over the period 1965-97, and conduct impulse response analysis to determine the existence of long-run relations among the growth of sectors. Because of the possibility of more than one co-integrating relation, the authors apply full information maximum likelihood (FIML) techniques to test for the order of the co-integrating rank. Their results indicate a large degree of interdependence in the long-run sectoral growth in sub-Saharan Africa.

The most robust findings for all three countries are significant positive long-run relationship and short run dynamics between the agricultural, industrial and service sectors. In turn this implies that the sectors ‘grow together’ or, there are inter-linkages externalities / spillovers amongst sectors in the long-run. These findings contradict with the basic dual economy model, which predicts nonexistent of a long-run relationship between growth in agriculture and industry. The impulse response and short-run analyses supported these findings and show a positive link between growth in the industry and agriculture sectors in both the short and the long run. As for the service sector, it is found to be weakly exogenous in all three cases. This implies that the service sector is an important growthpromoting sector. The growth rate in GDP of these three economies revealed the existence of one long-run sectoral relationship in Cˆote d’Ivoire and Zimbabwe but no co-integrating relationship in Ghana at the aggregate level.

2.2.1. Empirical Literature Review from Ethiopia

In the case of Ethiopia, (Block, 1998) employed a four-sector macroeconomic model to simulate economic growth as a function of growth in four sectors (agriculture, services, modern industry and traditional industry) and their interactions with one another. The model used as a tool for measuring aggregate sectoral growth multipliers. The study measures the linkages between the major productive sectors and presented in macroeconomic growth multipliers and obtains the following growth multipliers: agriculture (1.5), manufacturing (1.3), services (1.8) and traditional industry (1.2). The most robust linkages appeared from the simulation experiments are between the agriculture and service sectors. Agriculture and services share the largest portions of the net impacts of income shocks with each other. In contrast, the two types of industrial sectors provide relatively smallest multipliers in absolute terms. Modern industry holds a much larger share of the net impact of an own-sector income shock than do any of the other sectors.

Alemu, Oosthuizen& Van Schalkwyk(2003)used vector auto regression (VAR) model to investigate causal relationships between agriculture and non-agricultural sectors, and estimate the contribution of growth in agriculture to growth in other sectors of the Ethiopian economy over time.Using two VAR modelstheyinvestigated the causality between the agricultural sector and the manufacturing sector, and the agricultural sector and the services sector for two different periods. The first period was before 1975;during which market forces used to determine resource allocation and the period after 1975, which was a period of command economy.

Theresultrevealed that the coefficients for agricultural value added were insignificant at the 5% level of significance for the period between 1975 and 1998; indicating that agriculture was a passive sector during these periods. On the other hand, agriculture had a significant contribution to growth in the services sector before 1975. Growth of agricultural sectorwas negative between 1975 and 1978, and as a result its contribution to services' sector growth was low. The contribution of the services' sector to the growth of agriculture value added was insignificant after 1975. The contributions of growth in the manufacturing and service sectors to the growth in agriculture were positive, increasing and significant before 1975; reflecting the beginning of integration of agriculture into the economy. The contribution of agriculture to growth in the manufacturing sector was insignificant throughout but positive and increasing before 1975.

Ramakrishna (2015)investigatethe long run and short run relationship among the variables that influence economic growth of Ethiopia for the period 1981-2012 by using ARDL co-integration technique and error correction model. The co-integration test has been conducted using ARDL bounds test procedure and the result reveals that there exists co-integration among the variables a sign of the existence of long run relationship among variables included in the model. The study indicates that growth in services and agriculture sectors positively influence the economic growth of Ethiopia.

Fekadu*etal* (2007) applied two complementary approaches, fixed-price semi-input-output (SIO) model and flexible-price economy-wide multimarket (EMM) model to assess agricultural growth linkages in Ethiopia. Both approaches provide the same pattern of linkages, even if with differences in the magnitudes occupied. The SIO result indicates that large gross value of output and growth linkages are generated in most of the sectors examined. However, agricultural activities provide the larger share, because of the given economic structure of Ethiopia. Much higher value-added created by the direct increase in agricultural outputs and smaller value-added generated by the direct increase in manufacturing and other industrial output. As a result the value added in total output is much higher in the agricultural sub-sectors, ranging between 77 per cent and 98 per cent. SIO model assumes that a sector's output and corresponding incomes have increased due to a productivity gain or expansion in input use. As a result demand for inputs and consumer goods rise.SIO model also used to measure the economic linkages or the multiplier effect by evaluating selected sector by sector, but such analysis is 'too narrow and focused on single-sector growth.

Flexible-price economy-wide multimarket (EMM) is adapted for this study in order agricultural sector to be consistent with the non-agricultural sectors. It is used to derive sectoral-level growth multipliers, deriving from total factor productivity (TFP) shocks in corresponding agricultural sub-sectors and estimate staples production and agricultural export. The model result indicates that the impact of agriculture growth has larger power on poverty reduction than the reduction driven non-agriculture sector growth. As a result agricultural-led growth in Ethiopia pickups more rural people out of poverty compared to non-agricultural-led growth as its larger impact on poverty. Non-agriculture-led growth also reduces urban poverty more than agriculture-led growth. However, a larger number of people came out of poverty in the agriculture-led growth compared to non-agriculture-led growth, due to the fact that more people live in rural, as a result a larger number of people came out of poverty and overall GDP grows at the same rate in both situations. Estimates also imply that growth in staple production and agricultural export will generate more than proportionate increase in total GDP.

Zelalem and Sidhu (2016) applied decomposition analysis to test the contribution of service sector to the change in total employment rate and per capita value added during the period 1999-2014 in the case of Ethiopia for two different periods. The two periods are the low growth period (1999– 2005) with average GVA growth of 4.8% and high growth period (2005 - 2013) with average growth rate of 11%. The study identified the sectors and factors which are most linked to per capita GDP growth. During the period between 1999 and 2005, agriculture accounted 85.1% of the growth in employment rate followed by manufacturing, construction and public services contributing 10.2%, 7.8%, and 5.8% respectively. But, due to the negative share of the distributive trade service, the service sector reduces employment growth at an aggregate level. With regard to per capita value added, agriculture accounts 41.2% of total per capita output

(GDP) followed by the manufacturing, construction, and personal service sectors contribution to per capita GDP growth by 26.12%, 20.01% and 14.93%respectively.

During 2005-2013, in the second period, the share of agriculture in employment rate growth is replaced by the service sector, specifically by the non-market service like government service and personal services. Conversely, agriculture, manufacturing, and distributive service had a negative contribution to the change in per capita GDP. As a result the service sector (particularly non-market service) dominated the contribution to changes in GDP per capita growth from both employment and productivity sides. It accounted 56.2 per cent of the change in GDP per capita growth, the larger share originating from the distributive trade (26.8 per cent due to its highest productivity level. The service sector has become the major contributor in Ethiopia for the growth of per capita GDP, for the productivity growth and intersectoral shifts during 2005-2013. The major contribution of service sector to per capita GDP growth drives from the distributive sector due to its higher within sectors productivity change, its contribution to employment to the GDP per capita growth originates from the non-market service sectors and its contribution to inter-sectoral shifts also comes from the higher inter-sectoral shifts occurred in the finance and business service sector.

The literature review carried out in this section shows that the results of different researchers regarding sectoral linkages and their contribution to economic growth differ from country to country, from one time period to another time period in the same country, and also depending on the variables used in the analysis and the definitions given to sectors to examine inter-sectoral linkages. Following this, different researchers argued that inter sectoral linkages between different economic sectors of an economy are complicated and multidirectional in nature and it is not an easy task to be predict easily. All these points indicate the need for precaution and make a careful and cautious interpretation of the results during the establishment of the empirical relationship between the different sectors in terms of policy implications

CHAPTER THREE

METHODOLOGY OF THE STUDY

This section presents empirical methods and data used to estimate the inter-sectoral linkages among different sectors of Ethiopian economy. This study investigate the contribution of economic sectors to economic growth and their linkages using a multivariate econometric technique for the period between 1974/75 and 2015/16 with the aim of identifying the main lines of causality and the intersectoral dynamics so as to have a better understanding of the process of economic growth, and to provide inputs for the formulation of development strategy for the country.

3.1. Theoretical frame work and Model Specification

The theoretical framework that the study is based on is an Endogenous Growth Model. Such a model is basically a log transformation of the Cobb-Douglas production function. The log form of this model allows including any relevant variable which affects the growth of each sectors. The theoreticalbases of the growth model date from the works of Ramsey (1928), with more recent applications being those of Echevarria (2000)and Gollin et al. (2004). The analytical extension here is in the presence of intermediate factorsof production. At each period, the economy has three sectors agriculture, industry and services. This section develops a three-sector model.The model developed here will emphasize differential in sectoral productivity growth as the main feature explaining differences in structural transformation processes. A representative economy is composed of three production sectors, the agricultural, the industrial and the service ones, which we denote by superscripts ”A”, ”I” and ”S”, respectively.Theresources that the economy employs are Labor (N), the stock of capital (K), and the stock of land (L).Both labor and capital are employed in theproduction of the three goods. Land is specific to the agricultural sector.The goods produced are: manufacturing (Qm), agriculture (Qa), and services (Qs).

1), the agricultural good isproduced using a Cobb-Douglasproduction function with labor (N) and land (L) asthe only inputs. This formulation assumes that capital and intermediate inputs are notused in the production directly, rather, the effects of capital and the useof intermediate inputs are completely captured by agricultural TFPquantitatively. The agricultural good is only used for consumption so the resource constraint is givenby:

$$A_t = A_{\alpha t} N_{\alpha t}^{\alpha} L_t^{1-\alpha} \quad \text{..3.1}$$

Where the TFP evolves as: $A_{\alpha t} = A_{\alpha}(1+\eta_{\alpha t})^t$. The TFP parameter Aα and $\eta_{\alpha t}$ in the equation above are assumed to be country specific.

2), Industry and Services: The Industry and service sectors produceoutput using standard Cobb-Douglas production functions with capital and labor asinputs. The Industry sector'soutput is used for consumption (Q_t) in the composite good and investment (R_t). The Industry sector resource constraint is:

$$Q_t + R_t = A_{qt} K_{qt}^{\theta} N_{qt}^{1-\theta} \quad \text{..3.2}$$

where TFP evolves as: $A_{qt} = A_q(1+\eta_{qt})^t$. The law of motion of the aggregate capitalstock (K_t) in the economy is given by: $K_{t+1} = (1-\delta)K_t + R_t$ 3.3

where δ is the depreciation rate.

The output of the service sector is only used for consumption through the compositegood. Therefore, resource constraint for the service sector is given by:

$$S_t = A_{st} K_{st}^{\theta} N_{st}^{1-\theta} \quad \text{..3.4}$$

where TFP evolves as: $A_{st} = A_s(1+\eta_{st})^t$ and the TFP parameters Aq, As, $\eta_{qt} and \eta_{st}$ are also assumed tobe country specific.

Therefore, the level of output produced depends on how the economy (firm) distributes capital across its production sectors. According to Romer (1986), output of each individual sector also depends on how capital and labor are distributed across the agricultural, the industrial and the service sectors at the aggregate level. Thus, the production function of each sector is

$$F(k_t^A, k_t^I, k_t^S, n_t^A, n_t^I, n_t^S, l_t, \Theta_t) \quad \text{..3.5}$$

Where $k_t^A, k_t^I, k_t^S \geq 0$ are the capital stocks of the agricultural, the industrialand the service units, respectively; n_t^A, n_t^I, n_t^S are the labor forceof the agricultural, the industrialand the service units, respectively, l_t is land used by the agriculture sector and Θ_t is a set of aggregate variables,which represent spillovers (externalities). We assume that the production function (5) exhibits constantreturns to scale and follow the form of Cobb-Douglas production function.

In this study the researcher specified the Endogenous Growth Model to identify the inter-sectoral linkages and to understand how they affect the economy,based on the above (Equation, 5) where the production function of the economy is given and constructed in the following form:

$$G_i = f(AGRI, INDS, SERV) \quad \text{......} 3.6$$

Where G_i stands for the growth of the sector *i;AGRI*is agricultural value added; *INDS*isindustrial value added; and *SERV* is services' value added. All the data values of the variables are transformed into log to avoidhetroscedasticity (Gujarati, 2004). If the variables are in log form, coefficients could be considered as elasticity.The natural logarithm does not change the original co-integration relationship of variables under investigation, but it can linearize the data trend and eliminate time-series hetroscedasticity. Studies such asMishraetal (2017) and Subramanian and Reed(2009) applied similar specification to analyze inter-sectoral linkage in SAARC countries and Poland and Romania respectively.

3.1.1. Estimation of Empirical Model

Before selecting the model the researcher perform the stationary to examine the data generating process ofthevalue added of agriculture sector, the value added of industry sector and the value added of the service sector. This helps to examine the time-series properties of the data in particular to determine the degree of integration of each variable. The next step is to test for cointegration among the variables involved. Cointegration test requires selection of appropriate lag length. An appropriate lag selection helps to solve problems of over-parameterizations or underparameterization (Subramaniam, 2010).Once the order of integration and the appropriate lag length are determined, the series can be further tested for the existence of long-run relationships among the variables using the co-integration technique. Following this,the short-run and long-run relationships between variables in a time series vector error correction framework would be investigated. Then, the granger causality test should be implemented to show the direction of causality between variables in both long run and short run. Finally, the researcher used Variance Decomposition Analysis and the Impulse Response Functiontoassessthe dynamic interaction among the variables.

3.2. Stationary Tests

The data of most time series macroeconomic variable show a trend and therefore they are non-stationary in level in most cases. Econometric estimations involving non-stationary time series often lead to the problem of spurious regression. The results obtainedwiththis spurious regression may indicate a relationship between variables which does not actually exist. The other reason for testing stationarity before applying a model is to determine the order of integration; whether the variables are all I(0), I(1), I(2)etc or mixed, which is a precondition for an appropriate model selection. Augmented Dickey - Fuller (ADF) and Phillips and Perron (PP) unit root tests would be used to examine the stationary property of the variablesat levels and first differences. Both tests performed with three different trend assumptions only intercept, both linear trend and intercept, and no intercept and no trend depending on the data generating process of the variablesto identify whether only the interceptor both the trend and intercept or none of them are statistically significant (Mallik&Chowdhury, 2001).

The null hypothesis in both test are H0: the series is non-stationary or has a unit root against the alternative hypothesisHa: the series is stationary or has no unit root.If the ADF and pp test statistics are less than the critical value in absolute terms, we fail to reject the null hypothesis.On the other hand, if the ADF and pp test statistics are less than the critical value in absolute terms, we fail to reject the null hypothesis.

3.2.1. Augmented Dickey-Fuller (ADF) Test

ADF is a widely used stationarity test in time series analysis, and it is an expanded version of Dickey-Fuller (DF) test (Dickey and Fuller, 1979). Dickey-Fuller (DF) test is conducted based on autoregressive of order one, AR (1) of the variablewitha white-noise error term. DF test regression does not include values of variables more than one lag, although the error term may be serially correlated with further lags. Thus, the results of this test may be biased and are not valid (Davidson and Mackinnon, 1999; Gujarati, and Kirchgassner and Wolters, 2007). The ADF test avoids this problem because it corrects for serial correlation by adding lagged-difference terms (Greene, 2003). The ADF test includes extra lagged terms of the dependent and independent variables to eliminate autocorrelation. ADF test consists of three different regression equations to test the presence of a unit root.

The general form ADF equation in which no intercept term and time trend.

$Y_t = \delta Y_{t-1} + \sum_{i=2}^{p} \beta i \Delta Y_{t-i+1} + \varepsilon_t$ 3.7

ADF equation with the auto regression includes only intercept

$Y_t = \alpha_0 + \delta Y_{t-1} + \sum_{i=2}^{p} \beta i \Delta Y_{t-i+1} + \varepsilon_t$ 3.8

ADF equation, when the auto regression includes the intercept and a trend, the equation form:

$Y_t = \alpha_0 + \delta Y_{t-1} + \sum_{i=2}^{p} \beta i \Delta Y_{t-i+1} + \alpha_1 t + \varepsilon_t$ 3.9

where Yt is any variable in the model to be tested for stationarity at time t, $\varepsilon_t$is an error term with $\varepsilon_t \sim N(0, \sigma^2)$, t is a time trend variable; Δ denotes the first difference operator and ***p*** is the optimal lag length of each variable chosen such that first-differenced terms make a white noise. In the above three equations, the null hypothesis of ADF is $\delta=0$ and the alternative is that $\delta < 0$, where a rejection of this null hypothesis indicates that the time series is stationary and it does not contain a unit root (Enders 1995).

The critical values of the three regressions are different. After estimating each equation with OLS, the calculated "t" values are compared with the respective Dickey-Fuller table's critical values. However,MacKinnon (1991) implemented a large set of critical value thantabulated by Dickey and Fuller, which permit the calculation of Dickey-Fuller critical values for any sample size and for any number of right-hand variables. If the t-calculated value is greater than the MacKinnon critical value, the null hypothesis of the presence of the unit root will be rejected. Therefore, MacKinnon critical values are used for the unit root test in this study.

