The Impacts of Public Spending on Economic Growth and Poverty Reduction in Ethiopia: A Dynamic Computable General Equilibrium Analysis

By: Jibril Haji Ketebo

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Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university, and that all sources of materials used for the thesis have been duly acknowledged. The advisor's and examiners' comments have been duly incorporated.

Declared by:

Name: Jibril Haji Ketebo

Signature: _______________ Date: _____________________________

Approved by: Board of Committee

Advisor: TassewWoldehanna (Associate Professor)

Signature: _________________ Date: ____________________________

Internal Examiner: Girma Estiphanos (PhD)

Signature: _________________ Date: ____________________________

External Examiner: AlebelBayiru (PhD)

Signature: _________________Date: ____________________________

Abstract

Public expenditure could play an important role in promoting economic growth and poverty reduction. Given the significant role of public spending, this study empirically explores the impacts of public spending on long-run economic growth and poverty reduction in Ethiopia. In particular, the researcher assessed the effects of public spending (disaggregated by function into human capital and agriculture) that can be financed via government saving or foreign saving on economic growth and poverty reduction in the country through its indirect effects on total factor productivity. The researcher employed a dynamic computable general equilibrium model that linked with micro simulation model that is solved recursively for the period 2009-2020. The CGE model used the updated 2009/10 social accounting matrix (SAM) while the MS model employed the 2004/05 household income, consumption and expenditure (HICE) survey to investigate household poverty via the consumption expenditure changes from the CGE model.

The results of the study revealed that the government spending either allocated towards human capital or agriculture has improved the macro-economy, welfare and poverty situation of the country regardless of financing options. Given high elasticity of public expenditure on human capital with respect to total factor productivity, public spending targeted towards human capital resulted in high GDP growth and hence significantly reduced the poverty as compared to expenditure targeted agricultural sector. Moreover, the magnitudes of the welfare and poverty improvements is differ among financing options where the improvement of welfare of households and reduction of poverty is large under foreign saving means of financing against government saving financing schemes.

Financing additional public expenditure through foreign saving increases the consumption of all households group more than financing through domestic resources (government saving) as households are supposed to save more at the expense of consumption under government saving financing option. In each simulation, the urban households reap more benefit from the improvement of income and consumption than rural households.

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Table of Contents

List of Figures

List of Tables

List of Appendices

List of Acronyms

CES-Constant Elasticity of Substitution

CGE – Computable General Equilibrium

DAD – Distributive Analysis Software

EDRI – Ethiopian Development Research Institute

EEA – Ethiopian Economic Association

EV-Equivalent Variations

FGT – Foster-Greer-Torbecke

GDP – Gross Domestic Product

GE – General Equilibrium

GTP – Growth and Transformation Plan

HDI – Human Development Index

HICES – Household Income, Consumption and Expenditure Survey

HIPC – Highly Indebted Poor Countries

IFPRI – International Food Policy Research Institute

IMF – International Monetary Fund

MDG – Millennium Development Goals

MOFED – Ministry of Finance and Economic Development

MS – Micro Simulation

PASDEP – Plan for Accelerated and Sustained Development to End Poverty

ROW – Rest of World

SAM – Social Accounting Matrix

SDPRP – Sustainable Development and Poverty Reduction Program

S-I – Saving-Investment

TFP- Total Factor Productivity

UN- United Nation

CHAPTER ONE

INTRODUCTION

1. 1Background of the Study

With a population of over 80 million, Ethiopia is one of the poorest and least developed countries in the world. According to 2004/05 household income and expenditure survey (HIES), the proportion of population below the poverty line at national level measured by poverty head count index is 38.5 percent. In 2010/11 the percentages of poor people reduced to 29.6 percent according to 2012 interim poverty report. Though there is an improvement in poverty level, still many of people live under the poverty line. On the United Nations Development Program's 2011 human development index, Ethiopia ranks 174 out of 187 countries. Human development indicators are low, with exceptionally alarming statistics regarding food security and women's status and well-being.

However, in recent time Ethiopia is one of the developing countries that performed well in economic growth. According to MOFED (2011) report Real GDP averaged growth 11.4 percent per annum during the period between 2003/04 and 2010/11, which placed Ethiopia among the highly performed countries in sub-Saharan Africa. Hence, this virtuous growth performance can significantly contribute to the poverty reduction strategy and meeting of both MDGs and current growth and transformation plan (GTP) of Ethiopia.

As the developing countries national governments develop plans for sustainable growth and reducing poverty with the support of their development partners, it need clear understanding of the specific mechanisms through which public policy interventions can contribute to growth and poverty reduction. Governments can use a diverse set of interventions to achieve various development objectives including trade, price, tax, monetary, and spending policies. Among these, public spending is one of the most effective instruments that governments can use to achieve development goals such as economic growth and poverty reduction.

Given the severity of poverty and the quest for accelerated growth and development, the government of Ethiopia has adopted various policy measures and strategies. In 2002, Ethiopia launched the full poverty reduction strategy program known as Ethiopia's sustainable development and poverty reduction program (SDPRP) that gave main emphasis in areas such as infrastructure, rural development, human development, good governance and social security. As the MDGs initiative started in 2000, the SDPRP targeted economic growth averaging 7 percent per annual in order to reduce poverty by half in 2015. Building on the performance of previous poverty reduction strategies –the sustainable development and poverty reduction program for 2002/03-2004/05 and a plan for accelerated and sustainable development to end poverty for 2005/06-2009/10(PASDEP) were developed. In addition to the objectives of SDPRP, PASDEP includes new focus areas such as private sector development, urban development, industry and the commercialization of agriculture.

Currently in line of PASDEP, growth and transformation plan (GTP) intended to achieve the MDGs in Ethiopia by 2015 and reaching middle income status by 2020-23 are introduced. The core objectives of GTP are to: attain high growth with stable macro-economic framework and achieve MDGs in social sector- investment in human capital through sustains rapid growth, invest in infrastructure and enhance social development. All these strategies force the government and other international development community intensifying their efforts to increase and redirect resource in order to achieve specific development objectives.In order to improve the welfare of citizens' nations can spend their financial resources in many ways. Investment in such things as research and development, health, education and infrastructure may facilitate economic growth and hence reducing poverty over long term. However, given the financing means have not been secured to achieve all these objectives, public spending should have to be prioritized and based on various costs and benefits analysis (Edward Anderson, 20006).

UN millennium project (2005) has re-emphasized the need for a big push strategy in public investment to help poor countries break out of their poverty trap and meet the MDG challenge. The report argues that to enable all countries to achieve the MDG, there should be identification of priority public investments to empower poor people and achieve the rapid economic growth (Chemingui, M., 2007). This big push investment strategy is designed to set low –income economies on growth path that will become self-sustainable, as core investment in infrastructure and human capital will enable poor people to join the global economy and establish the base for private sector led diversified exports and economic growth.

1.2Statement of the Problem

In the last three to five decades, many studies have analyzed the relative contribution of factor inputs and technical progress to economic growth. The studies on the determinants of economic growth highlight the importance of total factor productivity, such as Easterly and Levine (2000), who explain that the salient features of countries' growth experience cannot be explained by factor accumulation alone. Since the seminal work of Solow (1957), total factor productivity—defined as the efficiency with which firms turn inputs into outputs—has been considered as the major factor in generating growth.

Ethiopia has undertaken a far-reaching program of economic reforms, which have delivered strong economic growth (IMF Report, 2011). Accordingly, the Ethiopian government has been designing and implementing strategies and plans to manage the overall development of the country and achieve its key objective of broad-based, accelerated, and sustained economic growth so as to eradicate poverty. Policies like MDGs, GTP and reaching middle income status countries have been introduced to increase public spending on human capital, agriculture and infrastructure, among other things. Particularly, Economic growth and other development targets set in the GTP are even higher than those in PASDEP and earlier plans. Achieving these targets, however, will require very large productivity growth and huge amounts of financial resources anticipated to be sourced from increased domestic saving mobilization, foreign direct investment, and foreign borrowing. As Ethiopia pursue macroeconomic adjustment in relation to its limited public resource it is critical to analyze the relative contribution of various government spending to growth and poverty reducing in order to gain valuable insights for improving efficiency and effectiveness of public spending.

Various study attempted to analyze the impact of government spending (education, health, infrastructure, agriculture, or a combination of them) on economic growth and poverty reduction, such as Lofgren and Robinson (2004), Chemingui M. (2007), Agenor.et al (2004) (by applying dynamic CGE model), Fan et al. (1999 , 2002, 2004 ,2006), using regression analysis, Tewodaj.et al (2006) and Lofgren.et al (2005). However, the empirical evidence across studies on the relative contributions of public investment across different sectors in different countries is mixed (both in magnitudes and direction of impacts); as the impact of public spending is limited by various factors and constraints such as targeting, good governance, composition of expenditure and institutional quality; and also perhaps reflecting the range of methodologies employed, the variation in the types of economies studied and the relative sectoral emphases of the different studies. Those studies that examine the link between public expenditure and development outcomes fall into one or two or more of economic sectors.

Moreover, the expansion of public spending can affect economic growth and poverty through different channel though the impact varies from country to country based on the structure of its economy and its initial physical capital stock (Edward Anderson et al, 2006). Public investment could affect the economy both at the macro and micro levels. It can directly or indirectly affect the economic growth. Public expenditure directly affects the production of output through entering into the production function as third input (public capital), in addition to private capital and labor. As enumerated in many literatures, public spending indirectly affect economic growth through improving the productivity of inputs as investment on human and physical capital increased the efficiency of total factor productivity (TFP) (Lofgren and Robinson 2004, Chemingui, M. 2007). Hence, through improvement of TFP, the economy will grow faster. Consequently, as public policies were found to affect poverty indirectly through their impact on growth and income distribution, poverty will decline.

The contribution of public investment to growth and poverty reduction has not always been as positive as one might expect. Easterly et.al (2001) founded that public expenditure between 1974 and 1982 often yielded few returns due to badly implemented, investment portfolio priority. In many developing countries, resource allocations are based on political rather than technical priorities (Wilhelm, V. and Fiestas, I., 2005).Furthermore, the means of financing additional public expenditure can have a significant implication for macro-economic growth and poverty reduction. The effects of financing additional public spending via domestic resource mobilization or international transfers in the form of grant/foreign aid could affect macro-economic variable such as real GDP, absorption, private consumption, exports, imports, etc. and poverty indicators in different ways (both in magnitude and directions). Thus, the issue of effectiveness and efficiency of public investment and its appropriate resource allocation given limited public resource should be re-examined. In other word, exploring the linkage between public spending, growth and poverty reduction, with the aim of providing information on the relative contribution of additional public spending financed through different means of financing is very vital. In addition to this, understanding the linkage can enable government to set priorities for expenditures. This is particularly important at present, as we are once again witnessing pressure for substantial increase in public investment in Ethiopia, likewise other developing countries.

In Ethiopia there are a few studies that have examined the effects of public spending on growth and poverty. One can mention such as Agenor.et al (2004), Lofgren et al (2005) and Tewodaj Mogues.et al (2006) are among done research papers related to the growth and poverty impacts of public investment. Agenor et al (2004) applies an aggregate one-representative, one good macroeconomic model to Ethiopia that link between foreign aid, public investment, economic growth and poverty reduction. Agenor et al simulate the effects of a shift from recurrent to capital expenditure rather than considering additional public spending targeted towards specific economic sectors at one time. Lofgren applies the dynamic CGE model to assess the impacts of public spending allocated either to human capital or infrastructure on MDGs indicator. Using multi-stage analysis TewodajMogues et al. analyses the relative contribution of public spending across sectors to household welfare of Ethiopia. The study found that the returns to road investments are both significantly higher than returns to other spending, as well as much more variable across regions (higher returns in those areas which have a better developed road networks). On the other hand, the household expenditure impacts of per capita public expenditure in agriculture and in education are smaller but also less variable across regions than the effects of road spending.

Therefore, despite the abundance research done on economic growth and poverty, the rigorous economy-wide studies to address the relative contribution of public spending policies across sectors are scarce in Ethiopia though growth and poverty reduction are core public policy problems. In an effort to fill this knowledge gap, the objective of the paper is to examine the channels through which public spending in Ethiopia affect development indicators in long-run and to identify the relative contribution so as to maximize the social and economic development impact of limited public resource using dynamic CGE model.

1. 3 The Research Questions and Objectives

The core research questions of the study are:

- How much do alternative government spending strategies (human capital and agricultural expenditures) contribute to economic growth and poverty reduction?
- What is the trade-offs and policy implications of alternative means of financing these public spending?

The main objective of the study is to explore the link between public spending, growth and poverty reduction in Ethiopia. Specifically the paper attempt to:

- Ø quantify the impacts of increase in public spending targeted towards human capital and agricultural sectors on economic growth and poverty reduction
- Ø Assess the impact of different means of financing additional spending in specific areas (such as funding from foreign aid and mobilization of domestic resource in the form of government saving)
- Ø Point out the trade-offs and policy implication of financing public spending through domestic resources in the form of government saving or via foreign grant

1.4 Methodology of the Study

To attain the stated objectives, the researcher used the recursive dynamic Computable General Equilibrium (CGE) model to analyze the impacts of public spending on growth and poverty reduction in Ethiopia. The standard CGE model that is linked to a Micro-Simulation model is used. It is numerically calibrated based on the 2009/10 adjusted Ethiopian SAM while the MS model is employed 2004/05 household income, consumption and expenditure (HICE) survey of the Central Statistical Agency to solve the impacts of public spending policies on poverty. The model is dynamic and is solved recursively from 2009-2020. The basic features of the CGE model are: the optimizers respond to relative price, that is, changes in relative prices signal to agents need for altering their production, trade and consumption patterns, and the behavior of core agents are derived from constrained optimization problems as economic theory requires. In general the CGE models employ the market clearance, zero profit and income balance conditions to solve simultaneously for the set of prices and the allocation of goods and factors that support general equilibrium.

The CGE modeling approach has been chosen because the public spending reform that Ethiopia is currently witnessing are so large that both the first order and second order effects are very likely to be important. In other words, this modeling framework permits both the first order and second order effects and macro-economic dimensions of public expenditure shocks to be captured. Furthermore when inter-sectoral comparisons are necessary as in the case of assessing alternative investment portfolio CGE models can be helpful. These allow for quantitative macroeconomic analysis of a large variety of public investment policies. The economic wide approach support analysis of the trade-off and synergies between different public spending strategies.

As the impact of public spending on economic growth and poverty can vary across different financing scenarios, alternative ways of financing these additional spending could also be considered. The additional public spending can be financed through domestic resources, foreign aid (external grant) and/or foreign or domestic borrowings. In this study three ways of financing additional spending were considered, which includes rising of domestic resources in the form of government saving, direct international transfers in the form of foreign grant and a combination of domestic resources and foreign grants. In all cases, there could be increasing public spending in priority/specific areas while keeping unchanged its level on the remaining areas. There are two alternative public scenarios that were assessed for every financing scheme adopted. That is increasing in public spending in human capital and agriculture. The alternative scenarios assume an increase in public spending devoted to a given sector will improve the total productivity of an economy. Such an improvement in TFP will affect the whole economy directly, in general, and poverty level indirectly through changes in the household consumption expenditures and consumer price index, in particular.

1. 5 Significance of the study

Sustainable growth and poverty reduction have been core components of development objective and hence among the highest priorities of the government of Ethiopia. Government spending is basic means of achieving such objectives. Given the shortage of financial resources on one hand and numerous sector needs government spending on the other hand, the government has to face a difficult task of choosing prior spending strategies to achieve the growth and poverty reduction objectives. Thus, this study provides developing countries, including Ethiopia's, policymakers with the empirical evidence they need to create priorities for their public resources and to increase the efficiency of public interventions. By comparing the simulation result of alternative spending strategies, the study could suggest policy-makers with the best strategies which in turn support policy decision on government spending and investments. In addition, it could also help future researchers interested in extending areas in various dimensions.

1.6 Scope of the study

The study basically focused on the impact of public spending on growth and poverty reduction in Ethiopia. The impacts of government expenditures can be assessed based on economic classification (recurrent and capital expenditures) and functional allocation (includes spending on defense, public administration, health, education and infrastructure); but this study explore the impacts of public spending based on sectoral/functional allocation (human capital and agricultural) as it is the main means of achieving various development objectives. The paper were used the 2009/10 updated Ethiopian social accounting matrix (SAM).

1.7 Organization of the paper

The study is organized as follows. The first chapter discusses the general purposes of the paper. The second chapter reviews various related literature on the link between public spending, growth and poverty. Chapter three overview the Ethiopia economy along with the trends and composition of public expenditures based on economic and functional classification. The fourth chapters introduce the data base (SAM) and specifies theoretical framework for the CGE and MS models. The fifth chapter simulates the impacts of reforming government spending and its allocation among economic sectors on economic growth and poverty reduction using a computable general equilibrium (CGE) and Micro-simulation (MS) models. Finally the study provides concluding remarks and policy implications.

CHAPTER TWO

Review of the Literature

2.1 Theoretical Literature

2.1.1 Theoretical Underpinning of Public Spending

Since the times of Keynes, the role of government in influencing the economy has become an area of intense debate in economics. This institution has gained a central position in the allocation of resources, stabilization of the economy, realization of economic growth, and redistribution of income (Tanzi, 2008). While the instruments to bring about these objectives may differ, as Tanzi argues, there is a consensus that the role of the government revolves around these major objectives. During 1950s and 1960s many economist believed that government intervention was one of the best way to achieve different development goals such as economic growth and poverty reduction in a given country though yet the direct and indirect impacts of public spending on economic growth and poverty reduction remained inconclusive.

But, in 1980s there was a growing debate on the importance of government intervention. Indeed, government expenditure policies are one of the major components of fiscal policies. The major government instruments constitute government consumption and investment. The consumption aspects constitute mainly wage and non-wage consumption of the government expenditures whereas investment aspect represents allocation of government funds mainly to the provision of public goods such health and education (Cavallo, 2005). The broad principles for guiding public expenditure allocations are based on the need to address market failure (public goods, externalities) to promote growth, and improve distribution and reduce poverty through public interventions. The sources of market failure commonly identified in the literature are: the absence of competitive markets, the existence of positive or negative externalities in consumption and production, the undersupply of public goods by the market, imperfect information on production and consumption opportunities and coordination failures(Wilhelm, V. and Fiestas, I., 2005).

Public investment can be defined as public expenditure that adds to the public physical capital stock which includes building of roads, schools, hospitals, electric power, etc. This corresponds to the definition of public investment, in national income account data, capital expenditure (Lofgren and Robinson, 2004). It is important to recognize that, unlike tax policy, where the theory of optimal taxation was developed; there is not a comparable theory of optimal expenditure policy that provides comparably well-defined rules for expenditure allocation (Stefano Paternostro et al, 2005). Since public resources are limited and thus have opportunity costs, setting priorities is critical. Hence, policymakers must set their priorities among the many classifications of government spending.

The IMF and WB often divide total spending in to three broad categories: economic spending (agriculture and infrastructure), social spending (education, health, nutrition and safety nets) and public administration and defense spending. Government spending can also divided into those expenditures whose welfare goals are meant to be realized in the long-term or short-term (Ali, G.A., and Fan, G., 2007). The long-term expenditures include investment on human and physical capital (infrastructure, education, health, and technology) while the short-term expenditures are social safety nets/welfare spending. Public expenditure diverts economic resources in to channels determined by the government in accordance with national objectives and public policy. As a consequence, the scale and direction of public expenditure may affect the: pattern and levels of consumption, volume of production, allocation of resource, distribution of income, levels of prices and employment.

2.1.2 TheoreticalLinkages of Government Spending,Economic Growth and Poverty

In this section, the study discusses different channels through which public spending can affect economic growth and poverty reduction. The researcher review different literature on the direct or indirect effects of public spending on economy-wide variables and on households and firms which in turn important to analyze the impact of public investment on poverty reduction.

Existing evidence on the growth and poverty impacts of public spending is hardly conclusive and complex, but points to a number of interesting issues. However, in recent years there has been a growing body literature that establishes the link between public expenditure, economic growth and poverty. As identified in many literatures the basic concern of poverty reduction and economic growth lies in pro-poor investment.

The theories and evidence shows that there are several channels through which public investment can affect economic growth, household's incomes and poverty, and that the impacts can be direct or indirect that can be assessed at several levels (e.g. household, regional and national). In the literature it is generally assumed that public capital forms an element in the macroeconomic production function and enters in two ways(Chemingui, M., 2007). First, its stock may enter the production function directly, as a third input. Second, its stock may influence multifactor productivity (through total factor productivity) and thereby production in an indirect way. It depends on the functional form of the production function whether both effects can be identified. As economic growth is mostly driven by labor, physical capital and total factor productivity (TFP), which includes human capital, any investment intended to improve the productivity of labor, physical capital and TFP will improve the sustainability of economic growth and hence in reducing poverty in a given country.

Public spending on research and development (R&D), infrastructure, and human capital is believed to be one of the leading determinants of economic growth, mainly by improving TFP (Fan et al. 2002,Chemingui, M., 2007, Robinson and Lofgren, 2004). According to Agenor.et al (2004) public investment particularly infrastructure may increase private capital formation and thus the overall rate of accumulation of physical capital. It also might affect output growth by influencing rate of productivity growth, independently of its effect on factor accumulation. He claimed that the increase in the stock of public capital in health raises the efficiency of educated labor whereas the increase in stock of public capital in core infrastructure raises the marginal productivity of all other production factors and hence higher domestic economic growth.

Public expenditure typically affects poverty through three channels: economic growths, employment and wages. It implied that, firstly through entering into growth equation, public investment on human capital and physical capital affects growth. Secondly, the growth of GDP can significantly affects employment and wages. As a result, poverty will be affected. It also helps to increase national productivity which in turn helps to increase wages and employment. Increase in agricultural output through public investment in rural infrastructure often leads to lower food price which indirectly helps to reduce the incidence of poverty (GaziMinul Hassan, 2006). Thus, public investments on education, health and rural infrastructure have significantly contributed to growth directly, and towards poverty reduction indirectly. There is a broad consensus that a scaling up of investment in low-income countries, particularly human capital and infrastructure, is critical to achieve sustained economic growth. In many low income countries, deficiency in infrastructure, especially in energy, roads and communication, reduce productivity at least as much as structural factors, such as bureaucracy, corruption, and lack of financing (Calvo, C. and Dercon, S., 2007).

Public spending can also indirectly help to develop the private sector and have a direct impact on the poor, through direct transfers to households and through public spending on social services and private investment. According to Edward Anderson et al (2006), at the macro level, the channels through which public investment can affect economic growth are namely: complementing private capital, crowd-in private investment, increased market integration, aggregate demand and national saving and other affects such as employment and real exchange rate. At micro level, it affects the household welfare and firms profit through affecting the quality and/or quantity of public goods and services, and price effect.

