Economic Transformation and Sectoral Growth Options in Ethiopia:

Considerations for Achieving Middle Income Country Status

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THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DOCTOR OF PHILOSOPHY IN ECONOMICS OF THE UNIVERSITY OF NAIROBI

November 2013

DECLARATION

This thesis is my original work, which has not been presented for a degree in any university.

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DEDICATION

This thesis is dedicated to my parents Sime Eshete and Belynesh Taffesse and to the association of Mahibere Kidusan under the Ethiopian Orthodox Church for equipping me with unbeatable spirit in my success.

My greatest mentor and example in life

ACKNOWLEDGEMENTS

"I will extol thee; my God, O King, and I will bless thy name forever and ever"

Psalm 145:1

Foremost, I would like to express my gratitude to my supervisors Professor Peter Kimuyu and Dr. John Matovu for their immeasurable comments, guidance and encouragements for the triumphant achievement in this study.

I am also indebted to the resource persons assigned by the AERC for their concrete reflections and feedbacks that helped me to capture the contemporary knowledge frontier in the area of this study. Special thank also goes to Professor Andrew Feltenstein from Georgia State University, Shanta Devarajan, Chief Economist of the World Bank, Professor Dick Durevall from University of Gothenburg, and Professor David Rob from South Africa for their insightful comments that enlightening me regarding linking time series econometrics and dynamic CGE model in the study in order to capture the contemporary knowledge.

My gratitude also goes to scholars and thesis committee of the University of Nairobi for their encouragements and contributions in advancing my work. I would also like to express my gratefulness to University of Dar Es Salaam for capacitating me through a tough course work program. Last but not the least; I would like to thank the University of Nairobi and AERC for giving me admission and a scholarship for the PhD program in Economics. This adequately prepares and inspires me to build the African future on the basis of home-grown thinking and speaking out in African own language about African development.

ABSTRACT

This study examines the impact of openness, imported capital goods and liberalization induced sectoral total factor productivity on economy wide growth and the structural change process in Ethiopia. It also investigates the role of government in sustaining growth and structural change. We use sectoral growth accounting approach and vector autoregressive model that incorporates exogenous variables in order to calibrate the induced sectoral total factor productivity growths. We then introduce the calibrated sectoral total factor productivity in the dynamic computable general equilibrium model that uses the Social Accounting Matrix 2006. We also calibrate and introduce the elasticities of total factor productivity to change in spending composition in the dynamic computable general equilibrium model in order to capture the impact of shifting public resource towards productive sectors. The simulation results show that openness induced agricultural total factor productivity highly improves the welfare of households as compared to other growth scenarios. The liberalization induced total factor productivity in the service sector is also more efficacious in terms of enhancing the growth rate of the economy. The imported capital goods induced industrial total factor productivity is also better in fostering structural change of the economy. However, the broad-based growth option that combines the induced total factor productivity of all sectors enables the economy to achieve more sustainable growth, rapid structural change and welfare gain at the same time. Furthermore, the net effects of shifting public resources from administration to productive sectors positively influence growth rate, but have different implications on the structural change process. It is only the spending option of shifting public resources towards industry that generates a positive impact on the structural change process. The study therefore suggests the need to undertake a series of economic policy revisions and launch industrialization-centered broad-based growth strategies. This is also need for the government to be actively involved particularly in the area of manufacturing. We also recommend that foreign trade openness, service trade liberalization, and imported capital goods and services should receive special attention for driving sectoral total factor productivity. We also recommend that the government gives more emphasis to enhancing total factor productivity to complement factor accumulation in order to achieve perpetual growth and rapid economic transformation.

Key words: - S*tructural change process, sector-specific growth option, broad-based growth option, recursive Dynamic CGE model, composition of public spending, and middle-income country status*

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ACRONYMS

ADLI	Agricultural Development Led Industrialization
AO	Additive Outlier
CGE	Computable General Equilibrium
CMR	Clemete, Montanes and Reyes test
CSA	Central Statistics Authority
ECA	Economic Commission for Africa
EDRI	Ethiopian Development Research Institute
EEA	Ethiopian Economic Association
EPRDF	Ethiopian People's Revolutionary Democratic Front
EV	Equivalent Variation
FDI	Foreign Direct Investment
FFY Plan	First Five Year Plan
GDP	Gross Domestic Production
GTAP	Global Trade Analysis Project
GTP	Growth and Transformation Plan
HDI	Human Development Index
ICT	Information and Communications Technology
IFPRI	Institute of Food Policy Research Institute
IMF	International Monetary Fund
IO	Innovative Outlier
MDGs	Millennium Development Goals
MEDaC	Ministry of Economic Development and Cooperation
MOFED	Ministry of Finance and Economic Development
NBE	National Bank of Ethiopia
NSE	New Structural Economics
R&D	Research and Development
ROW	Rest of the World
SAM	Social Accounting Matrix
SFY Plan	Second Five Year Plan
SSA	Sub Saharan Africa

TFP	Total Factor Productivity
TFY Plan	Third Five Year Plan
UN	United Nation
UNCTAD	United Nations Conference on Trade and Development
USD	United State of America Dollar
VAR	Vector Auto Regressive model
VARX	Vector Auto Regressive model with Exogenous Variables
WB	World Bank
WDI	World Development Indicator
ZA	Zivot and Andrews test

CHAPTER ONE: INTRODUCTION

1.1 Background

Ethiopia has experienced three main political regime changes with five economic policy shifts[1] in the last five decades along with an unremitting political instability and war. In the imperial regime (1940-1974), a mixture of feudalism and capitalism was the main framework of the economy. The government also attempted to introduce some technological advancement and acquainted the country with modernization. One of the crucial activities during the early l950s was the government launched a centrally administered development plan with the aim of building an Agro-industrial economy[2]. However, the plan failed to promote agricultural industrialization (Shahidur *et al.*, 2007).

The government then established the National Economic Council in 1954/55 and filled the gaps by preparing and coordinating the national development program. The council prepared three consecutive five year plans over the period 1957-1974, intended to enhance infrastructure, commercial agriculture, agro-industry and manufacturing. It also undertook a series of economic policies favoring and protecting import substituting industries. In addition, the government also directly participated in strategic capital intensive industrial enterprises to complement both foreign and private domestic investments. During the early 1970s, the industrialization policy widened its scope and heavily accounted for various policy incentives meant to speed up private-based economic transformation (Chole, 1992).

The FFY Plan (1957-1962) mainly focused on industrialization and infrastructural development. It also specifically emphasized industries that produce light consumer goods to satisfy domestic demand and ignite the structural change in 1957-1961.

[1] The three political regimes are imperialism (1940-1974), socialism (1974-1991) and reformation (1991 to date). In the socialist regime, the government pursued command economy policy over the period 1974 – 1988 and mixed economic policy over the period 1988-1991. The reformist government also implemented neo liberalization policy over the period 1991-2000 and pro-poor growth policy in the context of state led development program since 2001 (MEDaC, 1999 and MOFED, 2010)

[2] The economic performance during 1950s is comprehensively heavily discussed in the website http://www.mongabay.

Agriculture received less attention compared to the industry. However, most of these agro-industrial projects in the plan failed to provide the expected outcomes. The contribution of manufacturing to GDP remained insignificant within the plan period. As a result, the country was not able to satisfy the demand for food and then became a net importer of food (Rahmato, 2004). In addition to commercial agriculture and transport service, the SFY Plan (1963-1968), therefore, gave more priority to the industries that produce chemical and metal instead of heavily depending on the consumer goods. These policy shifts caused the economy to grow with an encouraging result in investment, export market and employment opportunity. However, agriculture still received less attention compared to industry, and the result of the plan was disappointing (Chole, 1992 and Admassie, 1995). Considering the lesson from the first two five year plans, the government in the TFY Plan (1969-1974) redirected the focus boldly to both commercial agriculture, and industries (Rahmato, 2004). Nonetheless, most of the targets stated in the plan did not provide satisfactory results, attributing to the poor performance of agriculture and resource mobilization as well as the existence of high domestic transportation cost and drought (WB, 1975). In general, at the end of the five years plan, the share of manufacturing in GDP increased to 4.4 percent in 1974 (CSA, 1974).

Amidst this performance, the socialist government (1974-1991) seized power and nationalized all the emerging private industries. The government firmly controlled all economic activities and marginalized private investors from main activities. The government then had drawn the Ten Year Perspective Plan with the major objectives of improving the well-being of the people. However, both agriculture and industry grew at negligible rates, due to war, internal conflict and the like. Though the socialized industries were privileged with a preferential right of getting bank credit, they were not profitable and efficient even in the export market so that they faced acute short of domestic capital and foreign currency (Chole, 1992). Following this economic crisis and the declining of socialism hegemony particularly in Soviet Union, the government inevitably shifted towards a mixed economic policy in 1988. The real per capita GDP declined by around 1.4 percent annually while the foreign currency reserve almost dwindled to 10 days of import coverage at the end of the reign of socialist government (MEDaC, 1999; NBE, 1992).

In May 1991, the current EPRDF government toppled the socialist regime after a long period of internal conflict and War. The government has subsequently undertaken a series economic reform program of WB and IMF with three phases, focusing on the private sector development. The first phase reform (1992/93-1994/95) mainly focuses on monetary policy and fiscal policy. The second one (1994/95-1996/1997) also put due emphasis on restricting the role of government and enhancing private sector activity (MOFED, 1998). In the third phase (2002/03-2005/06), the government tried to reduce poverty with a stable macroeconomic environment. In general, the government sets poverty reduction as the core objective for which growth is considered as the means (MOFED, 2005). Since 2005, the government pronouncedly redirected the basic framework of the economy towards a state-led Development program and achieved a successive high economic growth rate above 7 percent on average. In order to keeping up this economic growth, the government also drew the Growth and Transformation Plan (GTP) in 2010 as a stepping stone to reach the middle-income status by 2025. It also intended to complement the ADLI performance by achieving an 11 percent growth rate of GDP, allowing the per capita income to reach USD 698 at the end of the GTP planning period (MOFED, 2010). However, many argue that the plan is ambitious so that it will not be feasible mainly due to institutional incapability and financial inadequacy (WB, 2011 and Desta, 2012).

Through all these policy shifts experimented over the last two decades, the government considers ADLI as a fundamental growth policy with the responsibility of bringing economic transformation and sustainable growth. The objective of ADLI is to enhance sectoral interdependence mainly between agriculture and industry and then secure the overall growth. However, the policy instruments of ADLI are extremely narrow and not adequate enough (Dercon and Zeitlin, 2009). As a result, the ADLI is not able to bring industrialization and transformation as evidenced by the manufacturing sector which accounts for only around 5 percent in GDP. Rather, the service sector dominates the structure and the sectoral contribution to GDP growth, leading to structural change burden. One of the causative factors, among others, is low and erratic TFP growth. The factor accumulation, instead of growth rate of TFP, explains the growth trajectory in Ethiopia. The TFP that comprises change in technology, technical efficiency, and allocative efficiency shows a negative growth rate, on average, in the last five decades,

critically bogging down the economic growth and structural change process (Geda and Degefe, 2005). It is hard and unthinkable to achieve sustaining economic growth without structural change that mainly emanated from growth in TFP. If the concerned bodies do not deal with these problems shortly and properly, the associated problems extend beyond the macro-economic sphere of growth and a short-term period effect. It will rather leave the country to uncharacteristically dependent on primary commodities, which have a risk of high growth volatility, deteriorating term of trade, and lack of international competitiveness. This will also have persistent and adverse effects on food security, poverty reduction and sustainable development (MOFED, 2005). In general, erratic growth and sluggish structural change are the main feature of the overall economic growth in 1980-2011, persistently slowing down the country's progress towards the middle-income country status by 2025, precipitating an immediate and rigorous policy analysis to solve the inherent problems. In this regard, there is a hot debate among concerned political parties and policy makers about the merits and demerits of sector-specific growth and broad-based growth in order to rescue the erratic performance.

It is in these reasons that our study first reviews the reference of middle-income countries experience that have relatively similar experience to Ethiopia: Angola, Ghana, Zambia, and Botswana from Africa and Vietnam, Brazil, Sri Lanka, Malaysia, Thailand, and China from the rest of the world. Based on the experience of these countries, the paper examines the hefty issues of how Ethiopia can reach the middle-income country status by 2025. The study is in this regard devoted to investigating the impact of sector-specific TFP growth and broad-based TFP growth on economy wide growth and structural change process. Moreover, the study examines the role of government in public resource allocation towards productive sectors. In doing so, the study employs sectoral growth accounting approach, VARX model, and dynamic CGE model for addressing the issues of estimating sectoral TFP growth, examining the determinants of sector TFP and investigating the impacts of various growth options, respectively.

1.2 Problem Statement

Learning from the review of growth and structure of the Ethiopian economy; there are mainly two basic and persistent problems. Firstly, the economic growth and the associated per capita income characterized by mixed, volatile, erratic and poor performance. Secondly, the structural change is slow in pace and marginal in magnitude as evidenced by the manufacturing sector which has a negligible share in GDP and an insignificant contribution to GDP growth rate.

The economy exhibits a mixed performance of positive and negative real GDP growth rate. It shows negative growth rate performances seven times in 1981-2010 (WB, 2011). This reflects that the economy has been moving back and forth, owing to inadequate and irregular rainfall, political instability and the like. Irrigation, which is one of the mechanisms expected to address rain dependency problem, does not have a significant influence to tackle the problem. The ratio of irrigated land to arable land accounts for only 0.48 percent in 2009 while sufficient water resources exist in the country. In addition to erratic and poor economic growth, the structure of the GDP in 1980-2010 was characterized by lowest and stagnant share of the manufacturing sector (4.8 percent on average) that was expected to drive productivity and sustain economic performance. This is far below the performance of structurally transformed countries[3]. The share of agriculture to GDP has been declining while service sector as share of GDP has concomitantly been increasing. As a result, the multiple role of manufacturing is insignificant and unable to be a productivity powerhouse and source of innovation. This is partly due to a poor enabling environment. For instance, investors failed to invest 82 percent of their licensed capital in 1992-2010 although they are willing to invest (EIA, 2010). During the socialist regime, the economy grew at an average growth rate of 1.9 percent while population grows at 2.7 percent, causing a decline in per capita income of about 0.8 percent (Chole, 1992). During the reformist period, the economy wide growth

[3] The comparators' performance shows that the share of manufacturing in GDP accounted for 20, 25, 30, and 31 percent in Vietnam, Thailand, Brazil, and China during their transitions, respectively. The share of industry in these countries accounts for from 35 percent to 45 percent, on average (WB, 2011).

rates show a mixed performance. The growth rate showed negative performance of 13 percent, 6 percent, 3 percent, and 8 percent in 1998, 1999, 2001, and 2002 respectively. No matter how the reformists attempted to reform the economy and implement the ADLI policy since 1994, the actual performance of the economy remains erratic. It is not able to avoid high volatility and poor growth performance, causing sluggish transformation (ECA, 2011). This is mainly attributed to the fact that the ADLI is extremely confined within input supply (like fertilizers and best seeds) and some credit facilities as most influential policy instruments. Beyond these, there are no other policy initiatives like irrigation, mechanized farming and commercialized farming during the implementation of ADLI (Dercon and Zeitlin, 2009).

Many suspect that the current unprecedented high growth rate is attributed to a combination of pro-poor growth policy (since 2003 onward) and a state-led development program (since 2005 onward). However, the share of manufacturing in GDP is still insignificant, accounting for only around 5 percent in 2010. Rather, the service sector keeps dominating the structure of the economy in terms of sectoral contribution to GDP growth and share of GDP. Instead of transforming from agriculture to industry as other healthy developing economies do, the service sector takes the leading share in GDP (45 percent), growth rate (58percent), capital investment (46percent) and public expenditure (75percent) in 2010 (NBE, 2011). However, the service sector was dominated by trade and real estate (55 percent) in 2010. Many suspect that productivity and per capita income will be limited overtime as the share of the service sector increases. This is because of weak sectoral linkage and labour-intensive nature of service activities. As a result, this shift will constitute a structural change burden as explained by Baumol's disease (Baumol, 1967). One of the principal causative factors for erratic growth and sluggish structural change process is insufficient and poor change in technology and efficiency, leading to poor sectoral TFP growth dominated by negative growth rate over the 1970-2011 periods. Such negative TFP growth affects economy wide growth rate and structural change process and inherently slows down the country's pace towards the middle-income country status by 2025, which will require Ethiopia to triple its per capita GDP from the current level of USD 358. Some comparators reach the middle income country status by growing 7 to 11 percent annually within 8 to 13 years. The study,

therefore, examines whether Ethiopia can truly reach the middle income status by 2025 in the same manner.

The main research questions that the paper addresses are the following:

1. What are the factors that influence the sectoral TFP growth in order to drive a perpetual growth rate and structural change?
2. Which TFP growth options can likely lead the country into a sustained economy-wide growth and a rapid structural change process: sector-specific or broad-based TFP growth?
3. What should be the role of the State in public resource allocation to achieve sustainable growth trajectory and rapid structural change?

1.3 Objective

The general objective of this study is to examine the impacts of the induced sectoral TFP on economy wide growth and structural change process in Ethiopia necessary for reaching the middle income country status by 2025. The specific objectives of the study are to: -

1. Estimate the sectoral TFP growth rates and examine their determinants in agriculture, industry and service sectors.
2. Scrutinize the impacts of the induced sectoral TFP growth on the economy-wide growth and structural change.
3. Examine the role of government in public resource allocation for achieving sustaining economic growth and rapid structural change.

1.4 Justification

The main justification of the study is attributed to the severity and the extent of the problem associated with erratic growth and stagnant structural change process that harm the lives of millions. Moreover, considerable size of the population is expected to

improve their welfare from the implementation of the result of the study. The specific justifications are as following:

The existence of abysmal poverty and regular drought: The country faced seven main droughts with five famines in 1980-2010. About one third of the population lives below a poverty line. Nearly 6 to 13 million people risk starvation every year (MOFED, 2005). This is mainly due to erratic growth and sluggish transformation. The food gap also rose significantly (Befekadu and Birhanu, 2000). This situation is also further aggravated by a climate change, leading to a reduction in agricultural yields (Parry, 1990). As a result of erratic growth, the population affected by droughts, floods and extreme temperatures soar by 3.2 percent in 1990-2009 (WB, 2011).

A structural shift towards a low-productive sector: The structure of GDP is characterized by low and stagnant share of the manufacturing sector (4.8 percent on average) in 1980-2010(WB, 2011). Though the government launched ADLI in 1994 and State-Led development program in 2005 in order to transform the economy, the share of manufacturing in GDP remains the same. This economy tends to be service-led from one which is agriculture-led economy. This means that the economy structurally shifts towards a low-productive service sector causing a structural change burden to the economy.

Declining growth trajectory projection: On top of the problems mentioned earlier, the current remarkable economic growth rate is projected to decline. The IMF report shows that the economy projected to decline with a range of 5 percent to 6.5 percent in the period 2012-2016 (IMF, 2012). This has an adverse effect on the dream to become a middle-income country. There is no guarantee that the per capita income that was USD 358 in 2010 will not slide back. Besides, this figure is far away from per capita income which is required to join a middle-income country status (WB, 2011).

Unsolved political debates: There is an intensive and hot political debt regarding alternative sectoral growth options in the sphere of reaching a middle-income country status. However, the debate does not derive from a rigorous analysis and holistic economy-wide approach. It is rather affiliated with politics. Therefore, the paper seeks to investigate these issues meticulously.

1.5 Significance

This research focuses on one of the controversial and thrilling issues in the heart of economics and its relevance to sustainable economic development in Ethiopia. It is intended to have a multifaceted contribution to science and Ethiopian economy and fills knowledge gaps that exists in growth and structural change theories. Most of the growth options are focused at macro level rather than exploring the distinct determinant of sectoral growth options. Nonetheless, this paper brings to the attention of scholars the root of perpetual growth and the key determinants of sectoral TFP at sectoral level using holistic approach. It acknowledges the meso-economy that represents the middle of the two extremes (macro-and micro-economy) growth and structural change options. In this regard, the principal determinants of TFP growth vary with the major economic sectors. As a result, the move towards and sustaining the middle income country class is a daunting task for developing countries unless there is adequate structural change. There is also theoretical gap about the causal relationship between growth and structural change in order to ensure economic development. The paper in this regard reveals that causal relationships depend on the type of major economic sectors, level of development, and determinants of sectoral TFP growth. In addition, the methodology used links both time series econometrics (VARX model) and dynamic CGE model and therefore adds value and takes techniques of estimation one step up. In this regard, the dynamic CGE model is enabled to selectively consider the coefficients that are established using VARX model only for statistically significant determinants of sectoral TFP. This makes the model useful for prescription of sound economic policy relevant to Ethiopia.

1.6 Scope

The study focuses on the estimation of sectoral TFP growths and examination of the induced sectoral TFP effects on the economy wide growth and the structural change process in Ethiopia. It also analyzes the alternative impacts on the country's effort to reach the middle-income country status by 2025. In such economic growth and structural change process, the study also investigates the role of government in public resource allocations via enhancing the TFP growths in productive sectors. The study uses growth

a accounting approach and VARX model in order to calibrate the induced sectoral TFP growth. Based on the 2006 Social Accounting Matrix as an initial condition, the study uses a dynamic computable general equilibrium model for simulating policy scenarios in order to assess outcomes in 2025 regarding the structure of the Ethiopian economy.

1.7 Organization of the Paper

This paper has six chapters. Apart from the introduction, the second chapter presents the actual performance of growth and structure of Ethiopian economy in 1981-2010. The third chapter focuses on the theoretical literature and empirical evidences of the reference countries. The fourth chapter discusses the methodology of growth accounting approach, the standard VARX model and the specification of the dynamic CGE models. The fifth chapter engages in producing, interpreting and analyzing the econometrics and dynamic CGE simulation results regarding sector-specific TFP growth options and broad-based TFP growth options. Finally, the last chapter gives conclusions and policy recommendations.

CHAPTER TWO: GROWTH AND STRUCTURE OF ETHIOPIAN ECONOMY

Ethiopia is the second most populous country in Africa and the fourteenth most populous country in World. It is also one of the least developed countries in terms of Human Development Index, ranking 174 out of 187 (WB, 2011; Altenburg T., 2010). Although the natural resources are richly available in the country, economic growth and structural change are some of the daunting challenges in the national development programs. Before delving into the details of literature review and methodology, this chapter presents what the actual performance of the economy looks like in 1980-2010.

2.1 An Overview of Macroeconomic Performance

Structural transformation is an automatic dynamic process of change in sectoral contribution in terms of GDP, employment, input uses, demand and the like. However, it is not freely being optimized in Ethiopia. Lack of a stable macro economy and well functioning markets are constraints, among other factors. The macroeconomic three gaps model can easily explain the link between macroeconomic performance and structural change. The existence of chronic domestic resource gap (saving-investment), foreign resource gap (import-export), and fiscal gap (tax-expenditure) causes macroeconomic imbalance and instability and puts pressure on the function of markets. As a result of these constraints, economic growth and transformation slow down, limiting the improvement of the wellbeing. The macroeconomic performance in this regard can be measured by indicators of real sector, monetary sector, government, and external trade developments. Many agree that investment per GDP is the most decisive factor that reflects the linkage of macroeconomic performance and growth.

The ratio of total investment to GDP was 16.2 percent on average in 1980s and increased to 23.3 percent in 2000s (Table 1). However, it slid back to 15 percent during the neo-liberalization period (1990s). The evolution of investment per GDP impinges that the macro economy passes through different episodes of mixed performances. This investment instability has adverse effects on growth. However, the national saving

shows an increasing trend from regime to regime. This is partly attributed to the fact that people save their money mainly for the precaution purpose. Thus, as uncertainty and instability get high, people try to save more. Saving is one of the factors determining growth and structural change. Comparing Ethiopia with comparators, the Ethiopian economy saving of 19 percent in 2001-2010 is lower than the performance in other countries such as Angola (25%), Vietnam (24%), Zambia (31%), Botswana (32%), Malaysia (30%), Thailand (31%), Brazil (22%) and China (38%) - at their respective ending years of transition periods. However, it is a bit higher than Ghana's (9%) and Sri Lanka's (15%) gross savings (WB, 2011). This shows that Ethiopia should put extra effort to mobilize gross savings in order to enhance sustainability of growth via financial sector development.

Table 1: Major Macroeconomic Performance Indicators

Major Macroeconomic Indicators	Part of Socialist Regime (1980-1990)	Neo-Liberalization Regime (1991-2000)	Pro-Poor growth Regime (2001-2010)
Total investment(% of GDP)	16.2	15.0	23.3
Gross national savings (% of GDP)	6.8	10.1	19.7
Government revenue(% of GDP)	14.4	13.7	18.4
Government expenditure(% of GDP)	18.5	18.7	21.9
Grant, excluding technical support (USD)	0.30	0.54	1.96
Broad Money (% of GDP)	20.0	29.7	38.6*
Total Reserve (in months of Import)	2.3	4.3	3.05*
Inflation rate	5.2	7.5	11.1
Total Export (percent of GDP)	6.5	8.7	12.7
Total Import (percent of GDP)	11.6	16.4	30.4

Source: WB Report 2011, and IMF Report 2012, online database

N.B: *data for both broad money and total reserve presented here up to 2008 and 2009 respectively. The classification of the regimes is presented according to the Ministry of Finance and Economic Development.

Comparing saving and investment, Table 1 indicates that there is a domestic resource gap as investment demand exceeds saving fund. Nonetheless, the gap gets narrowed from 10 to 4 percent of GDP across the regimes. On the same manner, the fiscal gap has existed overtime as the government expenditure outweighs revenue. However, the gap is not very wide as compared to saving-investment gap. Looking at the trade gap from Table 1, the foreign currency earned from the export is lower than the expense incurred on import, leading to an increase in the trade gap from 5 to 18 percent of GDP. This is partly due to the increase in importation of capital goods over time. The existence of such macroeconomic gaps over the reference period requires foreign assistance in terms of grants and loans so as to meet the ongoing demand for investment, import and public expenditure (Lemi, 2005). In addition to a link between growth and resource constraints, stability of macroeconomic performance, mainly measured by inflation and foreign currency reserve, is also compulsory to secure sustaining economic growth and transformation. Otherwise, it adversely affects the investment climate and thereby economic growth. The economy entertained a single digit inflation rate till the pro-poor growth regime, ranging between 5.2 percent and 7.5 percent, on average. However, it surged to11.1 percent on average in the pro-poor regime. Historically, inflation in Ethiopia is low relative to other sub-Saharan African countries. The first historic level of inflation was 21% in 1991/92, mainly owing to the forceful political power transition from the socialist government to the current regime. However, the recent inflationary spiral unprecedentedly increased despite good harvest of agricultural produce. The general inflation reached 37.2% as of September 2008 while food inflation was 51.8% (CSA, 2008; NBE 2007 and NBE, 2011).

With respect to foreign currency reserve, the country's gross official reserve when the socialist government was toppled in 1991/92 was almost nil, equivalent to 1.3 weeks of imports. It recovers up to 6 months of import coverage in the first phase of liberalization, due to the balance of payment support by donors augmented by the increase in export earnings. However, it exhibited a declining trend and dwindled to cover only 3.6, 2.3 and 2.2 months of imports as of June 2005, 2006, and 2007, respectively. The reserve position was 5 weeks of import coverage in December 2008 and created a deadlock situation especially for investment activities (Kagnew and Zerayehu, 2009).

The recent macroeconomic instability that mainly was caused by historically unprecedented inflation and acute shortage of foreign currency reserve that continues to hamper the ongoing investment and growth. The monetary authority attempted to curb this macroeconomic instability. However, the monetary policy's speed of adjustment towards the long run equilibrium is about 2 percent per quarter and about 8 percent annually when there is a macroeconomic shock to the system. In order to have full adjustment, it could take many years. This exacerbated a daunting challenge for the sustained economic growth. For these reasons, it is not easy to tackle the macroeconomic instability within a short time (Zerayehu, 2006). Many suspect that the state-led development program and extensive public expenditure in particular are the key causative factors of the recent instability in the macro economy.

2.2 Economic Growth and Per Capita Income

The Ethiopian economy has been growing with different fashions depending on the economic policies undertaken by the ruling governments at their times. During the 1980s socialist regime, the economy grew by 2.3 percent while the population grew by 3.2 percent on average. In effect, the per capita real GDP deteriorated overtime and was equal to USD 133 annually, accompanied with a negative 0.8 percent growth rate on average (Table 2).

Table 2: Average Economic Growth Performance and Per Capita GDP

Indicators*	Part of Socialist (1981-1990)	Neo-Liberalization (1991-2000)	Pro-Poor Growth (2001-2010)	2010
Real GDP, USD billion	5.6	6.7	12.4	18.3
Real GDP growth rate (%)	2.3	3.0	8.5	10.1
Real GDP per capita, USD	133	117	163	220
Real GDP per capita growth (%)	(0.8)	(0.09)	5.9	7.8
Nominal GDP per capita, USD	225.9	162.9	219.7	358.2
Nominal GDP per capita growth (%)	2	(9)	9	(9)

Source: WB, WDI database, online version

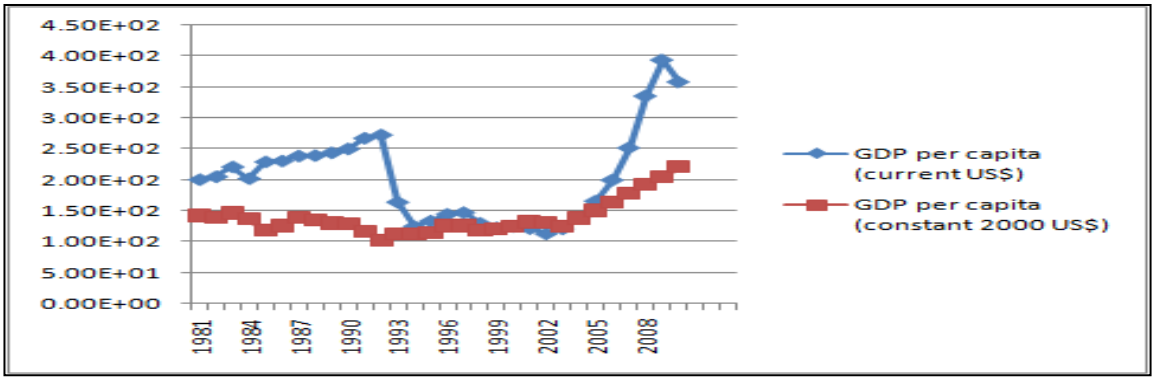
*The Real indicators reflected in constant 2000 USD price whereas the nominal presented in current USD price

The economic doctrine changed to make the economy more market oriented in the context of neo-liberalization in 1991. The government also launched ADLI, which gives more emphasis to small landholders[4]in order to achieve broad-based economic growth and industrialization (MOFED, 2005 and Tadele, 2008). However, the per capita real GDP in the 1990s dwindled to USD 117 on average with a negative growth rate. At that point, the government shifted its policy towards pro-poor growth strategy, from neo-liberalization strategy. Millennium Development Goals (MDG) in this regard also received due emphasis. These allow substantial government involvement in order to realize MDG targets and pro-poor growth. As a result, the average real GDP exhibits a progressive performance and grows by more than 8 percent. This boosted up the real per capita GDP with an average growth rate of 5.9 percent in 2001-2010. Though the economy in terms of GDP performs progressively across the regimes, the average nominal per capital income in 1991-2010 was lower than the 1980s performance.

The stochastic economic growth and per capita income impose difficulties on the country's move to cross to the middle income country threshold. There is, therefore, no guarantee that the per capita income that reached USD 358 in 2010 could not slide back as occurred in some developing countries. Looking at the trend of growth rate, Figure-1 below shows that the real GDP has not grown consistently and characterized by positive and negative performances ranging from 13 percent and negative 11 percent. This mainly attributed to the vagaries of nature (shortage of rainfall and drought), internal conflict, political instability and war. The positive growth rate also bounced up to 13 percent in 1993 and 2004 in response to recover a negative growth rate in the preceding year. In a nutshell, there has been a persistent coexistence of erratic economic growth rate and stable population growth rate, causing the per capita income and its growth rate to oscillate in the reference period.

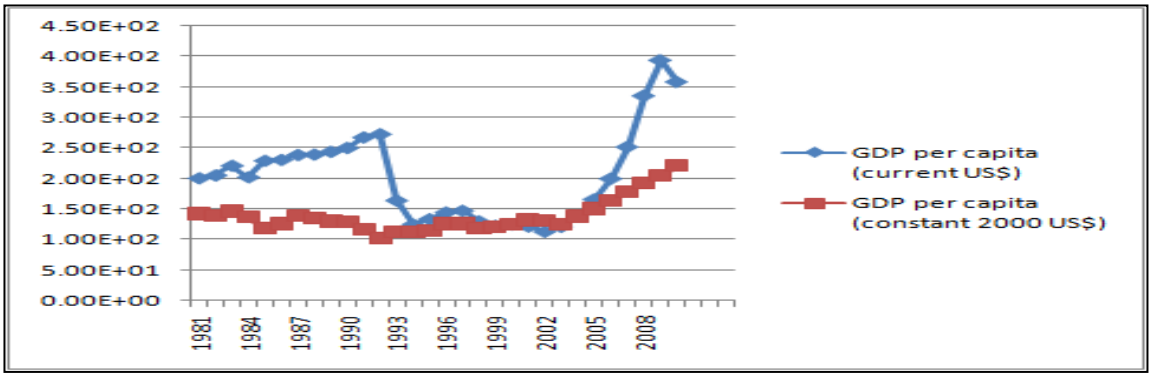
[4] They produce more than 90% of agricultural output and cultivate close to 95% of cropped land.

Figure 1: Growth Rates of Real GDP in 1981-2010



Source: WB, WDI database, online version

Figure 2: Trend in GDP per capita in 1981-2010

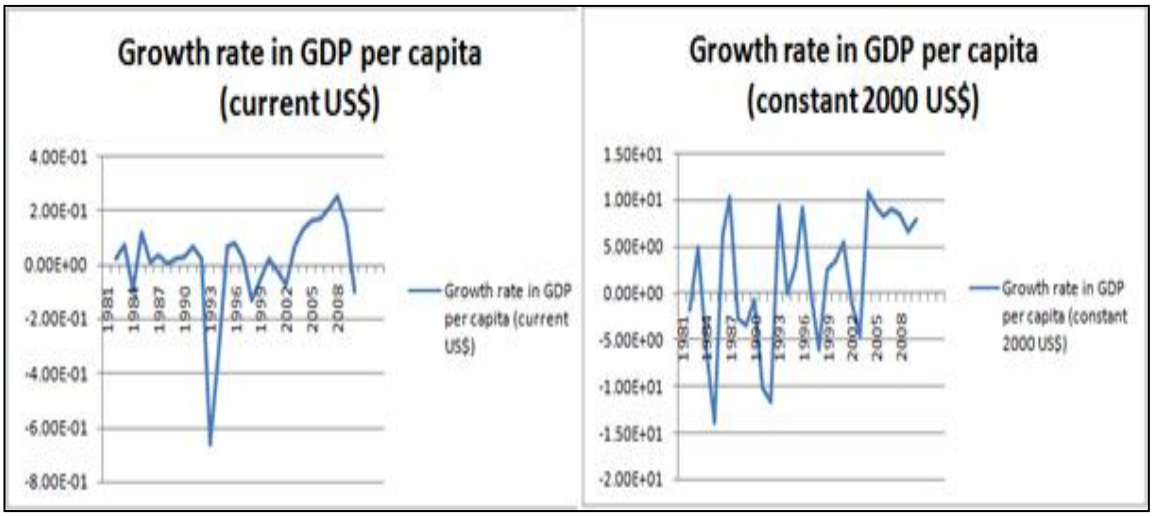


Source: WB, WDI database, online version

The nominal per capita income increases over the period 1981- early 1990s and then declines sharply for the subsequent ten years (Figure-2). Since 2002, it has unprecedentedly grown to USD 358 in 2010, mirroring the stochastic move towards reaching the middle income status by 2025. Not only has the lower GDP per capita in terms of level been a challenge, but also the rate at which it has been stochastically growing is also a daunting challenge (Figure 3). Thus, the country in this regard will take a longer and unpredictable time to reach the middle income country status, mainly due to the existence of low base and mixed performance in per capita income. In comparison with the selected ten reference countries, except Ghana and Sri Lanka, the growth rate of GDP per capita in the reference countries was between 9 and 16 percent, on average, during their transitions, which is negative 9 percent in 1991-2000 and then 9 percent on

average over the period 2001-2010 in Ethiopia. Besides, the average growth rate of real GDP in the reference countries was between 5 to 11 percent within the transition period of 8 to 13 years (WB, 2011). Though the Ethiopian performance seemingly approached to these figures, the performance has been mixed, volatile, erratic and poor in the reference period. On top of erratic per capita income, the growth rate of per capita income in terms of real and nominal values are not stable in 1981-2010. Comparing each other, the growth rate of real per capita income is highly stochastic, ranges from positive 10 percent to negative 15 percent growth rate. This presents the real performance of the economy after netting out the price effect.

Figure-3: Trend in Growth rate of per Capita income in 1981-2010



Source: WB, WDI database, online version

One of the causative factors for this mixed performance of the economy is irregularity of the rainy seasons as many people agree. The economy is constantly and heavily depends on the nature because of neglecting irrigation in the implementation of ADLI program. The adverse effect of variation in the rain and water resources not only affects the agricultural performance of the economy, but also negatively influences the performance of industrial and service sectors through sectoral linkage in exchanging inputs and outputs.

2.3 Controversies in Growth Rates Since 2005

Recently, there has been a pronounced disagreement about the officially reported economic growth rates of the Ethiopian economy between the government and others. The government claims that the economy has been growing at 11.2 percent on average since 2005. Such growth rate, however, is not shared by independent bodies. The majority of independent sources including the WB do not confirm the significantly overstated actual growth rates. According to the note on GTP, WB staff estimates suggest robust growth of 7-8 percent for the same period (WB, 2011). On the other hand, IMF staff projects the economic growth at 7.5 percent in 2011 while the government officially claims there was a double digit growth rate of 11.4 percent in 2011. Apart from the actual performance, there is also significant variation in the projection of future growth. The government projects that the economy will continue to grow around 11 percent in 2011-2015 (MOFED, 2010). However, the IMF report (2012) predicts a more modest growth in the range of 5 percent to 6.5 percent over the 2012-2016 periods (IMF, 2012). No matter how intensive the debate, the lowest estimate of 7 percent growth rate since 2005 is historically unprecedented for Ethiopia. However, the basic question raised by scholars is about the sectoral sources of this growth. What makes the economy grow like this? Previously many agreed that agriculture is the main driving force of the growth in Ethiopia. Recently economic growth has, nonetheless, become more dominated by the service. The government reports suggested that the contribution of agriculture to economic growth declined from 6.4 percent to 2.7 percent in 2005- 2010 (Table 3). The contribution of the service sector to GDP growth rate concomitantly increases from 5.1 percent to 7 percent. However, the contribution of industry to GDP growth stuck at 1.4 percent, showing the poor performance of economic transformation.

Moreover, the NBE report (2011) also confirms that the contribution of the service sector to GDP structure accounts for the lion share, followed by agriculture, and industry. The dominant power of service sector over agriculture and industry has its own implication on sustainability and pace of the economy wide growth and the process of structural change process in the economy. Experience from comparators also shows that the poor performance in the service sector causes the entire economic performance to grow within a limited bound.

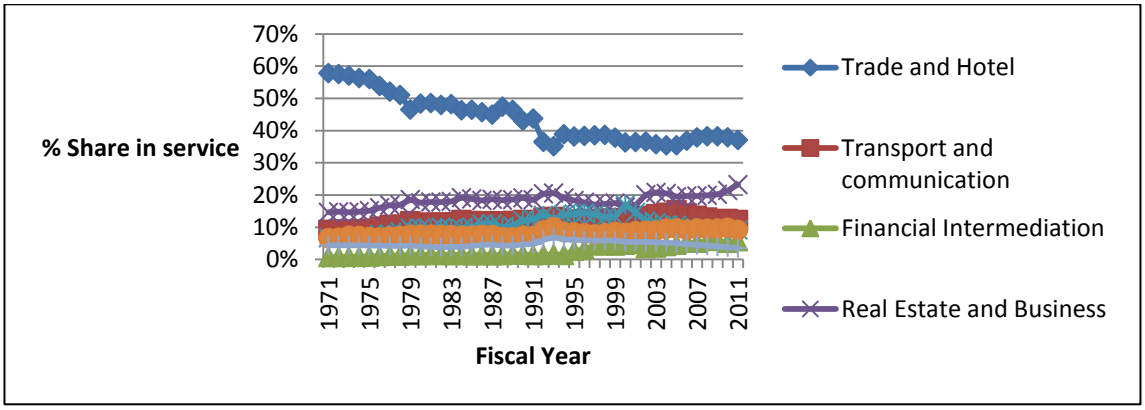
Table 3: Sectoral Contribution to GDP Growth Rate in 2000-2010

Sectors	Fiscal Year in the Pro-poor period									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Agriculture	4.8	-1.0	-5.1	8.1	6.4	5.1	4.4	3.3	2.7	3.2
Industry	0.6	0.7	0.8	0.9	1.3	1.4	1.3	1.3	1.3	1.4
Service	1.5	-0.2	1.9	2.3	5.1	5.4	6.4	7.0	6.3	6.0

Source: NBE

Looking at the figure 4 below, the most influential and growing activities that enable the service sector to take the leading position are domestic trade (whole sales and retail trade) and hotels business. Real estate and the associated business take the second largest share in the value-added of the service sector. These sectors also received a considerable share of bank credit that heavily pushes the sector over others (NBE, 2010). Note that the top service sub-sectors are not innovative and mainly use traditional labour intensive operations, slowing down the process of economic transformation.

Figure 4: The Evolution of the Structure of Service in 1971-2010



Source: MOFED

The retail and wholesale domestic trade activities dominate services. They are less innovative, productive and use non-ICT technology. Besides, the service is highly restricted and not exposed to liberalization. Therefore, shifting towards the service-led economy put much pressure on the economy as it is more of consumption sectors while agriculture and industry, which are the productive sector, are not able to go along with the aggressively growing demand for services.

As a result, macroeconomic instability, shortage of foreign currency reserves, and high inflation rate has been becoming the feature of the economy since 2005. The government attempted to undertake a series of policy adjustments in order to minimize an increase in inflation and external imbalances (WB, 2011). In conclusion, the recent economic performance will keep growing if and only if the government is strong enough to reduce the existing macroeconomic imbalances along with other economic debacles. Note that the inherent nature and structure of the service sector in Ethiopia is not similar to the Indian experience which was highly characterized by information science, technology and capital intensive activities that create a synergy of innovation in the economy, leading to productive and innovative service-led economy (Nirvikar, 2006).

2.4 Structure of the Economy and Sectoral Dynamism

With erratic growth performance, agriculture largely determines the economic performance and sustains around 82% of the populations. Nonetheless, agriculture is dominated by the smallholders who cultivate less than 0.5 ha on average and produce basic staples for subsistence (Hassan, 2006). It also increasingly uses fertilizer that accounts for 9.4 kilograms per hector in 2001-2004 and increased to 11.8 kilograms in 2005-2009. As a result, the average real agriculture value added per worker also increases from 169 in 1993-1996 to 196 in 2005-2009 (WB, 2011). Though the government attempted to ease the tight problems associated with agriculture, the sector is highly volatile depending on the rainfall. Irrigated land also accounted for only 2.5 percent of total land despite the fact that Ethiopia is one of the water towers in Africa and there exist an adequate agricultural land. The existence of fragmented land and subsistence agriculture is still a main character of the economy and causes the economy not to have a rapid structural change.