3.2.2. Phillips-Perron Test

According to Nandwa and Mohan (2007), Phillips-Perron (PP) test is the other test of stationarity with the same null hypothesis as ADF test. Phillips-Perron (PP) test statistic follows the same asymptotic distribution as the ADF test statistic *(*Gujarati, 2004). PP test is an improvement over the ADF test with respect to finite sample properties.Advantage of using Phillips-Perron (PP) test over the Augmented Dickey and Fuller (ADF) test is that the PP tests are robust to serial correlation and general forms of time-dependent hetroscedasticity in the error term ε_t(P.C.P. Phillips, P.C.B. and P. Perron, 1988).Besides, unlike the ADF technique, the PP test does not specify a lag length and does not add lagged difference terms to account for a potential serial correlation in the error terms.

3.3. Determination of Lags and Order of Integration

3.3.1. Determination of Lags

Before testing stationarity the appropriate number of lags to be included must be determined using the standard information criteria. Determination of the optimal lag length is so crucial, because it helps us to address the issue of over and under parameterizations and also to save the degree of freedom. Adding too few lags generates residual autocorrelation and lead to the regression residuals do not behave like white-noise processes and may tend to over reject the null hypothesis when it is true. This means the model will not appropriately capture the actual error processes so that the coefficients and their standard errors will not be well-estimated. On the other hand, including too many lags causes an increase in the mean-square forecast errors of the VAR and reduces the power of the test to reject the null hypothesis of a unit root; because an increased number of lags require an estimation of additional parameters and it causes a loss of degrees of freedom (Lütkepohl, 1990).

Davidson and Mackinnon, (1999: 612)proposed that the optimal lag length determined by using information criteria such as the Akaike Information Criteria (AIC) and the Schwartz Bayesian Information Criteria (BIC). TheAkaike Information criterion (AIC) has an advantage for lag selection of small sample size. In this study both information criteria are used to determine the optimal lag. The following formulas are used to estimate AIC and BIC criteria:

$$AIC(k) = n\log(\sigma^2) + 2k \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.10)}$$

$$BIC(K) = n\log(\sigma^2) + k\log(n) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.11)}$$

Where*n*is the sample size and k is the total number of parameters to be estimated. Given the residual sum of squares is $\sum \varepsilon^2 = \frac{Rss}{(n-k)}$∑in order to find the best fitted model, one should select a model with the lowest AIC or BIC.

3.3.2. Identifying Order of Integration

According to the Engel-Granger ApproachofEngel and Granger (1987) the order of integration of each individual time series variables must be determined before testing the existence of co-integration. One way todetermine the order of integration is ADF unit root test. Differencing and de-trendingare way oftransforming non-stationary variables.If non-stationary series is differenced once to make it stationary, then the series is said to be integrated of order one I (1). If the non stationary series becomes stationary after differencing d times, the series is said to be integrated of order d, therefore, *I (d)*.

3.4. Co-Integration Analysis

Co-integration test is applied after stationarity test is completed to check whether the linear combination of variables is stationary or not. If a long-run equilibrium relationship exists among variables, variables are said to be co-integrated. According to Harris (1995), if two or more non-stationary series are linked to form an equilibrium relationship in the long run, the implication is that; the series will move together overtime and their linear combination among them may become stationary.

Co-integration test checksfor the long run linear relationships among variables in the sense that there are short-run deviations from the long run equilibrium in the past, which determine the current relations among variables. If two time series y_t and x_t are both integrated of order *d* (i.e. I (*d*)), any linear combination of the two series will be I (*d*); and the residuals obtained by regressing y_t on x_t are also I (*d*). However, if there exists a vector *b*, the disturbance term from the regression ($e_t = y_t - bx_t$) is a lower order of integration I (*d*-*b*), where *b*>0, then Engle and Granger (1987) define y_t and x_t as co-integrated of order (*d*, *b*). Three common methods of testing for co-integration are (1) The Engel-Granger two step method, (2) Johansen Procedure and (3) the Error Correction or Autoregressive Distributive Lag Approach. In this particular, the Johansen Procedure will be used; because it is superiorto the Engel-Granger Approach. The ARDL implicitly assumes one cointegrating vector and a distinctive selection of variables as endogenous and exogenous. This makes use of the results of the Johansen method.

3.4.1. The Johansen Approach

The Johansen co-integration test is used to test whether the linear combination of the non-stationary variables is stationary or not. Johansen (1988) co-integration test method is preferred than Engel-Granger two step procedure due to the following reasons.Itallows testing for the presence of more than one co-integration vector or the presence of multiple co-integration relationships. It permits to estimate the model withoutseparating variables into endogenous and exogenous and it determines how each endogenous variable responds over time to a shock in that variable itself and in every other endogenous variable.The VAR model is formulated in Johansen procedure to determine co-integrating vector. Therefore, in this study the VAR modelfollows the Johansen (1988, 1991) and the Johansen and Juselius (1990) methodology to test and estimate co-integration.

According to Johansson procedure, the variables are modeled as an unrestricted vector autoregressive VAR (p) which represented by defining a vector of potentially endogenous variables,Y_t.

$$\Delta Y_t = \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + ... + \theta_P Y_{t-p} + \beta X_t + \varepsilon_t \text{ .... } (3.12)$$

where, Y_t is a vector of (nx1) non-stationary I(1) variables, $\theta_i$is a matrix of (nXn_p), where $n_p$the number of lag length and β are (nxm) matrices of parameters, X_t is a vector of(mX1) deterministic exogenous variables, and ε_t a (nX1) vector of white noise error term.

On the other hand, the Johansen approach follow the vector error correction format to analyze the co-integration relation when all variables are integrated of order one I (1). Based on the VECM set-up Johansen (1988) determine the number of cointegrating vector between the variables from the rank (r) of the long run matrix (Π). There are three cases to determine the number of the number of co-integrating vector or rank (r). The first case is when $r = 0$, in which case the short-run dynamics depends only on the lagged changes in the variables. The levels of any of the variables in vector Y have no long run relationship. It is tantamount to mean that there is no co-integration relation; all rows are linearly dependent and the system is non-stationary. The second case is when, the number of cointegrating vectors (r) equals the number of endogenous variables (n) $r = n$, all linear combinations would be stationary and the VAR is an appropriate model. In this case, estimating the level VAR and the VECM with unrestricted OLS will yield identical results *(*Davidson and Mackinnon, 1999).

The third case is the usual intermediate case of $0 < r < n$ In this case, the model is non-stationary, but there are *r* cointegrating relationships that are stationary; Π contains stationary long-run equilibrium information and has reduced rank. However,exogenity and causality tests support rank determination to obtain an economically interpretable linear relationship among the variables *(*Badawi, 2005*)*. The cointegrating rank test determines the number of linearly independent columns of long-run relationships (Π).Johansen (1988) proposed that, the two likelihood ratio tests; trace (λ_{trace}), and maximumeigen value ($\lambda_{maximum}$) statistics are used to determine the rank of the long-run matrix (Π) and the number of co-integrating vectors. The tests identify the number of characteristics roots that are significantly different from unity.

$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i)$ ……………………………… (3.13)

$\lambda_{maximum}(r, r+1) = -T \ln(1- \lambda_{r+1})$ ……………………………………(3.14)

where*r*is the number of co-integrating vectors under the null; $\hat{\lambda}_i$ is the estimated characteristic root (eigen values) from the estimated *Π* matrix; and *T* is the number of usable observations.

Equation 3.13 is called the *trace test*, which tests current (actual) values of the fundamentals with the hypothesis that there are at most *r* cointegrating vectors. In this test, λ_{trace} equals zero when all$\hat{\lambda}_i$ are zero. If theestimated characteristic roots are moveawayfrom zero, then the more negative is $\ln(1 - \hat{\lambda}_i)$and the λ_{trace} statistic will be larger. To test this hypothesis Ho: r =0(notco-integrated) against the alternative Ha: r > 0(one or more co-integrating vectors), and then calculate the $\lambda_{trace\,(0)}$ statistics as follow:

$\lambda_{trace}(0) = -T[\ln(1- \lambda_1) + \ln(1- \lambda_2) + \ln(1- \lambda_3)]$ …………………………..(3.15)

If the calculated statistics in this equation is rejected by comparing with critical value, then the conclusion is that there exists at least one cointegrating relationship among the variables.Equation 3.14 is the *maximum eigenvalue test*, in this test the null hypothesis is that the number of cointegrating vectors is *r* against the alternative hypothesis of (*r+1)*cointegrating vectors. If the closer the estimated value of the characteristic root to zero, then the $\lambda_{maximum}$ will be small.

Likewise, r = *0* can be tested against *r = 1* through $\lambda_{maximum}{}^{(0)}$ by using the following statistic:

$\lambda_{maximum}(0) = -T \ln(1- \lambda_1)$ ……………………………………………….(3.16)

If the calculated statistic of this equation is rejected by compared to the critical value, then the conclusion is that there exists one cointegrating relationship. To determine the exact number of cointegrating vectors, the above processes will be continued by testing $\lambda_{trace}(1)$ and $\lambda_{maximum}(1)$ $\lambda_{trace}(2)$ and $\lambda_{maximum}(2)$ and so on until we fail to reject the null hypothesis. Based on these results, we can establish the number of cointegrating vectors. When the researcher has established the number of cointegrating vectors, the next step of this analysis is to estimate the long-run estimates and the speed of adjustment coefficients using the appropriate deterministic terms.In both cases if the test statistics are greater than the critical values, the null hypothesis that there exists r co-integrating vectors against the alternative hypothesis that there are more than r (for λtrace) or r+1 (for λmax) co-integrating vector is rejected (Johansen, 1988).

3.5. Vector Auto Regressive and the Vector Error Correction Model

3.5.1. Vector Auto-regressive

In structural equation approach, basically economic theory is used to model the behavioral relationship among the variables of interest. However, economic theory is not enough to provide a dynamic specification to identify all relationships(Rahman, 2004).Endogenous variables may appear on both the left and right sides of the equations and this make estimation and inference complicated in the model. In this context a vector autoregressive (VAR) framework is needed for structural modeling by allowing all variables as potentially endogenous in the system as a function of the lagged values of all endogenous variables in the system.

According toGujarati, (2004) co integrated VAR model helps to account for spurious correlation and exogenitybias for non-stationary time series and not required to classifying variables as endogenous and exogenous as well as imposing some arbitrary restrictions on the parameters to insure identification (Gujarati, 2004). Additionally, the VAR model helps to capture empirical regularities which remain hidden to standard procedures through systematic approach by imposing restrictions.

The General VAR system of equations can be specified as:

$$\Delta Y_t = \alpha_0 + A_1 \Delta Y_{t-1} + A_2 \Delta Y_{t-2} + ... + A_k \Delta Y_{t-k} + \varepsilon_t \quad \text{.......................................(3.17)}$$

WhereYt is an nx1 vector that contains n variables in the system. αo is an nx1 vector of constants and A1 up to An are nxn vector of white noise process, with mean zero.

In most case, time-series variables have been non-stationary, the results obtained from the level VAR are spurious and misleading (Mukhopadhyay and Pradhan, 2010). If the level variables share the long run relationship (co-integrated)utilizing properly differenced variables in the VAR may lead to model miss-specification and may possess a major limitation to ignore the long run properties of the variable. In this case the VAR should be written in a VECM (Vector Error Correction Model) form as indicated below.

3.5.1.The Vector Error Correction Model

A vector error correction model (VECM) is a modeling technique which adds error correction features to a multi-factor model such as a vector auto regression model. The formation of the VECM treats all variables as potentially endogenous. Each variable, expressed in its first difference is specified to respond to changes in other variables and to the deviation of the variables under consideration from the long run equilibrium path (Mukhopadhyay&Pradhan, 2010).

The VECM has co-integration relations built into the specification; the relationship among the co integrated variables is tested using the VECM which avoids arbitrary selection of dependent and independent variables. Accordingly, endogenous variables are restricted from their long-run behavior to return to their co-integrating relationships and to allow short-run adjustment dynamics. The VECM describes how variables are adjusted towards the long-run equilibrium state. When the variables are co-integrated, the corresponding error correction representations must be included in the system. The co-integration term is known as the error correction term and the coefficients of the error-correction terms indicate the proportion by which the long-run disequilibrium in the dependent variables is corrected gradually through a series of partial short-run adjustments. By doing so, one can avoid misspecification and omission of the important constraints. Therefore, the VAR can be re-parameterized as a Vector Error Correction Model (VECM) form and VECM is a restricted VAR designed for use with non-stationary series that are known to be co-integrated (Hamilton, 1994).

Moreover, VECM can lead to a better understanding of the nature of any non-stationarity among the different component series and can also improve long term forecasting over an unconstrained model. It provides clear information about the instantaneous adjustment of the actual economic growth to its desired level. In addition, according to Engel and Granger (1987 VECM capture both the short-run and long-run properties of the model, with disequilibrium as a process of adjustment to the long run model. In order to capture both the short and long-run relationships in the model the study uses Vector Error Correction Model (VECM) which can be specified as:

$$\Delta Y_t = \mu\Omega + \Pi Y_{t-1} + \theta_1 \Delta Y_{t-1} + \ldots + \theta_p \Delta Y_{t-p-1} + \varepsilon_t = \mu\Omega + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \theta_i \Delta Y_{t-1} + \varepsilon_t \ldots\ldots(3.18)$$

where Y_t is a column vector of the current values of all endogenous variables in the system, Ω is a matrix of deterministic variables such as intercept and time trend, ε_t is the vector of errors. $\theta_j = -\Sigma A_i$, is an nxn coefficient matrix in the error correction term, which is j=1 parameters of a short-run adjustments to changes in Y_t.

$\Pi = \Sigma (Ai - I)$, is an *nxn* coefficient matrix in the error correction term, which is *i*=1 parameters of long-run adjustments to change in Yt. The *p* is the number of lag periods included in this model, which is determinedby using the AIC and BIC. The first term in equation captures the long-run effects on the regressors and the second term captures the short-run impact. The long run parameter matrix will be of the order *n x n*, with a maximum possible rank of *n*.

3.6. Granger Causality Test

Before conducting the Granger causality test, it needs to examine the time series properties of the variables in the study. Because the estimation of VAR equation to conduct the Granger causality test with non-stationary data does not provide reliable result and do not allow us to make statement about causal relationships. The co-integration test only shows the degree of association between variables and not the direction of linkage. Therefore, in order to examine the direction of linkage, Granger causality tests have been conducted. The purpose of causality test in multivariate time series analysis is to identify which variable causes (precedes) another variable. The concept of granger causality relates to whether a certain variable under investigation can help to improve the forecast of another variable. It is the test of forecast capacity. In other words, it shows to what extent the series of one variable contains information about the other series. This technique was proposed by Granger (1969).

According to Granger (1969), given two variables X and Y the existence of co-integration between X and Y must be evaluated before performing a causality test. If a co-integrating relationship is identified, then causality must exist in at least one direction. Causality can be unidirectional, if the lagged values of X predict Y but at the same time lagged value of Y not predict X that is, causality can run only from X to Y and X is said to Granger-cause Y. Conversely, causality can be bi-directional causality between X and Y, If lagged values of X predict Y and, at the same time, lagged values of Y predict X, then there exist a feedback effects. If the innovation to Y and innovation to X are correlated, then there is direct causality. On the other side, there may be no causality at all; in this case, the variables are said to be independent. In general, a time series X is said to Granger-cause another time series Y if it can be shown that the series X values provide statistically significant information about the future values of series Y; if not, X does not Granger-cause Y (Verbeek, 2003).

For a VAR first-differences system with co-integrated variables the Granger causality test must be conducted in a vector error correction model (VECM) setting (Greene 2008). Then, we next investigate the direction of causality by estimating a VECM derived from the long-run cointegrating relationship.

$$\Delta AGRI_{it}=\alpha_{1i}+\sum_{j=1}^{p}\beta_{11ij}\Delta AGRI_{it-j}+\sum_{j=1}^{p}\beta_{12ij}\Delta IND_{it-j}+\sum_{j=1}^{p}\beta_{13ij}\Delta SERV_{it-j}+\gamma_{1i}ECT_{it-1}+\varepsilon_{1it} \quad \text{……………………………………………………(3.19)}$$

$$\Delta IND_{it}=\alpha_{2i}+\sum_{j=1}^{p}\beta_{21ij}\Delta AGRI_{it-j}+\sum_{j=1}^{p}\beta_{22ij}\Delta IND_{it-j}+\sum_{j=1}^{p}\beta_{23ij}\Delta SERV_{it-j}+\gamma_{2i}ECT_{it-1}+\varepsilon_{2it} \quad \text{……………………………………………………(3.20)}$$

$$\Delta SERV_{it}=\alpha_{3i}+\sum_{j=1}^{p}\beta_{31ij}\Delta AGRI_{it-j}+\sum_{j=1}^{p}\beta_{32ij}\Delta IND_{it-j}+\sum_{j=1}^{p}\beta_{33ij}\Delta SERV_{it-j}+\gamma_{3i}ECT_{it-1}+\varepsilon_{3it} \quad \text{……………………………………………………(3.21)}$$

3.7. Diagnostic Tests on the Residual of the Vector Error Correction Model

Diagnostics test are usually undertaken to detect model misspecification, as a guide for model improvement and help as an indicators of the validity of employing impulse-response functions and variance-decomposition analyses. The estimated error correction model must pass all diagnostic tests. The post estimation diagnostic tests include: serial correlation, hetroscedasticity and normality tests (Jarque-Bera).These tests are used to confirm the basic assumptions regarding the residual and the validity of the results in this study.

