ADDIS ABABA UNIVERSTY
School of Graduate Studies

Short-run Impacts of WTO Accession on the Ethiopian Economy

A Structuralist CGE Modeling Approach

By
Solomon Lemma

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirement for the degree of Master of Science in Economics

July, 2007
Addis Ababa

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

"Short-Run Impacts of WTO Accession on the Ethiopian Economy."

By

Solomon Lemma Dulla

Approved by the Board of Examiners:

Alemayehu GOS
Advisor

Signature

Ernest Alemu
Examiner

Signature

EGS Tesfaye
Examiner

EGS
Signature

Acknowledgment

At first, may all the honor and glory be extended to the exalted Heavenly God, for Help, guidance and encouragement which has enabled me to complete my work despite difficulties.

This paper has been accomplished with the help of many people to whom I am indebted. My appreciation goes to my advisor, Dr. Alemayehu Geda, for his comments and suggestion throughout the work of this thesis. I would also want to thank my friends, Belay Fekadu, Yonatan Sheferaw and yordanos G/meskel for providing me all necessary data, software's and reading materials. I am also indebted to all my friends, especially, Gebere Belay and Abebayehu Berhanu for their moral and financial support.

I also owe special thanks to my beloved sisters and brothers especially Meron, Azeb, Aster and Akililu Lemma for all their care and love through out my academic career.

Abstract

Using a Structuralist CGE modeling approach, this paper examines the short-run impacts of WTO accession on the Ethiopian economy. The analysis is made based on Ethiopian Social Accounting Matrix (SAM) of 2001/2002 constructed by IFPRI. The simulation experiments suggest that impact of trade liberalization, import tariff reduction, has a mixed effect on the Ethiopian economy.

Import tariff reduction is likely to increase domestic production and exports of commodities particularly produced in agriculture and service sector. Connected to import tariff reduction, liberalization also have a positive effect on domestic investment and growth due to increase the demand for investment in agriculture and service sector which arises from a decrease in prices of intermediate commodity and subsequent increase in demands of domestically produced commodity by the rest of the world.

On the other hand, tariff reduction has negative effects on government fiscal revenues, public investment and on terms of trade balance. Moreover, liberalization is likely to reduce domestic production of manufactured goods due to a switch of consumption in a favor of cheep imports which intern can lead to the domestic import competing firms to face a downward pressure on sales and profits.

An important policy implication of this analysis is that the success of trade liberalization critically depends on the extent to which trade policies; trade facilitation and institution are synchronized for modernizing the public sector, improving tax collection and playing the regulatory role in order to attract local and foreign investment by incentive measures in favor of exporting companies. Moreover, a convincing programmes and policy action has to be supported by technical assistance to strengthen Ethiopia's ability to increase its participation in world trade by enhancing its competitiveness' and consequently to derive larger benefits from trade.

ABBREVIATIONS AND ACRONYMS

ADLI	Agricultural Development Lead Industrialization
AGOA	African Growth Opportunity Act
AoA	Agreement on Agriculture
CD	Cobb-Douglas Production Function
CET	Constant Elasticity of Substitution
CGE	Computable General Equilibrium
COMESA	Common Market for Eastern and Southern Africa
CPI	Consumer Price Index
DTIS	Diagnostic Trade Integrated Study
EBA	Everything But Arms
EEA	Ethiopian Economic Association
EPDRF	Ethiopia People Democratic Republic Front
EU	European Union
FTA Free	Trade Area
GATT	General Agreement on Tariffs and Trade
GATS	General Agreement on Trade in Services
GSP	Generalized Systems of Preferences
GDP	Gross Domestic Product
GAMS	General Algebraic for Modeling System
H-O	Heckscher-Ohlin
IFPRI	International Food Policy Research Institute
LDCs	Less Developing Countries
MFN	Most Favored Nation
MoFED	Ministry of Finance and Economic Development
OECD	Organization for Economic Cooperation and Development
PTA	Preferential Trade Area
ROW	Rest of the World
SAM	Social Accounting Matrix
SPS	Sanitary Phyto-sanitary
TRIPs	Trade Related Intellectual Property
WB	World Bank
WTO	World Trade Organization

List of Tables

Table of Contents

CHAPTER ONE

1. Introduction

1.1. Background

After having been an observer for the last few years, Ethiopia applied for becoming a membership in the World Trade Organization (WTO). This decision to apply for WTO membership marked an important step in the country's process of integration into the global economy. The WTO's principles and obligations expected to make the country's trade policy, to be relatively more liberal. Even though, each country has the right to determine the degree of liberalization, it is difficult to foresee its impact on economic growth and income inequality among different economic agents.

The WTO framework allows some flexibility within the scope of legally permissible policy possibilities. Within this framework, Ethiopia may chose to seek its objectives either in a liberal, ambitious or cautious, gradual way in accordance with development goals. Most developing accession countries proceed with gradual liberalization with particular attention given to development through a selective utilization of derogations/transitional arrangements in phasing out quotas and licensing and phasing in the entry of foreign companies (Benine et al., 2005).

The effect of trade and trade related policies on country's economic performance has been debated for more than a century. For instance, writers [Dollar (1992), Kruger (1997), Ben-David (1993), Sachs and Warner (1995), Edwards (1998) and Frankel and Romer (1997)] have argued for the benefit of openness. They have concluded that elimination of trade distortions leads to gain from increased trade and domestic activity, i.e. increase in trade or capital flow will raise productivity through accumulation of capital. Moreover, Imports of new good embody new technology, which in turn raises productivity while; incoming foreign investment provides the possibility of technology transfer. If the income effect is fairly uniform, then increase in aggregate income resulting from liberalization induces productivity gains to the extent that the poor are also beneficiary of those out comes.

Contrary to this, it is also argued that poor countries would suffer more by opening their economy for many reasons. First, liberalization may increase the propensity to import than export which leads to worsening of trade balance and also decrease net demand for domestically produced goods and services; which intern leads to lower income for domestic producers and generally lower gross domestic product (GDP). Moreover, poor workers who are engaged in import competing sector cannot relocate between jobs easily due to existence of inflexible labor laws and small farmers who can not compete with the more efficient and technological supported mechanized farmers of the developed countries are likely to be hearted (Pawell and Thirlwall, 1990).

In practice, and certainly in most transition economies, changes in trade policies have taken place concurrently with macroeconomic stabilization policies. This means that one has to consider the implications of carrying policy change. WTO accession is linked with country's economic growth through different channels of economic variables. The expected potential linkages through which liberalization will affect the economic variables are via tariff, non-tariff, exchange rate and export policy reform.

The elimination of domestic tariffs reduces domestic import price and increase the import volumes. At the same time, increase world demand for exports offsets failing world export prices such that domestic export prices rise. In response, local producers reorient their production from the domestic market towards the export market, at the same time as local consumer substitute to world cheaper imports. Local demand fails faster than local supply, this results a fall in local producer and consumer price. The drop in local price results in a depreciation in the real exchange rate, which reinforces to rise in exports and a fail in imports.

Therefore, establishing the link between WTO accession and its short term impact on micro and macro economic indicators requires more than just a description or projection of trade pattern. A counterfactual 'no change' scenario must be compared with simulated scenario after accession. An Appealing way of addressing this is to use an appropriate computable general equilibrium (CGE) model that compares the status quo with the relatively more liberalized trade policy.

The researcher's hypothesis is that integration in to the world economy has a mixed effect on the economy. That is, integration has positive effect on level of output, export and consumption and a negative impact on government revenue, domestic product sell. To test this argument, an applied CGE model incorporating relevant structural characteristics of Ethiopian economy has been built. In fact, a country's trade performance is influenced by a large number of domestic factors including its structural characteristics, resource endowments and policies. External economic environment is no less important in determining the country's trade balance. As the detailed country analysis is not the purpose of this study, the scope of this research is confined to examining the economic impacts of tariff reduction. The basic model is essentially static, best suited for understanding short-run macroeconomic and resource re-allocation effects that emanate from different shocks to the economy.

1.2. Statement of the Problem

The World Trade Organization (WTO) is a sizeable organization with 149 memberships, over three-quarters of which are developing countries and LDCs. The WTO expanded the scope of GATT, which originally dealt only with goods, to include several sub-sectors such as agriculture, trade-related investment measures, sanitary and phyto-sanitary measures and technical barriers to trade. It also introduced new rules on trade in services and trade-related aspects of intellectual property rights (TRIPS). It is attempting to expand further to cover other fields related to trade such as labor, investment, competition and transparency in public procurement.

Currently, 32 (21.5%)[1] of the WTO members are LDCs aside from those in the process of accession. WTO's objectives of economic and social development through trade are enticing especially for these poverty-stricken LDCs. However, the difference in the level of economic development of members in the GATT/ WTO resulted in inequality in absorbing the advantages offered by the system. For instance, according to the annual reports of the

[1] *See Membership, Alliance and Bureaucracy, Supra note 4. It is stated that eight additional LDCs are in the process of accession to the WTO. They are: Bhutan, Cape Verde, Ethiopia, Laos, Samoa, Sudan, Vanuatu and Yemen. Furthermore, Equatorial Guinea and Sao Tome and Principe, which are also LDCs, are Observers and they have to start accession negotiations within five years of having such a status.*

United Nations Conference on Trade and Development (UNCTAD) on LDCs show that LDCs are not benefiting from the multilateral trading system and warn that if the trend continues, they would likely be the 'main locus' of extreme poverty by 2015[2].

Ethiopia is currently submitted the Memorandum on the Foreign Trade Regime to the WTO, Even though, the decision for a membership to WTO marked as an important step for country's process of integration into the global economy, there are both opportunities and challenge that the country face by acceding to WTO as the case for many developing countries.

The main opportunity obtained from integration includes, primarily increase in volume and processing level of its export provided that international standard of quality achieved. Secondly, the agreement sends a strong signal that the country is committed to various obligation and rules with respect to trade that also spills into investment and thus would be a factor in attracting foreign direct investment. Thirdly, it helps the country to avail itself to a well established process for impartial dispute settlement as a member of the organization. Finally, the accession process itself help the country to address some of its barriers to trade such as high tariff in some sectors, opening some remaining sectors to foreign investment and adopting rules for contingent protection such as for antidumping, safeguards, subsidies and countervailing duties[3].

Contrary to the benefits, the primary challenge the country expected to face is strict rules and obligation which is adopted by WTO. For instance, WTO covers a large group of agreements ranging from goods and services to intellectual property and environmental issues while attempting to expand further (see table1). To accept these agreements, the WTO follows what is known as the principle of "single undertaking". This principle requires virtually all items of a negotiation to be part of a whole as an indivisible package and cannot be accepted separately. Stated differently, the principle is: "Nothing is agreed until everything is agreed"[4]. Following this, different factors like, formidable barriers in the area of sanitary

---

[2] *United Nations, The Least developed Countries Report 2004: Overview (United Nations, Geneva, 2004)*

[3] *Diagnostic trade integration study(DTIS:2004)*

[4] *This principle is derived from Article II (2) of the WTO Agreement that articulates that the agreements and associated legal instruments included in Annexes 1, 2 and 3 (GATT, GATS, and TRIPS) are its integral parts, binding on all members.*

and phyto-sanitary, structural bottleneck (institutional and capacity building), low productivity, lack of competitiveness both domestically and internationally and lack of export information on markets and foreign trade opportunity. Supply constraints due to lack of infrastructure and diversification in the country's agricultural export is also one of the highlighted problem.

Therefore, with the expected benefit and challenge that a country faces in acceding into world economy, it is the interest of the researcher to address the question *what is the potential impact of entry into WTO on the economy? And whether integration into the world economy enhances economic condition of Ethiopia?* Which is one of poorest country in the world whose economy is characterized by low income (GDP per capita $100[5]), highly depend on rain-fed agriculture, with little external market power and weak infrastructural and institutional formation.

More specifically, the researcher addresses the potential impact of liberalization on sectoral indicators and effects in altering the direction of macroeconomic variables in the short run.

1.3. Objective

The general objective of this research is to investigate the short-run potential effects of import tariff reduction[6] on micro and macroeconomic indicator variables.

Specific Objective of the Study is

- To analyze the impacts of tariff reduction on sectoral indicators
- To analyze the impacts of tariff reduction on macroeconomic variables

1.4. Hypothesis of the Study

The Ethiopian government adopted the Agricultural Development Led Industrialization (ADLI) strategy in 1992. This strategy designed to strengthen the interdependence between agriculture and industry by increasing productivity of peasant farmers, expanding large scale

---

[5] *World Bank Ethiopia Economic Memorandum, 2004*

[6] *The model simulation is made on reduction on import tariff reduction particularly industrial commodity which is resulting form acceding with WTO.*

private commercial farms, and by reconstructing the manufacturing sector in such a way that it can make use of the country's natural and human resources (DTIS 2004). Therefore, it is hypothesized that, greater integration with the world trade allows the country to import the essential ingredients to raise agricultural productivity such as fertilizer, pesticides, farm machinery and technology. Consequently, this activity makes to increase the level of output, consumption (imported commodities) and imports. Moreover, greater trade integration allows the country to export agricultural outputs as well as light manufactures.

On the other hand, Integration in to the world economy has negative effect on government revenue and terms of trade due to loss in revenue obtained from import duties and increase in import-export ratio.

1.5. Significance of the Study

Ethiopia applied for a membership to WTO on 13, January 2003[7]. The WTO General Council established a Working Party on 10 February 2003. The country is currently about to submit the Memorandum on the Foreign Trade Regime to the WTO, after which accession negotiations will start. Ethiopia's decision to apply for WTO membership marked an important step in the country's process of integration into the global economy. Therefore, this study expected to deliver information regarding:

- The potential impacts of WTO accession on Economy of Ethiopia particularly in the short run
- What measures and commitment should be taken by government and international community to bring sustainable economic growth.
- Suggesting policy action taken by policy makers to react proactively if Ethiopia accedes to WTO
- Enriches, the filed of the study by filling gap and delivering information to the academy

[7] *Ethiopia trade and transformation: Diagnostic Trade Integration Study (DTIS) 2004.*

Generally, the research contributes towards understanding of short run impacts of trade liberalization on Ethiopian economy. The advantage using CGE modeling is that different polices and shocks can be evaluated separately in order to gain insights into ex-post results of policies and shocks.

1.6. Scope of the Study

The process of integration in to the world economy has a wider range of implication on the economy both at micro and macro level. A range of variables that are significant to the overall change in any of economic environment are likely to be affected explicitly or implicitly when a country move in to world market integration.

Those effects could be, change in: price of imports or exports, transfers from the rest of the world, balance of payment deficit, domestic structural and productive parameters, level of fixed factors of production and aggregate level of labor supply . Additionally, change in policy instruments and different parameter which include elasticity of substitution and transformation, supply elasticity and other exogenous variable and shocks (Sadoulet, 1995).

On the other hand, economic variable changes such as, increase in export and import volume, commitment to eliminate all non-tariff barrier measures, market access opportunity and other trade related reactions at the domestic side and the change in external economic condition and policy by other WTO members have great impact in affecting countries economic performance and growth.

However, in this study the researcher will focus only in assessing the quantitative impacts of trade liberalization, reduction in agricultural commodity tariff, on micro and macroeconomic indicator variables in short-run. Thus, result of the analysis should be interpreted based on the scope of study design to cover.

1.7. Limitations in the Model

The quality and availability of consistent and complete data set determine the output of the analysis by large. However, in Ethiopia there is a problem in consistency of data obtained

from different institutions. In addition to this, the model used in this research is not very disaggregated; therefore, it may not take all the necessary elements into account.

1.8. Organization of the Study

This paper is organized in seven chapters. The next chapter develops a conceptual framework that traces the effect of trade liberalization on economic growth and examines different argument arise in different literature on impacts of liberalization. Moreover, the chapter considers the empirical evidence obtained from developing countries and the correspondence evidence on effects of macroeconomic reform in Ethiopia. Chapter three describes about function, principles and rules of WTO. Moreover, the section discuses about the benefit and cost liberalization on economy, particularly in line with WTO accession.

Chapter four describes the change in Ethiopian economic policy and performance that occur since empirical regime, emphasizing the agricultural, industrial and service sector and how each sector performance have been affected by the policy developments over the period. Particular attention is given to the recent period of major economic reform under Ethiopian people democracy and republic front (EPDRF) regime. The important component includes the liberalization of trade and exchange rate policies, fiscal policy for the deregulation of domestic and external marketing.

Chapter five describes the structure of the 2002 social accounting matrix (SAM) for Ethiopia, which incorporates the important economic features. The chapter also considers the rationale and structure of the CGE model, the parameter which calibrated to benchmark SAM, and highlights the basic features of the model specification used in the study. In general, the section elaborates the methodology employed to assess the impact of the accession, the basic assumption behind the model and aggregation of social accounting matrix which serve as a data base for the analysis.

Following this, chapter six discuses the results form the calibration and simulation of the research. Finally the last chapter synthesizes the study's findings and offers some policy perspectives on the impact of liberalization on country's economy based on the result obtained in the previous chapter.

CHAPTER TWO

2. Theoretical and Empirical Literature Review

2.1. Trade Liberalization

Major theories about trade liberalization are the Heckscher and Ohlin (HO)[8] theorem and its Stolper-Samuelson corollary that show, under restrictive assumption, free trade raises income of all trading partners and reduces the wage disparity in the country exporting labor-intensive goods. A reformulation of this approach by Wood (1994) suggest that in developing countries with an abundance of semi-skilled workers, trade liberalization leads to an expansion of labor–intensive exports which results to increase the demand for unskilled. Meanwhile, in the developed countries, a rise in labor–intensive imports and reduce the demand for semi-skilled workers, depress their wage rate and rises wage inequality. Therefore, outer oriented trade reform in developing counties should be pro-poor since these countries are most likely to have a comparative advantage in producing goods made with unskilled labor.

However, Ross et al. (2000) has stated that, opponents to free trade had several rebuttals on the theory of comparative advantage. They argue that the notion of comparative advantage was static, concerned with maximization of real incomes at each point in time and did not focus on the dynamic aspects of the ways in which comparative advantage might change with growth. It also seems to have been implicitly assumed that developing economies would remain specialized in primary commodity production in the absence of intervention to promote import substitution.