As can be seen from Table 4, agriculture in 2010 accounted for 48% of GDP, followed by the service sector (38 percent), and then the industrial sector (14 percent). The share of manufacturing in GDP accounts for only 5 percent in the same year, showing how the country is far from actualizing structural change. Understanding the sectoral dynamism from figure-5 above, the share of agriculture in GDP has been declining while services as share of GDP concomitantly increased overtime in 1980-2010. They converged and

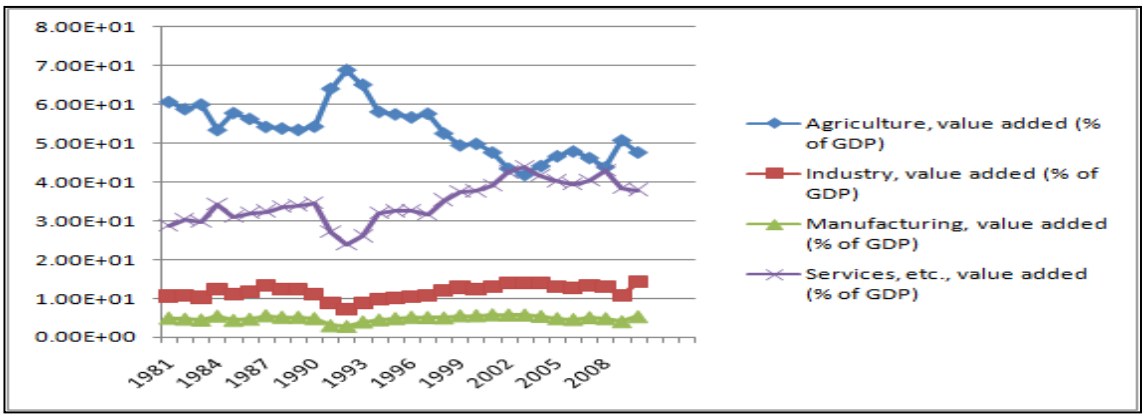
nearly met in 2003 and then diverged a bit and then converged again in 2008. This reflects that the service sector seems take the leading position in the near future (NBE, 2011). Industry in general and manufacturing in particular, however, remain stagnant in terms of share in GDP, structure, employment, and technological content (Demeke *et al.*, 2003). Note that the share of manufacturing accounts for nearly 31 percent of GDP in China and Brazil. It also accounts for above 20 percent in Thailand, Vietnam, Sri Lanka, and Malaysia at the ending years of their transformations. Ethiopia's performance in this regard is quite far away from the comparator countries' performances, it accounts for only 5 percent (WB, 2011).

Table 4: Structure of GDP in Ethiopia

Sectors	1981-1990	1991-2000	2001-2010	2010
	Part of Socialist Regime	Neo-Liberalization Regime	Pro-Poor Growth Regime	
Agriculture, value added				
Annual growth rate	1.89	2.52	6.78	5.84
Share in GDP (%)	56.30	58.00	46.05	47.68
Industry, value added				
Annual growth rate	3.31	2.67	8.94	8.80
Share in GDP (%)	11.58	10.29	13.19	14.28
Manufacturing, value added				
Annual growth rate	3.12	2.47	7.32	9.76
Share in GDP (%)	4.89	4.51	5.07	5.24
Services, value added				
Annual growth rate	3.89	3.99	10.72	15.20
Share in GDP (%)	32.12	31.71	40.76	38.03

Source: WB, WDI database, online version

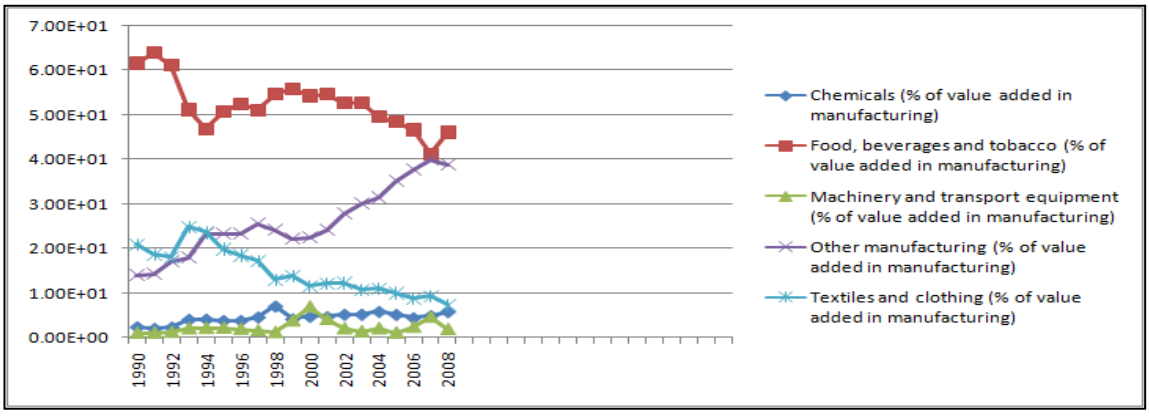
Figure-5: Sectoral Dynamism in 1981-2010



Source: WB, WDI database, online version

Figure 6 below gives a summary of structure of manufacturing sectors in 1981-2010. The share of food and beverage accounts for 40 percent to 60 percent of manufacturing goods. However, it decreases over time while the share of other manufacturing concomitantly increases from 15 percent to 40 percent during the transition. On the other hand, textiles and clothing (which could have exploited the country's comparative advantage) as well as chemicals as share of manufacturing stayed stagnant over time in the last three decades. The manufacturing sector as a whole was largely limited to ordinary agro-processing activities and production of basic consumer goods, limiting the multiple role of manufacturing in the economic transformation.

Figure 6: The Structure of Manufacturing in 1981-2010



Source: WB, WDI database, online version

The Chinese experience, however, indicates that the share of other manufacturing at the beginning year and the ending year during the period of transformation takes the largest share of 43 percent and 48 percent, followed by machinery and transport which accounted for 18 percent and 14 percent respectively. The share of food and beverages at the initial year and ending year took the third position with a percentage share of 13 percent and 14 percent, respectively (WB, 2011).

Regarding the structure of merchandise exports and imports (Table 5 below), it is revealing to focus on manufacturers import, and export as the study puts emphasis on structural change and sector growth options. Theoretically, many believe that a country should import capital goods mainly manufacturing goods so as to enhance the production capacity of the economy, facilitate import substitutions factories, expand export and enable the country to save and earn foreign exchange. Accordingly, the Ethiopian economy behaves in the way that manufactures import as share of merchandize import accounted for the largest share, ranging from 60 percent to 84 percent. However, the resultant effect of the largest share of imported manufactured goods on the export market and other industrial activity is not significant. This suggests to the scanty share of the exported manufacturing goods in the last three decades. This shed light that the correlation between manufacture import and manufacture export is not efficacious in creating dynamic momentum and structural change.

Unlike structurally transformed economies, the manufactures' exports in the share of merchandize export constitute a negligible share ranging from 4.5 percent to 14 percent in 1991-2009 while the food generally took the largest share above 70 percent (Table 5). All manufacturing exports are agriculture-based. The agricultural sector supplies around 73% of the raw material (Eshetu and Mammo, 2009; Hassan, 2006).

Table 5: The Structure of Merchandise Import and Export[5]

Structure of Import and Export	2001	2002	2003	2004	2005	2006	2007	2008	2009
Percent of Merchandise imports									
Agricultural raw materials imports	1.0	0.9	0.7	0.9	0.9	1.6	0.9	1.2	0.5
Food imports	14.5	11.3	21.5	12.3	10.6	8.5	7.0	14.3	10.9
Fuel imports	17.5	12.4	12	14.9	15.1	19.9	13.3	23.2	15.9
Manufactures imports	65.2	73.9	64	70.8	72	68.5	76.4	60.2	71.5
Ores and metals imports	1.5	1.2	1.5	0.8	1.2	0.8	1.4	1.1	1.2
Percent of Merchandise exports									
Manufactures exports	13.4	14.3	11.4	3.8	4.6	5.4	13.8	9	8.7
Ores and metals exports	2.7	1.3	0.7	1.1	1	0.6	3	0.6	0.8
Agricultural raw materials exports	23.2	15	25.9	12.2	15.3	17.3	20.4	14.1	11.9
Food exports	60.7	69.3	62	75.4	78.7	76.5	62.1	75.3	77.5

Source: WB, WDI database, online version

Compared to the reference countries, the share of food items in merchandise export took nearly 20 percent in Vietnam, Malaysia and Sri Lanka and accounts for around 5 percent in Zambia and China, 37 percent in Thailand, and 54 percent in Brazil at the respective ending years during their transition. However, the share of food items accounts for 75 percent on average in Ethiopia. Similarly, the share of manufactures export in 2009 accounted for 8.6 percent whereas the average share of manufactures export for all reference countries was 19 percent. Specifically, the share of manufactures was 88 percent in China, 25 percent in Brazil, 51 percent in Thailand, 73 percent in Sri Lanka, 55 percent in Vietnam, and 20 percent in Ghana (WB, 2011). Compared to other SSA countries, the manufactured exports per capita in Ethiopia was lowest at USD 1.7 while that for SSA African countries was USD 131.5 (Mulu and Eyersualem, 2010).

On top of the supply side structure of the economy, the demand structure is also indicative about the move towards the achievement of structural change. Out of the

[5] The data is not available for the period 2010-2011.

components of demand, the share of household final consumption expenditure in GDP has taken the largest part in the last three decades. Table 6 gives the details in this regard. The share of export and gross capital formation in GDP accounted for only below 10 percent, on average. The Ethiopian export and gross capital formation as a share of GDP is far below that of the selected countries' average of 42 percent and 29 percent at the ending years of their respective transformation period.

Table 6: The Structure of Demand as share of GDP

Component of Demand	**1981-1990**	**1991-2000**	**2001-2010**	**2010**
	Part of Socialist Regime	**Neo-Liberalization Regime**	**Pro-Poor Growth Regime**	
Government final consumption				
Annual growth rate (%)	4.78	10.31	2.8	31.76
Percentage Share in GDP	11.38	10.24	11.88	10.19
Household final consumption				
Annual growth rate (%)	2.05	2.69	11.53	15.19
Percentage Share in GDP	78.24	80.18	83.17	89.4
Gross capital formation				
Annual growth rate (%)	5.15	4.22	11.13	-6.22
Percentage Share in GDP	15.44	17.24	22.72	21.48
Exports of goods and services				
Annual growth rate (%)	2.8	7.08	10.19	14.36
Percentage Share in GDP	6.52	8.71	12.79	11.41
Imports of goods and services				
Annual growth rate (%)	2.64	6.47	15.32	15.86
Percentage Share in GDP	11.58	16.37	30.56	32.48

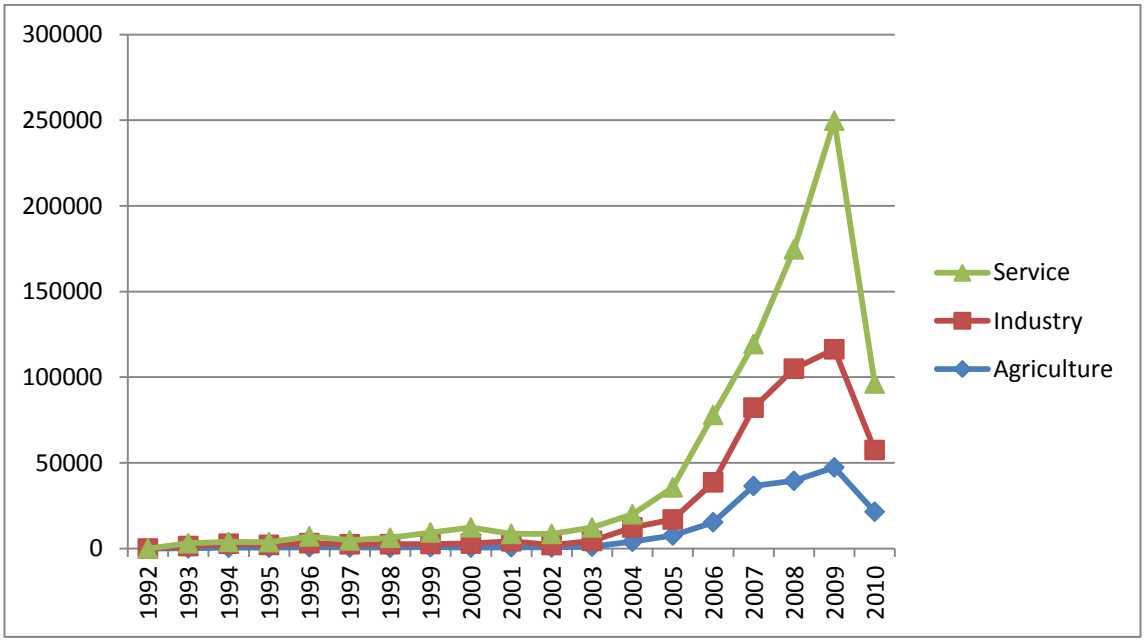
Source: WB, WDI database, online version

2.5 Structure of Sectoral Capital Investment

Since the onset of a more of market economy in 1991, the government has been encouraging the domestic investors and foreigners in order to build private sector - driven economy. The number of service projects accounts for the lion's share amounting to 54 percent, followed by the industry and agriculture. In terms of paid-up capital investment, the service sector has taken 46 percent of the total licensed paid-up capital investment in 1992-2010. The industrial and agricultural sectors have also attracted 33 percent and 21 percent of the total capital investment for the licensed projects in Ethiopia (EIA, 2010).

Figure 7 shows that total investment for the licensed projects has unprecedentedly increased since 2005. This predominantly is attributed to the aftermath of 2005 election and policy shift towards state-led development program. Even though the willingness to invest, as measured by the licensed projects, in all the three sectors is encouraging, the actual performance of investment is a bit far away from their willingness (Table 7).

Figure 7: Investment Capital for the Licensed Projects by Sector in 1992-2010



Source: EIA, Vol. 2

Table 7: Licensed Investment Projects by Investment Status and Type in 1992-2010

Investment Type	Pre-Implementation		Implementation		Operation		Total	
	No. of Projects	Capital Mln Birr	No. of Projects	Capital Mln Birr	No. of Projects	Capital Mln Birr	No. of Projects	Capital Mln Birr
Domestic	34,862	328,550	2,182	21,697	4,418	24,874	41,462	375,121
Foreign	5,752	298,420	376	32,497	1,219	24,118	7,347	355,035
Public	68	113,131	12	5,945	27	4,767	107	123,843
Grand Total	40,682	740,101	2,570	60,140	5,664	53,759	48,916	853,999

Source: EIA, Vol. 2

Looking at the Table 7 above, 83 percent of the total number of licensed projects and 87 percent of total capital investment demand were not yet implemented in 1992-2010. Rather, they stayed at the pre-implementation process mainly due to the lack of an enabling environment and shortage of investment funds, among other factors. This in general shows how hard it is for domestic and foreign investors to pursue their investment dream. Pertaining to the employment opportunity, many projects have potential to increase employment opportunity by 2.3 million people in the last two decades. However, the country failed to exploit this since 83 percent of projects were not implemented (EIA, 2010).

2.6 State Intervention in Economic Transformation

The role of government in sustaining growth and economic transformation varies from regime to regime. The imperial regime attempted to establish the foundation for private sector industrialization. However, the socialist government after taking over political power in 1974 nationalized industries and subsequently reorganized them into state-owned corporations. The socialist government also participated in producing and distributing basic goods along with providing basic infrastructure and social services. The government parastatal, institutions and public enterprises drove the entire economy by neglecting the private investors' role in economic transformation. The government favored the socialized sectors with the preferential right to access bank credit at lower interest rate against the private sector.

The socialized sector, however, did not efficient and productive to meet the demand of the economy and export market and failed to repay loans back. As a result, the persistent and widening fiscal deficit, along with the macroeconomic imbalance, challenged the performance of the economy. The industrial sector in this regard experienced structural, policy and technical constraints. The current expenditure accounted for 70 percent of total expenditure. Around 40 percent of recurrent outlay was allocated for defense, which in turn adversely affected the industrial development in the country in the socialist regime (MEDaC, 1999). Table 8 gives us the summary of government finance in 1981-2010.

Table 8: Summary of Government Finance in 1981 -2010

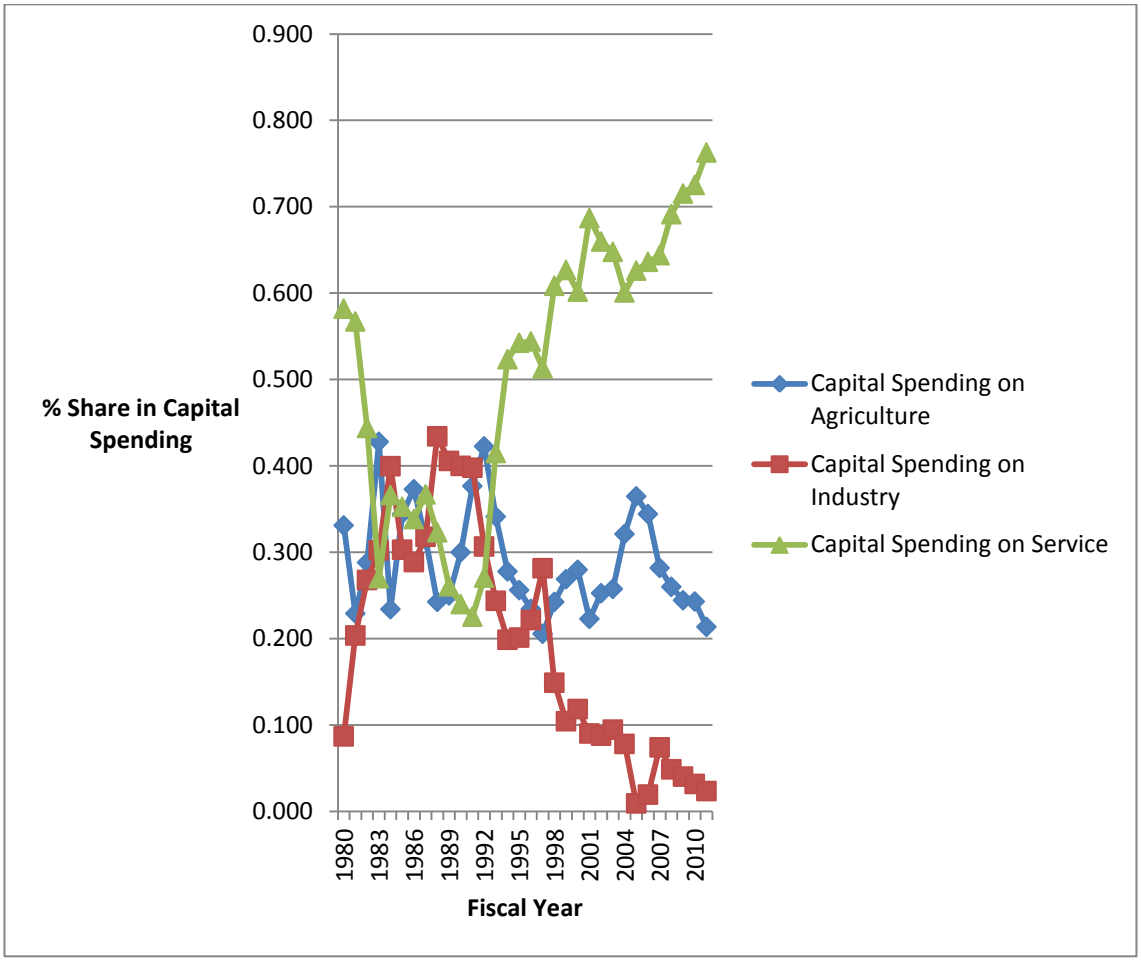
Particulars	**Summary of Government Finance as percentage of GDP (%)**		
	Part of Socialist Regime (1980-1991)	Neo-Liberalization Regime (1991-2001)	Pro-poor growth Regime (2001-2010)
Total Revenue and Grants	23	17	18
Revenue	20	15	14
Grants	3	3	4
Expenditure	29	23	23
Current expenditure	20	15	13
Defence	8	4	3
Capital expenditure	9	7	10
Overall balance including grant	-6	-6	-5
Overall balance excluding grant	-9	-8	-8
Financing	6	6	5
External (net)	3	3	3
Domestic	3	3	2

Source: MOFED

The incumbent government after toppling out the socialist regime launched a fiscal federalism system which provides substantial authority to regional states. The total expenditure as a share of GDP that was 29 percent in 1980s reduced to 23 percent in the subsequent reformation period. Government spending on capital formation shows a mixed performance in terms of the structure. The government expenditure on services

accounts for the lion's share in the pro-poor growth regime, followed by agriculture, and industry (Figure 8).

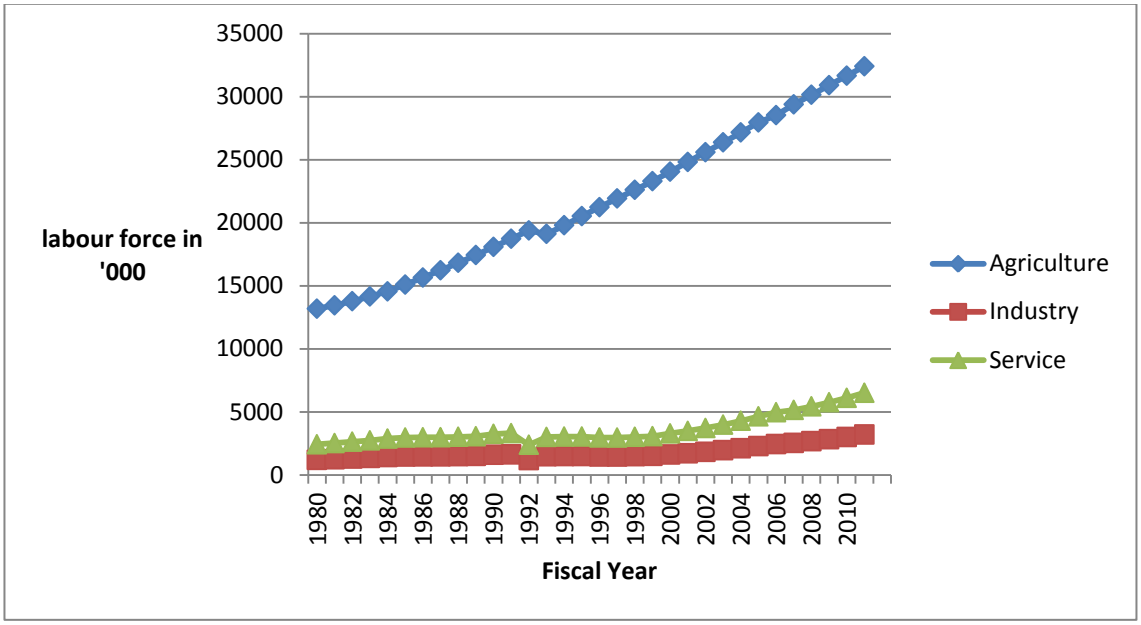
Figure 8: Sectoral Government Capital Expenditure by Sector in 1980-2010



Source: MOFED

One compelling point is that the service sector accounts for the lion's share in four indicators:- structure of GDP, contribution to GDP growth rate, structure of capital investment, and structure of government capital expenditure. However, the number of employed people who sustain their lives in service activities is not as such larger comparing with the agriculture. This indicates that the sector where capital injected is different from the sector where many people sustain their lives in Ethiopia.

Figure 9: labour force by Sector in 1980-2010



Source: Own calculation, based on the data from UNCTAD, http://unstad.org

In conclusion, the performance of the Ethiopian economy reflects erratic, mixed, volatile and sluggish in terms of economic growth, per capita income and structural change over the 1981-2010 periods. Though the economy has performed remarkably well since 2004, the service sector significantly dominates the structure of the economy including investment, GDP and growth rate of the economy. Meanwhile, the manufacturing sector that expected to ignite transformation and sustaining growth became marginalized. The role of the government in directing the resource into the service sector accounts for the lion share in this regard. However, the service sector is not in a position to rescue the economy. Rather, it imposes structure change burden. This is mainly due to the fact that the service sector is poor productivity, uses traditional labour technology, is weak in innovation, and has only employed restricted liberalization. Therefore, the future will be gloomy in terms of growth and structural change if the government keeps counting on the same economic policies. The IMF projection also indicates that the Ethiopian economy will grow at a declining rate and cause a persistent problem unless the problems are solved in time (IMF, 2012).

CHAPTER THREE: - LITERATURE REVIEW

Ensuring sustainable economic growth and rapid structural change have received an immense attention and become a debatable agenda in the history of economics. Both of them are compulsory in many facets of development so as to raise the standard of living and increase the pace towards reaching the middle-income country status. With its limitation, the per capita GDP and the relative contribution of industry to GDP are the leading economic indicators that help to measure the performance of countries with respect to reaching the middle income country status. The growth rate of the economy must constantly be higher than the rate at which population is growing. Otherwise, the resultant per capita income would be indicative of erosion in the standard of living over time and forces the countries to stay in the poor income country group. Growth and structural change are in general driven by improvements in total factor productivity and factor accumulation. However, factor accumulation is susceptible to diminishing return to scale while total factor productivity blessed with increasing return to scale. The TFP growth is, therefore, the ultimate driving force of long-run economic growth and rapid structural change.

3.1 Theoretical Framework and Concept of Transformation

A growing tree continually changes the size, shape and configuration of its branches depending on soil, air, water, sunlight, and an environment available to it. With the same analogy, a healthy growing economy changes the structure of its supply and demand sides. In particular, change in final outputs and inputs are the consequences of structural change of the economy. The structural change is, therefore, not a spontaneous phenomenon. It is rather a dynamic and gradual process. The growth rate of TFP is the main driving force to enhance the efficiency and the capacity of the long run economy. It reflects the facts that the growth of TFP is vital not only for sustaining growth and catching cross-countries growth differences, but also it is a vital factor in explaining erratic growth performance and business cycles (Comin and Mark, 2006).

3.1.1 Conceptualization of Economic Transformation

The concept of structural change represents a dynamic process of change in sectoral relative contributions to GDP in which for example, the share of industry (manufacturing) in GDP rapidly increases. Such increase in the share of industry causes the agricultural share in GDP to decline concomitantly in a non-linear pattern. Amidst, the contribution of services in GDP begins to grow. This dynamic process continues until the share of manufacturing takes the leading position and contributes to GDP (Kuznets, 1966; Chenery and Taylor., 1968; Kongsamut *et al*., 1997; and ECA 2011). Comparing with agriculture and service, industrializing the economy means moving towards higher productivity, higher earnings and profit, integrated industrial products, product sophistication and output diversification, relatively low risk (volatility and vulnerability), widen employment creation and so one. These structural change outcomes have direct and indirect effects (via sectoral linkage channels) on agriculture and service sectors. Industrialization is therefore the central process of structural change. Broadly, there are two basic framework of structural change process/economic transformation: -Factor accumulation framework and factor productivity framework in the thinking of accumulationist and revisionist, respectively. We review these frameworks separately in the mages their follow.

Factor accumulation framework:

This refers to an increase in the quantity of factors of production (labour, land, capital, investment, saving, natural endowment etc) in the production process. The more factors injected into the economy, the more goods and services the economy produces. However, such accumulation of factors does not have unlimited contribution to economic growth. Rather it is subject to a diminishing return to scale and scarcity of factors. This means that the economy wide growth rate in this framework is likely constrained by factor scarcity, factor depleting, and diminishing factors of production. With its limitation, the Big Push theory in this regard advocates for a substantial amount of investment injected into the economy so as to achieve growth and transformation (Rosenstein-Rodan, 1943). The Rostow's five stage growth model also indicates the requirement of massive capital investment at take-off stage of transformation (Rostow,

1956). Factor accumulation in industry received much attention as an option of industry-led transformation (a direct approach). Import substitutions strategy is one policy of factor accumulation in the 1950s and 1960s which is worth mentioning. However, this approach in some countries caused inefficiency to industries and delayed transformation. It also paved a way for an alternative sectoral model of factor accumulation. The dual-sectors growth model which followed acknowledges the strong interdependence between agriculture and industry. Lewis (1954), Fei and Ranis (1964), Jorgenson (1961), Dixit (1968), and Kelly *et al*. (1972) emphasized the dual sectors growth model. In case of the Lewis model, the process of industrialization assumed to continue until the modern sectors absorb the factor accumulation of all surplus rural labor, leading to the turning point of transformation and sustainable economic growth. Lewis also concludes that the rate of structural change depends on the capital accumulation rate and the reinvestment of earned profit in the industrial sector. Fei-Ranis gave more emphasis on the contribution of agriculture for transformation and growth, arguing that growth in the agriculture can restrain growth in the industrial sector (Fei and Ranis, 1964).

Instead of accumulating factors in two sectors, the Fisher-Clark (1939) proposes the three sector hypothesis of economics in which a healthy economy passes through from agriculture (pre-industrialization) to industry and then to services (post-industrialization). In the industrialization stage, the role of manufacturing causes income and productivity to rise. This in turn leads to a higher demand and rapid industrialization, shrinking the size of the agricultural sector. However, in added in Fisher-Clark an explicit concern about the role of service sector in the economy and structural change on the condition that the service sector has characteristics of high income elasticity of demand which trigger increases in income and employment. Instead of sector-based growth model, others advocate country-specific factor accumulation growth model (Hirschman, 1958). However, others indicate that factor accumulation of saving and investment should be considered as a necessary but not sufficient condition for sustaining economic growth and transformation (Todaro and Smith, 2011). The decreasing return to scale in factor accumulation raises the need for an alternative framework of factor productivity to complement, not to replace, the role of increasing factor accumulation. This leads to the analysis of factor productivity framework.

Factor Productivity Framework:

In addition to decreasing return to scale after a certain level of factor accumulation, and the scarcity of factors of production, many studies show that factor accumulation does not explain cross-cross differences and catching up growth rate. This means that factor accumulation produces only a transitional effect on growth, not a permanent effect. The other typical nature is the fact that factor accumulation is persistent while growth is not persistent, but erratic. So this allows looking for something else that principally drives the long run economic growth. It is increasing the TFP that complements the contribution of factor accumulation and enables the country to achieve a permanent long run economic growth (William E. and Ross L., 2001). The change in TFP growth refers not merely to technological change. Rather, it embraces all changes in technology, technical efficiency, allocative efficiency, economies of scale effects, and the like. It also considers all factors that increase the productivity of all factors of production like technical change, human capital via education and health, development expenditures etc (Hafiz *et al*., 2010). It also gives more emphasis on acquiring knowledge through learning by doing, economy wide knowledge stock and externality and spillover effects.

It was Solow (1956) who first questioned the accumulationist view and then kicked off the debate that growth involves technical change. He found that seven-eighth of output growth attributed to TFP growth in his study. Following the exogenous growth model, the endogenous growth model pioneered by Romer's (1986) and Lucas' (1988) provides due emphasis on new knowledge (Grossman and Helpman, 1991), innovation (Aghion and Howitt, 1992) public infrastructure (Barro, 1990; Stephen, 2001) and the like. In general, the recent theories suggest that TFP in the sense of change in technology, knowledge, human capital and spillover effect drives the long-run growth while accumulation of factors does not explain long run growth. This does not mean that factor accumulation is irrelevant for long growth and structural change process. Without adequate factor accumulation, increasing TFP can be limited to some extent. In general, many studies indicate different source of transformation. Some believed that technology-led productivity growth is the source of sustaining growth and transformation (Kuznets 1973; Schumpeter 1947 and Schultz 1964) while others focus on the rapid capital accumulation (Chenery, 1960; Rodrik, 1999; Kuznets, 1961; Krueger 1988, and

Rosenstein-Rodan; 1964). Studies conducted by Hirschman (1958) and Johnston and Mellor (1961) give more emphasis on the role of linkages of the economy. Many also pay attention to the roles of the market, and institutions (Matthews, 1986 and Rodrik, 2003), research and development (Aghion and Howitt, 1992; Romer 1990), and low resource cost and enabling environment (Thaddee *et al*, 2009). The study undertakes the amalgamation of factor accumulation in the base-run scenario and growth of TFP in the simulation scenario of the dynamic CGE model.

3.1.2 Major Determinants of The TFP Growth

As discussed earlier, TFP is a residual factor, which is other than labour and capital, explains economic growth. It comprises change in technology, allocative efficiency, technical efficiency, economies of scale and the like. Technical efficiency in this regard means producing maximum output from the minimum quantity of factors of production. It is necessary and indispensable for allocative efficiency. Allocative efficiency, on the other hand, refers to the production level where marginal utility of the good equals to its marginal cost. This indicates that allocative efficiency accounts for optimal distribution of goods and preferences of consumers.

TFP is the driving force of long run growth and has a permanent effect on structural change. It also generates an increasing return to scale and sources of efficiency. In general, it is the growth of TFP that creates synergy and speeds up the process of economic transformation and perpetual economic growth as well as enhances the welfare of the society (Andres, 2007). Therefore, what are the chief determinants and sources of change in TFP in order to articulate a sound economic policy? Both neoclassical and modern growth theories propose differently about the determinants of technological change. The neoclassical models consider technological progress as an exogenous variable like manna coming from heaven (Solow, 1956). However, the modern growth models explain the sources of technological change as an endogenous variable (Romer, 1990). As TFP refers to efficiency, technological change, and scale of economies, the study identifies the key determinant of TFP on the basis of the endogenous growth model. This model takes endogenous knowledge creation as the principal determinant. The existence of new ideas and stock of ideas creates the dynamic process of economic transformation (Romer, 1990). From the theoretical perspective and empirical

evidences, the best disaggregated determinants of TFP are: creation of knowledge and innovation; transfer of innovation; adoption and adaption of innovation; and absorptive capacity (Anders, 2007). Each of these determinants is discussed in details below.

Creation of knowledge and Innovation:

It is the creation of a new idea of production methods and technology that produces more in an easy way and by lowering unit cost of production. It saves time, manpower, and money on one hand and it advances quality, efficiency and competency, on the other hand. In effect, knowledge creation positively influences the TFP growth (Abdih and Joutz, 2005). Interestingly, without the generation of a new idea, this world would be frozen somewhere in the past. Hence, discovering technology and new ideas about how to produce is the principal driving machine for perpetual economic growth and improvement in the wellbeing of the society. Romer (1990) in this regard argues that the stock and the creation of new knowledge are plenty as compared to any other resources and have a character of building each other cheaply, against the assumption of diminishing return to scale. In short, he proposes to exploit the untouched benefit of building knowledge-based economy. To do so, R&D is one of the key sources of innovation and knowledge as well as facilitates the process to enhance the absorptive capacity. Both domestic R&D discoveries and international R&D spillovers are worth mentioning in economic transformation. A network of public and private institutions that carried out the R&D activities considered as a source of R&D so as to foster new products, knowledge, technologies, processes, and methods of production (Chen and Dahlman, 2004). However, R&D by itself is costly so that most developing countries could not afford it. As a result of this and a slow diffusion process, the effect of R&D on the long run growth might be inconclusive, against Romer's result (Jones, 1995).

Transfer of Innovation:

Because of cost of creating knowledge through R&D, most countries acquire the state-of-the-art technology from countries which are leading in discoveries and idea creations (Torfinn and Jorn, 2005). Developing countries in this regard are far away from the world technology frontier and face an enormous gap in the way they produce and in the quality of production. This puts pressure on the term of trade to deteriorate overtime as

these countries export primary commodities. To fill this gap, several countries attempt to acquire technologies through importation of knowledge intensive goods and service, and foreign direct investment in order to scale up the production capacity of the country.

With regard to importing technology intensive goods and service, foreign trade matters in increasing the TFP growth of the economy. It is a carrier of innovation from foreign countries to the domestic economy in terms of both importations of technology and skilled human capital service to smooth out the transfer of innovation (Mayer, 2001). In addition to this, foreign direct investment also facilitates the transfer of innovation from abroad. Not only the investment of foreign capital, but also the associated inflow of skill, experience, knowledge, spillover and positive externalities are the most crucial factors that multiply the effect of FDI on TFP (Keller and Yeaple, 2003). However, Aitken and Harrison (1999) indicate the negative effect of FDI on productivity where the FDI deprives the domestic man power and plants. Therefore, the effects of both importation of knowledge intensive goods and FDI on TFP depends on the absorptive capacity and system of patent rights.

On top of these factors, the transfer of technology from abroad and the diffusion of technology in the domestic economy heavily depend on the openness of the foreign trade and level of liberalization of the domestic trade (the service sector). Widely opened international trade causes the TFP to grow faster by accessing large international market, advanced technologies and cheap imported intermediate goods (Grossman and Helpman, 1991 and Khan, 2006). Regarding domestic trade, i.e. service trade; it is one of the basic factors that are responsible for shaping TFP. Studies conducted by Nicoletti and Scarpetta (2003) shows that service liberalization and TFP are highly interactive so that more service liberalization positively influences the TFP. Arnold, Javorcik, and Mattoo (2007) also come to the same conclusion.

Adoption and Adaption of Innovation:

Once the innovation is created domestically or imported from abroad, the next issue is how the recipients use the innovation. There are two possible ways taken by countries: adoption and adaption. Some use the innovation as it is (adoption) and some use it by customizing with their own existing environment (adaption). This also depends on the

technology and the absorptive capacity of the recipients. Both adoption and adaption are part of diffusing the innovations into the practice. In either case, the capacity to adopt or adapt is a necessary condition for deriving the maximum benefit of innovation. Accumulation of human capital in general and educational achievement in particular in this regard matters and plays a pivotal role (Nelson and Phelps, 1966). Otherwise, the recipients are not able to fully unitize the innovation even if it comes across from abroad, reducing the contribution of technology to enhancing TFP. Romer (1990) points out that an increase in the ability to acquire and use innovation depends on the level of education which conveys capacity for adaption and adoption foreign technology.

Absorptive Capacity:

This is a part of the adoption and adoption capacity of the recipients. It refers to a wide range of capacity to absorb innovation and the ability to make it efficient by exploiting its maximum benefits. It is also applicable to both capacity of innovating and adapting/adopting. Such innovative and adapting capacity is measured in terms of the level of R&D activities, stock of human capital including educational achievement and health status, and infrastructural development. Benhabib and Spiegel (1994) in their study indicate that the level of human capital positively influences the innovative capacity and thereby the TFP growth. However, other studies show that the effect of human capital might be insignificant and negative (Isaksson, 2002). As the key element of human capital, health also affects TFP through increasing labour productivity which in turn enhances household income.

Following the same argument, a study by Nachega and Fontaine (2006) also points out that education and health directly or indirectly enhances the TFP growth and thereby economic growth. In addition to educational achievement and good health status, government spending on infrastructure also plays a key role in enhancing the TFP growth through the channel of intensifying marketing, fostering technology transfer, increasing resources, reducing the cost of production, and creating a fertile ground for crowding in the private sector in the long run (Aschauer, 1989). Some other studies like Fan and Zhang (2004) give more emphasis on rural road, among others, and demonstrate the existence of greater influence of rural road on TFP. However, some argue that the

effect of infrastructural development on TFP growth depends on the effectiveness of public spending (Hulten, 1996), and relies on country-specific factors. Apart from the aforementioned factors, macroeconomic stability has its own implication on the growth of TFP. Providing distinctive attention to developing countries, macroeconomic stability in general and inflation in particular are key factors in TFP growth. If it is stable, it has a positive influence on TFP growth. Otherwise, the inflationary condition could cause investment to be discouraged due to economic uncertainly, adversely affecting the TFP growth (Akinlo, 2005).

3.1.3 The Process of Economic Transformation

Economic transformation refers to the dynamic and the long-term process of endogenous change in the structure of an economy, measured in terms of change in the structure of demand, supply, output, input and income. It is a process of shifting towards higher demand for capital goods and supply of manufacturing goods. Upgrading the quality of output, higher capital formation, widening employment, and offering competitive goods and service in the international market are the consequences of structural transformation. In a summary, structural change is a shift from primary, to secondary and then, to tertiary production.

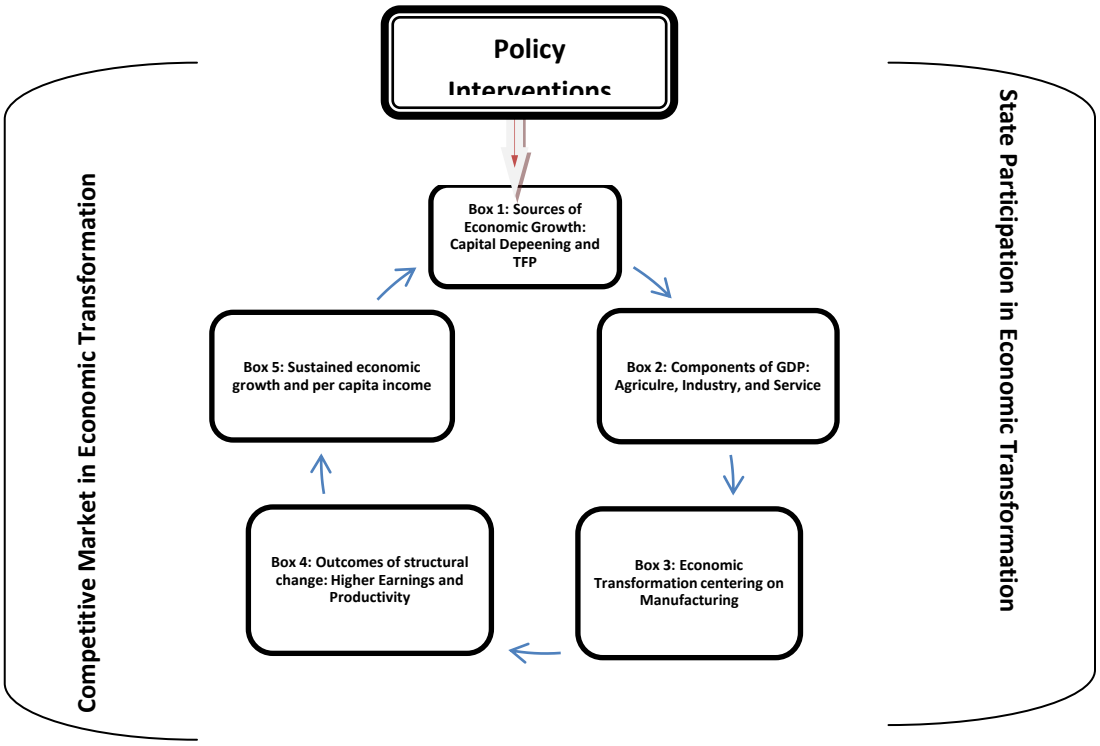
As can be seen in the figure 10 at Box 1, both capital deepening and TFP are the broad sources of remarkable economic performance. In growth accounting approach, growth can be achieved either by factor accumulation (labor, capital and land), or factor productivity (TFP). Theoretically, there are two measures of productivity: Total Factor Productivity (TFP) and Factor Productivity (FP). The TFP refers to Solow residual and assumed to reflect the productivity of factors of production, technology, and knowledge. However, FP is a measure of productivity of each factor, and is therefore partial productivity. Bigsten and Kimuyu (2002) also indicate that partial factor productivity has limited ability in explaining the overall economic performance of manufacturing firms.

The study therefore uses total factor productivity instead of partial productivity. This is because partial productivity measures the productivity of a single factor, keeping the other factors constant. However, the TFP considers how a change in efficiency of one

factor of production affects the other factor of production (Nega and Moges, 2003). Both capital deepening and TFP are, therefore, relevant for policy prescription in order to achieve meaningful economic growth and structural change. This allows the study to shock TFP growth in the simulation scenario given the base-run scenario of increasing factor accumulation. This causes the relative contribution of sectors (agriculture, industry, and service) to change as seen box 2 in the figure 10. Taking the effect of capital deepening and TFP, as well as identifying the sectoral drivers of growth, the second item of the agenda is about which sector causes or ignites structural economic transformation. In this regard, economy wide growth is decomposed into the agriculture, industry, and service to understand the roots of growth and structural change.