3.7.1. Residual Vector Normality Test

Normality test of the residuals is one of the imperative post-estimation diagnostic tests in time series empirical studies. The multivariate Jarque-Bera (*JB*) test has been used to test the normality of residual which compares the third and fourth moments of the residuals to those from the normal distribution and test whether the series is normally distributedor not *(Eviews 9 user's guide II)*. This test statistic measures the difference of the skewness and kurtosis of the series with those from the normal distribution.Making the result normally distributed as well as the distribution is symmetrical around the mean and the kurtosis, help to ascertain the validity model.

The statistic is calculated as follows:

$$JB=\frac{N}{6}\left(S^2+\frac{(K-3)^2}{4}\right) \qquad (3.22)$$

Where N is the number of observation; S is the coefficient of Skewness, K is a measure of kurtosis; and the test statistic is χ^2 distributed with 2 degrees of freedom. The joint test is based on the null hypothesis that the residuals are normally distributed (i.e., S = 0 and K= 3) and the rejection of the null hypothesis at the standard critical values indicates non-normality of the residuals.

3.7.2. Error Vector Autocorrelation Test

Error vector auto correction test is the test of serial correlation of the residuals. It helps to identify the relationship that may exist between the current value of the regression residuals and lagged values for evaluating the complete specification and robustness of the results of an econometric model. A multivariate Breusch-Godfrey Lagrange Multiplier (LM) test isused in this study to test residual serial correlation up to some specified lag order *(Eviews 9 user's guide II)*. The test statistic for the chosen lag order (L) is computed by performing an auxiliary regression of the residuals (ε_t)on the original variables and the lagged residuals (ε_{t-L}).

$$LM = (N-D)R^2_{\varepsilon^\wedge} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.23)$$

Where D is the degrees of freedom and $R^2_{\varepsilon^\wedge}$ is the coefficient of determination obtained from the auxiliary regression, and the LM test statistic is χ^2 distributed with the null hypothesis of no serial correlation against an alternative of auto correlated residuals.

3.7.3. Heteroskedacity Test

Hetroscedasticity test of the VECM is another form of diagnostic test which is evaluated by using White's test of residuals(the Breusch-Pagan-Godfrey test),to investigate violations of the Gauss-Markov assumptions and to make sure that we have the best linear unbiased estimate (BLUE).The hetroscedasticity test includes the levels and square terms of the residuals and helps to identify whether the variance of the errors in the model are constant or not.With White's test the null hypothesis is the residuals are homoscedastic (noHetroscedasticity problem) against the alternative hypothesis of thereisHetroscedasticity problem. The test ofHetroscedasticity performed by regress each cross-product of the residuals on the cross-products of the regressors and testing the joint significance of the regression *(Eviews 9 user's guide II)*.

3.8. Dynamic Analysis in a Co-Integrated VAR Framework:

Impulse Response Function (IRF) and Variance Decomposition Analysis are the two ways in which we forecast the dynamic behavior of the VAR model.

3.8.1. Impulse Response Functions

Impulse response function (IRF) is used to estimate the total impacts of an innovation in one sector on the other and toinvestigate the responsiveness of dependent variables to shocks of each of variables in a co integrated VAR framework. According to Pesaran and Shin, (1998), an innovation (shock) to a variable in a VAR model directly affects that variable and transmitted to all other endogenous variables in the system through the dynamic structure of the VAR. IRF traces the effect of a one standard deviation shock on the current and future values of the endogenous variables and provides information for analyzing the dynamic behavior of a variable due to a random shock or innovation in other variables. The IRF show the sign, magnitude, and persistence of real and nominal shocks to the dependent variable. Impulse response only traces out the time path of the effects on a variable of an exogenous shock to another variable in the VAR model. In other words, this approach is designed to determine how each variable responds over time to an earlier shock in that variable and to shocks in other variables. The response is measured in terms of the standard deviation.

According to Hamilton(1994), to impose a one-period shock to one of the endogenous variables, say the agricultural sector, the error term of the agricultural sector equation will be increased by one standard deviation at time t=0. The shock will be maintained for only one period. In that period, the agricultural sector will affected by the shock and the shock will transfer through the system and affecting all other variables in the model. In later periods it may even have a greater impact on the agricultural sector than it did initially because of feedback effects through the other variables in the system. This study constructs IRFs to determine how a shock in the one sector will be transferred to the other sectors, and how that sector responses to shocks in the other sectors.

Impulse response function is a method of assessing the interaction among the variables in a co integrated VAR framework. It helps to identify the positive or negative impact of the shocked variables and determine how long it would take for that effect to work. The result of impulse response function based on cholesky's impulse response analyses are sensitive to the order and lag length of the variables (Lutkepohl, 1990). The results in this study are based on the generalized impulse response functions (GIRFs), to account problem of ordering and lag length based on the works of Pesaran and shin (1998).

3.8.2. Variance Decomposition

Variance DecompositionAnalysisprovides information about the relative importance of each random innovation to the variables in the VAR model and indicatestheamount of the movements in the dependent variables that are due to their own shock versus shocks to the other variables. According to Hamilton (1994), Variance decomposition can also provide a different method of system dynamic representation. It decomposes variation in an endogenous variable into the component shocks to the endogenous variables in the VAR. This approach measures the proportion of forecast-error variance in a variable that is explained by innovations themselves and the other variables. In other words, variance decompositions illustrate the portion (or relative importance) of variance in the prediction for each variable in the system that is attributable to its own innovations and to shocks to other variables in the system.

Enders(1995) suggested that variance decomposition technique breaks down theforecast-error variance of each variable toidentify which variables are strongly affected and those that are notaffecteddue to its own earlier shocks vis-a–vis shocks arising from other variables in a VAR model.

3.9. Data Source and Variable Description

The paper uses annual time series data on the value added of agriculture, industry and service sectors and real GDP, all in real terms expressed in Ethiopian local currency covering the period between 1974/75 and 2015/16. The data is obtained from the Ethiopian Federal Democratic Republic Ministry of Finance and Economic Cooperation (MOFEC), National Bank of Ethiopia (NBE) and National Planning Commission. The reason for the use of 1974/5 as a cutoff point is because consistent data could be found in the National Bank of Ethiopia (NBE) and Ministry of Finance and Economic Cooperative (MoFEC) for most variables used in this studystarting from this particular year. As this study examines the contribution of agriculture, industry and service sectors to economic growth in Ethiopia, secondary data is appropriate.

Data on industrial sectoris the summation of large and medium scale manufacturing, small scale industry and handicrafts, cottage industries, mining and quarrying, construction, electricity and water. Data on service sectors is composed of trade, hotels and restaurant, transportation, communication, banking, insurance, real estate and ownership dwellings, public administration, defense, education and health. Data on agriculture sector includes forestry, fishing, crop and animal farming and hunting. All the series are converted to natural logarithms.

CHAPTER FOUR

OVERVIEW OF ETHIOPIAN ECONOMY

4.1. Economic Growth History in Ethiopia

In modern Ethiopian political economic history, there are three regimes that followed their own macroeconomic policies to guide the economic performance and growth the country. These periods are pre 1974, between 1974 and1991 and from 1991 to the present. Each form of economic system adopted during these periods is intended to govern the national economic objectives and strategies, and also characterizes the institutional environment in which the economy is working. During the Imperial regime (pre 1974), the economic policy was largelymarket-oriented with some intervention of the ruling class; in effect it was a mixed economic policy). The period between 1974 and1991 was characterized by centralplanningorcommand economic system. Since 1991, EPRDF switched to a market-oriented economic system(Geda and Degefe, 2005) with still government interventions in some areas. In all periods, the Ethiopian economy has been primarily characterized as agrarian in which small holding subsistence farming plays a dominant role. As a result, factors that affect Ethiopian agricultural sector have had a significant impact on GDP due to its largest share in the national income and the indirect effect that agriculture has on the other sectors.

The Ethiopian economic performance was poor before the recent rapid and consistent economic growth rates since 2004. The dynamics of production structure of the economy are associated with resource reallocation; factor input and technology. This needs an understanding of the roles played by factor inputs and technological progress in the Ethiopian economy in all regimes (MoFED, 2009). The following sections present a review of the Ethiopian economy over the three regimes based on some empirical studies conducted by other researchers and descriptive analysis based on secondary data from different sources.

4.1.1. The Imperial Regime: (1930 - 1974)

During the Imperial period,land was the most important resource and source of power, accordingly the economy was predominantly subsistence agrarian with landlords used to determine the distribution of output. During this period, the Ethiopian economy had a mixed type of economy, where private and public sectors were given equal importance. The economic strategy contained elements of both export-oriented growth and import-substitution industrialization. After 1960, however, the emphasis was shifted to import substitution and protecting infant industries from external competitors (Kuris, 2003).

During l950s, new economic policy was launched to transform the subsistence agrarian economy to an agro-industrial economy. To implement this policy, the government established the National Economic Council (chaired by the emperor) during 1954/55 with the objective of improving agricultural and industrial productivity, eradicating illiteracy and diseases, and improving living standards for all Ethiopians. According to Ofcansky and Berry (1991), to achieve the objective the National Economic Council prepared two five year plans. For the first time, the country introduced the First Five-Year Development Plan (1957-61) envisaged to develop a strong infrastructure such as transportation and communications to connect rural areas; expand and improve health and education to create skilled and semi-skilled personnel to work in processing industries and to accelerate agricultural development by promoting commercial agriculture. A legislation was introduced in 1950 (Notice No. 10, 1950) with the objective of encouraging private investment growth by attracting domestic and foreign investors to participate both in the agricultural and industrial sectors (Muhammed, 2006). During this period, gross national product (GNP) increased by 3.2 percent annually, but growth in economic sectors such as agriculture, manufacturing, and mining failed to meet the national plan's targets. Exports increased at a 3.5 percent annual rate while imports grew at a rate of 6.4 percent per annum in the first planperiod (Ofcansky and Berry, 1991).

The Second Five-Year Plan (1962-67) designed to diversify production, launch modern processing systems and enlarge the productive ability of the economy. In this plan the economy was expected to grow annually by 4.3 percent, whereas agriculture, manufacturing and service sectors to grow 2.5, 27.3, and 6.7 percent respectively (Ofcansky and Berry, 1991).

Finally, the Third Five-Year Plan (1968-73) prepared by planning commission with the aim to facilitate the economic well-being of Ethiopia's by raising manufacturing and agro-industrial performance. However, the plan could not achieve its primary goals of transforming the subsistence agrarian economy to agro-industry and improve living standard of the population. The main factors that contributed to the failure of the objective ware, government's inability of administrative and technical capabilities to implement a national development plan and project managers (staffing) problems in the planning agency to identify resources (Ofcansky and Berry, 1991).

According to Geda and Degefe (2005), during the period 1960-1974, the economy achieved an average growth rate of GDP by 3.7 percent per annum. However, this growth rate was comparatively lower than the rates predicted in both the First and Second Five-Year Development Plans, which were 4.3% and 6% respectively (First Five-Year Development Plan, 1956; Second Five-Year Development Plan, 1962). The growth performances for agriculture, industry and service sectors were 2.1 percent, 6.9 percent and 7.6 percent respectively.Despite this relatively performance, the living standard of most people did not improve, because the feudal system used to exploit most of the people, particularly tenants.

4.1.2. The Socialist (Derg) Regime: 1974-1991

The military government also called Derg changed the political and economic system from a market-oriented to a command economic system with the aim of establishing a socialist economy. To this effect, the government established different economic and political institutions such as peasant association and cooperatives, marketing boards, the so called workers' party. With proclamation No. 26/1975, the government nationalized a large number of domestic and foreign producers, distributors, and service-providing establishments (Berhanu, 2001). Accordingly, government nationalized all financial institutions and private properties (extra houses, major enterprises in manufacturing industries, banks and insurance companies.). It also nationalized land in the rural and urban areas and granted the peasants "possessing rights" two parcels of land not to exceed ten hectares per grantee. It gave emphasis to the expansion of state owned medium- and large-scale manufacturing enterprises. The agricultural policy was directed to state and cooperative farms with peasants made to move into settlements under village settlement programs. The government's role in the economic activity was increased and guided by central planning in such a way that the public sector was favored while the private sector's role was diminished (Kuris, 2003).

Inappropriate economic policy, mismanagement and inappropriate institutions, together with extended internal and external social and political conflict (such as the war with Somalia and drought) were at least partially responsible for the poor and the unpredictable performance of the economy during this period. According to Geda (2001), growth decelerated to 2.3 percent between 1974/75 and 1989/90 from its average growth rate of 3.7 percent in the Imperial regime. Ofcansky and Berry (1991) disaggregated the Derg regime growth performance into four phases to have better insight into the dismal economic performance and its irregular nature of growth.

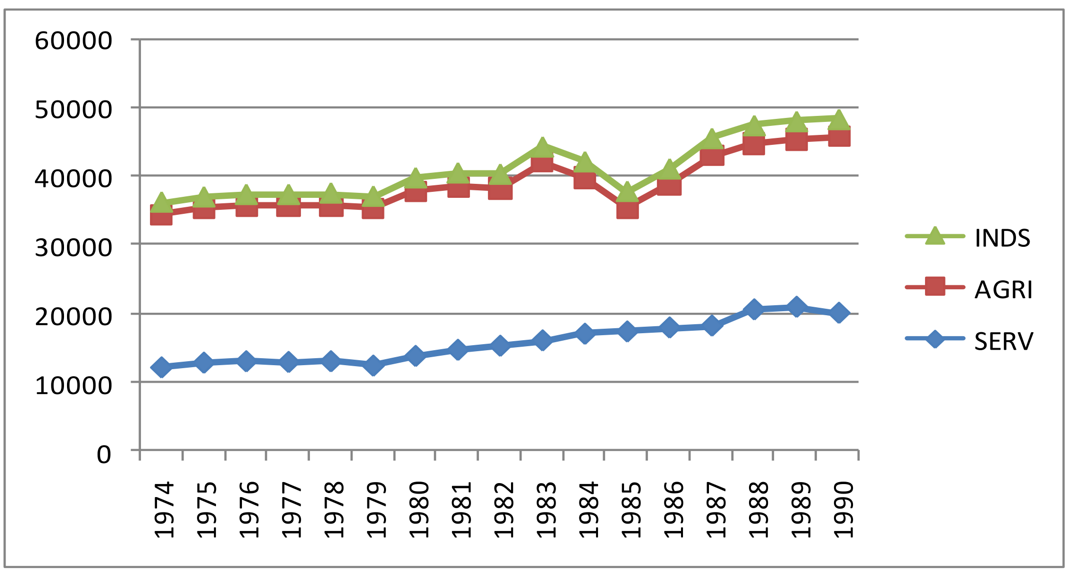
The first phase (1974-78) was the period of the revolution; immediately after the fall of the Imperial regime. It was characterized by internal political disorder, armed conflict and radical institutional reform. This condition fueled by drought made the economy dependent on naturally vulnerable agriculture. Geda (2001) indicated that the more unfavorable the weather the lower the growth of agriculture and consequently the lower the growth of the economywould be. As a result, the average annual growth of GDP was as low as 0.4 percent.

In the second phase (1978-80), the economy began to recover because implemented institutional reforms. The government's new development policy through Cooperation Campaign (known as “zemecha”) contributed to the economic recovery (Eshetu and Mekonnen, 1992). The economy on average has grown by 5.7 percent over the period 1978/79 to 1980/81 and the period was characterized by relative stable. There was improvement in security conditions both internally and externally and there was good weather condition. Benefiting from good weather, agricultural production increased at an average annual rate of 3.6 percent, and manufacturing increased at an average annual rate of l8. 9percent (Ibid).

During the third phase (1980-85) the economy experienced severe drought (1983/84 and 1984/85). Except for Ethiopian fiscal year 1982/83, the growth of GDP continued to decline. Both manufacturing and agricultural output declined dramatically. As a result, the government was unable to respond to famine due to scarce resources and forced to postponelong-term development projects. Defense expenditures accounted 40 to 50 percent of the government's current expenditure and the largest military establishment created a major burden on the economy during this time (Ofcansky and Berry, 1991).

During the fourth period (1985-90), the economy continued to stagnate, despite an improvement in the weather condition in 1985/86 and 1986/87, which helped to increase the agricultural output. GDP and the manufacturing sector also grew during up to 1988. After that the economy started to de-accelerate because of the increased intensity of the civil strife. . The collapse of manufacturing and the construction sector were responsible for the sharp drop in the industry's value added which resulted GDP to stagnate at an average annual rate of 5 percent despite revival of agriculture at a relatively higher rate (Ofcansky and Berry, 1991).