Ross et al. (2000) also argue that, the poor countries with an abundance of unskilled labor do not always gain from outward trade policy. This is because; the HO framework assumes for a comparative advantage to increase the income of the unskilled, they need to be able to move out of contraction sector and shift into expanding one. But the country studies show that labor is not nearly as mobile as the HO trade model assumes. Moreover, the poor may not gain from trade reforms in that developing countries have historically protected sector

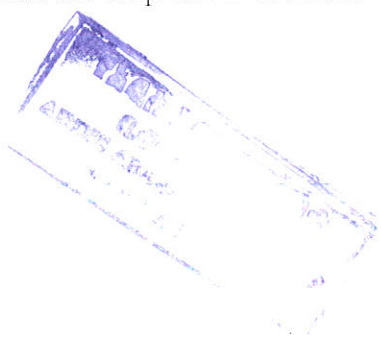
[8] *This idea can be found in any international economics books: Feenistra, Bo- Soderstine*

that use unskilled labor, such as textile. Trade reform may result in less protection to unskilled worker who are most likely to be poor. Hence, penetrating global markets even in sectors that traditionally use unskilled labor requires more skill than the poor developing countries typically possess. While this point is obvious, it bears repeating as some of empirical work reviewed below interprets openness in a very different manner.

As Part of the empirical literature, for instance, Barro (1991) and Sachs and Warner (1995) found that, trade distortions were associated with slow growth. Dollar and Kraay (2001) found that growth and poverty reduction were highest in countries that significantly cut tariff rates or expanded volumes of export and import simultaneously. Widely cited articles such as Dollar (1992), Kruger (1997), Ben-David (1993), Edwards (1998) and Frankel and Romer (1997), using different measures of open trade policies noted that openness is significantly and positively associated with growth.

Kruger (2004) argues that export-oriented strategy would put in place a set of frameworks that result in the adoption of other efficiency and growth-enhancing liberalization policies and in turn these policies permit further gains to be realized from the trade strategy and induce more growth and efficiency. The author provides four plausible explanations that contributed to the export led GDP growth. One of the explanations is a typical trade theory story that the economies made a transition from a highly protective trade regime to an export-oriented strategy and in the process realized their comparative advantages. The measures towards export orientation resulted in increases in the capital-output ratio and guaranteed faster growth even at a constant savings rate. In turn, outward-orientation resulted in the realization of economies of scale. The final explanation is related to the avoidance of the stop-go policies associated with balance of payments difficulties.

According to, Dollar (1992) outward orientation generally means a combination of two factors: first, the level of protection, especially for inputs into the production process, is relatively low (resulting in a sustainable level of the real exchange rate that is favorable to exporters); and second, there is relatively little variability in the real exchange rate, so that incentives are consistent over time. He verifies that the number of anomalies declines substantially if the real exchange rate distortion measure is combined with real exchange rate variability to produce an outward orientation index. Finally, with the help of 97 countries



experiences the writer has concluded that in the absence of distortion and variability, trade will enhance economic growth for a country.

Rodrigues and Rodrik (2001), have critically examined the main findings of Dollar and Ben-David (1992), Sachs and Warner (1995), and Edwards (1998) on their analysis of open trade polices in the sense of lower tariff and non-tariff barrier to trade being significantly associated with economic growth. They noted that the literatures gave largely an affirmative answer regarding the question '*do countries with lower policy-induced barriers to international trade grow faster, once other relevant country characteristics are controlled for?*' Though they have noted that there is a methodological problems with the empirical strategies employed in this literature that left the results open to divers interpretations. In many cases, the indicators of "openness" used by researchers are poor measure of trade barriers or are highly correlated with other source of bad economic performance. In other cases the methods used to ascertain the link between trade policy and growth have serious shortcomings, the removal of which results in significantly weaker findings.

The main point by Rodriguez and Rodrik (2001) is that some of the widely used openness indicators serve as a proxy for a wide range of policy and institutional differences, and that they could give biased results to the implication of trade policies. The authors, however, are in no way suggesting pursuing trade restriction. In their own words, they stated "what we would like the readers to take away from this paper is some caution and humility in interpreting the existing cross-national evidence on the relationship between trade policies". However, they argue that the effect of trade policy on economic growth seem to be indirect and much more modest. This is because the fundamentals for long run growth, i.e. human resources, physical infrastructure, macroeconomic stability, and the rule of law are relatively underdeveloped.

Other economists have also attempted to analyze impact of liberalization from different context. Easterly (1999) showed that liberalization could affect the income of the poor in two opposite ways. If productivity levels are similar but endowments are different then liberalization should raise the income of the poor. Liberalization, by relaxing constraints on the movement of goods and factors, will allow factor returns to equalize across countries. If

poor countries are more endowed with unskilled labor, then relaxing constraint on global trade of factor flow will leads to capital flow to poor countries which intern increases per capita incomes.

Galiani et al. (2002) have also drawn an economic theory to show how trade can accelerate growth through learning effect from development of new product, technologies and information source. They stated that countries that have adopted outer oriented development strategies were reported to have reached higher rates of growth as compared to countries that have adopted the import substitution strategy. On the other hand, there is an argument that, a poor country trading with the rest of the world may result in increase in propensity to import than export leading to worsening of trade balance and may also decrease in net demand for domestically produced goods and services, which likely caused a decreased on domestic income (GDP).

Researchers on both sides of the issue also increasingly agree on the importance of country specificity and of institutions in disentangling the various policies that affect trade and growth. What if the country is lagging behind in its technology and concentrates on traditional goods and services? A model which is first developed by Matsuyama (1992) and letter modified by Grossman and Helpman (1995) noted that a country that is behind in technological development can be driven by trade to specialize in traditional goods and will consequently experience a reduction in its long run rate of growth. The issue can be clarified with the help of a simple model of a small open economy with learning by doing. According to Grossman and Helpman's (1995) finding, tariff exerts two counteracting effects on growth. One is by pulling resource into manufacturing sector; it enlarges the scope for dynamic scale benefit, and thereby increases growth. But it also imposes a static efficiency loss, the cost of which rise over time as the manufacture sector become larger.

The model by Grossman and Helpman's (1995) also clarifies a number of issues. First, it shows that it is relatively straight forward to write a well-specified model that generate conclusion on some countries prospect especially, when those countries are lagging in technological development and have an initial comparative advantage in "non dynamic" sector. In the model there is no determinate theoretical link between trade protection and

growth. One real world phenomenon variables such as learning, technological change, and market imperfection are taken in to account. Therefore, it highlights the exact sense in which trade restriction distort market outcomes. A trade behavior affects resource allocation because it alters a domestic price ratio by raising the domestic price ratio and opportunity cost relative cross border price. A trade barrier has resource-allocation effects because it alters a domestic price ration. It raises domestic price of import-computing activities relative to the domestic price of exportable, and hence introduces a wedge between the domestic relative-price ration and opportunity costs reflected in relative border prices.

Generally, review on literatures by Rodrigues and Rodrik (2001) show that there is no strong evidence that open trade policy will ensure economic growth. This is for the reason that, studies have not adequately controlled for other economic policies (either that the "*trade policy*" measure used captures more than just trade policy or that other plausible control variables have not been included). The policies correlated with growth (trade openness, macro stability, small government consumption, rule of law) are all highly correlated among themselves. Hence, when all of these policies are included in regression analyses, it can be difficult to identify the separate effects of different policies. Even though all these and other studies have been conducted, the association of trade with growth is a controversial.

2.2. Benefits and Costs of Trade Liberalization

To judge whether trade reform will benefit the country, one need to have a reasonably good idea of both the expected costs of adjustment associated with the reform, and in particular how those costs compare with the expected gains. In this section we examine briefly what economic theory has to say about the likely relationship between the long-term gains from trade and adjustment costs.

There will always be industries in which foreign competitors are more efficient than domestic producers (Louis et al., 1999). According to Louis et al. (1999), when import barriers on the products of those industries are lowered, the foreign producers will be able to attract domestic consumers with lower prices. Domestic import competing firms in those markets will face downward pressures on sales and profits, which in turn can lead to

pressure for lower wages, job losses and perhaps even company closures. Lower wages and/or job losses, and the prospects of lower returns to capital, will cause workers and capital to leave in order to find employment in other parts of the economy.

Provided the country is pursuing sound economic policies, other parts of the economy i.e. the export sector are also likely to be expanding, as consumers who are benefiting from lower prices due to the trade liberalization expand their purchases of a range of other goods and services. Sometimes transitions from the previous employment to the new employment take place relatively smoothly, as happens when a booming export sector "pulls" workers and capital away from domestic import competing firms (Louis et al., 1999). Unfortunately, this is not always the case. This is due to adjustment costs in the form of periods of unemployment, along with moving expenses and/or retraining costs to obtain new skills (Annabi, 2005). Entrepreneurs and shareholders in the declining import competing firms are also likely to suffer adjustment costs in the form of declines in capital values.

The integration of a country into the global economy brings benefits and challenges not only to consumers and business but also to the public sector. For many developing countries, tariff reductions are an element of trade liberalization which is of particular concern due to its negative impact on tax revenue. This concern is justified given the fact that tariff revenues are still an important source of tax revenue. In the mid 1990s tariff revenue exceeded 30 per cent of the government's total tax revenue in more than 25 developing countries. This contrasts sharply with the situation in high-income countries for which tariff revenues typically represent less than 2 per cent of total tax revenue. In this regard developing countries have also expressed concerns about the revenue implications of the introduction of the WTO Customs Valuation Agreement (Edwards et al., 1998).

As regards the revenue implications of trade liberalization, one has to distinguish at least two features. First, trade liberalization which takes away non-tariff barriers (quota, restrictive licensing requirements, etc.) and replaces them with tariffs will have a positive revenue impact (Siphana, 2005). Once trade protection is based only on tariffs, the revenue implications of reductions in applied tariff rates depends on the price elasticity of imports and exports. According to a recent study (Siphana 2005, Annabi et al. 2005) price elasticity's

in open economies have to be much higher than empirically observed elasticity's for trade liberalization to be self-financing. These findings imply that significant tariff reductions should be planned together with a reform of the general tax system to avoid the emergence of fiscal deficits or a reduction of government expenditure (Devarajan and Li, 2001).

Trade liberalization, however, will lead to two basic types of gains for the economy. Consumers gain from the lower prices increased quality and variety that come with trade liberalization. In addition, the adjustment process described above will bring efficiency gains, as increased international specialization allows factors of production to shift into activities in which the country is relatively more productive (which is in line with its comparative advantage). Trade liberalization brings even more gains when companies can exploit economies of scale and when trade boosts the country's growth rate; for example, by increasing the inflow of new technologies (Ilham et al. 2003). Although the economy may be worse off in the short run, the gains from trade will outweigh short-run adjustment costs in the medium to long term Even though trade liberalization brings net gains to the economy, this does not imply that the economy is immediately better off. It may well be that for a period of time following the liberalization; the economy is worse off than without liberalization. In this case the adjustment costs are an investment the country makes in order to reap future "profits" in the form of higher incomes. Below are some reviews on evidence of developing countries experience in trade (Annabi et al. 2005).

2.3. The Empirical evidence of Liberalization on Developing Countries

Trade liberalization in developing countries over the last century has been implemented with expectation of growth being stimulated; though evidences on its growth enhancing effect are mixed. Developing countries experience depicts that, although trade offers long-term benefits for developing countries, trade liberalization alone is not sufficient for economic growth. Rather, it has become clear that maximizing trade and welfare outcomes depends on the underlying macroeconomic environment, i.e. industrial policies for export development, design and sequencing of trade policies, external constraints and opportunities, and other complementary policies [Rodrik (1999), Stiglitz (1998)].

There are many interesting pair-wise comparisons between the liberalizing group and the non- liberalizing group: Vietnam versus Burma, Bangladesh versus Pakistan, and Costa Rica versus Honduras. In each of these cases, the economy that has opened up more has had better economic performance. Thus, what we have in the 1990s is an important group of countries, china and India, growing faster than rich countries and hence gradually catching up, while the non- liberalizing part of the developing world is falling further and further behind. These cases provide suggestive evidence about the effect of openness on growth. Nevertheless, examination of individual cases always raises questions of how general the results are (Dollar and Kraay 2001).

Empirical evidence on the impact of major trade liberalization program shows that revenue implications are not necessarily significant. For Bangladesh, Chile and Mexico trade liberalization since the mid- 1980s has reduced applied tariff rates by more than 10 percentage points, reducing the ratio of duties to total tax revenue significant in Bangladesh, but only slightly in Chile and Mexico. In each case import growth accelerated sharply. An interesting feature of the trade liberalization in Chile and Mexico is the fact that in the initial years of trade liberalization, the ratio of import duties to total tax revenue was rising in both countries but declined steadily thereafter (Dollar and Kraay, 2001).

On the other hand, Anwar (2002) in his study on impact of liberalization on growth in Pakistan found that Pakistan's trade performance has been dismal. Growth in export remained slow, while degree of openness (terms of trade as percent of GDP) declined after the liberalization. Researcher's justification was that foreign direct investment, which is a complementary requirement for trade liberalization to be successful in promotion of export, did not increase sufficiently. In addition, Pakistan went too fast in trade liberalization, which is also reflected in a substantial decline in the growth rate of large scale manufacturing sector. These development together with persistent devaluation resulted in increased indebtedness and high debt servicing ration.

Annabi et al. (2005), in their study of trade liberalization and growth in Senegal, found that full tariff removal in Senegal leads to a small increase in poverty and inequality in the short run, as well as contractions in the initially protected agriculture and industrial sectors. In the

long run, trade liberalization enhances capital accumulation, particularly in the service and industrial sectors, and brings substantial increases in welfare and decreases in poverty. However, a decomposition of poverty changes shows that income distribution worsens, with greater gains among urban dwellers and the non-poor.

In Ethiopia there are few studies conducted to assess the impact of trade liberalization on economic growth. Bienen et al. (2005) have tried to assess the impact of Ethiopia accession to WTO using a dynamic neoclassical CGE modeling approach. The simulation result shows both negative and positive effects. The negative effects are mainly focused on the reduction of the government fiscal revenues, which consequently may hamper public investment and then the economic growth. The positive effects are the increase of foreign investment and the stimulation of domestic demand that will result from the households' purchasing power improvement. The research output depicts that there is a positive sign that liberalization have a potent to enhance countries economic growth.

Demeke et al. (2003) in a study on actual effects of the economic reform measures undertaken in the agricultural sector have found that the overall short-run welfare effect of Ethiopia's accession to COMESA-FTA is positive. It is also expected that the dynamic welfare effect resulting from trade partnership would even be higher than the short-run effects. However, the dynamic welfare effect of regional economic integration depends upon the capacity of the country to attract and stimulate investment.

In general, the experience of most developing countries shows that openness affects growth through the level and efficiency of investment in a number of ways. First, an open trade regime can increase market size and thus lead to investment in industries with increasing returns that could not have been possible in a small market size. Second, openness may lead to increased investment and thus capital goods that were either not available or available at too high cost. Third, openness may increase the efficiency of investment and lead to higher foreign direct investment. Finally, openness may lead to greater exposure to a worldwide stock of productivity enhancing knowledge and thus increased growth (Kruger 2004). However, to reap the benefits of liberalization at its most the strategy should be complimented by appropriate trade policy and provision of institutional backups.

CHAPTER THREE

3. International Trade Arrangements

3.1. World Trade Organization[9]

Multilateral trading system can be broadly defined as the body of international rules by which countries are required to abide in their relation with one another. The basic rule is to encourage countries to pursue open and liberal trade policy. The first major effort to adopt the rules to govern international relation was made by countries in the year immediately after Second World War. These efforts resulted in the adoption of General Agreement on Trade and Tariff (GATT) in 1948.

From 1948 to 1994, the GATT provided the rules for much of world trade and presided over periods that saw some of the highest growth rate in international commerce. However, GATT's success in reducing tariff to a low level combined with a series of economic recession in the 1970's and early 1980's drove governments to devise other forms of protections for sectors facing increased foreign competition. High rates of unemployment and constant factory closure led governments in Western Europe and North America to seek bilateral markets sharing arrangements with competitors and to embark on subsidies to maintain their agricultural trade. Both those changes undermine GATT's creditability and efficiency. Moreover, the globalization of the world economy was underway trade in service were not covered under GATT rules but has become a major interest of many countries. This and other factors convinced GATT members that a new effort to reinforce and extend the multilateral system should be attempted. That effort resulted in the Uruguay round, the Marrakech Deceleration, and finally creation of WTO in 1 January 1995.

The WTO is often described as "rule based" trading system. These rules are actually agreements that governments negotiated. Hence, WTO facilitates the administration of trade Agreements on Goods (General Agreement on Trade and tariff-GATT), Services (General Agreement on Trade in Services-GATS) and service (Trade Related Intellectual Property

---

[9] *This section is summarized from the World Trade Organization web site www.wto.org information and media relations Division (2005).*

Rights-TRIPS). Moreover, it administers Dispute Settlement and trade policy review Mechanism.

3.2. Functions and Principles of WTO

3.2.1. Function of WTO[10]

WTO and regional trade arrangements establish common rules and obligations. This enables governments to manage their economies in ways which create opportunities to maximize their economic benefit by participating in the global economy. These rules are designed to encourage governments to improve competitiveness in their own economies by creating opportunities for business to participate in foreign markets. The overall goal is to create an environment in which all economic enterprises will have best opportunities to participate in foreign markets, regardless of their size. The predictability of a WTO member's trade regime could also help to attract foreign investment.

WTO Agreements are complex. However, a number of simple, fundamental principles run throughout all of these documents. There are several principles as the foundation of the multilateral trading system: The agreement establishing WTO provided that it should perform the following four principal functions[11]:

- To establish and administer the international rules governing international trade in goods and services

- To serve as forum for progressive liberalization of international trade

- To provide a means for resolving disagreement between trading countries with regard to the rules. The WTO dispute settlement mechanism provides member countries with a way of resolving these disagreements.