Looking at the figure 10 at Box 2, the possible sectoral source of growth and structural change is the subsequent issue in the process and allows us to examine various options that cause structural change: single-sector growth or broad-based growth. Historically, there are two ways of industrialization and thereby structural change. The first one is an indirect approach or linkage approach. This approach includes both agricultural and services led industrialization. The second approach is a direct approach focusing on the industrial sector in general and manufacturing in particular. The study in this regard examines and contrasts the two approaches independently, and the combination of both of them in order to look for better options of securing economic transformation and sustaining growth.

Figure 10: Major Economic Transformation Process Channels



Source: Author

The direct approach picks up the manufacturing development for achieving rapid structural change process. The main advantages of the direct approach are to generate structural change bonus, higher productivity, capital intensity, economies of scale, embodied and disembodied technological progress, technological advance and capacity to diffuse, strong linkage effect and spill-over effects (Szirmai, 2009). Rodrik (2006) in a different way puts on due emphasis on the expansion of manufacturing which has a multiplier impact via externalities and spillovers for securing sustained growth and rapid transformation. However, some criticized this approach by considering the past failures in many developing countries in general and Ethiopia in particular. Some believe that agriculture led-industrialization should be the most suitable policy. This approach considers growth in agriculture ignites sustained overall economic growth and structural change. The advocates of this idea claim a justification of historical success events during the industrial revolution in Europe (Dercon and Zeitlin, 2009). In addition to historical evidence, the argument in favor of agriculture led industrialization includes:

providing food and ensuring food security prior to industrialization, supplying materials for basic needs and industrial products, creating more employment and foreign currency earnings than in any other industry. Moreover, the agricultural sector is more about labor and land intensive so that it offers the country's resource-based comparative advantage.

Some others also argue for service-led industrialization on account of the ongoing growth in the service sector. Traditionally, the service sector is perceived as less innovative. However, since the introduction of ICT, innovation in the service sector leads to a higher efficiency and performance. The rationale for this approach relies on the role of the service sector in building human capital, advancing information technology, creating demand, and facilitating transport system. In addition to this, according to Cristina (2007) who taking the case of the Malaysian economy argues that the service sector produces intermediate services for other sectors and intending exports of services. She also argues that many services do not require high fixed asset investment to get started. However, some in this regard criticize it became the service sector in Ethiopia, for instance, is inherently characterized by poor financial development, information technology, and transport and communication system. Specifically, they believe that the service sector is characterized by low productivity and Baumol disease. Victor (1965) emphasizes that the service sector itself passes through an industrialization process. However, there is a likelihood of structural change burden in cases where the share of service in GDP takes the lead (Szirmai, 2009). On the other hand, most intellectuals and economists in the country strongly argue for the combined growth in the entire three sectors in order to speed up industrialization. They argue that combining all the sectors is the only way to create reinforcements, interactions and complementarities among sectors and thereby industrialization. They also believe that economic performance in Ethiopia is an ominous development (Befekadu and Birhanu, 2000). Besides, the ongoing bubble growth in the service sector has created higher aggregate demand since 2005 while the production sector (industry and agriculture) is not able to satisfy the resultant demand, requiring the broad-based growth option in order to solve problems associated with growth and structural change. Otherwise, the recent macroeconomic instability problems will not be solved. The study, therefore, takes into account all lines of argument and captures them through dynamic CGE

simulation. The relative contribution of sectors in GDP changed overtime due to the expansion of capital deepening and TFP. This process continues until the structure of the economy is dominated by industry and manufacturing (Figure 10 at Box 3).

So far we have seen alternative sectoral options for industrialization. The next issues shown in figure 10 at Box 4 onwards are the consequence of structural change. Following economic transformation, industry in general and manufacturing in particular starts to contribute to the structural transformation of the economy. The industrial sector is a high-value-added sector and improves the productivity of labor. For instance, the average manufacturing–agriculture labor productivity ratio for low-income Africa is 2.5 (Ajakaiye and John, 2011). In effect, as the size of manufacturing firms increases, manufacturing firms become highly efficient and productive. Structural characteristics related to diversity and sophistication influence productivity growth. This also creates strong domestic and international market linkage as well as sectoral linkage, partly leading to stimulating and enabling environment in which manufacturers earn higher price and earnings as can been seen in the figure 10 at Box 4 (Ajakaiye and John, 2011). In this regard, developing countries will be growing on the basis of specializing in high value added manufactures and exploitation of larger externalities (Rodrik, 2006; Matthee and Naude, 2007). Looking at the figure 10 at Box 5, the resultant effects of higher earnings and productivity cause the economy to grow continuously so that which the per capita income of the country grows in a sustainable manner. This enables and speeds up the pace of the country to sprint to achieve the middle income country status. The real per capita income of an economy constantly increases. The productivity of non-agricultural labor exceeds that of agriculture labour. In effect, the entire economy starts to be dynamic and vibrant for industrialization, and causes the economy to generate a higher level of capital deepening and TFP endogenously. As a result, the economy starts to move to another round of economic transformation with unprecedented speed as can been seen in the figure. These processes keep moving, and the contribution of manufacturing to GDP increases without essentially attaining a turning point in the economy (ECA, 2011). In this process, the existence of competitive markets and the role of government should be pronounced and well-articulated to realize an economic transformation and growth.

3.1.4 The Nexus of Growth and Structural Change

There was time some intellectuals dreamed to have a single theory of growth and structural change (Lewis, 1984). However, through time, other economists increasingly promoted the country-specific approach in order to secure sustained growth and structural change (Rodrik, 2003; *Nicholas* et *al.,* 2005). As a result of such contentions, the nexus of structural change and growth remains debatable among economists (Artelaris et al., 2007; Syrquin, 1988 and Adelman, 2001). Some scholars advocate that there is no casual relationship between growth and structural change. However, Hausmann, Hwang and Rodrick (2006), and Hausmann and Klinger (2007) indicate the positive impact of structural change on growth through export diversification. Some believe that slow growth and limited structural diversification go hand in hand (Ndulu *et.al*, 2007).

According to Todaro and Smith (2011), the nexus between growth and structural change, nevertheless, depends on the typology of growth be a country pursues such as modern-sector enlargement growth, modern-sector enrichment, and traditional-sector enrichment. The modern-sector enlargement growth causes an increase of absolute income with a reduction in poverty. However, Kuznets (1955) suggests the existence of a rising income inequality following an inverted U-shaped relationship. This is in the sense of predicting that industrialization leads to an initial increase in inequality and then decline in inequality when the process continues. However, this does not happen practically. The modern-sector enrichment growth typology causes an increase in income associated with higher inequality and unchanging poverty levels. It also couples with an equal distribution of income and less poverty in the case of the traditional-sector growth typology (Todaro and Smith, 2011).

On other aspects, the neoclassical school considers the structural change as a powerful engine for growth and an automatic result of market development. This heavily emphasizes the savings and investment as a crucial determinant of economic performance with level effects, not in growth effects (Solow, 1956). However, this does not reflect the experience of developing countries. Rather, they chronically suffer from low saving, shortage of capital, capital flight, sluggish knowledge diffusion and

structural problems. This extends the argument to which poor market development causes developing countries to lower investment and TFP, leading to sluggish structural change and thereby poor economic growth (Todaro and Smith, 2011). Some scholars who advocate endogenous growth believe that structural change is not an automatic result of the perfect market. They rather consider an increasing return to scale in research and development sector and include non-market factors such as new knowledge (Grossman and Helpman, 1991), innovation (Aghion and Howitt, 1992) and public infrastructure (Barro, 1990) in order to explain TFP growth. However, this model ignores a number of factors: poor infrastructure, inadequate institutions and low capacity utilization in developing countries (Todaro and Smith, 2011). Recently, the New Structural Economics (NSE) has come into existence with a new approach that links the nature of endowment and industrial structure. This approach also gives more emphasis on competitive market system and facilitative state for a strong nexus between economic transformation and growth (Lin, 2012).

3.1.5 The Role of State in Transformation and Growth

The economic role of government in terms of taxation and expenditure has its own implication on economy wide growth and structural transformation. This is because it influences sustained economic growth via capital formation or productivity growth-with respect to accumulationist view and revisionist view. Capital formation can be addressed by increasing government expenditure while TFP can mainly be captured by changing resource allocation towards productive sectors. As a matter of interest, the study emphasizes the role of public resource allocation (change in spending composition) on TFP growth and thereby economy wide growth rate. This helps to address two basic questions: which state intervention is desirable? Which economic sector is crucial in fostering TFP growth? The sub section below presents the theoretical framework for the role of government in the context of increasing TFP and thereby economy wide growth and transformation.

State Intervention:

The role of government in economic transformation and growth can be classified into five namely the classical state, the Keynesian state, the socialist state, the development state, and the facilitating State. The classical economists advocate the philosophy of laissez-faire with which individual self- interest promotes the functioning of the economy in the context of the invisible hand. This implies that the government is involved in the economy with a minimum level of public expenditure. In contrast, the Keynesians acknowledge that government uses extensive public expenditure as a tool of economic policy to manage a national economy so as to counteract unemployment and depression via its multiplier effects. The socialist ideology on the other hand considers an extreme case and advocates an entirely state-owned economy entirely and marginalizes the role of private sector in economic growth and transformation. After the failure of socialist ideology and revision of the Washington consensus, both WB and IMF conceived an alternative pro-poor growth option since 2000 which considers inevitable role of the government (John and Shruti, 2007) on account of narrow goals with a focus on price stability and unnecessary reliance on markets as anticipated in Washington consensus (Stiglitz, 1998 and Naim, 1999). After long contentions, a considerable role of the state in economic development was acknowledged (Haq, 2003) and the debate nowadays is redirected towards facilitating state versus developmental state depending on the depth of government interventions.

The facilitating state emphasizes both a functioning market and a facilitating state. It plays a pivotal role in creating an enabling environment for the private entrepreneurs via addressing infrastructure problems, externalities and coordination failures (Lin and Monga, 2010). The state intervention in this context focuses on structural improvement so that the role of the government should not be far away from a country's comparative advantage. The state identifies the list of tradable, prioritizes adopts measures, encourages self discoveries, builds export processing zones, encourages industrial clustering, and provides certain incentives to domestic pioneer firms in order to speed up the transformation process. However, the experience from some countries indicates that most of the governments have failed to play a facilitating role and to assist the private sector in order to enhance diversification and sophistication (Kuznets, 1966). Altenburg

(2011) and Dirk (2011) question the capacity of the state in delivering the required activities for dynamic structural change and growth.

On the other hand, the developmental state was first introduced by Amsden (1989) and Wade (1990) based on South Korean and Taiwanese development experiences, respectively. However, the theoretical aspects of a 'developmental state' were pronounced by Evans (1995) and Woo-Cummings (1999). According to this thought, the State not only facilitates but also pursues selective industrial policies and state owned enterprises (Wing, 2011). The role of a developmental state is wider than that of the facilitating one. Therefore, it is suggested that the government should build democracies and implement development programs for promoting diversification and economic transformation (ECA, 2011). There are, however, at least some principal problems with their contention: when the capacity and size of government is exceedingly small relative to the size of the economy, developmental state industrialization is difficult to achieve. Moreover, based on Wade's conclusion, the governments may not able to design the turning-points in industrial evolution as there are critical problems regarding the optimal size of government and potentially severe macroeconomic instability.

Change in Spending Composition:

Many researchers focus on investigating the effects of increasing government magnitude on economic growth and find negative implication (Barro, 1990). However, as a matter of interest, this study focuses on the nature of activities and the distribution of spending on productive and unproductive activities. In such approach, each component of spending has different impacts on economic growth via TFP, which helps to understand the dynamics of the impact of change in spending composition (Ashni, 2008). According to Landau (1986), government spending on education and capital formation has a positive impact on growth. On the contrary, Devarajan *et al*. (1993) finds that expenditure on defense; education and capital accumulation negatively affect growth. He also indicates that the current expenditure and health expenditure positively influence growth. Similarly, Wyatt (2005) finds defense, health, economic and administration expenditures positively affect growth while spending on education negatively affects it. Shifting a public resource from one component to another, meaning change in spending

composition, also provides insights looking into the economies of productivity. For instance, Fan *et al* (2000) find that spending on road infrastructure and agricultural technology is more productive and enhances TFP when shifting public spending from education and health. Ashni (2008) also finds that spending on agriculture and health negatively affects the TFP. However, spending on infrastructure and education positively influences the Indian economy. Such experiences indicate that change in spending composition causes the TFP to increase or decline depending on the nature and magnitude of the expenditure as well as the structure of the economy in general.

Focusing on the classification of spending into productive and unproductive, many literature reviews show that shifting public resource from unproductive activities to productive activities is preferable. For instance, the endogenous growth models treats spending on government consumption as non-productive in that does not promote productivity while other activities like education, R&D, infrastructure are considered as productive (Barro, 1990; Aschauer and Greenwood, 1985). Grier and Tullock (1987) indicate that government consumption has a negative effect on economic growth.

3.2 Empirical Literature Review

The per capita growth rate of the globe was 0.05 percent on average in the 18th century, and grew approximately by 1 percent in the 19th century. Following the industrial revolution, countries have an opportunity to improve their economic performance and structural change with which the per capita growth rate tended to be around 2 percent on average in the 20th century (Lin, 2012). For instance, the Chinese economy, which is the second largest world economy had a per capita income of 478 (current USD) in 1960 which grew rapidly to become 42,831 in 2010, mainly driven by the economic transformation towards an industrial economy and an unremitting upgrading in the manufacturing sector (WB, 2011). On the contrary, most developing countries in general and African in particular have faced a daunting challenge and suffered from erratic growth and abysmal poverty. A large number of the low income countries is still trapped and bogged down in the mire of poverty. This is mainly due to the failure of achieving a structural change, among other factors.

According to a report by the ECA, African economies reflect a decreasing share of agriculture with stagnant share on manufacturing. Only few African countries have recorded sustained growths over the period 1970–2007, of which only Tunisia actualizes structural transformation (ECA, 2011). In general, experience of countries with regard to growth and structural change is different across countries and overtimes. Some countries have crossed the threshold of the middle-income country status with a significant structural change while others joined the middle-income status without structural change in their economies. Others, resource-rich countries like Angola, Botswana, Zambia, and Equatorial Guinea joined the middle income country status without securing structural change. On the other hand, Cape Verde that had limited natural resources has joined the middle country status by improving the tourism services with an active role of the government (WB, 2011).

In nutshell, most of the African countries export primary commodities with limited diversification in production and input use as well as unskilled labour. The share of manufactures in GDP, in Africa, remained low and constant in 1995-2004, and far below the average of its developing country (Ron S. and Hannah E., 2011). We focus on ten countries since these countries, whose detailed are presented below, have similar features with Ethiopian economy.

Growth and Per capita Income during Transition:

Looking at Table 9 below, Angola, Botswana and Vietnam have taken 10 years to reach the middle income status. Their respective average annual growth rates were 7.1 percent, 11.2 percent, and 7 percent during transition, respectively. During such transitions, the average per capita income grew above 10 percent. Conversely, the contribution of sub-sectors to these growth rates is different among countries depending on their natural resources and comparative advantage. In Angola, the average GDP growth of the agriculture was 11.7 percent, followed by the industry (8.5 percent) and service (2.9 percent). However, in Vietnam, manufacturing took the lead (by 11.2 percent) during the transition period while the agriculture and services grew by 4 percent and 6.5 percent, respectively. The per capita income also grows by double digit in the reference countries. Nonetheless, it grows less than 10 percent in Ghana, Sri Lanka and Thailand.

In the case of Botswana, the per capita GDP was around USD 77 in 1966. Natural resources especially diamonds are the main factor that enables the country to join the middle-income status. However, diversification is a daunting challenge in improving the level of poverty (Leith, 2005).

Table 9:- The Economic Growth and Sector Contribution in Reference Countries

No.	Comparators	Initial Year	End Year	Years elapsed	Average Annual Growth rate during Transition					
					Based on Current USD		Based on Constant USD in 2000			
					GDP	PCI	Agric.	Industry	Manuf.	Service
1	Angola	1994	2004	10	15.4	11.9	11.7	8.5	7.0	2.9
2	Vietnam	1998	2008	10	11.9	10.6	4.0	9.4	11.2	6.5
3	Ghana	1978	2010	32	8.6	5.8	NA	NA	NA	NA
4	Zambia	2002	2010	8	19.3	16.5	1.0	9.8	5.3	6.0
5	Botswana	1974	1984	10	16.6	12.4	-2.9	17.5	11.6	8.4
6	Sri Lanka	1984	2004	20	6.9	5.8	1.4	5.4	6.5	5.0
7	Malaysia	1968	1977	9	15.6	12.8	5.1	8.1	12.1	9.2
8	Thailand	1975	1988	13	11.6	9.2	4.2	9.2	8.2	7.2
9	Brazil	1967	1975	8	18.6	15.8	4.5	10.4	NA	10.7
10	China	1992	2001	9	13.2	12.4	3.8	13.1	12.5	11.1

Source: Own computation based on WDI data base, online version

N.B:- Initial year represents year when the per capita income reached around Ethiopia's performance (USD 356). End year denotes for a year when comparators join the middle-income country status. Year Elapsed represent the number of years required to reach the middle-income country status. Besides, PIC stands for per capita income

The Chinese economy was poor in performance in the late 1970s. However, the government committed to achieving sustainable growth and rapid structural change and joining the middle income country status in 2001. The Chinese economy grows by 10 on average during the transition and became the second-largest world economy in 2010. Interestingly, the demand for copper from China and India creates a wide opportunity for Zambia which supplies an enormous amount of extracted copper. This helps Zambia for reaching the middle income status. Besides, Brazil from South America and Malaysia and Thailand from Asia took 8-12 years to reach the middle income country status with an average GDP growth rate of above 7 percent (Table 9).

Structure of GDP:

The contribution of agriculture to GDP declines while the industry relatively increases in the reference countries, except Angola. However, the share of services in total GDP declined in Vietnam, Zambia, Botswana, Malaysia, and Brazil. Experience from non-African countries shows that the manufacturing sector plays a pivotal role and became a gear shifter for economic transformation. Regarding the aforementioned African countries, the share of manufacturing in total GDP decreased by 2 percent on average, indicating their moves towards crossing the benchmark of the middle income country status depends on exploitation of natural resources. For instance, the contribution of agriculture to GDP in Botswana shrinks significantly from 29.9 percent to 7.6 percent due to the sharp rise in mining.

Table 10:- Structure of GDP in the Reference Countries

No.	Comparators	Structure of GDP							
		Agri. (1)	Agri. (2)	Ind. (1)	Ind. (2)	Manuf. (1)	Manuf. (2)	Service (1)	Service (2)
1	Angola	6.6	8.6	66.9	66.1	4.9	3.9	26.5	25.3
2	Vietnam	25.7	22.2	32.4	39.8	17.1	20.3	41.9	38.0
3	Ghana	65.0	30.2	12.8	18.6	9.2	7.9	22.2	51.2
4	Zambia	22.0	18.9	25.9	37.2	11.5	9.15	52.1	43.9
5	Botswana	29.9	7.6	33.6	57.3	7.2	5.5	36.5	35.1
6	Sri Lanka	28.6	12.5	26.3	28.6	14.9	18.7	45.1	58.9
7	Malaysia	28.4	26.5	25.3	36.0	10.7	19.2	46.3	37.5
8	Thailand	27.0	16.0	25.7	34.5	18.6	25.8	47.3	49.5
9	Brazil	15.1	12.0	33.8	40.1	26.0	30.2	51.1	47.9
10	China	21.7	14.3	43.0	45.1	32.7	31.6	35.3	40.6

Source: Own computation based on World Development Indicator, online version

N.B:- (1) and (2) represent the initial year and the last year during transition.

The two countries that took relatively long time to join middle-income status are Ghana and Sri Lanka, taking 32 and 20 years from the position where Ethiopian existing (USD 358) in 2010. The growth rates of real GDP and per capita income accounted for nearly 4 percent and 5.8 percent during the transition period, respectively. However, manufacturing accounted for 7.9 percent and 18.7 percent for Ghana and Sri Lank,

respectively, indicating that the Sri Lanka's economy has almost structurally shifted while the Ghanaian economy has not structurally changed.

Structure of Merchandise Export:

Growth in exports is typically faster than economic growth in most developed countries. This reflects the importance of external demand in growth accelerations and structural change since it allows production growth to exceed growth in the domestic demand. Looking at the structure of merchandise export, it has four categories according to the World Bank classification. The share of agriculture in export tends to decline during the transitions in non-African countries. However, the export market still dominated by the primary commodities with a deteriorating terms of trade. For instance, export share of agriculture accounts for 5.3 percent and 60 percent in China and Ghana, respectively. As can be seen Table 11, the structure of the export of most of the reference countries also changed during their transitions. Except Vietnam, the share of agricultural exports in total merchandise exports declines. The share of manufacturing exports in total merchandise, however, increases in the transition period.

Table 11:- Structure of Merchandise Export in the Reference Countries

No.	Comparators	Structure of Merchandise Export							
		Agri. (1)	Agri. (2)	Ind. (1)	Ind. (2)	Manuf. (1)	Manuf. (2)	Service (1)	Service (2)
1	Angola	NA	NA	NA	NA	NA	NA	NA	NA
2	Vietnam	30.7	20.0	1.8	2.9	25.9	22.0	41.6	55.1
3	Ghana	76.6	60.6	6.3	6.9	16.0	11.9	1.1	20.6
4	Zambia	9.4	5.5	5.0	0.9	71.2	87.4	14.4	6.2
5	Botswana	NA	NA	NA	NA	NA	NA	NA	NA
6	Sri Lanka	52.8	20.6	10.7	2.2	9.9	3.3	26.6	73.9
7	Malaysia	10.5	19.1	50.1	38.6	33.6	27.3	5.7	15.0
8	Thailand	62.7	37.0	12.3	8.0	10.4	3.5	14.6	51.5
9	Brazil	68.0	54.0	13.6	3.8	8.6	17.0	9.8	25.2
10	China	11.3	5.3	2.2	0.8	8.2	5.3	78.3	88.6

Source: Own computation based on World Development Indicator, online version

N.B:- (1) and (2) represent the initial year and the ending year of the transition, respectively

In Malaysia, the share of agricultural raw material in the total merchandise export constitutes the lion-share of 50 percent at the beginning of the transition and declined to 38 percent at the end of the transition period with a concomitant increase in manufacturing share, a promising attempt to structural change. The share of manufacturing in the total merchandise export takes the lion's share of 88 percent, 73 percent, 55 percent, and 51 percent in China, Sri Lanka, Vietnam, and Thailand, respectively. The share of manufacturing in export increases, in all comparators, during the transition. Exceptionally, it declines from 14 percent to 6 percent in Zambia as the government pays more attention to exploiting copper that takes the lion-share.

Structure of Demand:

It is one of the stimulating factors to have a sustaining long run economic growth and structural change. Household final consumption expenditure as a share of GDP takes the lion's share in all the reference countries, except Vietnam and Botswana, at the ending year of transition (Table 12).

Table 12:- Structure of Demand in Reference Countries

Comparators	Structure of Demand (%)											
	HH (1)	HH (2)	GG (1)	GG (2)	GC (1)	GC (2)	Ex (1)	Ex (2)	Im (1)	Im (2)	GS (1)	GS (2)
Angola	33.8	NA	40.1	NA	16.6	9.1	85.3	69.6	75.8	53.7	26.10	25.0
Vietnam	70.6	69	7.6	6.1	29.0	39.7	44.8	77.9	52.1	93.1	21.7	24.5
Ghana	84.6	79	11.3	11.2	5.38	22.4	8.3	25.3	9.60	38.4	4.0	9.2
Zambia	80.3	55	11.8	13.2	21.9	22.4	27.7	44.1	41.7	35.0	7.8	31.4
Botswana	58.7	42	17.2	25.0	40.9	60.8	40.9	60.8	64.8	57.9	24.0	32.2
Sri Lanka	72.3	71	7.7	12.6	25.8	24.7	28.8	35.3	34.7	44.1	19.8	15.9
Malaysia	63.7	53	14.7	16.2	18.3	23.2	39.4	47.3	36.1	42.7	21.5	30.3
Thailand	67.6	58	10.3	10.0	26.7	32.6	18.4	33.0	22.9	34.4	22.1	31.2
Brazil	71.5	66	11.5	10.6	16.9	26.8	5.7	7.50	5.7	11.5	16.9	22.8
China	45.7	45	15.6	15.9	37.4	36.3	18.6	22.6	17.5	20.4	38.6	38.3

Source: Own computation based on World Development Indicator, online version

N.B:- (1) and (2) represent the initial year and the last year of the transition, respectively. Besides HH represents household, GG for general government, GC for general capital formation, EX for export, IM for import, GS for gross saving

Next to that, gross saving in China, gross capital formation in Brazil, import in Ghana, Vietnam, Botswana, Thailand and Sri Lanka, export of goods and service in Malaysia and Zambia takes the second lead at the end of the transition period. The gross saving as a share of GDP in all reference countries was 20 percent, on average, at the beginning and grew to 26 percent at the end of the period. Ghana and Sri Lanka are a bit far away and below this average, accounted for 9 percent and 16 percent of the ending year, respectively. The average of general government consumption expenditure for all the reference countries also accounted for 15 percent at the beginning and reduced to 12 percent at the end of the transition.

On top of this empirical evidence, some countries that joined the middle income country status slide back to the low-income country group. 25 countries in this regard moved back to lower-income country over the period 1978-2003, claiming that they were not structurally transformed (Seth, 2012). Therefore, they have faced problems of the vagary of nature, substantial drop in commodity prices, war and internal conflict, and depletion of resources. The structure of exports has also undiversified and concentrated on primary commodities (Breisinger *et al*. 2008). Because of this, the speed of structural transformation varies across countries and over time. In the pace of transformation, for instance, the speed of transformation in China is 2.4 and 72.6 times that of in Malaysia and Ghana economy, respectively, in 1962–2000. This Chinese experience gives a good lesson for other developing countries regarding diversification and promotion of export goods and service (Thaddee *et al*., 2009). In summary, experiences from non-African countries show that they experienced a structural change during their transition while African countries meet the requirement without significant structural change in their economies. The African experience has faced major challenges in diversification and industrialization (Ajakaiye and John, 2011).

CHAPTER FOUR: - METHODOLOGY

In order to address the three specific objectives of the study, the paper uses different methods. To satisfy the first objective, it uses the sectoral growth accounting approach and the VARX model for estimating the sectoral TFP growths and examining the determinants of sectoral TFP growth, respectively. Out of the determinants of sectoral TFP growths, the study picks up some of positive statistically significant explanatory variables in order to calibrate the induced sectoral TFP growths for the dynamic CGE model. To meet the second objective, the study uses the recursive dynamic CGE model to analyze the impact of the induced sectoral TFP growths on economy wide growth and structural change process. To address the third objective, the study uses the expenditure recursive dynamic CGE model to examine the role of government in public resource allocation for sustaining growth and economic transformation. The methodology presented below provides the details.

4.1 Sectoral Growth Accounting Approach

In understanding the different components and definitions of TFP, there are different types of estimation technique for sectoral TFP. The growth accounting approach; regression approach, parametric and semi parametric approach are mentioned in literature. The study, however, uses the growth accounting approach in order to reap the benefits derived from taking into account all compositions of TFP and for keeping uniform assumption with the dynamic CGE model. Abramovitz (1956) and Solow (1956) introduced TFP for the first time, which refined by Denison (1967). TFP in this approach includes technological progress, technical and allocation efficiencies, scale effects and the like. The residual factor in GDP growth rate captures the TFP, not explained by growth in capital, land and labour. According to this approach, there are two distinct sources of growth: input-driven (increasing factor accumulation) and TFP-driven (increasing factor productivity). The first one invokes the assumption of diminishing return to scale while the latter one invokes increasing return to scale.

Consider a Cobb-Douglas production function for each sector – agriculture, industry and service as presented by equation 1. Note that the model excludes agricultural land, N, through all equations for non-agricultural sectors.

$$Y = f(A, L, K, N) \quad \ldots\ldots (1)$$

Where Y denotes sectoral GDP, L stands for sectoral labour, K stands for sectoral capital stock, and N stands for agricultural land. 'A' also designates the sectoral TFP. The model assumes constant return to scale at sectoral level, which directly fits with the CGE model assumption. By differentiating both sides, equation 1 can be written as follows.

$$dY = \frac{\partial Y}{\partial A}.dA + \frac{\partial Y}{\partial L}.dL + \frac{\partial Y}{\partial K}.dK + \frac{\partial Y}{\partial N}.dN \quad \ldots\ldots (2)$$

Dividing the entire equation by Y yields the growth rate of sectoral GDP, i.e.

$$\frac{dY}{Y} = \frac{\partial Y}{\partial A}.\frac{dA}{Y} + \frac{\partial Y}{\partial L}.\frac{dL}{Y} + \frac{\partial Y}{\partial K}.\frac{dK}{Y} + \frac{\partial Y}{\partial N}.\frac{dN}{Y} \quad \ldots\ldots (3)$$

Manipulating equation 3 mathematically by multiplying the independent variables with A/A, L/L, and K/K as presented in equation 4. This helps to get factor income share in the coefficients.

$$\frac{dY}{Y} = \frac{\partial Y}{\partial A}.\frac{dA}{Y}.\frac{A}{A} + \frac{\partial Y}{\partial L}.\frac{dL}{Y}.\frac{L}{L} + \frac{\partial Y}{\partial K}.\frac{dK}{Y}.\frac{K}{K} + \frac{\partial Y}{\partial N}.\frac{dN}{Y}.\frac{N}{N} \quad \ldots\ldots (4)$$

Rearrange equation 4 and get equation 5

$$\frac{dY}{Y} = \frac{\partial Y}{\partial A}.\frac{A}{Y}.\frac{dA}{A} + \frac{\partial Y}{\partial L}.\frac{L}{Y}.\frac{dL}{L} + \frac{\partial Y}{\partial K}.\frac{K}{Y}.\frac{dK}{K} + \frac{\partial Y}{\partial N}.\frac{dN}{N}.\frac{N}{Y} \quad \ldots\ldots (5)$$

Letting $g_y = \frac{dY}{y}, g_A = \frac{dA}{A}, g_L = \frac{dL}{L}, g_K = \frac{dk}{K}, g_N = \frac{dN}{N}$ permits construction of equation 6 as follows.

$$g_y = \frac{\partial Y}{\partial A}.\frac{A}{Y}.g_A + \frac{\partial Y}{\partial L}.\frac{L}{Y}.g_L + \frac{\partial Y}{\partial K}.\frac{K}{Y}.g_K + \frac{\partial Y}{\partial N}.\frac{N}{Y}.g_N \quad \ldots\ldots (6)$$

The term $\frac{\partial Y}{\partial A}.\frac{A}{Y} = g_{TFP}$ is not directly observable and refers to as Solow residual or total factor productivity growth. This means that

$$g_y = g_{TFP} + \frac{\partial Y}{\partial L}.\frac{L}{Y}.g_L + \frac{\partial Y}{\partial K}.\frac{K}{Y}.g_K + \frac{\partial Y}{\partial N}.\frac{N}{Y}.g_N \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(7)}$$

The sectoral growth accounting approach imposes the assumptions of competitive markets and constant returns to scale in the context of neoclassical economics. This assumption implies that the coefficients that are the output elasticities are equal to the factor income share. As factors earn their marginal product in neoclassical economics, the marginal products of labour, capital and land are wage (w), capital rent (r) and land rent (z), respectively. Therefore, we can substitute $w = \frac{\partial Y}{\partial L}, r = \frac{\partial Y}{\partial k}, z = \frac{\partial Y}{\partial N}$ in the equation 7 and get the following equation that explains output growth in terms of factor income share.

$$g_y = g_{TFP} + w.\frac{L}{Y}.g_L + r.\frac{K}{Y}.g_K + z.\frac{N}{Y}.g_N \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(8)}$$

Looking at equation 8, the multiplication of marginal product and input ratio per output gives the factor income share out of total income. Mathematically, the parameter $\alpha = w\frac{L}{Y}, \beta = r\frac{K}{Y}, \gamma = z\frac{N}{Y}$ measure the factor income share of labour, capital and land respectively. Therefore, equation 8 can be rewritten as follows.

$$g_Y = g_{TFP} + \alpha.g_L + \beta.g_K + \gamma.g_N \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(9)}$$

Rearrange equation 9 to get the growth rate of TFP equation, lead to:

$$g_{TFP} = g_Y - (\alpha.g_L + \beta.g_K + \gamma.g_N) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(10)}$$

In the sectoral growth accounting approach, the factor income shares are exogenous variables so that they can be calculated using national accounts. If the data is not available in the national account, it is also possible to find a proxy using labour composition. Alternatively, it is feasible to borrow the factor income shares from past

studies in similar countries. Given this background, the study picks up the national income account of year 2006 in order to calculate the factor income share (Table 13). This helps to have a consistent base with the SAM 2006 for CGE model.

Table 13:- Sectoral Factor Income shares using 2006 National Income Account

Factors of Production	Sectoral Factor Income Share		
	Agriculture	Industry	Service
Labour	0.754	0.3405	0.23
Capital	0.102	0.6595	0.77
Land	0.144	-	-

Source: Ethiopian SAM 2006

On the basis of such factor income shares out of the total national income, the final measure of sectoral TFP for the agriculture, industry and services presented below gives complete specifications for each sector. Note that such factor shares for each sector are almost similar with some countries experience[6].

For the agricultural sector:

$$g_{TFP} = g_Y - (0.0754 g_L + 0.102 g_K + 0.144 g_N) \quad (11)$$

For the industry:

$$g_{TFP} = g_Y - (0.3405 g_L + 0.6595 g_K) \quad (12)$$

For the services: -

$$g_{TFP} = g_Y - (0.23 g_L + 0.77 g_K) \quad (13)$$

---

[6] Many studies assume a constant labor share ranging from 0.55 to 0.7 on average. Bosworth *et al*. (2007) indicate that a capital share of 0.4 for the industry and services as well as the factor shares in agriculture sector are 0.5, 0.25, and 0.25 for labor, capital and land, respectively. Rubina V. (2008) in this regard calculates labour shares of 0.58, 0.54 and 0.56 for agriculture, industry and service respectively in India. He calculates a capital share of 0.22, 0.55, and 0.44 to the corresponding sectors as well as a land share of 0.20 for the agriculture. He also undertakes the GTAP factor share estimation, as reported by Terry Roe, in which capital accounts for 0.61 and 0.50 for industry and services, respectively. The labour shares are 0.39 and 0.50 for the corresponding sectors. The GTAP estimates also show shares of 0.58, 0.54 and 0.56 for labour, capital and land in agricultural sector (Thomas and Marinos, 2010). These evidences reflect that our assumption of factor share for Ethiopian economy is fair.

4.2 Specification of the VARX Model

This is to estimate the sectoral productivity dynamics in order to calibrate the induced sectoral TFP growth in the dynamic CGE model. Using the estimates of the sectoral TFP growth from the growth accounting approach, the study specifies, estimates and analyzes the sectoral productivity dynamics given the sectoral TFPs interactions and exogenous variables. This is crucial in calibrating the induced sectoral TFP growth rates by identifying the required candidate policy variables from the determinants, based on their statistical significance levels and interest of the study. The study specifies the determinants of sectoral TFP that consist of change in technology, allocative efficiency, technical efficiency, and scale effects in a combined way. Regardless of the sector, the broad source of the TFP growth is innovation (knowledge creation) in a domestic economy and technology transfer (absorption and transmission of knowledge) from abroad. We present this in equation 14 presents as follows.

$$g_{TFP} = f(\textit{innovation}, \text{technology } \textit{transfer}) \qquad \text{...} \ (14)$$

Many studies show that research and development (R&D) serve as a proxy for knowledge creation and point out its long relationship with the TFP growth rate (Chen and Dahlman, 2004). Research conducted by Alston, Norton and Pardey (1998) also indicates the long-lasting impact of R&D on TFP in the long run. Therefore, equation 14 can be rewritten as:

$$g_{TFP} = f(R \& D, \text{technology } \textit{transfer}) \qquad \text{...} \ (15)$$

The world technology frontier, moreover, provides positive externalities and spillover effects to the individual country in order to fill the technology gap. Most countries prefer to acquire technology from abroad instead of creating the state-of- the art technology due to the cost of innovation. Hence, the technology created abroad crosses the national border and is principally transferred to the domestic economy through importation of technology (Keller and Yeaple, 2003; Mayer, 2001). Such channels, in turn, depend on the nature of imported technology and barriers during technology transfer. Importation of capital goods is mostly relevant for enhancing TFP growth and thereby structural

change. Thus, equation 15 can be extended to the following equation by taking into account importation of capital goods and transfer barriers.

$$g_{TFP} = f(R\&D, imported\ capital\ goods, technology\ transfer\ barriers) \quad \ldots\ldots\ldots\ldots\ldots \quad (16)$$

A barrier to technology transfer reduces the absorption of technology from the world frontier and shrinks the TFP growth rate. This repercussion ranges from slowing down the pace of transfer to blocking technology adoption. In effect, it widens the gap between the world technology frontier and the domestic technology innovation (Ngai, 2004). Trade barriers and capacity barriers are worth mentioning in this regard so that equation 16 can be written as follow.

$$g_{TFP} = f(R\&D, imported\ capital\ goods, trade\ barriers, capacity barriers) \quad \ldots\ldots\ldots\ldots\ldots \quad (17)$$

In most developing countries, capacity and trade barrier is broadly explained in terms of openness of the economy and service trade liberalization in order to addressing the limitations associated with both external economy and domestic economy, respectively. The existence of limited openness of the economy is the main challenge in encouraging the inflow of technology and thereby productivity growth. The size of openness of the economy matters the access to capital goods, advanced technologies and competitive market. On top of this foreign trade, domestic service trade restriction causes poor productivity and slows down economic growth overtime (Asghar, 2007). Note that limited openness can be caused by low TOT, high tariff, poor quality and the like. These are the factors behind the limited openness that restrict technology transfer. Equation 18 gives the extended one by decomposing trade barriers into openness and service trade liberalization index as presented in the following way.

$$g_{TFP} = f(R\&D, imported\ capital\ goods, opennes, service\ trade\ liberalization, capacity\ barriers) \ldots \quad (18)$$

Capacity barrier, as mentioned in equation 18, includes both innovative capacity and absorptive capacity barriers. The level of human capital development can address the constraints associated with the innovative and absorptive capacity (Nelson and Phelps, 1966; Benhabib and Spiegel, 1994). In addition to human capital, Easterly and Rebelo

(1993) proposes infrastructural development as one of the key factors responsible for capacity constraints. Both primary school enrollment and road network human capital are proxy variables for human capital and infrastructural development, respectively. The endogenous growth model also explicitly takes in to account both accumulation of human capital and physical capital in terms of infrastructure in order to explain the international variation in growth rates across countries (Romer, 1990).

Therefore, equation 18 can be extended as follow.

$$g_{TFP} = f(R\ \&\ D, imported\ capital\ goods, opennes, service\ trade\ liberalization, human\ capital, infrastructure) \quad \ldots. (19)$$

On top of the specified determinants, the stability of macroeconomic performance has its own implication on the TFP growth. If instability exists, this negatively affects the TFP growth. Therefore, the study incorporates inflation rate as a proxy variable for measuring the stability of macroeconomic performance. Therefore, equation 20 presented below gives the final model of TFP at the aggregate level.

$$g_{TFP} = f(R\ \&\ D, imported\ capital\ goods, opennes, service\ trade\ liberalization, human\ capital, infrastructure, inflation) \quad \ldots\ldots.(20)$$

On the basis of the aggregate TFP growth model, the study then drives sectoral TFP growth models for the agriculture, industry and services. Following the flow of inputs and outputs among sectors in terms of investment and consumption, the study adds the lag of sectoral TFP growths in order to capture the interactions of sectoral TFP among the three sectors. This makes the model to have two broad components such as dependent interactive variables and exogenous variables. Such incorporation of sectoral interaction in the model claims the VARX model. The VARX model refers to a VAR that contains dependent variables that interact with each other and the exogenous variables. This allows the lag values of the sectoral TFP growths in order to build the model of sectoral productivity dynamics.

Considering the lack of data on R&D for the entire economy, the study takes into account only agricultural R&D. On the same note, the study takes the number of enrolled pupils in primary education and road network as proxy variables for human

capital and infrastructure, respectively. The ratio of private credit to GDP is also considered as a continuous proxy variable for service trade liberalization index. A high ratio means that the economy is more liberalized, which is a lower ratio indicates the existence of more trade restriction in the economy.

Following the growth accounting approach that gives TFP in terms of growth rate, the study, therefore, considers all explanatory variables in terms of growth rates so as to be uniform with TFP. However, the explanatory variables of openness and service trade liberalization index considered in terms of ratios. Such presentation helps in generating stationary time series, robust modelling and good diagnostic tests. Taking TFP in terms of growth rate also helps in keeping consistence with the dynamic CGE model as CGE model takes sectoral TFP in terms of growth rate. Note that sectoral TFP is expressed in terms of growth rates for two reasons. As an outcome, the sectoral growth accounting approach produces a growth rate of sectoral TFP. On the other hand, the dynamic CGE model requires TFP in terms of growth rate as an input. These two facts require that the most explanatory variables be expressed in terms of growth rate for securing uniformity, stationarity and robust diagnostic test.

Therefore, the final VARX model for each sector is presented as below.

For the agriculture:

$$g_{TFPA} = f(g_{LTFPA}, g_{LTFPI}, g_{LTFPS}, g_{ard}, g_{imc}, g_{pep}, g_{nwr}, opp, lr, inf) \quad \text{(21)}$$

For the industry:

$$g_{TFPI} = f(g_{LTFPA}, g_{LTFPI}, g_{LTFPS}, g_{ard}, g_{imc}, g_{pep}, g_{nwr}, opp, lr, inf) \quad \text{(22)}$$

For the service:

$$g_{TFPS} = f(g_{LTFPA}, g_{LTFPI}, g_{LTFPS}, g_{ard}, g_{imc}, g_{pep}, g_{nwr}, opp, lr, inf) \quad \text{(23)}$$

Where g_{TFPA} = TFP growth rate for agriculture; g_{TFPI} = TFP growth rate for industry; g_{TFPS} = TFP growth rate for service; g_{LTFPA} = lag values of TFP growth rate for agriculture; g_{LTFPI} = lag value of growth rate for industry; g_{LTFPS} = lag value of growth rate for service; g_{imc} = growth rate of imported capital goods g_{ard} = growth rate of government expenditure for agricultural R&D ; g_{pep} = growth rate of pupils in primary school; g_{nwr} = growth rate of road net works in kilometers ; opp = openness of the economy; lr = service trade liberalization index; $\inf$ = inflation

Note that the VARX model has a comparative advantage over the VAR model. The VAR model consists of all dependent variables and is used for forecasting purpose whereas the VARX model contains both dependant (endogenous) variables and exogenous variables included in the model allowing articulation of policy prescription.

Unit Root Test with Structural Breaks:

The ADF test is often applicable in detecting the existence of stationarity in a time series with the assumption of no structural break. However, neglecting the issues of structural breaks leads to biased results and lessens the possibility of rejecting a bogus unit root (Perron, 1989). The study, thus, considers endogenous structural breaks in the time series data. This helps to detect the exact nature of stationarity of time series, and to know the year when the structural break is in time series. Zivot and Andrews (1992) test and Clemete, Montanes, and Reyes (1998) test are widely applicable in cases of single break and two-breaks, respectively.

The Zivot and Andrews (ZA) model considers one structural break and uses many dummy variables for each structural break year. As the exact endogenous break is unknown, the ZA model then assumes every point as a potential break. It, therefore, sequentially conducts a regression for every structural break point, in which the minimum t-statistic indicates where the endogenous structural break date is found.