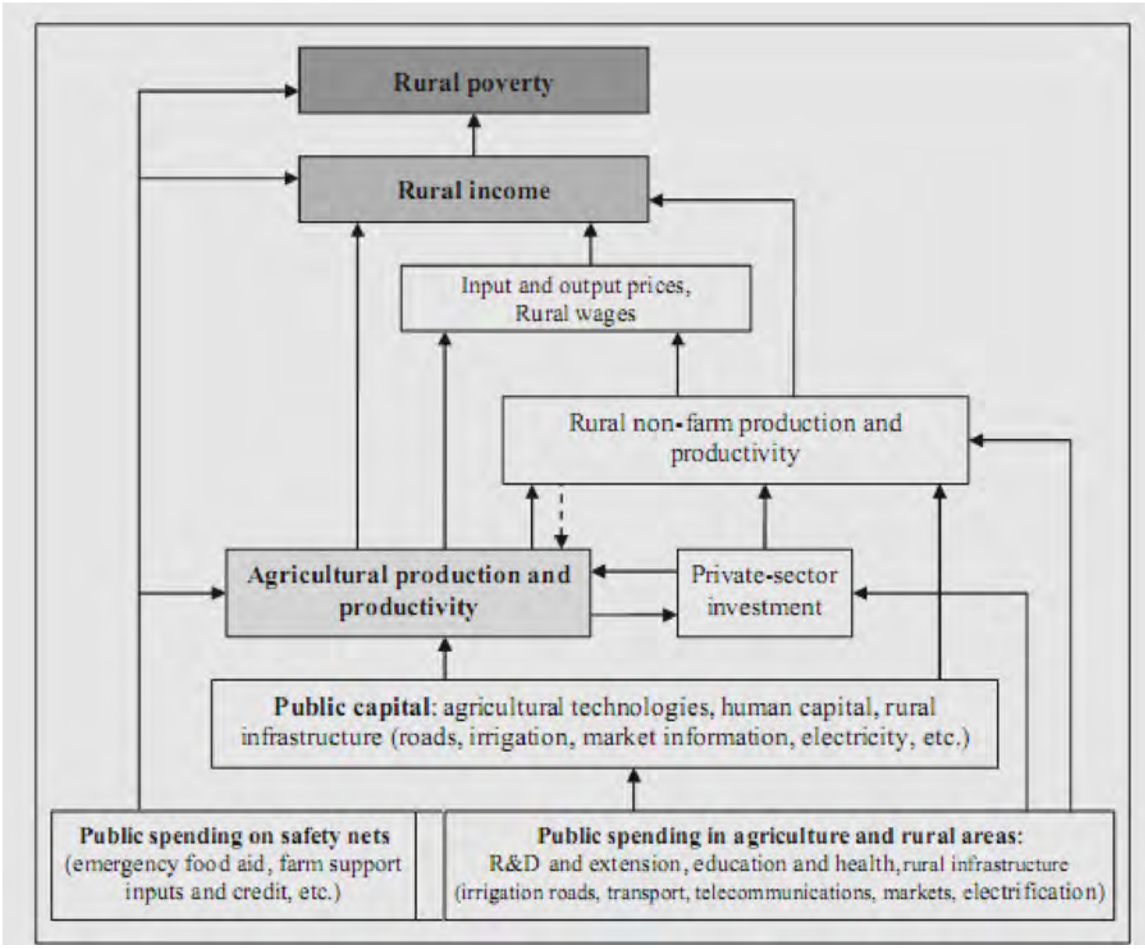
Fan et al. (2002) have indicated that government spending on production-enhancing investments, such as agriculture and research development, irrigation, education and infrastructure, all contributed to agricultural productivity growth and reduced regional inequality and rural poverty. This induces linkage effects through income generation and reallocation of production factor which may ultimately will lead to poverty reduction. Improvement in TFP implies efficient use of inputs which in turn can faster economic growth. Consequently, there could be an improvement in income and welfare; then poverty will decline.

Tewodaj, M. et al (2006) revealed that public spending on agriculture, health, education, and other sectors builds up public capital and improves public services at the sector level. Better public services and sector-level development increases incomes of rural residents in two ways: it fosters agricultural productivity, which improves agricultural incomes, and also enables more non-farm income earning opportunities, which increases both wages and off-farm employment. Agricultural productivity has also a price effect, as it reduces agricultural price relative to other prices. Hence, the prices and farm and off-farm income effects significantly contribute to poverty reduction**.** Wilhelm, V. and Fiestas, I. (2005) argues that public spending has a potential to affect growth and poverty reduction in two ways: first it can raises the overall performance of the economy; secondly it can increase the chances of poor to contribute to the growth process mainly by strengthening human capabilities and reducing the transaction costs. Public spending can also be a significant determinant of growth if countries are able to devote a significant fraction of these expenditures to productive uses in connection with private sector investment (Blanca Moreno-Dodson, 2010).

Moreover, Fan.et al have modeled and estimated the impacts of different types of public investment on economic growth and poverty reduction as well as on other development indicators (see Fan et al. 2000, 2004, 2005; Fan and Rao 2003; Fan and Zhang 2004). For instance, they indicate channels through which public investment affect agricultural growth and rural poverty in different countries. Figure 2.1 provides a conceptual framework of the potential channels through which various types of public investment in agriculture and rural areas can affect agricultural production, rural income and poverty.

The various types of public expenditure including spending on agricultural research and development (R&D), extension, education, health, and infrastructure lead to the development of public capital in related activities, which in turn affect agriculture productivity and production. A key underlying assumption linking public capital and agriculture production is that public and private capital are complements (Edward Anderson.et al. 2006), so that an increase in the public capital stock raises the productivity of all factors in agricultural production including private capital, which in turn leads to higher farm wages and incomes and poverty reduction.

Figure 2.1: Growth and Poverty reduction pathways of public spending in rural areas



Source: Fan, S. et al(2008)

In addition to their agricultural productivity impacts, public investment in rural areas directly creates non-farm rural employment opportunities, thereby directly improving rural wages and incomes and hence reducing rural poverty. Investment in safety nets (such as emergency food aid and farm support programs) directly supports the incomes and consumption of specific socioeconomic groups, especially those that are unable to participate at all or equally in the growth process (including the aged, pregnant women, children, disabled persons, and internally displaced persons) (Fan et al, 2004). Such direct transfers can also contribute indirectly to the growth and poverty-reduction process by raising the productivity of those target groups through investments in their human capital including education, skills, health, and nutrition (Schultz, 1982). However, recipients of such transfers may alter their farm labor supply, which may negatively impact agriculture production or their consumption and savings choices such that the net income gain is less than the amount of the transfers (Van de Walle, 2003). There are also indirect price effects of transfers, particularly arising from subsidies to producers or suppliers for restricting or encouraging production and supply of particular agricultural inputs and commodities. However, because of the market-distorting characteristics, such transfers can crowd out private investment in agriculture. Another key impacts pathway derives from market development and integration arising from reduced transportation and transaction costs with increased public spending on infrastructure which in turn leads to reduced input and food prices and hence raises the real income of households.

The other important point is that the source of financing public spending has important implications for private sector and overall growth and poverty reduction through multiplier effects. Basically, government revenue which used to finance public spending derived from domestic sources (taxes and domestic borrowings) and foreign sources (grants and loans). Financing through taxes can have an inconclusive effect (Minea, 2008). For instance the increase of tax revenue to financing public spending might reduce the savings as households adjust their consumption which in turn will lead to raise interest rates and may crowd out private investment. The same is true for domestic borrowing. To that extent, public spending is financed from external sources, but it will tend to appreciate real foreign exchange rate and in turn reduce the competitiveness of the tradable sectors and economic growth (Minea, 2008). Though several studies pointed out the impacts of public spending, different types of public spending share common pathways affect or are affected by other types of public spending, suggesting that it may be difficult to attribute impacts to a single type of public investment and hence substitutability and complementarity among investment is important.

The impacts of public spending can differ depending on various factors. According to Edward Anderson et al (2006), the impact of public investment will be varied depending on: kind of investment, amount of investment, initial stock of public sector and economic context in which investment occurs. In addition to these, complementarity of public spending across sectors, spending priorities within sectors, institutional quality and good governance (execution and planning of budget) determine the efficiency of public spending(Wilhelm, V. and Fiestas, I., 2007).

2.2 Empirical Literature

Using econometric, statistical and general equilibrium method of analyses, various empirical studies indicate that the impact of various types of government spending on economic growth and poverty is mixed. Fan and Rao (2004) estimate Cobb-Douglas production functions for Africa, Asia, and Latin America with national GDP as the dependent variable, and, as independent variables, labor, private capital, and public capital stocks. The latter are disaggregated into agriculture, education, health, transportation and telecommunication, social security, and defense. Public capital stocks variables were constructed from past government spending (both current and capital) in each functional area. In Africa, government spending on agriculture and health was particularly strong in promoting economic growth while defense and education spending has a negative effect (which is wrong sign for education). Asia's investment in agriculture, education, and defense had positive growth-promoting effects.

Growth in agricultural production is most crucial for poverty alleviation in rural areas (Fan and Rao, 2003). Uganda and Thailand case study found that additional spending on agricultural research and development improves agricultural productivity the most and hence the largest impact in reducing rural poverty. Education spending has the largest poverty reducing effects in several studies (e.g. Fan et al. 2002 and Fan and Rao, 2004), while transportation spending has either limited or even negative impact on poverty (Lofgren and Robinson, 2004).

In two separate studies, Fan et al. (1999) and Fan et al. (2002) have tried to analyze the role of different types of Government expenditures in contributing to poverty alleviation in rural areas in India and China, respectively. The results indicate that Government's production-enhancing investments in agriculture, investment in rural infrastructure, and expenditures on health and education have a visible impact on poverty, with expenditures on education having the largest impact in reducing poverty in the case of China, and expenditures on roads to have the largest impact in the case of India.

Using dynamic CGE model, Lofgren and Robinson (2004) for Sub-Saharan Africa simulates the effect of a reallocation of government demand into alternative priority areas (agriculture, human capital, and infrastructure) while keeping the real growth of total government demand constant. The paper simulates several policy scenarios, from an increase only in agriculture or human capital or infrastructure, to a combined increased in all sectors. They found that an increase of public spending in human capital (education and health), agriculture or infrastructure has a positive effect on growth and hence an even larger effect on poverty reduction. But, if the objective is poverty reduction, investment in agriculture is likely to be most effective, followed by investments in human capital and infrastructure. They simulate the impacts of an increase in government demand (both consumption and investment) by 1.9% per year and they found that most macro aggregates, including real household consumption, grow at annual rates of between 1.5% and 2% while the headcount poverty rate remain roughly the same. Regarding to the simulation that involve the reallocating government demand into alternative priority areas while keeping the real growth of total government demand constant shows that the reallocating spending exclusively to agriculture, terminal year headcount poverty rate is 2.7% points lower than the base simulation.

The study by Lofgren and Robinson (2004) compares the effects of alternative means of financing additional government spending (comparing financing through domestic resource mobilization or through foreign aid). The results clearly shows that the return from government spending in target areas without cuts elsewhere are lower since, in the absence of foreign financing, less resource is available for private consumption and investment which implied that foreign grant can play a significant role in strategies aimed at drastic improvements in economic performance.

Fan, S.et al 2006, using CGE model for Egypt, indicated that a targeted cash transfer program promotes higher GDP growth than targeted subsidies. Both macro and micro indicators are higher under the cash transfer program than under the subsidies. Using simultaneous equation model, the study by Gazi showed that government expenditure on education, health and rural development significantly contributed to the growth with elasticity of 0.126, 0.161 and 0.245 respectively and hence towards poverty reduction indirectly. As per sector, the finding reveal that a unit increases in education, health and agricultural development expenditure reduces the incidence of poverty by 0.05, 0.1 and 0.16 percentage respectively. Calvon and Dercon, 2007 using physical indicators of infrastructure showed that if low income countries halved their infrastructure gap, reaching the level in middle income countries, annual growth rate would increases by 2%.

Lofgren et al (2005), Ethiopian case, using dynamic CGE model found that focus on human development (sufficiently to achieve human development MDGs) puts the economy on a slower growth track that does not permit the economy to reach MDG1 (poverty reduction) by 2015 while focus on infrastructure puts the economy on a faster growth that raises household consumption sufficiently to reach poverty reduction, and achieve the other MDGs within a few years after 2015. The paper on the impacts of public spending on rural household in Ethiopia indicated that the returns to road investment are significantly higher than the returns to other sector spending while the household expenditure impacts of public expenditure in agriculture and education were smaller (Tewodaj, M. et al, 2007).

Means of financing public spending can determine the extent of the effects of public spending on some macro-economic variables such private consumption and investment and hence poverty reduction. There is a mixed and complex empirical result regarding the impacts of different means of financing additional public investment. Minea (2008) finds that financing productive public spending by taxes could enhance economic growth. However, it could also adversely affect the economy. For instance, financing of government spending through taxation can adversely affect the private consumption or crowd- out private investment which might in turn negatively affect the economic growth and hence the aim of poverty reduction (see case studies in Ghana and Hondrus, as cited in Meina, 2008). Study in Ghana revealed tax financing public spending decreases consumption as compared to foreign grants. The strand of literature that investigates the impacts of aid financed investment on an economy largely support the view that the conventional Dutch disease effects may overturned if there are productivity spillover effects both in tradable and non-tradable sectors.

In general, previous work on the returns to public spending (investment) in various regions has revealed a number of consistent themes, some of which might be instructive for Ethiopia. First, the returns to public investment vary widely across different types of investment and regions, even within the same country. Regional analysis in Asia (china, India, Thailand and Vietnam) suggests that investments in less developed areas offer the largest poverty reduction per unit of spending and also highest economic returns. On the other hand, research in Africa shows high returns to public investment even in high potential areas, indicating an overall lack of in all regions for that continent. Second, agricultural research, education and rural infrastructure are the three areas of public spending that most effectively promote agricultural growth and poverty reduction. Evidence from china and Uganda shows that simple, low-cost of infrastructure, such as rural feeder roads; often have the highest returns in terms of growth and poverty reduction, per unit of investment. However, government spending on anti-poverty program generally has only a small impact in reducing poverty in some countries, mainly due to inefficient targeting and misuse of funds.

2.3 Measurement of Poverty

A major challenge facing sub-Saharan Africa is to eradicate poverty. The definition of poverty remains the center of debate among policy analysts. This controversy has brought about gradual evolutions from the traditional definition as lack of income. In the 1980s and 1990s, the definition evolved from the notion of 'minimum level of subsistence' to the notion of 'relative deprivation' (Box et al., 2006). Other elements such as capabilities, dignity, autonomy, and empowerment are also included in the definition of poverty as it is a multi-dimensional.

But, a classic definition of poverty is the inability to attain minimal standards of living measured in terms of basic consumption needs or the income required for satisfying them. Poverty is thus characterized by the failure of individual, household or entire communities to command sufficient resources to satisfy their basic necessities (Adrian Gauci, 2007). The United Nations (UN 1995) defined absolute poverty as "a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services". The poverty measure is decomposable in the sense that total poverty is a weighted average of the sub-group poverty levels (Foster, James., Greer J. and Eric Thorbecke, 1984).

Many alternative measure of poverty is exists. However, three main indicators are often used to measure poverty: poverty incidence, poverty gap index and severity of poverty. The incidence of poverty (headcount index) measure the share of the population whose income or consumption is below the poverty line; that is, the share of the population that cannot afford to buy a basic basket of goods. On the other hand, poverty gap index measures the depth of poverty, considering the number of poor people and how far the poor households are from the poverty line (how poor they are). This measure captures the mean aggregate income or consumption shortfall relative to the poverty line across the whole population. It is obtained by adding up all the shortfalls of the poor (assuming that the non-poor have a shortfall of zero) and dividing the total by the population. In other words, it estimates the total resources needed to bring all the poor to the level of the poverty line (divided by the number of individuals in the population). Severity of poverty (which is squared poverty gap index) shows not only the distance separating the poor from the poverty line, but also the degree of inequality among the poor, that is higher weights is placed on those households further away from the poverty line.

These measures can be defined in terms of well- known Foster, Greer and Thorbecke (FGT index) (1984) Pα class of poverty measures. The general expression of the FGT poverty measures can be written as follows:

$$P\alpha = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{(Z-Yi)}{Z}\right)\alpha \text{ ; } \alpha \geq 0, \text{ for } Y<Z$$

Where Z is the poverty line, i is the sub-group of individuals with income below the poverty line, Yi is the value of poverty indicator chosen (consumption expenditure below the poverty line in increasing order), n is the total population size, q is the total number of poor people in the population, and α is the poverty aversion parameter (the policymaker's degree of aversion to inequality among the poor). By setting the value of α to zero, one, two respectively, the FGT poverty formula delivers a set of poverty indices. If α equal to zero, P_0, reduces to the head count index (*n/q*) measuring the incidence (prevalence) of poverty. If α equal to one, P_1 becomes the poverty gap measuring the depth or intensity of poverty. If α equal to two, P_2 will be squared poverty gap measuring the severity of poverty (the weighted sum of the poverty gaps themselves). The Gini-coefficient is the indicator used for measuring the inequality of the income distribution and consumption.

2.4 Approaches of Assessing the Impacts of Macro-Economic Policies

Different approaches have been proposed to assess the impact of macro-economic policies analyses. In line of this many literatures used various methodologies in assessing the impact of public policy on economic growth and poverty reduction. These approaches can includes regression analysis (system of equations), benefit incidence analysis, targeted based approach, behavioral incidence analysis and computable general equilibrium analysis. As indicated in both theoretical and empirical literatures, previous studies have indicated one or a combination of these methodologies were used to analyses the policy effects either at macro or micro or at both levels. For instance, Fan and Hazell, 2001 china case, Fan, Zhang and Rao, 2004 Vietnam and Uganda case employed regression analysis while Lofgren and Robinson, 2004 sub-Saharan Africa ,and Jung and Thorbocko, 2003 Tanzania and Zambia case, used a CGE model to analysis the effect of public spending.

Partial equilibrium model is mathematical models that examine the (first round) effects of a limited set of factors caused by changes in economic variables (Ahmed and Donoghue, 2004). They are mainly categorized as reduced-form models and multi-market models. In the former, supply and demand equations are solved to obtain reduced form equations. These reduced form equations are used to examine determinants of growth, poverty, income inequality etc. Ahmed and Donoghue (2004) also stated that quantitative models of such sort, like VAR models, were used in the 1990s for estimating the impacts of structural adjustment policies. The latter are basically intended to selectively assess the distributional outcomes of policy changes in specific sectors. But econometric models in this partial equilibrium framework were heavily criticized in economy-wide analysis as these models are not transparent enough to highlight the intricate (second round) economic flows.

The benefit incidence is also one method of analyses that has been used extensively in the analysis of public expenditure, particularly on health and education. This approach involves measuring the amount of some category of public expenditure which is received by household (Edward Anderson.et al, 2006). This approach is mainly used to analyses the direct impacts of fiscal measures on poverty and income distribution. It can be conducted with minimum man-power (Ahmed and Donoghue, 2004). However, this approach has two main drawbacks. First it is difficult to carry out for public investment expenditure, or public spending on infrastructure more generally. Since it is difficult to assign consumption of infrastructure services to individual and/or households; and government subsidies are often difficult to measure as channeled through public enterprises. Second, benefit incidence analyses only indicate the distributional impacts of public expenditure and say nothing about its absolute impacts on poverty or on economic growth. Furthermore, it cannot capture the indirect impacts of public spending (such as spending on infrastructure).

The other approach used to making inter- sectoral investment is target based approaches. In this approach, public expenditure is a problem of seeking to maximize welfare given a fixed fiscal budget constraint. The target based approach initially used by Ferroni and Kanbur (1990) to assess the optimal inter-sectoral decision of public resource. The direct impacts of public spending on each welfare indicator and its indirect impact on each indicators, via its effect on other welfare indicators is required to apply this approach (Edward et al, 2006). The main problem with this approach is that: difficult to estimate accurately what the effect of a given category of public spending on any measure of welfare is; which could be addressed by comparing the level of welfare between regions, state or countries with different level of public investment(with and without approach). In other way, it is tricky to net out the effect of other difference that may affect welfare (for e.g. private sector, which may crowd in public investment) (Edward .et al, 2006). The other problem with this approach is that it is data-heavy, particularly when considering the reciprocal and complex interaction among the different dimensions of standards of living. Furthermore, it requires estimating the effect of public expenditure on welfare using statistical methods, in which the choice of the welfare indicators to be targeted may be determined by data availability.

Behavioral-incidence analysis constitutes the other method for analyzing direct distributional impact of policies. This method combines simple benefit-incidence with econometric household behavioral estimation. It is usually employed to measure distributional changes that result from government policy change at the “grass-root level” mostly in social sectors (Ahmed and Donoghue, 2004). The important improvement of this method over benefit-incidence is that it recognizes the change in behavior of households as a result of the change in the fiscal policy by giving due consideration to the counter-factual and the marginal incidence. This will indicate the true impact of the fiscal policy though the analysis becomes more demanding of large data and complex model formulations difficult to implement in practice unlike the benefit-incidence approach. Thus, several behavioral response models like labor supply responses, inter-household transfers and the like may be required for several fiscal policy reforms.

However, in order to discuss the link between public spending, growth and poverty, this study employed a dynamic computable general equilibrium analysis. The concept of general equilibrium is generally attributable to Walras (1834-1910), although in his lifetime his work went largely unnoticed (Lofgren et al, 2002). Over the last several decades, CGE modeling has emerged as a widely accepted method for conducting empirical economic analyses because it provides the ability to integrate economic theory with real-world data. The theoretical foundation of these models is a Walrasian general equilibrium structure (Lofgren and Robinson, 2004).

In contrast to partial equilibrium a “general equilibrium,” in its simplest form, includes components such as the composition and the behavior of the households sector in the economy that have an initial endowment of factors of production and a set of preferences for goods; the production activities and technologies in the economy the producers maximize profits that have constant- or decreasing-returns-to-scale production functions; the factor and commodity market which is the sum of all demands agents’ demands that depend on prices; solution prices that conform to Walras’ law (expenditures equal income for any set of prices, or more specifically, as a consequence of assuming non-satiation, for any set of prices the value of excess demands over all markets is zero); an equilibrium solution characterized by prices and production levels such that demand equals supply for all commodities, income equals expenditures, and production activities break even at solution prices (in the case of constant-returns-to-scale production), the government activity, foreign trade and balance of payment account (Thurlow, 2004). By combining this theoretical structure with numerical methods, CGE models can be used to estimate the effects of policy changes on all parts of the economy.

The CGE models are a class of multi-sectoral and price endogenous models that are based on actual transactions and that simulate the working of market economies (Tihalefang, J. and Sebikiri, M., 2011). Similarly to the evolution of CGE modeling, we can have several types of GE and CGE models based on various inherent characteristics. Based on the time dimension, we can have static and dynamic CGE models (Lofgren and Robinson, 2004). Static version of CGE models apply to a single period and address short-run comparative static analysis in which moves from one set of exogenous conditions to another examined. On the other hand, dynamic (Multi-period) CGE models incorporated the inter-temporal dimension of policy analysis. The dynamic CGE models can divide in to recursive and optimal growth models. In recursive models, all agents make their decision based on past and current conditions. It implies that one can assume that the economy is on a stable growth path, and hence agents can simply assume that the future will be like the present. On the other hand, optimal growth models assume all agents have rational expectations and make inter-temporal decisions- everybody knows all about the future.

A Recursive dynamic model can be divided into a ‘within-period (in essence a static CGE model) and between-period models that links the within-period models by updating selected parameters (particularly factor supplies, and total factor productivity) on the basis of exogenous trends and past endogenous variables (Lofgren and Robinson, 2004). Another classification of CGE models as neo-classical and structural. Neo-classical modeling have based on the assumption of Walirasian general equilibrium (assuming market demand equals market supply for all commodities) while the structural modeling in addition to these assumptions, it consider various macro-economic features as well as imperfect competition.

Despite of a being recognized as a reliable tool for economic impact analysis CGE models have been subjected to a great deal of pros and cons debate. Firstly, the model has an advantage of taking into account the economic flows in flexible manner that is the specifications can be changed and one can choose amongst the choices of closure rules according to the analytical needs (Tihalefang, J. and Sebikiri, M., 2011). Secondly, as public spending is likely to affect the whole people, it is better to employ model that cover the consequences of policies on all households, for this a CGE model is powerful. Thirdly, it enables the identification and quantification of some of the most important transmission channels relevant to poverty changes, including relative factor and commodity price changes and capital deepening caused by domestic saving (Chemingui, M., 2007). Fourthly, unlike the partial equilibrium analysis that consider only first order effects, the CGE models includes the feed-back effectsand market interdependencies that may either mute or accentuate first-order effects that in turn used for long term perspective analysis (Tihalefang, J. and Sebikiri, M., 2011).