---

[10] *Lessons from Cambodia's entry into the world trade organization Siphana (2005)*
[11] *ADBI policy papers No 7 (2005)*

- Finally, WTO is responsible for carrying out periodic review of trade policy of its member's countries

3.2.2. Principles of WTO[12]

WTO agreements are lengthy and complex because they are legal texts covering a wide range of activity. They deal with agriculture, textile and clothing, Banking, Telecommunication, government purchase, industrial standards and product safety, food sanitation regulation, intellectual property and much more. But a number of simple fundamental principle run through out these entire document. This includes

- **Most-favored-nation (MFN)**: Under the WTO agreements, countries cannot normally discriminate between their trading partners. Granting a special favor for one nation leads to provision of the same favor for all other WTO members. However, some exceptions are allowed like, the preferential treatment of LDCs (under the Generalized System of Preferences – GSP) and regional free trade agreements that do not apply to goods from outside the area. Other cases are permitted only under strict conditions: e.g. a country can raise barriers against products from specific countries that are considered to be traded unfairly. And in services, countries are allowed to discriminate, in limited circumstances.

- **National Treatment**: Treating foreigners and locals equally: imported and locally produced goods should be treated equally-at least after the foreign goods have entered the market. The same should apply to foreign and domestic services, and to foreign and local trademarks, copyrights and patents. National treatment only applies once a product, service or item of intellectual property has entered the market.

- **Freer Trade**: Lowering trade barriers is one of the most obvious means of encouraging trade. The barriers concerned include customs duties and measures such as import bans or quotas that restrict quantities selectively. The WTO agreements allow countries to

[12] *Siphana (2005)*

introduce changes gradually through "progressive liberalization". Developing countries are usually given longer period to fulfill their obligations.

- **Predictability**: *through binding and transparency:* In the WTO, when countries agree to open their markets for goods or services, they "bind" to their commitments. A country can change its bindings, but only after negotiating with its trading partners, which could mean compensating them for loss of trade. This is to warrant for substantially higher degree of market security for traders and investors. This will improve predictability and stability of policies.

- **Special and differential treatment for developing countries**. The concept largely amounts to providing poorer countries with easier conditions at the end of WTO trade rounds. That can mean making certain provisions of new agreement inapplicable to developing countries. Alternatively, it can mean granting poorer nation longer time periods to implement such provisions than the period applicable to developed countries.

In general, WTO operates on the basis of non discriminatory, multilateralism, and application of the principles of Most Favored Nations (MFN), expansion of trade through the reduction of tariffs and unconditional reciprocity between members.

3.2.3. WTO and less developing countries

The WTO agreements involve legal commitments on the rule and regulations that government should adhere to conduct international trade. In fact, the Agreements contain no explicit reference or direct links to policies affecting growth. Their impact derives from the trade policies that governments have committed to pursue based on their WTO commitments. More than 100 of the 147 WTO members are developing countries. Almost all the 30+ countries seeking to accede are also developing countries or economies in transition (WTO, 2005:11).

Within the WTO agreements, developing countries are supposed to receive special and Differential Treatment aimed at addressing their particular circumstances in international trade. The poorest of the developing countries—the 49 countries on the UN list of least

developed countries (LDCs) are provided with further additional more favorable treatment. The Special and Differential Treatment provisions involve five sets of measures:

- Developing countries are given more flexibility in terms of their own trade policies—i.e. they have not had to reduce their tariffs significantly in previous multilateral trade negotiations and they do not have to 'bind' all their tariffs;
- Their exports can be charged lower preferential tariff rates in developed or other developing country markets;
- They are given longer 'transition' periods to implement provisions contained in some WTO Agreements;
- Developed countries are supposed to provide them with technical assistance to help them implement the commitments they have assumed; and
- Developed countries are to implement their WTO commitments in a manner 'favorable' to developing country interests.

WTO provisions in general, and those which apply to developing countries in particular, tend to be quite permissive in terms of the trade policies an individual country can pursue and hence do not tend to constrain these policies in ways that would harm the poor . At the same time, they are on the whole supportive of trade and foreign direct investment policies that would tend to promote poverty alleviation. Beside this, the availability of an effective dispute settlement mechanism and the guarantee of MFN treatment for all its members can be of special importance to developing countries in their dealings with more powerful developed country trading partners (WTO, 2005)[13].

However, the permissiveness of the WTO Special and Differential Treatment provisions has been a problem for LDCs. This has enabled developing countries to maintain higher levels of domestic protection, which has harmed their own economies. And, export subsidies often used to offset the disincentives of protection are a drain to the budget, and hence are not affordable, and can not be relied upon to provide sustainable, labor intensive export growth that helps alleviate poverty (Winters and Cirera, 2001).

[13] *For further reading please see at www.wto.org*

The accession process of the WTO is difficult for the Least Developed Countries (LDC's) that lack the human resources and technical capabilities required by the process. Realizing this difficulty, member countries have agreed to facilitate and accelerate the LDC's accession process. The multilateral agreements constituting the WTO system are binding on all member countries. However, some of these Agreements recognize that it may not be possible for a number of developing countries and for LDCs to accept immediately all or some of the imposed obligations (Binene et al., 200).

Even though, Strong institutional framework, human and financial resource, technical capability and other trade related policy play a crucial role to perform effective trade with the rest of the world, most developing country luck this basic future. For instance, World Bank studies have shown that the administrative costs of implementing just three WTO agreements (SPS, Customs, and TRIPS) are $130 million annually for the average developing country[14].

3.3. The Linkage between WTO accession and Economic Growth

In practice, and certainly in most transition economies, changes in trade policies have taken place concurrently with macroeconomic stabilization policies. This means that one has to consider the implications of carrying policy change. WTO accession is linked with country's economic growth through different channels of economic variables. The expected potential linkages through which liberalization will affect the economic variables are via relaxing tariff and non-tariff barriers, exchange rate liberalization and export policies reform.

The impacts of trade liberalization strongly depend up on the mechanism a government adopts to offset forgone tariff revenue. For instance, if the indirect and/or income tax is used as mechanism to replace the revenue lost due to liberalization. The elimination of domestic tariffs reduces domestic import price and increase the import volumes. At the same time, increase world demand for exports offsets failing world export prices such that domestic export prices rise. In response, local producers reorient their production form the

[14] *For a detailed analysis of the new modeling projections, see Frank Ackerman, "The Shrinking Gains from Trade: A Critical Assessment of the Doha Round Projections," Tufts University, GDAE Working Paper No. 05-01, October 2005:*

domestic market towards the export market, at the same time as local consumer substitute to world cheaper imports. Local demand fails faster than local supply, this results a fall in local producer and consumer price. The drop in local price results in a depreciation in the real exchange rate, which reinforces the rise in exports and a fail in imports. When the two replacement taxes are compared, one notes that import and consumer prices fall more when lost tariff revenue is replaced by the introduction of a uniform income tax, but that volume responses are roughly the same (Annabi et al., 2005).

When compensatory income tax is substituted for the consumption tax, import, domestic sales and consumer process all fall more given the presence of a price-increasing indirect tax. However, as producers no longer need to absorb part of the indirect tax, output and value added process fall less and indeed increase in the case of industrial and service value added process. Domestic production is consequently reoriented more markedly from the service sector in favor of the industrial sector. This linkage serves as developing scenario of the paper on assessing the impact of WTO accession on economic growth i.e. a tax measure taken by the government to replace the lost in the revenue.

CHAPTER FOUR

4. General Overview of the Ethiopian Economy

Ethiopia was one of the most regulated and inward oriented countries between the 1974 to mid 1991. However, after 1991, Ethiopian People's Revolutionary Democratic Front (EPDRF) responded to the dismal economic outcome of the Derg regime by embarking on extensive economic reform aimed at improving macroeconomic stability, accelerating economic growth, and reducing poverty. Tariffs have been cut, quota constraints relaxed, licensing procedures simplified, foreign exchange controls eased, compulsory grain delivery and forced membership to cooperatives discontinued, a privatization process begun, private banks authorized, interest rates decontrolled, and an inter-bank money and foreign exchange market introduced. Moreover, liberalization of foreign trade and exchange regimes, decontrol of domestic input and output prices, public sector reform, privatization of some enterprises, financial market reform and opening the door to foreign investors characterize the prevailing regime of the country (Alemayehu and Tadele, 2004).

4.1. Growth and Sectoral performance

Like many Sub-Saharan African countries, economic growth has been highly volatile and unsustainable in Ethiopia for the last half of a century (see figure 1). This high degree of volatility and unsustainability of the economy performance is due to the relative contribution of each economic sectors particularly agriculture, industry and service to the overall national income. Therefore, the writer will make cursory review on these sectors in there respective order.

4.2. The Agricultural Sector

4.2.1. The Agricultural Sector Performance

Agriculture is the most important contributor to the country's GDP. This sector, on average, accounted for 68%, 56% and 47% of the GDP in the periods 1960/61-1972/73, 1973/74-1990/91 and 1991/92-2004/05, respectively (See table 2). Moreover, agriculture is a significant contributor to employment. About 85% of the population earns their living from

this sector[15]. Agriculture is undoubtedly a vital sector in the country to achieve self-sufficiency in food production, reduce rural poverty and foster sustainable economic development.

Agriculture is also quite important in terms of foreign exchange contribution as it contributes 90% of the export earnings of the country. Exports are composed of cash crops like coffee, pulses and oilseeds, fruits and vegetables and chat. The other component of the export is the livestock sub-sector that includes mainly hides and skins, live animals and leather products. Although, 65% of the land is arable, only roughly 10% of this arable land is under food crop cultivation. Further, 96% of cropped land and 90% of agricultural out put is managed by small scale farmers, most of whom practice non input intensive, rain-fed farming that does not result in a higher yield.[16]

Agriculture performed very poorly in the 1980s, under the former military government. Its growth rate averaged a mere 0.7% per annum between 1980/81 and 1989/90. This sector's was only 2.6% on average during the period 1991/92 - 2000/01. The major reasons for the dismal performance of the sector includes diminishing farm size and subsistence farming, massive soil degradation, inadequate and erratic rainfall, poor marketing infrastructure and weak research base. Rapid population growth has led to declining farm size. Farmers with very small plots seldom produce enough for their home consumption. They have limited capacity to invest in modern inputs such as fertilizer and improved seeds. The problem is further compounded by lack of adequate rainfall, combined with variability on the onset and duration of rain. A growing proportion of the farmland now suffers from drought (EEA, 1999/2000).

4.2.2. The Agricultural Sector Policy

The government recognizes that the key to transformation from peasant agriculture to a modern internationally trading nation is to raise agricultural productivity. To achieve this goal the government adopted the Agricultural Development Led Industrialization (ADLI)

---

[15] *Ethiopia Trade and Transformation: Diagnostic Trade Integration Study, (DTIS) (2004).*
[16] *EEA, Annual Report on the Ethiopian Economy 1999/00, pp 146-147*

strategy in 1992. The objective of ADLI is to strengthen the interdependence between agriculture and industry by increasing productivity of peasant farmers, expanding large scale private commercial farms, and by reconstructing the manufacturing sector in such a way that it can make use of the country's natural and human resources. Owing that the country endowed with large number of working age population and sizable arable land with scarce capital, ADLI's strategy is to use labor extensively and land intensively by promoting the use of technologies that are labor intensive and land augmentation through the use of fertilizer and improved seeds[17].

According to the strategy of ADLI, Growth in agriculture is supposed to include overall economic growth by stimulating both demand and supply. The program aims to enhance the productivity of the agricultural sector first by improving agricultural practices through increased use of fertilizers and improved seeds as well as training programs. Second, it develops agricultural infrastructure through small-scale irrigation, improved rural banking credit facility and promoting large–scale private as well as state owned commercial farming (Rahel, 2003).

Despite that, the interrelationship between agriculture and industry and their interdependence and integration play key role in order to accelerate the country's development and to bring about socio-economic changes, in Ethiopia, under the prevailing circumstance of the interrelationship and interdependence, the two productive sectors has remained very weak. Moreover, since the economy of the country is highly dependent on rain fed agriculture, the impact of ADLI on the economic growth has been ineffective. In line with this, Alemayehu (2001) has discussed the negative multiplier effect of high degree of dependence on rain-fed agriculture on level of production. He noted that a shock in one period is often carried over into the next since the drought in that period deprives the farmer not only of current income but also of asset. Alemayehu also pointed that the government's development strategy ADLI does not adequately address this central problem in agriculture, i.e. the extremely reliance on rainfall.

---

[17] *Ethiopia Trade and Transformation: Diagnostic Trade Integration Study, Volume2 (DTIS) (2004).*

4.3. The Industrial Sector

One of the key indicators of the degree of industrialization of an economy is its production structure as reflected by the relative contribution of the economic sectors to the overall national income. The contribution of the sector to GDP, on the average, accounted for 9%, 11% and 11% in the periods 1960/61-1972/73, 1973/74-1990/91 and 1991/92-2004/05 respectively. The overall average contribution of the sector to GDP during all this period is only 10%. The sectoral growth per year averaged 1.5% over the period 1973-2005 (table 2). Similarly, the total industrial group's contribution to employment was only 5 percent and to export earnings about 15%[18].

Historically it is to be noted that this has not changed much for a long time. For the last twenty years most of the manufacturing enterprises in Ethiopia have been engaged in production of labor intensive, and by large in low value added consumer goods. This is particularly true of the small scale and handy crafts group of manufacturing industries. The small scale and handy crafts type of enterprises constitute about one-third of the manufacturing sector and the remaining two-third is categorized as large & medium scale (LMS) manufacturing sub-sector (Haile et al., 2003).

In a modern economy, industrial output is a function of output in services and gross investment in non-agriculture. However, Ethiopia's modern industrial sector is essentially unrelated to the agricultural sector, which neither supplies inputs to modern industry nor provides substantial demand for its output. This implies that the manufacturing sector is neither capable of supplying the required intermediate inputs, let alone capital, to other sectors of the economy, nor it is capable of absorbing all agricultural supplies for further processing. This makes the economy totally dependent on the rest of the world both for its demand and supply. Moreover, poor production structure of manufacturing industries has lead to loose and unbalanced structural linkage with in manufacturing itself. This is witnessed by industries/firms being heavily dependence on imports both for capital goods, intermediate and consumption goods (EEA 2004:168).

---

[18] *Ethiopia Trade and Transformation: Diagnostic Trade Integration Study, Volume2 (DTIS) (2004)*

Technological capabilities are the skills, technical knowledge and organizational coherence that enable productive enterprises to utilize machineries and equipment as well as technical information efficiently. It involves the technology embodied in physical equipment, the educational qualification of employee's skills and learning acquired by employees experience and training, the entrepreneurial and managerial skills, and the degree of interaction and information flow between industries and firms. In the case of Ethiopia technological backwardness is a cumulative result of various factors, including importing and developing technologies inappropriate to the countries endowment, lack of internalizing and upgrading the technologies and limited diffusion of knowledge within the country (World Bank, 2003).

In recent years, however, the government has started to initiate new policy measures. One noticeable measure that has taken place recently is the establishment of an industrial development fund. Connected with the establishment of this special fund, the Development Bank of Ethiopia has started disbursing funds to enterprises that are engaged in the export market. A proclamation is also enacted to establish a public private partnership. As a means to resolve some policy problems, the government has also started forming a consultative group in which representatives from the private sector, sector institutions and Ministry of Trade and Industry are members. Following this initiative, joint consultation has already begun focusing on the textile sector. Similarly, to promote the operation of the leather sector, a training institution has been established and in some sectors contracting and leasing of management has started (Haile et al., 2003).

4.4. The Service Sector

The service sector in Ethiopia is one of the dominant sectors as can be read from the value-added component of the GDP. The sector can be categorized into broad sub sectors as distributives services i.e. trade, hotel and restaurant, followed by transport and communication accounting for 12%, 14% and 15% of the GDP respectively. Other sectors which includes banking, insurance and real estate, public administration, defense, education, health, and other domestic services. Sectoral contribution to GDP on the average was, 11%, 19% and 28% for the periods 1960/61-1972/73, 1973/74-1990/91 and 1991/92-2004/05, respectively (See Table 2).

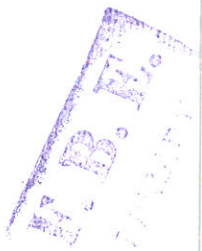
The total contribution of the service sector to GDP, on the average, accounted for 23%, 33% and 43% in the periods 1960/61-1972/73, 1973/74-1990/91 and 1991/92-2004/05 respectively. The overall average contribution of the sector to GDP during all this period is 33%. The sectoral growth per year averaged 5.79% over the period 1973-2005(See table 2).

As can be seen from the same table the distributive sector grows by less proportion than other service sector for which the later constitutes much of government expenditure showing that most part of sector is under the control of government. The contribution of services to Ethiopia's total external trade during the last decade has, on the average, been around 35%. The service sector is also important as source of foreign exchange having, contrary to the trade balance, a positive balance for a considerable period of time. Despite the expansion, the sector is strongly protected and expected to be affected most by WTO accession, due to commitments that will be made in terms of market access and national treatment.

4.5. Foreign Trade Sector

4.5.1. Export

Efforts to raise general living standard by the country through trade policy reforms or creation of infrastructure and institutions for some purpose will not be fully realizable if the country export faces market access constraints. Moreover, such beyond the border barriers prevent the country from diversifying its trade structure particularly exports, leading to continuous instability in export receipts. In particular export diversification is hampered by low export growth.



Despite some progress in the second half of the 1990s, Ethiopia's export bundle remains relatively small and very concentrated, both in terms of products and markets. Moreover, products exported by Ethiopia have been experiencing negative growth in world markets (see Table 7). Though, some of Ethiopia's exports have some times been able to grow in these declining markets by capturing a larger market share, part of the explanation lies on the fact that products exported by Ethiopia face higher tariffs and quantitative restriction both in developed and developing countries (DTIS 2004).

The trade policy failed to diversify trade so that excessive commodity concentration remained to be the major characteristic feature of the country's trade. The export sector in particular is characterized by sharp fluctuations and excessive dependence on a few primary commodities. During the period between 1980/81-1989/90 and 1991/92-2004/05, coffee constituted, on the average, about 67 and 53 percent of the total export earnings, followed by hides & skins, which, on the average, accounted for 14.29 and 10.86 percent of the total export earnings respectively (Table 3). Five major agricultural export items (coffee, hides skins, oilseeds, pulses and chat) had an average combined share of more than 85%[19] of the total export earnings during the period (Table 3).