The following equation gives the ZA model.

$$y_t = \alpha + \beta t + \gamma DU1_t + \omega DT1_t + \mu y_{t-1} + \sum_{i=1}^{k} \lambda \Delta y_{t-i} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (24)$$

$$DU1_t = \begin{Bmatrix} 1 if\ t > T_B \\ 0, otherwise \end{Bmatrix} and, DT1_t = \begin{Bmatrix} 1, if\ t > T_B \\ 0, otherwise \end{Bmatrix}$$

Whereas y_t is a time series variable, t is the time trend, $DU1_t$ is the intercept dummy variable indicating mean shift (change in the level), $DT1_t$ stands for the slope dummy representing change in the slope of the trend function. Besides, T_B represents a potential break point, k denotes lag length.

The null hypothesis states that the time series that excludes any structural break is non-stationary whereas the alternative hypothesis indicates that the series that includes one structural break is stationary. The Clemete, Montanes and Reyes (1998) model, on the other hand, test stationarity in the presence of two breaks in the time series. They propose two models: - Additive outlier (AO) model and Innovative outlier (IO) model in order to address instantaneous structural break and gradual change, respectively.

The following equation gives the IO model as below.

$$y_t = \alpha + \beta y_{t-1} + \delta_1 DT_{1t} + \delta_2 DT_{2t} + \omega_{1t} DU_{1t} + \omega_{2t} DU_{2t} + \sum_{i=1}^{k} \gamma_i \Delta y_{t-i} + \varepsilon_t \quad \text{..... (25)}$$

$$DU_{1t} = \begin{Bmatrix} 1, if\ t > T_B \\ 0, otherwise \end{Bmatrix}, \quad DU_{2t} = \begin{Bmatrix} 1, if\ t > T_B \\ 0, otherwise \end{Bmatrix} \text{ for representing intercept dummy}$$

$$DT_{2t} = \begin{Bmatrix} 1, if\ t > T_B \\ 0, otherwise \end{Bmatrix}, \quad DT_{2t} = \begin{Bmatrix} 1, if\ t > T_B \\ 0, otherwise \end{Bmatrix} \text{ for representing the slop dummy}$$

The AO model, moreover, has two stages in order to test for stationarity. The first step removes the deterministic part of the variable by modeling:

$$y_t = \alpha + \omega_{1t} DU_{1t} + \omega_{2t} DU_{2t} + \overline{y_t} \quad \text{..... (26)}$$

In the second step, the study uses the following model in order to test.

$$\overline{y_t} = \rho \overline{y_{t-1}} + + \omega_{1i} DT_{1t-i} + \omega_{2i} DT_{2t-i} + \sum_{i=1}^{k} \varphi \Delta \overline{y_{t-i}} + \varepsilon_t \quad \text{..... (27)}$$

Where

$$DU_{1t} = \begin{Bmatrix} 1, if\ t > T_B \\ 0, otherwise \end{Bmatrix}, \quad DU_{2t} = \begin{Bmatrix} 1, if\ t > T_B \\ 0, otherwise \end{Bmatrix} \text{ for representing intercept dummy}$$

$$DT_{1t} = \begin{Bmatrix} 1, if\ t > T_B \\ 0, otherwise \end{Bmatrix}, \quad DT_{2t} = \begin{Bmatrix} 1, if\ t > T_B \\ 0, otherwise \end{Bmatrix} \text{ for representing the slop dummy}$$

Note that the endogenous structural break test has a comparative advantage on ADF test and exogenous structural break test. It considers structural break which the ADF test does not take into account. Besides, the endogenous structural break test considers the response of policy changes and lags structure whereas the exogenous structural break test does not consider them. In addition to these, non stationary time series data allows us to have spurious regression results that adversely affect the statistical significance level of coefficients in the VARX model, misleading policy prescription. This in turn negatively affects simulation results from the dynamic CGE model through inappropriate calibrated induced TFP growth rates. Therefore, we need to have stationary time series data and a model of VARX that satisfies stability condition.

4.3 Specification of the Dynamic CGE Model

This is to estimate the impacts of the induced sectoral TFP, calibrated on the basis of the aforementioned methodology, on the economy wide growth and structural change process. Many researchers use a number of methodologies in order to analyze the impact of alternative sectoral TFP growth options on economy-wide growth and structural change process. Broadly, past studies[7] have used five methods to examine growth and

[7] For instance, John W. Mellor and Paul Dorosh (2010), Clemens Breisinger and Xinshen Diao (2008); Stan Metcalfe, John Foster and Ronnie Ramlogan (2005); Dercon S. and Zeitlin A.(2009) and Soderbom M.(2011) use statistical descriptive analysis to examine issues related with growth and structural change. However, it has some flaws: it heavily depends on a trend analysis and cannot determine causality. The role of market and price is not directly considered so that the policy prescription that is based on descriptive analysis does not go beyond proximate sources of sustainable growth and rapid economic transformation. Some other studies use an institutional approach (Monika Bak, 2004) and others are also interested in using product space model in order to address some issues of growth and economic transformation (Kristine and Davidsons, 2008). However, both methods are incapable of addressing the issue of sectoral contribution to economy-wide growth effect and the dynamic nature of structural change in the context of general equilibrium. On the other hand, some other scholars like Bah, El-hadj M (2008);

economic transformation in different contexts: statistical descriptive, econometrics analysis, institutional economics analysis, product space method, and CGE Modeling. Among the five estimation methods, the study uses the dynamic CGE model based on SAM 2006 due to the following advantages and reasons. The dynamic CGE model considers the entire economy in the sense of general equilibrium and enables comparison of the benchmark and counterfactual policy scenarios. It also runs simulation for economy-wide impacts of exogenous shocks and assesses the welfare effect based on the household survey. Besides, it incorporates the dynamic nature of structural change and market interactions and feedbacks. Exceptionally, it produces disaggregated results at micro-level and/or aggregated at macro-level. This does not mean that the CGE model is a perfect estimation technique. It mainly focuses on the real side of the economy in the context of neoclassical economic assumptions and neglects markets for financial assets. However, some corrective measurements emerged through time regarding assumptions, model calibration, structure of the economy and CGE model equation specification to address these shortcomings.

There is also an increasing interest in applying CGE-models in various development issues like environment, poverty reduction, inequality, and foreign trade (Adelman and Robinson, 1988). Clemens *et al*. (2007) attempted to assess the inter-sectoral and economy-wide linkages for accelerated growth and structural change in Ghana's economy by 2015. However, this paper does not address the role of government in economic transformation. The study also used partial productivity analysis instead of TFP in some of the simulation.

Regarding studies in Ethiopia, EDRI and IFPRI (2011) tried to assess alternative sources of finance for achieving the GTP in Ethiopia by 2015. However, it is confined to alternative sources of financing for GTP, not attempted to investigate whether the ongoing GTP can bring structural change or not. This study does not also investigate the relative importance of the agriculture, industry, and service in economic transformation.

Tomasz and Dorota (2008); Zou Wei (2004); Florian Noseleit (2011); Rashmi and Bishwanath (2004) and Geda A. and Degefe B.(2005) use econometrics approach to understand the nature of growth and structural change process. However, they have some limitations- not effectively able to conduct controlled experiments for alternative sectoral policy choices in the way that a dynamic CGE model does.

Tadele (2008) also examined alternative growth options and their impact for a cereal dependent village economy in Ethiopia using a framework of SAM. However, his study does not reflect growth and structural change at national level. Therefore, this study fills the gaps left by past studies and examines the alternative sectoral growth options and their impacts on structural change at the macro level with respect to reaching middle income country status by 2025.

4.3.1 Specification of CGE Model for Ethiopian Economy

The specification of CGE model in the study follows the manual developed by Sherman Robinson and his colleagues in 2002. It considers the neoclassical-structuralist tradition in order to address some of the structural features of the Ethiopian economy. Specifically, it takes into account the existence of home-consumed commodities (non-marketed commodities) and transaction costs of import, export and domestic trade. The model presents the behavioral relationship and interactions of economic actors given the SAM 2006 in terms of linear and non-linear simultaneous equations subject to constraints functions (Look at annex 1 for CGE model equations). The CGE model has different components as described below along with the equations specified at annex 1.

Production and Trade Block:

Production Activities: This refers to the production of goods and services. As the assumption of neoclassical economics thought, the main objective of producers is profit maximization subject to the choice of production technology. In order to determine the production level, producers choose the combination of intermediate inputs and value-added factors using either constant elasticity of substitution technology or Leontief fixed proportion technology. We call it the top level (aggregated) technology in the CGE model. However, the CGE model assumes that producers have only option at the disaggregated level in order to determine both the level of intermediate inputs and value-added factors. Producers choose various types of factors of production using constant elasticity of substitution in order to determine the level of aggregated value-added factor. Besides, it is assumed that they use Leontief fixed proportion for choosing between imported intermediate inputs and domestically produced intermediate inputs in order to determine the level of composite commodities and thereby intermediate inputs.

Commodity Markets: This also refers to the flow of marketed good and service in domestic and international market. Various commodities from various activities form an aggregate output using constant elasticities of substitution. The aggregate output is sold at the domestic market and export market. In other word, both domestic sales and aggregate export constitute aggregate output. The CGE model assumes that producers make decisions to sell either domestically or abroad subject to the technology of constant elasticity of transformability. In our case, however, all productions do not go to the market. Households consume some fixed portion of production at home. The neoclassical-structural CGE model takes into account this feature. The domestic market receives the aggregate imports in order to fill the domestic production gap. The domestic consumer in this regard chooses between domestically produced goods and imported goods subject to constant elasticity of substitution technology. Both aggregate import and domestic sales constitutes the composite commodity and satisfies the demand for household consumption, government consumption, investment and intermediate use.

Price Block:

This refers to the structure of prices of goods and services ranging from producer price to the final price. Starting from the producer price, the aggregation of prices of various activities with activity taxes constitutes a producer price of a commodity. For the export commodity, for example, the government levies export tax and it becomes the final export price, which is a summation of producer price and export tax. Producers in this regard have an option of selling commodity is either at producer prices domestically or final export price abroad. Such interaction determines the final supply price for the domestic market in the production side. However, there must be transaction costs associated with the goods and services moved from the production area to consumption area. This incurs such transaction cost on domestic supply prices that give the domestic demand prices. Using the same logic for the imported goods, the final import price includes both import tariffs and transaction costs. Consumers, in this regard, have an option of paying final import price for imported goods or domestic demand price for domestic sales. Such interaction of the final import price and domestic demand prices determines the price of the composite commodity. Adding sales taxes to the composite price gives a final market price.

Institution Block:

This refers to the actors who have their own motives in economic activities. The CGE model considers the mainly economic agents such as households, firms, the government, and the rest of the world. In order to meet their objectives of maximizing profit and utility, there is an intensive behavioral interaction among institutions which makes the economy vibrant. The households in this regard generate income and get transfer from firms and other institutions on one hand and allocate their total income into consumption, tax payments and make transfers to other institutions. Firms also receive income and transfers. They then fulfill their obligation of direct taxes and make savings and transfers to other institutions. The rest of the world as an institution generates foreign receipts through exports and incurs foreign cost through imports. The government receives taxation income and transfers and allocates them to public spending and to public transfers to institutions. Finally, the residual difference between income and expenditure constitutes savings for all institutions.

System constraint Block:

The CGE model considers a number of constraints on the behavioral equations which limit the principal objectives of the institutions. The model in this respect acknowledges the following main constraints functions.

1. For government account, government revenue is equal to the summation of direct taxes from institutions, direct taxes from factors, activity tax, import tariffs, sales tax and transfer from rest of the world.
2. For output, composite supply is equal to the summation of composite demand for intermediate use, household consumption, government consumption, fixed investment, stock change and demand for trade input use.
3. In the current account balance for the rest of the world, the summation of import spending and factor to ROW transfers is equal to the summation of export revenue, institutional transfer from ROW and foreign savings.

4. For fundable resources, the summation of non government saving, government savings and foreign savings are equal to the summation of fixed investment and stock change.
5. Total absorption is equal to the summation of household market consumption, household home consumption, government consumption, fixed investment, and stock change.
6. Ratio of investment to absorption is equal to the summation of fixed investment and stock change

4.3.2 Assumptions in the CGE model

The CGE model is built on assumptions regarding factor market, government balance, external balance and saving-investment balance. By investigating the alternative scenarios, the study takes a scenario of assumptions which nearly reflect the Ethiopian economy.

External Balance: there are two options. The first one assumes fixed foreign savings and flexible real exchange rate to adjust in order to hold the trade balance constant. However, the second option suggests the contrary. Considering the performance of the Ethiopian economy, the study uses the assumption of flexible real exchange rate and fixed foreign savings.

Government balance: The CGE presents three optional assumptions in this regard. The first option assumes fixed tax rates for all, and flexible government saving. The second option assumes fixed government savings and flexible direct tax rates with a fixed number of percentage points for selected institutions. The final option also provides fixed government saving and flexible direct tax rates, but it considers scaled direct tax rates for selected institutions. In all the options, the CGE model assumes fixed government consumption in real terms or as a share of total absorption. Taking the fiscal performance of the Ethiopian economy, the paper, therefore, considers flexible government savings and fixed direct tax rates.

Savings and investment balance: The CGE proposes various assumptions depending on the Johansen, neoclassical and balanced closures. The Johansen thought is that

savings is investment-driven so that saving rate adjusts to maintain a fixed capital formation (fixed investment level). However, the neoclassical thought suggests that investment is saving-driven so that the amount of investment (capital formation) is flexible and limited to the fixed saving rate. The balanced closure in this regard is an investment-driven closure with a balanced adjustment in all compositions of absorption in order to maintain fixed share of each component in total absorption. Reviewing the Ethiopia economy in this respect, the study picks up the assumption that advocates investment is savings driven.

Calibration of Dynamic Variables

Following dynamic natural growth of the population overtime, labour as the factor of production grows accordingly or probably with different rates. The CGE model assumes that such labour growth pushes up the other factors of production-cultivated land and capital- to grow in order to enhance output growth. The changes in factors in one year have effects on the next year's performance. In effect, investment (capital formation) dynamically soars up in order to accompany the growth of factors of production. The dynamic CGE model, therefore, considers these factor adjustments overtime which enables the model to reflect the dynamic feedbacks via change in factors of production. It also accounts for the cost of adjustment and the time taken to full adjustment process. Linking one period to the next period, the dynamic part of the model is captured by updating variables that grow at a constant rate per period and by controlling the accumulation of capital. The study, therefore, takes the dynamic CGE model that considers the following assumptions: The growth in total labor supply is consistent with the projected annual population growth of 2.4 percent. The average annual growth rate of agricultural land across the modeled period is 3.1 percent. Capital accumulation is an endogenous outcome of savings and investments and assumed to increase by 11.5 percent with 5 percent depreciation rate (NBE, 2010 and WB, 2011).

There are two dynamic approaches relevant here: the first one is recursive or sequential or myopic, and the second one is inter-temporal or clairvoyant. The inter-temporal dynamic approach takes into account the rational expectation. However, economic agents in the recursive approach make their decisions on the basis of adaptive

expectations and combine both a within-period module (mainly the static model) and a between-period module (link the within-periods modules by updating selected parameters endogenously and exogenously). Considering the types of economic agents in Ethiopia, the study uses a recursive dynamic model with between-period modules. This helps to assess the projected economic performance for 15-20 years, which directly tallies with the interest of reaching the middle-income status by 2025.

4.3.3 Simulation Parameters: Shocking the Induced Sectoral TFP

Considering a plan for reaching the middle income country status by 2025 as a destiny, the study sets the SAM 2006 as a starting point for running various simulation scenarios. As it is impossible to have a sustainable growth without a change in TFP, the model assumes change in TFP growth as a simulation parameter. In order to calibrate the induced sectoral TFP growths, the study follows the following steps:

1. **Set the sectoral TFP growth**: The study estimates sectoral TFP growth using the growth accounting approach, and compares the estimates with the required growth rate of sectoral TFP that the selected comparators needed to achieve the middle-income country status. In summary, we set the sectoral TFP using estimates and countries' experience.
2. **Calibrate the induced sectoral TFP growth**: Once the study set the sectoral TFP growth, the next step is inducing it with statistically significant factors that affect it. Hence, the study uses the regression result of VARX model in which it picks up statistically significant explanatory variables and examines their relationship with sectoral TFP growth via their respective coefficients. This gives the induced TFP growth.
3. **Shock the induced sectoral TFP growth**: finally, the study examines the impacts of changes in the induced sectoral TFP growths on economy wide growth and structural change process in Ethiopia.

4.4 Specification of the Expenditure Dynamic CGE Models

This is to examine the impacts of change in public expenditure compositions. Through this, the study examines the effect of shifting a certain share of public resources from non-productive activities to productive activities. The study investigates the impacts of improving the growth rate of sectoral TFP. In such impact assessment of sectoral TFP, the study is, moreover, interested in examining the role of government in public resource allocation in order to enhance sectoral TFP and thereby structural change. In doing so, the government reduces the share of unproductive government spending and increases spending towards more productive and efficient activities. This leads to a change in spending composition which has an effect on sectoral TFP growth through elasticity. The study, therefore, incorporates the estimated elasticity of sectoral TFP growth in response to the change in spending composition in the CGE model.

The study considers a specification of Cobb Douglas production function augmented with public expenditure following Fan and Rao (2003) and Davoodi and Zou (1998) in order to work out the link between TFP growth and spending composition. Equation 28 shows the augmented Cobb Douglas production.

$$y = f(L, K, G) \quad \text{..... (28)}$$

Whereas Y denotes output; L stands for labour; K stands for capital; G stands for government expenditure. The government expenditure in this case consists of public expenditure on human capital (GH), expenditure on agriculture (GA), expenditure on industry (GI) and expenditure on administration (GD), expenditure on infrastructural development(GF) and other expenditure (GO). Hence, equation 28 can be rewritten as follow.

$$y = f(L, K, GA, GH, GI, GD, GF, GO) \quad \text{..... (29)}$$

Taking total differential form of equation 29, we obtain the following

$$dy = \frac{\partial y}{\partial L} dL + \frac{\partial y}{\partial K} dK + \frac{\partial y}{\partial GA} dGA + \frac{\partial y}{\partial GH} dGH + \frac{\partial y}{\partial GI} dGI + \frac{\partial y}{\partial GD} dGD + \frac{\partial y}{\partial GF} dGF + \frac{\partial y}{\partial GO} dGO \quad \text{..... (30)}$$

Expressing the dependent variable in terms of growth rate by dividing by 'y' and using some mathematical manipulation in labour and capital part, we obtain

$$\frac{dy}{y} = \frac{\partial y}{\partial L}\frac{L}{Y}\frac{dL}{L} + \frac{\partial y}{\partial K}\frac{K}{Y}\frac{dK}{K} + \frac{\partial y}{\partial GA}\frac{GA}{Y}\frac{dGA}{GA} + \frac{\partial y}{\partial GH}\frac{GH}{Y}\frac{dGH}{GH} + \frac{\partial y}{\partial GI}\frac{GI}{Y}\frac{dGI}{GI} + \frac{\partial y}{\partial GD}\frac{GD}{Y}\frac{dGD}{GD} + \frac{\partial y}{\partial GF}\frac{GF}{Y}\frac{dGF}{GF} + \frac{\partial y}{\partial GO}\frac{GO}{Y}\frac{dGO}{GO} \quad \text{..... (31)}$$

Presenting in growth notation gives

$$g_y = \beta_1.g_L + \beta_2.g_K + \beta_3.g_{GA} + \beta_4.g_{GH} + \beta_5.g_{GI} + \beta_6.g_{GD} + \beta_7.g_{GF} + \beta_8.g_{GO} \quad \text{……... (32)}$$

Whereas $\frac{\partial y}{\partial L}\frac{L}{Y} = \beta_1, \frac{\partial y}{\partial K}\frac{K}{Y} = \beta_2 \frac{\partial y}{\partial GA}\frac{GA}{Y} = \beta_3, \frac{\partial y}{\partial GH}\frac{GH}{Y} = \beta_4, \frac{\partial y}{\partial GI}\frac{GI}{Y} = \beta_5, \frac{\partial y}{\partial GD}\frac{GD}{Y} = \beta_6, \frac{\partial y}{\partial GF}\frac{GF}{Y} = \beta_7, and \frac{\partial y}{\partial GO}\frac{GO}{Y} = \beta_8$ are the respective elasticities. The growth rates for factors of production and spending compositions are presented by

$$\frac{dy}{y} = g_y, \frac{dL}{L} = g_L, \frac{dK}{K} = g_K, \frac{dGA}{GA} = g_{GA}, \frac{dGH}{GH} g_{GH}, \frac{dGI}{GI} = g_{GI}, \frac{dGD}{GD} = g_{GD}, \frac{dGF}{GF} = g_{GF}, \frac{dGO}{GO} = g_{GO}$$

By introducing the Solow residual concept, the study calculates the TFP growth rate by $g_{TFP} = g_y - (\beta_1 g_L + \beta_2 g_K)$ on the basis of growth accounting approach. Therefore, equation 32 can be rewritten as follows:

$$g_y - (\beta_1.g_L + \beta_2.g_K) = \beta_3.g_{GA} + \beta_4.g_{GH} + \beta_5.g_{GI} + \beta_6.g_{GD} + \beta_7.g_{GF} + \beta_8.g_{GO} \quad \text{……. (33)}$$

Explaining the TFP growth rate in terms of other variables gives equation 34 as follows:

$$g_{TFP} = \beta_3.g_{GA} + \beta_4.g_{GH} + \beta_5.g_{GI} + \beta_6.g_{GD} + \beta_7.g_{GF} + \beta_8.g_{GO} \quad \text{……..…… (34)}$$

The dynamic CGE model assumes that government expenditure is exogenous and fixed. This indicates that the positive growth rate in one of the components occurred at the cost of the growth of the other component, allows a change the composition of expenditure in order to keep the fixed government expenditure. Therefore, it is possible to substitute the growth rate of spending components by the corresponding shares in the total expenditure (Fan and Rao, 2003).

$$g_{TFP} = \beta_3.S_{GA} + \beta_4.S_{GH} + \beta_5.S_{GI} + \beta_6.S_{GD} + \beta_7.S_{GF} + \beta_8.S_{GO} \quad \text{…… (35)}$$

Such a specification permits to calibration of the coefficients that show the relationship between change in spending composition and TFP. On the basis of these coefficients, the study examines the impacts of shifting public resource towards productive activities from unproductive activity on economy wide growth and structural change process through the expenditure share induced TFP. Accordingly, there are two ways of estimating the elasticity coefficients in equation 35 such as Meta Regression Analysis and calibration based on the base-run scenario. The study prefers to use calibration based on the base-run scenario which sets sectoral TFP growth rate equal to one in the base-run scenario as the CGE model sets (Matovu, 2010). The study, therefore, uses the average spending composition in terms of share out of total expenditure in 2006-2011 in order to set the base-run scenario spending share. Accordingly, Table 14 gives the details of percentage shares as follow.

Table 14: Average Government Spending Compositions in 2006-2011

Spending Composition	Government expenditure (Millions)	percentage share	Elasticity of sectoral TFP in response to spending share based on the base-run calibration
Administration	62,426.34	17.74	2.66
Agriculture	57,333.33	16.29	2.54
Industry	8,555.06	2.43	1.24
Human capital	67,060.14	19.06	2.25
Infrastructure	45,368.12	12.89	2.78
Others socioeconomic service	111,145.84	31.59	4.00
Total	351,888.84	100	-

Source: MOFED, Ethiopia

Setting the TFP growth rate equal to one and taking the spending share of the above in the base-run scenario are crucial in estimating the elasticities of TFP growth in response to change in spending share of each component, after transforming the explanatory variables into log form in equation 35. The study then estimates the elasticity coefficients by setting TFP=1 and with the spending share as mentioned above, in the base-run scenario. As a result, the study presents the elasticity of sectoral TFP in response to spending share in the Table 14. For the simulation scenarios, the study uses such calibrated elasticities and then examines the impacts of increasing the share of

spending on productive activities (it is interested in the agriculture, industry and infrastructure) by the 5 percent. However, such shifting spending towards the productive sectors has an opportunity monetary cost associated with reducing the share of spending on administration which generates a wide range of benefits like social security, peace building, and externality and spillover effects.

The study, therefore, considers a reduction in TFP due to a decrease in spending on administration as an opportunity cost so that it examines the net effect of change in spending compositions (both increasing spending on productive sectors and decreasing spending on administration) on economy wide growth and structural change through sectoral TFP. In other words, the study examines the combined effect of reducing spending on administration and increasing spending on productive activity by the same percent. This allows capturing the monetary cost of shifting public resources towards productive sector from administration. The reduction in TFP due to a reduction in spending on administration is treated as a monetary cost of change in spending composition favoring the productive sectors.

4.5 Data Source

We collect data for sectoral real GDP from the MOFED. Agriculture GDP consists of crop, animal farming, forestry and fishing while industry GDP includes mining, quarrying, manufacturing, electricity and water development and construction. The service GDP also includes domestic trade (wholesale and retail), hotel and restaurant, transport and communications, real estate, renting, public administration, education, and health. I also collect data for agricultural and non-agricultural Labour from UNCTAD web site. Given this non-agricultural labour data, I decompose the number of labors in the non-agricultural sector into industrial labour and service labour based on the share of employment rates of 33 percent in the industry and 67 percent, in service. The Labour survey in 2005 referred for confirmation.

The UNCTAD website also gives the data for gross capital formation. According to the definition, it includes gross outlays, fixed assets and net changes in inventories. Fixed assets include roads, plant, railways, machinery, schools, equipment, land hospitals and

buildings. We decompose the aggregated gross capital formation into sectoral level using the sectoral share of public expenditure. This is because of the fact that the government expenditure has the same fashion with gross capital formation. Besides, it is the key contributor of gross capital formation. The study also takes data for the factor income shares from the national income account of year 2006. On top of these, we also collect the data that are relevant for estimating the determinants of sectoral TFP growths from various sources. We collect data for government spending on the agricultural R&D and spending shares for each composition from MOFED and we also gather time series data for the inflation rate, openness, imported capital goods, private credit per GDP from NBE. Finally, we find the data for road network, and cultivated land from EEA and data for a number of pupils enrolled at primary school from WB database center.

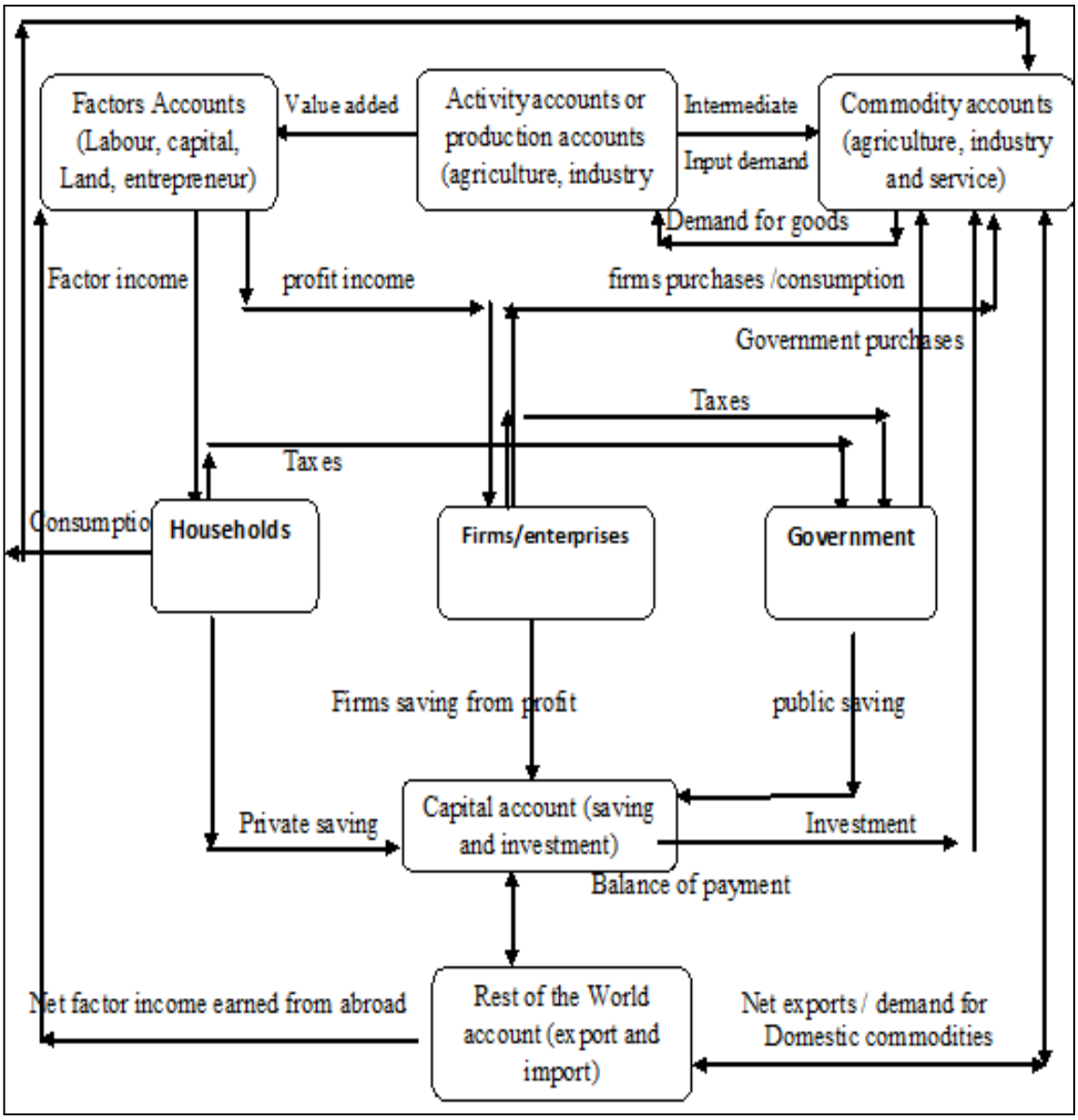
4.6 Characteristics of Social Accounting Matrix 2005/06

As an input data for CGE model, the dynamic CGE model is calibrated to 2006 SAM that comprises database that shows the flow of economic resources and transactions among economic agents. The Ethiopian SAM 2006 consists of 47 activities disaggregated to 14 agricultural, 19 industrial, 1mining and 13 service sub-activities. It has also 93 commodities disaggregated to 25 agricultural, 27 industrial, 3 mining and 38 service sub-commodities. To account for the variations in factors of productions, labor disaggregated into agricultural labor, administrative workers, professional workers, non-agricultural unskilled workers, and non-agricultural skilled workers. Capital is also disaggregated into the land for rural poor, land for rural non-poor, livestock for rural poor, and livestock to rural non-poor and non-agricultural capital. There is one marketing margin account which records the sum of trade and transport margins and five factor accounts. Both capital and labor are mobile across the three sectors.

The SAM also consists of institutions of households, private enterprises, the government, and the rest of the world. Households are disaggregated into rural poor, rural non-poor, urban poor, and urban non-poor. The SAM also presents a detailed tax system: nine types of direct taxes and eight indirect commodity taxes. Note that the problem in estimating a social accounting matrix (SAM) includes a problem of finding

an efficient information from a variety of sources and excluding market for financial assets (EDRI, 2009). Figure 11 gives a summary of the flow of resources and the transaction among sectors. This transaction and flow of resources are based on the variation in motives of economic actors, leading to market interactions and feedback.

Figure 11: Resource Flow and Transactions in a multi-sectors economy



Source: an extension of Elsenburg work (2003)

An activity (production) account shows the value-added relationship between employed factors of production and outputs produced. These activities are valued at producer prices. The commodities (activity output either sold domestically or exported and imports) valued at market prices. These commodities at the end become consumption goods for households, purchases for government and firms, and the ROW. On the other hand, linking activity accounts with factor accounts, payment to all factors of production calculated based on their contributions to the production of goods. Households and firms distribute their income to consumption, tax payment and saving. The government in this regard generates tax revenue from which it partly spends to the government purchase in terms of recurrent expenditure and capital expenditure. The remaining balance goes to the public saving in the capital expenditure. All savings generated from household, firms, government and BOP are employed for investment. Regarding the international market, the flow of the resources between the commodity accounts and the capital accounts depend the magnitude of the net export. If exports exceed imports, the flow of the resource is from the ROW to the commodity account and the balance of payment account. If not, the direction of the flow of the resources moves in the reverse direction.

CHAPTER FIVE:-EMPIRICAL RESULTS AND ANALYSIS

As described in the methodology, the sectoral growth accounting approach produces the estimates of TFP growth rates for the agriculture, industry and services. Using the estimates of sectoral TFPs, the VARX model that considers both sectoral interaction and exogenous variables identifies the powerful determinants of sectoral TFP growth in order to calibrate the induced sectoral TFP. Eventually, the study uses the estimated induced sectoral TFP growth rates and examines their impacts on the economy wide growth and structural change of the Ethiopian economy using the dynamic CGE model. The study also investigates the alternative role of government in allocating public resources in achieving sustainable economic growth and swift structural change in the country.

5.1 Estimates of Sectoral TFP Growths and their Determinants

5.1.1 Estimates of Sectoral TFP growths and Sources of Growth

Both empirical and theoretical evidences show that economic growth can be decomposed into factor accumulation and factor productivity. The Ethiopian economy in this regard manifests a multifaceted performance depending on the political economic policy regimes such as the feudal-capitalism (up to 1974), socialism (1975-1988), mixed economy (1989-1991), more of liberalization (1992-2000) and the pro-poor growth regime (2000 to date).

The sectoral growth accounting approach decomposes the source of growth into labour, capital and TFP as presented in table 15. The empirical results indicate that the accumulation of labour factor is the dominant source of growth in the agriculture sector over the period 1972-2010. Both capital and land positively contribute to the average growth rate of agriculture while the agricultural TFP growth rate is negative on average in 1972-2010. Following the pro-poor economic policy shift, the agricultural TFP growth takes the lead in influencing the agricultural growth during 2001-2011. This might be because of the pro-poor growth strategy that addresses the rural-poor that are heavily engaged in agriculture.

Table 15:-Sectoral TFP growth using Growth Accounting Approach (%)

Sectoral Decomposition of GDP Growth Rate	Political economy regimes*					Average for 1972-2011
	1972-1974	1975-1988	1989-1991	1992-2000	2001-2011**	
Agricultural GDP growth rate	1.5	1.0	3.4	1.6	7.1	3.1
Contribution of labour	1.4	2.3	2.7	2.1	2.1	2.2
Contribution of land	0.1	-0.1	-0.1	1.0	0.5	0.3
Contribution of capital	1.7	1.6	0.9	0.3	1.4	1.2
TFPG-Agriculture	-1.7	-2.7	-0.1	-1.7	3.2	-0.6
Industrial GDP growth rate	5.2	4.1	-6.3	4.1	9.7	4.9
Contribution of labour	1.2	0.8	1.0	0.3	2.2	1.1
Contribution of capital	19.2	25.9	-6.1	-3.8	22.9	15.5
TFPG-Industry	-15.3	-22.6	-1.3	7.7	-15.4	-11.7
Service GDP growth rate	5.5	3.9	2.7	4.2	10.7	5.9
Contribution of labour	0.8	0.5	0.7	0.2	1.5	0.8
Contribution of capital	2.1	8.6	-13.1	14.6	12.3	8.8
TFPG-Service	2.6	-5.2	15.1	-10.6	-3.0	-3.7

Source:-Author's own calculation based on sectoral growth accounting approach.

*Note that Ethiopia passes through different political economy regimes-feudal-capitalism in 1940-1974, socialism in 1975-1988, mixed economy in 1989-1991, more of liberalization in 1992-2000, and pro-poor growth regime in 2001-2011.

**Data for sectoral GDP are collected on the basis of the government report that states 11 percent GDP growth rate, on average, in 2005-2011. This figure is not shared by independent bodies.

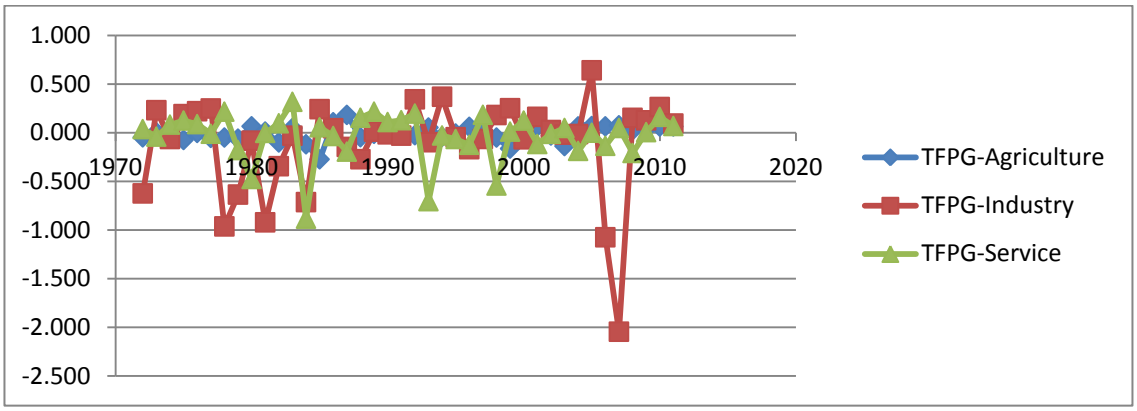
Regarding industrial TFP growth, accumulation of capital dominates the growth rate of the industry value-added in the same reference period, followed by labour contribution. The TFP growth still remains negative as manifested in the agriculture sector in 1972-2010. During the period 1992-2000, the industrial TFP growth positively contributes and takes the lead in the contribution to growth rate of the industry value-added. This is mainly due to the fact that many industrial firms are encouraged and participated as the

economy was free from the bondage of socialism in 1991. In the service sector, the contribution of capital to the service value-added is dominant during the socialist and liberalization regimes while the TFP growth dominantly influenced the service value-added during 1972-1974 and 1989-1991. In short, sources of growth vary with the types of economic sectors and policy regimes.

In a nutshell, labour is the dominant source of the agricultural growth while capital deepening is the big source of growth in industry and services in 1972-2011, regardless of the various political economy regimes. However, the sectoral TFP growths negatively affect the growth rate of each sector in 1972-2010. This negative growth rate possibly reflects the lack of efficiency and the shortage of technological change in the economy. This leads to deterioration of productive efficiency and erratic economic growth. In addition to this negative performance, the sectoral TFP growth rates are highly fluctuating overtime and across sectors in the entire period. Comparing with total productivity, the main finding is that the Ethiopia economy can be explained by factor accumulation, not factor productivity in the reference period. By implication, the stochastic trend in sectoral TFP and the average negative TFP growth explain the erratic economic growth rate. Therefore, such TFP growth is the bottleneck to the long run growth and structural change, creating severe economic debacles and a deadlock situation. The VARX model examines the determinants of sectoral TFP growth rate on which it is possible to calibrate the induced TFP for the dynamic CGE model.

Pertaining to the dynamics of sectoral TFP growth rate, Figure 12 shows that the growth rate of TFP in the agriculture, industry and service moves stochastically around zero overtime. However, the fluctuation varies across sectors. In the case of agriculture, the dynamics of TFP growth rate seems less swinging as compared to the other two sectors. The growth path of the industrial TFP highly fluctuates across time with some outliers. Such variations indicate that factors that are heavily responsible for variations in the sectoral TFP growth rate are likely to be different per each sector.

Figure 12: The Dynamics of Sectoral TFP growth by growth accounting approach



Source:-Author's own calculation, estimated using sectoral growth accounting approach

The alternative regression-based approach, unlike the growth accounting approach, treats the coefficients of growth equation 9 as the elasticities of output to factors. Note that these coefficients are not equal to factor income share so that it violates the assumptions of constant return to scale and perfectly competitive market. The regression equation of sectoral output on growth rates of factors of production generates the elasticity of sectoral GDP growth rate in response to the growth rate of factors (Table 16).

Table 16:- The Estimated elasticity of sectoral output to factors using regression model

Factors	Estimated Elasticity of output to factors of production		
	Agriculture Sector	Industry Sector	Service Sector
Labour	0.675642	0.478128	0.520051
Capital	0.0474227	0.0293424	0.0354559
Land	0.114464		

Source: - Author's calculation using the regression-based approach

Table 17 gives the estimates of sectoral TFP growth rates based on regression approach. The growth rate of value added in each sector is heavily dominated by the labour contribution in the period 1972-1991. Contrary to the growth accounting approach, the TFP growth in the industry and service takes the lead in dominating the sectoral growth rate in the subsequent period following the policy shifts.

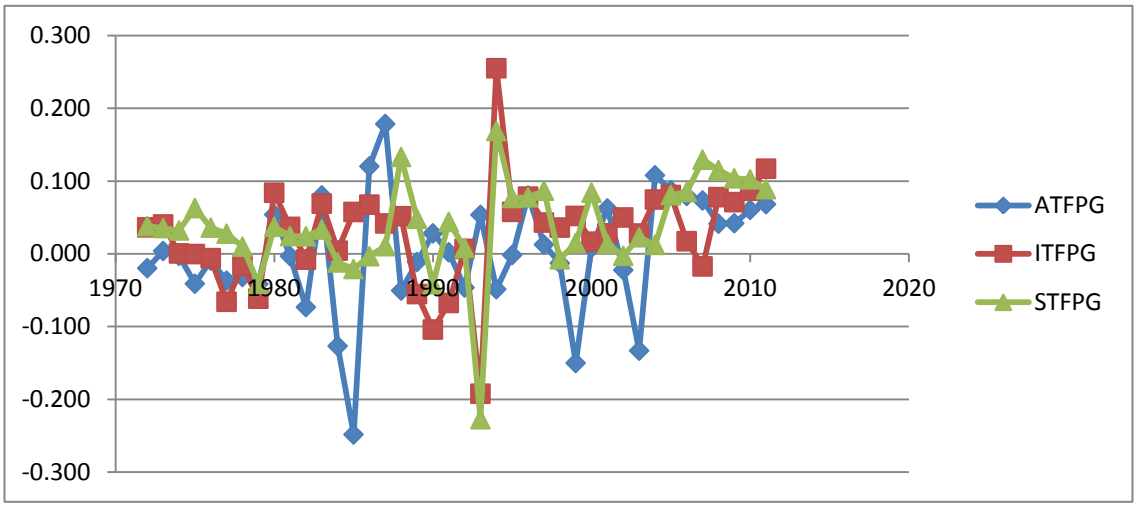
Table 17:-Sectoral TFP growth using the Regression-based Growth Approach

Sectoral Decomposition of GDP Growth Rate	Political economy regimes*					Average for 1972-2011
	1972-1974	1975-1988	1989-1991	1992-2000	2001-2011	
Agricultural GDP growth rate	.51	1.05	3.40	1.62	7.15	3.1
Contribution of labour	1.24	2.06	2.46	1.91	1.86	1.9
Contribution of land	0.09	-0.10	-0.08	0.77	0.37	0.2
Contribution of capital	0.80	0.73	0.40	0.12	0.66	0.6
TFPG-Agriculture	-0.62	-1.64	0.63	-1.17	4.24	0.3
Industrial GDP growth rate	5.16	4.11	-6.34	4.14	9.66	4.9
Contribution of labour	1.73	1.13	1.47	0.38	3.06	1.6
Contribution of capital	0.86	1.15	-0.27	-0.17	1.02	0.7
TFPG-Industry	2.57	1.82	-7.56	3.93	5.58	2.7
Service GDP growth rate	5.50	3.92	2.67	4.20	10.72	5.9
Contribution of labour	1.88	1.23	1.59	0.42	3.33	1.7
Contribution of capital	0.10	0.40	-0.60	0.67	0.56	0.4
TFPG-Service	3.51	2.30	1.68	3.13	6.83	3.8

Source:-Author's own calculation using Regression-based growth approach

The TFP growth rate dominates the agricultural value-added growth rate in 2001-2011, due to the pro-poor growth strategy designed to address the issues of creating employment and holding a large number of populations. Unlike the growth accounting approach, the average growth rate of TFP becomes positive in 1992-2011. The agricultural GDP is heavily contributed by labour whiles the value-added in the industry and service are heavily and unusually contributed by the sectoral TFP growth during the entire period. In comparison with the previous dynamics of sectoral TFP growth, the TFP growth rates in all sectors show stochastic movement with many outliers in all sectors of agriculture, industry and services.