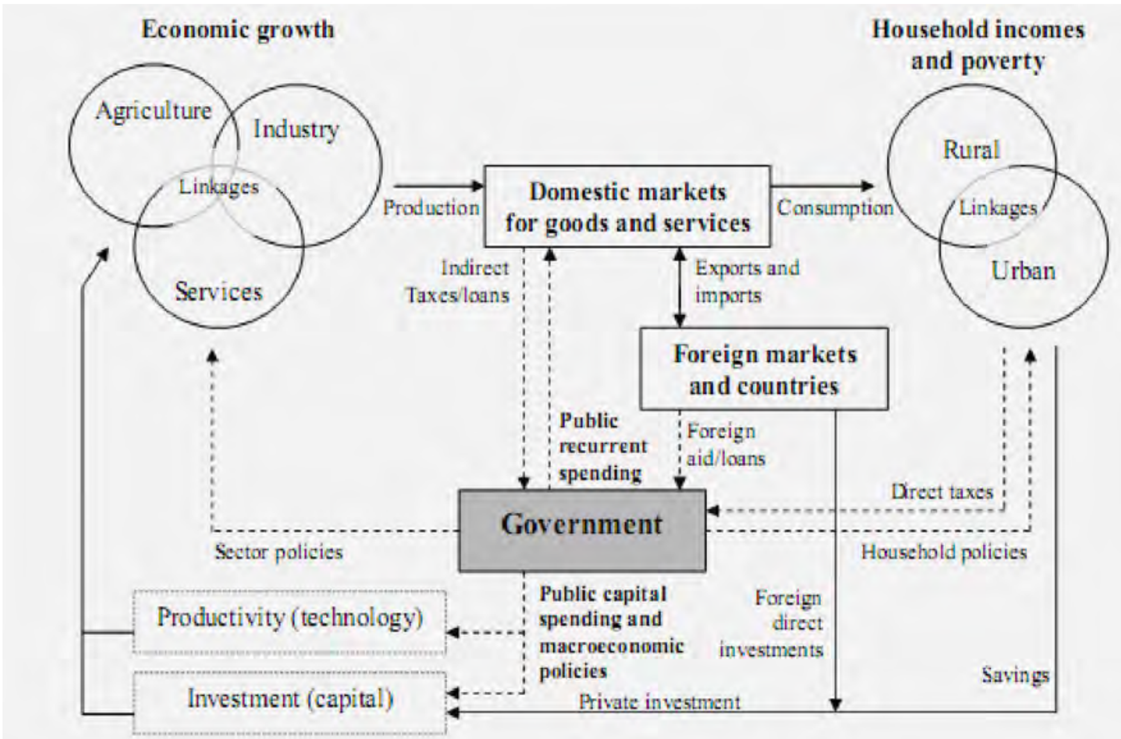
The CGE model also allows to capturing the interaction of various factors through direct, indirect and multiple effects overtime; this means that it incorporating the poverty model to examine those impacts of several alternative government spending on growth and poverty (Edward .et al, 2006).The other benefit of the CGE model is that it enables to compare the effect of one sector investment with other types of investment. In other word, this approach enable to examine the trade-offs and complementarities (inter-sectoral, inter-temporal, inter-regional, etc.) among different investment portfolios, in order to assess the synergies between investment (Edward et al, 2006).

In general, to assess the effect of public spending on economic growth and poverty changes, the use of a comprehensive analytical tool – a computable general equilibrium model (CGE) - is powerful. This type of model has become a standard tool for the integrated assessment of public policies and income distribution for small economies since it is helpful in the possibility of combining detailed and consistent databases with a theoretically sound framework. Furthermore, the CGE model also has the advantage of being fully coherent. All accounts must be balanced. This model also allows us to identify the winners and losers of the different scenarios analyzed, to simulate various fiscal policies to fund investment and to provide a comparative analysis of winners and losers (Perrault, Luc Savard, and Estache, 2008). In addition to these, it enables to compare the effect of funding options for public spending disaggregated sectorally in terms of distributional impact, as well as to effects on real exchange rates and efficiency. The capacity to explain the consequences of major changes in a particular sector in relation to the economy as a whole is another benefits of using this model.

Figure 2.2 gives an overview of the linkages between public investment and economic activities in a CGE model, which unlike Figure 1, shows how the effects of public spending filters through the entire economy. As shown in figure 2.2 the central agent in the CGE model regarding public spending is the government, who interacts with the rest of the economy and institutions in many ways. Thurlow, et al (2008) analyses the linkages of public spending with the rest of economy through a CGE model. The government generates income from domestic resources in the form of different types of tax revenues and from foreign sources in the form of direct international transfers. The impacts of changes in public investment on the economy can be simulated in the model through either reallocation of government budget across activities or increases in total government spending (i.e. more of the same activities).

There are direct and indirect impacts to be considered. The direct impacts are captured not only at macro-economic level, such as the balanced government account, foreign account (if international inflows were involved) or capital account, but also at sector and household levels if the increased spending is to be financed through increased tax income (Thurlow et al, 2008). Such direct economy-wide impacts of changes in public spending can be simulated without relying on any parameters that are estimated from econometric analysis. However, the indirect impacts of changes in public investment on theeconomy in a CGE model, i.e. the impact due to improvement in productivity at sector or factor levels associated with increased public goods and services, have to be simulated with a combination of parameters that are exogenous in a typical CGE model. As such, the total impacts of public investments, including the effects of increased public spending and public goods and services, are captured simultaneously through economy-wide interactions in a CGE model. The question of prioritizing public investments across space or evaluating the impacts of public investments across space (e.g. province or region) differential can also be analyzed in a CGE model by incorporating spatial differences in production technologies and institutional characteristics.

Figure 2.2: Economy-wide linkages of public spending in a CGE mode



Source: Thurlow(2008)

Despite the notable development of applied general equilibrium modeling over the past few decades, this methodology is not without limitations. Although their widespread use in policy analysis, computable general equilibrium (CGE) models are sometimes criticized for having uncertain empirical foundations and for being insufficiently validated. The problem of endowing large CGE models with numerical parameters values is formidable, and numerous choices also have to be made about model structure (Thurlow, 2004). These make the estimation of model's data and parameters very difficult in addition to lack of statistical tests to confirm the validity of the model specifications. In many cases the trustworthiness of a model may be based largely on the assertions of the modeler that is the model's functional forms, elasticity type, tax treatment, etc., is the main problem confront when a researcher modeling a specific economy (Tihalefang, J. and Sebikiri, M., 2011). Its inability to assess the impacts of price fluctuation and financial sector is another limitation of the CGE model. That is the CGE models only solve for relative prices. Furthermore, the result of CGE model is very sensitive to closure rules we choose.

Despite these limitations, the application of CGE models for economic analysis has recorded a significant advancement. Both individuals and organizations, like IFPRI, that use CGE model in their assessment of policy reform impacts have expanded over the last few decades.

CHAPTER THREE
OVERVIEW OF ECONOMY, POVERTY AND PUBLIC SPENDING IN ETHIOPIA

3. 1 Growth Trends and Poverty Profile of Ethiopia

3.1.1 The Economy of Ethiopia

Some empirical evidence and theories on growth theories consider factor accumulation as the driving force of economic growth. However, when comparing growth experiences across many countries, "unexplained part of growth" – besides factor accumulation – plays a prominent role in explaining differences in economic performance. This "unexplained part of growth" accounts for the majority of cross-country differences in both the level of Gross Domestic Product (GDP) per capita and the growth rate of GDP per capita. The profession typically uses the term "Total Factor Productivity (TFP)" to refer to the "unexplained part of growth" (besides physical factor accumulation) that accounts for economic growth differences.

In the last three to five decades, many studies have analyzed the relative contribution of factor inputs and technical progress to economic growth. Since the seminal work of Solow (1957), total factor productivity—defined as the efficiency with which firms turn inputs into outputs—has been considered as the major factor in generating growth. Therefore the changes of economic performance in Ethiopia can be explained by either changes in physical factor accumulations or total factor productivity. So, any policy that can improves the physical capital accumulation and/or the productivity of these inputs, leads to high GDP and per capita GDP growth.

There are few studies that analyses the contribution of factor inputs and TFP to economic growth in Ethiopia. During the imperial and Derg regime, the total factor productivity is almost negative (Alemayehu.et al, 2007). The negative contribution of productivity continues at the early of 1990s although reduced in magnitudes. According to the study, capital significantly contributes to the economic growth while the labor contribution is weak in explaining the performance of economy over a given regime. The impact of public policies particularly public spending on growth were also negative though its negative impact decline during 1990s as share of defense expenditure has been declined. However, after the late 1990s the productivity starts to contribute positively for economic growth. In other studies, we see a contradiction results against the above findings. The study by Alemayehu et al. (2008) has revealed that average contribution of capital is negligible while that of labor and factor productivity is positive and significant.

The Ethiopian economy returned to growth in the early 1990s after the overthrow of the *Derg* regime and the end of its repressive economic policies as the ascent of the EPRDF to power, the country adopted typical structural adjustment policies (liberalization). After this reform, the economic performance has shown improvement. In 1990s the real total and per-capita GDP on average grew at 3.7 % and 0.7 % per annum in respective order. But, the performance has been fragile and growth uneven (Alemayehu.et al, 2007) as it is highly dependent on vagaries of nature and external shocks such as Eritrea war which affect economic growth as more public spending diverted towards defense.

Real GDP grew on average by 5.8 percent from 1992/93 to 2001/02 while population growth was about 2.7 percent over the same period. The Ethio-Eritrean Border conflict affected GDP growth rates in 1998-2000 and the economy faced a sharp decline and a negative growth rate as a result of the drought in 2002/03 fiscal year (WB, 2004; Alemayehu.et al, 2007). The agricultural sector continues to be a major contributor to the overall Ethiopian economy although its contribution has decreased from year to year while the services sector has emerged as the major sector in the economy. The share of industry didn’t show any significant change over the same period of time.

Overall the pattern of growth in Ethiopia, for past three/four decades can be characterized as erratic. This point is vividly supported by the sectoral growth performance reported in table 3.1. The table shows that: sectoral growth trends, in particular in industrial and agricultural sectors, are quite erratic, and (b) the trend of sectoral composition of the source of growth is also quite erratic (AlemayehuGeda et al, 2007). In 2002/03 fiscal year, the real GDP declined by 2.2 percent, which is mainly explained by the reduction of agricultural sectors (declined by 10.5) due to widespread drought across country. Since 2003/04 fiscal year, the growth rates of GDP by economic activity have shown a positive growth. The service sectors such as construction, hotel and restaurant, social services (health and education) and transportation, has grown at alarming rate which significantly contribution for the growth rate of real GDP. On the other hand, the industrial sector, particularly manufacturing has grown on average by 10.0 percent since 2004/05 fiscal year, implied almost constant growth rate.

Table 3.1: Growth rates of GDP by economic activity at constant prices 1990/00 (as %) from 2002/03-2009/10

sector/year	2002/03	2003/0 4	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Agriculture, hunting and forestry	(10.5)	17.0	13.5	10.9	9.4	7.5	6.4	7.6
Fishing	(20.08)	(25.10)	8.62	(8.2)	7.7	34.0	26.5	1.7
Mining and quarrying	4.1	2.0	4.1	7.2	(15.4)	21.4	12.8	44.2
Manufacturing	0.8	6.6	12.8	10.6	8.3	10.3	9.1	10.0
electricity and water	4.8	6.6	7.9	8.8	13.6	4.8	5.0	5.1
Construction	13.6	19.5	7.5	10.5	10.9	11.3	11.7	10.9
Whole sale and retail trade	3.1	5.1	13.1	17.5	16.8	15.8	11.7	8.6
Hotels and restaurants	6.3	6.2	11.6	19.5	27.5	23.3	23.9	24.1
Transport and communication	10.5	9.5	19.2	5.7	9.3	11.5	8.9	13.8
Financial intermediation	10.8	19.7	24.2	28.7	15.1	28.1	16.5	13.7
Real estate, renting and business activities	9.7	4.5	7.4	14.5	15.2	17.3	15.9	19.9
Education	11.6	11.5	12.6	8.6	21.2	14.8	13.0	17.0
health and social work	(4.2)	15.9	16.9	9.8	15.8	15.5	19.3	8.3
Public administration and defence	1.4	0.2	11.6	6.4	11.8	12.5	18.4	3.4
Other community, social and personal services	1.5	4.8	8.0	9.2	8.5	11.7	6.4	7.8
Real GDP	**(2.2)**	**13.6**	**11.8**	**10.8**	**11.5**	**10.8**	**8.8**	**12.4**

Source: EEA Data Base (2010)

Since the introduction of a poverty reduction strategy (PRS), known as the Plan for Accelerated and Sustained Development to End Poverty (PASDEP), Ethiopia is experiencing an unprecedented spell of economic growth, although this performance has been accompanied by growing economic imbalances. For the last 8 year in succession, Ethiopia's economy has grown at double digit except for 2008/09. Supported by improved agriculture production and large- scale public investment in infrastructure, during the fiscal years (2003/04-2010/11), overall economic performance measured by growth in the real GDP growth has registered 11.4% on average — an important achievement for a country whose per capita income is yet lowest even when compared to Sub-Saharan Africa. Within the same period, the average growths in value added of agriculture, industry and service sectors were 10.2%, 10.8% and 12.9%, respectively (see table 3.2). The cumulative impact of public investment in basic infrastructure, in particular agriculture, roads, power, telecommunications, and water as well as public spending in education and health have clearly raised the overall productivity of the economy.

Table 3.2: Growth rates of GDP by major industrial classification at constant basic prices (%)

Sector/ year	2003/ 04	2004/ 05	2005/ 06	2006/ 07	2007/ 08	2008/ 09	2009/ 10	2010/ 11	Average
Agriculture	16.9	13.5	10.9	9.4	7.5	6.4	7.6	9.0	10.2
Industry	11.6	9.4	10.2	9.5	10.1	9.7	10.6	15.0	10.8
Services	6.3	12.8	13.3	15.3	16.0	14.0	13.0	12.5	12.9
Real GDP	11.7	12.6	11.5	11.8	11.2	10.0	10.4	11.4	11.3
Sectors shares (%)									
Agriculture	47	47.4	47.1	46.1	44.6	43.1	42	41.1	44.8
Industry	14	13.6	13.4	13.2	13.0	13.0	13.0	13.4	13.3
Services	39.7	39.7	40.4	41.7	43.5	45.0	46.1	46.6	42.8

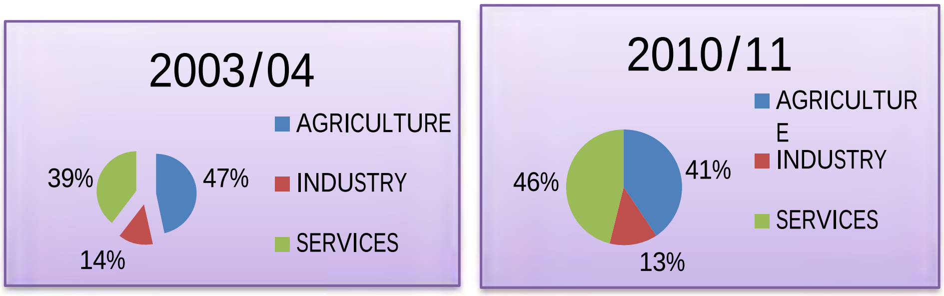
Source: MOFED (2011)

In 2010/11, Ethiopia continued to register the fast growth as it has for the last 8 years. Gross domestic product (GDP) growth in 2010/11 remained strong at 10.4%. Growth is driven by the industrial sector (15%), followed by the service (12.5%) and agricultural (9%) sectors.

Currently, there is a historic shift in the Ethiopian economy. Without much notice, since 2008/09 agriculture ceased to be the largest sector in the economy for the first time in Ethiopia's history as it has been overtaken by the service sector. The recent release of Fiscal Year 2008/09 GDP statistics revealed that the service sector is now clearly at top, comprising 45 percent of GDP, followed by agriculture at 43.1 percent, and Industry at just 13.0 percent. This heralds a major structural transformation of the economy and the 2011/12 MOFED report forecast that the services sector—which covers real estate, hotels, transportation, communication, banking, health and education—will make up more than half of Ethiopia's GDP. This reverses a centuries-long economic structure, wherein agriculture was the dominant sector, followed in a distant second place by the services sector, and lastly a very small industrial sector.

Indeed, for close observers, the trend lines have been prevalent for almost a decade: agriculture was more than 50 percent of GDP as recently as 2000/01 but started a gradual decline over the past decade, falling to about 47 percent in the middle of the decade and to a low of 41.1 percent of GDP most recently. The service share of GDP moved slowly but consistently in the other direction, moving up from just 38 percent at the start of the decade to 46.6 percent of GDP most recently. However, yet when it comes to other important metrics—such as employment— agriculture retains its primary role and accounts for most of the country's labor force (for more than 80 percent). However, what the higher share of services in GDP reveals is that the collective economic contribution of the large labor pool in agriculture has now fallen short of the combined value-added of a much smaller group of employees engaged in services and industry. With respect to Industry, its role in the Ethiopian economy is notable for its near-static share over the last decade. The share of industry has been close to 13 percent (plus or minus one percentage point) for the past decade.

Figure 3.1: Compositions of GDP in 2003/04 and 201/11



Source: MOFED(2011)

However, the country remains one of the poorest in the world, though underscoring the urgency of accelerated growth and development on a sustained basis.Moreover, the economy faces several risks, e.g., double-digit inflation, that implies that the understandable optimism over recent growth should be moderated by caution over the potential threats to sustained economic expansion.

3.1.2Poverty Profile

Over the past decade Ethiopia has made significant strides in improving the living standards of its citizens. The poverty description and indicators used in this section are based onPASDEP, andHICES report 1995/96, 1999/00 2004/05 and 2010/11 and panel data 1994, 1997, 2000 and 2004. The poverty incidence (head-count rate) which describes the percentage of population whose income or total consumption expenditure is below the poverty line has shown a decline trends over a given period. Based on this incidence, according to HICE survey of 1995/96, 46% of Ethiopians lived below the poverty line among which 48 percent in rural areas and 33 percent in urban areas. On the other hand, poverty gap index that combined the measurement of the incidence and depth of poverty is 13% at the national level which provides a measure of the ratio of the minimum cost of eliminating poverty. However, the households are more far from the poverty line in rural areas (13%) than in urban areas (10%). The Severity of poverty at national level is 5 percent, but slightly rural poverty (at 5.3%) appears to be far more severe than urban poverty (4.1%).

The 1999/00 HICE survey indicates slight change in poverty level compared to 1995/96 household survey: the head-count rate at national level declines to 44 percent among which rural poverty reduced to 45 percent but urban poverty incidence raised to 37 percent, poverty gap ratio reduced to 12 percent both at national level and rural areas while remain constant at urban areas (10 percent). However the severity of poverty shows no change both at national and rural and urban areas.

Household survey evidence suggests that between 1999/00 and 2004/05, real total expenditure per capita grew by 19 percent (15 percent with respect to 1995/96). This has resulted in significant reductions in poverty: the headcount fell by 11.4 percentage points between 1999/00 and 2004/05 (which is 39 percent) and by 15.2 percentage points since the mid-1990s. This takes similar but higher trends of decrease in rural areas by about 18.75% whereas urban poverty increased by 6% in the same period.

Table 3.3: Trends in monetary poverty and inequality, by area of residence

(Percent of households)

		national				rural				urban		
	1995/96	1999/00	2004/05	2010/11	1995/96	1999/00	2004/05	2010/11	1995/96	1999/00	2004/05	2010/11
head count	46	44	39	30	48	45.4	39.3	30	33	37	35	26
depth of poverty	13	12	8.3	7.8	13	12.2	8.5	8	9.9	10	7.7	6.9
severity of poverty	5.1	4.5	2.7	3.1	5.3	4.6	2.7	3.2	4.1	3.9	2.6	2.7
Gini-coefficient	0.3	0.3	0.3	0.3	0.3	0.26	0.26	0.3	0.3	0.4	0.4	0.4

Sources: PASDEP, HICES Report 1995/96, 1999/00, 2004/05and 2010/11

With respect to the poverty gap and squared poverty gap indices in table 3.3, we recognize significant declines in both poverty measures at the national and rural levels. Between 1995/96 and 2004/05, at the national level, depth and severity of poverty declined by 38.4% and 40% in that order and closer to this, in rural areas, these measures declined by 30.7% and 40%, respectively. But in case of urban areas, similar declining trends were recorded with a slip in the 1999/00 period where the poverty gap has almost remaining constant before dropping down in 2004/05 compared to 1999/00. From 1995/96 to 2004/05, we see a decline in the depth and severity of poverty in urban areas by 20% and 25%, respectively.

The poverty has declined substantially between 2004/05 and 2010/11. In 2010/11, the incidence of poverty reduces to 29.6, 30.4 and 25.7 at national, rural and urban areas respectively. Similarly, the depths of poverty at national, rural and urban areas are 7.8, 8.0 and 6.9 percent respectively. In contrary to the incidence and depth of poverty, the severity of poverty has increased when we compare with 2004/05. In 2010/11, the severities of poverty at national, rural and urban levels are 3.1, 3.2 and 2.6 percent respectively. The 2010/11 poverty head count index (incidence of poverty) is lower than the index for 2004/05 by 24% while the poverty gap is lower by 5.5% indicating a substantial decline. The 2010/11 urban poverty head count and poverty gap are lower than that of 2004/05 by 27% and 10%, respectively, and poverty severity of 2010/11 is higher than of 2004/05 by 5%. The 2010/11 rural poverty head count and poverty gap are lower than that of 2004/05 by 23% and 5.5%, respectively, but poverty severity of 2010/11 is higher than of 2004/05 by 17% indicating that inequality in rural started to rise.

In addition to national data report, different researchers try to compute the incidence of poverty in Ethiopia. Of these studies, *Bigsten and Shimeles (2007)* using panel data collected by Addis Ababa University, Department of Economics, calculate the incidence of poverty and income distribution at national, rural and urban areas.

Table 3.4: Trends in poverty and inequality in Ethiopia: 1994-2004, Panel Data

	1994	19995	1997	2000	2004
Headcount ratio					
Rural	48	40	29	41	31
Urban	33	32	27	39	37
National	46	39	29	41	33
Gini- Coefficient					
Rural	49	49	41	51	45
Urban	43	42	46	49	46
National	48	48	42	51	45

Source:Bigsten and Shimeles (2007)

Accordingly, between 1994 and 2004, the number of people lived below the poverty lined declined by 28% (reduced from 46% in 1994 to 33% in 2004) at national level. But, Progress in poverty reduction across urban and rural areas has been uneven as it reduced in rural areas by 35.4% while increased in urban areas by 15% over a given period of time. While urban areas contributed a considerable percent of economic growth over the decade up to 2004/05, they saw stagnant poverty reduction. Despite this progress, monetary poverty remains a significant challenge, particularly considering that millions people thought to be living below the poverty line in Ethiopia. Regarding the distribution of income as measured by gini-coeffecients remain stagnant during the analyzed period except small variation.

3.2 Trends and Compositions of Public Expenditure in Ethiopia

As part of the market reform process, the government took important macroeconomic reform including taxation. The participation of the private sector has increased. The end result was an increase in Government revenue, which partially contributed to increase in government spending. Under the broad poverty reduction strategy and other social sector development remains at the center of the government agenda; with the exception of some expenditures items, which have relatively lower share, the public expenditure has substantially increased during post reform period.

The total expenditure during the fiscal years 1992/93-1999/00 increased at an annual rate of 19.6% per annum. Though both recurrent & capital expenditure have been rising, recurrent spending accounted for a larger part of the increase in total spending (on average by 22.6%) since capital spending declined during 1997/98 and1999/00. But if we see during the fiscal year from 1992/1993-1996/97, the increment of total spending were largely captured by capital spending. Similarly recurrent expenditure as a ratio to GDP has declined during the post-reform period while that of capital expenditure increased from their pre-reform levels. Much of the increased in capital expenditure was accounted for by spending on roads, energy, education and health sectors. On the recurrent side, wages and operating expenses and debt servicing took the lion’s share during the period under review.

Recent developments also indicate a trend of increasing government expenditure, especially expenditure on priority sectors such as education, health and roads. Total expenditure has increased on average by 21.8 percent per annum during the fiscal year 2003/04-2010/11. Similarly both capital expenditure and recurrent expenditure have increased by 30.6% and 15.5% respectively though an uprising of capital expenditure is higher than recurrent expenditure since expenditure on economic and social development highly increased during the same fiscal year.

Like the trends, the compositions of public spending also matters. An uprising interesting change in the pattern of public expenditure began in 1992. In 1990s the overall growth in sectoral spending has shown volatility partly because of the war situation with Eritrea. Nevertheless, towards the beginning of 2000 and onwards, the patterns of overall expenditure, has shown an upshot increasing trend, to meet the growing demand for investment in infrastructure, health, education and transport and communication. Though during 1990s recurrent expenditure shares on average more than 65 percent of total expenditure while the remained part was the share of capital expenditure, after the introduction of MDGs the compositions of public expenditure have been changed.

Table 3.5 has clearly shown the trends and compositions of public spending during the 2000/01-2008/09 fiscal year. The share of capital expenditure of total has increased to 53 percent in 2008/09 from 32.5 percent in 2000/01 fiscal year. Most of capital expenditure fell into economic development (particularly much part goes to road construction) followed by social development and general services. From social sector development expenditure education took the largest share. Similarly, of economic development expenditure, road construction took the lion shares.On the other hand, the share of recurrent expenditure as percentage of total has been declined over the same fiscal year. Its share goes down to 47 percent of total in 2008/09 fiscal year among which general services particularly defense share the largest portion followed by social services (especially education) as compared to 67.5 percent in 2000/01 fiscal year.