The destination of our exports as well as the origin of our imports has remained the same for a long period of time. Going as far back as the 1980s and even further, the major trading partners remained Europe, Asia and America. Europe has retained its predominance both as the destination for exports as well as source of imports, although its share in both has tended to decline (Tables 4 and 5). The major markets in Europe constitute Germany, Italy, France, the United Kingdom and the Netherlands. On the average, these countries alone accounted for about 18.59% of the country's total export following USA with 31.33 % on average (Table 4). These five countries also dominate the import side, accounting for about 16.41% of our total value of imports following USA with 23.91% over the period 1984/85 – 1991/92 (Table 6). But the import has been shifted from those countries to other Asian countries in the post reform period and the share declined to 6.82%and 13.13%, respectively, for Europe and USA.

The Asian market has increased its share both as supplier of imports as well as buyer of exports. However, these markets are concentrated in Japan and Saudi Arabia, which together account the lion's share of Ethiopia's exports to and imports from Asia. In the case of Africa, the most important destination of Ethiopia's exports is Djibouti, while Kenya constitutes our main supplier of imports from Africa (Table 5).

[19] *Ethiopia Trade and Transformation: Diagnostic Trade Integration Study, Volume2 (DTIS) (2004).*

4.5.2. Import

One of the major challenges of growth in developing countries at large is the external resource imbalance. The bulk of industrial sector highly depends on imported inputs. Though the country is the main producer of primary commodity it has also been importer of such items. Import structure of the country is mainly composed of petroleum products, wheat, corn and other cereals in grain form, different parts for vehicles, electronic devices and medicaments. For instance, imports of crude petroleum and products constitute on average 50.02% and 44.86 % over the periods 1971/72-1990/91 and 1991/92-2004/05, respectively(see Table 5).

The country's import of strategic material such as fertilizer, metal and metal manufacturing, machinery and aircraft and electrical materials, which can play a great role for the country growth, is relatively less than 11.17% of the total import on average (Table 5). This means that Ethiopian imports are mainly concentrated on final consumption goods, sometimes intermediary goods and rarely equipment goods. Roughly speaking, one could say that Ethiopia imports more for its final consumption than for its economic development.

Ethiopia imports major of its material form U.S.A followed by Europe which constitute 23.91% and 16.41%, respectively, over the period 1984/85-1990/91. The import origin still remains more or less the same with those courtiers from 1991/92-2004/05. Moreover, volumes of import are increasing alarmingly from time to time (Table 6). As can be seen for the same table the growth of import and export goes in opposite direction i.e. while export declines import is increasing from time to time which leaves the current account balance at deficit.

4.6. Major Trade Policy Features

4.6.1. Tariff

There are no guidelines in the WTO Agreements for setting the average tariff rates for concessions of individual acceding countries. However, the relative average tariff levels of other WTO members with similar social conditions and stages of economic development could be used as a reference. The level of bound tariff rates will depend on negotiations

between the acceding country and interested WTO members, while vigorous requests from the latter should be expected (Siphana, 2005).

Ethiopia is levying low tariffs on imports as part of a program for economic transition or a Structural Adjustment Program. In this tariff reform program which is made since 1992 were resulted in a decrease of import tariff from its maximum level of tariff rate 230% to 35% and as well number of tariff bands also decline from 23 to 6 in these two consecutive regimes (See table 8). In practice, the initial offers of many acceding countries in the past included bound rates, which exceeded their applied tariffs.

The primary effect of trade liberalization in a poor country like Ethiopia is mainly the reduction of the government fiscal revenue, which may hamper public investment and consequently economic growth unless substituted by private sector investment. Moreover, it results in the contraction of previously protected infant industries. Ethiopian maximum tariff rate is 35% and revenue collected form tariff accounts 2.6% of GDP (see table 9). The trade tax revenue accounts 18.4% of the total revenue earned by government (see also table 9). The macroeconomic effects of tariff reduction have been reflected through wage and employment, scale of production, foreign and saving constraint.

4.7. Other Related Trade Policy Issues

Strong institutional arrangements for trade are a crucial requirement for a sound trade policy framework. Ethiopia, like other least developed countries, faces the challenge of putting in place an effective policy framework for trade. In order to ensure that trade facilities growth and development, there is a need for a well structured national institutional framework that would not only formulate and analyze trade policy, but also ensure its implementation, monitoring and evaluation. specifically, this set up is needed to ensure 1)an effective policy making organization for investment and trade; 2) to provide effective support for export development and promotion ; and 3) to ensure policy reform properly implemented and anticipate impact of the reform on producers and consumers alike (DTIS, 2004).

In general, experiences and research of different studies (DTIS 2004, Demeke et al. 2003, Benine et al. 2005) show that, Ethiopia has not utilized the advantages of trade preferences

provided by the advanced countries to any substantial degree mainly due to its own supply deficiency. Production and supply constraints related to limited capacity of production consequent upon obsolete technology and unskilled manpower constitute the major impediments to the expansion of export trade. Lack of product diversification is another impediment for the expansion of export trade in the country. Narrow product range and predominance of primary products has made the export trade of the country precarious. Underdeveloped infrastructure facilities and lack of timely and accurate market information has also adversely affected the performance of the export sector.

Moreover, even though depreciation of the real exchange rate is expected to encourage exports by raising payment for exports, it is also expected to discourage imports by pushing prices higher. While exerting a positive impact on the balance of payments by stimulating exports and restraining imports, devaluation also influences the cost of living, the government budget and production. Increasing prices of essential import goods, such as fertilizer, fuel and certain basic consumer goods consequent upon the devaluation may put extra cost on the economy.

CHAPTER FIVE

5. Research Design and Methodology

The Model

CGE models may be defined as economy wide model whose solution depicts a simultaneous general equilibrium in all markets of the economy. The model is in general equilibrium because a set of prices and quantities exists, such that all excess demands for commodities and services, in nominal as well as in real quantities, are zero. CGE models are aggregate representation of the economy and are based on the flow equilibrium in product and factor market in real as well as in nominal values (Dixon 1982, Dervis, De Molo and Robinson 1992). Unlike to input-output models, both quantities and relative prices are endogenous, while consumption is no longer exogenous but linked to income (Thissen 1998).

The general equilibrium approach, in contrast to partial equilibrium models which analyze the different sectors separately under ceteris paribus assumptions, intends to model all links within the economy that represent a transaction of money or goods. The analysis is usually based on comparative numerical static analysis of changes in exogenous conditions. Thus, the base equilibrium situation is compared with the new equilibrium after the exogenous shocks of the policy measures have taken place (Thissen 1998).

In general, the aim of CGE modeling is to build a model with relative transparent structure in order to clarify the mechanism with which policy measures or exogenous shocks affect the economy within a multi-sector framework. Given the existing limitation in parameter estimation and, therefore, also the model structure, it is often not the objective to forecast the exact outcome of policy measures, but to give only the indication for the direction and size of the effects (Robinson 2003). These models preferred over partial equilibrium models because complex interdependencies are included in the analysis. That is, it allows capturing links between different sectors, links between micro and macro levels, and the effect of changes in policies and external shock on sectoral structure for one country focusing on income distribution or resource allocation (Adelamn and Robinson, 1978).

5.1. Macro and CGE Models

CGE models have long been used to examine issues such as the impact of macro shocks and the design of structural adjustment. The origin and nature of these shocks vary widely so that a policy response to such macro shocks issues of macro stabilization (Thissen 1998). A CGE model provides a good framework for analyzing structural adjustment issues: the impact of shocks and policies that work through changing prices and market incentives to affect resource allocation and structures of demand, production and trade. The classic CGE models do not incorporate the sorts of financial issues and macro variables that would support analysis of stabilization issues. But short-run stabilization problems involve links between the financial and real side of the economy (Robinson 2003). Therefore, the existence of such real-financial links serious strains the Walrasian paradigm underlying the classic CGE modeling frameworks.

The debate on how best to use empirical models to analyze both stabilization and adjustment issues is active and far from settled. A number of schools of thought have been emerged on how best to adopt and use CGE models for the purposes of stabilization and adjustment and how to reconcile or integrate the CGE and macro modeling frameworks. These are the fundamentalist (classical), Bahá'i and ecumenical schools (Robinson, 2003).

5.1.1. The Fundamentalist School

This schools of thought can be summed up in the maxim '*There is only one model, and its prophet is Walras*' in this view, the Walrasian CGE model is theoretically elegant and complete, and any attempt to add macro feature and financial variables simply corrupts the model. CGE models should only be used to analyze issues of allocative efficiency, relative price and the structure of employment, production and demand in an environment of well-functioning markets. Macro issues should be left to macro economists (Yeung 1984, Bell and Srinivasan 1984 and Srinivasan 1982).

Classic CGE model specifies fixed supplies of primary factors of production and assume that all markets 'clear' in that price and wage adjust to achieve supply-demand equilibrium in all product and factor markets. In macro terms, the model will always generate full

employment of all factors and hence the economy is always operating on the production possibility frontier. Moreover, the model can only determine relative price, and some price and price index is chosen as numeraire. The absolute price level is indeterminate and must be specified exogenously. The supply and demand equations in the model are all homogenous of degree zero in price. The model display strong neutrality of money (Robinson, 2003). The main objective of Walrasian CGE analysis is to analysis the quantitative effects of exogenous changes on the optimal allocation of resources, on efficiency and on welfare.

5.1.2. The Bahá'i School

In this view, one should build integrated models that incorporate the best elements from Walrasian CGE models and a variety of macro and financial models. The multi-sector CGE model can be used to provide the supply side of a much richer integrated macro-CGE model that includes assets, including money, asset markets, interest rates, inflation , expectations , and any other future drawn from modern macro theory that seems appropriate to the issues being analyzed (McKibbin and Sachs 1991, Mckibbin and Wilcoxen 1998 and Agenor and Montiel 1996). This model all embeds a CGE model in a dynamic macro model that includes financial variables and asset markets (Robinson, 2003).

To describe the economy at hand the macro CGE models, in contrast to Walrasian CGE modes, may include ad-hoc elements while behavior of economic agents may not be used to derive the optimizing behavior (Decaluwe et al. 2005). Thus, it may be argued that these models trade off internal rigor for increases in empirical relevance resulting in models that are often impossible to solve analytically. And on the aggregate level, these models are comparable to the short run macro modes of the previous decades with an extensive multi-sector input–output sub model (Robinson, 2003).

5.1.3. The Ecumenical School

The maxim for this school of modeling is '*render unto walras the things which are walras and unto Keynes the things which are Keynes*'. The philosophy is to use separate CGE and macro-financial models, keep the two models separate, but specify ways through which the models can talk to one another (Robinson and Tyson 1984 and Powell 1981). A macro model might

determine the price level and various macro aggregates as endogenous, and these variables are then specified as exogenous variables in a CGE model. The CGE model, in turn, might determine endogenously variables such as the wage rate and various prices which are taken as exogenous in the macro model (Robinson, 2003). The two models can communicate, and perhaps be solved simultaneously. The advantage of this approach is that the two modeling system are kept separate, with no need to mix paradigm in a single model (Caeser et al. 2005).

To summarize, the influence of both the fundamentalist and ecumenical school have been declined, while Bahá'i school has clearly grown. First it has been widely recognized that an applied economy wide model must incorporate macro balances and nations of macro equilibriums. Second, advances in modeling software and solution algorithms have made the specification and solution of forward looking dynamic CGE models incorporating asset markets and inter-temporal optimization feasible. Third, increased data availability and advance in econometric methods have made it feasible to estimate the parameters of such model.

5.2. Classification of CGE Models

There are two paradigms in the closure of CGE models[20]. The Neoclassical CGE model, which assumes full-employment equilibrium and market-clearing prices and structuralist CGE model typically involve wage and price rigidities, partial adjustment mechanisms, and equilibrium with out market clearing, including unemployment(Robinson 1989 and Willenbockel 1994). These two paradigms embody very different notions of equilibrium. The issue of macro closure in CGE models brings together the different strands of analysis. To use CGE model either with or within a macro model requires extension of the core model to incorporate macro features (Thissen 1998).

5.2.1. Neoclassical CGE Model

The saving-leading-investment approach is at the heart of neoclassical CGE models (Solow 1970). In these models, output, income distribution and saving all come from the supply

[20] *See, Sen 1963, Taylor 1983, 1990, Rottso 1982, Robinson 1989, 1991 and Dewatripont and Michel 1987.*

side. That is, a mechanism exists such that investment is brought into equilibrium with savings at a level that guarantees full employment in the economy. In other word what ever saved is invested (Thissen 1998 and Luis 1993).

Neoclassical models assume that at least two factors of production (labor and capital) have to be explicitly considered as homogenous productive factors and in the long run there exist 'well behaved' and smooth continuous production functions. Therefore, changes in the relative price of factor resulting from changes in the relative supply and demand for those factors alter the relative factor intensity in the productive process (Solow, 1956)[21]. This implies that capital and labor are perfectly substitutable and that factors of production are paid according to the value of their marginal contribution to output. Under these conditions, the price mechanism will ensure that the economy will move towards an equilibrium position (Scarf and Shoven 1984, Shoven and Whalley 1992, Solow 1956). For neoclassical economist, 'equilibrium' is understood as a position in which all factors of production are fully employed at the price equal to their marginal product (Luis 1993).

In neoclassical theory the rate of investment is determined by the speed at which firms adjust their capital stock towards desired levels. The desired capital stock is larger when firms expect to produce more and when the rental cost of capital is lower than the shadow price of capital (Dornbush and Fisher 1987). With regard to equilibration between saving and investment, once the economy is at full employment, a reduction in demand (i.e. fail in investment) would quickly, through its effect on the interest rate, be accompanied by an equal contraction of saving, and therefore an equal expansion of consumer spending, so that aggregate spending would remain unchanged; only its composition would alter. With the interest rate playing this role, it seems say's low can be retained, and there will be no problem of deficient aggregate demand (Luis 1993). Generally, in the neoclassical framework perfectly competitive condition ensures equilibrium in both products and factors (Robinson 2003).

5.2.2. Structuralist CGE model

Structuralist often assumes that macroeconomic causality runs broadly from demand injections to leakages under conditions of passive money supply. They treat the extended

[21] *Solow, Robert M. 1956 'A contribution to the theory of economic growth ' quarterly journal of economics 70: 65*

functional distribution and at least some sector's out puts as endogenous in their macro models, subject of rules such as markups and fix-price/flex-price distinctions regarding price adjustment (Taylor 2004). Structuralist maintain that even though macroeconomic causality is influenced by microeconomic detail, at an aggregate level it flows form investment, exports, and fiscal demand as exogenous variables to income distribution, imports, and output flows, which generate supplies of savings (Taylor 2004).

Structuralists argue, however, that very often excess demand in developing countries will not be accompanied by higher rate of growth (Taylor 2004). They maintain that although there would be an extensive excess capacity in the economy in the form of widespread unemployment and unutilized equipment, a number of structural factors would prevent higher levels of production and growth. Therefore, if there is an increase in aggregate demand it will not be followed by inadequate output response because the economy will be constrained by bottlenecks and structural rigidity. such factors are mainly related to (1) production structure, which is characterized by resource immobility , low productivity in agriculture, market segmentation, and disequilibria between sectoral demands and supplies; (2) the structure of the origin trade which is characterized by unfavorable tendencies in the terms of trade and low capacity to expand the production of exportable and import substitution, a reliance on primary commodity exports, and a high level of dependence on imported goods; and (3) the existence of underdeveloped systems of financial intermediation which are largely segmented and do not provide to all sector the same access to funds (Luis,1993).

In general in the neoclassical framework, perfectly competitive conditions ensure equilibrium in both products and factor markets. However, in reality these assumptions don't hold for LDCs like Ethiopia for a number of structural factors. Therefore, this paper builds a CGE model, drawing mainly the structuralist approach of Davies[22] et al. (1994). The structuralist CGE model is inspired by structuralist tradition in formulation and applying CGE models in economies of the developing world (Taylor, 1990). The model emphasize class relationships and income distribution changes, as Taylor points out, they relay more explicitly on the

[22] Davies 1994 believes that excess demand will be followed by changes in imports and output flows that will generate savings supply.

analytical heritage of Keynes(Kalecki 1976 and Kaldor 1955). A clear advantage in utilizing a CGE model is the fact that it builds around the accounting framework provided by social accounting matrix. For this study we employ a social accounting matrix of 2001/2002 developed by World Bank as data base.

5.3. Design of Social Accounting Matrix (SAM)

SAM is a comprehensive system for organizing economy wide data for a specified time period as a snapshot of the economy. SAM captures the circular flow of income form product market through factor payment to the household back to product market through expenditure on final goods. It is in the form of a square matrix and each cell in the SAM represents a payment from a column account to a row account (Thorbecke 1998). Moreover, SAM must be consistent and complete i.e. the total receipt (income) and expenditure (payment) of each account must balance (Sadoulet, 1995).

A simplified framework for economywide analysis which is used in this study is shown in figure 4 annex III. It traces the circular flow of incomes from product markets through factor payments to households and back to product markets through expenditures on final goods. Additionally, income flows involving producers, government, rest of the world and capital account are included in the diagram. Moreover, the structure of SAM used in the study reflects the following relationships and income flows among the various accounts.

As can be seen from figure 4 of annex III, Production activities account purchases intermediate inputs from the commodities account and the services of factors (value added) from the factor account. The output of these production activities is sold to either the domestic market (for intermediate input use, final private or government consumption, and investment purposes) or to foreign markets in the form of exports both of which are tracked by the commodity account. This account also keeps track of the imports of goods and services entering the country.

The primary factors of production labor and capital earn income by supplying services to the production activities. This income is then distributed to households in the form of labor

earnings, and to enterprises as capital income. Firms save part of their income for investment purposes, some earnings are retained and distributed to households, and profits taxes and other transfers are paid to the government. Incomes received by households are spent on purchasing final goods and services, paying income taxes, saving and transferring resources abroad. The receipts of the government consist of income taxes paid by households, profits taxes paid by enterprises, indirect tax revenue (commodity sales taxes), direct taxes, import tariffs and export duties, and aid transfers from the rest of the world.