Figure 13:-The Dynamics of Sectoral TFP growth by regression-based approach



Source:-Author's own calculation, estimated using the regression-based approach

Comparing the estimated sectoral TFP growth rates from both approaches, the study chooses the growth accounting approach in order to calibrate the induced sectoral TFP growth. This is mainly because of 1) maintaining a consistent assumption of constant return to scale across the paper including the CGE model 2) The results from the growth accounting approach show that the agriculture uses labour intensive technology while the industry and service use capital intensive with negative TFP growth rate across sectors, on average. This result relatively reflects the actual economic performance of the Ethiopian economy and other comparators' experience.

5.1.2 Analyzing the Determinants of Sectoral TFP Growths

Using the estimates of the TFP growths for the agriculture, industry and services, the paper specifies, estimates, and analyzes the determinants of sectoral TFP growth using VARX model. On the basis of the econometric results, the study uses statistically significant explanatory variables in order to generate the induced sectoral TFP growths. Hence, the empirical results of descriptive analysis, optimal lag length, stationarity test, regression outcomes, diagnostic test, impulse response function, and variance decomposition are presented as follows.

Descriptive Analysis

Descriptive analysis gives the general features of the data and emphasizes how it looks like the distribution of time series. Table 18 below presents both central tendency and variation measures of the distribution of the data in 1972-2011. The average value or the mean value of the sectoral TFP growth for the three sectors is negative, indicating how the sectoral TFP growths can be the daunting challenge for economic transformation and sustainable growth. All variables in the VARX model have a wide range of dispersion around the mean with a mix of positive and negative skewness and peakedness.

Table 18:-Summary of Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Variance	Skewness	Kurtosis	Min	Max
TFPGA	40	-.005	.081	0.006	-0.81	4.73	-.274	.182
TFPGI	40	-.116	.487	0.23	-1.91	7.55	-2.04	.64
TFPGS	40	-.037	.246	0.06	-1.73	6.12	-.884	.317
GARD	40	.170	.470	0.22	1.69	6.61	-.627	1.77
GRNW	40	.046	.0479	0.002	0.72	3.94	-.0502	.172
GIMC	40	.058	.366	0.13	-0.37	3.26	-.99	.724
GPEP	40	.083	.104	0.10	-0.04	2.79	-.163	.315
OPP	40	28.35	10.62	112.95	0.56	2.21	11.73	51.53
IR	40	15.73	5.61	31.51	0.14	1.56	6.15	24.65
INF	40	9.25	11.29	127.53	1.11	4.64	-9.81	44.4

Source:-Author's Estimation

TFPGA stands for TFP growth rate for agriculture; TFPGI stands for TFP growth rate for industry; TFPGS for TFP growth rate for service; GARD denotes growth rate of government expenditure for agricultural R&D, GIMC denotes growth rate of imported capital goods ,GPEP denotes growth rate of pupil in primary school; GRNW stands for growth rate of road net works in kilometers ; opp stands for openness of the economy; LR denotes service trade liberalization index and INF for inflation.

With these descriptive statistics, the variables show some fashion of statistical relationship among themselves as captured by the Pearson product-moment correlation coefficient (Table 19). This coefficient is symmetric and gives some clue about the

correlation between two variables. As can be seen from the table 19, growth rates of industrial and service TFPs, agricultural R&D, road network, and inflation rate have a negative relationship with agricultural TFP growth. However, openness and growth rate of number of enrolled pupils negatively influence the industrial TFP growth. On the contrary, the service TFP growth has a positive relationship with index of liberalization.

Table 19:-The Pearson Correlation and Statistical Relationship

	TFPGA	TFPGI	TFPGS	GARD	GRNW	GIMC	GPEP	OPP	IR	INF
TFPGA	1.0000									
TFPGI	-0.0879	1.0000								
TFPGS	-0.0542	0.0944	1.0000							
GARD	-0.2755	0.1548	-0.5013	1.0000						
GRNW	-0.0797	0.0437	-0.1335	0.1403	1.0000					
GIMC	0.1076	0.3566	-0.0392	0.1474	0.1809	1.0000				
GPEP	0.1802	-0.041	-0.1984	0.0172	0.3357	0.3162	1.0000			
OPP	0.2865	-0.092	-0.0829	-0.0466	0.2734	0.1623	0.3070	1.0000		
IR	0.1019	0.0897	0.1684	0.1348	-0.0193	-0.0382	0.0811	0.6352	1.0000	
INF	-0.2160	0.0127	0.1012	-0.1428	0.0287	0.0052	-0.210	0.1262	0.0630	1.0000

Source:-Author's Estimation

Optimal Order of Lag:

The optimal number of lags is important for appropriateness of the model and determines the statistically significance level of explanatory variables and the forecasts. Table 20 gives alternative techniques of Akaike Information criterion (AIC); Schwarz Bayesian criterion (BIC), Hannan-Quinn criterion (HQC) and the log likelihood ratio (LR).

Table 20:-Selection of the Optimal Lag Length

lags	LR	p(LR)	AIC	BIC	HQC
1	50.64228		-0.813460	0.770059	-0.260769
2	68.99877	0.00003	-1.333265*	0.646134*	-0.642402*
3	73.30875	0.47307	-1.072708	1.302570	-0.243672
4	77.37432	0.52099	-0.798573	1.972585	0.168635

Source:-Author's estimates

The log likelihood ratio suggests the order of lag 2 as the probability of LR is small compared to the 5 percent level of significance. This is also confirmed by the AIC, BIC and HQC. Therefore, the paper uses an optimal lag length of 2 for testing stationarity of the time series and estimating the VARX model.

Unit Root Test:

All time series data must be stationary, meaning constant mean and variance over time, in the regression model. Otherwise, the regression result becomes spurious. The paper in this regard uses three alternative tests to detect whether there is stationarity in the time series. The ADF test assumes no structural beak in the time series. However, the Zivot-Andrews unit root test assumes one structural break whereas Clemente-Montanes-Reyes unit-root test accounts for two structural breaks in the time series. The latter two believes that structural break does have a permanent effect, not transitory effect, in the pattern of time series.

The ADF test

Table 21 gives the ADF test with order of lag 2. Optionally, the table presents the explanatory variables in terms of level, and growth rate. All the time series that expressed in terms of their growth rates keep consistency with the sectoral TFP growth rates in either option. However, openness and a proxy for an index of liberalization are naturally ratios so that the study considers them as they are in terms of ratio. Table 21 gives the ADF test for unit root.

Table 21:-Augmented Dickey-Fuller test for unit root

1% critical value -3.668		5% critical value -2.966		10% critical value -2.616
Option-1		**Option-2**		
Variables	Test Statistic with ADF	Variables	Test Statistic with ADF	
TFPGA	-2.860 (0.0501)**	TFPGA	-2.860	(0.0501)**
TFPGI	-3.214 (0.0192)*	TFPGI	-3.214	(0.0192)*
TFPGS	-3.942 (0.0017)*	TFPGS	-3.942	(0.0017)*
ARD	-1.644 (0.4603)	GARD	-3.295	(0.0151)*
IMC	5.250 (1.000)	GIMC	-3.539	(0.0070)*
PEP	0.082 (0.9648)	GPEP	-2.948	(0.0400)**
RNW	2.981 (1.000)	GRNW	-3.781	(0.0031)*
PRICE	-1.891 (0.3365)	INF	-2.079	(0.2532)
OPP	-0.895 (0.7896)	OPP	-0.895	(0.7896)
LR	-1.648 (0.4583)	LR	-1.648	(0.4583)

Source:-Author's estimation

*N.B- Values in the bracket are the MacKinnon approximate p-values * denotes statistically significant at 5% level of significance and ** stands for statistically significance at 10% level of significance.*

The option-1 points out that only sectoral TFP growth rates are stationary while all other time series are not. The option-2, on the other hand, shows that all variables expressed in terms of growth rate (sectoral TFP growths, agricultural R&D, imported capital goods, pupil enrolled in primary school and road network) are stationary while the two ratio variables and inflation rate are still not stationary. However, the most empirical evidences that exhibit stationarity for ratio time series provide a suspect of the existence of structural break that affects the pattern of time series of the two variables. Besides, the unparalleled political economic shifts in Ethiopia in 1970-2011 cause the economy to have a structural break that affects the pattern of time series, calling for Zivot-Andrews and Clemente-Montanes-Reyes unit-root test.

Zivot-Andrews unit root test for allowing for one break

Table 22 provides the Zivot-Andrews unit root test for all variables. Except inflation rate, all the variables explained by the growth rates are stationary at 5% level of significance. Inflation rate is non-stationary even in the case of one structural beak.

Both openness and liberalization index remain non-stationary despite one structural break. Note that variables with one structural break do not alter the stationarity decision for the ratio variables.

Table 22:-Zivot-Andrews unit root test for allowing for a break in intercept

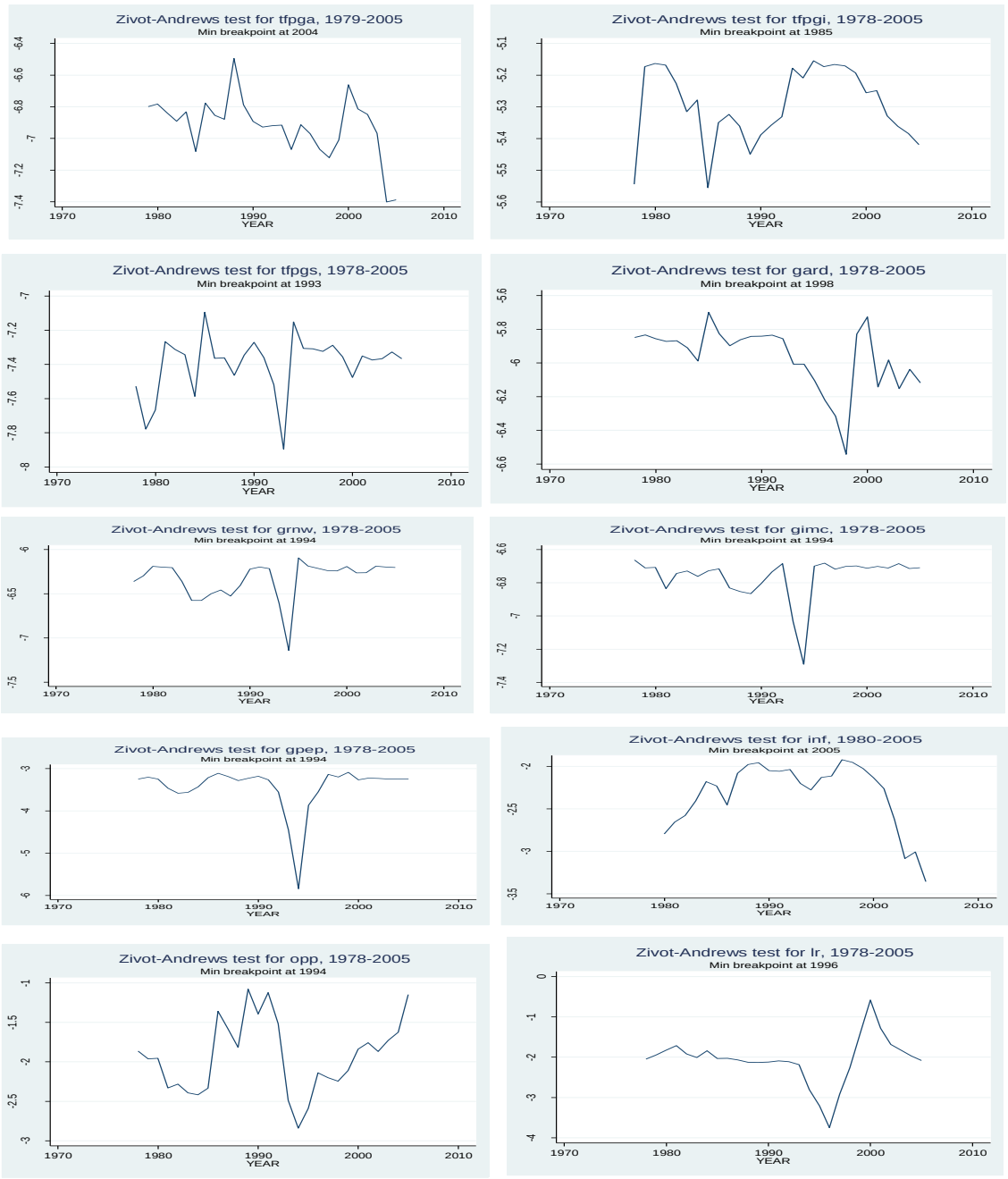
Variables	Break year	Minimum t-statistics	Critical Values	
			1% level of significance	5% level of significance
TFPGA	2004	-7.401*	-5.43	-4.80
TFPGI	1985	-5.555*	-5.43	-4.80
TFPGS	1993	-7.896*	-5.43	-4.80
GARD	1998	-6.543*	-5.43	-4.80
GIMC	1994	-7.290*	-5.43	-4.80
GPEP	1994	5.841*	-5.43	-4.80
GRNW	1994	-7.142*	-5.43	-4.80
INF	2005	-3.357	-5.43	-4.80
OPP	1994	-2.839	-5.43	-4.80
LR	1996	-3.751	-5.43	-4.80

Source:-Author's estimation

One of the interesting points in this test is that the year chosen for structural break for each variable is not uniform. Except the industrial TFP growth, all variables in the VARX model show the existence of endogenous structural break in the post-liberalization period (after 1992). Though the government committed to liberalize the economy in 1992, it does not fully liberalization the market so that some sectors of the economy remain as they were. Moreover, some of the variables do not respond out rightly to the structural adjustment policy and a series of economic policy reforms. For instance, the break year for the private credit per GDP is 1996 where the private banks were allowed to participate in the economy in 1996/97. Inflation rate has a structural break in 2005. This indicates that the trend in inflation rate from 1972-2004 almost similar. However, since 2005, the inflation rate does not behave as the previous period, possibly mainly due to the fact that the government successively runs extensive public expenditure and depletion of the foreign currency resource following election 2005

disputes and a paradigm shift towards state-led development program. The graphical presentation for the ZA test is as following.

Figure 14: Zivot-Andrews unit root test for allowing for a break in intercept



Source:-Author's estimation based on ZA unit root test

Clemente-Montanes-Reyes unit-root test for two breaks with AO and IO models

The ZA test points out that the inflation rate, openness, and index of liberalization are non-stationary in the existence of one structural break. This claims the CMR unit-root test that enables to examine the stationarity condition in the existence of two structural breaks in the time series for both additive outlier (AO) and innovation outlier (IO). Table 23 gives the details.

Table 23:- Clemente-Montanes-Reyes unit-root test with double mean shifts, AO and IO model

Variable	Additive Outlier (AO)		Innovational Outlier (IO)	
	Min t	Optimal Breakpoints	Min t	Optimal Breakpoints
INF	-8.195*	1979 & 2004	-6.269*	1978 & 2006
OPP	-3.681	1995 & 2001	-5.645*	1986 & 1991
LR	-6.807*	1976 & 1997	-3.372	1991 & 1994

Source: Author's Estimation

N.B:- Min.'t' is the minimum t-statistics calculated. 5% critical value for the two breaks; -5.490

The AO assumes a rapid structural break by which both inflation rate and liberalization index are stationary. However, openness is not stationary in the assumption of a rapid break in slope. Interestingly, it becomes stationary in the case of innovation outlier (IO) that considers a gradual structural break. This indicates that openness of the economy shows the existence of a gradual structural change than a rapid structural change.

Finally, all variables that are expressed in terms of growth rate and ratio are stationary when the study considers structural break using by ZA unit root test and its complement, the CMR unit root test. Note that there are cases where the VARX model with non-stationary data eliminates the stochastic part and produces stationary residuals and cointegration, yields consistent parameter estimates. The graphical presentation for the CMR test is as following.

Figure 15:-Clemente-Montanes-Reyes unit-root test with double mean shifts

Source:-Author's estimation based on the CMR unit root test

Regression Results and Analysis for VARX Model

At the optimal lag order of 2, the OLS estimates for the VARX system using the data 1972-2011 are presented below with three equations. The inclusion of addition information of exogenous variables in the VAR model contributes for a better trend predictability compared with the simple VAR model.

The first equation in the VAR system indicates there is a strong sectoral TFPs interaction of the industry and service with the agriculture at different lags. The lagged values of sectoral TFP growth are statistically significant at different lags for each sector, reflecting different lag structure matters differently for the sectoral impacts of agriculture TFP. Exceptionally, only the agricultural TFP growth and service TFP growth at lag 1 have a positive impact on the current period of agricultural TFP growth, mirroring the service sector as the leading consumer of the agricultural products and thereby creates a massive demand for the sector. Thus, the higher growth of service TFP stimulates agriculture to enhance productivity.

Table 24: Equation for the agricultural TFP with Heteroskedasticity-robust standard errors

Variables	coefficient	std. error	t-ratio	p-value
const	-0.0391166	0.0277652	-1.409	0.1717
tfpga_1	0.226065	0.130303	1.735	0.0956 *
tfpga_2	-0.426641	0.145727	-2.928	0.0074 ***
tfpgi_1	0.0223727	0.0251977	0.8879	0.3834
tfpgi_2	-0.0513581	0.0184041	-2.791	0.0101 **
tfpgs_1	0.133646	0.0505163	2.646	0.0142 **
tfpgs_2	-0.0376304	0.0425246	-0.8849	0.3850
gard	-0.0768301	0.0287418	-2.673	0.0133 **
grnw	-0.174601	0.261843	-0.6668	0.5113
gimc	0.0392750	0.0215664	1.821	0.0811 *
gpep	-0.00730330	0.0909797	-0.08027	0.9367
inf	-0.00114779	0.00101903	-1.126	0.2712
opp	0.00336982	0.00151023	2.231	0.0353 **
lr	-0.00238199	0.00273760	-0.8701	0.3929

Source: Author's estimates

Looking at the lags, all sectoral TFP growths have positive impacts at lag-1 and negative impacts at lag-2 on the current period agricultural TFP growth. Such inconsistent relationships reveal the existence of erratic TFP growth rates across sectors and overtimes, leaving the envisaged sustainable economic growth with an inherent challenge. Apart from sectoral TFP growths, the other statistically significant explanatory variables are government expenditure on agricultural R&D, imported capital goods and openness of the economy. As can be seen from Table 24, the growth rate of government expenditure on R&D is statistically significant and has a negative impact on agricultural TFP growth. This does not mean that R&D, which is a proxy for technological innovation, adversely affects the agricultural TFP growth. It rather means that the government might not able to utilize this public resource efficiently and productively for R&D activities due to many factors. Among other factors, the existence of low investment in agricultural R&D along with negative growth rates in above one-third of the study period causes a negative implication for sectoral TFP. Except in the case of industry, the correlation statistics also point at the existence of a negative correlation between the growth rate of agricultural R&D and TFP growth in agricultural and service sectors. Unlike developed economies, the payoffs from the agricultural R&D are negligible are constrained by the lack of sound intellectual property rights, low human capital development, and the inexistence of a strong link between research outputs and practical activities.

Openness to international trade, on the other hand, positively influences the agricultural TFP growth. This implies that it allows the economy to acquire advanced technologies and intermediate capital that scale up the production capacity efficiently. It also exposes the economy to the intensively competitive and sizable market that sharpens the exported agricultural products to fit with international standard. Thus, such wide opportunity for acquisition and exposition causes the agricultural TFP to grow more and positively influence the growth rate of the sector, creating a fertile ground for agricultural technology transfer from abroad. Understanding the structure of trade and GDP in the study period, agricultural products account for the lion’s share in the export market so that widening the agriculture sector to the international market provides an opportunity of increasing the sector TFP growth. The importation of capital goods including fertilizers, agricultural machineries, chemicals, and other technologies puts on

positive influences on the agricultural TFP growth, reflecting technology transfer through importation of capital goods is a decisive factor that is responsible for structural change process via TFP. However, the low human capital development negatively affects the TFP growth and technology diffusion. In a nutshell, the expenditure on agricultural R&D for technology innovation cannot be an alternative way for enhancing the TFP as R&D requires immense and expensive investment so that the country is unable to do so. Rather, technology transfer from abroad in terms of importation of capital goods has a positive implication for TFP growth. This shed some light that technology transfer is preferable as compared to technology innovation. This is mainly attributed to the lower unit cost of technology in the case of technology transfer comparing with innovation.

The second equation in the VAR system explains the determinants of industrial TFP growth (Table 25). Very few of the explanatory variables are non-random ration outcomes. It is only the growth rate of imported capital goods which has a strong relationship with the industrial TFP growth. This means that technology transfer in terms of capital goods is the chief source of industrial TFP growth, instead of technological innovation proxied by R&D. Most of the manufacturing industries in Ethiopia require a surge of advanced imported technologies of machineries, metals and the like.

Unlike the first equation, agricultural and service TFPs are not statistically significant, attributing to the existence of poor performance and scanty share of manufacturing in GDP. Note that the share of manufacturing accounted for only nearly 4.5 percent of GDP in the study period. This also reflects the fact that the industry cannot be the power house and driver of innovation, allowing the share of agriculture in GDP to reduce while that of the services increases.

Table 25:- Equation for the industrial TFP with Heteroskedasticity-robust standard errors

Variables	coefficient	std. error	t-ratio	p-value
const	-0.185540	0.233255	-0.7954	0.4342
TFPGA_1	-0.609601	0.728661	-0.8366	0.4111
TFPGA_2	-0.112920	0.950747	-0.1188	0.9064
TFPGI_1	0.141439	0.250223	0.5653	0.5771
TFPGI_2	-0.161042	0.200483	-0.8033	0.4297
TFPGS_1	0.0327591	0.323906	0.1011	0.9203
TFPGS_2	0.301932	0.274486	1.100	0.2822
GARD	-0.0511189	0.172789	-0.2958	0.7699
GRNW	1.42159	3.28087	0.4333	0.6687
GIMC	0.535041	0.258871	2.067	0.0497 **
GPEP	-0.189120	0.803942	-0.2352	0.8160
INF	0.000256301	0.00582208	0.04402	0.9653
OPP	-0.0202679	0.0210487	-0.9629	0.3452
IR	0.0373625	0.0309338	1.208	0.2389

Source: Author's estimation

Most R&D activities and technology creation occur in the developed countries. Only that marginal share of these activities belongs to developing countries. Therefore, most of the poor countries like Ethiopian opt to import and diffuse technology in terms of capital goods towards the industrial sector. This benefit is generated from the R&D activities in the developed countries and then spread to the domestic economy of Ethiopia through imports of capital goods. This improves the existing manufacturing techniques and develops advanced products that enhance economic growth.

Equation 3 in the VAR system explains about the determinants of service TFP growth (Table 26). In sectoral interactions, there are no lagged values of sectoral TFP growth that are statistically significant in the model. However, the TFP growths for both industry and agriculture have positive impacts at lag 2 and negative impact at lag 1. Besides, the lagged values of service TFP have a negative relationship with the current growth rate of service TFP.

Table 26: -Equation for service TFP with Heteroskedasticity-robust standard errors

Variables	coefficient	std. error	t-ratio	p-value
const	-0.0531573	0.128952	-0.4122	0.6838
TFPGA_1	-0.0928793	0.375716	-0.2472	0.8069
TFPGA_2	0.368335	0.356431	1.033	0.3117
TFPGI_1	-0.0190266	0.0574678	-0.3311	0.7435
TFPGI_2	0.0146389	0.0668758	0.2189	0.8286
TFPGS_1	-0.264068	0.193095	-1.368	0.1841
TFPGS_2	-0.241372	0.167465	-1.441	0.1624
GARD	-0.305120	0.0725031	-4.208	0.0003 ***
GRNW	0.202089	0.492782	0.4101	0.6854
GIMC	0.0761891	0.0911215	0.8361	0.4113
GPEP	-0.351061	0.428494	-0.8193	0.4207
INF	0.000344785	0.00340992	0.1011	0.9203
OPP	-0.0167168	0.00621506	-2.690	0.0128 **
IR	0.0349581	0.0138799	2.519	0.0189 **

Source:-Author's estimation

Apart from such sectoral interactions, the growth rate of expenditure on agricultural R&D, and openness are statistically significant and have a negative implication on the service TFP growth rate. An inefficient utilization of public resource that channeled towards R&D causes the negative relationship. The correlation statistics test also confirmed such a relationship. However, the causative factors that are responsible for the negativity of openness on service TFP growth may be attributed to the lack of ability to absorb the technology spillovers and externalities derived from openness due to the country's technological and institutional incapability in the service sectors. The negative impact of openness might also attribute to its transitory impacts, instead of permanent impacts as shown in several developing countries and technological and institutional incapability of the sector to utilize and reap the benefits derived from openness. In addition, the nature of the services sector is dominated by the hotel and restaurant, domestic trade and the like. This means that the service in Ethiopia characterized by the traditional activities, much away from technology and ICT. This service composition does not allow the sector to generate a positive relationship between openness and service TFP growth in the study period.

An index that measures the extent of liberalization in the service trade is statistically significant and has a positive relationship with the service TFP growth. When the service trade was liberalized by increasing the participation of private investors, it surges up the TFP growth in the service sector. Therefore, the service TFP growth requires lesser service trade restriction and regulation for both domestic and foreign investment. In this regard, the financial development in general and private credit per GDP in particular is relevant for increasing the service TFP. The government, therefore, should attempt a series of economic policy reforms and structural adjustment program which allows the economy to be activated and creates a vibrant conducive investment environment. However, there are still many restrictions and regulations that retard the service sector. For instance, the government policy does not allow foreigners to invest in the financial sector even though the government launched liberalization and structural adjustment program since 1991.

Taking a positive relationship between service TFP growth and index of liberalization in terms of private credit, the service sector has untapped potential of increasing the service TFP by liberalizing the service trade more. To recapitulate, the statistically significant determinants of the sectoral TFP vary from sector to sector. Widening the openness of the economy, increasing imported capital goods, and liberalization are the crucial determinants of the sectoral TFP growth in the agriculture, industry and services, respectively. Besides, the impact of technology transfer is preferable comparing with the technology innovation, mainly due to the fact associated with innovation like inefficiency and expensiveness.

Diagnostic Test

No research can conclude the results of regression analysis without considering a range of diagnostic tests for heteroskedasticity, autocorrelation, normality, goodness-to-fit and the like. The diagnostic tests assist to detect the inadequacy of the model and identify the strengths and weakness of the model. They also reduce the probability of wrongly rejecting or accepting the null hypothesis. In general, the diagnostic tests minimize the drawbacks by indicating problems associated with it. Table 27 gives the summary of the diagnostic tests.

VAR system, lag order 2, OLS estimates, observations 1974-2011 (T = 38)
Determinant of the covariance matrix = 7.552551e-006; Log-likelihood = 62.319886

Table 27:-Summary of Diagnostic Tests

Particular	Assumptions	Tests	Distribution & Values	Remarks
For the VAR as a whole	Normality	Jarque-Bera test	Chi-square=16.834 (0.00991)	Reject Ho
	Normality	Doornik-Hansen test	Chi-square(6) = 27.588 [0.0001]	Reject Ho
	Goodness to fit	Likelihood ratio test	Chi-square(9) = 26.4502 [0.0017]	Reject Ho
	Autocorrelation	Portmanteau test	LB(9) = 80.7407 [0.0654]	Accept Ho
For Agricultural TFPG equation	Goodness to fit	F-test	R-squared 0.693306 ; Adjusted R-squared 0.527181 F(13, 24) .053240 ; P-value(F) 0.001489	Reject Ho
	Normality	Jarque-Bera test	chi2 = 5.085 (0.07866)	Accept Ho
	Autocorrelation	Durbin-Watson test	rho -0.035449 Durbin-Watson 2.055865	Accept Ho
For industry TFPG equation	Goodness to fit	F-test	R-squared 0.320062 Adjusted R-squared -0.048238 F(13, 24) .877320 P-value(F) 0.584948	Accept Ho
	Normality	Jarque-Bera test	chi2 = 10.327 (0.00572)	Reject Ho
	Autocorrelation	Durbin-Watson test	rho -0.044372 Durbin-Watson 1.988101	Accept Ho
For Service TFPG growth	Goodness to fit	F-test	R-squared 0.621293 Adjusted R-squared 0.416160 F(13, 24) .261640 P-value(F) 0.000058	Reject Ho
	Normality	Jarque-Bera test	chi2 = 6.281 (0.04327)	Reject Ho
	Autocorrelation	Durbin-Watson test	rho -0.088418 Durbin-Watson 2.131882	Accept Ho

Source:-Author's Estimation

N.B:- The null hypothesis (Ho) for testing the autocorrelation is that there is no autocorrelation while the null hypothesis (Ho) for normality test is that the time series is normal. The null hypothesis for F test states that the coefficients of all the explanatory variables are equal to zero. Besides, when the Durbin-Watson test tends to approach 2, it indicates that there is no autocorrelation. Otherwise, error terms are serially correlated negatively or positively.

For testing the goodness-of-fit, the Likelihood ratio test indicates that all explanatory variables jointly explain the VARX model as a whole. In other words, all the explanatory variables are jointly statistically significant in explaining the VARX model. The F-tests generated for each agricultural TFP equation and service TFP equation also point out that the dependent variables are jointly explained by the independent variables and the model is a good fit. However, the F-test for the industry TFP equation in the system does not show joint statistical significance. This does not lead to rejection of the VARX model. Rather, it calls for the Granger causality test in order to identify the causality relationship for forecasting.

The table also presents the diagnostic results of Portmanteau test and Durbin-Watson in order to check the existence of autocorrelation. The Portmanteau test on the basis of Ljung–Box test indicates that there is no serial residual correlation in the VARX model as whole at 10% level of significance. The Durbin-Watson test for each question tends to approach 2, indicating the inexistence of serial residual autocorrelation in each equation. Both the Jarque-Bera test and the Doornik-Hansen test confirm that the residuals in the system of VARX are not distributed normally. The Jarque-Bera test for each equation confirms that the error terms in equation of industry and service normally distributed when testing at 5% level of significance. However, it is not normally distributed in the equation of agricultural TFP. This abnormality problem does not affect the property of BLUE and consistency. Nonetheless, it is mainly important to put on hypothesis about population parameters (Enders, 1995). Note that the VARX model considers heteroskedasticity-robust standard errors so that the model is free from the problems associated with heteroskedasticity. In a nutshell, the VARX model and the equations in the system satisfy the OLS assumptions.

Granger causality Test

Testing the Granger causality for the sectoral TFP growths using Wald test indicates that the agricultural TFP growth equation shows some causality relationship among sectors. It rejects the null hypothesis that industry TFP growth and/or service TFP growth, jointly and separately, does not cause agricultural TFP growth. In short, both industry and services TFP Granger cause agricultural TFP growth. However, no sectoral TFP growth

causes the industrial TFP growth and services TFP growth. This also indicates the poor sectoral economic performance and weak sectoral linkages with industry and service in terms of TFP growth (Table 25).

Table 28:-Granger causality Wald tests Results

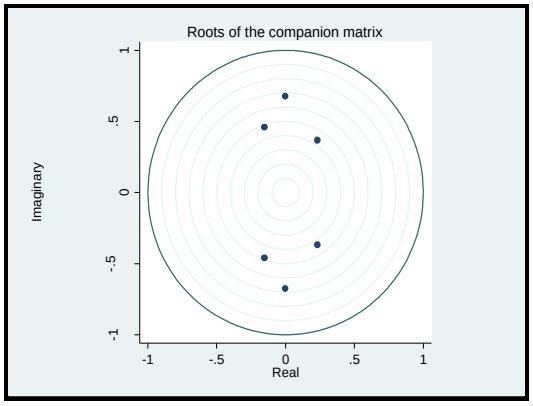
Equation	Excluded	chi2	df	Prob > chi2
TFPGA	TFPGI	10.654	2	0.005
TFPGA	TFPGS	21.687	2	0.000
TFPGA	ALL	32.374	4	0.000
TFPGI	TFPGA	0.46914	2	0.791
TFPGI	TFPGS	0.76883	2	0.681
TFPGI	ALL	1.0382	4	0.904
TFPGS	TFPGA	2.4435	2	0.295
TFPGS	TFPGI	0.23377	2	0.890
TFPGS	ALL	2.8896	4	0.574

Source:-Author's estimation

Stability Condition of the VARX Model and Analysis of One-Time Shock

The requirement of satisfying the stability condition of the VARX model points out that the unit roots or the solutions of the VARX system are below one, or all the Eigen values lie inside the unit circle, which is the necessary and sufficient condition for stability. Otherwise, the impact of the impulse (shock) in some variables might not decrease with time. A crucial condition for the VAR model to be valid and consistent requires the covariance to be stationary in order to avoid the formation of explosive roots. This confirms that the VARX model the study uses satisfy the stability condition and can be used for forecasting. Graphically, the result confirms the stationarity of VARX as all characteristic roots lie inside the unit circle.

Figure 16:- Stability Test for VARX



Source: Author's estimation

Table 29:-Eigen value stability

Eigen value	Modulus
-.00205458 + .6758683i	.675871
-.00205458 - .6758683i	.675871
-.15411940 + .4591577i	.484333
-.15411940 - .4591577i	.484333
.23281170 + .367998i	.435458
.2328117 - .367998i	.435458

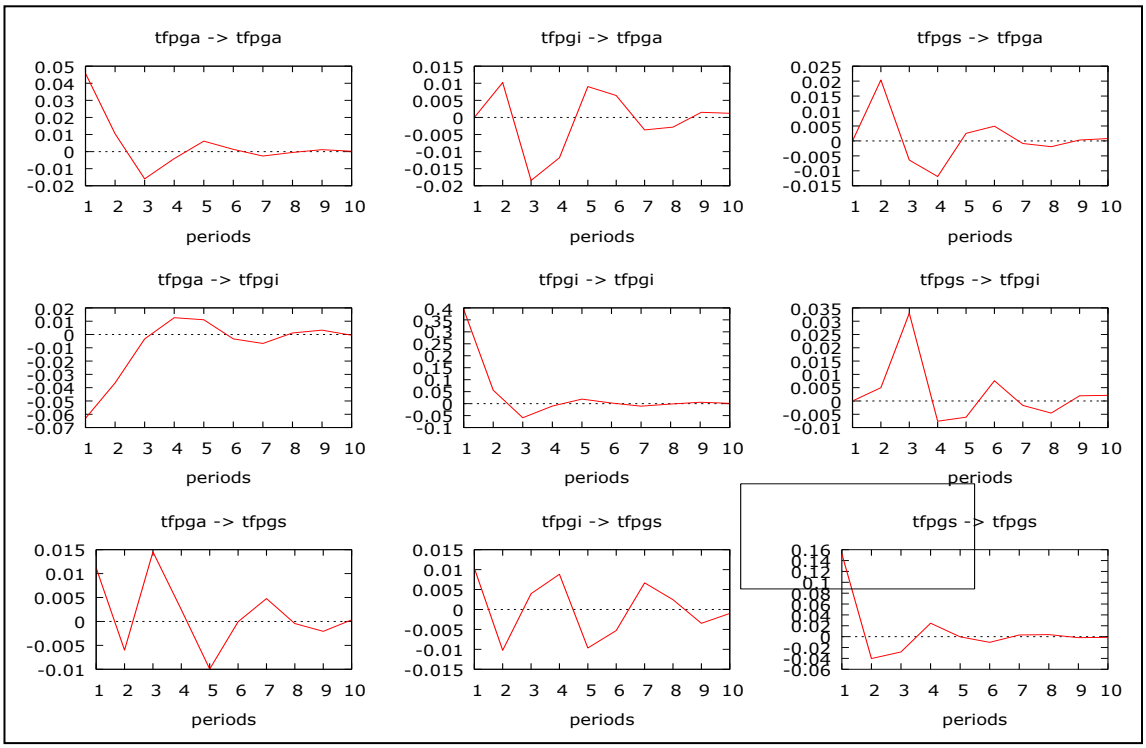
Source: Author's estimation

N.B: - For a characteristic equation of the type, $a\lambda^2 + b\lambda + c = 0$, $\lambda_1, \lambda_2 = \frac{-b}{2a} \pm \frac{i\sqrt{b^2 - 4ac}}{2a} = \alpha \pm \beta i$; Real roots: $\lambda_1, \lambda_2 = \alpha \pm \beta$ Imaginary roots: $\lambda_1, \lambda_2 = \alpha \pm \beta i$ where $i = \sqrt{-1}$. In general case, the modulus of a complex number, a + bi is $\sqrt{a^2 + b^2}$. The stability of the VAR model requires the moduli of the Eigen values to lie within the unit circle. Otherwise, the system is not stationary. Rather it is explosive or non-convergent.

As the VARX model is stable, the next issues the paper discuses are the impulse response functions and variance decomposition in response to a one-time shock in the system. The Impulse Response Function refers to the dynamic interactions among endogenous variables of sectoral TFP growths and traces the effect of a one-time shock on current and future values of the endogenous variables. It sheds light for empirical causal analysis and policy effectiveness. Figure 17 shows the impulse response functions in the 10 forecasting periods and indicates how the sectoral TFP growths responded to a change in the other variables. As can be seen from the figure 17, all the responses in each equation are high at the initial period and the shock then dies through time and then tends towards zero at the end of 10 years. Each row of the graph indicates the response of sectoral TFP growths in one sector over time to a positive shock emanated from the TFP growths of the other two sectors.

All shocks create an explosive time path at the initial period and then converge to zero after some time, dying through time. This confirms that the VAR system is stable. Note that an unstable system would produce an explosive and divergent time path.

Figure 17:-Impulse Response Function for Sectoral TFP growths



Source:-Author's estimation

N.B: - tfpga , tfpgi and tfpgs stands for TFP growth rate in the agriculture, industry and services sectors.

Variance Decomposition refers to the separation of the variation in an endogenous variable into the component shocks during the forecast period. It also provides information about the contribution or the share of each sectoral TFP growths to the variation of the endogenous variables in each equation. Accordingly, 65 percent of the error variance of agricultural TFP growth in the agricultural TFP equation is explained by own shock while the remaining 35 percent is explained by the shocks on industrial TFP growth (26 percent) and the service TFP growth (9 percent). However, the equations of industrial and services TFP growths are heavily explained by own shocks:

94 percent and 89 percent respectively. This reflects both industry and services are relatively weak in sectoral linkage (Table 20).

Table 30:-Variance Decomposition for Sectoral TFP growths

Decomposition of variance for Agricultural TFP growth rate				
period	std. error	TFPGA	TFPGI	TFPGS
1	0.0457416	100.0000	0.0000	0.0000
2	0.0521541	80.9157	3.8276	15.2568
3	0.0579284	73.1779	13.2353	13.5868
4	0.0604446	67.6702	15.9725	16.3574
5	0.0614732	66.4156	17.6001	15.9844
6	0.0620158	65.3027	18.3595	16.3378
7	0.0621838	65.1243	18.6064	16.2692
8	0.0622799	64.9297	18.7561	16.3142
9	0.0623091	64.9018	18.7969	16.3013
10	0.0623262	64.8674	18.8245	16.3081
Decomposition of variance for Industrial TFP growth rate				
period	std. error	TFPGA	TFPGI	TFPGS
1	0.39917	2.4942	97.5058	0.0000
2	0.404765	3.2360	96.7488	0.0152
3	0.41038	3.1546	96.1842	0.6611
4	0.410772	3.2429	96.0629	0.6942
5	0.411397	3.3057	95.9802	0.7141
6	0.411489	3.3107	95.9414	0.7480
7	0.411686	3.3344	95.9167	0.7489
8	0.411717	3.3346	95.9043	0.7610
9	0.411774	3.3400	95.8969	0.7631
10	0.411781	3.3401	95.8943	0.7657
Decomposition of variance for Service TFP growth rate				
period	std. error	TFPGA	TFPGI	TFPGS
1	0.153188	0.5324	0.4577	99.0099
2	0.158831	0.6379	0.8411	98.5210
3	0.162009	1.4183	0.8681	97.7136
4	0.164136	1.4043	1.1358	97.4599
5	0.164721	1.7589	1.4712	96.7699
6	0.165138	1.7500	1.5660	96.6840
7	0.165372	1.8286	1.7249	96.4465
8	0.165433	1.8279	1.7455	96.4266
9	0.165492	1.8422	1.7881	96.3697
10	0.1655	1.8424	1.7916	96.3660

Source:-Author's estimation

5.2 Simulation Results and Analysis of Growth Options

Using the statistically significant determinants of the sectoral TFP growths, the dynamic CGE model calibrates the induced TFP growth for agriculture, industry and services. The study is interested in using openness, imported capital goods and service liberalization in order to induce the sectoral TFP growth for the agriculture, industry, and services respectively. Here, there are two things considered for calibration.

1. CGE model considers the TFP as an exogenous parameter so that the study sets the sectoral TFP growth rates based on two sources of facts- experiences from similar countries that joined the middle-income country status, and actual performance of the Ethiopian economy in 1970-2011.
2. Using the estimates of sectoral TFP growths, the study is interested in linking this estimate with statistically significant explanatory variables from the determinants of sectoral TFP growth, through their respective coefficients derived in the above VARX mode. The outcomes are stated below.

In this regard, the agricultural TFP is assumed to grow by 2.6 percent based on the experience[8] of comparators and the estimate of agricultural TFP in 2001-2011 in Ethiopia. In order to calibrate the induced agricultural TFP growth, the study calls the coefficient that shows the relationship between openness and the agricultural TFP growth. As a matter of interest and its strong statistically level of significance, the study accounts for ***openness induced TFP growth*** by linking openness and agricultural TFP growth through the coefficient presented in equation 1 of the VAR model. In order to have the agricultural TFP growth of 0.026, the required level of openness must have an increment of 7.7 in terms of ratio. In other word, an increase of 7.7 in openness ratio translates to 0.026 agricultural TFP growth rate.

[8] WB (2011) report states that experiences from Malaysia and Vietnam show growth in agricultural TFP estimated about 3 percent while it is approximately 1.5 percent in Thailand and Indonesia in 1991-2006. Agriculture in Ethiopia shows an average growth rate of 3.2 percent in 2001-2011, which is calculated, based on the data declared by the government. However, it is estimated below this by considering the WB projection. Moreover, the agricultural TFP growth rate in 2001-2011is characterized by a wide range of performance, ranging from negative 13 percent to 7.5 percent. Considering these experiences, the study is therefore using 2.6 percent TFP growth for high scenario and 2.2 percent for low scenario.

On the same manner, the industrial TFP is also assumed to grow by 3.0 percent by considering similar comparators' experience[9] and estimates of sectoral TFP in Ethiopia in 1972-2011. Again as a matter of interest and its strong statistically level of significance, the **imported capital good induced TFP growth** rate of 3 percent in industry requires an increase of 5.6 percent in the importation of capital goods given the elasticity coefficient as presented in equation 2 in the VARX model. In other word, a growth rate of 5.6 percent in imported capital goods causes the TFP in the industry to grow by 3 percent. The services TFP is also assumed to grow by 2 percent due to the same reasons mentioned[10] earlier for the other sectoral TFP. The study is also interested in ***service liberalization induced TFP growth*** in service. Given the coefficient estimated in equation 3 of VAR model, the service TFP growth rate of 0.02 requires a service liberalization index[11] of 0.57.