Table 3.5: *Summary of Functional Structure of Government Expenditure as Percentage of Total expenditure*

Expendure/Year	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Recurrent	67.5	63.3	68.2	58.5	53.6	52.3	48.5	48.4	47
General services	33	27.8	23.6	25.3	23.8	22.2	19.8	19.5	19.5
Defense	21.5	15.6	1	1.4	1.2	1.1	1.3	1.6	1.5
Economic services	6.1	6.3	6.7	6.8	6.2	6.8	6.2	6.7	6.6
Agriculture	4.1	4	3.7	4.4	4.7	5.3	4.8	5	4.7
Road construction	0.6	0.7	0.7	0.7	0.5	0.7	0.5	0.6	0.7
Transport & Communication	0.6	0.4	0.8	0.8	0.3	0.1	0.2	0.3	0.3
Mining and Energy	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Social service	14.5	16.8	16	16.3	15.7	17	17.4	18.5	17.7
Health	3.1	3.1	2.7	2.7	2.8	2.8	2.8	3.2	3
Education	9.8	10.7	11.5	12.6	12.2	13.3	13.7	14.2	13.9
Capital	32.5	36.7	31.8	41.5	46.4	47.7	51.5	51.6	53
General services	3.3	4.2	2.2	6.4	1.6	1.8	2.9	2.1	3
Economic development	20.6	20	21.9	24.8	34.7	35.5	34.8	37.9	37.8
Agriculture	3.2	4.8	4.7	9.4	11.8	11.4	9.6	8.3	8.3
Road constraction	9.6	9.2	9.6	9.2	10.8	11.7	13.5	17.3	16.7
Transport & Communication	1.8	2	0.7	0.4	2.7	4	0.4	0.4	0.8
Mining and Energy	2.4	2.2	2.7	2.3	0.3	0.9	3.6	2.4	2
Social development	8.6	6	7.7	10.4	10.1	10.5	13.9	11.6	12.2
Health	3.4	1.6	2.5	1.7	2.1	1.8	3.8	4.1	3.7
Education	4.3	3.2	5.1	8.4	7.8	8.4	9.8	7.3	8.2
Total expenditure (in millions birr)	15,383.00	16,681.30	19,829.70	19,921.80	24,457.20	29,418.60	35,696.80	46,766.00	57,774.30

Source: EEAData Base(2010)

According to MOFED (2011) report share of capital expenditure of total further raised to 56.8 percent while recurrent expenditure shares reduced to 33.2%. The share of total expenditure as percent of GDP on average was 20.3% among which both capital and recurrent expenditure shares equal percent during 2003/04-2010/11 fiscal year. However, the recurrent expenditure as percent of GDP has declined trends while that of capital expenditure has increased trends.

Since the post reform period the pro-poor public spending has an upturn trends. Table 3.6 indicates the trends of poverty targeted sectors expenditure from 2003/04 to 2010/11.

Pro-poor spending has been high and rising, and represents among the highest efforts among all low income countries. It has goes up in real values by more than five times during the given fiscal year. During2003/04 fiscal year about 51% of the total government budget was allocated to the poverty reducing sectors and this amount picked up to level of 64.2% in 2007/08 but goes down to 63.1% in 2008/09 and raise up again to 66% during 2010/11 fiscal year. Almost all poverty reducing sectors as percentage of total have increased except for agriculture which has increased from 13.8% in 2003/04 to 16.7% in 2005/06 and then goes down as ratio of total expenditure since 2006/07 fiscal year.During 2003/04 fiscal year about 11.8 percent of government expenditure targeted to poverty reducing sectors and this amount picked up to level of 13.9% in 2005/06 but goes down to 10.8% in 2008/09 and raise up again to 12.2% during 2010/11 fiscal year.

Table 3.6: Trends in Pro-Poor Targeted Sectors expenditures as % of Total and GDP

Sector/Year	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
As % of total expenditure								
Agriculture	13.8	16.5	16.7	14.3	13.3	13.0	9.6	8.8
Education	21.0	19.9	21.7	23.6	21.4	22.1	23.8	24.9
Health	4.4	4.9	4.6	6.6	7.3	6.7	6.5	6.7
Road Construction	9.9	11.3	12.4	14.0	17.9	17.4	19.2	19.8
Total	51.1	57.3	62.2	62.6	64.3	62.7	65.8	66.5
As % of GDP								
Agriculture	3.2	3.8	3.7	3.0	2.5	2.2	1.8	1.6
Education	4.8	4.6	4.9	4.9	4.0	3.8	4.5	4.6
Health	1.0	1.1	1.0	1.4	1.4	1.2	1.2	1.2
Road Construction	2.3	2.6	2.8	2.9	3.4	3.0	3.6	3.6
Total	11.8	13.2	13.9	13.0	12.1	10.8	12.5	12.2

MOFED(2011)

In recent year's fiscal policy focuses on strengthening domestic revenue mobilization as pro-poor spending increase since the basic concern of poverty reduction and economic growth lies in pro-poor public spending. The main source of government revenue is tax revenue; especially the indirect taxes have taken the lion's share of the source of government revenue. For the past eight years on average 61.2% of total revenue and grants were come from taxes. If we excluded the grants, this percent goes up to 76% of government revenue (domestic revenue).

Like the public spending, government revenue has been increasing in real values. Table 3.7 has shown the trends of revenue from 2003/04-2010/11 fiscal year. During 2003/04 fiscal year tax revenue consists 61.2% of total revenue and grants of which 18.2% and 43% were direct and indirect taxes respectively. But these share of taxes goes down to 53.1% in 2008/09 and then picked up to 68.9% in 2010/11 and at the same time both the share of direct and indirect taxes declined to 18% and 35% and then raised to 22.8% and 46.1% respectively. Similarly, non-tax revenue shows volatility over a given period of time. In 2003/04 it was 15.5 percent of total revenue and grants, reached 23.1% and declined to 11.8 in 2010/11 fiscal year. During 2003/04 23.3 percent of total revenue and grants was external grant, raised to 25.8% in 2006/07 and then goes down to 19.3% in 2010/11 fiscal year.

In the last four years tax revenue has raised on average by 36 percent. In 2003/04 tax revenue was 12.1% of GDP; it dropped to 8.6% in 2008/09, but picked up to 11.5% in 2010/11 fiscal year. At the same time, the direct and indirect taxes revenue were 3.6 and 8.5%, dropped to 2.9 and 5.7% and then raised up to 3.5 and 7.7% respectively. Grant performance has been going down, as government targeted to reduce budget deficits though still shares more than 25 percent of total revenue including grants. On average external grant shares 3.85 percent of GDP.

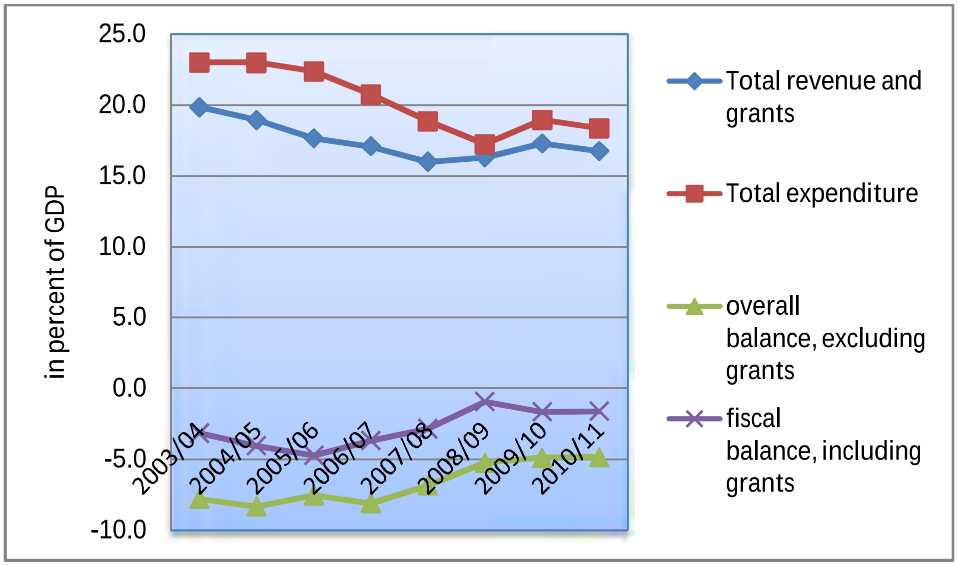
Table 3.7: Trends of government revenue as percent of total and GDP since 2003/04

	in percent of total revenue and grants							
Year	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Tax revenue	61.2	61.5	60.8	59.1	59.9	53.1	65.4	68.9
Direct taxes	18.2	19.5	19.0	17.6	17.7	18.0	22.5	22.8
Indirect taxes	43.0	42.0	41.8	41.5	42.3	35.0	42.9	46.1
Domestic indirect taxes	12.3	13.5	13.4	13.6	12.8	13.4	16.2	18.3
Foreign trade taxes	30.7	28.5	28.4	27.9	29.4	21.6	26.7	27.7
Non-tax revenue	15.5	15.8	23.1	15.1	15.1	20.5	15.9	11.8
Total revenue	76.7	77.4	83.9	74.2	75.0	73.5	81.3	80.7
External Grants	23.3	22.6	16.1	25.8	25.0	26.5	18.7	19.3
	in percent of GDP							
Tax revenue	12.1	11.6	10.7	10.1	9.6	8.6	11.3	11.5
Direct taxes	3.6	3.7	3.4	3.0	2.8	2.9	3.9	3.8
Indirect taxes	8.5	8.0	7.4	7.1	6.8	5.7	7.4	7.7
Domestic indirect taxes	2.4	2.6	2.4	2.3	2.1	2.2	2.8	3.1
Foreign trade taxes	6.1	5.4	5.0	4.8	4.7	3.5	4.6	4.6
Non-tax revenue	3.1	3.0	4.1	2.6	2.4	3.3	2.8	2.0
Total revenue	15.2	14.6	14.8	12.7	12.0	12.0	14.1	13.5
External Grants	4.6	4.3	2.8	4.4	4.0	4.3	3.2	3.2
Total revenue and grants	19.8	18.9	17.6	17.1	16.0	16.3	17.3	16.7

Source: MOFED (2011)

Figure 3.3 indicates the performance of fiscal balance over the past 8 years. The fiscal deficit (including grants) fell from 3.2 percent of GDP in 2003/04 to 0.9 percent of GDP in 2008/09—its lowest level and raised to 1.6 percent of GDP in 2010/11 fiscal year. The budget deficit is relatively more if we exclude external grants though follows the same trends. Over the same period, the deficits were declined to 4.8 percent in 2010/11 compared to 7.8 percent in 2003/04 and 5.2 percent in 2008/09. Fiscal policy has been increasingly counter-cyclical—relatively low deficit during boom times and high deficit during periods of downturn—a sharp contrast to the pro-cyclical fiscal policy seen in most developing countries.

Figure 3.3 Performance of fiscal balance, in percent of GDP



Source: MOFED (2011)

Owing mainly to increase in public spending, particularly pro-poor spending, under the sectoral investment programs (SIPs), the fiscal deficit yet high. Thus, the government can finance this deficit either domestically or externally. According to MOFED (2011) report the domestic deficit financing has been declined over a given period as the government targeted to reduce, if possible avoid, domestic bank borrowing for the financing of budgetary deficits in order to minimize inflationary pressures. To attain the stated objectives in GTP, the government of Ethiopia aimed to increase its expenditure. The total expenditure expected to increases on average by 23 percent in between 2009/10-2014/15 fiscal year. Like, the PASDAP period the pro-poor expenditure planned to rises continual so as to sustain economic growth and hence the reduction of poverty in the country. The pro-poor expenditure shares 69 percent of total on average over the GTP period. It rises on average by 25.5 percent on the given period.

Table: 3.8 Projected government expenditures, base case scenarios (in millions birr) as % of total expenditure

Items	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	Average
Poverty oriented expenditure	66.24	65.92	68.00	70.00	72.00	73.00	69.19
agriculture and food security	9.81	10.34	12.37	12.22	12.57	12.78	11.68
education	23.65	23.58	23.14	22.72	22.52	21.89	22.92
health	6.37	6.80	6.62	6.76	6.89	6.91	6.72
road	20.47	18.80	20.50	22.09	22.66	22.82	21.22
water	5.94	6.41	5.37	6.21	7.36	8.61	6.65
Total expenditure	71334	92,049	106125	130187	161452	201146	

Source: MOFED, 2010

Similarly, the human capital and agricultural expenditure, shares 29 and 11.7 percent of total expenditure, increases on average by 22 and 30 percent respectively. From poverty targeted expenditure, education and road expenditures share a large proportion followed by agriculture.

CHAPTER FOUR

DATA AND METHODOLOGY

The study uses a recursive dynamic CGE model solved recursively from 2009-2020 to analyses the growth effect of public spending disaggregated by functionally. The CGE model is linked with MS model to assess the poverty and inequality effect of public spending. First we introduce the concept of the SAM which is the baseline data for calibration before the discussion of the model. This is followed by detailed specification of the CGE model. Finally we introduce the MS model to be linked to the CGE model.

4.1 The Social Accounting Matrix

SAMs are designed as a means of characterizing and understanding the structure of an economy. The structure of an economy can be designed in terms of two key sets of elements (Tadela and Alemayehu, 2004). The first set is referred as the productive dimension of economic structure. It includes the relative importance of sectors in the economy in terms of production and factor use (such as sectoral shares in output and employment, rural vis-vis urban economic activity, input-output coefficients, openness to trade, saving and investment rates and expenditure patterns). The second set is distributional dimension of economic structure which includes the aspects of property right systems (such as land tenure system, private ownerships, etc.) and behavioral distinguishable groups (such as households, firms, farmers, wage workers, and entrepreneurs).

The most important database used for calibration in CGE modeling is the Social Accounting Matrix (SAM). A SAM is an extension of input-output model. The I-O analytical framework was developed by Wassily Leontief in the late 1930s. Its main purpose is to analyze the interdependence of industries or sectors in an economy. In its basic form, an I-O model consists of a system of linear equations, each one of which describes the distribution of a sector's outputs throughout the economy. Furthermore, its fundamental concept of analysis is concern with the flow of products from a producing sector to all other sectors that consume the product (EDRI, 2009). In addition to the income and expenditure flows of industries and their outputs (goods & services or commodities), the SAM contains detailed information on different institutions. For instance, not only do households earn incomes from the sale of factors of production like labor and capital to industries, but they also receive transfer payments from the government (in the form of safety net assistance, social security paychecks, and pensions) and from the rest of the world (in the form of remittances). Moreover, households also pay taxes to the government, purchase final goods, and save (or dis-save if expenditures exceed incomes).

In general a social accounting matrix (SAM) is a comprehensive, economy-wide set of accounts that quantify economic flows (incomes and expenditures) in an economy for a given period of time (usually one year) (EDRI, 2009). It owes its development to a long tradition of pioneers, particularly Erik Thorbecke, whose work is complemented by a large body of literature, including seminal contributions by Richard Stone (for which he was awarded the Nobel Prize in Economic Science in 1984) and Graham Pyatt, as well as a great deal of work from modelers like Sherman Robinson and Hans Lofgren, that in the aggregate have improved and refined the SAM both as a comprehensive and detailed economic database, and also as a logical framework for economy-wide empirical models.

By construction, a SAM summarizes the transactions (including transfers) among economic agents, and through them activities, in an economic system within an accounting period, commonly a year. The SAM represents a square matrix in which each account is represented by a row and a column denote, respectively, receipts (incomings) and expenditures (outgoings) of the accounts that correspond to the various institutions, activities, factors and products considered. Transactions are shown in the cells, so the matrix explicitly displays the interconnections in the economy. In addition, the SAM explicitly associates trade flows with transactions (trade and transportation) costs, also referred to as marketing margins. For each commodity, the SAM accounts for the costs associated with domestic, import, and export marketing. For domestic marketing of domestic output, the marketing margin represents the cost of moving the commodity from the producer to the domestic demander. For imports, it represents the cost of moving the commodity from the border to the domestic demander; while for exports it shows the cost of moving the commodity from the producer to the border (see Lofgren, 2002)[1].

The standard SAMs have four major types of accounts: activities, commodities, factors of production, and institutions (households, government and the Rest of World), including an aggregate savings-investment account[2]. In addition, it has multiple accounts for activities, commodities, factors, and domestic non-government institutions. The distinction between activities and commodities are required in cases where a given activity produces several commodities or a given commodity is produced by more than one activity (Lofgren, 2002). The activity accounts show the value of commodities (goods and services) produced by each activity and the cost of inputs into each production activity consisting of intermediate input purchases along with payments to primary factors of production. On the other hand, the commodities account shows demand for commodities on the row side and supply of commodities on the column side[3]. The demand mainly includes intermediate input use, final consumption, investment demand, government consumption and exports whereas the supply includes domestic production, imports, indirect taxes and marketing margins.

Factor accounts describe the sources of factor income (value added in each production activity) and how these factor payments are further distributed to the various institutions in the economy (households of different types, government and the Rest of World). Accounts for institutions record all income and expenditures of institutions, including transfers between institutions. Furthermore, Savings of the different institutions and investment expenditures by commodities are given in the savings-investment account. The account collects savings from various sources (government, private, and foreign) and spends the accumulated savings on capital goods (I). Investment demand in the SAM is only indicated by sector of origin, rather than sector of destination. The other accounts

[1] Lofgren shows the detail of how the transaction costs appear in both commodity and activity accounts using Zimbabwe SAM.

[2] Technically, the standard CGE model requires that the SAM have at least one household account; however, enterprise accounts are not necessary (Lofgren et.al, 2002).

[3] In the commodity columns, payments are made to domestic activities, the rest of the world, and various tax accounts (for domestic and import taxes). This treatment provides the data needed to model imports as perfect or imperfect substitutes vis- -vis domestic production (Lofgren, 2002).

here are for direct and indirect taxes collected from households and commodities respectively in the row section to be paid to the government in the column section. The basic SAM is represented in appendices A.

Having the brief concepts on SAMs, we can then discuss the Ethiopian SAMs. Although different SAMs have developed at different time such as 2004 World Bank SAM developedbyTadela and Alemayehu, the most comprehensive Ethiopian SAM was developed in 2005/06 by EDRI in collaboration with IFPRI. The 2005/06 SAM is produced in different levels of aggregations. The regionalized (micro) SAM is a fully disaggregated SAM with 255 rows and columns. It has disaggregated agricultural production and income generation regionally for the five main agro-ecological zones of Ethiopia.

This study uses the 2009/10 updated SAM by Robinson et al. (2011) for the analysis of the Ethiopia's growth and transformation plan using a recursive dynamic CGE model. The SAM was updated on the basis of 2005/06 Ethiopian Development Research Institute (EDRI 2009) national Social Accounting Matrix (SAM). The SAM is disaggregated into 113 activities (with 77 agricultural activities by agro-ecological zones, AEZs), 64 commodities, 16 factors (by AEZs except capital), and 13 institutions including 12 households. The SAM also has different taxes (includes both direct and indirect taxes: such as sales tax account that incorporates local VAT, domestic excise tax and service taxes and the import tax account consisting of import duty, surf tax, import excise tax, import VAT, and withholding tax), saving-investment, inventory, and rest of the world accounts to show the interaction of different economic agents. The saving account is disaggregated in to household and enterprise saving, government saving and foreign saving. Furthermore, both government and foreign savings are divided in to sector specific savings and non-sector specific savings.

4.2 The Computable General Equilibrium Model

In this section, we discuss the specifications of dynamic CGE model used in this paper. The dynamic CGE model described in this study has developed from the neoclassical-structuralist modeling tradition and has at its core of static CGE model[4]. The CGE model is formulated as a simultaneous equation system, including both linear and non-linear equations (Thurlow, 2004). The model explains all of the payments recorded in the SAM and hence it follows the SAM disaggregation of factors, activities, commodities and institutions (Lofgren, 2002). Since a recursive dynamic CGE model is solved one period at a time, it is possible to separate the *within-period* component from the *between-period* component, whereas the latter governs the dynamics of the model. The specifications of the model mainly follow Robison et al (2011) that used for the analysis of Ethiopian GTP along with Lofgren (2002) and Thurlow (2004). Although a detailed mathematical description can be found in Appendix C, in this part we present a more discursive overview of the model's structure.

4.2.1. Within Period Specification

The within-period component describes a one-period static CGE model. The model is based on a comparative static standard neoclassical-structuralist model developed by Lofgren *et al.* (2002). It is square- that is the number of equations is equal to the number of variables. The structure of the model is divided into four major blocks: price, production and trade, institutions and system constraint blocks.

4.2.1.1 Price Block

The price system of the CGE model is rich primarily because of the assumed quality differences among commodities of different origins and destinations (exports, imports, and domestic outputs used domestically). Profit maximization drives producers to sell its products for domestic and foreign (in the form of exports) markets where they can achieve the highest returns. These returns are based on domestic and export prices (where the latter is determined by the world price times the exchange rate adjusted for any taxes or subsidies)[5]. The final ratio of exports to domestic goods is determined by the endogenous interaction of relative prices for these two commodity types. Therefore, the

[4]The more detail of mathematical description of static and dynamic CGE model can be found in Lofgren *et al* (2002) and Thurlow (2004).
[5]Thurlow (2004) indicates that small-country is assumed to face a perfectly elastic world demand at a fixed world price.

price block consists of equations in which endogenous model prices are linked to other prices (endogenous or exogenous) and to non- price model variables.

The import price ( ) in local-currency units (LCU) is the price paid by domestic users for imported commodities (exclusive of the sales tax). Domestic import price of commodity c is the product of world import price ( ), the tariff adjustment (1+) and exchange rate (EXR) plus transaction costs to move the commodity from the border to the domestic demander. The exchange rate is in terms of local currency per unit of foreign currency. The exchange rate and the domestic import price are flexible, while the tariff rate and the world import price are fixed because of the assumption stemmed from small country.

The export price in LCU is the price received by domestic producers when they sell their output in export markets. The domain of the equation is the set of exported commodities, all of which are produced domestically. Under the small-country assumption, the regional price of an exported commodity is equal to that commodity's world export price ($pwer_{cr}$) times the exchange rate (*EXR*). Furthermore, since the export price represents the amount received by producers per unit sold abroad, the transaction costs per unit of output are removed from this price. This is equal to the share of transaction costs per commodity unit multiplied by the market price at which these transaction commodities are sold[6].

The consumer and producer price index can be determined as numeraire in the standard CGE equations. The CPI *can be* fixed and functions as the numeraire in the basic model version; alternatively, the producer price index (PPI)may be fixed.[7] However, in this study the producer price index is held fixed whereas the consumer price index is flexible.

[6]The main difference of export equations from import equations is that the tax and the cost of trade inputs reduce the price received by the domestic producers of exports (instead of adding to the price paid by domestic demanders of imports). The domain of the equation is the set of exported commodities, all of which are produced domestically (Lofgren, 2002). But, in Ethiopia there is no imposition of tax on export. Thus, te_c (export tax rate) is removed from export price equation because it is zero for the case of Ethiopia).

[7]The CGE model determines only relative prices and a numéraire is needed to anchor the aggregate price level.All simulated price and income changes should be interpreted as changes vis-a-vis the numeraire price index. For instance, consumer price index (CPI) is the numérairepriceindex since, so all changes in nominal prices and incomes in simulations are relative to a fixed CPI (Lofgren and Robinson, 2004).

$$CPI = \sum_{c \in C} PQ_C.cwts_c \text{ --- } 4.1$$

$$\overline{PPI} = \sum_{c \in C} PDS_C.dwts_c \text{ --- } 4.2$$

Where, $cwts_c$isweight of commodity c in the CPI (exogenous variable), $dwts_c$is weight of commodity *c* in the PPI (endogenous variable) for domestically marketed output.

We also have specification for demand price for domestically produced non-tradable goods. The model includes distinct prices for domestic output that is used domestically. In the presence of transaction costs, it is necessary to distinguish between prices paid by demanders and those received by suppliers. The domestic demand price (which is neither imported nor exported) defined as the domestic supply price plus the cost of trade inputs per unit of domestic sales of the commodity.

In addition to commodity price, the basis version of the model also includes equations for aggregate intermediate input price and activity price. The activity-specific aggregate intermediate input price shows the cost of disaggregated intermediate inputs per unit of aggregate intermediate input. It depends on composite commodity prices and intermediate input coefficients which show the quantity of input commodity cper unit of aggregate intermediate input (not per unit of output).

On the other hand, the activity price, the gross revenue per activity unit, is the return from selling the output or outputs of the activity, defined as yields per activity unit multiplied by activity-specific commodity prices, summed over all commodities because of the fact that activities may produce multiple commodities (Lofgren, 2002).