Figure 4.1: Sectoral Value Added in Derg regime in (, 000)



Source: Own computation based on MOFEC and NPC data source

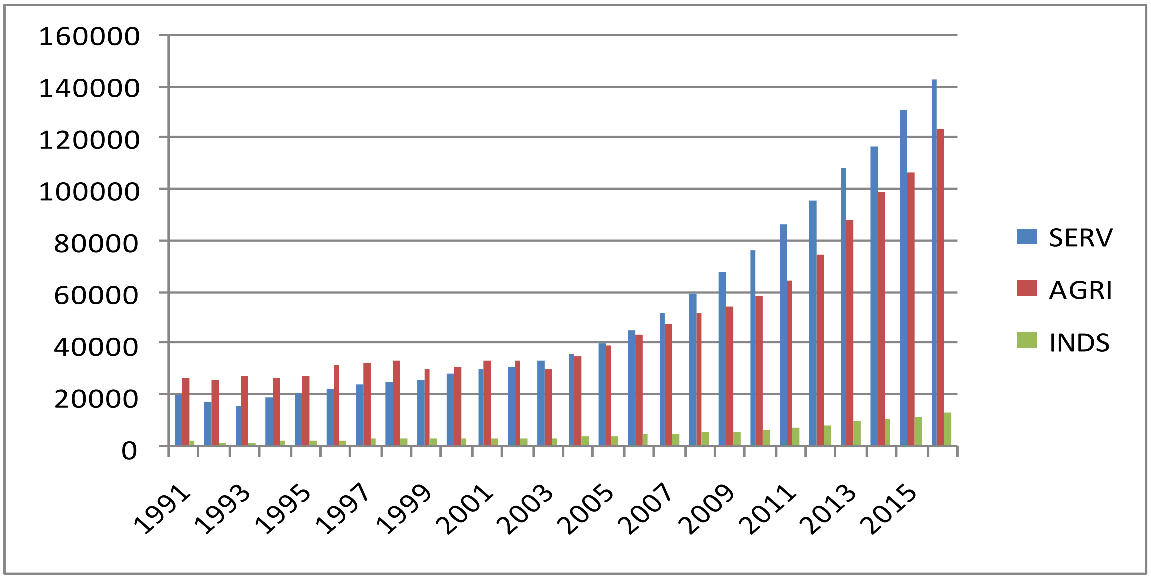
EEA (2007/08) indicated that the average annual growth of real GDP was 2% during the entire period (1974-1991) with growth rate of agriculture, industry and the service sectors being 1.3, 1.4 and 3 percent respectively. Figure 4.1 indicates that the service sector value added increased over entire period of the Derg regime. Due to the effect of drought in 1984 and 1985 agricultural value added decreased; which subsequently lead for the industry value added to decline. This pattern of growth is an indication of the significance of the agriculture sector in the growth of other sectors. To sum up, the Derg period was characterized by low economic growth and irregular growth pattern due to recurrent drought, conflict both internally and externally and the command economic system.

4.1.3. Ethiopian People Revolutionary Democratic Front (EPRDF): 1991 to the Present

The Transitional Government of Ethiopia (TGE) established after removing the Derg regime reduced the role of government in the economy and encouraged the private sector participation through various economic reforms (Ethiopian Investment Commission, 2008). It introduced a labor intensive, export-oriented and agriculture-led industrial development strategy (MoPED, 1993). The new economic policy aimed to creating a favorable environment for both domestic and foreign private investment. It also perused Structural Adjustment Program (SAP) as suggested by multilateral financial institutions,the World (WB) and the International Monetary Fund (IMF), which, among other things, created a wider room for the private sector to play a significant role in the economy. As a result, economic performance has shown a relative improvement instead of fluctuations (due to recurrent drought, war and land degradation) over the period.

Ethiopia registered strong economic growth within the past two decades due to the government policy emphasize towards public and private investment, commercialization of agriculture sector and nonfarm private investments (Gedaand Befekadu, 2005). Except the period between 1997/98 and 1998/99, when real GDP decreased by 0.1 percent because of severe drought and conflict with Eritrea, GDP continued to grow over the preceding year. As indicated in Figure 4.2, despite relatively high growth in all sectors, the service sector tended to grow faster and tended to dominate the agricultural sector in terms of the contribution for GDP. On the other hand, the industry sector has remained more or less stagnant in terms of its share in GDP although it has been growing over the period.

Figure 4.2: Sector Value Added after 1991 (, 000)



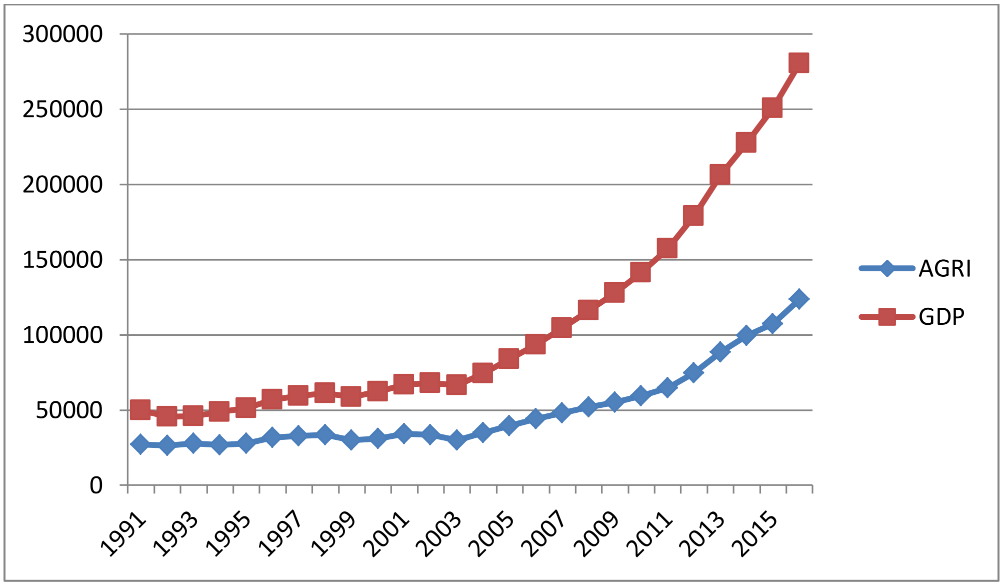
Source: own computation based on MOFEC and NPC data source

The contribution of agriculture continued to shrink and reached to 36.7 percent from 52 percent between 1992 and 2015/16(NBE, 2015). The share of service rose from 31 percent in1992 to 47.3 percent in 2015, while the share of industry in GDP increased marginally from 13.3 percent in 1992 to 16.7percent in 2015 on average. This indicates the existence of some form of structural transformation from agriculture to the service sector in the Ethiopian Economy. This indicates that the economic performance of Ethiopia mainly depends on the volatile and vulnerable agricultural sector and the recently increasing service sectors.

According to Geda (2001), dependence on rain-fed agriculture had a negative multiplier effect on production levels in subsequent years. Because the fall in agricultural production creates a severe shock to the Ethiopian economy and the shock in one period is transferred into the next as the early years of the drought damages d not only the current income but also thewealthof peasants to the extent of forcing them to sell their oxen. The next season agriculture may also be severely affected as farmers might have lost their capital (oxen) or other inputs might have migrated somewhere to search for food. In general, the role of agriculture in GDP growth performance has been significant. Rate of growth of GDP has been positive since 2004 and the service sector tended to take the dominant role of agriculture in shaping the growth trend of GDP

Figure 4.3 supports this idea. Up to 2004, GDP growth mainly depended on the agriculture sector and there were periodic and irregular co-movement of GDP and agricultural growth. After 2004, GDP continued to grow rapidly even periods where there has not been significant increase in agricultural value added.

Figure 4.3: Real GDP and Agriculture value added in (,000)



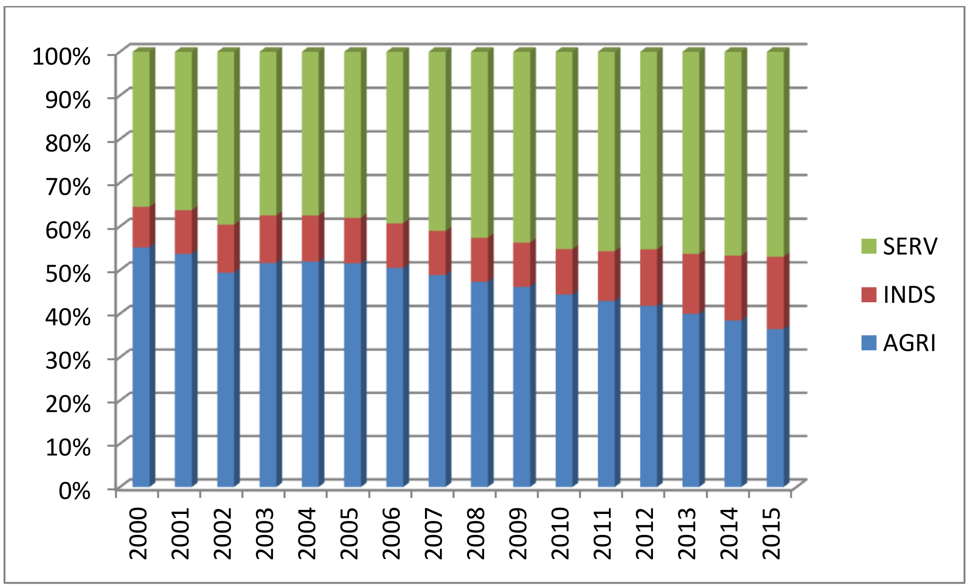
Source: Own computation based on Magic and NPC data source

This might indicate that the introduction of Agricultural Development Led Industrialization (ADLI) strategy and other policy packages helped to raiseproductivity of smallholder agriculture and also the growth of labor intensive industrialization. Agriculture has played a deriving-force behind the rapid growth in the economy.

4.2. Economic structure and macroeconomic performance of Ethiopia

The agriculture sector has played a central role in the economy of Ethiopia for the last four decades (1970/71- 2008/09) with an average share of about 55 percent. As a result of this, agriculture has been the central focus of all governments. However, the sector has been performing different levels from one government to another. Over the years, the role of agriculture in economy has been declining. For instance, agriculture sector share was 65 percent in 1970/01 and this share declined to 36.7 percent in 2015/16. The share of industry was oscillating on average around 13 percent rate of growth evenincluding the period when the country has been experiencing a continuous double digit growth. Service sector's share has increased from 24.5 in 1970/71 to 47.3 percent in 2015/16 (NBE, 2015/16). The increase in the share of the service sector is coming from the increase in wholesale and retail trade, renting and business activities. The percentage contribution of each of the sectors from total GDP for the last two decades is given in Figure 4.4.

Figure 4.4: Share of Agriculture, Industry and Service sectors in GDP in %

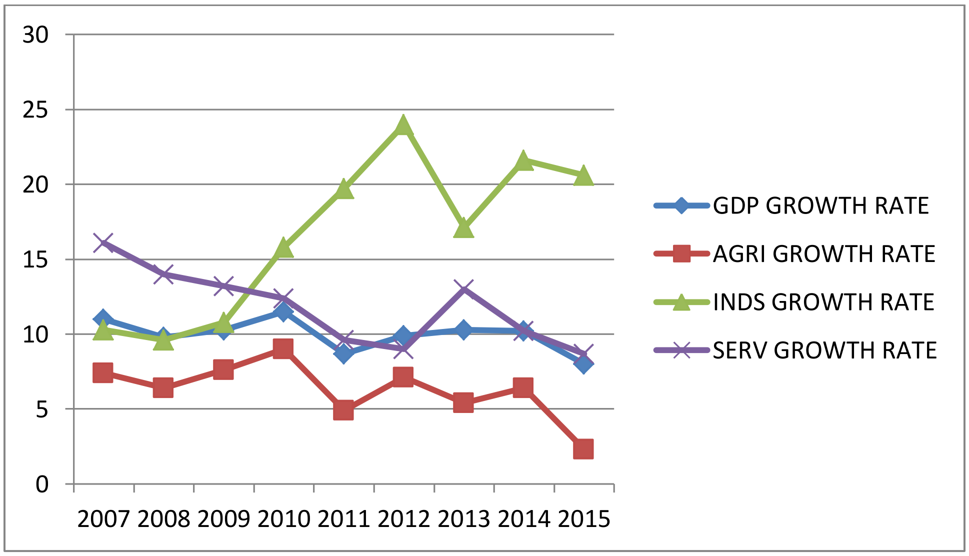


Source: Own computation based on MoFEC and NBE (2015)

Ethiopia has achieved a remarkable and sustained economic growth in the last two decades. According to Figure 4.4the share of agricultural value added to GDP has been declining after 2003 and the service sector has taken up the leading role. This is an indication of the process of structural transformation; asectoral lead shifts from agriculture sector to service sector in a natural dynamic history of economic development (NBE, 2015).

Ethiopia has a vision of becoming a middle income country in the coming one and half decades after implementing three successive five years transformation and development plan. **.** Following Sustainable Development and Poverty Reduction Program (SDPRP), the country experienced an impressive GDP growth performance (10.5 percent)between2003/04 and2012/13 (NBE, 2013/14). In 2015/16, growth rates of GDP declined from its average 10.5 percent to 8.0 percent, mainly because of a significant drop in the growth rate of agriculture to 2.3 percent and a decline in the service sector performance to 8.7 percent although industry value added has grown by 20.6 percent (NBE, 2015/16).

Figure 4.5: Growth Rate of GDP and the Three Sectors between 2007 and 2015 in %



Source: Own computation from MOFEC and NBE data source.

According to African Development Bank report of 2017, the reason for slower performance in 2015/16 was growth in the agriculture sector negatively affected by the El Niño induced drought in 2015/16. From the above we could understand that the Ethiopian economy has grown between 2007 and 2015 fast despite some years of economic fluctuations because of natural and human made problems.

CHAPTER FIVE

EMPIRICAL RESULTS AND DISCUSSION

This chapter presents and discusses the results of the empirical analysis on the relationship between economic sectors in Ethiopia based on econometric frameworks given in the methodology section using annual data from 1974-2016. Before we go directlyto the estimation of the VAR model, we conduct and present the results of various preliminary tests. We firstemploy unit root test to check whether the time-series is stationary or not followed by identification of the optimal lag length based on the VAR model and then check the presence of co-integration relationsusing the Johansen procedure. The long-run and short-run relationships are also assessedand finally the Granger causality test is employed to find the direction of causality between economic sectors. For the various types of econometric estimations, reviews 9.0 econometric soft ware is used.

5.1. Time Series Property of the Variable

5.1.1. Stationarity Test

As presented in the methodology, ADF and PP tests are performed to test stationarity.Table 5.1 represents the results of the ADF unit root test. All variables are in logarithmic forms, wherebyLNAGRI, LNSERV and LNINDSrepresent natural logarithms for agriculture value added, service value added and industry value added respectively. The results of the ADF test in different alternative formulations are presented in Table 5.1. The test result as shown in Table 5.1 indicates that the absolute values of the calculated test statistics for all variables at level are less than their corresponding probability, critical values and MacKinnon (1996) critical valueat 5 percent level of significance. As a result, all variables are non-stationary at level and the series have unit root. Thus, the null hypothesis, that the series at levels contains unit root, could not be rejected for all time series variables in the model. However, the same tests were applied to the first differences all variables and they are found to be stationary at 1% level of significance and at MacKinnon (1996) critical value. The results demonstrate that all variables in the model are integrated of order one I (1).

Table 5.1 : Augmented Dickey Fuller Unit Root Test Results

	Variable	Test Statistic Under Different Assumptions			Order of Integration
	MacKinnon critical value	Intercept	Intercept and Trend	No Trend and No Intercept	
		-3.58 (1%)	-4.15 (1%)	-2.62 (1%)	
1	LNSERV Prob.	-2.630618 (1.0000)	0.134516 (0.9967)	2.896589 (0.9987)	I (1)
	D (LNSERV) Prob.	-3.915966*** (0.0043)	-5.043559*** (0.0010)	3.626928*** (0.0008)	
2	LNAGRI Prob.	2.395369 (1.0000)	1.176907 (0.9999)	-1.594743 (0.9993)	I (1)
	D (LNAGRI) Prob.	-3.946084*** (0.0002)	-7.055951*** (0.0000)	- 3.139819*** (0.0003)	
3	LNINDS Prob.	1.769178 (0.9996)	-0.567858 (0.9758)	3.590222 (0.9998)	I (1)
	D (LNINDS) Prob.	-4.993154*** (0.0002)	-5.362256*** (0.0004)	-4.090022*** (0.0001)	

*Source: Author's own calculation using Eviews 9. Note: D shows the variable is differenced at once. MacKinnon (1996) one-sided, critical values for rejection of a unit root are used here in addition to the critical value and probability, with Null hypothesis: series has unit root andthealternative hypothesis series has not unit root, *Rejection at the 10 % level. ** Rejection at 5 % and *** Rejection at 1%) level of significance.*

The Phillips-Perron test in the Table 5.2 also gives a result that is consistent with and supports the results of the ADF. Therefore, both tests revealed that all variables included in the model are not stationary at their levels but they become stationary in their first differences and thus the variables are integrated of order 1, *i.e.*, I (1).

Table 5.2 : Phillips-PerronStationarity Test Result

	Variable	Test Statistic Under Different Assumptions			Order of Integration
	MacKinnon critical value	Intercept	Intercept and Trend	No Trend and No Intercept	
		-3.58 (1%)	-4.15 (1%)	-2.62 (1%)	
1	LNSERV	3.264111	-0.035662	2.525637	I (1)
	Prob.	(1.0000)	(0.9944)	(1.0000)	
	D (LNSERV)	-3.975465***	-5.015332***	-4.409945***	
	Prob.	(0.0037)	(0.0011)	(0.0018)	
2	LNAGRI	6.882603	0.900706	3.050039	I (1)
	Prob.	(1.0000)	(0.9997)	(0.9992)	
	D (LNAGRI)	-5.134691***	-6.491125***	-4.297769***	
	Prob.	(0.0001)	(0.0000)	(0.0001)	
3	LNINDS	1.816331	-0.567858	3.268455	I (1)
	Prob.	(0.9997)	(0.9758)	(0.9995)	
	D (LNINDS)	-5.010085***	-5.310587***	-4.106485***	
	Prob.	(0.0002)	(0.0005)	(0.0001)	

Source: Author's own calculation using Eviews 9.