The savings/investment (capital) account is where the savings of households, enterprises and the government are placed. This account also records the current account deficit (foreign savings) of the country. These savings are used for investment purposes in the various production sectors. The rest-of-world account documents transactions between Ethiopian and the rest of the world. This concerns mainly imports and exports of commodities, but also financial transfers between Ethiopian institutions and foreign private and government entities. Therefore, the rest of the world account receives incomes from its export to Ethiopia, transfer made by government and households. It spends on purchasing final goods and services that is produced by the Ethiopia and transfers to natives household and government account (see figure 4).

5.3.1. The Ethiopian SAM

The primary source of the Ethiopian SAM is Alemayehu and Tadele (1999) which later on modified to WB-2001/2002 SAM. The 1999/2000 Ethiopian SAM is a 40x40 matrix and contains an account each for fifteen production activities, four factors of production, eight commodities, transactions costs, eight institutions, public investment, savings/investments of institutions other than the government, food aid, and the rest of the world (net of food aid). On the other hand, The 2002-Wb SAM is also a 40x40 matrix and contains an account each for twelve production activities, four factors of production, eight commodities, transactions costs, ten institutions, public investment, savings/investments of institutions other than the government, food aid, and the rest of the world.

In this study, in order to meet the desired objective, the researcher aggregates the WB- 2002 SAM in to 15X15 matrix which contain three production activities (agriculture, industry and service), three commodities agriculture, industry and service, two factor (capital and labor) and four institutions (household, firm, government and rest of the world), two tax (direct and import tax) and saving investment accounts see table 10 in the annex I for detailed structure of the SAM.

The structure of the Ethiopian economy in the benchmark year shows that agriculture activity constitutes a large share (43.3%) of the total value-added (see Table 10 of Annex I). Accordingly, the service sector generates about 40.7% of the total value-added. The rest, industrial sector accounted for 15% of the total value-added in the economy. In terms of commodity production volume, agriculture sector still takes the largest share in commodities production accounting 34.7% while industry and service sector constitute 31.5% and 30.2%, respectively.

Expenditure on food crops came out as the largest component of final demand, followed by traditional agricultural exportable. The commodity composition of final demand reveals a pattern consistent with the level of development in Ethiopia. From table 10 of annex I, household consumption is by far the largest component of the demand side of the Ethiopian economy. It amounted to 76.7% of gross domestic expenditure (GDE) on goods. Government expenditure on goods amount 10.9% and the remaining is accounted for rest of the world consumption 12.4%.

Regarding import components, agricultural sector constitute 4.0% and other manufacturing have high import to output ratios. For example, manufacturing has the highest import ration compared to the other sector by 78.1%, which suggest a high degree of import dependence regarding manufactured goods. Finally, the import ratio of service sector to total import constitutes 17.9%.

The following section explains how the CGE model treats price, production, domestic institutions and the rest of the world. The so-called system constraints (the markets for

commodities and factors, and macro balances for savings-investment and the current account of the rest of the world) are also described.

5.4. The CGE Model

This section provides a detailed specification of the applied CGE model, reporting on all variables, parameters, and equations used. Different blocks of equations are introduced following the conceptual functionality of the CGE approach. First, the price equations that define the underlying price system of the model are presented. Second, the quantity equations are presented, which describe production and value added generation, followed by the blocks of income equations that describe the distribution of factor income to institutions. Third, the expenditure equations that characterize the budget constraint of the various actors of the model are described. Finally the equation block of system constraints is presented, which defines the market clearing conditions and their related macroeconomic closures of the model.

5.4.1. Price Block

The price system of the model is rich, primarily because of the assumed differences among commodities of different origins and destination. For a developing country like Ethiopia, the prices of most of its outputs are determined by its supply and demand in the market due to production being highly depend on sluggish technology and annual rain[23] i.e. whenever good weather condition and rain then high yield with low price for agricultural out put and vise versa. On the other hand, since the economy has no impact on international markets, Ethiopia is a price taker in the world market for its supplies. Therefore, the world prices of import and export are assumed to be exogenous to the model.

The price block consists of equations in which endogenous model prices are linked to other variables. The local price is made up of the producer price plus indirect tax. The import price and the domestic price then form the composite price for the composite commodity. The local import price is the world price adjusted by the exchange rate and import taxes. The

[23] *Alemayehu (2001)*

experiment of removing taxes will thus have an impact on the composite price. Output price affects the export price and itself affected by input price.

Fixing the price of imported commodity (PMc) by means of the exchange rate and customs duties, we can influence the nominal pricing system and also the composition of the demand between the external and internal goods, and therefore on the price of the internal goods. On the other hand, the export price in Local Currency Unit (LCU) is the price received by domestic producers when they sell their output in export markets. At the exports side, Ethiopia is considered as a small country, which leads to an exogenous fixing of the prices of exports by the world market. Price of exported commodity (PEc) is thus determined in a local way in the model according to the exchange rate and to the taxation rate. The detail of equations and transmission mechanism of price which is used in this study is explicitly depicted in annex II and annex III figure 3, respectively.

5.4.2. Production Block

The sectorial production modeled as a multi-level structure, which represented by nested Leontief function. At the top level the production structure, total value add is combined in fixed proportion with intermediate inputs to form output, i.e. domestic output of each sector is a Leontief (LEO) function of value added and an intermediate input aggregate (see figure 2). This assumption made on the basis that the structure of production for each sector especially agriculture and industry is stagnant in technology and premature stage. Hence, substitutability between value-added and intermediate expected to be very low.

At the bottom level Value added is Leontief functions of primary factors labor and capital land. In developing countries like Ethiopia the size of capital to labor substitution parameters is very low which less than unity (Gelan, 2002). The intermediate input is determined by sector specific fixed input-output coefficient multiplied by sector activity levels. Demand for factors of production is derived from the first order conditions of profit maximization behavior of producers.

Capital is sector specific and labor is costlessly mobile across sectors. As a result, the model is well suited for short-run analysis. Capital stock on the other hand is sector specific and

fixed in the short run. In this model, value-added in each activity is produced using two factors of production labor; L and capital; K. It is represented by cobb-douglas function of labor (wage labor) and capital both Nonagricultural (industry and services) and agriculture sectors. The production function Value added in the public sector is generated by labor alone. Labor is assumed to be fully mobile in the model (see fig 2: annex III).

5.4.3. Institutional Block

The model captures the circular flow of incomes in the economy. The income of each factor, generated by the production activities or transferred from the rest of the world (fixed in foreign currency) is split among the domestic institutions in fixed factor specific shares. That is, low income household relay more heavily on labor income in the rural area from work in agriculture and high-income households receive the bulk of their incomes from capital and in the rural area land. In addition to the factor income, household receives transfers from the government and the rest of the world. Household income is spend to pay direct tax, saving and consumption. Direct tax and saving are fixed and flexible shares of household income, respectively. Consumption demand is also derived from a cobb-douglas utility function.

Government revenue consists of mainly of taxes i.e. direct tax from households, indirect tax form activity, import and export tariff and transfers from the rest of the world. Apart the transfers to household and rest of the world the government uses its income to buy goods and services, save and pay consumer subsidy (fixed share of consumer price). In this model it is assumed that transfer between the government and other institution is fixed in both direction and also it is specified that the base year quantities of disaggregated government demands be scaled to insure that total value of government consumption is a fixed share of total absorption. Government saving is the residual difference between government receipts and spending.

5.4.4. The Foreign Trade Block

The rest of the world interacts with Ethiopia through commodity trade and transfers to domestic institution. Money adds to or deducts from the income of domestic institutions implies the rest of the world demand exports or supplies imports. For agricultural, industrial and service exports are demanded according to constant elasticity of demand curves. As the case for most developing countries, Ethiopian foreign elasticity of demand or exports and home country elasticity of demand for imports is very small (i.e. their sum being less than one) due to most of its export is primary commodity and on contrary imports goods are strategic to the economy (Benin et al. 2005). Therefore, for all commodities of countries export and import international price are fixed in the foreign markets.

5.4.5. Out Put Transformation

On the supply side, producers make an optimal distribution of their production between exports and domestic sales according to a constant elasticity of transformation (CET) function. The sales is determined on the assumption that domestic producer maximize profit subject to imperfect transformability between this two alternatives.

5.4.5.1. Commodity Market

The model comprises four "flex-price" product markets. The "flex-price" assumption implies that prices of commodities are endogenously determined. In some CGE applications like Clarete and Roumasset (1987), trade policies in LDCs are explicitly modeled by adopting the small country assumption as in theoretical models. In these models, it is assumed that the economy acts as a price taker in both export and import markets. Thus, imports are perfect substitutes for comparable domestic products. In other models like Taylor (1991 & 1993), imports are categorized by end use before import functions are specified. Capital goods are perfect complements to comparable domestically produced goods while imports of other goods (household consumption goods and intermediate imports) are treated as perfect substitutes (competitive) to domestic output.

On the other hand, Composite supply function follows model that avoid these extreme cases by adopting the Armington (1969) specification. This indicates that commodities of the same type, but with different geographical origins, are not perfect substitutes. The reasons for the use of the Armington assumption are many-fold. Firstly, when perfect complementarities of imports to the national output are assumed, any given change in trade policy does not produce a large direct effect on the structure of the economy. This is so because of the price insensitive behavior of intermediate and final users. On the contrary, a small change in trade policy may generate a large change when the perfect substitution assumption is used. The Armington assumption restricts these extreme demand responses to changes in trade policy changes. Secondly, in model calibration procedures, the demand function for imported goods can be identified separately from the demand for domestically produced commodities through the nesting of production functions.

5.4.5.2. Aggregate Demand

Aggregate demand for each commodity group consists of intermediate and investment Demand by domestic producers and final demands by households, government and exports demand. Each of these demand categories is specified with a CES functional form except for government final demand that is modeled with Leontief functional form. The latter assumption is intended to capture insensitivity of government demand for goods and services to price changes. However, it is important to bear in mind that the model allows for flexibility of Government demand to satisfy government budget constraint, with a given condition in the world market, for instance, a fall in the price of Ethiopia's coffee exports is likely to generate more external demand than a similar decline in manufacturing prices. Accordingly, we use large export demand elasticity for agricultural exports and relatively low export elasticity for urban sectors[24].

5.4.6. Macroeconomic Balance

[24] *5.0 for agricultural export elasticity*

System constraints are constraint that have to be satisfied by the economic system, but are not considered in the optimizing decision of any micro agent. These include three macroeconomic balances associated with the accounts for the government, rest of the world, saving–investment and supply-demand balance in the product and factor markets. The closure rules of the model indicate the mechanisms on the basis of which the model satisfies these constraints (Robinson, 1989).

5.4.6.1. Factor Markets

The total quantity demanded and the total quantity supplied for each factor is equal. In this research capital is assumed to be fixed. Since, labor is abundant in the economy wage of labor is not determined through demand and supply of the market, but by skill and quality of workers (effective wage). Therefore, in this model we assume that supply of labor is exogenous and nominal wage is rigid downward. The real wage, w is the equilibrating mechanism that assures that this equilibrium is satisfied. Composite commodity markets at the micro level, the system constraint applies to markets for commodity and factors. As noted, in the commodity markets, domestic production is supplied to export markets where demand is infinitely elastic at exogenous world price and domestic sales.

5.4.6.2. Government Balance

The saving is a flexible variable that clears the government balance. When Savings clear the balance, the investment value adjusts to changes in the value of total savings. For the rest of the world, the alternatives of a flexible exchange rate or flexible foreign savings are permitted in the current formulation. Savings value determines the investment value.

5.4.6.3. Current Account Balance for ROW

The current account balance which is expressed in foreign currency imposes equality between the country's spending and its earning of foreign exchange. For the rest of the world, the basic assumption is that foreign savings (current account deficit) are fixed and the real exchange rate is flexible and adjusts to clear the balance. Given that all non-trade items (transfers to or from domestic institution) are fixed, fixing foreign saving is equivalent to

fixing trade deficit. Therefore, for this model foreign saving is fixed and exchange rate (EXR) serves the role of equilibrating variable to the current account balance.

5.4.6.4. Saving to Investment Balance

Equation below states that total savings and total investment have to be equal. Total saving is the sum of savings from domestic nongovernmental institutions, the government, and the rest of the world with the last item converted into domestic currency. For the savings-investment balance, the model treats the investment decision as given: the economy allocates fixed quantities of a set of commodities for investment purposes. Given this, the value of savings has to adjust to assure that it equals the investment value. The basic approach is to let the marginal propensity to save vary for the domestic non-government institutions.

5.5. Definition of Scenario

5.5.1. Scenarios in Addressing the Objective of the study

The key scenarios performed to address this study are related to assessing the impacts of custom tariff reduction and/or its removal on economic variables. The Rationale and details of why the scenario has been chosen has been considered in the following chapter, but the brief scenario that have been built for this impact study can be described as:

- Baseline or reference scenario: no change in duties,
- Scenario 1: the redaction of import tariff for agricultural commodity by 10%.
- Scenario 2: the reduction of agricultural commodity import tariff by 50%.
- Scenario 3: total removal of agricultural commodity import tariff.

CHAPTER SIX

6. Simulation Results

With all its simplifications, the Ethiopian applied computable general equilibrium model represents a structuralist version of marketed and non-marketed relation in the country's economy. Therefore, it can be used to simulate the impact of import tariff[25], change on major sectoral and macro economic indicators. In this section, we present multi-sectoral CGE model developed with General Algebraic Modeling System (GAMS)[26] using the data for Ethiopia and apply the analysis of three different simulations regarding the short-run effects of trade liberalization measures on country's economy.

Empirical implementation of the model follows two different stages. This includes parameter estimation based on the SAM and assigning exogenous variables of the base year. Thus, the optimal solution of the model must replicate the original values of the variable for the base year. At the end of the stage, the saved base year values compared with the result of simulation carried out in the second stage.

In final stage, a set of exogenous variables and parameters modified to mimic a given policy, in our case trade liberalization oriented policy. The model is then solved to find a solution compatible with the modifications in the base mode. At this stage, additional program in GAMS is necessitated to list the result of the policy simulation and those of the base year. In the following section the rationale of our three simulations is explained.

Simulation I

WTO entry implies the introduction of a more liberal trade policy but not one of the complete free trade. Therefore, with the rules and discipline of WTO, each country can negotiate as to how restrictive or liberal its trade regime will be. Though, there is specific rule

---

[25] *In fact other variables like non-tariff barriers have greater impact on determination of multilateral trading than tariff barriers.*
[26] *The GAMS software is used to implement the model. For more information see Brooke, Kendrick and Meeraus (1998),Rutherford (1995) provide more information on PATH and MILES*

that states the maximum level at which a country has to bind its tariffs or how its service sector to liberalize, Countries have a strategic choice during the negotiations phase of how liberal their trade regime should be consistent with WTO discipline.

Under the WTO rules, less developing country's trade distortion on agricultural commodity is allowed up to 10% of the value of output (Siphana, 2005). Thus the first scenario will be analyzing impact of a 10% decrease in import tariff on macroeconomic variables and sectoral indicators.

Simulation II

The second simulation imposes a 50% decrease in the price of import tariffs. The choice of this value is based on the policy of WTO that assumes a further progressive reduction on imports of tariff level. Furthermore, the simulation of this scenario serves as not only a comparison with simulation-I but also help to see the impact if at all the special and differential treatment assumption by WTO is not considered.

Simulation III

Finally, total removal of import tariff scenario for import price of agricultural commodity is considered. This is the most radical liberalization scenario taken into account. It should not be considered as a realistic policy option. Rather, its purpose is to show the maximum effect of trade liberalization on the Ethiopian economy that can be predicted by the model.

6.1. Sectoral Impact of Tariff reduction

The main determinants of trade liberalization effects are: sectoral prices, values of trade elasticities, the share of imports and exports, the cost of inputs, and the general equilibrium effects of supply and demand. The experiences of most LDCs[27] show that elimination of domestic distortions which is caused by tariff reduction leads to more efficient factor reallocation between sectors to the benefit of the export oriented sectors by making worse off the import computing sector. The same result is obtained for Ethiopia that opening of

27 See chapter two ***section 2.3*** *'The Empirical evidence of liberalization on developing countries'*

market to the rest of the world has a contractionary effect particularly for industrial sector and expansionary effect on both agriculture and service sector.

6.1.1. Impacts on Sectoral Prices

The channel through which liberalization affects the domestic economy is by changing the value of commodity prices both produced domestically and imported from the rest of the world. Tariff elimination primarily reduces import prices, which leads to an increase in import demand and a decrease in domestically produced commodities. The change in domestic good demand influences their prices (and supply). These price changes also impose its effect on composite good price, factor demands and remunerations, and value added prices (see figure 3 annex III and table 11: annex I).

As can be seen from table 11, across all scenarios the shock of tariff elimination leads first to decrease in the domestic price of imports. We find that the greatest reduction is in the industry sector by 6.6% 13.8% and 21.7% for all consecutive scenarios, respectively. Moreover, in the agriculture sector it is also observed a decrease by 6.8%, 1.6% and 9.1% in all the consecutive scenarios. However, the impact on the service sector is relatively mild.

On the other hand, price of exported commodity has show an increase for all sectoral commodity and simulations. In this regard, the price of export for agriculture, industry and service sector has increased by 7.8%, 0.7% and 76.3% respectively in the first scenario. Increase in export price has a positive effect for the country's trade. That is, it stimulates the supply domestically produced commodity to the international market which consequently enhances productivity benefiting sectors engaged in export. We recall the assumption that Ethiopia is price taker in the world market. Because of this closure rule, the increase in export price does not affect the demand for domestically produced commodity.

As can be seen from table11 of annex I, Domestic price of domestically produced commodity has shown an increase by 2.3%, 1.4% and 3.4% and 6.5% 9.3% and 15.7% in the entire consecutive scenario's, respectively, both for agriculture and service sector. This effect partly explained by excess demand for domestically produced commodity due to

liberalization in not followed by output rather price adjustment. That is, supply tends to be inherently price elastic in the short run and therefore price tends to be sensitive to be change in demand. However, the domestic price will decrease for industrial sector by 9.3%, 1.5% and 38.5% in the entire scenarios, respectively, for reason that import tariff reduction will result in increase imports of industrial commodity in which foreign producers have a comparative advantage. From the same table one can observe that the price for composite commodity show an increase for agriculture and service sector by 9.8% and 4.8% while for industry sector there is a decrease by 2.8% for the first scenario.