Furthermore, marketed output value and absorption equations are specified.[8]Absorption is total domestic spending on a commodity at domestic demander prices exclusive of the

[8]For each domestically produced commodities the marketed output value at producer prices is stated as the value of domestic sales and exports, activity pricerepresented as multiplication of yields per activity unit by activity-specific commodity prices summed over all commodities, and activity revenue and cost equations state for each activity, total revenue net of taxes is fully exhausted by payments for value-added and intermediate inputs(Lofgren et al, 2002).

sales tax. Absorption is expressed as the sum of spending on domestic output and imports at the demand prices. For each domestically produced commodity, the marketed output value at producer prices is stated as the sum of the values of domestic sales and exports. Domestic sales and exports are valued at the prices received by the suppliers both of which have been adjusted downwards to account for the cost of trade inputs.

4.2.1.2 Production and Trade block

The production and trade block covers four categories: domestic production and input use, the allocation of domestic output, the aggregation of supply to the domestic market and the definition of the demand for trade inputs that is generated by the distribution process.

The production in the economy takes place in each activity to yield the commodities produced domestically. The production function in the model is governed by the neoclassical production functions. Producers in the model make decisions in order to maximize profits subject to constant returns to scale (production technology), with the choice between factors being governed by a constant elasticity of substitution (CES) function as this specification allows producers to respond to changes in relative factor returns by smoothly substituting between available factors so as to derive a final value-added composite (see Thurlow, 2004) or, alternatively, a Leontief function of the quantities of value-added and aggregate intermediate input (Lofgren et al, 2002)[9]. And then these factors are combined with fixed shares intermediates using a Leontief function[10]. In this study, the technology at the top level is a Leontief function of the quantities of value added and aggregate intermediate input. For this model version with a Leontief function at the top of the technology nest, the demands for value-added (QVA a

[9]Profit maximization implies that the factors receive income where marginal revenue equals marginal cost based on endogenous relative prices.

[10]The aggregate intermediate inputs are a composite of both domestically produced and imported (see for more Lofgren, 2002).The use of fixed-shares reflects the belief that the required combination of intermediates per unit of output, and the ratio of intermediates to value-added, is determined by technology rather than by the decision-making of producers (Thurlow, 2004). That is the fixed proportion of inputs to outputs is represented by Leontief specification.

) and the aggregate intermediate inputs (QINTA a) are defined as Leontief functions of the activity level as represented by the CGE equations.

Regarding the flow in the commodity market, domestically produced marketable commodities, a particular commodity from each producer is combined to derive aggregate commodity output. This aggregation is determined by constant elasticity of substitution (CES) which allows demanders to substitute between the different producers supplying a particular commodity, in order to maximize consumption subject to relative supply prices (Thurlow, 2004). Producers may produce output to sell in domestic market or foreign market. Hence, Substitution possibilities exist between production for the domestic and the foreign markets. The allocation decision of marketed domestic output to domestic sales and exports are governed by a constant elasticity of transformation (CET) function, which distinguishes between exported and domestic goods, as a result it enable to captures any time or quality differences between the two products (see Thurlow, 2004).

Mathematically, Allocations of the marketed domestic output, *QXc*, to domestic sales, QD*c and exports, QEc, are formulated* in the output transformation (CET) function as follows:

$$QX_c = \alpha_c^{\,t} . \left[\delta c^t . QEc^{\rho_c^{\,t}} + (1-\delta_c^{\,t}) QD_c^{\,\rho_c^{\,t}} \right]^{1/\rho_c^{\,t}} ----c\varepsilon\,(CE \cap CD)------------4.3$$

Where, $\alpha_c^{\,t}$ denotes a shift parameter, δc^t denotes share parameter, and $\rho_c^{\,t}$ denotes an elasticity exponent in the CET function. The shift parameter measures the supply shift in the destination of domestic products based on the profitability of the destination. The share parameter, however, represents the share (proportion) of exports or domestic sale from domestically produced output.

The exponent shows the elasticity of transformation between the two destinations. The imperfect transformability between these destinations is the underlying assumption (Lofgren *et al.*, 2002).

Based on the assumption of imperfect transformability between the two destinations, the export-domestic supply ratio is formulated. Then the optimal mix between exports and domestic sales is explained by export-domestic supply ratio. Export-domestic supply ratio which is stated in the following equation is defined as a function of export-domestic price ratio. This indicates that relative supply of export to domestic increases as the relative prices of export increases because profit maximization drives producers to sell in those markets where they can achieve the highest returns. The returns are based on domestic and export prices and the final ratio of exports to domestic goods is determined by the endogenous interaction of relative prices for these two commodity types (Thurlow, 2004).

$$\frac{QE_c}{QD_c} = \left[\frac{PE_c}{PDS_c} . \frac{1-\delta_c^{\ t}}{\delta_c^{\ t}} \right]^{1/\rho_c^{\ t}-1} \text{--}4.4$$

Domestically produced commodities that are not exported are supplied to the domestic market. Substitution possibilities exist between imported and domestic goods under a CES, Armington specification[11]. So, Composite supply function or Armington function (QQ_c) is function of import quantity (QM_c) and domestic use of domestic output (QD_c)[12]. It is specified to absorb imperfect substitutability of imports and domestic output sold domestically. The CES aggregation function in which the composite commodity that is supplied domestically is produced by domestic and imported commodities entering this function as inputs capture the imperfect substitutability of imports and domestic output sold domestically.

$$QQ_c = \alpha_c^{\ q} \left(\delta_c^{\ q} . QM_c^{\ -\rho_c^{\ q}} + (1-\delta_c^{\ q}) . QD_c^{\ -\rho_c^{\ q}} \right)^{-\frac{1}{\rho_c^{\ q}}} \text{-------------------------------------}4.5$$

---

[11]When the domain of the CES function is restricted to commodities that are both imported and produced domestically, then, this function is often known as'' Armington" function, which is named after Paul Armington in honour of his work in 1969 (Lofgren et al., 2002).

[12] In the Armington function the shift parameter measures the shift in demand based on the expensiveness of the quantity supplied to the domestic economy while the share parameter signifies the domestic market share of imports or domestically produced output. The Armington exponent shows the elasticity of substitution between the two types of commodities.

Where, α_c^q = an Armington function shift parameter, δ_c^q = an Armington function share parameter, and ρ_c^q = an Armington function exponent.

Then the optimal mix between imports and domestic output is defined by import-domestic demand ratio which is function of domestic to import price ratio. The import-domestic demand ratio equation assures that an increase in the domestic-import price ratio generates an increase in the import-domestic demand ratio, that is, a shift away from the source that becomes more expensive.

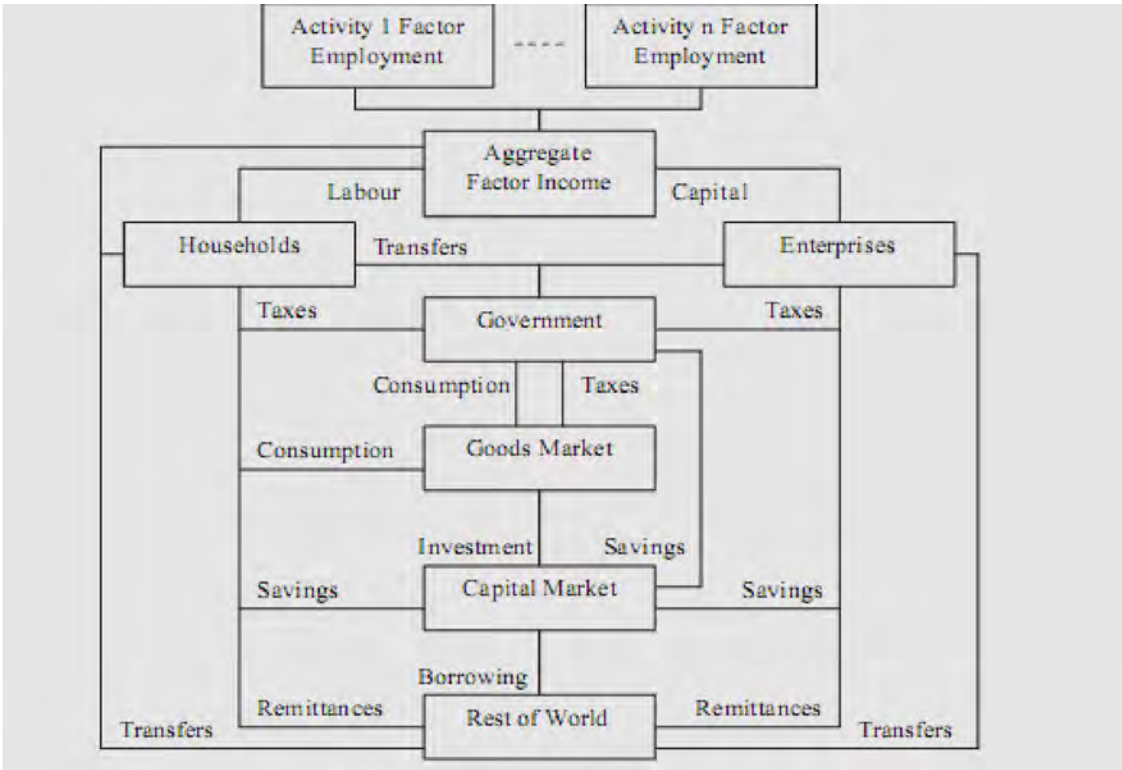
4.2.1.3 Institutional Block

This block consist four institutions: households, enterprises, the government, and the rest of the world. Under this block, the receipt and payment among various institutions are considered.

Figure 4.1 clearly summarizes the interaction between institutions in the model. The households earn their primary source of income from factor returns (such as capital and labor). In addition to this, they also receive transfers income from other institutions such as government (e.g. safety nets), and rest of the world (e.g. remittance). In turn after saving some parts they spend their income on consumption, tax payment and transfers to other institutions. Similarly, the enterprises earn income from the factor returns and transfers and in turn spend on saving, tax payment and transfers to other institutions. But the enterprises are the sole recipient of income from capital income. Savings by households and enterprises are collected into a savings pool from which investment is financed.

The government earns most of its income from direct and indirect taxes, and then spends it on consumption (since it is the primary consumer) and transfers to households. Both of these payments are fixed in real terms. Though not indicated in the below figure, government also makes payments to the rest of the world.

Figure 4.1: Institutional Incomes and Domestic Demand



Source: Thurlow (2004)

The total income of each factor, f, is the sum of activity payment (activity specific wages times employment level (Lofgren et al, 2002). It defines the total income of each factor.

$$YF_f = \sum_{a \in A} WF_f . \overline{WFDIST_{fa}} . QF_{fa}$$ --4.6, Where YF_f = total factor income of factor f, WF_f is activity specific wage and QF_{fa} is employment level.

The total factor income is split among domestic institutions is fixed shares after payment of direct factor taxes and transfers to the rest of the world. Ethiopia does not impose direct tax rate for factor f. Hence, direct tax rate for factor f equals zero and, income of each institution from factor payment is the product of share of income of factor to institution and income of factor after transfer to the rest of the world are paid.The total Income of domestic non-government institutions, *i,* is then the sum of factor incomes, transfers from other domestic nongovernment institutions, transfers from the government, and transfers from the rest of the world.

$$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i \in INSDNG} TRII_{ii'} + trnsfr_{igov}.\overline{CPI} + trnsfr_{irow}.EXR \quad \text{---------------------4.7}$$

Where, i ∈INSDNG (=INSDNG. ⊂INSD)= a set of domestic nongovernment institutions, YI_i= income of institution i (in the set INSDNG), and $TRII_{ii'}$ = transfers from institution *i'* to *i* (both in the set INSDNG).

We have seen modelling of the income of institutions; we now proceed to modelling the expenditure sides of institutions. The institutions spend their income on different activities. Households spend their disposable income on consumption of commodities. The disposable income is income after tax, saving and transfers to rest of world. So, the total value of consumption spending is defined as the income that remains after direct taxes, savings, and transfers to other domestic nongovernment institutions[13].

$$EH_h = \left[1 - \sum_{i \in INSDNG} shii_{ih}\right].(1 - MPS_h).(1 - TINS_h).YI_h \quad \text{-------------------------------4.8}$$

Where, i ∈H (⊂INSDNG) = a set of households, and EH_h= household consumption expenditures, $TINS_h$ is direct tax rate for households, MPS_h represents marginal propensity to save for household h.

However, households spend their disposable income on two categories of commodities: consumption of marketed commodities purchased at market price and consumption of home production valued at their opportunity cost. Thus, we can have a separate function for household consumption spending. Households consumption spending on market commodity c which is total household consumption spending, market price of c, and other commodity prices (market and home). Household consumption spending on home

[13] Consumer preferences are represented by a linear expenditure system (LES) of demand, which is derived from the maximization of a Stone-Geary utility function subject to a household budget constraint. Given prices and incomes, these demand functions define households' real consumption of each commodity (see Thurlow, 2004).

commodity *c* from activity *a* which is the total household consumption spending, producer price, and other commodity prices (home and market).

Apart from household consumption, investment demand and government consumption and revenue are extracted from the model. The investment demand is expressed as the base-year quantity multiplied by an adjustment factor (this factor is exogenous in the basic model version). The exogenous of adjustment factor makes the investment quantity exogenous in process.

Then, it is framed as:

$$QINV_c = \overline{IADJ}.\overline{qinv_c} \quad c \in C \text{ ---------------- } 4.9$$

Where, $QINV_c$ denotes quantity of fixed investment demand for commodity, $IADJ$ denotes investment adjustment factor, and $qinv_c$ denotes the base-year quantity of fixed investment demand.

Similarly government consumption demand is defined as the base-year quantity multiplied by an adjustment factor (this factor is exogenous; consequently the quantity of government demand is fixed). In addition to the government consumption, there are also other equations in the model representing the revenue and expenditure of government. Government is treated as a separate agent with income and expenditure. As its income source, government collects its revenue from taxes, factors and transfers from rest of the world. However, in Ethiopia direct tax from factors, ‘’value-added taxes’’ on activities, activity taxes and export taxes are excluded from the equation specifying the government revenue sources because not practiced.

The government spends its revenue to purchase commodities for its consumption (its consumption is fixed in real (quantity) terms) and to make transfer to other institutions (households and enterprises). Hence, total government spending is the sum of government spending on consumption and transfers. Unlike that of government consumption, transfers to domestic institutions are PPI (producer price index) indexed.

4.2.1.4 System constraints and Macroeconomic Closure

The generations of factor incomes and payment of these incomes to domestic institutions links production with demand. Balance between demand and supply for both commodities and factors are needed in order for the model to reach equilibrium. This balance is imposed on the model through a series of system constraints (Thurlow, 2004). For the different macro-economic balances of the model- government balance, savings-investment balance, and balance of payments, macro closure rules are required. The notion of closure rule implies equality of equations and endogenous variables which requires fixation of some variables for the model to have a solution. The choice of closure rules should depend on the policy issues being analyzed and the time frame for the analysis. The standard CGE model defined three macro-balances: commodity markets, factor markets and external balances. Equilibrium in the goods market requires that demand for commodities equal supply[14]. This equilibrium condition is attained through the endogenous interaction of relative prices. Aggregate demand for a good comprises consumption spending, investment spending, and export and transaction services demand. Supply in turn includes both domestic production and imported commodities.

Unlike the goods market, the equilibrium condition of factor market is dependent on how the relationship between factor supply and wages is defined (Thurlow, 2004). The standard CGE model imposes equality between quantity demanded and quantity supplied.

$\sum \qquad\qquad f \in$ ………………………… 4.10

In the case of fixed supply, the factor wage is the equilibrating variable that assures factor market equality (Lofgren, 2002). But, this rule works if factors are fully employed, otherwise not. If capital is fully employed and sector specific, sector specific wages adjust to ensure that demand for capital equals supply.

In this study, the factor market closures are defined as: skilled labor is fully employed and mobile while semi-skilled and unskilled labor is unemployed and mobile across

[14]Equilibrium is attained in goods market through the endogenous interaction of domestic and foreign prices, and the effect that shifts in relative prices have on sectoral production and employment, and hence institutional incomes and demand (Thurlow, 2004).

sectors; land is fully employed and mobile across sectors, and capital is fully employed and activity specific. The fully employed factors imply that they have fixed supply (thus, skilled labor, land, and capital are fixed in quantity supply) whereas semi-skilled and unskilled labor is unemployed and hence its employment is flexible[15]. On the other hand, labor and land are mobile across sectors implying that they can be used in different activities. But capital is immobile across sectors and hence it is activity specific in our case. Moreover, the model also includes three broad macroeconomic accounts: the current account, the government balance, and the savings and investment account. In order to ensure equilibrium conditions in these macro accounts it is necessary to specify a set of 'macro-closure' rules, which provide a mechanism through which adjustment is assumed to take place.

For current accounts balance, we have two closures: the first one is default closure in which foreign saving is fixed while real exchange rate, *EXR*, is flexible. The second closure is fixed real exchange rate while foreign saving (trade balance) is flexible. However, in this study foreign saving is fixed, and thus it is the real exchange rate that plays the equilibrating role[16]. So, the current account balance in foreign currency, equates the country's spending and its earning of foreign exchange. Accordingly, import spending plus factor transfers to the ROW must equal the sum of export earning, institutional transfers from the rest of the ROW and foreign savings.

$$\sum_{c \in CM} pwm_c . QM_c + \sum_{f \in F} trnsfr_{rowf} = \sum_{c \in CE} pwe_c . QE_c + \sum_{i \in INSD} trnsfr_{irow} + \overline{FSAV} \quad \text{..............4.11}$$

Where, $\overline{FSAV}$ denotes foreign saving (in foreign currency unit). According to the above equation, import spending plus factor transfers to the ROW must equal the sum of export earning, institutional transfers from the rest of the ROW and foreign savings.

[15]Unemployment amongst unskilled and semi-skilled, and skilled labor is assumed to be sufficiently large such that wages are fixed in real terms and supply passively adjusts to match demand. Highly-skilled labor is neither fully employed nor significantly unemployed to justify either a fixed supply or a fixed wage. Rather the supply of this factor is responsive to changes in real wages, which adjust to ensure that demand and supply are equal in equilibrium (Thurlow, 2004).

[16]This closure is appropriate given Ethiopia commitment to a flexible exchange rate system, and the belief that foreign borrowing is not inexhaustible. Flexible exchange rate adjusts in order to maintain a fixed level of foreign borrowing (or negative savings).

Regarding government account balance we have three closures: government savings is flexible while tax rates are fixed (in which government savings is the endogenous variables that clears the government balance); direct tax rates on domestic non-government institutions are flexible to allow for an adjustment in revenue and thereby maintain government savings fixed; and the third closure assumes that the tax rates are multiplied by a fixed scalar (scaling direct tax) and government savings are fixed. In all cases it is assumed that government consumption expenditure is held fixed either in real terms or as a share of total absorption. For our purpose, the study employed the second closure in which the government saving is held fixed while Public receipts are adjusted endogenously to achieve the predetermined net government position by shifting the household income tax that equilibrate the economy. Mathematically, the government account balance is formulated as the equality of government revenue and the sum of government expenditure and savings.

$$YG = EG + \overline{GSAV} \qquad 4.12$$

The third macro balance account is saving-investment account. For saving investment balance-the critical difference between the various constraints available for the savings-investment balance lies in whether savings are assumed to be investment-driven or whether investment is considered to be savings-driven (Thurlow, 2004). Therefore, closures are either investment driven (the value of savings adjusts) or savings-driven (the value of investment adjusts). In this study, we choose the closure rule of investment is saving-driven. Fixed savings rates for government and ROW institutions and flexible capital formation are specified so that all savings are channeled into investment. Real investment quantities are fixed (Lofgren et al, 2002).

Accordingly, the sum of savings from the government, domestic non-government institutions and the ROW are equated with the sum of fixed investment (gross fixed capital formation) and stock change. To cater for imbalance, the S-I balance also has an optional addendum in ‘WALRAS’ which is valued at zero if the model is in equilibrium (balanced).

$$\sum_{i \in INSDNG} MPS_i.(1-TINS_i).YI_i + \overline{GASV} + EXR.\overline{FSAV} = \sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c \quad ---4.13$$

Where, $qdst_c$ represents the quantity of stock changes

Accordingly, the sum of savings from the government, domestic non-government institutions and the ROW are equated with the sum of fixed investment (gross fixed capital formation) and stock change. To cater for imbalance, the S-I balance also has an optional addendum in 'WALRAS'which is valued at zero if the model is in equilibrium (balanced).

4.2.2 Between Period Specifications

This section describes the dynamic extension of static CGE model. Though the static model described above is shows in detailed representation of the Ethiopian economy within a particular time-period, its inability to account for second-period considerations limits its assessment of the full effect of policy and non-policy changes. The model cannot capture the impacts of policy-changes includes dynamic aspects, such as the inter-temporal effects of changes in investment and the rate of capital accumulation (Thurlow, 2004). In attempting to overcome these limitations, we extended static model to a recursive dynamic model in which selected parameters are updated based on the modeling of inter-temporal behavior and results from previous periods.

Over the time period being analyzed a number of policy-independent changes are assumed to take place. Together these effects form a projected or counterfactual growth path for the economy. These inter-period adjustments include population and labor force growth, capital accumulation, factor productivity changes, and changes in government expenditure[17]. Thus, current economic conditions, such as the availability of capital, are thus endogenously dependent on adaptive expectation, but remain unaffected by forward-looking expectations. The dynamic model is also exogenously updated to reflect demographic and technological changes that are based on observed or separately calculated projected trends

[17]In the dynamic recursive CGE model, Labor and land stocks are updated on the basis of exogenous trends. The population in each time period is also exogenous while the accumulation of private and government capital stocks and foreign government debt is endogenous (Lofgren and Robinson, 2004).

Similar to the static model, each representative household in the model consumes commodities under a linear expenditure system (LES) of demand. The LES allows for an income-independent level of consumption measured as the market value of each household's consumption of each commodity that is unaffected by changes in disposable income (Thurlow, 2004). Population growth is assumed to enter the model through its direct and positive affect on the level of private consumption spending. During the dynamic updating process, the level of each household's consumption of a particular commodity is adjusted upwards to account for greater consumption demand due to population grows. Hence, it is necessary to increase the quantity of income-independent demand (γ^{m}_{ch}) at the same rate as population growth to make an adjustment for upward raises of consumption of commodities[18].

Unlike the population growth, the updating process in the entrance of changes in labor supply in the dynamic model depends on the labor market closure adopted for each labor category. As stated in the static model, four alternative closure options are possible for each factor market. The first closure is: labor supply is flexible and real wage is fixed; that means labor supply is adjusted by real wage elasticity of labor supply. Since labor supply adjust endogenously to determine final employment and wages, no exogenous updating of labor supply (QFS_f) is needed. But if labor supply is growing exogenously, then QFS_f^o is adjusted exogenously. The second closures assume labor supply is fixed and the real wages adjust to clear factor market. This closure is based on the assumption of full employment. In the dynamic model, the fixed level of labor supply is adjusted exogenously.

In contradiction to labor supply (which is determined either exogenously or market closure), all changes in total capital supply are endogenous in the between periods. In this case given a time period, the stock of capital depends on the past capital stock, new investment and depreciation rates. But the problem arises is how the new capital stock resulting from previous investment is to be allocated across sectors. At the extreme cases, specification of the model would allocate investment in proportion to each sector's share

[18] But, still new consumers are assumed to share the same consumption preferences as existing consumers as constant coefficient of the consumption equations.

in aggregate capital income or profits. But, these proportions are adjusted by the ratio of each sector's profit rate to the average profit rate for the economy as whole in current dynamic model. Along with changes in factor supply, the dynamic model also takes into consideration changes in factor productivity. In this study, total factor productivity is exogenously updated. Finally, the value of elasticity used in the model is presented in appendix B.

4.3 The Micro Simulation Model

In addition to the within-period and the between-period modules discussed above, a separate poverty module is used to compute the inequality and poverty indicators. Hence, the CGE model must be linked with various models to assess the poverty effects of public spending in Ethiopia. There are two approaches used to address the question of poverty and income distribution within the CGE framework. The first and the most common one is the representative household (RH) approach in which the household agent is disaggregated according to socioeconomic or geographical criteria and where the solution from the CGE model is sequentially augmented with household survey data to simulate poverty and inequality indices. The main shortcoming of this approach with respect to poverty analysis is its assumption that income distribution within the groups represented by the household agents is not affected by the policy shock.