5.1.2. Optimal Lag Length Selection

In order to estimate the VAR model, the next step is to test the existence of the long run relationship among the variables. Hence, the Johansen co-integration method is applied. However, The Johansen co-integration test results could be highly sensitive to the number of lags included for the endogenous variables in the estimation of the VAR model. Before applying the Johansen co-integration test, it is critical to choose appropriate lag length that yields a good model and check the stability of the VAR model. Alternative tests including the sequential modified Likelihood Ratio test [LR], Final Prediction Error test [FPE], Akaike information criteria [AIC], Shwarz information criteria [SIC] and Hannan-Quinn information criteria [HIC] are used to determine the optimal lag length of the VAR model of co-integration test.

In Table 5.3, the result of the lag length selection criterion is tabulated. The LR, FPE, and AIC choose three lag lengths to be the optimum lag length of the VAR model, whereas, SIC and HQ tests suggest an appropriate lag length of the VAR model is one , all at a 5% level of significance. The best fitting model is the one that minimizes AIC or SIC or HQ indicates that the optimal lag length of the VAR model. The smaller the value of the information criteria, the better is the model. However in Table 5.3 the result of the AIC is different from SIC and HQ optimal lag result. To check whether three lag or one lag is appropriate in the model, VAR lag exclusion Wald test was employed to choose between lag one and lag three.

Table 5.3:VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	38.22336	NA	3.30e-05	-1.806326	-1.67836	-1.760413
1	177.5943	250.1530	4.13e-08	-8.492015	-7.980150*	-8.308362*
2	185.7607	13.40124	4.35e-08	-8.449265	-7.553501	-8.127873
3	197.9080	18.06524*	3.79e-08*	-8.610666*	-7.331003	-8.151534
4	202.1201	5.616162	5.06e-08	-8.365134	-6.701572	-7.768262

*Source: Author's own calculation using Eviews 9, * indicates lag order selected by the criterion at the 5 % level of significance.*

5.1.3. Lag Exclusion Test

To check the suitability of the lags included in the estimation techniques VAR lag exclusion test is required. The selected optimal lag length of some endogenous variables may have insignificant contributions individually as well as jointly to movements of variables. Therefore, the chosen optimal lags of all variables of the model should be evaluated individually and jointly to include in the testing of co-integration and estimation of the VECM. This optimal lag test was taken with the Wald lag exclusion test, which is asymptotically chi-square distributed. Given that VAR modeling requires uniform lag length for each variable, the result in Table 5.4 shows that the first lags of all of the endogenous variables are significant both individually and jointly at the 5 percent level of significance. Therefore, lag exclusion test confirms and suggests the first lag to be the appropriate lag.

Table 5.4 : VAR Lag Exclusion Wald Tests[1]

	LNAGRI	LNINDS	LNSERV	Joint
Lag 1	28.12498 [3.242e-06]	32.85468 [3.46e-07]	49.32091 [1.11e-10]	110.0588 [0.000000]
Lag 2	11.04271 [0.011497]	6.198950 [0.102322]	10.87842 [0.012402]	26.34549 [0.001793]
Lag 3	15.39663 [0.001507]	1.307459 [0.727363]	1.682458 [0.640841]	20.23317 [0.016527]
df	3	3	3	9

*Source: Author's own calculation using Eviews 9; *denotes rejection at 5% significance level. Chi-squared test statistics for lag exclusion: Numbers in [] are p-values*

After choosing the appropriate lag length, the next step is to specify which deterministic terms will be included in the VECM or in the cointegrating relation; a constant term and/or a trend, or none of them included in the model. Juselius (2006) suggests it is possible to use the Pantula principle in Eviews and let the software package determine which of the five models in the Johansen co-integration test is appropriate to use and which deterministic terms should enter to the model or not. Based on Pantula principle, Akaike information criteria [AIC] and Shwarz information criteria [SIC] indicates the first model of there are no trend or intercept in the cointegrating relations is the most appropriate model to determine the long-run relationships and short-run dynamic estimates.

5.1.4. Residual Stationarity Test

Like other variables in the model, the residual stationarity test was performed by ADF stationary test. The null hypothesis specifies that there is "a random walk" against an alternative hypothesis there is no random walk. The result in the Table 5.5 below reveals that the null hypothesis was rejected at the 5 percent level of significance. This indicates that variables in the model are co-

[1]The value in the square bracket indicates that the probability value of the corresponding chi-square statistics.

integrated. The values in parentheses are t-statistics for the ADF stationarity test for the residual term.

Table 5.5: Residual Stationarity Test (RST)

Variable	ADF Test	Probability	Order of Integration
ECT=RESIDUAL	-2.262107 (-2.262107)	0.0291	I (0)

Source: Author's computation using Eviews 9:

5.2. Co-Integration Analysis

The ADF and Philips-Perronstationarity test results demonstrate that all of the variables are stationary at first difference, the order of integration or lag of each variable in the model is equal to one and the residuals are stationary in level. The above result can be further strengthened by the Johansen (1988) co-integration test that investigates whether there is more than a single co-integration relationship or not.

Table 5.6: Johansen Unrestricted Co-integration Rank Test (Trace and Maximum Eigen value)

Types of Test	Null Hypothesis	Alternative Hypothesis	Eigen Value	Cointegration Test Statistic	Critical Value (5%)	Probability
Trace statistical test	Ho: r=0	Ha: r>0	0.525767	40.56066*	24.27596	0.0002
	Ho: r=1	Ha: r>1	0.168560	9.972325	12.32090	0.1200
	Ho: r=2	Ha: r>2	0.056946	2.403907	4.129906	0.1429
Maximum Eigen value test	Ho: r=0	Ha: r=1	0.525767	30.58834*	17.79730	0.0004
	Ho: r=1	Ha: r=2	0.168560	7.568418	11.22480	0.2040
	Ho: r=2	Ha: r=3	0.056946	2.403907	4.129906	0.1429

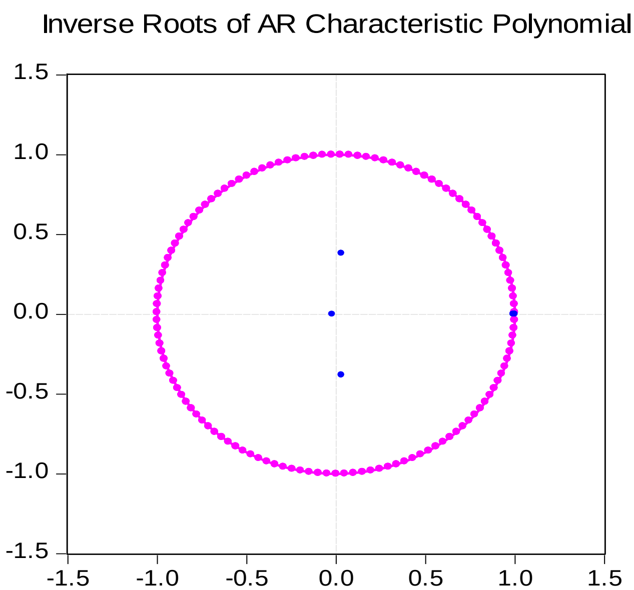
Source: Author's computation using Eviews 9, both trace and maximum eigen value test indicates 1cointegratingeign(s) at the 0.05 level, denotes rejection of the null hypothesis of no co-integration at the 0.05 level, **MacKinnon-Haug-Michelis (1996) p-values.*

Johansen co-integration test usestrace and maximum eigen value statistic, which compares to 5% critical values. Both the unrestricted co-integration rank test of trace and maximum eigen value results show that null hypotheses of r equals 0 are rejected at the 5% level (the estimated values are greater than the critical values). This suggests that both the traces and maximal eigen value tests identified one co-integrating relationships at the 5% level of significance (See, Table 5.6 above). This is an evidence to conclude that there is a significant long-run relationship among the variables and the resulting model should be a vector error correction model (VECM).

5.2.1. Model Stability Test

The stability of the model and post estimation diagnostics could affect the validity and robustness of the results of the impulse response functions and other diagnostics of estimated model. Therefore, it should be tested before proceeding to further analysis. Companion matrix and inverse roots of the AR characteristic are used to test the stability of the model. The companion matrix provides all the roots of the characteristics polynomial and their corresponding modulus. Appendix 1 indicated that the residuals of VECM has two unit roots and all other characteristic roots of the polynomial moduli are less than one and all lie in the unit circle which state that the VECM is stable. This result can also be visualized from the graph of the inverse roots of the AR characteristic polynomial (Figure 5.1).

Figure 5.1: Inverse Roots of AR Characteristics Polynomial



Source: Author's computation using Eviews 9: The VECM specification imposes 3 unit moduli

The Figure5.1 above shows that all characteristic roots of the moduli lie inside the unit circle. As a result both companion matrix and inverse roots of the AR characteristic polynomial suggests that the model under consideration satisfies the stability condition.

5.3. Vector Error Correction Model

After indicating the presence of the long-run co-integration relationship among model variables using the Johansen approach, the short-run dynamics of the long-run economic growth is examined by estimating a vector error correction model (VECM). Vector Error Correction Model (VECM) is estimated based on the Johansson test of co-integration results and using a predetermined optimal lag order chosen by the appropriate information criterion results. VECM has two parts: the matrix of long-run co-integrating coefficients (used to derive the long-run co-integrating relationship), and the short-run dynamics coefficients that are used for further analysis including the speed of adjustment (ECTt-1). The speed of adjustment towards the long run equilibrium is measured by the coefficient of error term (ECTt-1) and it is considered to be good if its range is between 0 and 1.

The appropriate model selected using information criteria of AIK and SIC indicates there is no intercept and time trend to determine the long run relationships and short run dynamics estimation.

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \theta_i \Delta Y_{t-i} + \varepsilon_t \qquad \text{5.1}$$

Π is a *3x3* matrix of the model, as the model contains three endogenous variables. One co-integration was imposed to estimate the Π matrix for each dependent variable in the model.

5.3.1. Long-run Equilibrium Co-Integration Result

Before estimating the values of the model to find the long run relationship between the variables, the researcher hastested for the stationarity and co-integration tests which make the model fit for the estimation. The number of lags also determined through VAR lag selection criteria. After imposing this normalization restriction by the Johansen method, the Cointegration test was run and one co-integrating relationships were obtained using Johansen test of co-integration. Using standard notation, the long run equilibrium condition is finally stated. The equations were estimated through unrestricted co-integrating vector with ad-hoc normalization and the Johansen test was used to confirm the suitability of the selected co-integrated equations

The long run matrix is

$$\begin{bmatrix} \Delta LNAGRI \\ \Delta LNINDS \\ \Delta LNSERV \end{bmatrix} = [\Pi] x \begin{bmatrix} LNAGRI_{t-1} \\ LNINDS_{t-1} \\ LNSERV_{t-1} \end{bmatrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5.2$$

The Π represents the product of long-term estimates, $\beta's$ and theadjustment coefficients, α , for each sector in the linkage equations. When one of the β's is randomly normalized the long-run relationships will be identified. From the above equation, there are three rows of the β matrix and three columns for the α matrix, and one can write three equations for the three variables involved in the model. The main objective ofthis study is to understand the contribution of each sector to the other sector and to what extent each sector influenced by other sectors in the economy,this study concentrates on all rows of the Π matrix (long term matrix) of VECM Equation (5.2) above.Since this study is focusing on all the three sectors, it is convenient to normalize on eachsectorindividually. Therefore, this study examine the following things: the impact of industry value added and service value added on agriculture value added; the impact of agriculture value added and service value added on industry value added; and the impact of agriculture value added and Industry value added on Service value added.

However, The Johansen co-integration test indicates there is one co-integration vectors, and then it is relevant to focus on the first column of the α matrix and the first row of the β matrix.Accordingly, the co-integration relationhas been required normalization and Zero restrictions imposed on the dependentvariables.The restriction of the identified model implies that a changein restricted variable does not have a direct long-run impact on the dependent variable.The normalization restriction for the parameter of what the economic theory suggests is the dependent variable yields a unique estimate up to a scaling parameter.But,ordering of variable lead to the most sensible set of co-integrating relation and the problem of dependent and explanatory variable identification may be happened. In this research variables should be treatedsymmetrically to avoid incredible identification restrictions and there is no a priori assumption about exogenity of variables, therefore, everything causes everything.

However, the co-integration result restricts the number of co-integration as one.As a result the researchers test each sector for weak exogenity by imposing a restriction on α matrix coefficientsstatistically zero. The validity of therestriction is tested with a classical chi-square distributed likelihood ratio test according to Johansen and Juselius (1990).The result of LR test zero restriction on the α matrix coefficients are rejected for the three sectors LNAGRI, LNINDS and LNSERV (see Appendix 3). In addition to the α matrix coefficients, the restriction in the long run coefficient of β matrix indicatives the LR restriction test rejected at 5% significant level (see Appendix 3). Therefore, it is possible to normalize with each sector separately to analyze the long run interaction among the three sectors. Thus, the single equation models with long-run coefficients are identified for each sector. The three sectors could be affected with each other in the long run. In order to determine the long run effect of all the sectors the researcher's use each sector as a dependent variable separately. While, the short runimpact of each sector on the other sector determine with the VECM simultaneously. Thefollowing section presents the results of the long-run relationships with estimated normalized co-integration coefficient vectors of all variables as below.

Case.1: Long-run Model for Agriculture sector as a dependent variable

The estimates for stable long-run equilibrium and the adjustment coefficients were estimated (Table 5.7) and normalized to the agricultural sector (Table 5.8). However, the co-integration result indicates there exist only one co-integration relationship, and then the researcher takes only the first equation of the model.

Table 5.7: Estimated Long-Run Model and Speed of adjustment

$$\beta \text{ matrix: } \begin{matrix} LNAGRI & LNIDS & LNSERV \\ -3.78614 & -7.775637 & 10.15896 \\ -1.841930 & 14.02719 & -9.187693 \\ -2.476983 & -6.391367 & 7.497069 \end{matrix}$$

$$\alpha \text{ matrix}: \begin{matrix} \text{LNAGRI} & 0.034074 & 0.005211 & 0.015232 \\ \text{LNINDS} & 0.038058 & -0.029654 & 0.000157 \\ \text{LNSERV} & 0.035917 & -0.011763 & -0.003847 \end{matrix}$$

Table 5.8: Normalized Long-Run Estimates and Speed of Adjustment Coefficients

$$\beta \text{ matrix}: \begin{matrix} \text{LNAGRI} & 1 \\ \text{LNINDS} & 2.054 \\ \text{LNSERV} & -2.68 \end{matrix}$$

$$\pi \text{ matrix}: \begin{matrix} LNAGRI & -0.129 \\ LNINDS & -0.144 \\ LNSERV & -0.136 \end{matrix}$$

The normalized co-integration equation form can be written as:-

$$LNAGRI = -2.053711 LNINDS + 2.683198 LNSERV \ldots\ldots\ldots\ldots\ldots\ldots 5.3$$

Variable	LNAGRI	LNINDS	LNSERV
Coefficient (β)	1	2.054*	-2.68*
standard error		(0.69281)	(0.54772)
T-value		[2.96431]	[-4.89887]

*Note: Values in closed bracket are t-statistics: Source: Author's Computation using Eviews 9: *indicates significant. Normalized co-integrating coefficients (asymptoticStandard error in parenthesis)*

The result of agricultural value added equation indicates that industry value added and service value added exert statistically significant long-run effects on the level of agriculture value added. The long-run impact of service sector on agriculture sector is found to be positive and statistically significant, which means that on average a one percent increase in service sector value added causes an increase in agriculture value added by 2.68 percent in the long run, holding all other variables that affect agriculture sector constant. This result reveals that the strong service sectorpositively influence investment in agricultural sector and leads agriculture sector to be a competitive sector in Ethiopia.

This result is consistent with the findings of Subramanian (2009) in RomaniaYao (2000)in China and Gemmell, et al. (2000) in Malaysian economy and their finding implies that agriculture is positively influenced by the growing service sectors and the service sector is an important growthpromoting sector in the long run. The expansion of certain services sub-sectors (transport and communications, marketing, storage, financial services, education etc.) provide agriculture with modern productive inputs, technology, and skilled managerial power that can allow the agriculture sector to take advantage of the benefits of economies of scale, and modernize its production techniques and thus increase its productivity.Thesewould have created a positive backward linkage to the agricultural sector and have a capacity to commercialized and increased productivity in the agriculture sector. This implies that the agricultural sector has benefitted from the fast growing service sector and the resource transfer from the agriculture to other sectors is somewhat limited. The direction of resource transfer confirms that the Ethiopian economy has not fully utilized its resources, and this implies that the Ethiopian economy is still at a progressing stage. It can be inferred that the agriculture sector and service sector have positive long-run equilibrium relationship between them.