In general, the impact of import duties reduction on sectoral prices is not clear. Some sectors show a decrease in their marginal value and other an increase. For instance, the expansion of exports is explained by the increase in price of exports. As we mentioned above, the efficiency (reallocation) and accumulation effects will determine the impact on production. Both effects are driven, in large extent, by value added price, factor remunerations and the cost of inputs represented by the composite price. The latter decreases for industrial sectors in the entire scenario could be due to the reallocation effects among the sectors as determined by the change in value-added price. The results indicate that resources will move towards the agriculture and service sector. Variations in value added prices influence the capital rental rate and labour wage rates (see table 11: annex I). Therefore, one should focus on strategic sector in order to benefit from the integration in to the world economy.

6.1.2. Impact on Sectoral Factor Price

Table 12 annex I shows tariff reduction has a positive impact on factors of production particularly for labour remuneration in agriculture sector. The labor Price in agriculture and service sector show an increase by 7.8%, 9.2% and 1.3% and 1.4%, 3.2% and 6.3% respectively, for the entire consecutive scenario. This could be probably due to increase in agricultural and service sectors production which likely lead to increased demand for wage labour in those sectors. However, there is a significant decrease in factor price for labour for industrial sector. From the same table 11 we can observe that factor price has shown a decrease by 19.1% and 4.5% in the first and second scenario. This could be due to lack of

competitiveness and shortage of demand in industrial commodity in both domestic and foreign markets.

The combination of these sectoral results underlines that even if the impact of trade liberalization stimulates the economic activity, the substitution of local goods by imported goods put a pressure on the production factors remuneration, particularly for those in import computing sector. In general the import tariff reduction has a positive impact for labour demand across agriculture and service sectors and negative impact in import computing sector-industry.

6.1.3. Impacts on Sectoral Output

On the production side, the simulation results shows that improvement of the households' purchasing power benefits all sectors of the economy, and increase of imports doesn't hamper production of local goods, particularly for agriculture and service sectors. For instance, domestic output for these sector increases by 12.9% and 10.5%, respectively, in the first scenario(see table 11). This is, partly, explained by a rise in price of these sectoral output in domestic market gives an incentive for farmers invest in the land. Moreover, liberalization will help individual in those sectors to mitigate the price risk and invest in modern technologies.

However, output of industrial sector showed a decrease by 21%, 41.4% and 41.6%, respectively, for the three scenarios. This can be explained partly by the production structure of Ethiopian manufacturing sector and structure of foreign trade. For instance, 37% of sectoral output is dominated by food production and 17%[28] textile production. Other industrial output such as machinery and transport equipment, iron and steel together accounted for less than 20% of total output. This effect possibly cause switch of consumption in favor of cheap imports which in turn can lead to the domestic import competing firms to face downward pressure on sales and profits. This may result in slow growth of investment and employment in sectors which used to be sources of livelihood for the urban poor.

---

[28] *Diagnostic Trade Integrated Study (2004)*

Despite increase in output, volume supply to the domestic market show a decrease by 21.1% and 65.7% for agriculture and 10.5% and 45.6% services in the first and third scenario respectively. The main reasons could be due to market access created the demand opportunity for domestically produced agricultural commodities (i.e. trade creation effect) and decrease in production cost of sectoral output that uses imported inputs making domestic producer of those sector more competitive.

6.1.4. Impact on Sectoral Saving and Investment

The simulation suggests that tariff reduction will have a positive impact on investment for all sectors, more particularly investment expansion for agriculture is significant than the other two. For instance, demand for investment in agriculture sector increased by 1.2%, 5.28% and 1.8%, respectively. Logically, the increase of investment in the agriculture sector mainly comes from the increase of the sector output and export expansion which is a result of comparative advantage. This result seems consistent with governments attempt in addressing ADLY strategy. In spite of increase in investment demand for all the sectors across the entire scenario, there happen to be unexpected result for the third scenario of service sector (a decrease in 4.99%).

On the other hand, from the same table, it is observed that the marginal propensity to save has showed a significant decrease by 7.1%, 7.3% and 7.6%, respectively, for the entire consecutive scenarios. The fail in marginal propensity to save could be probably due to the decrease in income of individuals especially in import competing sectors and rise price of domestically produced commodity which takes the largest share of there average income.

The excess demand in investment can be cleared through changes in nominal exchange rate. In the model closure it is assumed that excess demand in investment will produce a trade deficit, which in turn incurs excess demand for foreign exchange and eventually a depreciation of the nominal exchange rate. The nominal exchange rate depreciation is used to bring equilibrium investment balance through mechanisms of upward cost-push on domestic price.

6.1.5. Impact on Macroeconomic Variables

6.1.5.1. Fiscal Impact

The revenue obtained from import duties takes 18.4% of total government revenue and 2.7% of total GDP (see table 9: annex I). This analysis resulted that, the impact of decrease in imports of agricultural commodity imposes a reduction of government revenue by 3.3%, 5.1% and 17.4% for all scenarios, respectively. More precisely, the losses of customs duties are estimated at nearly ETB 395.47, 615.97 million and 2.08 billion for the consecutive scenarios.

This effect may hamper government spending on public goods particularly on those national institutions which play a crucial role for a sound trade policy framework. That is, In order to ensure that trade facilitates growth and development, there is a need for a well structured institutional framework that would not only formulate and analyze trade policy, but also ensure its implementation, monitoring and evaluation. Hence, attempts should be made to devise an alternative means (like broadening tax base) to make it up to the loss in revenue.

6.1.5.2. Impact on Trade Balance

The expected impact of trade liberalization on the trade balance can be observed by the trade ratio between export-import balance and net transfer to and from the country. The simulation result in table 12 of annex II export to domestic supply ratio for agriculture sector depicts an increase by 4.1%, 10.0% and 6.3%, respectively, across all scenarios. While the simulation have a mild impact on service sector which account 1.1%, 2.5 and 8.5%, respectively. However, industrial sector show a decrease by 17.3% 4.0% and 1.7%, respectively, resulting more supplies to the domestic market than export.

On the other hand, import to domestic supply ratio has showed an increase across all scenarios (see table 12 annex I). This may imply that, tariff reduction on agricultural commodity, may have a negative impact in addressing the current country's policy. Furthermore, because tariffs have fallen, it is reasonable for Ethiopian producers to

imperfectly substitute foreign for domestic inputs, so that imports rise even further. Even though, the expansion of export especially in agriculture and service sector improves the country's balance of payment, however, increase in imports would offset the gain from trade which in turn makes the current account deficit to deteriorate significantly further.

6.1.5.3. Impact on Final Consumption

Unlike the decline in consumer general price index (table 11), the increment on consumption of final goods showed a mild change. From table 12 of annex I can be observed that, consumption of final goods increased only by 1.60%, 1.1% and 1.70%, respectively, for all scenarios. This mild effect could be due to the fact that, though consumers have different choices of goods at relatively less price of final imported goods, the rise in domestic price of commodity particularly for agriculture and service sector discourages the demand final goods.

It must also be noted that the increase in manufactured products consumption is more than the fall in the prices, the elasticity price of the major part of the imported manufactured products being higher than one. Consequently, the products whose propensity to consume is the highest will benefit the most from the decrease of the taxes on imported goods, while the other ones will, on the contrary, suffer from this situation.

6.1.5.4. Impact on Saving and Investment

The simulation results show a quite significant increase of the investments for the scenario I with 12.8% change mainly attributing nominal exchange rate depreciation and increasing saving in rest of the World. The model assumes that all the benefits of the Rest of the World resulting from tariff reductions will not escape from the country and will be re-invested in the economy. In this case, the deterioration of the trade balance would be compensated by an equivalent increase of investments from the rest of the word, enabling trade liberalization policy to benefit to the country.

Finally, as the main support of economic growth is investment, the combined results of the scenarios can be seen as inducing a positive impact when the level of tariff is small and a negative impact when the level of tariff rate is abolished, under the assumption that tariff reductions would favor a decrease of prices on the domestic market as well as an increase of public and private investment.

6.1.5.5. Impact on GDP (Aggregate Economy)

The results of the model simulations indicate an increase of the GDP for all scenarios. From table 13 of annex I, both GDP at market and factor price has showed an increase by 9.3%, 1.6% and 1.7% and 7.4%, 1.5% and 1.6%, respectively, across the consecutive scenario. The positive effect on the economy comes from first, the decrease of prices of intermediate commodity, particularly import from the rest of the world make domestic production to increase in agricultural and service sector. Secondly, increase in demands of domestic commodity by the rest of the world mechanically stimulates domestic production which pushes the economy more than the degradation of the government revenue.

However, the increase in GDP across the scenario is not the same in magnitude. More GDP increment is registered in the first scenario than the rest two. As a result, one may advise the government to implement the scenario I, which assumes 10% decrease in import tariff have relatively makes the country better off. Moreover, import tariff reduction, will cause increase in the prices of domestic commodity on the local market which gives an incentive to stimulate the domestic production and thus the economic growth. Nevertheless, as previously mentioned, such a situation is based on the assumption that the custom duties tariff reduction will be totally transferred to the domestic prices.

CHAPTER SEVEN

Conclusions and Policy Implication

In this paper, attempts were made to look at the short-run impact of WTO accession on Ethiopian economy using a structuralist CGE modeling approach. For this purpose, the researcher used a 2001/2002 SAM which is developed by World Bank used as a data base. The import tariff reduction calculated by the model has far-reaching sectoral and macroeconomic consequences. In the model it has been found that, import tariff reduction has both positive and negative effects.

To start with the positive effect, the model based results suggest that, import tariff reductions raise the price of export and domestically produced commodities particularly for agriculture and service sectors. Domestic producers increase their export volumes in response, simultaneously reducing their local sales. The combination of reduced local sales and increased export price raises domestic consumer price. As local price increase relative to import prices, consumer substitute towards imports. Moreover, the rises in export prices play a role for improvement of terms of trade.

The model results also show that, import tariff reduction increases the domestic production of agricultural commodity to increase in the entire scenario implying the accession will permit the country to utilize its resource in the context of comparative advantage. More to the point, accession will help to address current domestic policy of the country i.e. increase production and productivity of agriculture sector.

Connected to import tariff reduction, liberalization has positive effect on domestic investment and growth due to increase the demand for investment in agriculture and service sector which arises from a decrease in prices of intermediate commodity and subsequent increase in demands of domestic commodities by the rest of the world (trade creation effect). Moreover, the improvement of the saving of the rest of the world would need to lead to an increase of foreign investment in the country to support the economic growth.

On the other hand, tariff reduction has negative effects on government fiscal revenues, output of industrial commodity, public investment and on terms of trade balance. The main impact of the trade liberalization process is thus expected to be fiscal stressing, that the government will have to find rapid ways of keeping the amount of tax revenues stable in order to maintain the level of investments that sustain economic growth. In other words, the main loser of the trade liberalization will be the government than the private sector. As the main support of economic growth is investment, the combined results of tariff reductions can be seen as a more negative impact in the short term.

The model simulation shows that the positive impact on the economy is not sufficient for the government to compensate the losses of the tax revenue in short term. For instance in scenario I, the loss of government duty taxes is estimated at an amount of 395.47million ETB, which represent about 3.33% of the current GDP at market prices and would be compensated only very slowly by the improvement of the economic situation.

Tariff reduction has an adverse effect on the production of import competing sector (industry). This could be due a fail in productivity and competitiveness of the sector with the rest of the world. These results imply that, the government will have to closely supervise the liberalization process in order to prevent the industry sector that arise simple decrease of the importer margin. Therefore, monitoring of price levels will be required in this regard, as will be a strengthening of sectoral competition.

It also appears relatively clear that substitution of locally produced goods by imported goods should be rather weak on a macro-economic and even on a sectoral viewpoint, but it nevertheless would make a strong or progressive pressure on factor remuneration. In other words, the trade liberalization policy should not directly reduce local output, mainly because the goods produced by the local enterprises are generally different from the ones that are imported by Ethiopia, but lead to a reduction of wages, mainly in the manufacturing sector.

Hence, the policy implication of this study that analyzed the challenge of trade liberalization for the Ethiopian economy appears to be the following:

- Public investment must be backed by the donor's development programmes and government development strategy particularly emphasizing on industrial sector to stimulate exports and by effect to reduce deterioration of the trade balance deficit.

- Consequently, adapting and realizing adjustment measurements will have to be elaborated in order to compensate the possible negative effects of trade liberalization and avoid them to hamper the economic growth of country.

- The results of the trade liberalization policy will depend mainly on the efficiencies of the domestic policies and the collaboration between Ethiopia and rest of the world which will be associated with the liberalization process itself. Well-organized support and cooperation to stimulate public and private investment is demanded from rest of the world to enhance production and growth in Ethiopia.

In conclusion, a convincing programmes and policy action to be supported by technical assistance to strengthen Ethiopia's ability to increase its participation in world trade by enhancing its competitiveness' and consequently to derive larger benefits from trade than at present. Moreover, improvement in trade policies, trade facilitation and institution are important for modernizing the public sector, improving tax collection (or broadening tax base) and playing the regulatory role in order to attract local and foreign investment by incentive measures in favor of exporting companies.

References

Adelman, I. and Robinson, S. (1978). *Income distribution policies in developing countries*, Stanford University press, Stanford.

Alemayehu Seyum and Tadele Ferede "*sectoral interdependence in Ethiopia a Social Accounting Matrix (SAM) Application*" 1999

Annabi, Cockburn, Decaluwé: CIRPEE and PEP, Université Laval, Quebec, Canada *Trade Liberalization, Growth and Poverty in Senegal: a Dynamic (2005) Micro simulation CGE Model Analysis.*

Anwar, Talat (2002), *Impact of Globalization and Liberalization on Growth, Employment and Poverty.* A Case Study of Pakistan.

Armington, P. S. 1969. *A theory of demand for products distinguished by place of production* IMF Staff Papers, 16: 159-176.

Barro, R. J. and X. Sala-I-Martin, (1991), *'Convergence Across States and Regions'*, Brooking Papers on Economic Activity, Vol.1, pp.107–82.

Brooke, A., D. Kendrick, A. Meeraus, and R. Raman. 1998. *GAMS: A user's guide.* Washington, D.C.: GAMS Development Corporation.

Davies, R., j.Rattso and R. Torvik(1994) ' *The Macroeconomics of Zimbabwe in the 1980's: a CGE model Analysis'*, Journal of African Economies, 3: 153-98

Decaluwe', B., AND A. MARTENS (1988): "*CGE Modeling and Developing Economies: A Concise Empirical Survey of 73 Applications to 26 Countries,*" Journal of Policy Modeling, 10, 529–568.

Demeke, Mulat. Tewodros Negash and Bekele Hundie *'African imperatives in the new World trade order: the case of the agricultural sector of Ethiopia'* January (2003)

Dervis,k., j.de Molo, and S. Robinson. 1982 *General equilibrium models for development* Cambridge: Cambridge university press.

Devarajan, D.S. Go and H. Li, "*Quantifying the fiscal effects of trade reform: A general equilibrium model estimated for 60 countries*".

Bienen Derk, eds., *Impact Assessment of WTO Accession: Technical Assistance to Support Ethiopia in its Accession to the WTO*, Draft

Dollar, David, *'Outward Oriented Developing Economies Really Do Grow More rapidly Evidence from 95 LDCs*, 1976-85,' Economic Development and Cultural Change, 1992, 523-544

Dollar, David and Aart Kraay, (2001), "*Trade Growth and poverty*," World Bank Policy Research Working Paper March 2001 (Draft paper)

Dornbusch, R. (1974), '*Tariffs and Non-traded Goods*', Journal of International Economics, Vol. 7, pp. 177–85.

Easterly, W., 1999, *'the ghost of financing gap: testing the growth model used in the international financial institutions'*, Journal of Development Economics, Vol. 60, pp.423-438.

Edward, Sebastian, *'Openness, productivity and Growth: What Do We Really Know?* Economic Journal 108, March 1998, 383-398

Edwards, S. (1998), *Openness, Productivity and Growth: What Do We Really Know?* Economic Journal: Vol. 108, pp.383-98

Ethiopian Economic Association. 1999/00 and 2000/01. *Annual Report on the Ethiopian Economy, Volumes 1 and 2.*

Frankel, A. Jeffery and David Romer (1997) *the American Economic Review* Vol.89, No.3, pp379-399.

Galiani and Sanguinetti, H. 2002 *Trade and related economic reforms in Transition Economies - what were the impacts of actual policy changes on agricultural development, trade and food security?*

Geda, Alemayehu "*Recent Economic Performance in Ethiopia*" university of London, school of Oriental and African Studies (SOAS), 2001

Gelan, A. (2002). *Impacts of devaluation on urban–rural interactions: A computable general equilibrium model for the Ethiopian economy.* Unpublished PhD thesis, Department of Economics, Strathclyde University.

Grossman, Gene, and Elhanan Helpman, *Innovation and Growth in the Global Economy*, Cambridge, MA, MIT Press, (1995)

Hile kebret, Alemayehu Kuma, Daniel Zerfu: *'imperative in the new world trade order'* (2003)

Ilham, H. Mahmoud, Y and Almas, H. (2003) The Impacts of trade Liberalization on Employment and Wages in Tunisian Industries. Institute for the study of Labor Bonn Germany

Kaldor, N.(1955) *Alternative theories of distribution* , Review of economic studies 23:94-100

Kalecki, M. (1976*). Essays on developing economies*, The Harvester Press, Hassocks.

Krueger A.O., (May 18, 2004), Willful Ignorance: *The Struggle to Convince the Free Trade* Skeptics, Geneva,

Luis C.J *'Micro-and Macroeconomic adjustment in Bolivia'* A neo-structuralist analysis of External Shocks, Adjustment and Stabilization policies.1993, Hague

Matsuyama, Kiminori, "*Agricultural Productivity, Comparative Advantage, and Economic Growth*," Journal of Economic Theory, 58(2), December 1992, 317-334.