[9] The research paper by Mulu G (2005) on manufacturing productivity in Ethiopia, the growth of TFP is estimated to be 2.5 percent on average in 1996-2003 using a dynamic panel model of GMM. Experience from China also indicates that the TFP growth in 1993-2005 amounted to 3.18 in the industrial sector and 2.4 percent for manufacturing industry (Selin, 2007 and Azam A., 2009). However, this study shows that the average growth rate of industrial TFP is estimated around negative 11.7 percent in 1972-2011 using growth accounting approach. It ranges from negative 96 percent to 64 percent. In the last four years, it shows a consistent improvement with an average growth rate of 15 percent. Therefore, the study then uses a 3 percent and 2.5 percent TFP growth for the high and low simulation scenarios respectively.

[10] A research paper conducted by Idris J.(2011) indicates that the TFP growth of the services sector in Malaysia for the period 1999-2008 was 1.3 percent per annum. Bosworth, Collins and Virmani (2007) also conducted a research about sectoral growth accounting in India and shows that service sector TFP growth is much higher than measured TFP growth in agriculture and industry for the period 1980- 2004 and the estimates of TFP growth rates in service is 2.9 percent. Using growth accounting approach, this study estimates negative 3.7 percent growth rate of service TFP in 1972-2011, on average. It ranges from negative 20 percent to 16 percent in the last ten years. The study therefore uses 2.0 growths of TFP in the service sector for high scenario, and 1.3 percent for lower scenario respectively.

[11] Bank credit to private sector per GDP considered as a proxy variable for service liberalization. A requirement of 57 percent ratio for securing 2 percent change in service TFP growth can be supported by the experience from comparators. For instance, the average private credit per GDP is around 40 percent in lower middle income countries while is nearly 75 percent in middle income group in 2011. In this regard, it accounts for 58 percent in Sub-Saharan African countries. In particular, the private credit per GDP accounts for 61 percent in Brazil, 127 percent in China, 50 percent in India, 112 percent Malaysia, 140 percent in Thailand, and 76 percent in Tunisia (WB, 2011).

In summary, the study examines the **induced sectoral TFP growths** on economy wide and structural change process in Ethiopia. Note that the induced sectoral TFP means openness induced to agriculture, imported capital good induced TFP to industry, and liberalization index induced TFP to service.

Shocking the dynamic CGE model by the induced sectoral TFP growths, the model falls out of equilibrium and requires a new equilibrium. The difference in the values of the variables between the old and the new equilibrium is the impact of an exogenous shock of the induced sectoral TFP. The study in this regard considers two scenarios: The high scenario assumes a TFP growth rate of 2.6 percent in the agriculture, 3.0 percent in the industry and 2.0 percent in services. In the low or sensitive scenario, the TFP growth for the agriculture, industry and service expected to grow by 2.2 percent, 2.5 percent and 1.3 percent respectively. The study focuses on the two extreme scenarios. The average of the two extremes is not presented here in order to manage the size of the paper. Besides, the two extreme scenarios produce similar outcomes in the face of policy prescriptions.

The assumptions regarding factor accumulations[12] are the same across the scenarios. Population is expected to grow by 2.4 percent with rural population growth rate of 1.8 percent and urban population growth rate of 4 percent. The cultivated land and labour are also expected to grow by 3.1 percent and 2.4 percent respectively. Capital is also projected to grow by 11.5 percent with depreciation rate of 5 percent. Note that the base-run scenario presents the performance of the economy if the economy keeps growing with the current growth path, without a shock. It considers only the growth dynamism of factors of production as the CGE model undertakes. This enables us to consider factor accumulation as one of the sources of growth. The simulation scenario, on the other hand, examines about the shocks in the sectoral TFP growth, giving an opportunity to know the effects of the second sources of growth, i.e. TFP, on the basis of base-run scenario. Hence, the study considers both source of economic growth- factor accumulation and factor productivity- so that it is possible to say the study examines the

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[12] The assumptions about factors of production are projected on the basis of the past economic performance reported by the concerned office in Ethiopia and some development partners (NBE, 2011; IMF 2011and WB 2011).

effects of various options of sectoral growths on sustainable growth and economic transformation process. With this understanding and the aforementioned assumptions and calibration, we present the effects of sector-specific TFP growth and the effects of broad-based TFP growth in the next sub-sections.

5.2.1 Analysis of Sector-Specific TFP Growth Options

The sector-specific induced TFP growth options refer to enhancing the sectoral TFP growth in the agriculture, industry, and service induced by openness, imported capital goods and service, and liberalization index, respectively. Each of the distinct sector-specific TFP growths exhibit different economy wide implications on macro and sectoral economic performances. The resultant effects depend on the actual performance of the economy in the base year as well as the structural and institutional nature of the economy. The dynamic CGE model simulation results presented below provide the economy wide effects of different simulation scenarios.

Impacts on Macroeconomic Indicators:

Table 31 shows the implications of the distinct sectoral TFP growth rates on the selected macroeconomic indicators of both demand and supply side of the economy. Domestic absorption in this regard includes demands for private consumption, government consumption and investment. Adding export demand, it gives total demand for domestically produced goods and services. The final total demand is a summation of the demand for domestically produced goods and service, and the demand for importation of goods and service from trading partners.

Table 31:-Impacts of Sector-Specific Induced TFP Growth Options on Macro Economy

Macro economy indicators	Initial Value	Base-Run Scenario	Sector Specific Induced TFP Growth Options		
			TFP-Agri.	TFP-Industry	TFP-Service
GDP at factor cost (in Billion)	122.2	409.78	460.08	428.36	502.28
Domestic Absorption	162.56	358.42	409.93	371.03	405.30
Total Private Consumption Demand	114.75	310.54	362.05	323.15	357.40
Government Consumption Demand	15.91	15.91	15.91	15.91	15.91
Gross Capital Formation	31.89	31.97	31.97	31.97	31.99
Export Demand	16.77	129.61	135.33	142.25	178.89
Total Demand for domestically produced	179.32	488.03	545.26	513.26	584.19
Import Demand	-47.00	-159.84	-165.56	-172.48	-209.12
Total Final Demand	132.32	329.19	379.70	340.80	375.07

Source:-Authors Simulation based on dynamic CGE model

N.B: - The initial value represents values in the SAM 2006. However, the base-run scenario presents the would-be economic performance in the simulation year of 2025 if the economy keeps growth with the current path. The simulation scenarios on the other hand explain the would-be economic performance when we shock the system by increasing the sectoral TFP growth in different forms. This explanation applies throughout the paper.

Comparing these results with the initial value in 2006, the base-run scenario projects the entire economy to grow by more than double, showing an improvement in the selected macroeconomic indicators. Note that the demand for investment is constant across all the scenarios including the base-run, due to the assumption set by the CGE. Compared against the base-run scenario, all induced sectoral TFP growths positively influence the demand side of macro economy. Enhancing liberalization induced service TFP growth enables the entire economy to grow more rapidly and stimulates the demand for international trade as compared to the other growth options. The intuition behind why the service TFP growth highly stimulates demand attributes to the nature of the service activities that determines the structure of the entire economy. As noted earlier, the service sector that accounts for the lion's share of GDP, growth, capital investment and

public expenditure is low productive and uses poor technology. Therefore, curing this problem by liberalizing the service trade boosts up the contribution of the service sector to macro economy. On top of this, the service sector is more of consumption sector as compared to agriculture and industry (more of the production sectors) so that it highly affects the demand.

Impacts on Economy Wide and Sectoral Growth Rates:

This section presents the effects of the induced sectoral TFP growth options on economy wide and sectoral growth rates. It also assesses the impacts on the per capita income in order to evaluate whether the country can join the middle-income country status. Table 32 gives the simulation results in this regard.

Table 32:-Impacts of sector-specific Induced TFP growth options on GDP

Indicators	Initial Values	Base-Run Scenario	Sector-Specific TFP growth Option		
			TFP-agri.	TFP-industry	TFP-service
Annual Growth Rate					
GDP	7.00	6.27	6.79	6.59	8.02
Agriculture	6.41	3.56	5.28	3.61	3.54
Industry	6.00	5.81	6.25	7.08	6.97
Manufacturing	5.40	4.56	5.15	6.90	4.42
Service	7.82	7.90	8.06	8.06	10.27
Sectoral Contribution to GDP growth rate					
Agriculture	3.00	1.08	1.93	1.05	1.08
Industry	0.82	0.86	0.86	1.22	0.97
Manufacturing	0.26	0.25	0.26	0.51	0.19
Service	3.17	3.63	3.56	3.69	4.30
Per Capita Income, in 2006 USD	294.51	599.01	701.86	624.20	692.61

Source:-Author's Estimation using dynamic CGE model

The base-run scenario indicates that the economy is expected to grow by 6.2 percent in 2025, showing a declining trend in the simulation period. Such declining projection is almost similar to the projection undertaken by the IMF in the medium term. This is

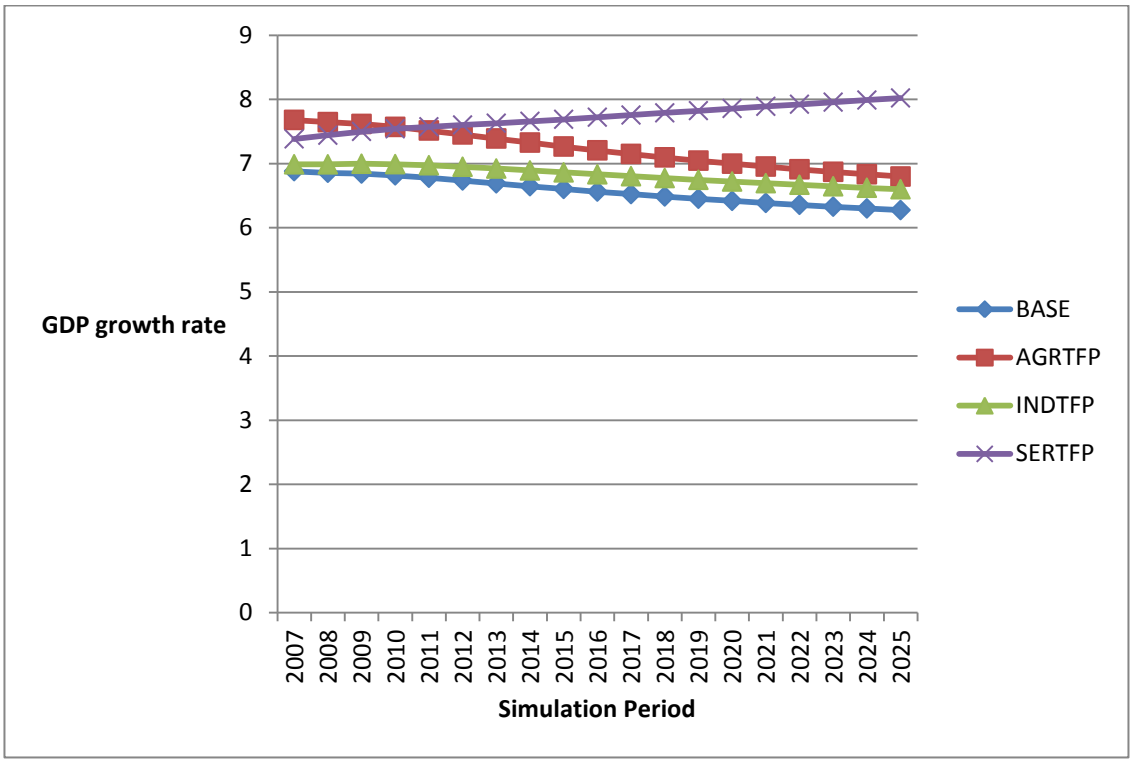
attributed to the dominance of services over the structure of the economy while it is poor in productivity and weak in sectoral linkage. Evidently, the contribution of services to the GDP growth rate of 6.2 percent is large and accounts for about 57 percent of GDP growth rate. This is likely leads to the problems of structural change burden- of which declining growth trend and poor productivity is a clear manifestation. As a result, it shows that the Ethiopian economy constantly tends to shift towards the service sector if the economy keeps going on the current path despite the government repeatedly announcing about the agricultural-led economy. Considering the population growth rate, the per capita income, as measured in the 2006 USD price, increases from USD 294 in 2006 to USD 599 in 2025. This tells that Ethiopia would not join the middle-income status by 2025 in the case of the base-run scenario.

Compared to the base-run scenario, all sector-specific TFP growths accelerate the growth rates of the economy and the contributions of each sector to GDP. Regarding growth rates, all sector-specific TFP growth options positively influence both economy wide and sectoral growth rates. It is also dominated by the service sector, followed by industry and then agriculture. Each distinct sectoral TFP growth option primarily favors the sector from which TFP is assumed to increase, and the benefits then spread to the other sectors. However, the growth option of increasing TFP in service negatively influences the growth rate of agriculture, and manufacturing. On the subject of sectoral contributions, all sector-specific TFP growth options positively influence the sectoral contribution to the GDP growth rate. Exceptionally, the increase in TFP in services and agriculture negatively affects the contribution of manufacturing and service to GDP growth rate, respectively. Each sector provides the highest contribution to GDP in its own respective growth option that focuses on itself. Given the projected population growth rate, all sector-specific TFP growth options positively affect the per capita income in which agricultural TFP takes the lead. However, none of them allow the country to cross the threshold of reaching the middle-income country status by 2025.

Figure 18 shows the possible evolution of GDP growth rate in response to change in sectoral TFP growths. Except the induced service TFP growth, all accelerating growth strategy of sector-specific TFP growths shows a negative trend of GDP growth overtime. This is due to the fact that the entire economy is heavily dominated by the service sector

in terms of growth rate, sectoral contribution to GDP growth rate and structure of the economy. The heaviness and significance of the existing performance of the service sector also emanated from factor accumulation (investment), not from enhancing sectoral TFP growth. In other words, it is hard to acquire sustainable economic growth with the increasing trend without increasing sectoral TFP growth. Therefore, the increase in service TFP enables the economy-wide growth to increase without the decreasing (Figure 18).

Figure 18:-Evolution of GDP growth rate in response to change in sectoral TFP growth



Source:-Author's simulation based on dynamic CGE model

Therefore, increasing the induced TFP in the service sector is paramount to curing the productivity problems associated the sector itself and reverse the declining growth path of the base-run scenario. This means that the government should redirect its attention from factor accumulation towards increasing productivity in services. Otherwise, the economy will decline overtime in Ethiopia.

Impacts on the Structure of the Economy:

In addition to the economy-wide growth effects, the sector-specific growth options have also their own repercussions on the structure of supply side and the demand side of the economy. The share of agriculture in GDP decreases to 29 percent in 2025 from 48 percent in 2006. The share of service concomitantly increases from 40 percent in 2006 to 55 percent in 2025. The share of industry in GDP, meanwhile, shows a marginal increase from in the base-run scenario. As the economy keeps with the current trend, the structure of the economy is shifted from agriculture-led into the service-led economy. Unlike the healthy economic transformation, this causes the structural change burden and raises questions about the sustainable economic growth path. In the simulation scenario of increasing the agricultural TFP growth, the openness induced agricultural TFP growth positively affects the share of agriculture in GDP and negatively affects the share of the industry and service overtime.

Table 33:-The Impacts of Sector-Specific TFP growth Options on Structure of GDP

Indicators	Initial Value	Base-Run Scenario	Impact of Alternative Sector Specific TFP Growth Options (%)		
			TFP-Agri.	TFP-Industry	TFP-Service
Agriculture	48.09	29.66	36.12	28.36	24.21
Cereal Crops	33.68	19.84	23.33	19.12	16.28
O/W- Non-Exportable	15.01	9.47	10.77	9.13	8.08
O/W- Exportable agriculture	8.41	4.81	5.84	4.65	3.72
Industry	11.49	14.80	13.73	17.31	13.89
Manufacturing	3.95	5.39	4.97	7.41	4.34
Other Industry	7.53	9.40	8.76	9.89	9.54
Service	40.41	55.53	50.14	54.31	61.88
Private Service	31.15	52.41	47.33	51.31	31.15
Public Service	9.25	3.12	2.80	2.99	2.64

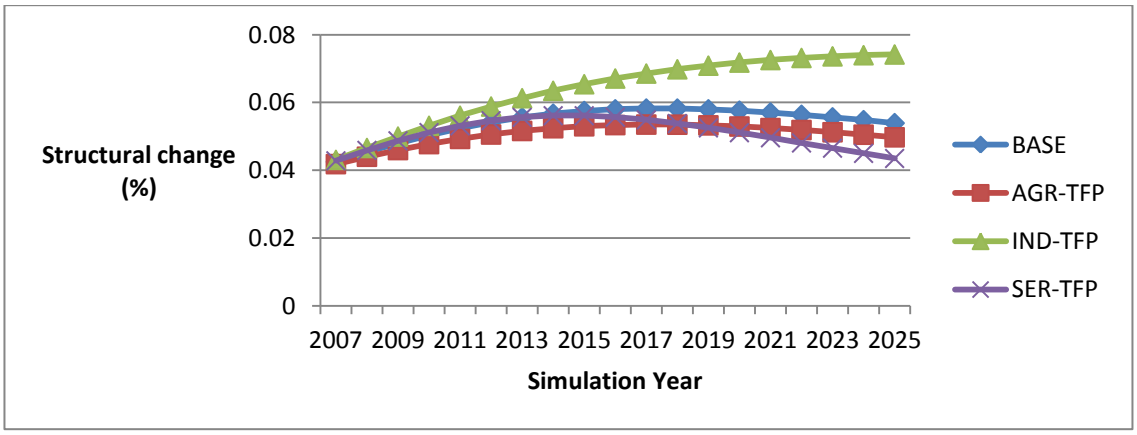
Source:-Authors estimation based dynamic CGE model Simulation

On the other hand, the industrial TFP growth strategy enables industry to have a larger share in GDP compared to the base-run scenario while the induced TFP in services

negatively influences the share from industry. Moreover, the structure of agriculture is highly dominated by cereal crops with which exportable agricultural items accounts for about 5 percent of GDP in the alternative simulation scenarios. The non-manufacturing sectors account for the higher share as compared to the share of manufacturing in the structure of the industry. However, the GDP share of manufacturing should have exceeded other sectoral shares in order to speed up the structural change process. The structure of the service sector is also heavily dominated by the private service sector as can be seen from the Table 23.

Looking at the figure 19, imported capital goods induced industrial TFP growth positively influences the structural change process of the country while increasing the liberalization induced service TFP erodes the structural change process of the economy. This gives a clue that the direct approach has better impact on the structural change process than the indirect (sectoral linkage) approach. In any cases, none of the induced TFP growth options causes full structural change by 2025. This is mainly attributed to the scanty share of manufacturing in GDP which causes weak sectoral linkage and looses multiple effects in order to create a vibrant economy. In the short run, both service TFP and agricultural TFP growths tend to show an increasing trend while their effect on the structural change becomes negative in the long run. However, accelerating growth in industrial TFP keeps positive influence in short- and long-run.

Figure 19:-Evolution of the structural change in a response to change in sectoral TFP



Source:-Author's simulation based on dynamic CGE model

Attention should be given to services as it has a dominant share in sectoral growth rates and in contribution to the economy wide growth rates. Increasing TFP in services, therefore, manages to reverse the declining trend of the growth path of the economy. However, it negatively influences the share of manufacturing in GDP and the structural change process even in the case of increasing TFP in services. The critical message from this finding is that the service sector has weak sectoral linkage with industrialization and is confined within the traditional service activities.

Pertaining to the structure of final demand (Table 34 below), demand for private consumption accounts for the largest share, followed by foreign trade demand. Although all TFP growth options positively influence the composition of demand, it is only the agricultural TFP growth strategy that negatively affects the share of demand for foreign trade. Besides, the demand for investment increases in the scenario of enhancing industrial TFP growth option.

Table 34:-The Impacts of Sector-Specific growth Options on Demand Structure

Structure of Total Final Demand (%)	Initial Value	Base-Run Scenario	Sector Specific TFP Growth Options		
			TFP-Agri.	TFP-Industry	TFP- Service
Total Private Consumption	86.72	94.62	95.35	94.82	95.29
Government Consumption	12.02	4.85	4.19	4.64	4.24
Gross Capital Formation	24.10	9.74	8.42	9.38	8.53
Export Demand	12.67	39.49	35.64	41.71	47.70
Import Demand	-35.52	-48.70	-43.60	-50.61	-55.75

Source:-Author's estimation based on dynamic CGE model simulation

To have a complete structural change process in the economy, there must be significant changes in the structure of demand with an increasing change in the share of importation of capital goods and capital formation. The firms then tend to use highly upgraded inputs in order to produce higher quality and competitive goods and services in the international market. A change in tests, preference and demand is the main character of structural change. However, this is not the case in Ethiopia as characterized by insignificant structural transformation.

Impacts on Factor Income and Institutional Income:

Factors of production receive their payment according to their contributions to GDP. All sector-specific TFP growth options positively influence the factor incomes. For the owner of capital, labour, and land, increasing the induced TFP in service sector generates the highest income growth rate across the alterative simulation scenarios. However, the livestock generates the highest percentage growth rate of income in the option of increasing the agricultural TFP growth option. Looking at the Table 35, the structure of factor income is dominated by labour income and then capital income across all growth scenarios. In the base-run scenario, 49 percent of the GDP at factor cost of 122.22 billion in 2006 goes to labour while capital receives 39 percent of the national income in the base-run scenario. All scenarios of growth options contribute to a marginal change in the structure of factor income as compared t. The experience of reference countries tells that there is a change in the structure of factor income, which tends to shift towards using capital intensive technology from labour intensive technology. This gives a wide opportunity to scale up productivity and reduce the unit cost from mass production. However, in the case of Ethiopian economy, it is the labour intensive technology that takes the leading contribution to GDP as labour is abundant resource.

Table 35:-The Impacts of Sector-Specific TFP growth Options on Factor Income

Factors	Initial	Base Scenario	Alternative sector-specific growth options		
			TFP-Agri.	TFP-Industry	TFP- Service
Both initial and base-run scenario are in billions					
Labour	60.29	230.71	13.81	6.00	16.33
Land	8.46	30.30	12.38	8.31	15.08
Livestock	5.47	14.06	20.22	2.26	10.75
Capital	47.99	174.29	7.87	3.76	22.93
Percentage share in total factor income in GDP (%)					
Labour	49.3	51.3	52.4	51.8	50.3
Land	6.9	6.7	6.8	6.9	6.5
Livestock	4.5	3.1	3.4	3.0	2.9
Capital	39.3	38.8	37.5	38.3	40.2

Source:-Author's estimation based on dynamic CGE model simulation

In addition to factor income, institutional income is also one of the indicators for economic performance and structure of the economy. Table 36 presents the response of the growth rate of income to the change in sectoral TFP growth. The base-run scenario indicates that 96 percent of the total institutional income goes to households[13]. Out of the total income to households in 2006, rural non-poor that accounted for 42 percent of the population takes 55 percent share in the total institutional income. However, 47 percent of the total population that is under the poverty line (rural and urban poor) accounts for 22 percent of total income.

Table 36: Impacts of Sector-Specific TFP growth Options on Institutional Income

Institutions	Initial Value (in billions)	Base Scenario (in billions)	Growth rate of institutional income under Alternative Sector Specific TFP growth Options (%)		
			AGRTFP	INDTFP	SERTFP
ENT	1.32	18.25	10.8	5.3	30.2
HHD	133.02	447.25	11.4	4.9	17.2
HHD-RURP	24.84	86.92	12.9	5.3	16.4
HHD-RURN	73.14	256.4	11.3	5.0	18.1
HHD-URBP	5.00	15.29	11.9	4.8	14.4
HHD-URBN	30.04	88.54	10.1	4.1	15.9

Source: Author's simulation based on Dynamic CGE model

Note that HHD stands for households, ENT denotes enterprises, HHD-RURP refers to rural poor households, HHD-RURN refers to rural non-poor households, HHD-URBP denotes urban poor households, and HHD-URBN stands for urban non- poor households. All sector-specific TFP growth options generate a positive growth rate of institutional income. Accelerating the service sector TFP growth strategy greatly enhances the income growth rate across all the institutions compared to other alternative scenarios. The accelerating agricultural TFP growth and then the industrial TFP growth

[13] Out of the total institutional income, households account for 96 percent while enterprises take only 4 percent as calculated on the basis of the base-scenario column of Table 36. The 96 percent of income forwarded to households is distributed to rural poor (19 percent), rural non-poor (55 percent), urban poor (3 percent), and urban non-poor (19 percent).

options take subsequent positions. This is partly attributed to fact that the more liberalized the services, the higher the growth of income for households and firms. As the service sector is more of consumption and demand creator, it can also be interpreted as the demand-pulling factor that relatively intensifies the income growth rate compared to the supply-push factor (production sector-agriculture and industry).

Impacts on Household Welfare:

Welfare refers to social wellbeing of all the people in terms of utility. The CGE model uses a technique of the Equivalent Variation (EV) in order to measure welfare change in terms of change in utility that arises from policy shocks. The EV in this regard considers the change in price and income between the base year price and the current year price, which means 2006 and 2025 in the CGE model. As it is a measure of wellbeing of the society, a positive EV indicates the existence of welfare gain due to policy change and negative EV implies loss of welfare. Table 37 shows that all sector-specific TFP growth options improve the welfare of each segment of the households. The rural non-poor that accounted for 42 percent of the total population obtain the highest welfare improvement as it has highest magnitude of EV.

Table 37:-Welfare status in response to the Induced Sectoral TFP growth

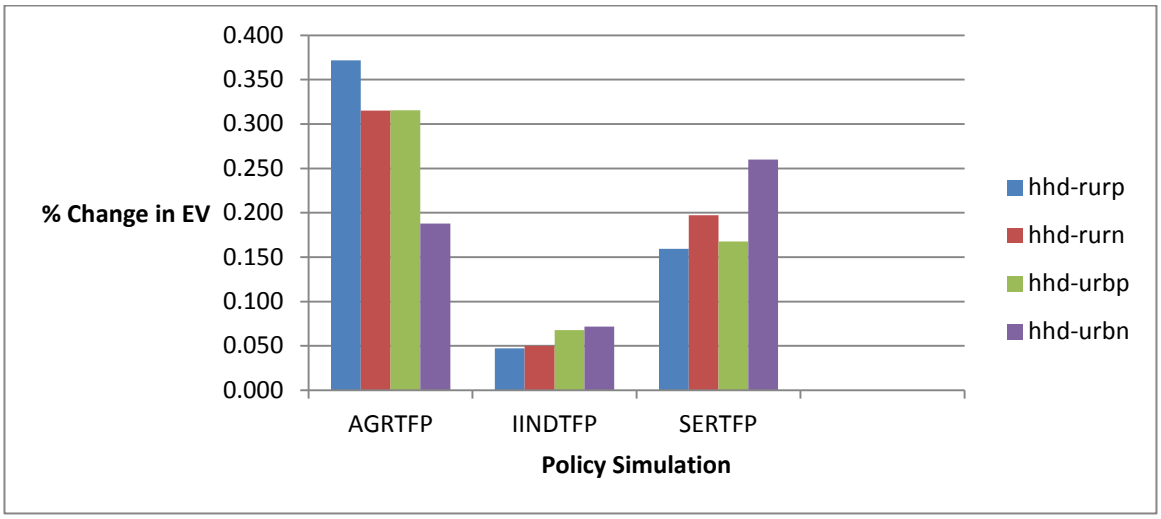
Institutions	EV value in Base Scenario	EV value in alternative scenarios of change in sectoral TFP growths		
		AGRTFP	INDTFP	SERTFP
HHD-RURP	0.039	0.045	0.035	0.038
HHD-RURN	0.047	0.143	0.114	0.130
HHD-URBP	0.041	0.008	0.006	0.007
HHD-URBN	0.042	0.045	0.040	0.047

Source:-Author's estimation based on dynamic CGE model

In terms of percentage, figure 20 indicates that accelerating openness induced agricultural TFP growth rate improves the welfare of rural poor, rural non-poor and urban poor as compared to all other policy shocks. However, the urban non-poor households receive the highest welfare in the growth option of enhancing induced TFP

in services. This indicates the fact that agricultural TFP growth is very crucial for improving the welfare of the majority of society and has a comparative advantage over other growth options. Notably, growth in the industry TFP also generates a positive growth rate of EV, but it is low in comparing with other scenarios. This attributes to the smallest share of industry in GDP and labour force.

Figure 20:-The Percentage of EV in response to the change in sectoral TFP growths.



Source:-Author's simulation results based on Dynamic CGE model

Summing the analysis regarding sector-specific TFP growth options, the results show some common effects on the economy wide performance and structural change process. Almost all of them positively influence the economy. However, they have mixed effects on the structure of supply side and demand side of the economy as well as the structure of income. Accelerating growth of TFP in agriculture and services causes the share of manufacturing to decline overtime. However, it improves the welfare of the households as compared to the accelerating industrial growth. In other words, the manufacturing that has the smallest share in GDP has positive impacts on the structure of the economy. On the contrary, both agricultural and service TFP growths negatively influence the structural change process of the economy. If the government increases higher factor accumulation in the industrial sector along with the induced TFP growth, its outcome on the overall economy and structure of the economy as expected to be greater.

5.2.2 Analysis Of Broad-Based TFP Growth Options

The broad-based growth options refer to the combinations of the TFP growths for agriculture, industrial, and service. It is also expected that such growth options generate a remarkable economic performance as compared to the sector-specific option. This is due to the TFP growths among sectors reinforce and strengthen their contributions.

Impacts on Macroeconomic Performance:

The broad-based growth options generate higher macroeconomic performance as compared to the sector-specific growth options. This is attributed to the sectoral TFP growths that are pooled together to create a sound and multiple effects. Among the combination, accelerating growth of combining the TFP of all the sectors causes the economy to perform at an astonishing rate. This is followed by accelerating growth of combining agriculture and service sectors growth options, indicating the lower contribution of industry to GDP (Table 38).

Table 38:-Impacts the broad-based growth options on Macroeconomics

Demand Composition	Initial Value	Base-Run	Alternative Broad-based TFP Growth Options			
			TFP-All	TFP-Agriculture & Industry	TFP-Agriculture & Service	TFP-Industry & Service
GDP at factor cost (in Billion)	122.2	409.78	581.98	482.12	555.67	526.76
Domestic Absorption	162.56	358.42	475.84	421.84	457.09	418.90
Total Private Consumption	114.75	310.54	430.92	376.95	412.18	373.99
Government Consumption [14]	15.91	15.91	15.91	15.91	15.91	15.91
Gross Capital Formation	31.89	31.97	29.01	28.98	29.00	29.00
Export	16.77	129.61	198.22	149.99	183.85	191.75
Total domestic Demand	179.32	488.03	674.06	571.83	640.94	610.65
Import	-47.00	-159.8	-228.4	-180.22	-217.08	-221.9
Total Final Demand	132.32	329.19	445.61	391.61	423.86	388.67

Source:-Author's simulation results based on Dynamic CGE model

[14] Government consumption in the dynamic CGE model is considered as fixed so that it shows the figures overtime and across alternative TFP growth options.

Increasing all the three sectoral TFP growths simultaneously at a time generates the highest macroeconomic performance as measured by the indicators. Following the broad-base growth option of combining all the three, the growth strategy of enhancing the growth rate of agricultural and service TFP together stimulates domestic demand and widens the absorption capacity of the economy. Nonetheless, demand for exports and imports are highly stimulated by the growth option of combining industrial and service sectors TFP at a time.

Comparing demand and supply side of the economy, the final demand created in the base-run scenario in 2025 increases by 148 percent while the supply of the economy in terms of GDP increases by 235 percent as compared with the initial value in 2006. This sheds some light that the rate at which the supply side of the economy increases exceeds the rate at which the final demand is stimulated, which is extremely relevant in stabilizing the production path of the economy. On the same fashion, the TFP-all scenario boosts the final demand and the supply by 35 percent and 42 percent respectively, contrasting sharply with the base-run scenario. This indicates that accelerating sectoral TFP in all sectors at a time narrows the gap in growth rate and almost favors both sides of the economy in terms of growth rate. In other word, where there is combining of factor productivity, this benefits the supply side by enhancing the production capacity and efficiency and stimulating the demand side of the economy by changing the structure of demand. This makes the remarkable growth in sectoral TFP tends to cause a balanced growth of demand and supply side of the economy.

Impacts on GDP Compositions and Per Capita Income:

Table 39 gives the results of the impact of combining sectoral growth options on GDP and per capita income. The growth rate of GDP that was 7 percent in the initial year declines to 6.2 percent in 2025. This means that the base-run scenario generates the deteriorating sectoral growth rates and their contributions to GDP growth rate due to less productivity, high restrictiveness and less innovativeness in the service sector. This prediction almost matches with the IMF projection up to the year 2016. However, combining sectoral TFP growth option rescues such a declining trend of growth rate of GDP through time. The service sector grows at a rate ranging from 8.2 percent to 10.7

percent in 2025 while the industry sector takes the second position in sectoral growth rate. With these sectoral growth rates of GDP, each sector that contributes to the growth rate of GDP varies across sectors in which the service sector accounts for the lion's share of contribution ranging from 4 percent to 6.2 percent in 2025.

Table 39:- Impacts of broad-based growth options on GDP and Per capita income

Indicators	Initial Values	Base-Run	Alternative Broad-based TFP growth Option			
			TFP-ALL	TFP-Agri. & Industry	TFP-Agri. & Service	TFP-Industry & Service
GDP at market Price	179.33	516.50	723.8	630.85	691.53	625.79
Annual growth rate						
GDP	7.00	6.27	8.73	7.15	8.40	8.33
Agriculture	6.41	3.56	5.22	5.23	5.20	5.62
Industry	6.00	5.81	8.24	7.97	7.37	7.47
Manufacturing	5.40	4.56	6.87	8.20	4.94	5.49
Service	7.82	7.90	10.73	8.25	10.40	10.52
Sectoral Contribution to GDP growth rate						
Agriculture	3.00	1.08	1.52	1.81	1.59	0.87
Industry	0.82	0.86	1.29	1.31	0.98	1.19
Manufacturing	0.26	0.25	0.42	0.59	0.21	0.33
Service	3.17	3.63	5.91	4.02	5.82	6.25
Nominal Per Capita Income, in 2006 USD	294.51	599.01	839.4	731.63	801.99	725.76

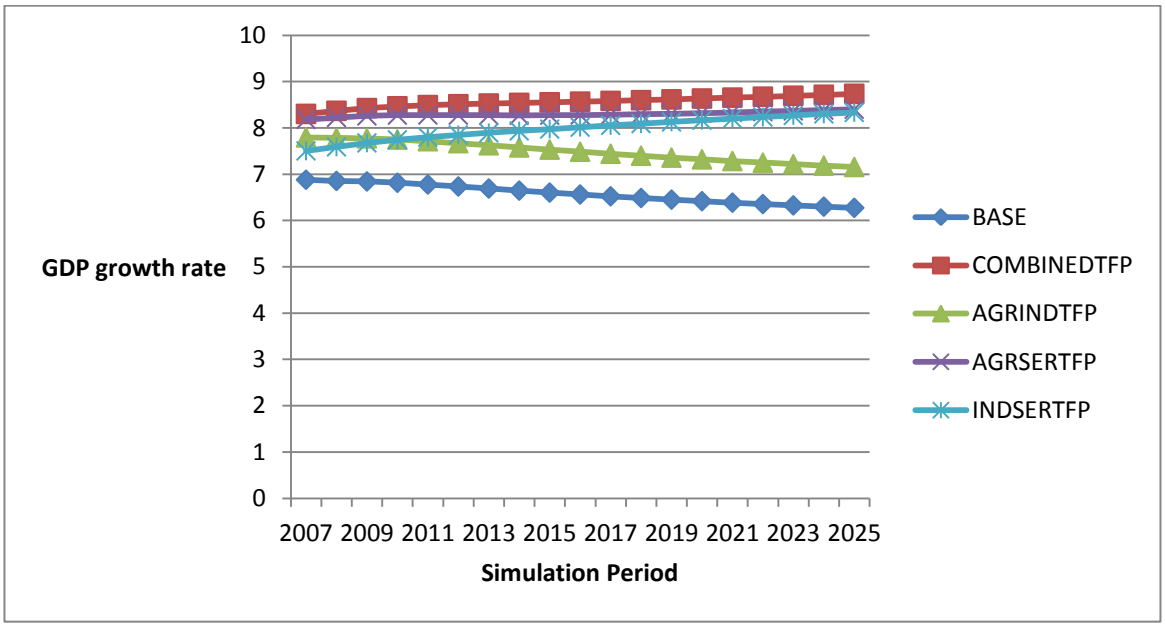
Source:-Author's estimation based on dynamic CGE model

The contributions of agriculture and industry to GDP growth rate are higher in the scenario of combining agriculture and industry. In any case, the TFP growth strategy of combining agricultural and service does not make any sector contributing a highest portion to GDP growth rate. With the population growth rate of 2.4 percent and the nominal GDP, the per capita income also varies under each scenario of growth options

and far away from the base-run scenario. However, it is only the broad-based growth option of combining all the three sectors that generates the highest per capita income, but does not enable the country to join the middle income group in 2025.

Unlike the sector-specific growth options, the time path of GDP growth rate in broad-based growth options at least shows a stable growth rate path. A growth strategy of combining all the three sectors generate an increasing trend of GDP overtime and conclusively reverses the current GDP growth rate that shows a declining trend overtime. As part of the combined TFP growth option, the increase in TFP growth rate of the service sector minimizes the productivity problem of the sector and accelerates the overall economic growth rate.

Figure 21:-Evolution of GDP growth in response to broad-based TFP growths



Source:-Author's estimation based on the dynamic CGE mode

In terms of the time horizon, service-included broad-based growth options show an increasing trend of GDP growth rate both in the long and short runs. On the contrary, service-excluded broad-based growth options make the entire economy growth rate decline in the short- and long- runs.

Impacts on the structure of the Economy

Under this section, we present both the structure of demand and the supply side of the economy. Assuming the economy keeps going on the current growth path, the base-run scenario shows that the share of agriculture declines while the service sector concomitantly increases, leaving industry in general and manufacturing in particular with the marginal share in GDP (Table 40).

Table 40:-Impacts of Broad-based TFP growth options on Supply Structure

Indicators	Initial Value	Base-Run Scenario	Impacts of Alternative Broad-Based TFP Growth Options (%)			
			TFP-All	TFP-Agriculture & Industry	TFP-Agriculture & Service	TFP-Industry & Service
1) Agriculture	48.09	29.66	28.23	24.06	29.76	23.19
Cereal Crops	33.68	19.84	18.74	22.45	19.38	15.71
O/W Non-Exportable agri.	15.01	9.47	8.97	10.36	9.30	7.79
O/W Exportable agri.	8.41	4.81	4.51	5.67	4.52	3.72
2) Industry	11.49	14.80	15.66	16.67	13.23	15.92
Manufacturing	3.95	5.39	6.09	7.35	4.18	5.90
Other Industry	7.53	9.40	9.93	8.69	9.34	9.61
3) Service	40.41	55.53	56.09	49.26	57.00	60.88
Private Service	31.15	52.41	53.77	46.57	54.58	58.33
Public Service	9.25	3.12	2.32	2.68	2.41	2.54

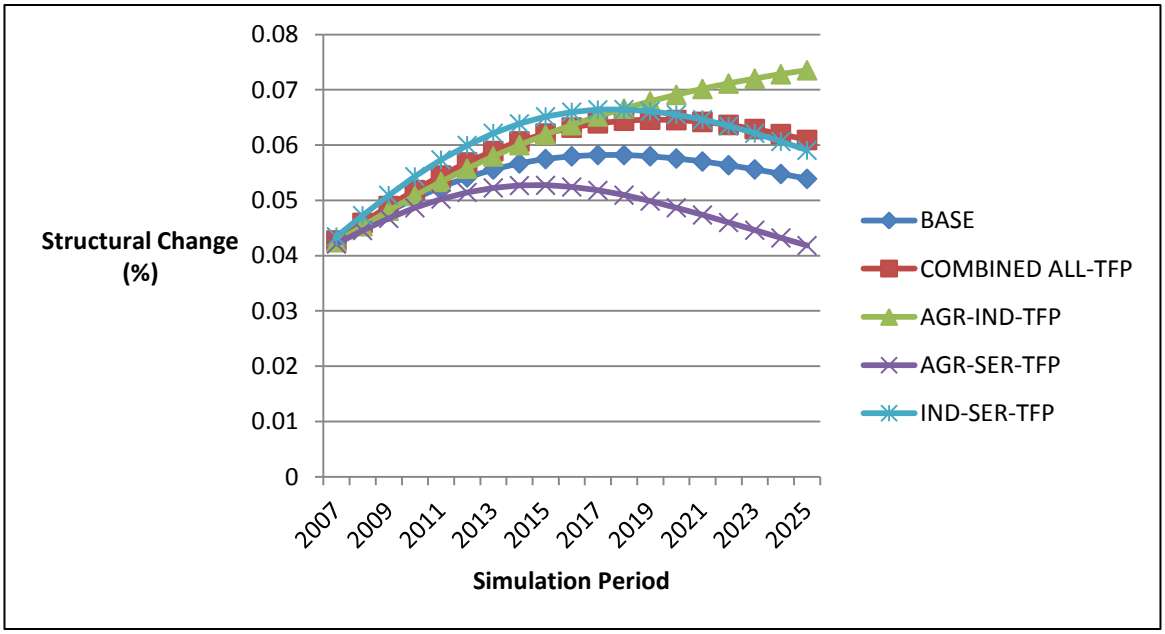
Source:-Author's estimation based on the dynamic CGE mode

In the alternative scenarios, agricultural share of GDP is negatively influenced by all the broad-based growth options. However, the growth option of increasing agriculture and service positively affect the share of agriculture in GDP. On the same manner, service sector share negatively affected by the growth strategy of combining both agriculture and industry. In general, the broad-based growth options improve the share of manufacturing in GDP and a growth strategy of combining agriculture and service negatively influences the share of manufacturing. This means that the sector that is not included in the sectoral combination of growth option can be negatively affected in terms of share in GDP. In a nutshell, the structure of the economy shifts into the service

sector while the agriculture sector concomitantly declines even in the simulation of broad-based growth option. The share of manufacturing accounts for 7.3 percent of the GDP in the scenario of combining both agricultural and industrial TFP growth together. This reflects the facts that the production sectors (agriculture and industry) are more preferable in order to have rapid structural change process, but boosting the service sector is a factor that undermines the economic transformation process in Ethiopia.

Moreover, the small share of manufacturing holds the potential of transforming the structure of the economy and can encourage sluggish transformation process. Looking at figure 22, it is only the growth option of accelerating agricultural and industrial TFP growths that positively and consistently influence the structural change process of the economy overtime both in the short run and long run. However, all other growth options positively affect the structural change process in the short run and then negatively in the long run. This is attributed to the sizeable service sector which forces the economy to generate structural change burden.

Figure 22:-Evolution of structure in a response to change in broad-based TFP growth



Source:-Author's estimation based on the dynamic CGE mode

On top of the structure of GDP, the structural of aggregate demand is heavily dominated by private consumption demand and then import regardless of the growth scenarios. Through the projection years, simulation under all scenarios also negatively influences the share of gross capital formation and positively affects the other components. Accelerating growth by combining agriculture and industry negatively affects the share of export demand in aggregate demand. However, the growth option of combining industrial and service sector TFP positively influences the share of import demand. Enhancing sectoral TFP growth causes the productivity and efficiency of the factors of production to grow as well as boosting up the international competitiveness (Table 41).