The long-run impact of industry sector on agriculture sector, suggest that an increase in the industrial sector affects the agricultural sector negatively. Holding other variables that determine agriculture constant, on average a one percent increase in the industry value added results a 2.05 percent decline in the agriculture value added. The law of comparative advantage implies agricultural growth and industrial growth have negative link and their end result determine the direction of linkages and the magnitude of multipliers (Wright, 1979). If the agricultural sector is negatively associated with the industrial sector, a technology and capital accumulation into the industrial sector will influence the agriculture sector negatively. As a result agricultural productivity lowered and this implies cheap labour supply, which the industrial sector can utilize. Rising labour wages by industrial sector also reduce labour force in agriculture sector. In this case adult labor forces that are illiterate, the driver and actively participant of the agriculture sector shift to the industrial sectors especially to the construction and furniture industrial sectors.Additionally, when the industrial sector competes with agricultural sector for fertile land and capital a harmful link emerged between agricultural and industrial productivity. Accordingly, resources are transferred from agriculture to industry sector. Site selection for industrial parks are not depend on the fertility of land, most of industrial parks are constructed on fertile land not on arable land so, site selection also matter the linkage, otherwise the two sector compute for land.

This finding also in line with the finding of Subramaniam (2009) in Romania, Kanwar (2000) in India and Yao (2000) in China economy, their finding reveals that, the growth process in some industrial sectors like the manufacturing sector and construction sector are more labour-intensive and compete with the agriculture sector for labour, thus resulting in negative sectoral linkages and does not significantly impact on the income generation in agricultural sector. Higher labor demand by the construction industry, cause skilled and matured man power migration from rural to urban. However, at the same time the industry sector could not provide technological product like fertilizer, pesticide, machineries, and tractors to the agriculture sector to recover the shift resources and to repeal its harmful impact immediately as well as to support irrigation system in the country. The other reason in Ethiopia may be that food processing industries like milk process industry, floor factories most of the time use imported inputs, which reduce demands of agricultural milk and wheat products in the domestic market. Finally this leads to a negative relationship between the industry and agricultural sectors in the long run.

Case 2: Long-run Model for Industrial sector as a dependent variable

The estimates for the stable long-run equilibrium and the adjustment coefficients were presented in (Table 5.9) and normalized to the industry sector (Table 5.10).

Table 5.9: Estimated Long-Run Model and Speed of Adjustment

$$\beta \text{ matrix: } \begin{array}{ccc} LNIDS & LNAGRI & LNSERV \\ -7.775637 & -3.786140 & 10.15896 \\ 14.02719 & -1.841930 & -9.187693 \\ 6.391367 & 2.476983 & -7.497069 \end{array}$$

$$\alpha \text{ matrix: } \begin{array}{cccc} \text{LNINDS} & 0.038058 & -0.029654 & -0.000157 \\ \text{LNAGRI} & 0.034074 & 0.005211 & -0.015232 \\ \text{LNSERV} & 0.035917 & -0.011763 & 0.003847 \end{array}$$

Table 5.10: Normalized Long-Run Estimates and Speed of Adjustment Coefficients

$$\beta \text{ matrix: } \begin{matrix} \text{LNINDS} & 1 \\ \text{LNAGRI} & 0.487 \\ \text{LNSERV} & -1.307 \end{matrix}$$

$$\pi \text{ matrix: } \begin{matrix} LNINDS & -0.296 \\ LNAGRI & -0.265 \\ LNSERV & -0.279 \end{matrix}$$

Variable	LNINDS	LNAGRI	LNSERV
Coefficient (β)	1	0.486924*	-1.306512*
standard error		(0.09545)	(0.09903)
T-value		[5.10133]	[-13.1925]

*Source: Author's Computation using Eviews 9: Note: Values in closed bracket are t-statistics: *indicates significant. Normalized co-integrating coefficients (asymptoticStandard error in parenthesis)*

The normalized co-integration in equation form can be written as:-

$$LNINDS = -0.486924LNAGRI + 1.306512LNSERV \ldots\ldots\ldots\ldots\ldots\ldots\ldots 5.4$$

The long run empirical analysis shows that agriculture sector in the Ethiopian economy has negative and statistical significant impact on the industry sector. It does not have an economic implication and it does not mean that ADLI is not working and important for Ethiopian economy; rather, agricultural production is not oriented to the industry needs and high dependency of manufacturing industry on imported raw materials and intermediate goods has remained the distinguishing feature of the Ethiopian manufacturing sector due to lowquality of domestic agricultural output, unavailability of raw materials in the local market and lack of sufficient local Industrial input supply from agriculture output. Series of surveys conducted by the Central Statistical Agency (CSA) on the manufacturing sector consistently reported that more than 50 percent of firms claim that their first major reason for their low capacity utilization are inadequate and poor quality raw materials, power shortage and frequent interruptions and limited inter-industry and industrial-sectorial-institutes level linkages .

In Ethiopia, contraband, agricultural row material export, low quality and industrial non oriented agricultural products are the main reasons that industrial sector does not properly utilized the agricultural output as an input and not benefit from the agriculture sector, rather the surplus product of the agriculture products such meat, cotton, oilseed, coffee and leather products exported to external market without industrial processing and value added by industry sector. The higher contribution of the agriculture sector to the GDP growth and its higher income elasticities compared to industry sectors demand for the agriculture sector output is increased and resources are transferred to the agriculture sector (Vogel, 1994). Therefore, if the industrial sector is not benefited from the growth in the agriculture sectors, there is a need to increase investments in industrial sector, like agro-processing industries, small scale, and medium and large scale manufacturing enterprise, to increase their capacity of utilizing agricultural output as input.

In contrast to the agriculture sector, the service sector affects the industry sector in the positive direction significantly. This means on average a one percent increase in the service value added results an increase in the industry value added by 1.31 percent in the long run, holding all other variables that affect industry sector constant. Higher productivity in the Industry sector indicates that the sector is utilizing the service sector very efficiently, mainly, the Industry sector utilizes, education for skilled workers, market outlet for output, finance, insurance, and transportation from the service sector. Therefore, a strong positive relationship between the Industry and service sectors is observed.

This outcome also confirms with the findings of Block, (1998) in Ethiopia and Kanwar (2000) in India economy, which asserted that countries with higher service sector productivity and infrastructure development significantly influences economy and strongly link to industry largely through investment. The growing service sector provides market access to the industry for both input and output market, provides financial service to grant investors and thus facilitates industrialization process. Therefore, an increase in the productivity and output in the service sector results an increase in the productivity of industry sector through providing input and output market and transport service to outreach the industry output in to both domestic and external market.

Case 3: Long-run Model for Service sector as a dependent variable

The estimates for stable long-run equilibrium and the adjustment coefficientswere presented (Table 5.11) and normalized to the service sector (Table 5.12).

Table 5.11: Estimated Long-Run Model and Speed of Adjustment

$$\beta \text{ matrix: } \begin{matrix} LNSERV & LNAGRI & LNINDS \\ -10.15896 & 3.786140 & 7.775637 \\ 9.187693 & 1.841930 & -14.02719 \\ 7.497069 & -2.476983 & -6.391367 \end{matrix}$$

$$\alpha \text{ matrix: } \begin{matrix} \text{LNSERV} & 0.035917 & 0.011763 & -0.003847 \\ \text{LNAGRI} & 0.034074 & -0.005211 & 0.015232 \\ \text{LNINDS} & 0.038058 & 0.029654 & 0.000157 \end{matrix}$$

Table 5.12: Normalized Long-Run Estimates and Speed of Adjustment Coefficients

$$\beta \text{ matrix: } \begin{matrix} \text{LNSERV} & 1 \\ \text{LNAGRI} & -0.373 \\ \text{LNINDS} & -0.765 \end{matrix}$$

$$\pi \text{ matrix: } \begin{matrix} LNSERV & -0.365 \\ LNAGRI & -0.346 \\ LNINDS & -0.387 \end{matrix}$$

Variable	LNSERV	LNAGRI	LNINDS
Coefficient (β)	1	-0.372690*	-0.765397*
standard error		(0.06386)	(0.08381)
T-value		[-5.83606]	[-9.13254]

*Note: Values in closed bracket are t-statistics: Source: Author's Computation using Eviews 9: *indicates significant. Normalized co-integrating coefficients (asymptoticStandard error in parenthesis)*

The normalized co-integration in equation form can be written as:-

$$LNSERV = 0.37269 LNAGRI + 0.765397 LNINDS \ldots\ldots\ldots\ldots\ldots\ldots 5.5$$

The long-run relationships between the agriculture and service sectors were strongly positive and statistically significant for the Ethiopian economy. The agriculture sector value added grows on average by one percent the growth of the service sector will be accelerate by 0.37 percent in the long run, holding all other variables that affect the service sector constant. In the recent years, increase in product differentiation is aremarkable development in the agriculture sector. The effect of consumerdemand for this differentiated food products and the progresses in agriculturaltechnological handling has been to encourage a movement away from commodityproduction towards the production of food products with variouscharacteristics in functioning market. The consequent production increase createsdemand for post harvest handling facilities such as processing, packaging,Storage, transportation and finally marketing, which has increased the agricultural demand for services, and thus, the forward linkages between agriculture and services. Therefore, increase in the productivity of agriculture sector serve as an input for the service sector activity and enhance the value added of the service sector. Finally,agriculture and service sector has strong positive and significant forward and backward linkage with each other in the Ethiopian economy in the long run.

This result in line with the finding of Fiess and Verner (2001) in Ecuador, XinshenDiao*etal* (2007) in Ethiopia,Yao (1996, 2000),in China and Vogel (1994)in developing countries economy, their finding reveals that growth in the agricultural sector has a significantly positiveinfluence on growth in the service sectorin terms of product, factor, and market contributions.An increase in agricultural staple production and agricultural export results increase commerce of service sector corresponding with agricultural products.

With regard to industry sector, industry value added has a positive and statistically significant impact on service sector value added in Ethiopia, in the long run. The result suggests that a 1percent increase in industry value added result raises in service value added by 0.54 percent, keeping all other variables that affect service sector constant in the long run. The industry sector provides outputsthat facilitateservice sector activities, like different mobile apparatus are not only be used as commodities in the service sector but also help to smoothen communications in the service sector; other finished products are also distributed through the service sectors. In addition to this, the industry sector helps to improve service sector productivity throughthe provision of modern technologies such as computer assembled locally. Therefore, industry and service sector have strong and significant linkages with each other in Ethiopian economy in the long-run.

5.3.2. Short-Run Growth Analysis

Vector Error Correction Model shows the speed of adjustment towards the long run equilibrium after a short run shock. According to Granger and Engle (1987), if the variables are integrated of order one and co-integrated, then there exists the Error Correction Term (ECT) that capturing the disequilibrium situation and these variables stands in equilibrium situation.By incorporating the results of co-integration analysis from the long run equation above, we can isolate the short-run effects from the long-run. Therefore, the long-run relationship information is included as explanatory components of the model to understand the short run relationship. The resulting model is called a short-run error correction model. The error correction terms with one lagged period is presented above for each variable. VECM run the short run interaction among all variables in the model simultaneously. Therefore, the researcher could run without selecting a particular dependent variable.

Table 5.13: Vector Error Correction Model Result

Error Correction:	D(LNAGRI)	D(LNINDS)	D(LNSERV)
D(LNAGRI(-1))	0.024096	0.214060	0.081749
Standard error	(0.14947)	(0.16610)	(0.09743)
T- statistics	[0.16121]	[1.28872]	[0.83910]
D(LNINDS(-1))	-0.017819	0.632019	0.562868
Standard error	(0.30894)	(0.34333)	(0.20137)
T- statistics	[-0.05768]	[1.84087]	[2.79516]*
D(LNSERV(-1))	-0.080591	-0.876849	-0.563478
Standard error	(0.49419)	(0.54920)	(0.32212)
T- statistics	[-0.16308]	[-1.59659]	[-1.74926]

Source: Author's Computation using Eviews 9:

Case 1: Error Correction Model of agriculture sector as a dependent variable

The short-run inter-sectoral linkages for dependent variable of agriculture value added presented in the Table 5.14 below, and the results suggest that the impacts of industrial and service sectors on the agricultural sector are statistically not significant. This implies that the short-run inter-sectoral relationships in Ethiopia are not strong.The country might have underutilized the available resource or the sectors may be increasing its productivity without affecting the other sectors productivity negatively or positively at significant level and sectors are independent in the short run.The lagged values of the agriculture sector itself affect the current level of agriculture sector positively in the short run but it is statistically insignificant. The result reveals that the agriculture sector is less sensitive to its past value.

The service sector has inconsistent short run and long run effect and it is expected, because, investment on services like education and infrastructure (road construction) has not a significant effect on agriculture sector in the short run. However, the long-run relationship shows service sector has positive and significant effect on agriculture sector that can be interpreted by the fact that investment on service sectors has a long run return.

Table 5.14: Error Correction Model with D(LNAGRI) as dependent variable

Variable	Coefficients	Standard Error	T- Statistics
ECT(-1) or coint.Eq1	-0.129008*	(0.04524)	[-2.85167]
D(LNAGRI(-1))	0.024096	(0.14947)	[0.16121]
D(LNINDS(-1))	-0.017819	(0.30894)	[-0.05768]
D(LNSERV(-1))	-0.080591	(0.49419)	[-0.16308]

Source: Author's own computation using Eviews 9;

The coefficient of the error term (the speed of adjustment towards equilibrium value) possesses the expected negative sign, indicating that it is error-correcting. The value (-0.13) implies that there is relatively low speed of adjustment towards long-run equilibrium. Any deviation from the long-run equilibrium of the system is corrected back to equilibrium, although at a slow pace of approximately 13% in each subsequent period. The relatively very low speed of adjustment may be attributed to structural rigidities, it is common in developing countries and that slow down the adjustment process.For full adjustmentto the long run it requires a period of 7.7 years.

Case 2: Error Correction Model of Industry sector as a dependent variable

The short-run inter-sectoral linkages of the dependent variable of industry value added are presented in the Table 5.15 below, and the result reveals that none of the sectors have influenced the industrial sector growth significantly at 5% significant level. The result reveals that there is no significant Resource transfer from one sector to another or movements of inputs and outputs from one sector to another are not significant.

The industry sectoralvalue added growth is positively related to its own past growth in the short run. The past year growth in the industry sector has higher impact on the current year industrial sector growth as compared to the other sectors impact; it is significant at 10% significant level. On average, a one percent increase in the last year's industrial sector value added itself leads to 0.63 percent increase in the current period service sector value added growth, holding all other variables that affect service sector constant.

Table 5.15: Error Correction Model with D(LNINDS)as dependent variable

Variable	Coefficients	Standard Error	T- Statistics
ECT(-1) or coint.Eq1	-0.295929**	(0.10325)	[-2.86614]
D(LNINDS(-1))	0.632019*	(0.34333)	[1.84087]
D(LNAGRI(-1))	0.214060	(0.16610)	[1.28872]
D(LNSERV(-1))	-0.876849	(0.54920)	[-1.59659]

Source: Author's own computation using Eviews 9;

The coefficient of the ECM model for the Industrial sector equation possesses the expected negative sign, representing that it is error-correcting. The value of the adjustment coefficient of -0.296 is suggests that a slow adjustment process in industrial sector. Only 29.6 percent of the disequilibria from the shock of the previous period in the system return to the long-run equilibrium in the current year. But the adjustment coefficient of the industrial sector is low and statistically significant at 5% level of significance. This implies the industrial sectors possessome rigidity to allow long run adjustments.For full adjustment to the long run it requires a period of 3.4 years.

Case 3: Error Correction Model of Service sector as a dependent variable

The short-run inter-sectoral linkages of the dependent variables of service sector are presented in Table 5.16.The growth in industry sector is positively related to the short-run service sector growth. The effect of industrial sector is statistically significant in the short run but agriculture has insignificant effect. On average a one percent increase in the industrial sector leads to an increase in the service sector by 0.56 percent significantly, holding all other variables that affect service sector constant in the short. In the short run the small scale industries provide their output to the service sectors like hotel and restaurant materials transportation materials telecommunication materials and others. This implies an increase in the value added of the industrial sector in the short run result an increase in the productivity of the service sector. The past period service sectoral growth is negatively affectedits own current growth and statistically significant at 10% significance level. On average a one percent increase in the past year's service sector growth caused a 0.56 percent decrease in the current period service sector value added, holding all other variables that affect service sector constant.

Table 5.16: Error Correction Model with D(LNSERV)as dependent variable

Variable	Coefficients	Standard Error	T- Statistics
ECT(-1) or coint.Eq1	-0.364884*	(0.07912)	[-4.61167]
D(LNSERV(-1))	-0.563478	(0.32212)	[-1.74926]
D(LNAGRI(-1))	0.081749	(0.09743)	[0.83910]
D(LNINDS(-1))	0.562868*	(0.20137)	[2.79516]

Source: Author's own computation using Eviews 9;

The coefficient of the error term or the speed of adjustment towards equilibrium value is (-0.36) which possesses the expected negative sign, indicating that it is error-correcting term. The coefficient of -0.36 suggests that a slow speed of adjustment process in service sector growth towards long-run equilibrium. This indicates that whenever there was a disturbance or a shock in the system, 36 percent of the deviation of the actual service sector growth from its equilibrium value is eliminated within a year. If there is a one percent disequilibrium or shock in the preceding period, the impact of a shock to change in Service sector growth is corrected by 36 percent per year. For full adjustment to the long run it requires a period of 2.77 years.

5.4. Granger Causality Test Result

Granger Causality (1969) analyzed that if the variables are co integrated then there should be at least one direction of causality between the two variables and this causality has been tested by F-statistics or chi-square tests. In order to examine the direction of linkage, the researcher has to conduct Granger causality tests among the variables.