Powell, A.A. and Lawson, T. (1990) *A decade of applied general equilibrium modeling, in* D.J. Gergman, L. and E.Zalai(eds), General equilibrium modeling and econmc policy analysis, Basil Blackwell, Oxford, pp.241-290

Rahel Kassahun "*Ethiopians Recent Growth Performance: A Survey of Literature*" (2003) World Bank (2003).

Robinson, S. (1989) *Multi-sector models, Handbook of development economics*, North-Holland, Amsterdam, pp. 885-947

Robinson, S. (2003) *Macro Models and Multipliers: Leontief, Stone and CGE models.* Washington, D.C:' International Food Policy Research Institute (IFPRI).

Ross Garnaut, Enzo Grilli and James Riedel (2000) *'Sustaining Export Oriented Development: ideas from East Asia'* Australian National University 2000.

Rodrik, Dani, *the New Global Economy and Developing Countries: Making Openness Work*, Overseas Development Council, Washington, DC, 1999.

Rodriguez Francisco and Dani Rodrik, (2001) *Trade Policy and Economic Growth: A Skeptic Guide to the Cross-National Evidence*, NBER Working Paper7081

Sachs, Jeffrey and Andrew Warner, *'economic Reform and the Process of Global integration* ', Brookings papers on Economic Activity, 1995:1 1-118

Sadulate, E. AND De Janvery Alain. 1995. *Quantitative development policy analysis* 1995. Baltimore: The Johns Hopkins University Press.

Stiglitz, Joseph E., "*Towards a New Paradigm for Development: Strategies, Policies, and Processes,*" 1998 Prebisch Lecture at UNCTAD, Geneva, October 19, 1998.

Solow, R. (1956) *A contribution to the theory of economic growth*, Quarterly Journal of Economics 70: 65-94

Scarf, H.E. and Shoven, J.B. (1984) *Applied general equilibrium analysis*, Cambridge University Press, Cambridge.

Shoven, J.B. and Whalley, j.(1992) *Applied general equilibrium analysis*, Cambridge University Press, Cambridge.

Srinivasan, T. N., AND J. WHALLEY (eds.) (1984): *General Equilibrium Trade Policy Modelling.* The MIT Press, Cambridge, MA.

Taylor, L. 1990. *Structuralist CGE models. In Socially relevant policy analysis*, ed. L. Taylor. Cambridge, Mass., U.S.A.: MIT Press.

Taylor, L. (Ed.). (1991). *Socially relevant policy analysis: Structuralist computable general equilibrium models for the developing world.* Cambridge, MA: MIT Press.

Taylor, L. (1993). Stabilisation, *adjustment, and reform. In Lance Taylor (Ed.), The rocky road to reform: Adjustment, income distribution, and growth in the developing world.* Cambridge, MA: MIT Press (pp. 55–75).

Taylor, L. 2004. *Structuralist CGE models. In Socially relevant policy analysis*, ed. L. Taylor. Cambridge, Mass., U.S.A.: MIT Press.

Thissen, M. (1998). *'A Classification of Empirical CGE Modeling'* SOM Research Report 99C01 University of Groningen, the Netherlands

Willenbockes, D. (1994) *Applied general equilibrium modeling; imperfect competition and European integration*, Wiley, Chi Chester U.K.

Wood, A. (1994), *North -South Trade, Employment and Inequality*, Clarendon Press: Oxford.

Annex I
Tables

Table 1: The 15 WTO mandatory agreements

The 15 WTO mandatory agreements

- The General Agreement on Tariffs and Trade (GATT)
- The Agreement on Agriculture
- The Agreement on the Application of Sanitary and Phyto-sanitary Measures (SPS)
- The Agreement on Textiles and Clothing
- The Agreement on Technical Barriers to Trade (TBT)
- The Agreement on Trade-Related Investment Measures (TRIMs)
- The Agreement on Antidumping (AD) - Implementation of Article VI of the GATT 1994
- The Agreement on Customs Valuation - Implementation of Article VII of the GATT 1994
- The Agreement on Pre-shipment Inspection (PSI)
- The Agreement on Rules of Origin
- The Agreement on Import Licensing Procedures
- The Agreement on Subsidies and Countervailing Duties (CVD)
- The Agreement on Safeguards (SG)
- The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), and
- The General Agreement on Trade in Services (GATS)

Optional WTO agreement

- The Government Procurement Agreement (GPA)
- Trade in Civil Aircraft Agreement (TCAA).

Source: Derk Bienen

Table 2: Gross Domestic product by sector at constant factor cost ('million)

Activity/year	1960/61-1972/73		1973/74-1990/91		1991/92-2004/05		Average share in %
	Average	Share (%)	Average	Share (%)	Average	Share (%)	
Agriculture &allied activity	4,463.5	68	5,289.2	56	7076.8	47	54
Industry	608.8	9	1,088.3	11	1632.1	11	10
Distributive services	764.9	12	1,360	14	2224	15	14
Other services	723.5	11	1,777.9	19	4267.5	28	19
Total	**6,560.7**		**9,515.4**		**15200.4**		

Source: computed data obtained from National Bank of Ethiopia (NBE)

Table 3: Percentage share of major export items in the total value of exports

Period	coffee	Oil seeds	Hide & skins	pulses	Meat & meat products	Fruits & Vegetable	Sugar	Live animals	Chat	others
1980/81-1990/91	67.09	2.07	14.29	2.76	0.62	0.96	1.81	2.14	2.86	5.41
1991/92-2004/05	53.16	8.12	10.86	3.64	0.85	1.52	1.13	0.46	11.54	8.73.

Source: Computed from Data Obtained from Customs Authority

Table4: Percentage of export by country of destination for the period 1985/86-1991/92

Countries	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	Average %
Africa	3.84	6.51	5.47	3.05	7.91	11.88	6.44
Europe	21.09	19.04	15.19	17.01	16.20	23.02	18.59
U.S.A	33.17	44.51	32.62	28.83	30.77	18.07	31.33
Asia	11.97	9.93	16.33	12.19	19.73	29.61	16.63
ROW	29.93	20.01	30.38	38.92	25.40	17.41	27.01

Source: computed form data obtained from NBE

Table 4.1: Continued: percentage of export by country of destination for the 1991/92-2004/05

Countries	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	Aver %
Africa	3.2	7.2	8.4	6.1	9.7	6.2	9.5	7.9	6.8	10.1	4.0	6.4	6.8	4.4	6.9
Europe	18.1	12.8	9.4	18.7	21.3	11.3	12.0	10.4	9.1	6.7	7.2	6.0	6.1	8.3	11.3
U.S.A	14.5	25.7	13.7	15.6	16.4	21.3	16.3	8.7	8.6	5.9	7.3	13.0	8.5	9.9	13.2
Asia	42.4	27.2	14.1	11.7	21.7	11.6	11.1	19.7	12.9	10.8	9.0	5.0	10.6	11.1	15.6
ROW	21.1	27.0	54.4	47.9	30.9	46.6	51.1	53.3	62.6	66.5	72.5	69.5	67.8	67.8	52.9

Source: National Bank of Ethiopia

Table 5: Percentage share of major imported items for the period 1971/72-04/05

Period	Food & live	Petroleum crude	Petroleum product	fertilizer	Paper & Manfc.	textile	Metal & Manfc.	Machinery & Aircraft	Road & motor vehicles	Electrical materials	Grain	Telecom apparatus	others
1971/72-91	19.6	46.8	3.2	2.6	1.0	0.8	4.7	1.4	1.5	2.3	10.5	0.1	6.8
1991/92-05	14.6	7.6	37.3	6.5	2.2	1.3	7.5	1.3	2.1	1.9	13.7	0.3	3.7

Source: computed from data obtained from National Bank of Ethiopia (NBE)

Table6: Percentage of imports by country of origin for the period 1984/85-1990/91

Countries	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	Average %
Africa	0.47	0.53	1.31	1.46	1.56	2.71	2.40	1.49
Europe	18.03	14.34	19.01	15.68	18.09	17.68	12.03	16.41
U.S.A	21.50	34.18	23.21	25.08	23.08	11.63	28.66	23.91
Asia	7.30	5.55	7.66	7.75	5.87	6.65	7.19	6.85
ROW	52.71	45.40	48.80	50.02	51.40	61.34	49.72	51.34

Source: computed form data obtained from NBE

Table 6.1: Continued percentage of imports by country of origin for the 1991/92-2004/05

Countries	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	Aver %
Africa	2.70	5.34	5.33	3.69	2.92	2.48	2.44	2.00	1.27	1.86	2.06	2.68	1.85	2.04	2.76
Europe	3.18	8.67	9.19	8.69	8.27	7.50	7.21	6.29	5.40	5.44	6.41	7.70	6.09	5.46	6.82
U.S.A	9.25	14.6	19.6	24.5	16.2	8.8	3.6	7.59	8.33	7.61	15.9	10.5	19.2	18.1	13.13
Asia	5.12	18.8	13.3	14.5	13.1	10.1	20.5	10.2	6.1	8.05	14.2	14.0	12.7	18.2	12.77
ROW	79.7	52.6	52.5	48.6	59.5	71.2	66.3	73.9	78.9	77.1	61.4	65.1	60.2	56.2	64.52

Source: National Bank of Ethiopia

Table 7 Growth Rates in the Value of Exports and Imports (1970/71 - 2004/05)

Year	export per import ratio	Annual growth rate	
		Export	Import
1970/71	0.95	-	-
1971/72	0.65	-0.04	0.28
1972/73	1.04	0.12	-0.41
1973/74	1.12	-0.19	-0.27
1974/75	0.97	-0.37	-0.18
1975/76	0.77	-0.01	0.19
1976/77	0.91	-0.11	-0.31
1977/78	0.96	0.10	0.05
1978/79	1.12	-0.77	-1.07
1979/80	0.67	-0.15	0.31
1980/81	0.60	-0.01	0.10
1981/82	0.40	-0.21	0.19
1982/83	1.47	-0.04	-2.80
1983/84	0.43	-0.17	0.66
1984/85	0.43	0.14	0.14
1985/86	0.41	-0.25	-0.20
1986/87	0.36	-0.01	0.12
1987/88	0.35	0.00	0.03
1988/89	0.37	-0.08	-0.17
1989/90	0.41	0.24	0.18
1990/91	0.25	-0.16	0.27
1991/92	0.15	0.15	0.49
1992/93	0.44	-1.03	-4.74
1993/94	0.26	-0.29	0.22
1994/95	0.42	-0.38	-1.19
1995/96	0.33	-0.18	0.07
1996/97	0.47	0.04	-0.37
1997/98	0.44	-0.27	-0.19
1998/99	0.30	-0.25	0.15
1999/00	0.33	0.02	-0.07
2000/01	0.27	-0.08	0.10
2001/02	0.23	-0.17	0.01
2002/03	0.22	-0.10	-0.07
2003/04	0.21	-0.40	-0.32
2004/05	0.23	-0.41	-0.57

Source: Computed from Data Obtained from Customs Authority

Table 8 Overview of tariff reforms from 1992-2003

Description	Pre-reform	Aug. '93 Amend.	Jan. '96 Amend.	Dec. '96 Amend.	Jan. '98 Amend.	Dec. '98 Amend.	Jan. '2003 Amend.
	Period	1st	2nd	3rd	4th	5th	6th
Maximum tariff rate	230	80	60	50	50	40	35
Number of tax exemption	327	138	169	170	168	167	179
Simple average tariff rate	79.1	35	28.8	24.3	24.3	20	20
Weighted average tariff rate	41.6	29.6	24.6	23.6	21.5	19.5	17.5
Number of tariff bands	23	9	8	7	7	7	6
Tariff Dispersion	225	75	55	45	45	35	30
Prohibited items	2	2	2	2	2	2	2
Specification items	157	4	4	4	4	3	-
Total number of items	1821	5332	5294	5295	5486	5426	5608

Source: Ministry of Finance and Economic Development (MoFED)

Table 9: Trade Tariffs and Revenues in Ethiopia (2004)

Description	Ratio
Maximum tariff	35
Simple Average Tariff	17.5
Trade tax revenue/GDP (in %)	2.6
Trade tax revenue/Total Revenue	18.4
Effective collected tariff rate	13.7

Source: International Monetary fund IMF (2004)

Table 10: The structure of Ethiopia macro-SAM

Expense \ Receipt		Factors		Institution				Tax		Activity			Commodity			Capital	Total
		Labor	Capital	HH	Firm	Gov	Row	D-tax	I-tax	A_1	A_2	A_3	C_1	C_2	C_3		
Labor	F_1									21,324	3,704	7,743					32,771
Capital	F_2									15,063	7,507	12,817					35,387
Household	I_1	32,771		1,942	20, 964	1,033	3,117										59,827
Firm	I_2		35,387														35,387
Gov	I_3						2,659	5,556	3,601				168				11,984
Row	I_4			95		548							646	12,470	2,854		16,612
D-tax	I_5			2,360	3,196												5,556
M-tax	I_6												102	3,138	361		3,601
AAGR	A_1												34,964	7,121	0.00		42,085
AIND	A_2												0.00	15,461	0.00		15,461
ASER	A_3												5,043	3,257	31,301		39,601
CAGR	C_1			31,821			3,433			1,882	349	198				3,073	40,923
CIND	C_2			13,841			525			2,001	2,482	4,886				17,712	41,447
CSER	C_3			4,629		7,203	4060			1,647	1,419	13,958				1,600	34,516
Capital				5,140	11,227	3,200	2,818										22,385
Total		32,771	35,387	59,827	35,387	11,984	16,612	5,556	3,601	42,085	15,461	39,601	40,923	41,447	34,516	22,385	

Factor

1. labor
2. capital

Institution

3. house hold
4. firm
5. rest of the world

Tax

6. direct tax
7. import tax

Activity

8. agricultural activity (A_1)
9. industrial activity (A_2)
10. service activity(A_3)

Commodity

11. agricultural commodity(C_1)
12. industrial commodity(C_2)
13. service commodity (C_3)

Table 11: Impacts of tariff reduction on sectoral prices

Indicators	Symbol	Base value	% change in indicators value		
			Simulation I	Simulation II	Simulation III
1. Price of value add					
• Agriculture	PVA_a	0.67	0.035	0.229	0.381
• Industry		0.72	-0.636	0.332	0.001
• Service		0.51	0.621	0.069	-0.002
2. Price of activity					
• Agriculture	PA_a	1	0.078	0.116	0.012
• Industry		1	0.087	-0.138	-0.004
• Service		1	0.076	-0.014	0.004
3. Price of composite commodity					
• Agriculture	PC_c	1	0.098	0.065	0.004
• Industry		1	-0.028	-0.062	-0.013
• Service		1	0.048	0.056	0.027
4. Price of exported commodity					
• Agriculture	PE_c	1	0.078	0.651	0.012
• Industry		1	0.007	0.062	0.004
• Service		1	0.763	0.056	0.027
5. Price of imported commodity					
• agriculture	PM_c	1	-0.068	-0.016	-0.091
• industry		1	-0.066	-0.138	-0.217
• service		1	-0.039	-0.014	-0.002
6. Producer price					
• Agriculture	PX_c	1	0.998	0.542	0.382
• Industry		1	0.093	0.087	0.005
• Service		1	0.098	0.047	0.021
7. Domestic price of domestically produced commodity					
• Agriculture	PD_c	1	0.023	0.014	0.034
• Industry		1	-0.093	-0.385	-0.015
• Service		1	0.065	0.093	1.570*
8. Factor price					
index=Labor					
• Agriculture	QF_f	1	0.078	0.092	0.013
• Industry		1	-0.019	-0.045	0.023
• Service		1	0.014	0.032	0.063
index=Capital					
• Agriculture		1	0.172	4.250	0.018
• Industry		1	0.004	0.836	-0.002
• Service		1	0.335	1.540	-0.023
9. Consumer price index	CPI	1	-0.033	-0.054	-0.069
10. Exchange rate	EXR	1	1.061	1.146	1.176
11. Marginal propensity to Save	MPS	1	-0.071	-0.073	-0.076
12. Total labor supply	LAB	32771	0.088	0.011	0.036

Table 12: Impacts of tariff reduction on sectoral output

Indicators	Symbol	Base value	% change in indicators value		
			Simulation I	Simulation II	Simulation III
13. Out put of activity					
• Agriculture	QA_c	42085	0.226	0.523	0.243
• Industry		15461	-0.069	-0.057	-0.115
• Service		39601	0.083	0.457	0.003
14. Quantity of domestic output					
• Agriculture	QD_c	40007	0.129	0.133	0.047
• Industry		25839	-0.210	-0.414	-0.416
• Service		31301	0.105	0.537	-0.006
15. Quantity of good supplied domestically					
• Agriculture	QX_c	31241	-0.211	-0.657	-0.047
• Industry		34101	0.105	-0.456	-0.016
• Service		25280	-0.067	-0.055	-0.006
16. Quantity of composite commodity					
• Agriculture	QQ_c	36574	2.401	0.940	0.019
• Industry		25314	0.204	0.223	0.424
• Service		27241	-0.029	0.015	0.052
17. Quantity of exported commodity					
• Agriculture	QE_c	3433	0.665	0.979	0.094
• Industry		525	0.058	0.446	0.013
• Service		4060	0.083	0.862	0.054
18. Quantity of Imported Commodity					
• Agriculture	QMc	748	0.478	0.198	0.196
• Industry		15068	0.239	0.397	0.444
• Service		3215	0.454	0.273	0.254
19. Total Consumption					
• Agriculture	CON	26517	0.083	0.085	0.015
• Industry		11534	0.078	0.093	0.570
• Service		38575	0.082	0.325	0.513
20. Intermediate consumption					
index=Agriculture		1707	0.098	0.931	0.005
• Agriculture		290	-0.091	-0.313	-0.522
• Industry		165	0.089	0.092	0.075
• Service					
index=Industry		1667	-0.746	-0.045	-0.027
• Agriculture	CI_c	2068	-0.266	-0.068	-0.008
• Industry		4071	-0.069	-4.250	-0.006
• Service					
index=Service		1372	-0.083	-0.836	0.063
• Agriculture		1182	-0.012	1.540	-0.001
• Industry		11631	0.002	-0.523	0.022
• Service					
21. Investment demand		2561	0.012	0.528	0.018
• Agriculture	INV_c	14760	0.002	0.048	0.001
• Industry		1333	0.003	-0.499*	-0.018
• Service					

22. Household consumption					
• Agriculture		31821	0.058	0.011	0.085
• Industry		13841	0.099	0.003	0.084
• Service		4629	0.519	0.000	0.004
23. Export to domestic supply ratio					
• Agriculture	EXDR		0.041	0.100	0.063
• Industry			-0.173	-0.040	-0.017
• Service			0.011	0.025	0.085
24. Import to domestic supply ratio					
• Agriculture	IMDR		-0.085	0.014	0.032
• Industry			0.012	0.528	0.018
• Service			0.204	0.048	0.001

Table 13: Impact of tariff reductions on macroeconomic variables

Indicators	Symbol	Base	% change in indicators value		
			Simulation I	Simulation II	Simulation III
25. Government revenue	YG	11984	-0.033	-0.051	-0.174
26. Direct tax	DTIX	5556	0.014	0.019	0.026
27. GDP at market price	GDP1	79771*	0.093	0.016	0.017
28. Private consumption	CONP	50291	0.016	0.001	0.017
29. Investment	INV	25385	0.128	0.142	0.102
30. Exports of goods and services	EX_C	8081	0.005	0.006	0.004
31. Import of goods and services	IM_c	15970	0.131	0.293	0.560
32. GDP at the factor price	GDP2	79771*	0.074	0.015	0.016

ANNEX II
Mathematical Equations for Ethiopian CGE[29] Model

1. Price Equations

The price system of the model is rich, primarily because of the assumed quality differences among commodities of different origins and destinations. The price block consists of equations in which endogenous model price are linked to other prices and non-price model variables. A number of prices in the model play specific roles. The introduction of various types of price is relevant, especially for those sectors where relative price are the main adjustment mechanism.