Table 41:-Impacts of Broad-based TFP growth options on the Structure of aggregate Demand

Structure of Total Final Demand	Initial Value	Base-Run Scenario	Impacts of Alternative Broad-based TFP Growth Options (%)			
			TFP-All	TFP-Agri.& industry	TFP-Agri.& Service	TFP-Industry & Service
Total Private Consumption Demand	86.72	94.62	96.70	96.26	97.24	96.22
Government Consumption Demand	12.02	7.84	3.57	4.06	3.75	4.09
Gross Capital Formation	24.10	9.74	6.51	7.40	6.84	7.46
Export Demand	12.67	39.49	44.48	38.30	43.38	49.33
Import Demand	-35.52	-48.70	-57.27	-46.02	-51.22	-57.11

Source:-Author's estimation based on the dynamic CGE mode

Impacts on Factor Income:

As can be seen from the table 42, the aggregated economy is labour intensive with about 49.3 percent (USD 60.29 billion) of the value added being paid to labour while 39.2 percent goes to capital in 2006. Considering the factor accumulation in the base-run scenario value in 2025, the labour income keeps obtaining the largest share (50.8 percent) out of the value added. This reflects the fact that the economy fails to transform towards capital intensive technology even with the accelerating broad-based growth options in the case of Ethiopia.

Table 42:- :-Impacts of Broad-based TFP growth options on growth rate of Factor income

Factors	Initial value	Base Run value	A Percentage Increase against the Base Scenario (%)			
			COMBINED TFP	AGRIND TFP	AGRSER TFP	INDSER TFP
Labour	60.29	230.71	41.4	20.7	32.2	24.0
Land	8.46	30.30	40.5	21.3	27.1	26.6
Livestock	5.47	14.06	31.5	18.6	31.6	13.9
Capital	47.99	174.29	42.3	14.2	35.0	28.1
Structure of Income						
Labour	49.3	51.3	51.4	52.4	51.1	50.7
Land	6.9	6.7	6.7	6.9	6.4	6.8
Livestock	4.5	3.1	2.9	3.1	3.1	2.8
Capital	39.3	38.8	39.0	37.5	39.4	39.6

Source:-Ethiopia computable general equilibrium model results

Compared with the base-run scenario, all factors of production except livestock grow at the highest rate of beyond 60 percent in the growth option of combining all the three sectors. However, the structure of factor income is almost the same across the scenarios[15].

Impacts on Institutional Income:

Accelerating broad-based TFP growth results have an encouraging impact on the institutional income (Table 43). Accelerating growth of TFP by combining all the three sectors generates the highest income growth rate in 2025 across all types of institutions. The public enterprise also receives a higher annual income growth compared to the total household in all scenarios given its small. Out of the households, the rural households benefited more than urban households in all growth options in terms of growth rate.

[15]Labour, land, livestock and capital account for 51, 7, 3, and 39 percent out of the total factor income respectively as calculated on the basis of the base-scenario column of Table 42.

Table 43:-Implications of Broad-based TFP Growth on Institutional income

Institutions	Initial value (in billions)	Base Scenario (in billions)	A Percentage Increase against the Base Scenario (%)			
			COMBINED TFP	AGRIND TFP	AGRSER TFP	INDSER TFP
ENT	1.32	18.25	56.4	19.6	46.4	37.3
HHD	133.02	447.25	39.3	17.5	31.2	23.8
HHD-RURP	24.84	86.92	39.9	19.0	31.5	23.4
HHD-RURN	73.14	256.4	40.4	17.6	32.0	24.9
HHD-URBP	5.00	15.29	36.4	17.7	28.6	20.8
HHD-URBN	30.04	88.54	35.9	15.5	28.8	21.4

Source:-Author's estimation based on dynamic CGE model

In the base-run scenario, the rural non-poor households accounts for the lion's share (around 55 percent) of the institutional income. The rural poor and urban non-poor subsequently take about 18 percent. However, the firms and the urban poor account for scanty share ranging within 3 to 5 percent. Given its highest values in the base-run scenario, the rural non-poor that accounts for 42 percent of the population receive the highest income from the policy of simulating the sectoral TFP growth, reflecting that accelerating sectoral TFP growth options benefits the majority of the population. In other words, 42 percent of the population (rural non-poor) receives about 55 percent of the total institutional income, and 35 percent of the population (rural poor) also obtains around 18 percent of the institutional income. However, the urban poor that accounts for 12 percent of the population receive 18 percent of the income.

Impacts on Household welfare:

Using a measure of EV, the table 44 indicates that all broad-based growth option improves the wellbeing of the society in response to the change in the alternative induced sectoral TFP growths.

Table 44:-Welfare status in response to the Induced Sectoral TFP growth

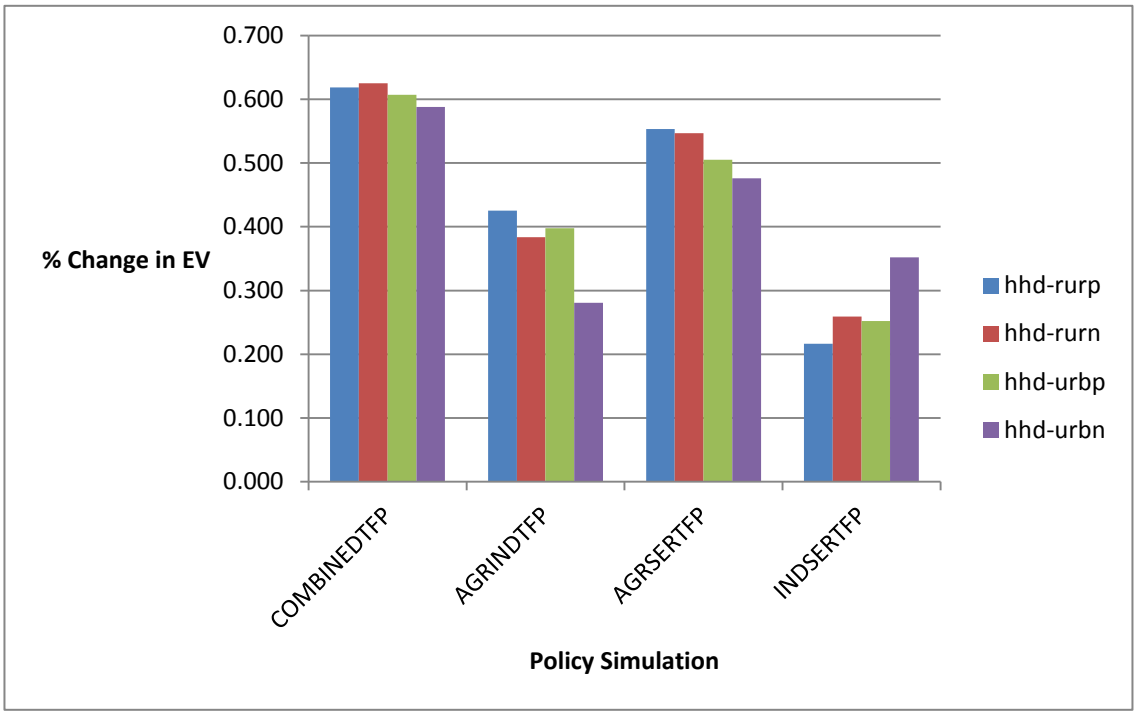
Institutions	EV value in Base Scenario	EV value in alternative scenarios of change in sectoral TFP growths			
		COMBINED TFP	AGRIND TFP	AGRSER TFP	INDSER TFP
HHD-RURP	0.030	0.054	0.047	0.051	0.040
HHD-RURN	0.101	0.176	0.150	0.168	0.137
HHD-URBP	0.006	0.010	0.009	0.009	0.008
HHD-URBN	0.037	0.060	0.048	0.056	0.051

Source:-Author's estimation based on dynamic CGE model

Nonetheless, the rural non-poor households that account for 42 percent of the population receive the higher welfare gain comparing with other segments of the households. Following this, the urban non-poor households that account for 12 percent of the population receives welfare gain. The rural poor that accounts for 35 percent of the population obtain considerable welfare gain due to the change in the induced sectoral TFP growths.

Figure 23 reveals that the percentage change in EV values in response to the shock in sectoral TFP growths as compared to the base-run scenario. All the percentage change is positive as compared to the base-run scenario. This indicates that all alternative policy scenarios improve the welfare of each segment of the households. In particular, the accelerating growth strategy of combining TFP growths in all sectors generates the highest percentage increase in EV. The welfare of rural poor is lower in the growth strategy of combining industry and service TFP growths, indicating that changes in agricultural TFP are essential elements and play a pivotal role to improve the welfare of rural poor. In a nutshell, combining TFP growths is preferable growth strategy in regarding generating the highest growth rate of welfare improvement to all segments of households. Moreover, the welfare of rural poor, rural non-poor, urban poor and then urban non-poor get improved in that order in terms of the percentage growth rate of EV.

Figure 23:-The Percentage of EV in response to the change in sectoral TFP growths.



Source:-Author's Estimation based on dynamic CGE model

5.2.3 Sensitivity Analysis for Sectoral Growth Options

Considering the volatility of economic performance and variation in assumptions, we undertake the low scenario by assuming the TFP growth rate of 2.2 percent for agriculture, 2.5 percent for industry and 1.3 percent for service. Such low growth scenarios generate the same fashion of economy wide effects with lower magnitude as compared to the higher scenarios. All types of sectoral TFP growth options positively influence both the demand and supply side of macroeconomic indicators. In comparison, accelerating growth of broad-based TFP enables the macroeconomic indicators to surge up at a higher rate than the sector-specific growth options. This indicates that TFP is not only a driver of output growth, but also it stimulates the aggregate demand of the economy (Table 45).

Table 45:-Impacts on Macroeconomics in the lower scenario

Demand Composition	Initial Value	Base Run	Alternative Sectoral TFP Growth Options						
			AGR TFP	IND TFP	SER TFP	TFP-All	TFP-AGRIND	TFP-AGRSER	TFP-INDSER
GDP at factor cost	122.2	409.7	446.3	423.3	434.6	486.9	460.6	471.7	448.8
Domestic Absorption	162.5	358.42	395.8	367.8	371.2	420.1	405.8	409.43	381.2
Private Consumption	114.7	310.54	348.0	319.9	323.3	372.2	357.9	361.54	333.3
Government Consumption	15.91	15.91	15.91	15.91	15.91	15.91	15.91	15.91	15.9
Gross Capital Formation	31.89	31.97	31.97	31.97	31.97	31.98	31.98	31.98	31.9
Export	16.77	129.61	133.7	138.3	142.4	155.4	142.7	146.38	150.9
Total Demand for domestically produced	179.3	488.03	529.5	506.1	513.7	575.5	548.6	555.81	532.1
Import	-47.0	-159.84	-163.9	-168.5	-172.6	-185.6	-173.0	-176.62	-184.4
Total Final Demand	132.3	329.19	365.6	337.5	341.0	389.8	375.6	379.19	346.9

Source:-Author's simulation results based on Dynamic CGE model

Looking at Table 46, in the base-run, the GDP growth rate would reduce to 6.2 percent in 2025 with the service sector growing at 7.9 percent, following by the industry sector (5.5 percent) and the agriculture sector (2.9 percent). The service contributes 4.6 percent growth rate. The agriculture and industry also contribute 0.8 percent and 0.79 percent to the GDP growth rate of 6.2 percent, respectively. The per capita income at USD 2006 price rises to USD 583, which lagging behind the middle-income country status requirement by a half (Table 46).

Table 46:-GDP and Per capita income in lower scenario

Indicators	Initial Value	Base Run	Alternative Sectoral TFP Growth Options						
			AGR TFP	IND TFP	SER TFP	TFP-All	TFP-AGRIND	TFP-AGRSER	TFP-INDSER
GDP at market Price	179.33	503.2	683.6	627.1	633.9	734.1	704.57	711.70	654.90
Annual growth rate									
GDP	7.00	6.23	7.58	7.45	7.70	8.30	7.84	8.05	7.94
Agriculture	6.41	2.98	5.77	4.49	4.45	5.73	5.74	5.74	4.49
Industry	6.00	5.58	7.03	7.62	6.98	8.24	8.15	7.32	7.67
Manufacturing	5.40	3.63	5.83	7.11	5.20	7.52	7.94	5.67	6.58
Service	7.82	7.95	8.97	9.00	9.53	9.89	9.13	9.69	9.74
Sectoral Contribution to GDP growth rate									
Agriculture	3.00	0.81	2.01	1.31	1.27	1.82	1.92	1.90	1.24
Industry	0.82	0.79	0.61	0.69	0.66	0.68	0.66	0.63	0.71
Manufacturing	0.26	0.17	0.30	0.49	0.26	0.48	0.53	0.28	0.43
Service	3.17	4.62	4.57	4.85	5.40	5.17	4.60	5.13	5.44
Nominal Per Capita Income, in 2006 USD	294.51	583.6	792.8	727.3	735.1	851.4	817.12	825.39	759.52

Source:-Author's estimation based on dynamic CGE model

Both sectors-specific growth options and broad-based growth options have better performance as compared to the base-run scenario. In all scenarios, the service sector grows at the highest rate while the manufacturing industry and then agriculture follows respectively. Regarding sectoral contributions to GDP growth rate, the service sector again dominates and contributes a considerable amount to GDP growth rate. However, the contribution of manufacturing industry to GDP growth rate is scanty across all the scenarios and is not in a position to stimulate the economy-wide growth. The per capita income in the sector-specific growth options ranges from USD 583 to USD 792 in 2025. It spans from USD 759 to USD 851 in the case of broad-based growth options. In a

nutshell, the country will not be able to join the middle-income country status by 2025. Looking at table 47, the base-run scenario simulation result shows that the structure of GDP is dominated by the service sector (59 percent), followed by the agriculture sector (26 percent) and the industry (15 percent). All scenarios of growth options positively affect the structural change process in the sensitivity scenario, dominated by the accelerating growth option of combining both agriculture and industry. In other words, enhancing TFP in the more of productive sectors generate a positive impact on economic transformation process.

Table 47:-Impacts on Supply Structure in lower scenario

Indicators	Initial Value	Base Run	Alternative Sectoral TFP Growth Options						
			AGR TFP	IND TFP	SER TFP	TFP-All	TFP-AGRIND	TFP-AGRSER	TFP-INDSER
1) Agriculture	48.12	26.53	34.28	28.47	27.80	31.0	32.89	32.36	26.86
Cereal Crops	33.7	17.10	21.89	18.86	18.32	20.2	21.32	20.73	17.83
O/W Non-Exportable agri.	13.7	8.64	10.73	9.16	9.00	9.70	10.13	9.98	8.75
O/W Exportable agriculture	6.20	3.66	5.10	4.38	4.11	4.71	5.04	4.74	4.10
2) Industry	11.48	14.36	14.09	16.78	14.54	15.8	16.14	13.90	16.31
Manufacturing	4.70	4.80	5.12	6.95	5.05	6.40	6.78	4.85	6.45
Other Industry	6.78	9.56	8.96	9.82	9.48	9.44	9.36	9.04	9.85
3) Service	40.40	59.11	51.62	54.74	57.65	53.0	50.95	53.73	56.82
Private Service	31.17	56.01	49.10	52.10	55.05	50.7	48.51	51.32	54.30
Public Service	9.23	3.09	2.51	2.64	2.59	2.34	2.44	2.41	2.52

Source:-Author's estimation based on the dynamic CGE mode

The other implication of the sensitivity scenarios is the impact of growth options on the structure of aggregate demand. Following the productivity increase, there must be changes in demand in which it is only demand for total private consumption that surges up in all scenarios. All other demands exhibit a mixed performance as can be seen in the Table 48. It is the combined growth strategy of increasing TFP in the industry and service that has a positive implication on foreign trade demand, attributed to the increase in sectoral TFP growths.

Table 48:-Impacts on Demand Structure in lower scenario

Structure of Total Final Demand	Initial Value	Base Run	Alternative Sectoral TFP Growth Options						
			AGR TFP	IND TFP	SER TFP	TFP-All	TFP-AGRIND	TFP-AGRSER	TFP-INDSER
Private Consumption	86.72	94.6	95.2	94.8	94.8	95.5	95.3	95.3	96.1
Gross Capital formation	24.10	9.7	8.7	9.5	9.4	8.2	8.5	8.4	9.2
Export Demand	12.67	39.5	36.6	41.0	41.8	39.9	38.0	38.6	43.5
Import Demand	-35.52	-48.7	-44.8	-49.9	-50.6	-47.6	-46.1	-46.6	-53.4

Source:-Author's estimation based on the dynamic CGE mode

All alternative growth scenarios improve the income level of factors of production. The broad-based one is preferable to the sector-specific one in this perspective. The growth option of increasing combining TFP of all the three sectors generates the highest factor income growth to all factors. Out of the factors of production, labour receives the lion's share of the income, followed by capital and then land. Table 49 gives the response of factor income to the change in sectoral TFP growths.

On top of these, the response of institutional income to a change in sectoral TFP growths is positive and attractive in the case of a growth strategy that combining all the three sectors. An increase in the institutional income provides an incentive and encourages institutions to produce more and upgrade the quality of products. Of the segments of households, the rural non-poor households earn the larger change in income as its share of institutional income is outsized. Finally, the sensitivity scenario has also its own repercussion on the welfare of the households (Table 50). The positive value of equivalent variation in all alternative growth options shows an improvement in the welfare of household due to a shock in sectoral TFP growth, dominated by the growth option of accelerating TFP of all sectors.

Table 49: Impacts on Factor and institutional income in lower scenario

Factors and institutions	Initial value (in billions)	Base Scenario (in billions)	A Percentage Increase against the Base Scenario						
			AGR TFP	IND TFP	SER TFP	TFP-All	TFP-AGRIND	TFP-AGRSER	TFP-INDSER
Labour	60.29	230.71	25.4	24.1	24.1	27.78	26.50	26.57	25.24
Land	8.46	30.30	3.3	3.2	3.1	3.64	3.49	3.42	3.37
Livestock	5.47	14.06	1.61	1.4	1.4	1.65	1.60	1.65	1.47
Capital	47.99	174.29	15.5	17.9	18.5	20.53	19.21	19.79	19.12
ENT	1.32	18.25	1.98	1.90	1.98	2.26	2.08	2.16	2.06
HHD	133.02	447.25	48.5	46.3	46.9	52.98	50.37	50.94	48.71
HHD-RURP	24.84	86.92	9.51	9.0	9.1	10.37	9.88	9.96	9.47
HHD-RURN	73.14	256.4	27.8	26.6	26.9	30.47	28.91	29.27	28.03
HHD-URBP	5.00	15.29	1.66	1.5	1.5	1.80	1.72	1.73	1.65
HHD-URBN	30.04	88.54	9.53	9.1	9.2	10.34	9.85	9.98	9.55

Source: Author's estimation based on dynamic CGE model

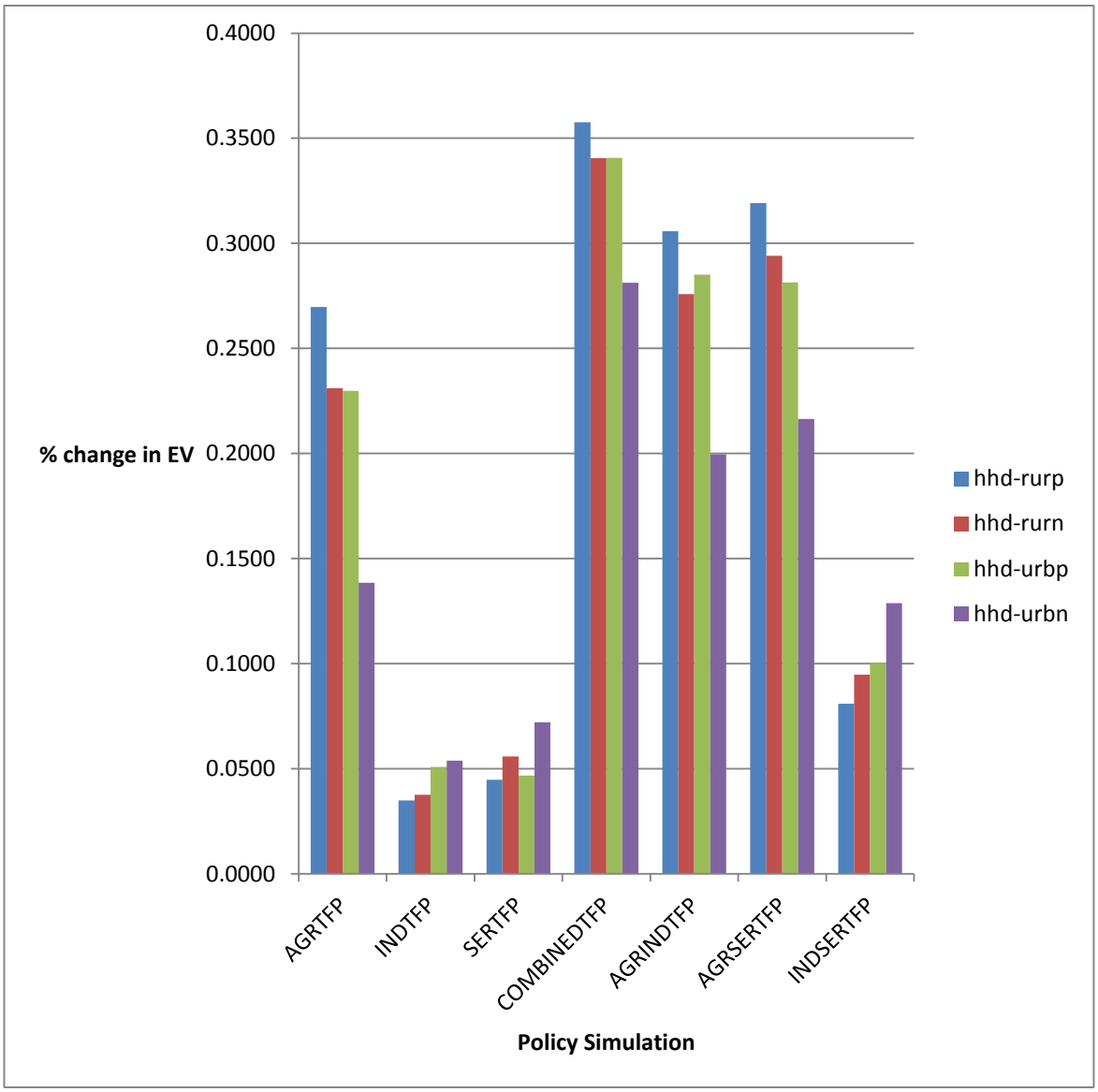
Table 50:-Welfare Impacts in the lower scenario

Institutions	EV value in Base Scenario	EV value in alternative scenarios of change in sectoral TFP growths						
		AGR TFP	IND TFP	SER TFP	TFP-All	TFP-AGRIND	TFP-AGRSER	TFP-INDSER
HHD-RURP	0.0331	0.0420	0.0342	0.0345	0.044	0.0432	0.0436	0.0357
HHD-RURN	0.1086	0.1337	0.1127	0.1146	0.145	0.1385	0.1405	0.1189
HHD-URBP	0.0061	0.0075	0.0064	0.0064	0.008	0.0078	0.0078	0.0067
HHD-URBN	0.0377	0.0429	0.0397	0.0404	0.048	0.0452	0.0458	0.0425

Source:-Author's estimation based on dynamic CGE model

The percentage change in EV values in response to the TFP shock exhibits encouraging outcomes as presented in figure 24. In particular, the accelerating growth strategy of combining TFP growths in all sectors generates the highest percentage increase, followed by the growth strategy of combining agriculture and service.

Figure 24:-The Percentage of EV in response to the change in sectoral TFP growths.



Source:-Author's Estimation based on dynamic CGE model

5.3 Analysis of Change in Spending Compositions

Public resources are some of the development resources mobilized from the general public through taxation and then administered by the government. The composition of public spending has its own implication on the economy-wide growth and the pace of economic transformation. In this study, the simulation analysis considers the net effect of increasing public spending on productive activities by reducing non-productive public spending. Such change in composition of spending and allocation of public resources also takes into account the link between the composition of government spending and TFP via elasticity of spending. The Expenditure dynamic CGE model in this regard assumes that the government reduces the share of unproductive spending (on administration, justice, defense, public order and security and general services) by 5percent and invests this share into the productive activities of agriculture, infrastructure and industry. The impact of spending induced TFP and efficiency of spending on the overall economy and structural change process is as following.

Impacts on Macroeconomic Performance:

The effect of change in spending composition on macro economy is intensively and extensively examined, but there are inconclusive results in literature. The dynamic CGE model in this regard contributes some facts to the literature. Table 51 presents the macroeconomic effect of the change in public spending composition.

The net effect of reducing the share of spending on administration and increasing spending on productive activities by the same share yields a positive impact on the macroeconomic indicators. In the initial year, the amount of goods and services demanded by the entire economy exceeds the goods and services produced by the economy. However, such relationship reversed in the destination year (2025) and across all the simulation scenarios. In particular, shifting public resources towards productive activities makes the economy to produce more and create an opportunity of expanding the foreign trade, as well.

Table 51:-Impacts of Change in Spending Composition on Macroeconomic Variables

Demand Composition	Initial Value	Base-Run Scenario	Shifting public spending towards productive Sectors		
			Agriculture	Infrastructure	Industry
GDP at factor cost (in Billion)	122.2	480.47	510.36	518.76	512.96
Domestic Absorption	162.56	402.92	435.40	418.42	424.51
Total Private Consumption	114.75	355.03	387.50	370.52	376.60
Government Consumption	15.91	15.91	15.91	15.91	15.91
Gross Capital Formation	31.89	31.98	31.99	31.99	32.00
Export Demand	16.77	160.28	162.08	186.35	186.93
Total Domestic Demand	179.32	563.20	597.48	604.77	611.44
Import Demand	-47.00	-190.52	-192.31	-216.59	-217.17
Total Final Demand	132.32	372.68	405.17	388.18	394.27

Source:-Authors Simulation based on dynamic CGE model

Impacts on GDP Growth Rates and Per Capita Income:

The base-run scenario shows that if the economy keeps going on the current path, the GDP at factor cost grows by 7 percent with which the service sector records the highest growth rate, among the major sectors. Besides, the service sector accounts for the highest share of 4.9 percent in contributing to the 7 percent growth rate of GDP. In other words, the service sector contributes 70 percent of GDP growth rate. Both agriculture and the manufacturing account for 16 percent and 3.5 percent of the GDP growth rate, respectively. This indicates that the nature of the entire economy is dominated by services which are relatively less productive and innovative. Such service-oriented current economic path ends up with the per capita income of USD 687 in 2025, leaving the country in the low-income country status (Table 52).

Table 52:-Impacts of Change in Spending Composition on GDP and Per Capita Income

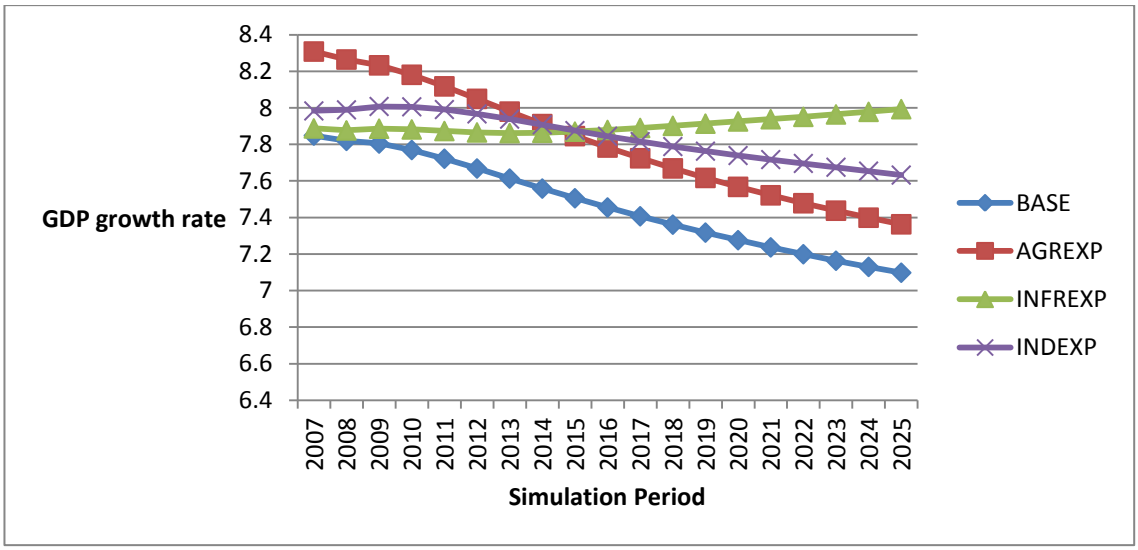
Indicators	Initial Values	Base-Run Scenario	Shifting public spending towards productive Sectors		
			Agriculture	Infrastructure	Industry
Annual Growth Rate					
GDP	7.00	7.09	7.36	7.99	7.63
Agriculture	6.41	4.09	5.14	4.01	4.15
Industry	6.00	6.44	6.71	6.98	8.65
Manufacturing	5.40	4.83	5.24	4.52	8.91
Service	7.82	8.78	8.88	9.97	9.00
Sectoral Contribution to GDP growth rate					
Agriculture	3.00	1.17	1.66	1.06	1.15
Industry	0.82	0.94	0.95	0.94	1.61
Manufacturing	0.26	0.25	0.26	0.19	0.75
Service	3.17	4.94	4.74	5.98	4.89
Per Capita Income, in 2006 USD	294.51	687.87	752.70	718.80	730.96

Source:-Author's Estimation using dynamic CGE model

Shifting government spending towards productive activities of agricultural, infrastructural and industrial development positively influences the GDP growth rate and the move towards the middle-income country status. The increase in the agricultural spending significantly stimulates the entire economy through agriculture. It also heavily favors the sector itself in comparison to the growth rates in other sectors and negatively influences the contribution of service to GDP growth rates. This is essential in order to reduce the debacles emanating from the service and spread to the entire economy. However, there is almost no change in the contribution of industry to GDP growth rate. Regarding the increasing spending on infrastructural development, it greatly benefits the service sector in terms of sectoral growth rate and contribution the GDP growth rate. It also negatively affects the contribution of agriculture and manufacturing to the economy-wide growth rate as compared to the base-run scenario.

On the same fashion, increasing spending on industrial development also generates higher GDP growth rate as compared to the base-run scenario. It also enables the manufacturing sector to contribute significantly to the economy-wide growth rate compared with the contribution generated by all other alternative scenarios, triggering the economy to have a structural change and then sustainable economy-wide growth. All scenarios of change in spending composition failed to make the country to reach the middle-income country status by 2025. However, they all have positive impacts on economy-wide growth rate and economic transformation process via enhancing the sectoral TFP.

Figure 25:-Evolution of GDP growth in response to Change in Spending Composition



Source:-Author's simulation based on dynamic CGE model

Figure 25 shows that the evolution of economy-wide growth rate in response to change in the spending composition. The change in spending composition that favors the productive activities illustrates different types of growth path across the alternative scenarios. Following the base-run growth of the economy, both spending options towards the agriculture and industry show a declining trend in growth rate. However, it is only infrastructural spending that causes the economy to grow with the increasing trend in the simulation period, stimulating the economy and laying a fertile ground for private sector development in long run.

Impacts on the structure of the economy:-

Broadly, the structure of the economy can be manifested by the structure of GDP and the structure of final demand. Looking at the structure of GDP in table 53, the service sector dominates the structure of the economy, which accounts for 57 percent. This is followed by the agriculture and then the industry. However, manufacturing takes only 5 percent of the GDP in base-run scenario. The impacts of increasing spending on agriculture, by reducing the spending on administration, positively influences the share of agriculture in GDP, but negatively affects the GDP share of the industry and service. However, the decreasing share of manufacturing in GDP harms the structural change process and the long-run economy wide growth of the country. Furthermore, the scenario of increasing spending on infrastructure negatively affects the share of agriculture and industry in GDP while it positively influences the GDP share of the service sector. Such infrastructural spending aggravates the structural change burden in the simulation period, has mixed effect in the face of economy wide growth and structural change.

Table 53:-The Impacts Change in Spending Composition on Structure of GDP

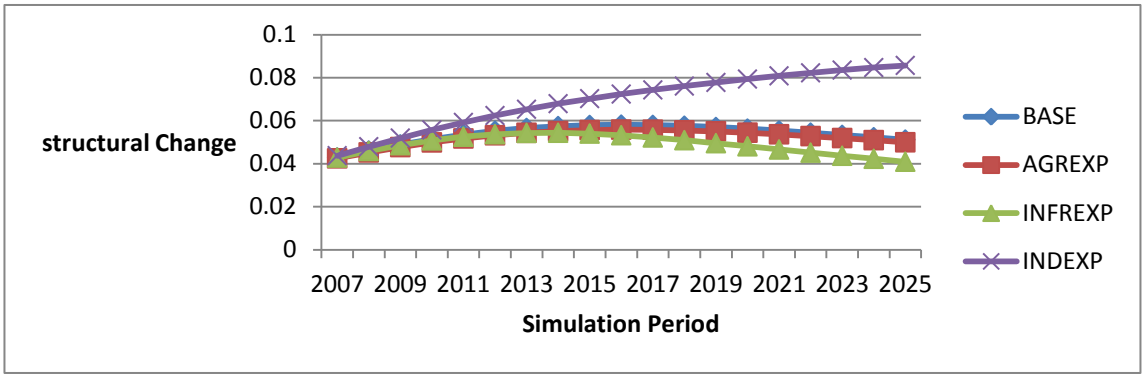
Indicators	Initial Value	Base-Run Scenario	Shifting public spending towards productive Sectors		
			Agriculture	Infrastructure	Industry
1) Agriculture	48.12	27.89	31.72	25.53	26.09
Cereal Crops	33.7	18.16	20.19	16.78	17.18
O/W- Non-Exportable	13.7	9.00	9.83	8.47	8.52
O/W- Exportable agriculture	6.20	4.00	4.49	3.59	3.96
2) Industry	11.48	14.61	14.11	13.33	18.85
Manufacturing	4.70	5.11	4.99	4.09	8.56
Other Industry	6.78	9.49	9.12	9.24	10.28
2) Service	40.40	57.48	54.16	61.13	55.05
Private Service	31.17	54.75	51.57	58.59	52.47
Public Service	9.23	2.73	2.58	2.53	2.58

Source:-Authors estimation based dynamic CGE model Simulation

The resultant effects of spending on industry generate negative impacts in the face of the share of agriculture and service in GDP. However, spending shifts towards industry generate a positive impact on the structural change process as is measured by the share

of manufacturing in GDP. This helps the economy to cure the structural problem emanated from low productive sectors. The graphical presentation of the evolution of structural change is below in figure 26.

Figure 26:-Evolution of the structural change in a response to change in Spending Composition



Source:-Author's simulation based on dynamic CGE model

Pertaining to the structure of final demand; the share of private consumption demand accounts for above 95 percent of the total final demand. Shifting spending share towards agriculture increases the share of demand for private consumption and negatively influences the share of all other components comparing with the base-run scenario. The infrastructural spending positively affects the share of export and demand. The infrastructural development creates an enabling environment for the export market, and consumption of more imported goods and service.

Table 54:- Impacts of Change in Spending Composition on Structure Final Demand

Structure of Total Final Demand (%)	Initial Value	Base-Run Scenario	Shifting public spending towards productive Sectors		
			Agriculture	Infrastructure	Industry
Total Private Consumption Demand	86.72	95.26	95.64	95.45	95.52
Government Consumption Demand	12.02	4.27	3.93	4.10	4.04
Gross Capital Formation	24.10	8.58	7.90	8.24	8.12
Export Demand	12.67	43.01	40.00	48.01	47.41
Import Demand	-35.52	-51.12	-47.46	-55.80	-55.08

Source:-Author's estimation based on dynamic CGE model simulation

Note that the summation of shares equal to one as the final demand considers demand for import which reduces the aggregate demand based on the identity equation of aggregate demand. Increasing spending towards industrialization also has a positive effect on the demand for foreign trade as it requires and provides advanced industrial products from and to the international market. In a nutshell, changing the composition of spending in favor of the industry assists the economy to achieve an encouraging structural change process compared to other scenarios. As the economy becomes structurally transformed, there exists a change in demand, tests and preference towards highly upgraded goods and service. Such relationship between change in demand and structural change process exhibits the bilateral relationship and reinforce each other.

Impacts on Factor and Institutional Income:

In the case of factor income, all spending scenarios show mixed effects on factor income. It is only the spending on agriculture and industry that produces positive effects to all factors of production. In particular, increasing spending on infrastructural development has a negative repercussion on income generated from land and livestock, but enables laborers and capital owners to have a positive income growth as compared to the base-run scenario. In general, the three alternative scenarios show that mix of factor intensities of labour and capita intensive technologies are the main features of the productive activities (Table 55).

Table 55:- Impacts of Change in Spending Composition on Factor Income

Factors	Initial (in billions)	Base Scenario (in billions)	The effects of Shifting public spending towards productive Sectors against the Base-Run Scenario (%)		
			Agriculture	Infrastructure	Industry
Factor Income and its percentage change					
Labour	60.29	265.99	7.18	0.59	8.45
Land	8.46	36.99	4.89	-1.14	12.22
Livestock	5.47	16.33	11.04	-1.65	2.68
Capital	47.99	206.79	4.32	7.13	4.05
Share of Factor Income in GDP (%) in all columns below					
Labour	49.3	50.6	51.1	49.4	51.3
Land	6.9	7.0	7.0	6.7	7.4
Livestock	4.5	3.1	3.3	3.0	3.0
Capital	39.3	39.3	38.7	40.9	38.3

Source:-Author's estimation based on dynamic CGE model simulation

The labour income is sill dominant across all the alternative scenarios, followed by capital income. Note that share of labour income accounts for an increasing share in factor income during rapid economic transformation. This is not the case for Ethiopian economy, showing stagnant structural change process as it depends on labour. This is attributed to the scarcity of capital goods in the domestic market as constrained by the acute shortage of foreign currency, among other factors. All scenarios of change in spending exert a positive influence on the income growth rate per annum (Table 56). Spending in agriculture generates the highest institutional income growth for all components of institutions as compared to other spending scenarios. On the same note, the public enterprise receives the highest growth rate of income in all scenarios, following by the rural non-poor household, rural poor household, and urban non-poor household.

Table 56:- Impacts of Change in Spending Composition on Institutional Income

Institutions	Initial Value (in billions)	Base Scenario (in billions)	Growth rate of institutional income under Alternative Sector Specific TFP growth Options (%)		
			Agriculture	Infrastructure	Industry
Institutional Income, and its growth rate simulation scenario					
ENT	1.32	22.75	5.70	9.80	5.70
HHD	133.02	519.40	5.94	2.23	6.49
HHD-RURP	24.84	100.56	6.72	1.23	7.29
HHD-RURN	73.14	300.16	5.82	2.77	6.65
HHD-URBP	5.00	17.39	6.35	0.24	6.68
HHD-URBN	30.04	101.28	5.46	1.96	5.21
Structure of Institutional Income (% in all columns below)					
ENT	0.49	2.14	2.14	2.30	2.13
HHD	49.75	48.93	48.93	48.85	48.94
HHD-RURP	9.29	9.47	9.54	9.37	9.55
HHD-RURN	27.36	28.28	28.24	28.38	28.32
HHD-URBP	1.87	1.64	1.64	1.60	1.64
HHD-URBN	11.23	9.54	9.50	9.50	9.43

Source:-Author's simulation based on Dynamic CGE model

The rural non-poor households that account for 42 percent of the total population take the largest share of institutional income, followed by urban non-poor (12 percent of the population) and rural poor (35 percent of the population). This means that there is not substantial structural change in institutional income across the alternative scenarios of spending shifts from unproductive to productive activities.

Impacts on Household Welfare:

As measured by the EV, the net effects of changing spending composition favoring the productive sectors improve the welfare of each segment of households. As can be seen the table 57, the rural non-poor that accounts for 42 percent of the population obtain the

better welfare improvement as EV values across the alternative spending scenarios exceeds the other segments of the households. This indicates that shifting public resources towards productive activities and enhancing the efficiency of spending improve the welfare of households.

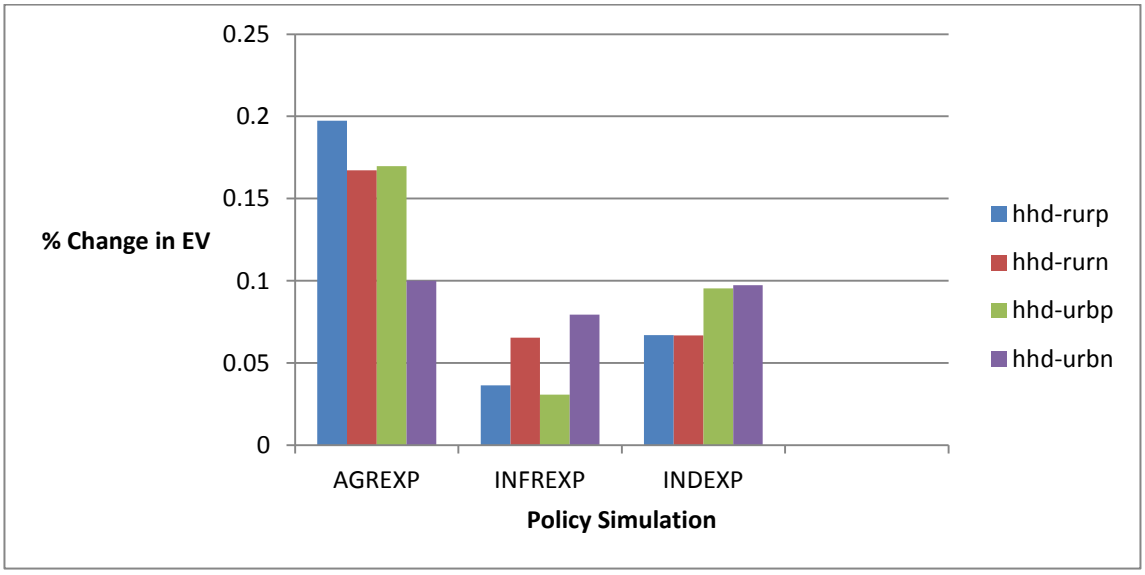
Table 57:-Welfare status in response Change in Spending Composition

Institutions	EV value in Base Scenario	EV value in alternative scenarios of change in sectoral TFP growths		
		Agriculture	Infrastructure	Industry
HHD-RURP	0.039702	0.047539959	0.041149	0.04236
HHD-RURN	0.133041	0.155271869	0.141746	0.141933
HHD-URBP	0.007222	0.008447054	0.007444	0.00791
HHD-URBN	0.045848	0.050431994	0.04949	0.050311

Source:-Author's estimation based on dynamic CGE model

Looking at the percentage change in EV in the figure 27, spending on agriculture highly improves the welfare of all segments of households as compared to other spending. This attributed to the fact that the majority of the population sustains their lives on agriculture.

Figure 27:-The Percentage of EV in response to the change in Spending Composition.



Source:-Author's simulation results based on Dynamic CGE model

For summarizing the findings of the study against the hypothesis, Table 58 gives the details in comparison. All sectoral growth options positively influence growth rate, per capital income and welfare of household. However, they have different implications for structural change process in Ethiopia. Induced agricultural TFP, industrial TFP and service TFP are preferable growth strategies in terms of growth, welfare improvement, and structural change, respectively.