Table 5.17: Granger causality test

Equation / Excluded	D(LNAGRI)	D(LNINDS)	D(LNSERV)	
D(LNAGRI(-1)) (χ^2) Prob.		1.660794 (0.1975)	0.704081 (0.4014)	Short run Granger causality
D(LNINDS(-1)) (χ^2) Prob.	0.003327 (0.9540)		7.812903** (0.0052)	
D(LNSERV(-1)) (χ^2) Prob.	0.026594 (0.8705)	2.549113 (0.1104)		
ECT(-1) (χ^2) Prob.	8.132016** (0.0043)	8.214750** (0.0042)	21.26754*** (0.0000)	Long run Granger causality

Source: Author's own computation using Eviews 9;

Table 5.17 shows the results of sector wise Granger causality between the variables. Result reveals the existence of unidirectional Granger causality between industrial sector and service sector in the short run. The causality comes from the industrial sector. Industry sector strongly granger cause the service sector in the short run. Therefore it is shown that granger causality runs one way from industry sector to service sector and not in the other way. Otherwise, there is no granger causality between the variables in the model in the short run. Therefore, economic sectors are independent on each other in their production activity and in their contribution to economic growth. This finding implies that the lagged value of the variables does not have significant roles in explaining the current and future values of some other variables in the model. While, the error correction term indicates that there are long run granger causality among the dependent variables in the long run.

5.5. Post-Estimation Diagnostics Test

After estimation, in order to determine whether the VECM and VAR model provides an appropriate representation, different post-estimation diagnostic tests were performed. This help to guarantee the residuals from the model are Gaussian that the assumptions are not violated and the estimation results and inferences are trustworthy.

5.5.1. Residual Vector Serial Correlation LM Test

The study used the LM test to investigate serial correlation. Table 5.18 presents the results of the Lagrange Multiplier (LM) test for residual serial correlation implies that, there is no problem of autocorrelation in the estimated model. This decision is based on the probability values derived from the test, which is greater than 5% level of significance. The null-hypothesis of the LM test that the residuals are not serially correlated (no autocorrelation) is accepted at 5% level of significance. The large p-values imply that the chi-squared statistics at all lags are not large enough to help reject the null of no autocorrelation at any of the usual critical values. Thus, the study could not find any evidence of autocorrelation problem in the residuals.

5.5.2. Residual Vector Normality Test

The JarqueBera normality test is used to check whether the regression error terms are normally distributed or not. The result (in Table 5.18) shows thatthe null-hypothesis that the residuals are multivariate normal residuals can be rejected using Jarque-Bera test. According to Enders (1995), the non normality may come from the small data size. However, econometric theory states that the existence of non-normality does not affect and alter the estimator's BLUE and consistency property

5.5.3. Residual Vector Hetroscedasticity Test

Hetroscedasticity test of the VECM evaluatedto investigate violations of the Gauss-Markov assumptions and to make sure that we have the best linear unbiased estimate (BLUE).The result in table 5.16 suggests that there is no enough evidence to help reject the null of no hetroscedasticity. The null-hypothesis that the residuals are homoscedastic since the p-value is larger than the conventionally accepted 5% level of significance and that there is no problem of misspecification. Therefore, the result indicates that the residuals of the variables of the model are homoscedastic, this, together with the results of the other pre and post estimation diagnostic tests, suggests the validity and robustness of the estimated results.

Table 5.18: Diagnostic Test Results

Residual Vector Serial Correlation LM Test	Lags	Statistics	Prob	
	1	6.471446	0.6920*	No serial correlation
	2	19.49898	0.2913*	No serial correlation
	3	3.567821	0.9375*	No serial correlation
Residual vector Normality (Jarque-Bera)	Joint	260.8051	0.0000	No normality
Residual vector Hetroscedasticity(Jarque-Bera)	Joint	61.45036	0.0920*	No hetroscedasticity

Source: Author's own computation using Eviews 9;

5.6. Dynamic Analysis in a Co Integrated VAR Framework

After investigating the long-run relationship and short-run adjustment dynamics of the major sectors such as agriculture, industry and service sectors in Ethiopia, the study has made use of the VAR model and reported the impulse response functions and variance decomposition analysis results in order to analyze the dynamic interaction among the variables.

5.6.1. Impulse Response Functions

This section focuses on how a shock in one sector will be absorbed by the other sectors in the economy.

Agricultural sector response for innovation in other sectors

Impulse Response Functions (IRF) is computed for agriculture sector response to the shock in the other sectors. The innovation in the industrial sector has not impact on agriculture sector in the first period, while, the result from Appendix 2 column two, row one indicates that beginning from the second period, the impact of positive shocks in the industrial sector on the agriculture sector changed to negative and continuous throughout the whole period. Therefore, an innovation in the industrial sector has negative influence on agricultural sector not only in the short run but also in the long run. Similarly, the shock in the agriculture sector itself has positive and decreasing impact in the short run and medium period of time. While, the continuous decreased impact changed to negative after some years and continues in the long run.

Conversely, an innovation in the service sectors has negative impact on agriculture sector in the short run. As we can see from the third column, row one of Appendix 2 the effect of one standard deviation shock of service sector value added on agriculture sector is negative in the short run, but after a few years they will start to have a positive relationship with agriculture sector and continues throughout the whole period. This implies that the service sector innovation has a positive impact for the growth of agriculture sector in the long run, but it has negative impact in the short run.

Industrial sector response for innovation in other sectors

The response of the industry sector to the shock in other sectors and industry sector itself based on row two of Appendix 2 is presented as follows. The innovation in the agriculture sector value added has positive impact on industrial sector only in the three years, while beginning from the fourth period its impact changed to negative and continuous throughout the whole period. Therefore, an innovation in the agriculture sector has positive influence on industrial sector only in the short run but its impact changed to negative in the long run. The innovations in the service and industry sector itself have a positive effect on industry sector over the whole period. As we can see from row two, column two of Appendix 2, the effects of one standard deviation shock on service sector is positive and decreasing in the short and medium period, and then again moves in positive and increasing direction in the long run. On the other hand, an innovation in the industry sector itself has positive and increasing impact in the short run, and then again moves in positive and decreasing direction in the long run.

Service sector response for innovation in other sectors

Finally, the impulse response function brings the response of service sector to the innovation in the other sectors and the service sector itself. An innovation in the agriculture sector value added has negative and decreasing impact on the service sector both in the short run and long run time horizon. On the other hand, the innovation in the industry sector has a positive impact on the service sector in the whole period. The result in Appendix 2 the last row, column 2 reveals that a one standard deviation shock in the industry sector value addedresults positive and increasing impact in the short run and changed to positive and decreasing direction in the long run period on the service sector value added growth. The innovation in the service sector itself has a positive effect on the sector in the short run and continues to grow in the long-run period. Hence, the service sector has a long run positive impact on itself and all other sectors.

5.6.2. Variance Decomposition

In the above discussion, Impulse response functions outlined the effect of an innovation in one endogenous variable on the other variables in the VAR, while variance decomposition separates the variation in an endogenous variable into the component innovation to the VAR. Mamatzakis (2001) states that the variance decomposition analysis indicates that how much of the uncertainty surrounding the predictions of respondent variable can be explained by the uncertainty surrounding the other variables.

Variance Decomposition Analysis for Agriculture sector response

Table (5.19) below, indicates the variance decomposition result for agriculture sector. The result reveals that the variation in agricultural sector value added is explained by only the lagged value of the variable itself in the first period. After the first period, the variation in agricultural sector value added can be explained by a group of other endogenous variables in the system. Beginning from the second period, the innovative effects of both service and industry sectors on agricultural sector continuously increase in the whole period. However, the innovative effect of agriculture sector itself in explaining the variation in the agriculture sector value added deceased in the long run and replaced by an increasing service sector. It is observed that at the tenth time horizon, a one standard deviation innovation in industry and Service sector explains 10.46 and 43.34 percentages of forecast error variance in the agriculture sector and the remaining 46.2 percentage forecast error variance explained by the innovation in the agriculture sector itself. The result reveals that agriculture sector itself has the leading effect followed by the service sector to explain the variation in the agriculture sector in the long run.

Table 5.19: Variance Decomposition of LNAGRI

Period	S.E.	LNAGRI	LNINDS	LNSERV
1	0.076509	100.0000	0.000000	0.000000
2	0.102135	98.08063	1.509505	0.409862
3	0.116881	94.48859	3.207949	2.303459
4	0.126815	89.97343	4.512154	5.514415
5	0.134739	84.12308	5.809975	10.06695
6	0.142346	76.79617	7.172645	16.03118
7	0.150888	68.48378	8.445536	23.07069
8	0.161304	60.05059	9.468711	30.48070
9	0.174252	52.40041	10.14646	37.45313
10	0.190109	46.19619	10.45762	43.34619

Source: Author's computation using Eviews 9:

Variance Decomposition Analysis for Industrial sector response

In the case of industry sector (see Table 5.20) below that the variation in the growth of industry value added is explained mostly by its lagged value and in some extent by the innovation in the agriculture sector in the first period. After the first period, the variation in industrial sector can be explained by a group of other endogenous variables in the system. The result indicates that the effect of innovation in the industry sector itself to explain the variation in the industrial sector growth decreases through longer time horizon, whereas, the effect of the innovation in the agriculture and service sector to explain the variation in the industrial sector growth are increasing in the long time horizon. In the long run, the most significant sector in explaining variation in industry sector is agriculture sector next to the innovation in the industrial sector itself. A one Standard deviation in the innovation in agriculture and Service sector explains 25.6, and 9.14 percentages of the forecast error variance in the industry sector respectively and the remaining part of 65.3 percent of the forecast error variance is explained by the innovation in the industrial sector itself in the tenth time horizon.

Table 5.20: Variance Decomposition of LNINDS

Period	S.E.	LNAGRI	LNINDS	LNSERV
1	0.085025	0.252476	99.74752	0.000000
2	0.126750	1.183640	97.90954	0.906825
3	0.148820	0.886499	98.39212	0.721382
4	0.166848	1.332711	97.91888	0.748408
5	0.184937	3.093577	95.65607	1.250354
6	0.203483	6.079082	91.71335	2.207565
7	0.223157	10.15795	86.24454	3.597505
8	0.244614	15.02181	79.66733	5.310856
9	0.268192	20.28243	72.51694	7.200631
10	0.294036	25.60059	65.26133	9.138089

Source: Author's computation using Eviews 9;

Variance Decomposition Analysis for Service sector response

Table (5.21) below on the other hand shows the variance decomposition result for the service sector. Unlike to the other variables above, the variation in the service sector can be explained by the innovation of all other endogenous variables including itself during the first period in the system. The estimated variance result indicates that the high variability in the service sector is due to the innovation in the industry sectors, which accounts 74.9 percent of the explanation in the forecast error variance of the service sector in the first period. Hence, the industry sector affects service sector growth strongly in the short run and thus causality seems to run from industry to service sectors. The impact of the industry sector to explain the variation in the service sector is increase in the second period, but after the second period it is decreasing in the long run and replaced by an increasing innovation effect of the agriculture sector.The innovative effect of agriculture sector on explaining the variation in the service sector value addedwill rise in the longer time horizon.While, the innovative effect of the service sector itself to explain the variation in the service sector decrease in the second period, while beginning from the third period again continuously increase in the long time horizon.

In the long run, the most significant variable in explaining variation in the service sector is the agriculture sector followed by the innovation in the service sector itself. A one Standard deviation in the innovation in agriculture and industrial sector explains 45.7 and 21.5 percentages of the forecast error variance in the service sector respectively and the remaining part of 32.8 percentage of the forecast error variance is explained by the innovation in the service sector itself in the tenth time horizon. Thus, the result of both impulse response function and variance decomposition analysis suggest that the service sector plays the main role in determining the overall growth rate of the economy through its linkages to other sector. The analyses of inter-sectoral linkages identify the service sector as the main economic sector that controls most economic activities in the Ethiopia economy in the long run.

Table 5.21: Variance Decomposition of LNSERV

Period	S.E.	LNAGRI	LNINDS	LNSERV
1	0.049870	0.703302	74.92028	24.37641
2	0.079741	0.897274	83.44525	15.65748
3	0.099117	3.162923	79.86929	16.96779
4	0.119074	9.056483	69.95266	20.99085
5	0.142271	16.57062	58.70299	24.72639
6	0.168404	24.01910	48.37511	27.60579
7	0.197452	30.79699	39.47285	29.73016
8	0.229416	36.66514	32.11445	31.22041
9	0.264131	41.59272	26.19192	32.21536
10	0.301393	45.67273	21.47695	32.85032

Source: Author's computation using Eviews 9;

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1. Conclusion

Strong inter-sectoral linkages play a significant role in the process of economic development. This study aimed at examining the sectoral interdependencies or linkages among agriculture, industry and service sectors and identifying the lead or the deriver sector in the case of the Ethiopian economy with the view to offer policy implications for accelerating economic growth. Using time series data for the period between 1974/75 and 2015/16 on agriculture, industry and services sectors' value added, multivariate time series econometrics, in particular Vector Error Correction Model (VECM) was estimated. Granger causality test was employed to examine the nature of interdependence between variables and the directions and magnitudes of the linkages among the sectors. Impulse response and variance decomposition analysis were also constructed to understand the static and dynamic relationships between the variables and to determine the impacts of an innovation (shock) in one sector on other sectors.

Accordingly, ADF and PP tests were used to check whether the time series variables under investigation were stationary or not. The results indicate that all the three variables capturing the natural log values of three sectors' value added were found to be non-stationary at levels; but become stationary in the first difference; indicating first order integration, 1 (I).

Johansen and Juselius (1990) co-integration test was performed whether the three variables are co-integrated, if so what are the number of co-integrating vectors formed amongst the three series. The test showed one co-integrating vector; which led to the use of Vector Error Correction Model (VECM). The study found evidence of long-run causality and co-integration relationship or inter-dependence between the economic sectors. The long run co-integration result implies that sectors have the tendency to return to the long-run equilibrium once they deviate from the stable long-run growth path.

More specifically, the Johnson and Juselius (1990) long-run co-integration results show a strong positive long-run equilibrium relationship between industry and service sector as well as between agriculture and service sectors. There exists bi-directional long-run positive relationship between the service and industry sectors and also between service and agriculture sectors.

The study, however, found a bi-directional negative long-run relationship (impact) between agriculture and industrial sectors. This may, among other things, imply that the agricultural sector may grow but it may not bring tangible positive impact on the industrial sector unless and otherwise it produces outputs that are to be used as raw materials in the industrial sector. For the last several years, agriculture has been growing but manufacturing sector particularly agro-processing industry, has still been suffering from shortages of critical inputs such as cotton, hides and skins, wheat, oil seeds, etc. On the other hand, most agricultural outputs are exported without being processed and added value. Similarly, the industrial sector has not yet able to create strong forward linkages with the agricultural sector in terms of providing fertilizer, machinery, etc. Resources might have also been transferred to the industrial sector, for instance, we observe the flow of people to the cities and engage in small and micro enterprises or the construction sector. This might have reduced the active and relatively more productive labour in the agricultural sector; which in fact needs to be confirmed by a similar study. Overall this is a manifestation of a weak relationship, even negative association, between the domestic infant industries and the agriculture sector in both forward and backward linkages.

The long-run relationship of the agricultural sector with service sector shows the existence of strong forward and backward linkages between the service and agricultural sector. The service sector plays a positive role on the growth of the agricultural sector and agriculture sector benefits from the current fast growing service sector. Industry and service sectors have strong long run backward and forward co-integration relationship. On the basis of the existing trend, one may suggest that the growth of the service sector may continue to positively influence the growth of the industrial sector and vice-versa in terms of creating both backward and forward linkages

The short run results based on vector error correction model indicate a weak and insignificant association between the sectors in the short run except the effect of industry on services. This revealed that short-run inter-sectoral relationships in Ethiopia were not as strong as expected. A possible explanation for such weak sectoral interdependencies is that Ethiopia might have underutilized its resources.

To further examine the nature of the relationship, Granger causality/Block exogenity Wald test was applied and a unidirectional relationship was detected from industrial sector to service sector, which indicates that industry sector granger causes and facilitates the growth of the service sector, in terms of providing intermediate inputs that may be used in the provision of services. The error correction term also indicates that there is long run granger causality between the variables in the model. This means that the agriculture sector affects the other sectors strongly in the long run.

Results of Variance Decomposition Analysis (VDA) at the tenth time (ten years) horizon suggests that agriculture value added explains 46.2 percent variance in itself, 25.6 percent variance in industry sector value added, whereas 10.46 percent variance in agriculture sector is explained by the industrial sector at the same time horizon. This means that the agriculture sector affects the industry sector strongly in the long run. Conversely, the agricultural sector explains 45.7 percent variance in the service sector, whereas 43.3 percent variance in agriculture sector explained by the service sector at the same time horizon. Therefore, agriculture and service sector affect each other at the same level in the long run.

On the other hand, industrial sector affect service sector strongly in the long run because 21.5 percent variation in the service sector is explained by the industrial sector, whereas the service sector explains only 9.12 percent of the variation in the industry sector at the same time horizon. Finally, Results of both impulse response function and variance decomposition analysis suggest that service sector play the most significant role in determining the overall growth rate of the economy through its increasing effect in all variations and has the strongest linkages to the remaining two major sectors.