The other approach is the micro simulation (MS) approach in which the household agents in the CGE model correspond to the observed individual households in a survey. By endogenzing intra-group distributions, this approach effectively circumvents the shortfalls of the RH approach, though it creates significant demands in terms of data, statistical procedures and modeling. In this study, we linked the CGE model with MS model to distribute the economy-wide results of CGE model to assess the poverty effect. The changes of policy reform introduced in the CGE model bring about economy-wide changes in the consumer price index and consumption expenditures of households once we run the CGE model. Then, these simulation results for the before and after shock period are fed into the MS model using distributional analysis software (DAD) that yields the FGT poverty indices.

CHAPTER FIVE

SIMULATIONS AND RESULTS

5.1 Description of Simulations

In this part, we state different scenarios that are used to assess the impacts of alternative policy shocks on economic growth and poverty reduction in Ethiopia. In the CGE modeling framework, it is essential to establish a baseline scenario that is counterfactual for comparing against the outcome of a policy shock. Hence, we begin with the baseline simulation.

5.1.1Base Simulation

In a dynamic analysis, this involves drawing on additional exogenous information to define what seems to be a plausible growth path for the Ethiopian economy up to 2020. The information includes the macro-economic indicators such as GDP, total investment, absorption, private consumption and external sectors. This should not be interpreted as an exercise in forecasting but as an attempt to define a benchmark for comparing alternative policy scenarios in order to isolate their specific effects. Table 5.1 indicates the macro-economic trend in the baseline scenario.

Table 5.1: Macroeconomic Trend in the Initial and Baseline Scenario (Percentages)

	2009/10(YR bil)	**Base simulation (%)**
Absorption	457.7	9.5
Private consumption	338.6	9.3
Fixed investment	85.5	11.5
Government consumption	31.8	5.7
Exports	52.1	18.8
Imports	-126.5	12.6
CPI	1.24	1.22
Real Exchange Rate	1.0	-2.5
Total Production	598.4	10.9
GDP at factor cost (GDPFC2)	355.0	10.6

Source: Simulation results from the CGE model

In the base simulation, GDP at factor cost (which is 355 billion birr) grow at 10.6 percent. Private consumption that shares 95.4 percent of the total GDP has grown by 9.3 percent at the baseline simulation while absorption has grown at 9.5 percent. The exports and imports that share 14.7 and 35.6 percent of total GDP have grown by 18.8 and 12.6 percent in respective order.

5.1.2 Alternative Policy Scenarios

In this part we presents the policy simulations that are intended to explore the growth, welfare, poverty and distributional consequences of the additional public spending in the Ethiopia in contrary to the baseline scenario. In each policy experiment we assess the effect of public spending on specific sectors along with different means of financing. Table 5.2 provides a brief description of all the alternative simulations under the three sets of policy experiments. Two sets of alternative public spending scenarios are assessed using the CGE model for Ethiopia. The scenarios are increasing public spending on human capital, and increasing public spending on agriculture. Since the saving-investment account in the Ethiopian SAM do not disaggregated, we assume additional spending towards specific sectors is assumed to be financed through savings. Based on this assumption, for each policy experiments described, three categories of financing of additional public spending are assessed. The first categories is analyzes the financing additional public expenditure for specific sectors through government savings toward one specific sector at a time (human capital (education and health) and agriculture). The second categories is the assessment of financing additional expenditure towards specific sectors by foreign saving that can be obtained in the form of foreign aid after excluding government saving. The third policy experiment is an analyses of the combined effect of policy scenario one and two, financing additional public expenditure towards specific sector through combination of government saving and foreign saving. Then, the effects on growth and poverty in the economy will be assessed comparing with a baseline growth path.

Based on public expending data during GTP, human capital and agricultural expenditure have grown on average by 22 and 30 percent per annum from 2009/10-2014/15 and assumed to continues in the same growth trend till 2020 respectively. According to saving investment closure rule, saving is channeled into investment. Therefore, the additional spending allocated towards human capital and agriculture can be matched with the same amount of increases in saving as clearly shown in table 5.2.

Table 5.2: Assumption for non-base simulation

Simulation Scenario	Description	TFP growth
GSAV_HC	Financing the increment of government expenditure on human capital by 22 percent via government saving	2.56
FSAV-HC	Financing the increment of government expenditure on human capital by 22 percent via foreign saving	2.56
BOTH_HC	Financing the increment of government expenditure on human capital by 15.4 and 6.6 percent via government saving and foreign saving, respectively	2.56
GSAV_AGR	Financing the increment of government expenditure on agriculture by 30 percent via government saving	1.56
FSAV_AGR	Financing the increment of government expenditure on agriculture by 30 percent via foreign saving	1.56
BOTH_AGR	Financing increment of government expenditure on agriculture by 21 and 9 percent via government saving and foreign saving, respectively	1.56

Source: Own Representation

Rather than doing regression to obtain the public spending elasticity, it is justifiable to use results on growth elasticities of public spending obtained from other studies. This is because of the estimation of TFP growth is very sensitive to the data used. Estimation of TFP growth requires data on the growth rate of real GDP, physical capital and labor input adjusted for human capital. While real GDP growth rates are available from many sources, measuring growth rates of capital stock and human-capital-adjusted labor input is more difficult. Measuring growth rates of capital stock is highly sensitive to assumptions regarding initial stocks and depreciation rates. In addition, estimating human-capital-adjusted labor input is, in itself, problematic. As per my knowledge there are no studies that assess the elasticity of public spending in Ethiopia, as a result we have taken the one used by Lofgren and Robinson (2004) for the analyses of the growth and poverty impacts of public spending in Sub-Saharan Africa. The elasticity assumptions for these scenarios are presented in Table 5.3.

Table 5.3: Assumed elasticities of public spending

Public spending category	Elasticity of public spending	Linkage channel
Agriculture	0.052	TFP in agriculture
Human capital	0.115	TFP in all sectors

Sources: elasticity estimates used by Lofgren and Robinson (2004)

As indicated in table 5.2 in the first three simulations (GSAV_HC, FSAV_HC and BOTH_HC) that focus on increasing human capital public spending by 22 percent on average is envisioned to raise the long-run TFP level by 2.56 for all activities in the SAM. The last three simulations (GSAV_AGR, FSAV_AGR and BOTH_AGR) that consist of evaluating the effect of an increase in agriculture public spending by 30 percent on average is assumed to increase the long-run TFP level of agricultural activities on average by 1.56 percent as it aimed to improve agricultural yields through investment in public agricultural research and infrastructure.

5.2Analysis of the Results of Public Spending Experiment

In this section, we analyze the results of the alternative policy simulations. We will see the consequences of alternative policy scenarios on macro-economic indicators, welfare, poverty and distributional indicators.

5.2.1 Macro-economic Effects

Table 5.4 shows the impacts of public spending on macro-economic indicators under different simulations. Most macro variables have recorded positive changes under all policy experiments. The first policy simulation (GSAV-HC) providesan interesting result. Real GDP has grown by 14.1 percent per year compared with 10.6 percent growth rate in the baseline scenario (the policy reform brought 3.5 percent increases in real GDP). Absorption has shown a 2.8 percent increase mainly due to the strong increases in investment (7.0 %) along with improvement of private consumption. We could also observed that private consumption rises by 1.3 percent due to strong positive effects of improvement in productivity on output production (rises by 3.76 percent) and reduction of consumer price index that increases the purchasing power of households which offsets the negative effect of domestic finance that can raised through increasing of taxes. Apart from these, external sectors, exports and import have shown a 4.6 and 3.4 percent increment respectively.

In the second simulation (FAS_HC), most results for macro economy indicators are very similar to the first simulation (GSAV_HC). Real GDP has shown a 3.3 % upturns at factor cost. Absorption has indicates a 4.8 percent growth due to 4.4 percent growth of private consumption along with 7% increases of investment. Compared to the first simulation, 2.8 percent increases, the increment is high mainly due to a more increase of private consumption which could be explained by a more increases of government income due to uprising of direct taxes which negatively affects household consumption in the first simulation along with more expansion of imported goods in the second scenario. On the other hand, real export has recorded a 0.3 percent declines in contrary to 4.6 percent raises in the first simulation while the real import has shown a more increment, 6.3 % rises compared to a 3.4 percent increases in the first simulation. This could be explained by more appreciation of real exchange rate associated with the increase of capital inflow from outside when we finance additional expenditure through foreign saving. In the model, the appreciation of the real exchange rate caused by the inflow of foreign currency provides the incentives required for suppliers to export a smaller share of their output and for demanders to switch from domestic outputs to imports. Thisis resulting in the increase of the trade deficit.

In Simulation 3 (BOTH_HC) we assess the combined effects of simulation one and two. Real GDP has grown by 3.5 %. Absorption increases by 2.9 percent that could be resulted from 1.4 and 7.0 percent growth of private consumption and fixed investment in that order. Regarding external balance, real exports and imports have recorded a 4.5 and 3.5 percent average annual growth respectively.

Table 5.4: Indicates the simulation results on macro-economic indicators (percentages)

	BASE	GSAV_HC	FSAV-HC	BOTH_HC	GSAV_AGR	FSAV_AGR	BOTH_AGR
Absorption	9.56	12.35	14.39	12.42	10.48	11.35	10.52
Private consumption	9.35	10.66	13.73	10.77	9.79	11.03	9.86
Fixed investment	11.54	18.53	18.50	18.55	16.04	16.03	16.04
Government consumption	5.70	5.70	5.70	5.70	5.70	5.70	5.70
Exports	18.81	23.43	18.51	23.30	19.29	17.17	19.24
Imports	12.56	15.98	18.89	16.04	12.90	14.13	12.93
CPI	-0.10	-0.63	-0.62	-0.63	-0.28	-0.28	-0.27
Real Exchange Rate	-2.41	-3.08	-5.45	-3.10	-1.95	-2.96	-1.94
Total Production	10.86	14.59	14.62	14.61	11.94	11.99	11.97
GDP at factor cost	10.58	14.07	13.89	14.08	11.82	11.71	11.85

Source: Simulation results from the CGE model

Note: GSAV_HC indicates 22% increases of human capital expenditure that financed through government saving,FSAV_HC indicates 22% increases of human capital expenditure that financed through foreign saving,BOTH_HC indicates 22% increases of human capital expenditure that financed through a combination of government saving and foreign saving, GSAV_AGR indicates 30% increases of agricultural expenditure that financed through government saving,FSAV_AGR indicates 30% increases of agricultural expenditure that financed through foreign saving and BOTH_AGR indicates 30% increases of agricultural expenditure that financed through a combination of government saving and foreign saving.

In the last three simulations we observe that the impacts of public spending on macro-economy variables are moderate compared to the previous simulations though positive for all macro indicators mainly due to differences in the total factor productivity elasticity of public spending. In simulation 4 (GSAV_AGR), we observed the 11.8 percent average annual growth rate of real GDP (1.2 percent increment) compared to the base simulation growth rate of 10.6 percent and 14.1 percent under simulation one. Absorption has increases by 0.8 % that could be supported with the 4.5% increment of investment and slight improvement of private consumption (0.4 percent rises) along with expansion of total current government expenditure. The real trade balance has also shows slight improvement as expansion of Real exports, 0.67 percent improvement overcome the 0.48 percent upturn of real imports.

The results of simulation 5 (FSAV_AGR) follows the same trends of simulation two though we observe differences on the extent of effects. A real GDP has recorded 11.7 percent of average annual growth rate compared to 10.6 percent growth rates in baseline simulation. Besides of the expansion in output, absorption has recorded 11.4 percent average growth rate opposed to 9.6 percent growth rate in baseline simulation. Along with expansion of absorption, private consumption and investment have shown a 4.5 and 2.3 percent annual average growth in respective order. The performance of trade balance has indicates a more worsening as real exports declined by 1.6 percent while real imports has shown 1.6 percent growth. The final simulation (BOTH_AGR), which tests the combined impact of simulation 3 and 4 in which the additional public spending allocated to agricultural sector financed through the combinations of domestic resources (government saving) and direct international transfers in the form of grant, results are quite similar to the fourth simulation. An 11.85 percent of real GDP growth rates have been achieved compared to 10.6 percent growth rates in baseline simulation. Similarly, absorption has grown by 1.0 percent as boosted by 0.5 and 4.5 percent expansion of private consumption and investment respectively along with more increment of current government expenditure. The trade balance has also indicates a positive performance.

Overall, the macro-economic effects of public spending vary based on targeted sectors along with differences in means of financing. The additional public expenditure targeted towards human capital has resulted in more positive effects on macro-economy variables compared to the one targeted towards agriculture. This could be explained by variation of public spending elasticity between human capital and agriculture sectors. In addition to this, expenditure allocated to human capital affects the whole economy through improving the total productivity of all sectors whereas agricultural expenditure affects the economy through improving the productivity of agricultural sector. When we come to means of financing, the results are mixed though positive for most macro-economic indicators. The impacts on Real GDP, total production and investment is almost similar either financed public spending through government saving or foreign saving, except slight increases under government saving means of financing. However, the impacts on absorption and private consumption are more positive under foreign means of financing than domestic financing. The trade balance shows an improvement under government saving against foreign saving means of financing.

5.2.2 Sectoral Effects

For reporting purposes we classified activities in to two; agriculture and non-agriculture. Table5.5 represents the results of policy simulations on the sectoral output growth. In all simulations we see positive impacts of increasing public expenditure either allocated to human capital or agricultural sectors. In simulation 1, spending of additional public expenditures on human capital that financed by government saving increases agriculture and non-agriculture outputs by 2.7 and 2.4 percent respectively. The underlying reason for these changes could be emanated from the increment of aggregate demand that leads to encourage producer to produce more goods and services in both sectors. The improvement of aggregate demand is mainly due to increases in investment along with decrease of the price of product due to declines of consumer price index which in turn increases the purchasing power of households.

The results of simulation 2 provides higher gains in agricultural outputs, increases by 3.0 percent against only 2.7 increases in the first scenario while gains in non-agricultural outputs is lower, 2.2 percent rises against 2.4 percent increases in the first simulation. In simulation 3, similar changes that follow from simulation 2 and 3 have resulted whereby agricultural and non-agricultural outputs have increased by 2.7% and 2.4%.

Table 5.5: Effects of Simulations on Sectoral Output (% changes)

	BASE	GSAV_HC	FSAV-HC	BOTH_HC	GSAV_AGR	FSAV_AGR	BOTH_AGR
Agriculture	7.53	2.66	3.00	2.72	1.77	1.97	1.83
Non-agriculture	10.97	2.39	2.18	2.42	0.45	0.39	0.48
total	10.86	3.73	3.76	3.75	1.08	1.13	1.11

Source: Simulation results from the CGE model

The gain of agricultural and non-agricultural output in the last three simulation scenarios is smaller than the first three simulation scenarios. This could be mainly emanated from the higher total production, 3.8 percent increases against 1.1 percent raises, as a result of more demand for goods and services under the first three simulations. In simulation 4, output levels in agriculture and non-agriculture have increased by 1.8 and 0.45 in respective way. The gains of agricultural output is more than non-agricultural output due to productivity effects of increasing agricultural expenditures affects economy-wide level through agricultural sectors. In simulation 5, we see agricultural and non-agricultural output increases by 2.0 and 1.4 percent respectively. The last simulation shows a 1.8 and 0.5 percent expansion of agricultural and non-agricultural outputs.

On the other hand, to see the impacts of policy scenarios on factor income of households, we classified factors of production in to four: labor, capital, land and livestock. Table 5.6 represents the impacts of simulations on factor income of households. In all simulation scenarios public spending either allocated towards human capital or agriculture resulted in positive returns in factor incomes of households. In simulation 1 the returns to labor and capital rises by 1.6 and 5.1 percent in that order. This could be resulted from fastest economic growth and huge investment that lead to raise demand for factor inputs which in turn affects real wage positively. In simulation 2 we see an increase of returns to incomes of labor, capital, land and livestock by 1.3, 4.4, 1.2 and 2.0 percent respectively. Relative to the first simulation incomes of labor and capital slightly declines due to moderate increases of demand for labor and capital. The result of simulation 3 follows similar changes of factor incomes in the first simulation.

The last three simulations have revealed the same trend of the factor income effects of the policy shock to that of the first three simulations. The return to labor and capital have increased by 0.6 and 2.1 percent in simulation four and six and 0.4 and 1.8 percent in simulation five respectively. Compared to the allocation of public spending towards human capital, the returns to factor input are lesser in the case of agricultural expenditure. This is explained by low output expansion that leads to slight increment of demand for labor.

Table 5.6: The Effect of Simulations on Factor Income of Households (percentages)

	BASE	GSAV_HC	FSAV-HC	BOTH_HC	GSAV_AGR	FSAV_AGR	BOTH_AGR
labor	9.0	10.6	10.3	10.6	9.6	9.4	9.6
capital	10.9	16.0	15.3	16.0	13.0	12.7	13.0
land	9.0	8.9	10.2	8.9	9.1	9.7	9.2
livestock	9.4	8.2	11.4	8.1	8.8	10.1	8.7

Source: Simulation results from the CGE model

In relations to income of households, the CGE result shows the similar change like output production and returns to factors of production. An increase investment, high GDP growth and increases return to factors of production resulted in increases in real income of both poor and non-poor households under all policy scenarios. In simulation 1 the income of urban household increases faster than the income of rural households. This is mainly due to, given inelastic demand for agricultural commodities, the productivity gains in agriculture tend to reduce the demand for labor in agricultural sectors, with surplus labor moving to the other sectors. This could explain why this policy reform benefits urban households than its counterparts. On the other hand, the incomes of non-poor households increase, 2.8 and 3.9 percent in rural and urban areas in respective order, faster than incomes of the poor, 0.8 and 3.6 percent rises in rural and urban areas. This result is largely due to high returns to capital and labor that accrue mainly to non-poor households.

Table 5.7: Effects of Simulations on income of households (% changes)

	BASE	GSAV_HC	FSAV_HC	BOTH_HC	GSAV_AGR	FSAV_AGR	BOTH_AGR
Rural poor	8.85	0.82	1.7	0.83	0.4	0.8	0.4
Rural non-poor	9.45	2.76	2.6	2.78	1.1	1.1	1.1
Urban poor	9.41	3.67	2.69	3.68	1.4	0.9	1.4
Urban non-poor	9.12	3.91	2.64	3.91	1.3	0.7	1.4

Source: Simulation results from the CGE model

In simulation 2 the rises of income of the households is lesser than the first simulation except for rural poor. The real of income of rural poor, rural non-poor, urban poor and urban non-poor households have increased by 1.7, 2.6, 2.7 and 2.6 percent respectively against 0.8, 2.8, 3.7 and 3.9 percent increases in the first simulation. This could be explained by the appreciation of real exchange rate that makes domestic production of import substitute industrial products less profitable, thereby reducing the earning of labor and capital in the case of financing additional expenditure by foreign saving. The raise of rural poor household real income could be emanated from the increase of returns to land and livestock factors which is the major source of poor rural incomes. The results of simulation 3, which assess the combined effects of the first and second simulation, are very similar to the first simulation in which real income of all households increases. The income growth of urban households is faster than the growth of rural households' incomes.

In the last three simulations the real income of households increases in the range between 0.4-1.4 percent in favors the non-poor households. The income of poor and non-poor have increased by 0.4 and 1.1 percent increases in rural areas whereas 1.4 and 1.3 percent growth in urban areas in simulation four and six respectively against 0.8 and 1.1 percent in rural areas and 0.9 and 0.7 percent in urban areas improvement in simulation five. Yet the urban households gain more income improvements from the policy reform comparing to the rural households. Overall, additional government expenditure on specific sectors (either human capital or agriculture) under each financing schemes results in increases in real income of households. And also, under each policy scenarios the urban households reaping more benefit than rural households.

5.2.3 Welfare Effects

The welfare of society can be indicated by using equivalent variation, income of households or consumption expenditure of households. As discussed in many literatures, equivalent variation is the most important indicators of the welfare effects of policy reform. Since policy shocks are usually followed by major price adjustments, the EV measures the level of income (in money terms) that the consumer needs to (presumably) pay before the shock to leave him as well off at the equivalent level of utility changes after the price changes. Since the consumer can be harmed or benefited prior to the policy change by paying or receiving the price equivalent in income, negative or positive EV changes represent welfare (utility) loss or gain as a result of the policy shock. Table 5.8 has shown the welfare effects of policy reform under different simulations.

In the first simulation (GSAV_HC), the EVs showed 0.41 (rural poor), 4.1 (rural non-poor), 7.7 (urban poor) and 4.7 (urban non-poor) percent increases in that order. The welfare of urban households improved larger than that of the rural counterparts mainly due to a more gains in income of urban households than the rural households. When we compare poor with non-poor, rural non-poor and urban poor benefits better than rural poor and urban non-poor in that order from the policy shock that could be emanated from higher returns to labor and capital along with more increases of government income that raised through impositions of taxes on households in which rural poor and urban non-poor more affected.

Comparing to the first simulation, the results of the second simulation (FSAV_HC) indicates a more positive welfare effect of policy simulations. Based on this, EVs showed increases for all household groups on average between 9.5 – 14.5 percent. This is explained by the reduction of taxes imposed on households that enable the households to consume more. In other way, financing of additional expenditure through foreign grant has increased the purchasing power of households and also permits the country to enjoy large trade deficits and higher absorption. Within the households, urban households reaping more benefit than rural households since the urban households gain more income than their counterparts. The policy reform favors the rural non-poor (12.7 %) and urban poor (14.1 %) relative to rural poor (9.7 %) and urban non-poor (12.8 %) households respectively.

The combined effects of policy scenario one and two has showed the more welfare gains compared to scenario one particularly for urban households, but lower welfare improvement against scenario two. The EVs results has showed a 0.5, 4.4, 8.4 and 6.9 percent positive welfare changes for rural poor, rural non-poor, urban poor and urban non-poor respectively.

Table 5.8: Welfare effects of the Simulations (% changes), Equivalent Variation

	BASE	GSAV_HC	FSAV_HC	BOTH_HC	GSAV_AGR	FSAV_AGR	BOTH_AGR
rural poor	13.83	0.41	9.67	0.48	0.6	4.2	0.8
rural non-poor	14.94	4.05	12.73	4.26	1.7	4.8	1.9
urban poor	14.3	7.68	14.08	8.44	2.7	4.6	2.9
urban non-poor	12.84	4.7	12.82	6.78	0.5	2.9	0.6

Source: Simulation results from the CGE model

In the last three simulations we observe a slower welfare improvement for all households due to lower changes in absorptions and households consumption along with small increases in real GDP comparing to the first three simulation scenarios. The productivity gains in agriculture tend to reduce the demand for labor in agricultural sectors which negatively affects real wage, with surplus labor moving to other sectors. This could explain why these policy simulations mostly benefits urban households. The households receive a better welfare improvement in simulation five, 4.2, 4.8, 4.6, and 2.9 percent increases, contrary to 0.6, 1.7, 2.7 and 0.5 percent improvement in the fourth simulation for rural poor, rural non-poor, urban poor and urban non-poor in respective ways. Like the previous simulations, yet the rural non-poor and urban poor receive a much of the welfare salutary from the outcomes of policy.

In general, the welfare of all households has improved under each policy scenarios. Financing of additional expenditure through foreign saving resulted in more welfare benefits for households in contrary to financing through government saving. An urban household has reaping more welfare improvement than rural households under all simulations.

5.2.4 Poverty Effects

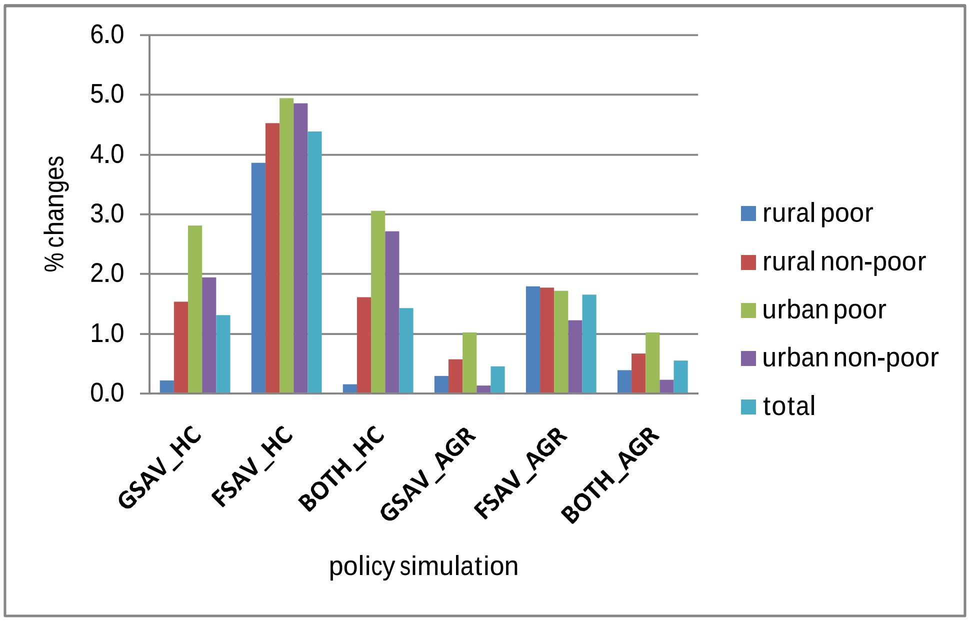
The international record based on the experiences of many countries, shows that economic growth is the most effective anti-poverty tool. Growth-oriented policies are considered to be the most effective vehicle for expanding the revenue base, which, in turn, leads to a reduction in poverty.