Table 58: Summary of Simulation Results against hypothesis

No.	Growth Options	Hypothesis				
		GDP growth rate	Per capita income	Reaching MIC	Structural change	Welfare Impact
1	Sector- specific growth options	+	+	No	+	+
2	Broad-based growth option	+	+	Yes	+	+
3	Government spending	+	+	No	+/-	+
No.	Growth Options	Simulation Results				
		GDP growth rate	Per capita income	Reaching MIC	Structural change	Welfare Impact
1	Sector- specific growth options					
	Agriculture	+	+	No	-	+
	Industry	+	+	No	+	+
	Service	+	+	No	-	+
2	Broad- Based growth options	+	+	No	+/-	+
	Combined all	+	+	No	+	+
	Agriculture and industry	+	+	No	+	+
	Agriculture and service	+	+	No	-	+
	Industry and service	+	+	No	+	+
3	Government spending	+	+	No	-/+	+
	Agriculture	+	+	No	-	+
	Industry	+	+	No	+	+
	Infrastructure	+	+	No	-	+

Source: Author's estimation based on dynamic CGE model

Table 58 tells that the point of departure from the hypothesis is attributed to the service sector that dominates the entire economy. The service sector has its own nature and weakness that tends to trap the structural change process and the productivity of the economy. Some of the facts are: (1) the service sector in Ethiopia is poor in innovation and ICT development, tends to generate a lower efficiency. (2)The growth in the service by itself is dominated by the wholesale and retail trades, hotels and restaurants, real estate and business, poor financial intermediation, transport and communication system. (3) The service sector in Ethiopia is characterized by low productivity as it is not intensified by advanced technology. Therefore, the economy is dominated by this type of poor service sector performance that put a negative pressure on the structural change process and reaching for middle income country status.

CHAPTER SIX: CONCLUSION AND POLICY PRESCRIPTIONS

6.1 Conclusion

The Ethiopian economy in the last decades has been growing in different fashions depending on the economic policies undertaken by the ruling governments at their times. The economic performance is characterized by positive and negative growth rates, ranging from 13 percent and negative 11 percent in 1981-2010. There were negative real GDP rates seven times in 1981-2010 (WB, 2011). This was mainly aggravated by the vagaries of the nature, drought, internal conflict, political instability and war. The existence of such an erratic economic growth rate that coexisted with a constant population growth rate causes the per capita income to oscillate up and down in the reference period. With such erratic growth performance, the structure of the economy is largely dominated by the service and then agriculture sectors. There is no structural change as evidenced by the manufacturing sector that accounts for a negligible share in GDP (4.8 percent) and an insignificant contribution to GDP growth rate. Though the economy has successively been growing at above 7 percent, on average, since 2005, the share of manufacturing in GDP still remains the same and low.

The share of services rather heavily dominated the structure of the economy in terms of GDP share, contribution to GDP growth rate, public investment, and private investment. According to the NBE report in 2010, the service sector accounts for the lion's share in terms of four indicators: structure of GDP (46%), contribution to GDP growth rate (58%), structure of capital investment (46%), and structure of capital expenditure (75%). However, the service sector is dominated by the share of trade and hotels in service accounts for around 57 percent in early 1970s and declines to 33 percent in 2010. In the same analogy, real estate and the associated business take the second largest share in the value-added of service, ranging from 12 percent in early 1970s to 22 percent in 2010 (WB, 2011). Note that agriculture, industry, and service sectors absorb 82%, 7% and 11% of labour force in 2010, respectively (UNCTAD database). The existence of such performance of the service sector leads to a structural change burden that persistently

slows down the country's pace towards reaching the middle-income country status by 2025. Therefore, sustainable economic growth and structural change confront Ethiopia with a daunting challenge for reaching the middle income country status by 2025.

In order to minimize these problems, increasing the growth rate of sectoral TFP is one of the principal sources of perpetual growth as it has a nature of an increasing return to scale. It represents technological change, technical efficiency, allocative efficiency, scale effects and the like. TFP is the driving force of perpetual growth and has a permanent effect on economy wide growth rate. In general, it is the growth of TFP that creates synergy and speeds up the process of economic transformation and perpetual economic growth as well as enhances the welfare of the society. As TFP is capable of curing the problems, the study identifies the key determinant of TFP using VARX model. The VARX model that accounts for both endogenous and exogenous variables produces remarkable econometric results. Out of the determinants, foreign trade openness, domestic trade liberalization and imported capital goods are statistically significant and positively influence the agricultural TFP, service TFP and industrial TFP, respectively. This allows the calibration of the induced sectoral TFP growths such as openness induced agriculture TFP, imported capital goods induced industrial TFP, and liberalization induced service TFP. Using these calibrations, the dynamic CGE model examines the impacts of such induced sectoral TFP growths on economy wide growth and structural change process.

According to the base-run scenario simulation results, if the economy continues to grow with the current path, it is expected to grow by 6.2 percent in 2025, showing a declining trend as compared to the initial value in 2006. Such declining projection is almost similar to the projection undertaken by the IMF in the medium term. This is attributed to the dominance of service over the structural of the economy while it is poor in productivity and weak in sectoral linkage. Evidently, the contribution of service to the GDP growth rate of 6.2 percent is large and accounts for about 57 percent of GDP growth rate in 2025. It negatively influences the structural change process. This leads to problems of structural change burden- of which declining growth trend and poor productivity is a manifestation. Besides, the marginal contribution of sectors to the economy wide growth rate shows that the economy constantly shifts to the service

sector. As a result, the country will not join the middle-income country status by 2025. All induced sector-specific and broad-based TFP growth options positively influence economy wide growth rate, per capita income and welfare.

In all measurements, the broad-based TFP growth options generate the highest remarkable performance as compared to the sector-specific growth options. Regarding the structural change process, the sector-specific growth options show mixed performance such that increasing agricultural TFP as well as increasing service TFP growth negatively affect the structural change process. It is only the direct approach of increasing industrial TFP growth has a positive impact on structural change process. The broad-based growth options, on the other hand, also indicate that they have a mixed performance on structural change process. The accelerating growth option of combining agriculture and service sectors has negative implication on economic transformation whereas the other two combinations positively influence structural change process in Ethiopia. None of the sector-specific and broad-based growth options enable the economy to cross the threshold of middle-income requirement. However, all scenarios of growth options improve the welfare of the society.

In the economic transformation process, the role of government in terms of increasing public investment in productive activities as well as enhancing its efficiency yields an encouraging result. The net effects of decreasing the share of spending on administration and increasing spending on the agriculture, industry and infrastructure positively influence the GDP growth rate and the per capita incomes. However, it is only the change in spending composition towards industry positively influences the structural change process while spending on agriculture and infrastructure has a negative impact on economic transformation process. Spending on infrastructural development also matters in the structural change process in the long run when the production sectors (agriculture and industry) are able to produce massive quantities and upgraded industrial products. Otherwise, increasing spending on infrastructure with poor performance of agriculture and industry would result in a negative repercussion on structural change process in Ethiopia.

6.2 Policy Implications

The existing economic policy of sector-specific growth option has not led to secure industrialization and structural change in the last twenty years. The share of manufacturing in GDP remains the same even after the post-reform period in general and since the onset of the ADLI in 1994 in particular. However, the incumbent government gives more weight to the ADLI that bears a responsibility of achieving industrialization. The outcomes of this policy shift are not as expected. On the contrary, it fails to satisfy the growing demand for food and is unable to stop the increasing risk of falling into hunger, starvation and drought each year. Some of the reasons are: it is not able to enhance strong sectoral interdependence and its policy instruments are very narrow and not adequate enough. It extremely engaged in input supply (like fertilizers and best seeds) and some credit facility. Beyond this, implementation of ADLI does not deeply consider other policy initiatives like enhancing TFP as it was happening in structurally transformed countries. On top of this, the growth rate of GDP behaves an erratic performance with a negative growth rate in every five years on average. The performance of such stochastic economy wide growth rates is mostly associated with erratic growth rate of sectoral TFP in the light of growth accounting approach.

Considering countries' experience, econometric and simulation results, this study recommends that the government and the concerned development partners could undertake the following policy actions for securing both sustaining growth and rapid structural change.

- There must be a series economic policy revisions focusing on enhancing total factor productivity. This is confirmed by the alternative simulation scenarios of increasing sectoral TFP against the base-run scenario of factor accumulation.
- Among the determinants of sectoral TFP growth, foreign trade openness, service trade liberalization, and imported capital goods and service should receive special attention for enhancing agricultural TFP, service TFP and industrial TFP, respectively, in order to achieve sustainable economic growth and rapid economic transformation. In other words, technology transfer for enhancing sectoral TFP growth in Ethiopia is desirable.

- As the service sector accounts for the lion's share GDP, contribution to GDP growth rate, public investment, and private investment, it is expected to pose a structural burden in the economy. This is due to the fact that the service sector in Ethiopia is poor in innovation and ICT development, tends to generate a lower efficiency, the growth in the service by itself is dominated by the poor wholesale and retail trades, hotels and restaurants and characterized by low productivity as it is not intensified by advanced technology. Therefore, the government should prescribe policies that enhance the productivity of service sector and redirect a certain amount of investment into a more productive sector as the service sector dominates the economy. Otherwise, the structural change burden is intensified and could create a deadlock situation in the economy.
- Compared to the sector-specific growth options, the broad-based growth options generate higher economic performance so that the government could redirect the policy paradigm of sector-specific (ADLI) towards the broad-based growth options.
- Out of the varies sector-specific and broad-based alternative growth options, the government could focus and introduce ***Industrialization-centered broad-based TFP growth options*** in order to take the country out of the bogging situations of erratic economic growth and sluggish economic transformation. Industrialization-centered broad-based growth option positively and highly influences economy wide growth rate, structural change process and the per capita income. In other words, except the growth strategy of combining agriculture and service that neglects the industrial TFP, all broad-based growth options produce remarkable performance in the major economic indicators.
- Taking change in spending composition into account, the role of government in terms of public resource allocation must focus on shifting public resources towards spending on industry in order to speed up economic transformation.

In summary, the industrialization-centered broad-based growth option along with the active role of the government in the manufacturing industry is a priority policy among all sectoral growth options for both sustaining growth and economic transformation.

6.3 Limitations of the Study and Issues for further Study

The study has some limitations in connection with data, assumptions of CGE, and the future potential of the country in projection. Regarding the data, data for the disaggregated capital formation and non-agricultural labour force is not available at sectoral level. Therefore, the study attempted to decompose the aggregated gross capital formation based on the sectoral composition of government capital expenditure as government accounts for the lion's share in national investment. Similarly, it tried to decompose the non-agricultural labour force into service and industrial labour force based on the structure of employment as indicated in the labour force survey in 2005. Besides, there is no consensus about government report of 11 percent economic growth rate. It is also not shared by any other independent organizations like WB and IMF. Most of the independent agents estimate the growth rate to be 7 to 8 percent.

As a result, the study is unable to use the estimated TFP along with the growth rate of labour and capital for the historical years (2006-2012) in the CGE model. It, therefore, sets the required growth rate of sectoral TFP on the basis of the experience of comparators and the estimated sectoral TFP growth rate of Ethiopian economy in 1980-2005. Besides this data limitation, the paper finds some flaws inherently emanated from the assumptions of CGE model. As the CGE model calibrated to the SAM 2006, the production technology assumed the same over time. The SAM 2006 was prepared based on government data and is likely to be exposed to some sort of political influence. Moreover, we do not have an updated SAM that reflects the current economic performance of the Ethiopian economy so that using old SAM 2006 may have its own effects on simulation results. Finally, the CGE model the study uses does not fully capture the future new opportunities of investment and threats of wars in the simulation period. For instance, the country has been building a big hydroelectric dam, which can generate 5000 MW, on the Blue Nile River. In addition, the possibility of oil discovery is also one of the prospects of the country faces in the future.

Regarding further research, the CGE model assumes constant return to scale technology to factors of production and considers fixed relation coefficient between output and intermediate inputs. These assumptions do not allow the model to capture the nature of

an increasing return to scale technology. The CGE model that addresses the structure of government expenditure into the analysis also faces some challenges. The elasticity of sectoral TFP to the change in spending composition requires a rigorous estimation technique like Meta regression analysis by pulling findings from previous studies. Therefore, estimating the response of sectoral TFP to the change in spending compositions requires other very sophisticated techniques in order to reflect the real performance of economy. Moreover, calculating techniques and decomposing gross capital formation for each sector requires further research.

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ANNEXES I: - CGE MODEL EQUATIONS[16]

A) SETS

Sets	Explanation
AC	Global set for model accounts-aggregated micro-sam accounts
A(AC)	activities
ACES(A)	activities with CES fn at top of technology nest
ALEO(A)	activities with Leontief fn at top of technology nest
C(AC)	commodities
CD(C)	commodities with domestic sales of output
CDN(C)	commodities without domestic sales of output
CE(C)	exported commodities
CEN(C)	non-exported commodities
CM(C)	imported commodities
CMN(C)	non-imported commodities
CX(C)	commodities with output
F(AC)	factors
INS(AC)	institutions
INSD(INS)	domestic institutions
INSDNG(INSD)	domestic non-government institutions
H(INSDNG)	households

B) Exogenous Variables

Variables	Explanation
$\overline{CPI}$	Consumer price index
$\overline{DTINS}$	Change in domestic institution tax share (= 0 for base; exogenous variable)
$\overline{FSAV}$	Foreign savings (FCU)
$\overline{GADJ}$	Government consumption adjustment
$\overline{IADJ}$	Investment adjustment factor
$\overline{MPSADJ}$	Savings rate scaling factor (= 0 for *f* base)
$\overline{QFS_f}$	Quantity supplied of factor
$\overline{TINSADJ}$	Direct tax scaling factor (= 0 for base; exogenous variable)
$\overline{WFDIST_{fa}}$	Wage distortion factor for factor f in activity a

[16] It is sourced from A Standard Computable General Equilibrium (CGE) Model in GAMS, by Hans Lofgren, Rebecca Lee Harris, and Sherman Robinson, with assistance from Marcelle Thomas and Moataz El-Said in 2002. The model incorporates features developed over recent years through IFPRI's research projects. These features of particular importance in developing countries include household consumption of non-marketed ("home") commodities, explicit treatment of transaction costs for commodities that enter the market sphere, and a separation between production activities and commodities that permits any activity to produce multiple commodities and any commodity to be produced by multiple activities. Moreover, the study also reconsider the ERDI-EFPRI (2011) CGE model.

C) EQUATION PARAMETERS

Parameters	Explanation
α_a^a	Efficiency parameter in the CES activity function
α_a^{va}	Efficiency parameter in the CES value-added function
α_c^{ac}	Shift parameter for domestic commodity aggregation function
α_c^q	Armington function shift parameter *c*
α_c^t	CET function shift parameter
β^a	Capital sectoral mobility factor
β_{ch}^m	Marginal share of consumption spending on marketed commodity c for household h
δ_a^a	CES activity function share parameter
δ_{ac}^{ac}	Share parameter for domestic commodity aggregation function
δ_{cr}^q	Armington function share parameter
υ_f	Capital depreciation rate
δ_{cr}^t	CET function share parameter
δ_{fa}^{va}	CES value-added function share parameter for factor *f* in activity *a*
γ_{ch}^m	Subsistence consumption of marketed commodity c for household h
θ_{ac}	Yield of output c per unit of activity a
ρ_a^a	CES production function exponent
ρ_a^{va}	CES value-added function exponent
ρ_c^{ac}	Domestic commodity aggregation function exponent
ρ_c^q	Armington function exponent
ρ_c^t	CET function exponent
η_{fat}^a	Sector share of new capital
QF	Quantity demanded of factor
$cwts_c$	Weight of commodity c in the CPI
$dwts_c$	Weight of commodity c in the producer price index
ica_{ca}	Quantity of c as intermediate input per unit of activity a
$icd_{cc'}$	Quantity of commodity c as trade input per unit of c' produced and sold domestically
$ice_{cc'}$	Quantity of commodity c as trade input per exported unit of c'
$icm_{cc'}$	Quantity of commodity c as trade input per imported unit of c'
inta_a	Quantity of aggregate intermediate input per activity unit
iva_a	Quantity of aggregate intermediate input per activity unit
$\overline{mps_i}$	

$mps01_i$	Base savings rate for domestic institution i
pwe_c	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
pwm_c	Export price (foreign currency)
$qdst_c$	Import price (foreign currency)
$\overline{qg_c}$	Quantity of stock change
$\overline{qinv_c}$	Base-year quantity of government demand
$shif_{if}$	Base-year quantity of private investment demand
$shii_{ii'}$	Share for domestic institution i in income of factor f
ta_a	Share of net income of i' to i (i' ε INSDNG'; i ε INSDNG)
$\overline{tins_i}$	Tax rate for activity a
$tins01_i$	Exogenous direct tax rate for domestic institution i
tm_c	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
tq_c	Import tariff rate
$trnsfr_{if}$	Rate of sales tax
	Transfer from factor f to institution i

D) Endogenous Variables

Variables	Explanation
AWF_{ft}^{a}	Average capital rental rate in time period t
$DMPS$	Change in domestic institution savings rates (= 0 for base; exogenous variable)
DPI	Producer price index for domestically marketed output
EG	Government expenditures
EH_h	Consumption spending for household
EXR	Exchange rate (LCU per unit of FCU)
$GSAV$	Government savings
QG_c	Government consumption demand for commodity
QH_{ch}	Quantity consumed of commodity c by household h
QHA_{ach}	Quantity of household home consumption of commodity c from activity a for h
$QINTA_a$	Quantity of aggregate intermediate input
$QINT_{ca}$	Quantity of commodity c as intermediate input to activity a
$QINV_c$	Quantity of investment demand for commodity
QM_{cr}	Quantity of imports of commodity c

MPS_i	Marginal propensity to save for domestic non-government institution
PA_a	Activity price (unit gross revenue)
PDD_c	Demand price for commodity produced and sold domestically
PDS_c	Supply price for commodity produced and sold domestically
PE_{cr}	Export price (domestic currency)
$PINTA_a$	Aggregate intermediate input price for activity a
PK_{ft}	Unit price of capital in time period t
PM_{cr}	Import price (domestic currency)
PQ_c	Composite commodity price
PVA_a	Value-added price (factor income per unit of activity)
PX_c	Aggregate producer price for commodity
$PXAC_{ac}$	Producer price of commodity c for activity a
QA_a	Quantity (level) of activity
QD_c	Quantity sold domestically of domestic output
QE_{cr}	Quantity of exports
QQ_c	Quantity of goods supplied to domestic market (composite supply)
QT_c	Quantity of commodity demanded as trade input
QVA_a	Quantity of (aggregate) value-added
QX_c	Aggregated quantity of domestic output of commodity
$QXAC_{ac}$	Quantity of output of commodity c from activity a
RWF_f	Real average factor price
$TABS$	Total nominal absorption
$TINS_i$	Direct tax rate for institution i (i ε INSDNG)
$TRII_{ii'}$	Transfers from institution i' to i (both in the set INSDNG)
WF_f	Average price of factor
YF_f	Income of factor f
YG	Government revenue
YI_i	Income of domestic non- government institution
YIF_{if}	Income to domestic institution i from factor f
ΔK^a_{fat}	Quantity of new capital by activity a for time period t

E) Production and Trade Block/ Equations

Equations	Explanation
CES Technology: Activity Production Fucntion: - $QA_a = \alpha_a^a \left(\delta_a^a . QVA_a^{-\rho_a^a} + (1-\delta_a^a) . QINTA_a^{-\rho_a^a} \right)^{-\frac{1}{\rho_a^a}}$ Activity level quantity of aggregate value added =CES(quantity of aggregate Intermediate input)	QA_a = Quantity (level) of activity α_a^a = efficiency parameter in the CES activity function, QVA= Quantity of (aggregate) value-added $QINTA_a$ = Quantity of aggregate intermediate input δ_a^a = CES activity function share parameter. ρ_a^a = CES activity function exponent
CES Technology: Value-Added–Intermediate-Input Ratio: - $\frac{QVA_a}{QINTA_a} = \left(\frac{PINTA_a}{PVA_a} . \frac{\delta_a^a}{1-\delta_a^a} \right)^{\frac{1}{1+\rho_a^a}}$	QVA_a = Quantity of (aggregate) value-added $QINTA_a$ = Quantity of aggregate intermediate input PVA_a = value-added price (factor income per unit of activity) δ_a^a = CES activity function share parameter. ρ_a^a = CES activity function exponent
Disaggregated Intermediate Input Demand: - $\mathrm{QINT_{ca}} = \mathrm{ica_{ca}} . \mathrm{QINTA_a}$	$\mathrm{QINT_{ca}}$ = Quantity of commodity c as intermediate input to activity a $\mathrm{ica_{ca}}$ = Quantity of c as intermediate input per unit of activity a $\mathrm{QINTA_a}$ = Quantity of aggregate intermediate input
Value-Added and Factor Demands : - $\mathrm{QVA_a} = \alpha_a^{va} . \left(\sum_{f \varepsilon F} \delta_{fa}^{va} . (\alpha_{fa}^{vaf} . QF_{fa})^{-\rho_a^{va}} \right)^{\frac{1}{\rho_a^{va}}}$	$\mathrm{QVA_a}$= Quantity of (aggregate) value-added α_a^{va} = Efficiency parameter in the CES value-added function δ_{fa}^{va} = CES value-added function share parameter for factor *f* in activity *a* α_{fa}^{vaf} = Efficiency parameter in the CES value-added function QF_{fa}= Quantity demanded of factor f ρ_a^{va} = CES value-added function exponent

Factor Demand:- $W_f.\overline{WFDIST}_{fa} = PVA_a.QVA_a.\left(\sum_{f\varepsilon F}\delta_{fa}^{va}.(\alpha_{fa}^{vaf}.QF_{fa})^{-\rho_a^{va}}\right)^{-1}.\alpha_{fa}^{va}(\alpha_{fa}^{vaf}.QF_{fa})^{-\rho_a^{va}-1}$ Marginal cost of factor f in activity a = marginal revenue product of factor f in activity a	W_f = Average price for factor f $\overline{WFDIST}_{fa}$= Wage distortion factor for factor f in activity a PVA_a =Value-added price (factor income per unit of activity) QVA_a =Quantity of (aggregate) value-added δ_{fa}^{va} = CES value-added function share parameter for factor *f* in activity *a* α_a^{va} = Efficiency parameter in the CES value-added function QF_{fa}= Quantity demanded of factor f ρ_a^{va} = CES value-added function exponent
Quantity demanded of factor f from activity a: - $QF_{fa} = \alpha_{fa}^{van}.\left(\sum_{f'}\alpha_{ff'a}^{van}.QF_{f'a}^{-\rho_a^{van}}\right)^{\frac{1}{\rho_{fa}^{van}}}$	QF_{fa} = Quantity demanded of factor f α_a^{va} = Efficiency parameter in the CES value-added function ρ_a^{va} = CES value-added function exponent
Leontief Technology: Demand for Aggregate Value Added: - $QVA_a = iva_a.QA_a$	QVA_a = Quantity of (aggregate) value-added iva_a = intermediate input per activity unit QA_a = Quantity (level) of activity
Leontief Technology: Demand for Aggregate Intermediate Input: - $QINTA_a = \text{int}\,a_a.QA_a$	$QINTA_a$ = Demand for Aggregate Intermediate Input $\text{int}\,a_a$ = intermediate input per activity unit QA_a = Quantity (level) of activity
Commodity Production and Allocation:- $QXAC_{ac} + \sum_{h\varepsilon H} QHA_{ach} = \theta_{ac}.QA_a$	$QXAC_{ac}$= Quantity of output of commodity c from activity a $\sum_{h\varepsilon H} QHA_{ach}$ = household home consumption of commodity c from activity a θ_{ac}= Yield of output c per unit of activity a QA_a = Quantity (level) of activity
Output Aggregation Function: - $QX_c = \alpha_c^{ac}\left(\sum_{a\varepsilon A}\delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ac}}\right)^{-\frac{1}{\rho_c^{ac}}}$ aggregate marketed production of commodity c=	QX_c= Aggregated quantity of domestic output of commodity α_c^{ac} = Shift parameter for domestic commodity aggregation function δ_{ac}^{ac}= Share parameter for domestic

CES(activity-specific marketed production of commodity c)	commodity aggregation function $QXAC_{ac}$ Quantity of output of commodity c from activity a ρ_c^a Domestic commodity aggregation function exponent
First-Order Condition for Output Aggregation Function: - $PXAC_{ac} = PX_c.QX_c\left(\sum_{a\varepsilon A}\delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ac}}\right)^{-1}.\delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ac}-1}$ *(*marginal cost of commodity c from activity a = marginal revenue product of commodity c from activity a)	$PXAC_{ac}$ = Producer price of commodity c for activity a PX_c = Aggregate producer price for commodity QX_c = Aggregated quantity of domestic output of commodity
Output Transformation (CET) Function: - $QX_c = \alpha_c^t.\left(\sum_r \delta_{cr}^t.QE_{cr}^{\rho_c^t} + (1-\sum_r \delta_{cr}^t).QD_c^{\rho_c^t}\right)^{\frac{1}{\rho_c^t}}$ Aggregate marketed domestic output= *CET(*export quantity, domestic sales of domestic output)	QX_c = Aggregated quantity of domestic output of commodity α_c^t = CET function shift parameter δ_{cr}^t = CET function share parameter QE_{cr}= Quantity of exports ρ_c^t = CET function exponent QD_c= Quantity sold domestically of domestic output
Export-Domestic Supply Ratio: - $\frac{QE_{CR}}{QD_C} = \left(\frac{PE_{cr}}{PDS_c}.\frac{1-\sum_r \delta_{cr}^t}{\delta_c^t}\right)^{\frac{1}{\rho_c^t-1}}$	QE_{cr} = Quantity of exports QD_c = Quantity sold domestically of domestic output PE_{cr} = Export price (domestic currency) PDS_c = produced and sold domestically δ_{cr}^t = CET function share parameter ρ_c^t = CET function exponent
Output Transformation for Domestically Sold Outputs Without Exports and for Exports Without Domestic Sales: - $QX_C = QD_C + \sum_r QE_{cr}$	QX_C = Aggregated quantity of domestic output of commodity QD_C = Quantity sold domestically of domestic output QE_{cr} = Quantity of exports

Composite Supply (Armington) Function: - $QQ_C = \alpha_c^q . \left(\sum_r \delta_{cr}^q . QM_{cr}^{-\rho_c^q} + (1 - \sum_r \delta_{cr}^q) . QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}}$	QQ_C = Quantity of goods supplied to domestic market (composite supply) α_c^q = Armington function shift parameter δ_{cr}^q = Armington function share parameter QM_{cr} = Quantity of imports of commodity c ρ_c^q = Armington function exponent QD_c = Quantity sold domestically of domestic output
Import-Domestic Demand Ratio:- $\frac{QM_{cr}}{QD_c} = \left[\left(\frac{PDD_C}{PM_c} \right) . \frac{\delta_{cr}^q}{1 - \sum_r \delta_{cr}^q} \right]^{\frac{1}{1+\rho_c^q}}$	QM_{cr} = Quantity of imports of commodity c QD_c = Quantity sold domestically of domestic output PDD_c = Demand price for commodity produced and sold domestically PM_c = Import price (domestic currency) δ_{cr}^q = Armington function share parameter ρ_c^q = Armington function exponent
Composite Supply for Non-imported Outputs and Non-produced Imports: - $QQ_c = QD_c + \sum_r QM_{cr}$	QQ_c = Quantity of goods supplied to domestic market (composite supply) QD_c = Quantity sold domestically of domestic output QM_{cr} = Quantity of imports of commodity c
Demand for Transactions Services: - $QT_c = \sum_{c' \varepsilon C'} (icm_{cc'} . QM_{cc'} + ice_{cc'} . QE_{c'} + icd_{cc'} . QD_{c'})$	QT_c = Quantity of commodity demanded as trade input $icm_{cc'}$ = Quantity of commodity c as trade input per imported unit $QM_{cc'}$ = Quantity of imports of commodity c $ice_{cc'}$ = Quantity of commodity c as trade input per exported unit c' $QE_{c'}$ = Quantity of exports $icd_{cc'}$ = Quantity of commodity c as trade input per unit of c' produced and sold domestically $QD_{c'}$ = Quantity sold domestically of domestic output

F) Price Block

Import Price: - $PM_{cr} = pwm_{cr}.(1+tm_{cr}).EXR + \sum_{c' \varepsilon CT} PQ_{c'}.icm_{c'c}$	PM_{cr} = Import price (domestic currency) pwm_{cr} = Import price (foreign currency) tm_{cr} = Import tariff rate $(1+tm_{cr})$ = tariff adjustment EXR = Exchange rate (LCU per unit of FCU) $PQ_{c'}$ = Composite commodity price $icm_{c'c}$ = Quantity of commodity c as trade input per imported unit $\sum_{c' \varepsilon CT} PQ_{c'}.icm_{c'c}$ = cost of trade inputs per import unit
Export Price: - $PE_{cr} = pwe_{cr}.(1-te_c)EXR - \sum_{c'} PQ_c.ice_{c'c'}$	pwe_{cr} = Export price (foreign currency) $(1-te_c)$ =tariff adjustment EXR = Exchange rate (LCU per unit of FCU) PQ_c = Exchange rate (LCU per unit of FCU) $ice_{c'c'}$ = Quantity of commodity c as trade input per exported unit of c' $\sum_{c'} PQ_c.ice_{c'c'}$ = cost of trade inputs per export unit
Demand Price of Domestic Non traded Goods: - $PDD_c = PDS_c + \sum_{c' \varepsilon CT} PQ_c.icd_{c'c}$	PDD_c = Demand price for commodity produced and sold domestically PDS_c = Supply price for commodity produced and sold domestically PQ_c = Composite commodity price $icd_{c'c}$ = Quantity of commodity c as trade input per unit of c' produced and sold domestically $\sum_{c' \varepsilon CT} PQ_c.icd_{c'c}$ = cost of trade inputs per unit of domestic sales

Absorption : - $PQ_c.(1-tq_c).QQ_c = PDD_c.QD_c + \sum_r PM_{cr}.QM_{cr}$	$PQ_c.(1-tq_c).QQ$ = absorption at demand prices net of sales tax PQ_c = Composite commodity price ; tq_c = Rate of sales tax QQ_c = Quantity of goods supplied to domestic market (composite supply) PDD_c = Demand price for commodity produced and sold domestically QD_c = Quantity sold domestically of domestic output PM_{cr} = Import price (domestic currency) QM_{cr} = Quantity of imports of commodity c
Marketed Output Value: $PX_c.QX_c = PDS_c.QD_c + \sum_r PE_{cr}.QE_{cr}$	$PX_c.QX_c$ = producer price times marketed output quantity PX_c = Aggregate producer price for commodity QX_c = Aggregated quantity of domestic output of commodity PDS_c = produced and sold domestically QD_c = Quantity sold domestically of domestic output PE_{cr} = Export price (domestic currency) QE_{cr} = Quantity of exports
Activity Price:- $PA_a = \sum_{c \varepsilon C} PXAC_{ac}.\theta_{ac}$	PA_a= Activity price (unit gross revenue) $\sum_{c \varepsilon C} PXAC_{ac}.\theta_{ac}$ = producer price times yields $PXAC_{ac}$= Producer price of commodity c for activity a θ_{ac} = Yield of output c per unit of activity a
Aggregate Intermediate Input Price: - $PINTA_a = \sum_{c \in C} PQ_c.ica_{ca}$	$PINTA_a$ =Aggregate intermediate input price for activity a PQ_c = Composite commodity price ica_{ca} = Quantity of c as intermediate input per unit of activity a $\sum_{c \varepsilon C} PQ_c.ica_{ca}$ = intermediate input cost per unit of aggregate intermediate input

Activity Revenue and Costs:- $PA_a.(1-ta_a).QA_a = PVA_a.QVA_a + PINTA_a.QINTA_a$	PA_a= Activity price (unit gross revenue) ta_a = Tax rate for activity a QA_a = Quantity (level) of activity PVA_a = Value-added price (factor income per unit of activity) QVA_a = Quantity of (aggregate) value-added $PINTA_a$ = Aggregate intermediate input price for activity a $QINTA_a$ = Quantity of aggregate intermediate input
Consumer Price Index: - $\overline{CPI} = \sum_{c \varepsilon C} PQ_c.cwts_c$	$\overline{CPI}$ = Consumer price index PQ_c = Composite commodity price $cwts_c$ = Weight of commodity c in the CPI
Producer Price Index for Non-traded Market Output $DPI = \sum_{c \varepsilon C} PDS_c.dwts_c$	DPI = Producer price index for domestically marketed output PDS_c = Supply price for commodity produced and sold domestically $dwts_c$ = Weight of commodity c in the producer price index

G) Institutional Incomes and Domestic Demand Equations

Equations	Explanation
Factor income: - $YF_f = \sum_{a \varepsilon A} WF_f.\overline{WFDIST}_{fa}.QF_{fa}$	YF_f = Income of factor f WF_f = Average price of factor $\overline{WFDIST}_{fa}$ = Wage distortion factor for factor f in activity a QF_{fa} = Quantity demanded of factor f
Institutional factor incomes:- $YIF_{if} = shif_{if}.\left((1-tf)YF_f - trnsfr_{rowf}.EXR\right)$	YIF_{if} = Income to domestic institution i from factor f $shif_{if}$ = Share for domestic institution i in income of factor f; tf= rate of direct tax on factors (soc sec tax) YF_f = Income of factor f $trnsfr_{if}$ = Transfer from factor f to institution i EXR = Exchange rate (LCU per unit of FCU)

Income of domestic , nongovernment institutions: - $YI_i = \sum_{f \varepsilon F} YIF_{if} + \sum_{i' \varepsilon INSDNG} TRII_{ii'} + trnsfr_{igov}.\overline{CPI} + trnsfr_{irow}.EXR$	YI_i = Income of domestic non-government institution YIF_{if} = Income to domestic institution i from factor f $TRII_{ii'}$ = Transfers from institution i' to i (both in the set INSDNG) $trnsfr_{igov}$ = Transfer from factor f institution i $\overline{CPI}$ = Consumer price index $trnsfr_{irow}$ = Transfer from factor f to institution i EXR = Exchange rate (LCU per unit of FCU)
Transfers Intra-institutional:- $TRII_{ii'} = shii_{ii'}.(1-MPS_h).(1-\overline{tins}_h).YI$	$TRII_{ii'}$ = Transfers from institution i' to i (both in the set INSDNG) $shii_{ii'}$ = Share of net income of i' o i (i' ∈ INSDNG'; i ∈ INSDNG) MPS_h = Marginal propensity to save for domestic non-government institution (exogenous variable) $\overline{tins}_h$ = Exogenous direct tax rate for domestic institution i YI_h = Income of domestic non- government institution
Household consumption Expenditure: - $EH_h = \left(1 - \sum_{i \varepsilon INSDNG} shii_{ih}\right)(1-MPS_h)(1-\overline{tins}_h).YI_h$	EH_h = Income of domestic non- government institution $shii_{ih}$ = Share of net income of i' o i (i' ∈ INSDNG'; i ∈ INSDNG) MPS_h = Marginal propensity to save for domestic non-government institution (exogenous variable) $\overline{tins}_h$ = Exogenous direct tax rate for domestic institution i YI_h = Income of domestic non- government institution

Household consumption demand for marketed commodities: -

$$PQ_c.QH_{ch} = PQ_c.\gamma^m_{ch} + \beta^m_{ch}\left(EH_h - \sum_{c'\varepsilon C} PQ_{c'}.\gamma^m_{c'h} - \sum_{a\varepsilon A}\sum_{c\varepsilon C} PXAC_{ac'}.\gamma^h_{ac'h}\right)$$

PQ_c = Composite commodity price

QH_{ch} = Quantity consumed of commodity c by household h

γ^m_{ch} = Subsistence consumption of marketed commodity c for household h

β^m_{ch} = spending on marketed commodity c for household h

EH_h = Consumption spending for household

$PXAC_{ac'}$ = Producer price of commodity c for activity a

γ^h_{ach} =subsistence consumption of home commodity c from activity a for household h

Household consumption demand for home commodities: -

$$PXAC_{ac}.QHA_{ach} = PXAC_{ac}.\gamma^h_{ach} + \beta^h_{ach}\left(EH_h - \sum_{c'\varepsilon C} PQ_{c'}.\gamma^m_{c'h} - \sum_{a\varepsilon A}\sum_{c\varepsilon C} PXAC_{ac'}.\gamma^h_{ac'h}\right)$$

$PXAC_{ac'}$ = Producer price of commodity c for activity a

QHA_{ach} = quantity of household home consumption of commodity c from activity a for household h

γ^h_{ach} =subsistence consumption of home commodity c from activity a for household h

β^h_{ach} =marginal share of consumption spending on home commodity c from activity a for household h

PQ_c = Composite commodity price

γ^m_{ch} = Subsistence consumption of marketed commodity c for household h

EH_h = Consumption spending for household

Investment demand: - $QINV_C = IADJ.\overline{qinv}_c$	$QINV_C$ = Quantity of investment demand for commodity $IADJ$ = Investment adjustment factor $\overline{qinv}_c$ = Base-year quantity of private investment demand
Government consumption demand: - $QG_C = \overline{GADJ}.\overline{qg}_c$	QG_C = Government consumption demand for commodity $\overline{GADJ}$ = Government consumption adjustment $\overline{qg}_c$ = Base-year quantity of government demand
Government expenditures: - $EG = \sum_{c \varepsilon C} PQ_c.QG_c + \sum_{i \varepsilon INSDNG} trnsfr_{igov}.\overline{CPI}$	EG = Government expenditures PQ_c = Composite commodity price QG_c = Government consumption demand for commodity $trnsfr_{igov}$ = Transfer from factor f to $_{if}$ institution i $\overline{CPI}$ = Consumer price index

System Constraints and Macroeconomic Closures

$$YG = \sum_{i \varepsilon INSDNG} \overline{tins}_i.YI_i + \sum_{f \varepsilon F} tf_f.YF_f + \sum_{a \varepsilon A} tva_a.PVA_a.QVA_a + \sum_{a \varepsilon A} ta_a.PA_a.QA_a + \sum_{c \varepsilon CMNR} tm_c.pwm_c.QM_c.EXP + \sum_{c \varepsilon CMNR} te_c.pwe_c.QE_c.EXP + \sum_{c \varepsilon C} tq_c.PQ_c.QQ_c + \sum_{f \varepsilon F} YF_{govf} + trnsfr_{govrow}.EXR$$

Government revenue= (direct taxes from institutions + direct taxes from factors + activity tax + import tariffs + sales tax + transfer from ROW)

YG = Government revenue $\overline{tins}_i$ = Exogenous direct tax rate for domestic institution i YI_i = income of domestic non-government institution tm_c = import tariff rate te_c = Export tariff rate pwm_c =Import price (foreign currency) pwe_c =Export price (foreign currency)	EXP = Exchange rate (LCU per unit of FCU) tq_c = Rate of sales tax PQ_c = Composite commodity price QQ_c = Quantity of goods supplied to domestic market (composite supply) YF_{govf} = Income of factor f $trnsfr_{govrow}$ = Transfer from factor f to institution i tf_f = direct tax rate for factor f

QM_c = Quantity of imports of commodity c QE_c = Quantity of export of commodity c EXR = exchange rate (LCU per unit of FCU) PVA_a = value-added price (factor income per unit of activity) QVA_a = quantity of (aggregate) value-added PA_a = activity price (unit gross revenue)	YF_f = income of factor f tva_a =rate of value-added tax for activity a QA_a = quantity (level) of activity ta_a = tax rate for activity a
Composite commodity markets $QQ_c = \sum_{a \varepsilon A} QINT_{ca} + \sum_{h \varepsilon H} QH_{ch} + QG_c + QINV_c + qdst_c + QT_c$ Composite Supply=intermediate use + household consumption + government consumption + fixed investment +stock change + trade input use	
QQ_c = Quantity of goods supplied to domestic market (composite supply) $QINT_{ca}$ = Quantity of commodity c as intermediate input to activity a QH_{ch} = Quantity consumed of commodity c by household h	QG_c = Government consumption demand for commodity $QINV_c$ = Quantity of investment demand for commodity $qdst_c$ = Quantity of stock change QT_c = Quantity of commodity demanded as trade input
Current account balance (in foreign currency)for rest of the world: $\sum_{rc \varepsilon CMNR} pwm_{cr}.QM_{cr} + \sum_{f \varepsilon F} trnsfr_{rowf} = \sum_{rc \varepsilon CENR} pwe_{cr}.QE_{cr} + \sum_{I \varepsilon INSD} trnsfr_{irow} + FSAV$ Import spending + factor to RoW transfers = export revenue + institutional transfer from ROW + foreign savings	
pwm_{cr} = Import price (foreign currency) QM_{cr} = Quantity of imports of commodity c $trnsfr_{rowf}$ = Transfer from factor f to institution i	pwe_{cr} = Export price (foreign currency) QE_{cr} = Quantity of exports $trnsfr_{irow}$ = Transfer from factor f to institution i $FSAV$ = Foreign savings (FCU)

Savings - Investment Balance:

$$\sum_{i \varepsilon INSDNG} MPS_i.(1-\overline{tins_i}).YI_i + GSAV + EXR.FSAV = \sum_{c \varepsilon C} PQ_c.QINV_c + \sum_{c \varepsilon C} PQ_c.qdst_c + WALRAS$$

Non government saving + government savings + foreign savings = fixed investment + stock change

MPS_i = Marginal propensity to save for domestic non-government institution (exogenous variable) $\overline{tins_i}$ = Exogenous direct tax rate for domestic institution i YI_i = Income of domestic non-government institution $GSAV$ = Government savings	EXR = Exchange rate (LCU per unit of FCU) $FSAV$ = Foreign savings (FCU) PQ_c = Composite commodity price $QINV$ = Quantity of investment demand for commodity $qdst_c$ = Quantity of stock change WALRAS= Saving- Investment Gap

$$MPS_i = \overline{mps_i}.(1+MPSADJ)$$

MPS_i = Marginal propensity to save for domestic non-government institution (exogenous variable)	$\overline{mps_i}$ = Base savings rate for domestic institution i $MPSADJ$ = Savings rate scaling factor (= 0 for base)

Government balance: -

$$YG = EG + GSAV$$

Government revenue =government expenditure + government savings

YG = Government revenue, EG = Government expenditures	$GSAV$ = Government savings

Factor Market Balance:- $\sum_{a \varepsilon A} QF_{fa} = QFS_f$: Demand for factor = Supply for factor

QF_{fa} = Quantity demanded of factor f	QFS_f = Quantity supplied of factor

Total absorption: -

$$TABS = \sum_{h \varepsilon H} \sum_{c \varepsilon C} PQ_c.QH_{ch} + \sum_{a \varepsilon A} \sum_{Ac \varepsilon C} \sum_{h \varepsilon h} PXAC_{ac}.QHA_{ach} + \sum_{c \varepsilon C} PQ_c.QG_c + \sum_{c \varepsilon C} PQ_c.QINV_c + \sum_{c \varepsilon C} PQ_c.q$$

Total absorption=household market consumption + household home consumption + government consumption + fixed investment + stock change

$TABS$ = total nominal absorption PQ_c = Composite commodity price QH_{ch} = quantity consumed of commodity c by household h $qdst_c$ = quantity of stock change	QHA_{ach} = quantity of household home consumption of commodity c from activity a for household h QG_c = government consumption demand for commodity $PXAC_{ac}$ = producer price of commodity c for activity a

Ratio of investment to absorption: - $INVSHR.TABS = \sum_{c \varepsilon C} PQ_c.QINV_c + \sum_{c \varepsilon C} PQ_c.qdst_c$

(Total absorption ratio) (total absorption) = fixed investment + stock change

$INVSHR$ = Investment share $TABS$ = total nominal absorption	PQ_c = Composite commodity price $QINV_c$ =quantity of investment demand for commodity $qdst_c$ = quantity of stock change

Ratio of government consumption to absorption: -

$GOVSHR.TABS = \sum_{c \varepsilon C} PQ_c.QG_c$: (Government consumption absorption ratio) (total absorption)= government consumption

$GOVSHR$ = government consumption share in nominal absorption $TABS$ = total nominal absorption	PQ_c = Composite commodity price QG_c = government consumption demand for commodity