6.2. Policy Recommendation

There is a need to take reforms that would nurture the relationship between agriculture and industry. Government supports policies which encourage agricultural production for a number of reasons such as food security, rural poverty reduction and rural employment opportunity, e.t.c. These policies may cause the agricultural sector to take in a large amount of resources even if the agricultural sector is less productive, but such policy may not have significant positive multiplier effects on economic growth. Besides taking into account the role of the sector in addressing poverty, policymakers should examine the directions and magnitudes of the inter-sectoral linkages before they set a policy.

In addition to giving attention between agriculture and industry through for instance supporting farmers that grow crops which could be used as inputs in the industrial sector, commercialization and modernization of the agricultural sector would play an important role in the overall economy. Investing in agriculture and take reforms in the sector to increase its productivity may reduce rural urban migration by creating more employment and reducing inflation particularly in food related items. The industry sector should also be encouraged to produce modern and tested agricultural machinery and equipment that will enhance productivity in the agricultural sector.

To sustain the bidirectional strong association between agricultural sector and service sector in particular in the long run, it may be necessary to take the following policy reforms. Timely provision of fertilizer, seeds and agro-chemical, pesticides to the farmers at low cost to encouraged and benefited the farmer from distribution service (trade and market) are important measures to improve the performance of the agricultural sector. Monetary authorities should promote rural commercial banking that facilitate investment to the agricultural sector and increase the agricultural credit guarantee to enhance credit delivery by banks to farmers and to make sure that farmers respond to food price changes. This helps to increase forward and back ward linkage of agriculture and service sectors through appropriate use of the financial service by farmers. Additionally, the government should continue investing on infrastructure and extension services to assure market access for the farmer's product timely.

Therefore, this paper give input to the policy makers to made policy change that benefited agriculture sector from the growth in other sectors through change its policy direction from the current practice structural issues, such as farmers poor crop management skills; lack of agriculture and rural infrastructure that cause higher post harvest losses; use of cheaper (unimproved) seed; inadequate funding for research and development in the agriculture sector, that will cause the gap between research and practical applications and limited research in the agriculture sector, lack of insurance and adequate market access for farmers surplus product. This and other issues are addressed by the government to benefit agriculture sector from other sectors of the economy to increase its productivity.

Similarly, to increase productivity capacity of the industrial sector, policy strategies and incentives for industrialization in Ethiopia should give priority through creating favorable investment environment for both domestic and foreign industries. The government should continue to reduce a high resource transfers from industry sector in the form of direct taxation or in the form of market control price and give incentives to private manufacturing enterprises. Fundamental industrial infrastructure and a healthy tax system must be formed and marginal land for industrial parks planed and proficiently allocated. To support industrial reform, investment effort in education and training must be strengthened to sustain the level of human capital development and ensure high productivity among the labor force in the manufacturing sectors. Increased investment and employment of more active labor in large-medium and small scale enterprises should be encouraged to expand economic activities and impact positively on the poverty reduction campaign in Ethiopia. To achieve this, the strong input and output market by both agricultural and service sector must be availed.

With regard to the service sector, to sustain the current strong connection with other sectors, policy makers should continue to ensure an enabling environment to expand the service sector across the country as it has been doing in the education and transport sector. The services sector has shown a continuous expansion and increased a share in GDP. The recent growth in the economy is mainly driven by the service sector but it would be difficult and probably become a major problem in the long-run unless the other sectors also grow as fast as the service sector and inter-linked to each other. In the absence of adequate growth in other sectors of the economy, the growth of services' sector alone would be adversely affected by demand and supply constraints in the long run. Therefore, there is a need for proper composition of sectors.

Finally, this paper analyzed sectoral linkages at an aggregate level, and the result may not represent how different sub-sectors were developed and related. There could be different types of linkages among sub-sectors; to understand how the intersectoral linkages were formed, one needs to disaggregate sectors in to sub-sectors. Using disaggregated sub-sector level data may provide more information on what policies a country need to establish such multidimensional linkages and thus is more advantageous. Therefore, the researcher suggests other researchers to analyze inter sectoral linkages at the sub-sector level.

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Appendix

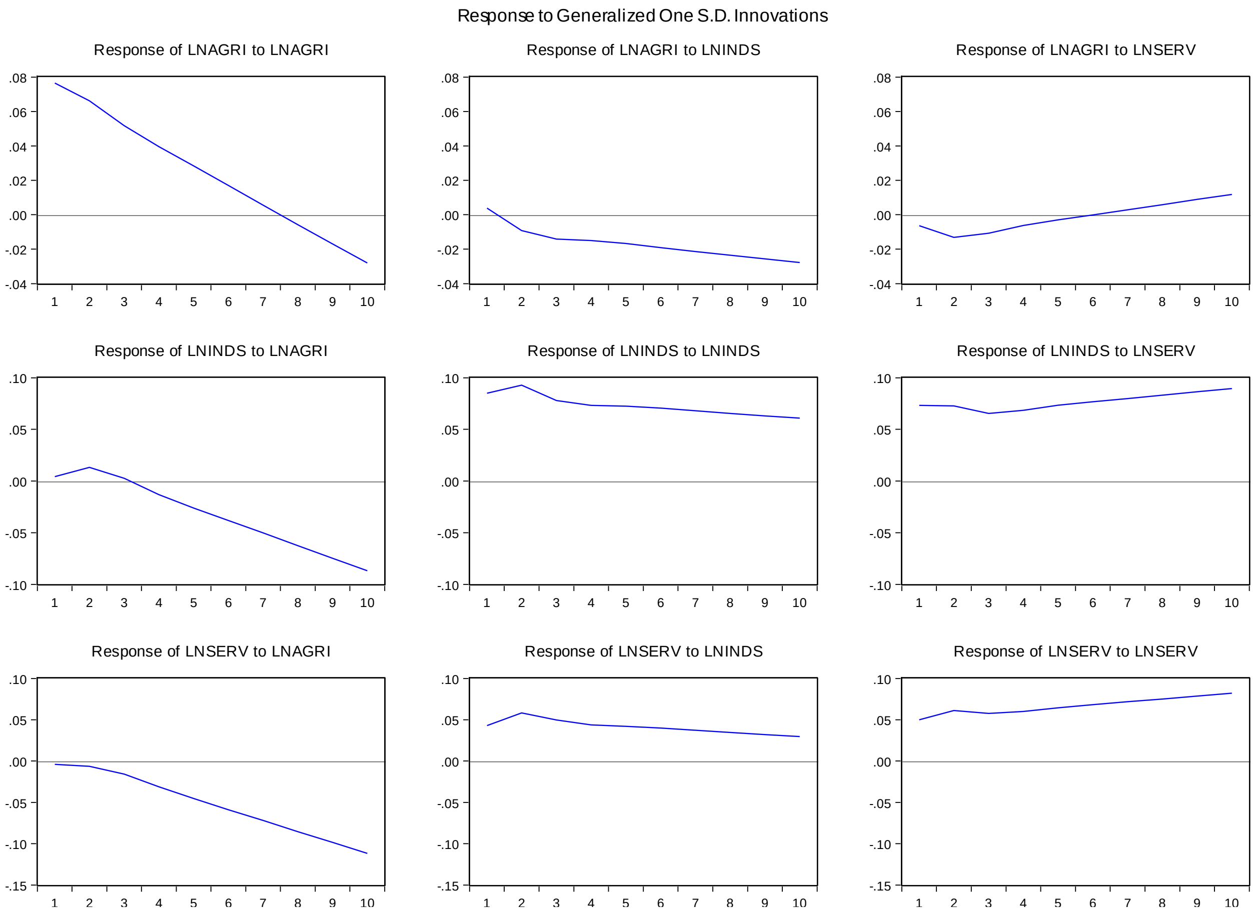
Appendix 1

Roots of Characteristic Polynomial
Endogenous variables: LNAGRI LNINDS LNSERV
Exogenous variables:
Lag specification: 1 1
Date: 06/03/18 Time: 04:29

Root	Modulus
1.000000	1.000000
1.000000	1.000000
0.992394	0.992394
0.030809 - 0.380998i	0.382241
0.030809 + 0.380998i	0.382241
-0.021429	0.021429

VEC specification imposes 2 unit root(s).

Appendix 2 Impulse response function

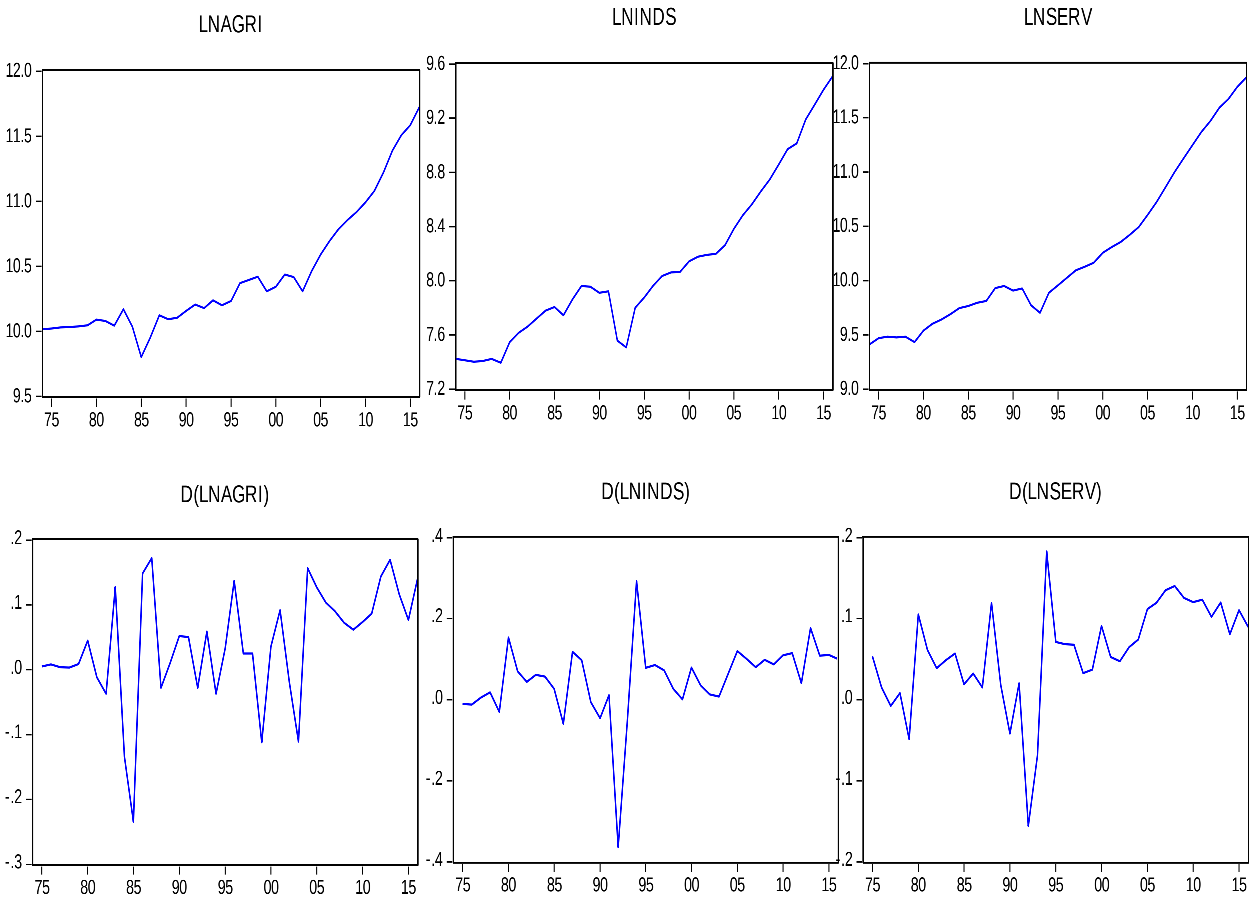


A PPENDIX 3: LR Restriction test

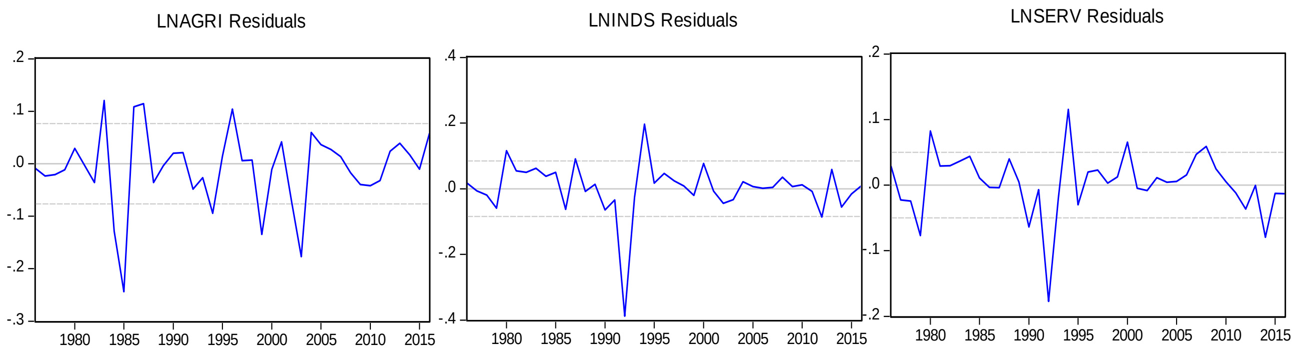
	LNAGRI	LNINDS	LNSERV
α Coefficient	0.034074	0.038058	0.035917
LR-test: χ^2 (≈ 1)	7.603549	6.589152	14.98935
P-value	0.005825***	0.010260**	0.000108***

	LNAGRI	LNINDS	LNSERV
β Coefficient	-3.786140	-7.775637	10.15896
LR-test: χ^2 (≈ 1)	17.15340	6.048620	12.25391
P-value	0.000034***	0.013917**	0.000464***

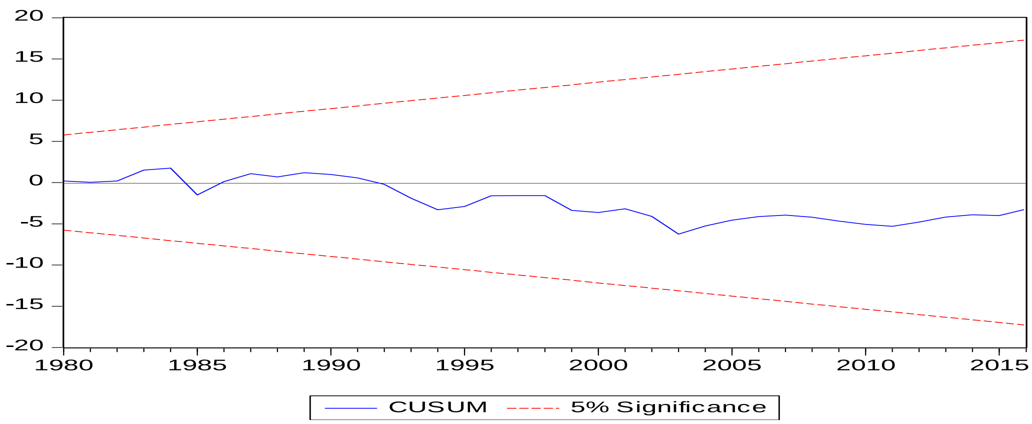
Appendix 4: Stationarity test

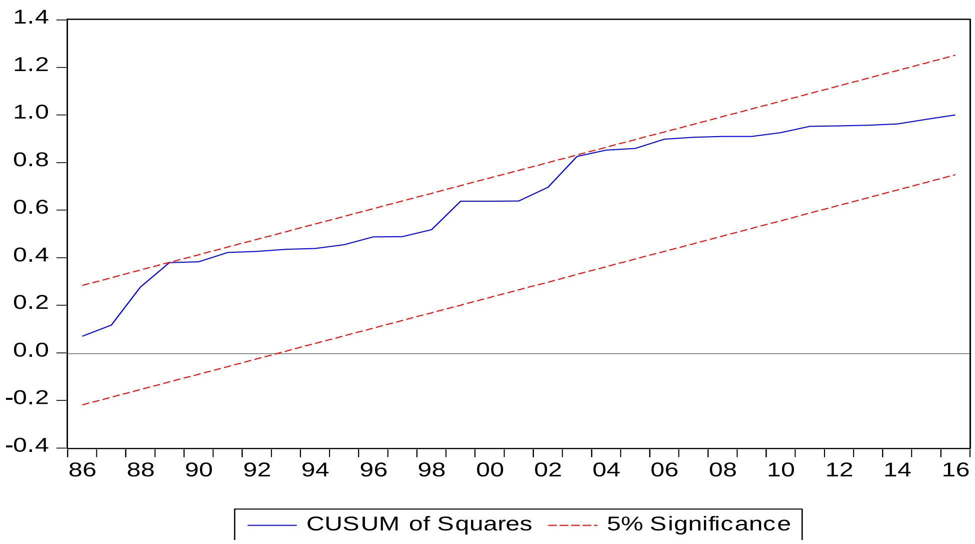


Appendix 5: Residual Graph



Appendix 6: Testing parameter stability using CUSUM and CUSUM square test





DECLARATION

I, the undersigned, declare that this thesis is my original work and it has never been presented for a degree or masters in any other university, and that all source of materials used for the thesis have been duly acknowledged.

The examiners' comments have been duly incorporated.

Declared by:

Name: Fasikaw Adimasu Techane

Signature: _______________

Date: ____________________

Confirmed by Advisor:

Name: Worku Gebeyehu (PhD)

Signature: ___________________

Date: ________________________

Place and Date of Submission: Addis Ababa University, June 2018