In order to analyze the impacts of policy shock on poverty indicators, we used the DAD distribution analysis software that allows a micro simulation analysis of the FGT decomposable poverty index using the 2004/05 HICE survey. In order to link CGE model with MS model we use economy-wide changes in consumption expenditure of household groups that are taken from the CGE model than income of households as it allows both the income distributional effect among the different household categories in the analysis and the changes in consumption patterns to be taken into account in conducting the poverty analysis using the three poverty indicators (head count ratio, P0, poverty gap, P1, and severity of poverty, P2). Figure 5.2 presents the CGE results for the effects of simulation on consumption of households.

In all simulations, the consumption expenditures of all household group increases. In the first simulation, household consumption expenditures have grown by 0.2, 1.5, 2.8 and 1.9 percent for rural poor, rural non-poor, urban poor and urban non-poor in respective order. The raise of consumption of households favors urban households than rural households, 2.4 percent increases for urban against 0.9 percent grew for rural. The urban poor and rural non-poor have benefited higher consumption than their counterparts. The households capture more consumption benefits under simulation two compared to first simulation, where public spending is financed through direct international transfers in the form of foreign aid. We have seen 3.9, 4.5, 4.9 and 4.9 percent booms of rural poor, rural non-poor, urban poor and urban non-poor household’s consumption expenditures respectively. Urban households benefited more from policy reform against rural households.

Comparison with the first three simulations, the increases of all household group consumption is lower in the last three simulations due to lower changes in absorption and income of households. In simulation 4 the consumption of urban and rural households increases by 0.5 and 0.45 percent in respective order. Urban poor and rural non-poor benefited more from the policy reform. Financing additional expenditure through foreign saving increases the consumption of all households group against financing through domestic resources (government saving).

Figure 5.2: Real households' consumption expenditure (% changes)



Source: simulation results

Overall, the rate of increase in household consumption under financing additional expenditure through government saving is lower for all household groups than under the foreign financing alternative, as households are supposed to save more at the expense of consumption.

To analyses the impacts of household consumption changes on poverty, the FGT poverty estimates for households at national, rural and urban levels are used. At the national level we have 21594 households of which 9493 were rural and 12,101 were urban. We divided households in to poor and non-poor rural and urban households based on the bottom 40 percent were considered as poor, since the SAM has delineated poor and non-poor households based on levels of consumption expenditure with the bottom 40 % as poor and top 60% as non-poor. Based on this demarcation we got 3861 as poor and 5632 as non-poor among the rural households whereas among urban households, we got 4,751 as poor and 7,350 as non-poor. We changed the household consumption expenditures in the survey to household expenditure per adult equivalent based on adult equivalent household size for the 2004/05 survey from CSA. After this all the necessary adjustment has been made on households' consumption expenditure in the 2004/05 HICE survey using the consumption expenditure results in the CGE model under each policy scenarios. Finally the poverty line is adjusted for the CPI in each simulations based on CPI results generated from the CGE model.

Table 5.9 presents the results for each poverty indicators under different policy simulations. The first indicator of poverty is the head count index (poverty incidence) that represents the proportion of the population whose consumption expenditure is below the poverty line. At the base simulation, 33.1% population is poor from the total population at the national level. The index becomes 33.4 percent for rural and 33.7 percent for urban population. Overall the incidence of poverty reduces under all policy simulations. In simulation1, the incidence of poverty has reduced by 2.0, 2.5 and 1.1 percent at national, rural and urban levels respectively. The reduction of incidence of poverty is more for rural than urban areas. Given that the non-poor rural population is relatively close to the poverty line, rural poverty rates are relatively sensitive to small changes in household consumption growth.

In the second simulation, the poverty incidence has decreased more than the first simulation at all levels. In this policy scenario the aggregate spending expansion leads to larger increases in aggregate household consumption and hence the much reduction in poverty head count rates mainly due to less imposition of direct taxes on households. The head count rates has declined by 4.0, 4.4 and 2.8 percent at national, rural and urban levels in respective order. The third policy scenario shows the similar effects on poverty to that of the first simulation. At the national, rural and urban levels the incidence of poverty has declined by 2.0, 2.5 and 2.4 percent in respective order. The reduction of poverty is more for rural than urban households.

In the next three simulations (four, five and six), the impacts is a modest acceleration in aggregate GDP growth (1.2 percentage points comparing to the base) and a moderate gain in poverty reduction. In simulation four the head count poverty rates is lower than a base simulation, 0.8, 0.8 and 1.1 percent poverty gains for national, rural and urban poverty levels in that order. The gains of poverty reduction is more for urban than rural households. Given the relatively inelastic demand for agricultural commodities, the productivity gains in agriculture tend to reduce the demand for labor in agricultural sectors, with surplus labor moving to other sectors. This explains why this policy reform benefits the urban households-1.1 percent reduction of incidence of poverty relative to the baseline scenario, compared with a gain of 0.8 for rural households. Financing of public spending on agricultural sectors by foreign savings leads to a more reduction in incidence of poverty at all levels. There is a 1.4, 1.9 and 1.3 percent reduction in poverty for national, rural and urban levels respectively in which the rural population benefits more than the urban. Finally, the poverty incidence impact of the fifth policy scenario is very similar to the fourth one.

In general the spending expansion in all simulations, either targeted human capital or agriculture, accompanied by an expansion in foreign grants has a salutary impact on poverty incidence reduction than through domestic resources in the form of government saving since it permits the country to enjoy a higher absorption and significant increases in household consumption. The lower reduction in poverty in the case of financing additional expenditure through raising government saving could be explained by the increases of government income due to raise of direct taxes and hence forces the household to save more at the expense of consumption.

The other indicator of poverty is the poverty gap index that represents the depth of poverty, how far the poor households from the poverty line (how poor they are). The results imply similar changes like the incidence of poverty in the sense that the index reduces in all policy scenarios. The poverty gap has reduced by 1.1, 1.0 and 1.4 percent at national, rural and urban levels in the first simulation. The reduction of poverty gap in urban area is larger than the rural one. This could be due to more rural households is close to poverty line that their distance from poverty line less compared to urban households, particularly those non-poor households. We observe a much reduction of poverty gap index in the second simulation. The results are very beneficial as the poverty has down wards by 1.8 percent for all households group. The reduction of poverty gap in the third scenario is quite similar to the first simulation as it falls between the ranges of 1.0-1.5 percent, in which urban households gains more reduction in poverty, 1.5 percent falls.

Tab le 5.9: Effects of Simulations on Poverty Indicators (% change)

	BASE	GSAV_HC	FSAV_HC	BOTH_HC	GSAV_AGR	FSAV_AGR	BOTH_AGR
	P0 (Head count index)						
national	33.11	-1.98	-4.0	-2.0	-0.83	-1.42	-0.84
Rural	33.39	-2.47	-4.42	-2.52	-0.8	-1.89	-0.82
urban	33.72	-1.08	-2.82	-2.41	-1.07	-1.34	-1.07
	P1(Poverty gap index)						
national	8.44	-1.07	-1.78	-1.09	-0.46	-0.79	-0.48
Rural	8.21	-1.02	-1.77	-1.03	-0.45	-0.81	-0.47
urban	11.33	-1.41	-1.79	-1.46	-0.54	-0.7	-0.54
	P2 (Severity of poverty)						
national	2.89	-0.47	-0.75	-0.47	-0.21	-0.35	-0.21
Rural	2.76	-0.43	-0.73	-0.43	-0.19	-0.34	-0.2
urban	4.73	-0.82	-1.02	-0.84	-0.32	-0.41	-0.32

Source: Micro simulation results

Note: GSAV_HC indicates 22% increases of human capital expenditure that financed through government saving,FSAV_HC indicates 22% increases of human capital expenditure that financed through foreign saving,BOTH_HC indicates 22% increases of human capital expenditure that financed through a combination of government saving and foreign saving, GSAV_AGR indicates 30% increases of agricultural expenditure that financed through government saving,FSAV_AGR indicates 30% increases of agricultural expenditure that financed through foreign saving and BOTH_AGR indicates 30% increases of agricultural expenditure that financed through a combination of government saving and foreign saving.

In the last three simulations, we see a moderate reduction of poverty gap compared to the previous policy scenarios. In the fourth and sixth simulations, poverty gap ratio has reduced by 0.46, 0.45 and 0.54 percent at national, rural and urban levels. Relatively, more falls were observed in the fifth simulation where the additional agricultural expenditure is financed by foreign resources mainly due to higher absorption and consumption expenditures.

The last indicator of poverty is the poverty severity index which shows not only the poverty gap but also indicates the inequality among the poor and hence imposes more weight on households that are found far below the poverty line. Compared to the baseline simulation, the severity of poverty has reduced for national, rural and urban by

0.5, 0.4 and 0.8 percent respectively in the first and third simulations. The severity has falls by higher margins for urban households compared to rural households. Moreover, the severity of poverty indicates a larger reduction in simulation two, 0.8, 0.7 and 1.0 percent for national, rural and urban levels.

Similar to the first and second indicators of poverty, the inequality among poor has indicates a moderate falls for the last three simulations. In simulation one and three, we realize a 0.2, 0.2 and 0.3 percent reduction of poverty severity at national, rural and urban levels in respective order. While in simulation three the severity of poverty shows a more moderate reduction at all levels. In all the last three simulations, the urban households benefited more than their counterparts.

At the last, but not least we will see the impacts of policy reform on income inequality. As proposed in many literatures, the gini-coefficient is the main indicators of income inequality in a given areas. There is evidence that shows that there is strong correlation between growth in real household consumption expenditure and the gini-coefficient. Table 5.10 depicts the impacts of simulations on income inequality of households.

Table 5.10: The Effects of Simulations on Income Inequality of Households (percentages)

	BASE	GSAV_HC	FSAV_HC	BOTH_HC	GSAV_AGR	FSAV_AGR	BOTH_AGR
national	31.98	32.17	32.08	32.25	31.96	31.92	31.97
Rural	26.80	27.04	27.04	27.04	26.85	26.80	26.85
urban	44.11	43.98	44.07	44.07	43.98	44.04	44.00

Source: Micro simulation results

In the first simulation the gini coefficient has shown 0.1 and 0.24 percentage points higher than the baseline simulation at national and rural areas respectively while in urban areas the gini coefficient is down wards by 0.13 percent comparing to the base one. The percentage changes of real household consumption expenditure of poor and non-poor could explain the changes in the gini coefficient of households. The up wards of gini coefficient at national and rural areas are mainly due to more increment of non-poor real household consumption expenditure than the poor households. On the contrary, the decline of coefficient in urban areas is associated with more increases of poor real household consumption expenditure (2.8) against 1.9 percent rises of non-poor households. Simulation 2 and 3 generates a very similar result to the first simulation; where the gini coefficient has increased at national and rural areas while it almost remain constant in urban areas due to the same percentage growths of real consumption expenditure.

In the last three simulations, gini coefficient has shown negligible changes at national and rural areas while slight reduction in urban areas. At the national levels, the inequality is nearly remaining constant under simulation four and six while it reduces by 0.06 in simulation five. In rural areas we observe a 0.05 percentage point increases of inequality in simulation four and six as compared to the base simulation while remain constant in simulation five. In contrast to rural areas, the gini coefficient has declined by 0.1 in simulation four and six and 0.07 in simulation five.

Overall the rise of gini coefficient explains the more inequality of income among households. The public spending targeted towards human capital under each means of financing leads to the rise of income inequality at national and rural levels while it resulted in declines of income inequality in urban areas. Alternatively, the public spending targeted towards agriculture resulted in negligible effects on income inequality at national level under government saving, and slight reduction under foreign saving financing schemes. In rural areas the inequality has shown slight increases under government saving financing schemes while remain constant under foreign means of financing, however in urban areas inequality has reduced under both financing schemes.

CHAPTER SIX

CONCLUSION AND POLICY IMPLICATIONS

6.1 Conclusion

The purpose of this paper is to analyze the impacts of public spending, particularly pro-poor spending (human capital and agricultural expenditure) on economic growth and povertyin Ethiopia.Along with the public spending scenarios, the researcher analyzed the effects of financing additional expenditure through government saving and/or foreign saving. The study used a dynamic recursive CGE model that linked to MS model to assess the poverty and distributional impacts of the policy reform. In so doing, the researcher employed the updated 2009/10 Ethiopian development research institute national social accounting matrix on the bases of 2005/06 SAM whereas the MS model used the 2004/05 HICE survey to examine the poverty and inequality effects.

During PASDEP public spending, especially pro-poor expenditure has increased along with government revenue so as to accelerate economic growth and reduce poverty. The government continues to raise its expenditure under GTP to sustain macro-economic growth and hence significantly reduces the poverty and distribution of income. According to GTP, the government projected to increase human capital and agricultural expenditure on average by 22 and 30 percent per annum, respectively.

All of the simulation experiments improve the macro-economic, welfare and poverty situation of the country. The results of increasing public spending targeted human capital provides a more positive changes for macro-economic, sectoral output, welfare and poverty indicators while the inequality is worsen. The real GDP has risen by 14.1 percent under government saving and 13.9 percent under foreign saving financing option against 10.6 percent growth rates in the base simulation. Unlike the effect of simulations on real GDP which is almost similar under each financing options, a result from the simulations on financing option has shown that the extent of effects on household welfare and poverty indicators is very different.

Financing additional human capital expenditure via foreign saving significantly improved the welfare and poverty situations in the country. The incidence of poverty reduced by 4.0, 4.4 and 2.8 percent at national, rural and urban areas under foreign saving financing option against only 2.0, 2.5 and 1.1 percent reduction under government saving financing options in respective order. This is emanated from the fact that the real household consumption expenditure improves much more in the case of foreign financing schemes, in other word financing additional expenditure through domestic resource mobilization forces the households to save more at the expense of consumption.

In regard to distribution of income, expansion of human capital expenditure under each financing options resulted in the rises of income inequality (measured by gini coefficient) at national and rural areas that indicates the widening of income inequality except in urban areas that shows slight reduction. The national inequality rises by 0.2 and 0.1 percent for government saving and foreign saving respectively whereas the rural inequality increases by 0.24 percent in each financing options. On the contrary the urban inequality reduces by 0.13 under government saving while remains constant under foreign saving. The increment of inequality at national and rural areas mainly emanated from the more increment of non-poor real household consumption expenditure than the poor households.

Given less elasticity of TFP with respect to agriculturalexpenditure, increasing public spending allocated to agricultural resulted in a moderate improvement of macro-economic situations in the country. The real GDP has grown by 11.8 and 11.7 percent under government saving and foreign saving financing respectively against 10.6 percent in the base. Sectoral outputs and income of households have also shown a moderate growth. As a result, the welfare and poverty situation of the country have improved in small magnitude as compared to the effects of human capital expenditure.

Like the first public spending scenario, financing additional agriculture expenditures through foreign saving has improved the welfare and poverty situation of households more against financing through government saving. The incidence of poverty has declined by 0.8, 0.8 and 1.1 percent under government saving while 1.4, 1.9 and 1.3 percent in the case of foreign saving at national, rural and urban levels, respectively.

Moreover, the real consumption expenditure of all households have improved more in the case of foreign financing option which in turn has a visible impacts on the poverty status of all households. In contrast to human capital expenditure, additional agricultural expenditure at least did not worsen the income inequality status of the country though has negligible impacts for the reduction of inequality except in urban areas. In both financing spending scenarios, the income inequality has slightly reduced in urban areas.

6.2 Policy Implications

The study has the following policy implications.
Firstly, currently the Ethiopian government has been raising public spending particularly pro-poor expenditure such as education, health and agriculture sectors. This expansion of public expenditure, especially human capital spending can significantly contributed to economic growth and poverty reduction through improving productivity of factor in the country. Therefore, the policies makers have to reinforce such policies so as to ensure sustain growth and poverty reduction since the economy is at its best.

Secondly, financing public spending through foreign saving schemes has improved the welfare and poverty situations than financing through government saving in the country. The results of the study have revealed that foreign saving has resulted in more improvement of consumption expenditure of all households groups. Hence, the government can use these policies as the best way to improve the welfare and poverty status of the country. However, this argument may challenges the other macro-balances such as reducing the budget deficit. Given the objectives of the government to improve the tax collection principally from domestic resources so as to finance the GTP along with reducing of budget deficit, the policymakers should have to take into account this policy trade-offs.

Finally, the estimated effects of additional targeted public spending on human capital rather than agriculture somewhat surprising, in light of other studies that have assessed returns to public expenditures along with the dominant role of agriculture in Ethiopian economy. This could be mainly emanated from differences in the elasticity of total factor productivity with respect to public spending for specific sectors in addition to differences in the linkage channel of factor productivity where the human capital expenditure affects the productivity of all sectors while agricultural expenditure affects economy through agricultural productivity. Moreover, the variances in the value of the various parameters or the structure of the economy where development of the model depends on across different countries could also explain the differences of returns to public expenditure in different countries. Hence, the estimation of elasticity of TFP with respect to different public spending across sectors in the context of Ethiopia might be important.

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References

Agenor, P.,Bayraktar N. and El Aynaoui K. (2004). *Roads Out of Poverty? Assessing the Link between Aid, Public Investment, Growth and Poverty Reduction*. Policy Research Working Paper, 3490.World Bank, Washington, DC.

Ahmed, V., and O'Donoghue, C. (2004). *Using CGE and Micro-Simulation Models for Income Distribution Analysis: A Surve*. Preliminary Version.

Alemayehu, G. and Befekadu, D. (2007). *Explaining African Economic Growth Performance: the Case of Ethiopia*.African Economic Research Consortium (AERC)Research Project, Nairobi, Kenya.

Alemayehu, G., Abebe, S. and Weeks, J. (2008).*Growth, Poverty and Inequality in Ethiopia: which way for Pro-Poor Growth?* Journal of International Development, 21(7): 947-970.

Alemayehu, S. and Tadele F. (2004).*The Structure of the Ethiopian Economy - A SAM-based Characterization*. A SAM Prepared for World Bank Institute, Washington, D.C.

Ali, G.A., and Fan, G. (2007).*Public Policy and Poverty Reduction in the Arab Region.* A paper prepared for the IFPRI/API Collaborative Research Project, the Arab Planning Institute, State of Kuwait.

Bigsten, A. and Abebe, S. (2007). *Poverty Transition and Persistence in Ethiopia: 1994 – 2004*. World Development, 36(9): 1559-1584.

Calvo, C. and Dercon, S. (2007). *Vulnerability to Poverty*. CSAE, Working Paper Series, No.03., Centre for the Study of African Economies, University of Oxford.

Cavallo, M. (2005).*Government Employment Expenditure and the Effects of Fiscal Policy Shocks*.Federal Reserve Bank of San Francisco, Working Paper, No.16.

Chemingui, M. (2007).*Public Spending and Poverty Reduction in an Oil-Based Economy: The Case of Yemen*. Discussion Paper No. 99, IFPRI, Washington, D.C.

Daniel A.(2011). *The Impact of Fiscal Policy on Poverty in Ethiopia: A Computable General Equilibrium Micro-simulation Analysis*. Thesis Paper for the Fulfillment of Master Degree at Addis Ababa University.

Easterly, W. and Levine, R. (2001).*It's not Factor Accumulation: Stylized Facts and Growth Models*. World Bank, Washington D.C. Photocopy.

EDRI (Ethiopian Development Research Institute) (2009). Ethiopia: Input Output Table and Social Accounting Matrix. Ethiopian Development Research Institute in collaboration with the Institute of Development Studies at the University of Sussex.

Edward Anderson, Paolo de Renzio and Stephanie Levy (2006).*The Role of Public Investment in Poverty Reduction: Theories, Evidence and Methods*. Working Paper 263, Overseas Development Institute, London, UK.

EEA (Ethiopian Economic Association) (2010).EEA: Statistical Data Base.Ethiopian Economic Policy Research Institute/ Ethiopian Economic Association.

Emmanuel E. Asma and Jorgen Levin (2008).*Aid-Financed Public Investments and the Dutch Disease: Evidence from Tanzania.* Working Paper No 3, Sweden, Örebro.

Era Dabla-Norris, Brumby, J., Kyobe, A., Mills Z. and Papageorgiou, C. (2010). *Investing in Public Investment: An Index of Public Investment Efficiency*.IMF Working Paper.

Ermias E., Seneshaw T., Eyasu T., Dario D., Dorosh P., and Robinson S. (2011). *Ethiopia's Growth and Transformation Plan: A Computable General Equilibrium Analysis of Alternative Financing Options*. The Ethiopian Strategy Support Program (ESSP) II, Working Paper 30**,** IFPRI, Washington, D.C.

Fan S., Perrihan Al-Riffai, El-Said, M., Bingxin Yu, and Kamaly, A. (2006). *A Multi-Level Analysis of Public-Spending, Growth and Poverty Reduction in Egypt*.DSGD Discussion Paper No.41, IFPRI, Washington, D.C.

Fan S., Zhang, X. and Rao, N. (2004). *Public Expenditure, Growth, and Poverty Reduction in Rural Uganda*.DSGD Discussion Paper 4, IFPRI, Washington, D.C.

Fan S., and Rao, N. (2004). *Public Spending in Developing Countries: Trend, Determination and Impact*. EPTD discussion paper No. 99, IFPRI, Washington, D.C.

Fan S. and Hazel, P. (2001). *Returns to Public Investments in the Less-favored Areas of India and China*.American Journal of Agricultural Economics, 83(5): 1217-1222.

Fan, S., Huong P.L., and Long, T.Q. (2004). *Government Spending and Poverty Reduction in Vietnam*.International Food Policy Research Institute, Washington, D.C.

Fan S., Hazel, P., Thorat, S. (1999). *Linkages between Government Spending, Growth, and Poverty in Rural India*.Research Report 110, International Food Policy Research Institute, Washington DC.

Fan, S., and Rao, N. (2003). *Public Spending in Developing Countries: Trend, Determination and Impact*. EPTD Discussion Paper No. 99, International Food Policy Research Institute, Washington, D.C.

Fan, S., Thurlow, J., Benin S., Nin Pratt, A., Breisinger, C., Mogues, T., and Diao, X. (2008). *Growth and Poverty Reduction Impacts of Public Investments in Agriculture and Rural Areas: Assessment techniques, tools and guide for practitioners*. Regional Strategic Analysis and Knowledge Support System (ReSAKSS), Working Paper No. 7, International Food Policy Research Institute (IFPRI), Washington D.C.

Foster, James, Greer J. and Eric Thorbecke (1984). *A Class of Decomposable Poverty Measures*.*Econometrica*, 52(3): 761-765.

Gezahegn .A, Tewodaj, M., and Zelekawork, P. (2006).*Trends in Public Investment in Ethiopia*. Ethiopian Strategy Support Program (ESSP), International Food Policy Research Institute, Washington, DC.

International Monetary Fund (2011).*FDRE (The Federal Democratic Republic of Ethiopia): The Joint Staff Advisor Note on Growth and Transformation Plan (2010/11- 2014/15)*. IMF Country Report No.11/303, Washington, D.C.

Lofgren and Robinson (2004).*Public Spending, Growth and Poverty Alleviation in Sub-Saharan Africa: A Dynamic General Equilibrium Analysis*. Mimeo, IFPRI, Washington, D.C.

Lofgren, H. and Diaz-Bonilla, C. (2005).*An Ethiopian Strategy for Achieving the Millennium Development Goals: Simulations with MAMS Model*. DECPG, World Bank, Washington DC.

Lofgren, H., Harris, R.L., Robinson, S., with El-Said, M. and Thomas, M. (2002).*A Standard Computable General Equilibrium (CGE) Model in*

GAMS.Microcomputers in Policy Research 5, International Food Policy Research Institute; Washington DC.

MoFED (Ministry of Finance and Economic Development) (2011).*Growth and Transformation Plan (2010/11 – 2014/15): Main Text.* Vol. 1 (November, 2010); Addis Ababa, Ethiopia.

MoFED (Ministry of Finance and Economic Development) (2012).Progress towards Eradicating Poverty: An Interim Report on Poverty Analysis Study (2010/11), Addis Ababa, Ethiopia.

Minea, A. (2008). The Role of Public spending in the Growth Theory Evolution. The Romanian Journal of Economic Forecasting, 9(2): 99-120.

Paternostro, S.,Rajaram, A., and Tiongso, E.R. (2005). *How Does the Composition of Public Spending Matters?*Policy Research Working Paper 3555, the World Bank Washington DC.

Schultz, T. (1982).*Investing in People: the Economics of Population Quality*.University of California Press, Berkeley, USA.

Schwartz, G. and Ter-Minassian, T. (2000).The Distributional Effects of Public Expenditure. Journal of Economic Surveys, 14(3): 338-358.

Tanzi, V. (2008).*The Role of the State and Public Finance in the Next Generation*. OECD Journal on Budgeting, 8(2): 1-27.

TewodajMogues, Gezahegn A., Zelekawork P., and Fan S. (2006). *How Effective is Public Spending? Public Investment Composition and Rural Welfare in Ethiopia.* Paper Prepared for Presentation at the American Agricultural Economics Association, Annual Meeting 23-26 July 2006.

Tihalefang, J. and Sebikiri, M. (2011).*A CGE Analysis of the Potential Consequence of Higher Food Prices for the Botswana Economy*. The International Journal of Economics and Business Studies, 1(2): 3-13.

Thurlow, J. (2004). *A Dynamic Computable General Equilibrium Model for South Africa: Extending the Static IFPRI model*. Working paper 1-2004, International Food Policy Research Institute, Washington, D.C.

Wilhelm, V. and Fiestas, I. (2005).*Exploring the Link between Public Spending and Poverty Reduction: Lessons from the 90s*.World Bank institute, Washington, D.C.

World Bank document, (2008). International Development Association Country Assistance Strategy for Federal Democratic Republic of Ethiopia: Report No. 43051-ET.

APPENDICES

Appendix A: Basic Structure of a SAM

	Activities	Commodities	Margins	Factors	Government	Households	Indirect Taxes	Direct Taxes	Investment	Rest of World(ROW)	Total
Activities		Output/Supply (bp)									Domestic production (bp)
Commodities	Intermediate input demand		Demand for margin services		Government consumption	Household final consumption			Investment demand	Exports (f.o.b)	Total market demand (pp)
Margins		Marketing margins									Total margins
Factors	Value added									Factor income from ROW	Factor income total
Government							Indirect tax revenue	Direct tax revenue		Transfers to government from ROW	Government income total
Households				Household factor income	Government transfers to households	Inter household transfers				Transfers to households from ROW	Household income total
Indirect taxes		Indirect taxes on products									Indirect tax revenue
Direct Taxes						Direct taxes					Direct tax revenue
Investment					Government savings	Household savings				Foreign savings	Total savings
Rest of World (ROW)		Imports c.i.f		Factor income to ROW							ROW account total (foreign exchange outflow)
Total	Activity expenditure (bp)	Total market supply (bp)	Total margins	Total value added	Government expenditure Total	Total household expenditure	Indirect tax revenue	Direct tax revenue	Total investment	ROW account total (foreign exchange inflow)	

Appendix B: Elasticities Used in the Model, Trade elasticities

	Armington	Transformation		Armington	Transformation		Armington	Transformation
Commodities	SIGMAQ	SIGMAT	Commodities	SIGMAQ	SIGMAT	Commodities	SIGMAQ	SIGMAT
cteff	1.30	1.30	cfish	1.25	1.25	cchem	3.30	3.30
cbarl	1.30	1.30	cfore	2.50	2.50	cnmet	2.90	2.90
cwhea	4.45	4.45	ccoal	3.05	3.05	cmetl	2.95	2.95
cmaiz	1.30	1.30	cngas	0.90	0.90	cmach	0.50	0.50
csorg	1.30	1.30	comin	0.90	0.90	cvehe	0.50	0.50
cpuls	2.45	2.45	cmeat	3.85	3.85	ceequ	0.50	0.50
coils	2.45	2.45	cdair	3.65	3.65	coman	3.75	3.75
cvege	1.85	1.85	cvprd	0.50	0.50	celec	2.80	2.80
cfrui	1.85	1.85	cgmll	2.60	2.60	cwatr	2.80	2.80
cnset	3.25	3.25	cmsrv	2.60	2.60	ccons	0.50	0.50
ccott	2.50	2.50	cpsgr	2.70	2.70	ctrad	0.50	0.50
csugr	2.70	2.70	cptea	2.00	2.00	chotl	0.15	0.15
cteal	0.50	0.50	cfood	2.00	2.00	ctran	0.50	0.50
cchat	3.25	3.25	cbeve	1.15	1.15	ccomm	0.50	0.50
ctoba	3.25	3.25	cptob	1.15	1.15	cfsrv	0.50	0.50
ccoff	3.25	3.25	ctext	3.75	3.75	cbsrv	0.20	0.20
cflow	0.20	0.20	cclth	3.70	3.70	creal	0.50	0.50
cocrp	3.25	3.25	cleat	4.05	4.05	cosrv	0.50	0.50
ccatt	2.00	2.00	cwood	3.40	3.40	cpadm	0.50	0.50
cmilk	3.65	3.65	cpapr	2.95	2.95	ceduc	0.50	0.50
cpoul	1.30	1.30	cptrl	2.10	2.10	cheal	0.50	0.50
caprd	1.30	1.30	cfert	3.30	3.30			

Appendix B: Elasticities Used in the Model, Production elasticity (continued)

Factor substitution

ACTIVITIES	PRODELAS	PRODELAS2	ACTIVITIES	RODELA	RODELA	ACTIVITI	RODELA	RODELAS
ateff-hc	0.75	0.30	acott-dp	0.75	0.30	angas	0.20	0.30
ateff-ho	0.75	0.30	asugr-hc	0.75	0.30	aomin	0.20	0.30
ateff-dp	0.75	0.30	asugr-ho	0.75	0.30	ameat	0.75	0.30
ateff-pa	0.75	0.30	asugr-dp	0.75	0.30	adair	0.75	0.30
abarl-hc	0.75	0.30	asugr-pa	0.75	0.30	avprd	0.75	0.30
abarl-ho	0.75	0.30	ateal-hc	0.75	0.30	agmll	0.75	0.30
abarl-dp	0.75	0.30	achat-hc	0.75	0.30	amsrv	0.75	0.30
abarl-pa	0.75	0.30	achat-ho	0.75	0.30	apsgr	0.75	0.30
awhea-hc	0.75	0.30	achat-dp	0.75	0.30	aptea	0.75	0.30
awhea-ho	0.75	0.30	achat-pa	0.75	0.30	afood	0.75	0.30
awhea-dp	0.75	0.30	atoba-ho	0.75	0.30	abeve	0.75	0.30
awhea-pa	0.75	0.30	acoff-hc	0.75	0.30	aptob	0.75	0.30
amaiz-hc	0.75	0.30	acoff-ho	0.75	0.30	atext	0.75	0.30
amaiz-ho	0.75	0.30	acoff-dp	0.75	0.30	aclth	0.75	0.30
amaiz-dp	0.75	0.30	acoff-pa	0.75	0.30	aleat	0.75	0.30
amaiz-pa	0.75	0.30	aflow-hc	0.75	0.30	awood	0.75	0.30
asorg-hc	0.75	0.30	aocrp-hc	0.75	0.30	apapr	0.75	0.30
asorg-ho	0.75	0.30	aocrp-ho	0.75	0.30	aptrl	0.75	0.30
asorg-dp	0.75	0.30	aocrp-dp	0.75	0.30	afert	0.75	0.30
asorg-pa	0.75	0.30	aocrp-pa	0.75	0.30	achem	0.75	0.30
apuls-hc	0.75	0.30	acatt-hc	0.75	0.30	anmet	0.75	0.30
apuls-ho	0.75	0.30	acatt-ho	0.75	0.30	ametl	0.75	0.30
apuls-dp	0.75	0.30	acatt-dp	0.75	0.30	amach	0.75	0.30
apuls-pa	0.75	0.30	acatt-pa	0.75	0.30	avehe	0.75	0.30
aoils-hc	0.75	0.30	amilk-hc	0.75	0.30	aeequ	0.75	0.30
aoils-ho	0.75	0.30	amilk-ho	0.75	0.30	aoman	0.75	0.30
aoils-dp	0.75	0.30	amilk-dp	0.75	0.30	aelec	1.50	0.30
aoils-pa	0.75	0.30	amilk-pa	0.75	0.30	awatr	1.50	0.30
avege-hc	0.75	0.30	apoul-hc	0.75	0.30	acons	1.50	0.30
avege-ho	0.75	0.30	apoul-ho	0.75	0.30	atrad	1.50	0.30
avege-dp	0.75	0.30	apoul-dp	0.75	0.30	ahotl	1.50	0.30
avege-pa	0.75	0.30	apoul-pa	0.75	0.30	atran	1.50	0.30
afrui-hc	0.75	0.30	aaprd-hc	0.75	0.30	acomm	1.50	0.30
afrui-ho	0.75	0.30	aaprd-ho	0.75	0.30	afsrv	1.50	0.30
afrui-dp	0.75	0.30	aaprd-dp	0.75	0.30	absrv	1.50	0.30
afrui-pa	0.75	0.30	aaprd-pa	0.75	0.30	areal	1.50	0.30
anset-hc	0.75	0.30	afish	0.75	0.30	aosrv	1.50	0.30
anset-ho	0.75	0.30	afore	0.75	0.30	apadm	1.50	0.30
acott-hc	0.75	0.30	acoal	0.20	0.30	aeduc	1.50	0.30
						aheal	1.50	0.30

SAM of Ethiopia, 2009/10

Appendix C: CGE Model

In this appendix the full formulation of the "within" or static CGE model and between (dynamic) model is specified.

Sets, Parameters and Variables in the model

Sets
$\alpha \in A$ - Activities
$\alpha \in ALEO(\subset A)$ - Activities with a Leontief function at the top of the technology nest
$c \in C$ - Commodities
$c \in CD(\subset C)$ - commodities with domestic sales of domestic output
$c \in CDN(\subset C)$ - commodities not in CD
$c \in CE(\subset C)$ - exported commodities
$c \in CEN(\subset C)$ - commodities not in CE
$c \in CM(\subset C)$ - imported commodities
$c \in CMN(\subset C)$ - commodities not in CM
$c \in CT(\subset C)$ - transactions service commodities
$c \in CX(\subset C)$ - commodities with domestic production
$f \in F$ - factors
$i \in INS$ - institutions (domestic and rest of the world)
$i \in INSD(\subset INS)$ - domestic institutions
$i \in INSDNG(\subset INSD)$ - domestic non-government institutions
$h \in H(\subset INSDNG)$ - households

Parameters (Latin Letters)
$cwts_c$ - 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 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'

$\text{int}\, a_a$ - quantity of aggregate intermediate input per activity unit

iva_a - quantity of value-added per activity unit

$\overline{mps_i}$ - base saving rate for domestic institution i

$mps01_c$ - 0-1 parameter with 1 for institutions with potentially flexed direct tax rates

pwe_c - export price (foreign currency)

pwm_c - import price (foreign price)

$qdst_c$ - quantity of stock change

$\overline{qg_c}$ - base – year quantity of government demand

$\overline{qinv_c}$ - base – year quantity of private investment demand

$shif_{if}$ - share for domestic institution i in income of factor f

$shii_{ii'}$ - share of net income of i' to i $(i' \in INSDNG'; i \in INSDNG)$

$\overline{tins_i}$ - exogenous direct tax rate for domestic institution i

$tins01_i$ - 0 - 1parameter with 1 for institutions with potentially flexed direct tax rates tm_c
- import tariff rate

tq_c - rate of sales tax

$trnsfr_{if}$ - transfer from factor f to institution i

Parameters (Greek Letters)

$\alpha^{va}{}_a$ - efficiency parameter in the CES value – added function

$\alpha^{ac}{}_a$ - shift parameter for domestic commodity aggregation function

$\alpha^{q}{}_c$ - Armington function shift parameter

$\alpha^{t}{}_c$ - CET function shift parameter

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

β^{m}_{ch} - marginal share of consumption spending on marketed commodity c for household h

δ^{ac}_{ac} - share parameter for domestic commodity aggregation function

δ^{q}_{c} - Armington function share parameter

δ^{t}_{c} - CET function share parameter

δ^{va}_{fa} - CES value –added function share parameter for factor f in activity a

γ^{m}_{ch} - Subsistence consumption of marketed commodity c for household h

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

θ_{ac} - Yield of output c per unit of activity a

ρ^{va}_{a} - CES value – added function exponent

ρ^{ac}_{a} - Domestic commodity aggregation function exponent

ρ^{q}_{c} - Armington function exponent

ρ^{t}_{c} - CET function exponent

Exogenous Variables

$\overline{CPI}$ - consumer price index

DPI - producer price index for domestically marketed output

$\overline{FSAV}$ - foreign savings (FCU)

$GSAV$ - government savings

$\overline{GADJ}$ - government consumption adjustment factor

$\overline{IADJ}$ - investment adjustment factor

$\overline{QFS}_{f}$ - 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

Endogenous Variables

$DMPS$ - change in domestic institution saving rates (= 0 for base; exogenous variable)

$\overline{CPI}$ - consumer price index

EH_h - consumption spending for household

$\overline{MPSADJ}$ - savings rate scaling factor (= 0 for base)

$\overline{DTINS}$ - change in domestic institution tax share (= 0 for base; exogenous variable)

EXR - exchange rate (LCU per unit of FCU)

$GOVSHR$ - government consumption share in nominal absorption

$INVSHR$ - investment share in nominal absorption

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_c - export price (domestic currency)

$PINTA_a$ - aggregate intermediate input price for activity a

PM_c - import price (domestic price)

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_c - quantity of exports

QF_{fa} - quantity demanded of factor f from activity a

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 household 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_c - quantity of import of commodity

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 marketed quantity of domestic output of commodity

$QXAC_{ac}$ - quantity of marketed output of commodity c from activity a

$TABS$ - total nominal absorption

$TINS_i$ - direct tax rate for institution i ($i \in INSDNG$)

$TRII_{ii'}$ - transfer from institution i' to i (both in the rest $INSDNG$)

WF_f - average price of factor f

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

The Model Equation, 'Within Period' Model

Price Block

[1]Import price

$$PM_c = pwm_c.(1+tm_c).EXR + \sum_{c' \in CT} PQ_{c'}.icm_{c'c} \quad c \in CM$$

[2] Export price

$$PE_c = pwe_c.EXR - \sum_{c' \in CT} PQ_{c'}.ice_{c'c} \quad c \in CE$$

[3] Demand price of domestic non-traded goods

$$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'}.icd_{c'c} \qquad c \in CD$$ [4] Absorption

$$PQ_c.(1-tq_c).QQ_c = PDD_c.QD_c + PM_c.QM_c \quad c \in (CD \cup CM)$$

[5] Marketed output value

$$PX_c.QX_c = PDS_c.QD_c + PE_c.QE_c \quad c \in CX$$

[6] Activity price

$$PA_a = \sum_{c \in C} PXAC_{ac}.\theta_{ac} \quad a \in A$$

[7] Aggregate intermediate input price

$$PINTA_a = \sum_{c \in C} PQ_c.ica_{ca} \quad a \in A$$

[8] Activity revenue and costs

$$PA_a.QA_a = PVA_a.QVA_a + PINTA_a.QINTA_a \quad a \in A$$

[9] Consumer price index

$$\overline{CPI} = \sum_{c \in C} PQ_c.cwts_c$$

[10] Producer price index for non-traded market output

$$DPI = \sum_{c \in C} PDS_c.dwts_c$$

Production and Trade Block

[11] Leontief technology: Demand for aggregate value-added

$$QVA_a = iva_a.QA_a \quad a \in ALEO$$

[12] Leontief technology: Demand for aggregate intermediate input

$$QINTA_a = \text{int}\, a_a.QA_a \quad a \in ALEO$$

[13] Value-added and factor demands

$$QVA_a = \alpha^{va}{}_a \left(\sum_{f \in F} \delta^{va}{}_{fa}.QF_{fa}{}^{-\rho^{va}{}_a} \right)^{-\frac{1}{\rho^{va}{}_a}} \quad a \in A$$

[14] Factor Demand

$$WF_f.\overline{WFDIST}_{fa} = PVA_a.QVA_a \left(\sum_{f \in F'} \delta^{va}{}_{fa}.QF_{fa}{}^{-\rho^{va}{}_a} \right)^{-1} .\delta^{va}{}_{fa}.QF_{fa}{}^{-\rho^{va}{}_a - 1} \quad a \in A \quad f \in F$$

[15] Disaggregated intermediate input demand

$$QINT_{ca} = ica_{ca}.QINTA_a \quad a \in A \,;\, c \in C$$

[16] Commodity production and allocation

$$QXAC_{ac} + \sum_{h \in H} QHA_{ach} = \theta_{ac}.QA_a \quad a \in A \,;\; a \in CX$$

[17] Output aggregation function

$$QX_c = \alpha^{ac}{}_c.\left(\sum_{a \in A} \delta^{ac}{}_{ac}.QXAC_{ac}{}^{-\rho^{ac}{}_c} \right)^{-\frac{1}{\rho^{ac}{}_c - 1}} \quad c \in CX$$

[18] First-order condition for output aggregation function

$$PXAC_{ac} = PX_c.QX_c \left(\sum_{a \in A'} \delta^{ac}{}_{ac}.QXAC_{ac}{}^{-\rho^{ac}{}_c} \right)^{-1} .\delta^{ac}{}_{ac}.QXAC_{ac}{}^{-\rho^{ac}{}_c - 1} \quad a \in A \,;\, c \in CX$$

[19] Output transformation (CET) function

$$QX_c = \alpha^t{}_c.(\delta^t{}_c.QE_c{}^{\rho^t{}_c} + (1 - \delta^t{}_c).QD_c{}^{\rho^t{}_c})^{\frac{1}{\rho^t{}_c}} \quad c \in (CE \cap CD)$$

[20] Export-domestic supply ratio

$$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c}.\frac{1 - \delta^t{}_c}{\delta^t{}_c} \right)^{\frac{1}{\rho^t{}_c - 1}} \quad c \in (CE \cap CD)$$

[21] Output transformation for non-exported commodities

$$QX_c = QD_c + QE_c \quad c \in (CD \cap CEN) \cup (CE \cup CDN)$$

[22] Composite supply (Armington) function

$$QQ_c = \alpha_c.(\delta_c.QM_c{}^{-\rho} + (1 - \delta_c).QD_c{}^{-\rho})^{-\frac{1}{\rho}} \quad c \in (CM \cap CD)$$

[23] Import-domestic demand ratio

$$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c} . \frac{\delta_c}{1-\delta_c} \right)^{\frac{1}{1+\rho}} \quad c \in (CM \cap CD)$$

[24] Composite supply for non-imported outputs and non-produced imports

$$QQ_c = QD_c + QM_c \quad c \in (CD \cap CMN) \cup (CM \cup CDN)$$

[25] Demand for transaction service

$$QT_c = \sum_{c' \in C'} (icm_{cc'}.QM_{c'} + ice_{cc'}.QE_{c'} + icd_{cc'}.QD_{c'}) \quad c \in CT$$

Institutional Block

[26] Factor income

$$YF_f = \sum_{a \in A} WF_f.\overline{WFDIST}_{fa}.QF_{fa} \quad f \in F$$

[27] Institutional factor incomes

$$YIF_{if} = shif_{if}.\left[YF_f - trnsfr_{rowf}.EXR \right] \quad i \in INSD\,; \quad f \in F$$

[28] Income of domestic, non-government institutions

$$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{gov}.\overline{CPI} + trnsfr_{irow}.EXR \quad i \in INSDNG$$

[29] Intra-institutional transfers

$$TRII_{ii'} = shii_{ii'}.(1 - MPS_{i'}).(1 - TINS_{i'}).YI_{i'} \quad i \in INSDNG\,; \quad i' \in INSDNG'$$

[30] Household consumption expenditure

$$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{ih} \right).(1 - MPS_h).(1 - TINS_h).YI_h \quad h \in H$$

[31] Household consumption demand for marketed commodities

$$PQ_c.QH_{ch} = PQ_c.\gamma^m{}_{ch} + \beta^m{}_{ch}.\left(EH_h - \sum_{c' \in C} PQ_{c'}.\gamma^m{}_{c'h} - \sum_{a \in A} \sum_{c' \in C} PXAC_{ac'}.\gamma^h{}_{ac'h} \right) \quad c \in C\,; \quad h \in H$$

[32] Household consumption demand for home commodities

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

$a \in A\,; h \in H$

[33]Investment demand

$$QINV_c = \overline{IADJ}.\overline{qinv_c} \quad c \in CINV$$

[34] Government consumption demand

$$QG_c = \overline{GADJ}.\overline{qg_c} \quad c \in C$$

[35] Government revenue

$$YG = \sum_{i \in INSDNG} TINS_i.YI_i + \sum_{c \in CM} tm_c.pwm_c.QM_c.EXR + \sum_{c \in C} tq_c.PQ_c.QQ_c$$

$$+\sum_{f \in F} YIF_{govf} + trnsfr_{govrow}.EXR$$

[36] Government expenditure

$$EG = \sum_{c \in C} PQ_c.QG_c + \sum_{i \in INSDNG} trnsfr_{i\ gov}.\overline{CPI}$$

System Constraint Block

[37] Factor market

$$\sum_{a \in A} QF_{fa} = \overline{QFS_f} \quad f \in F$$

[38] Composite commodity markets

$$QQ_c = \sum_{a \in A} QINT_{ca} + \sum_{h \in H} QH_{ch} + QG_c + QINV_c + qdst_c + QT_c \quad c \in C$$

[39] Current account balance for the rest of the world (in foreign currency)

$$\sum_{c \in CM} pwm_c.QM_c + \sum_{f \in F} trnsfr_{rowf} = \sum_{c \in CE} pwe_c.QE_c + \sum_{i \in INSD} trnsfr_{irow} + \overline{FSAV}$$

[40] Government balance

$$YG = EG + GSAV$$

[41] Direct institutional tax rates

$$TINS_i = \overline{tins_i}.(1 + \overline{TINSADJ}.tins01_i) + \overline{DTINS}.tins01_i \quad i \in INSDNG$$

[42] Institutional savings rates

$$MPS_i = \overline{mps_i}.(1 + \overline{MPSADJ}.mps01_i) + DMPS.mps01_i \quad i \in INSDNG$$

[43]Saving-investment balance

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

[44] Total absorption

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

$$+\sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c$$

[45] Ratio of investment to absorption

$$INVSHR.TABS = \sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c$$

[46] Ratio of government consumption to absorption

$$GOVSHR.TABS = \sum_{c \in C} PQ_c.QG_c$$

The Model Equation, ''Between Period'' Model

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[1] Average capital rental rate

$$AWF_{ft}{}^{a} = \sum_{a}\left[\left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}}\right).WF_{ft}.WFDIST_{fat}\right] - - - - - - - - -$$

[2]Share of New Capital

$$\eta^{a}{}_{fat} = \left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}}\right).\left(\beta^{a}.\left(\frac{WF_{ft}.WFDIST_{fat}}{AWF_{ft}{}^{a}} - 1\right) + 1\right)$$

[3]Quantity of new capital by sector

$$\Delta K^{a}{}_{fat} = \eta^{a}{}_{fat}.\left(\frac{\sum_{a} PQ_{ct}.QINV_{ct}}{PK_{ft}}\right)$$

[4] Unit price of capital

$$PK_{ft} = \sum_{c} PQ_{ct}\frac{QINV_{ct}}{\sum_{c'} QINV_{c't}}$$

[5] Average capital rental rate

$$QF_{fat+1} = QF_{fat} \cdot \left(1 + \frac{\Delta K^{a}{}_{fat}}{QF_{fat}} - v_f \right)$$

[6] Average capital rental rate

$$QFS_{ft+1} = QFS_{ft} \cdot \left(1 + \frac{\sum_{a} \Delta K_{fat}}{QFS_{ft}} - v_f \right)$$