1.1. Import Price (PMc)

An import price in Local Currency Unit (PM_C) is the price paid by domestic users for imported commodities. They are calculated by adding import taxes (tm_c) to the world price of commodities. The assumption is with the traditional theory, according to which the country can exert no influence on world market prices.

$$PM_c = pwm_c \cdot (1 + tm_c).EXR \quad \text{..... .... 1}$$

1.2. Export Price (PE_c)

The export price in Local Currency Unit (PE_c) is the price received by domestic producer when they sell their output in export market. It is calculated by subtracting export tax (te_c) from the domestic producer of export. Ethiopia is considered as small country, so price of export is determined exogenously by world market.

$$PE_c = pwe_c \cdot (1 - te_c) \cdot EXR \quad \text{..... .... 2}$$

1.3. Domestic Price (PD_c)

Domestic prices (PD_c) are the prices of locally produced goods sold in domestic market. In developing economies, like Ethiopian, where the productive structures are usually highly segmented all sectors doesn't have the same output responses capacity (Benin et al. 2005). For instance, output can comparatively be thought as exogenous in the short run which arise due to backward technological progress, heavily dependent on rain, and population growth (Alemayehu 2002). In such economy, supply tends to be inherently price elastic in the short term by being sensitive to change in demand Kalki(1954). Moreover, in Ethiopia, manufacturing production is very much dependent on imported imports[30].Therefore; price could be regarded as being predominantly demand determined.

$$PD_c = (1 + tq_c) PS_c \quad \text{..... .... .3}$$

---

[29] The CGE model used in this study follows the standard model developed at International Food Policy Research Institute (Lofgren et al. 2001). It is in the tradition of models of developing countries in Dervis et al. (1982) and Robinson (1989).

[30] See section 4.2 'industrial sector'

1.4. Marketed Output Price (PX_c)

The marketed output value (PX_c) is total domestic output price. It is calculated as the weighted average of the price of domestic (PD_c) and export (PE_c) by domestic output (D_c) and export (EX_c) in total output (Q_c). In this study total domestic output price is determined based on the assumption that sectors produce for both domestic and foreign markets.

$$PX_c = \left[\frac{PD_c \cdot D_c + PE_c \cdot EX_c}{Q_c} \right] \quad \ldots\ldots 4$$

1.5. Composite Commodity Price (PC_c)

Composite commodity price (PC_c) refers the internal prices for all goods and services (domestically produced and imported) sold in domestic market. It is expressed as the weighted average of domestic price (PD_c) and import price (PM_c) weighted by domestic output (D_c) and imported commodity (M_c) share in total consumption Q_c

$$PC_c = \left[\frac{PD_c \cdot D_c + PM_c \cdot M_c}{Q_c} \right] \quad \ldots\ldots 5$$

1.6. Activity Price (PA_a)

The classification of activities reflects a combination of differences in type, location, scale, and ownership structure of production. The activity price (PA_a) is the return from selling output or outputs of the activity, defined as yield per activity unit (θ_{ac}) multiplied by activity specific commodity price (PX_c) summed over all commodities.

$$PA_a = \sum \theta_{ac} \cdot PX_c \quad \ldots\ldots 6$$

1.7. Intermediate Price($PINT_c$)

The activity-specific aggregate intermediate input price ($PINT_c$) shows the cost of disaggregated intermediate input per unit of aggregate intermediate input for activity. It defined as quantity of commodity c per unit of aggregate intermediate input a (ica_{ca}) multiplied by the market price paid by domestic commodity demanders (PC_c); summed over all commodity c.

$$PINT = \sum PC_c \cdot ica_c \quad \ldots\ldots 7$$

1.8. Price Normalization

The consumer price index CPI is fixed and functions as the numeraire in the model. it defined as weight of commodity c in consumer price index ($cwts_{ca}$) multiplied by the market price paid by domestic commodity demanders (PC_c); summed over all commodity c .

$$cpi_c = \sum PC_c \cdot cwts_c \quad \ldots\ldots 8$$

2. Production Block

The production account breaks down into value-add and the intermediate consumption. The sector operate in relatively competitive markets depending on the level of buyer demand, price adjust in order to clear excess demand. Moreover, output responses to changes in aggregate demand in these sectors are quite limited because production is generally constrained by structural factors and bottlenecks (Luis 1993, Taylor 2004).

2.1. Production Function

Production is carried by activities that are assumed to maximize profit subject to their technology, taking price (for their output, intermediate inputs and factors) as given. The activity level is Leontief function of the quantities of value added and aggregate intermediate input.

$$XS_a = ad \prod \beta_{fa} \cdot QF_{fa}^{\beta_{fa}} \quad \text{..... ....11}$$

2.2. Factor Demand

Activities demand factor at the point where the marginal cost of each factors is equal to the marginal revenue product of the factor. The total income received by skilled wage-earners in each economic activity is equal to

$$WF_f \cdot wdist_{ac} = \frac{\beta_{fa} \cdot PVA_{a1} \cdot XS_{a1}}{QF_{fac}} \quad \text{..... .... 12}$$

2.3. Wage

The total output supply in all sectors is assumed to depend on labor supply at a fixed price. In equilibrium, the rural sector wage is below the wage rate in the formal sector by a fixed factor. The mark-up reflects the assumption that there is a transaction cost or leaving costs working in rural formal sector that is captured by mark-up[31].

$$w_i = (1 + \tau) WF_f \quad \text{..... .... 13}$$

2.4. Intermediate Input (INT_c)

The total aggregated intermediate input demand for activities is determined by aggregate intermediate input (intaa) times total output (XSa) summed over activities

$$INT_c = \sum \text{int}\, a_{ca} \cdot XS_a \quad \text{..... .... 14}$$

[31] τ is transaction or leaving cost of those working in the informal sector than working in the formal sector.

2.5. Marketed Output (QX_{ac})

Total production is aggregated as quantities that are allocated to market and home consumption. In this study home consumption is not considered. Marketed output (QX_{ac}) which is aggregated by Constant Elasticity of Substitution (CES) function is defined as yield of output c (θ_{ac}) times activity level (XS_a) summed over all activities.

$$QX_c = \sum_a \theta_{ac} \cdot XS_a \quad \ldots\ldots 15$$

2.6. Output Transformation

The division of the offer goods produced locally between the domestic and external markets is established via a Constant Transformation Elasticity (CET) function. The CET function, reflects the assumption of imperfect transformability between these two destinations. The elasticity of transformation between the two destinations is a transformation ofϕ, for which the lower limit is one.

$$QX_c = \beta_c \left[\delta_c \cdot EX_c^{\phi_c'} + (1 + \delta_c) D_c^{\phi_c'}\right]^{\frac{1}{\phi_c'}} \quad \ldots\ldots 16$$

2.7. Export to Domestic Supply Ratio

The first order condition makes it possible to deduce the relative share of export from the relation of the domestic demand. This equation assures that an increase in the export-domestic price ratio generates an increase in the export-domestic supply ratio. The modification of the level of exports can come from a change in the exchange rate, taxation rates or in the world price. A fall in the export tax or devaluation of the exchange rate will contribute to increasing the relative price exported in relation to the goods sold on the domestic market

$$\frac{QX_c}{D_c} = \left[\frac{1 - \delta_c}{\delta_c} \cdot \frac{PE_c}{PD_c}\right]^{\frac{1}{\phi_c' - 1}} \quad \ldots\ldots 17$$

2.8. Composite Supply Q_c

According to the proposition of Armington, for each category of products, the demand for composite good (Qc) defined as a constant elasticity of substitution function of the imported goods and goods produced domestically. Imperfect substitutability between imports and domestic output sold domestically captured by a Constant Elasticity of Substitution (CES) aggregation function in which the composite commodity that is supplied domestically is 'produced' by domestic and imported commodities entering this function as inputs.

$$Q_c = \beta_c^q \left[\delta_c^q \cdot M_c^{\phi_c^q} + (1 + \delta_c^q) D_c^{\phi_c^q}\right]^{\frac{1}{\phi_c^q}} \quad \ldots\ldots 18$$

2.9. Import to Domestic Consumption Ratio

Import to domestic ratio shows optimal mix between imports (M_c) and domestic (D_c) output. The aim is to find ratio which equalizes the marginal rate of substitution and the price ratio of the internal goods to imported goods

$$\frac{M_c}{D_c} = \left[\frac{1 - \delta_c^q}{\delta_c^q} \cdot \frac{PE_c}{PD_c} \right]^{\frac{1}{\phi_c^q - 1}} \quad \ldots\ldots 19$$

3. Income and Saving Block

3.1. Factor Income

Factor income is expressed in terms of the average factor price (WF_f) the quantity of factor demanded (QF_{fa}) in each sector, and factor price distribution parameter ($wdistf_a$)). The total income of each factor is given by

$$YF_f = \sum WF_f \cdot wdist_{fa} \cdot QF_{fa} \quad \ldots\ldots 20$$

3.2. Household Incomes and Saving

The earnings form wage are distributed to households and income form capital are distributed to household and firms. The households' income corresponds to the sum of the paid wages on which they pay taxes, buy consumer goods and save.

$$YH_h = \eta_f \cdot YF_f + THH_{hh} + DIV + TGH_{gh} + TRH_{Rowh} \cdot exr \quad \ldots\ldots 21$$

3.3. Disposable Income of the Household

Disposable income of the houshold(YDH_h) refers to income that remains available for spending after deductions for taxes.

$$YDH_h = YH_h (1 - tyh_h) \quad \ldots\ldots 22$$

3.4. Household Consumption Expenditure

Total consumption expenditure of each household group is the household income net of tax, saving, and transfers to other institution. In includes both consumption expenditure on marketed goods and home consumption. Household consumption of marketed goods determined by cobb-douglas consumption function

$$HCON_c = (1 - MPS_h) \cdot (1 - tyh) \cdot (YHh - THR_{h,row} \cdot exr) \quad \ldots\ldots 23$$

3.5. Household Consumption Demand

Consumption demand by household ($HCON_c$) is determined by cobb-douglas utility function subject to their income constraint.

$$HCON_c = \frac{\alpha_c^h \cdot YDH_h}{PC_c} \quad \ldots\ldots 24$$

3.6. Saving of Household

Households are assumed to save a fixed proportion (srh_h) of their disposable income (YDH_h) which is translated directly into demand for investment goods

$$SH_h = srh_h \cdot YDH_h \quad \ldots\ldots 25$$

3.7. Savings of Firms(SF_f)

Firms saving (SF_f) are equivalent to retained profits. They are calculated by deducting from total corporate income (YF_f) the following values: corporate tax (tyf_F) payments, and distributed profits to shareholders (DIV). Thus

$$SF_f = YF_f - tyf_f \cdot YF_f - DIV \quad \ldots\ldots 26$$

3.8. Government Revenue

The total government revenues includes indirect tax on domestically produced and imported goods(TAXM), income tax (tyh_h) revenues from households and direct tax from factor (tyf_f) and current transfers received from the rest of the world. Thus:

$$YG = tyh_h \cdot YH_h + tyf_f \cdot YF_f + TRG_{Rwo,g} \cdot exr + TAXM \quad \ldots\ldots 27$$

3.9. Government Expenditure

The government current expenditure comprise the government final demand (qg_c), current transfer to households (THG) and payments to the rest of the world (TRG)

$$EG = \sum PC_c \cdot qg + THG + TRG_c \cdot exr \quad \ldots\ldots .28$$

3.10. Investment Demand

Investment is fixed exogenously, but instead of adjusting the saving rate, a 'labor distortion' parameter, 'wdist' is introduced which measures the degree to which the wage deviates from the marginal product of labor. Wage distortion adjusts so that firms are 'induced' to hire the labor at the fixed wage necessary to generate the income necessary to generate savings necessary for finance investment.

$$INV_c = qinvbar \cdot \overline{IADJ} \quad \ldots\ldots 29$$

4. System Constraint Block

'System constraints' are constraints that have to be satisfied by the economy system, but are not considered in the optimizing decision of any micro agent (Robinson, 1989). These include three macroeconomic balances (associated with the accounts for the government, the rest of the world and saving-investment) and supply-demand balance in the product and factor markets. The 'closure rule' of the model indicates the mechanisms on the basis of which the model satisfies these constraints (Lofgren, 2001).

4.1. Commodity Demand

The aggregate demand for each commodity group consists of intermediate (INT_c) and investment (INV_c) demand by domestic producer and final demands by households (C_{ch}), government (qg) and stock change (qdist). On the domestic markets, flexible price assures the equilibrium for quantity demanded and supplied[32].

$$Q_c = \sum INT_{ch} + \sum C_{hc} + qg_c + INV + qdist_c \quad \ldots\ldots \quad 30$$

4.2. Labor Market

The total employment is the sum of employee in informal and formal sectors. The demand for labor is the sum of all employee demand in all sectors. In this model we assume that supply of labor is exogenous and nominal wage is rigid downward. The real wage, w is the equilibrating mechanism that assures that this equilibrium is satisfied. Factors are mobile between the demanding activities.

$$\sum LD = LS \quad \ldots\ldots \quad 31$$

4.3. Current Account Balance

The current-account balance, which is expressed in foreign currency, imposes equality between the country's spending and its earning for foreign exchange. For the basic model version, foreign saving is fixed; nominal exchange rate serves as role of equilibrating variable to the current-account balance.

$$CAB = exr \cdot \sum PWM \cdot M_c - exr \sum PWE_j \cdot EX_c + THR_{h,row} + TGR_{g,r} - TRH_{r,h} - TRG + \overline{FSAV} \cdot exr \quad \ldots\ldots \quad 32$$

4.4. Saving-Investment Balance

Total saving is the sum of savings from domestic nongovernmental institutions (household (YDh), firms (SFf)), the government, and the rest of the world, with the last item converted to domestic currency. The total investment is the sum of the values of fixed investment and stock changes. The balancing role is performed by foreign exchange market. Under this regime excess demand will produce a trade deficit, which in turn will incur excess demand for foreign exchange and eventually a depreciation of the nominal exchange rate. The nominal exchange rate depreciation is used to bring equilibrium investment balance through mechanisms of upward cost-push on domestic price. Extra savings supply comes in the way of increased foreign savings.

$$\sum MPS\ (1 - tyh_h) \cdot YH_h + SF_f + (YG - EG) + exr \cdot \overline{FSAV} = \sum PC_c \cdot INV_c + WALRAS \quad \ldots\ldots \quad 33$$

---

[32] Excess demand in developing countries will not be accompanied by higher rate of output growth. Moreover, manufacturing sector is highly dependent on imported input (Luis, 1993).

2. Variables

2.1. Endogenous Variables

			Number of variables
1.	PVA_a	Value added price for activity a	3
2.	PA_a	Out put per unit of activity a	3
3.	PC_c	Consumer price of composite good	3
4.	PE_c	Domestic price of exported good	3
5.	PM_c	Domestic price of imported good	3
6.	PD_c	Domestic price of good including taxes	3
7.	PA_a	Producer price of good c	3
8.	XS_a	Output of activity a (volume)	3
9.	PS_a	Supply price for commodity produced and sold domestically (volume)	3
10.	$PINT_c$	Aggregate intermediate input price for activity a	3
11.	INT_c	Intermediate consumption of goods in activity a (volume)	9
12.	YF_f	Firms' income	1
13.	YH_h	Household h's income	1
14.	YDH_h	Household h's disposable income	1
15.	SH_h	Household h's savings	1
16.	SF	Firms' savings	1
17.	YG	Government's income	1
18.	qg	Government's consumption for commodity c (volume)	1
19.	$HCONC_{c,h}$	Household h's consumption of good c (volume)	3
20.	D_c	Demand for domestic good (volume)	3
21.	INV_c	Investment demand for good c (volume)	3
22.	IT	Total investment	1
23.	EX_c	Exports in good c (volume)	3
24.	Q_c	Demand for composite good (volume)	3
25.	M_c	Imports in good (volume)	3
26.	QFf_a	Quantity demand of factor f from activity a	3
27.	WF_f	Average wage rate	1
28.	MPSh	Marginal propensity to save by household h	1
29.	EXR	Exchange rate	1
30.	CPI	Consumer Price Index	1
31.	PXc	Producer price for commodity c	3
32.	wdistac	Wage distortion factor for factor f in activity a	1
		Total:	75

2.2. Exogenous variable

			Number of variables
33.	CAB	Current account balance	1
34.	DIV	Dividends paid to capitalists households	1
35.	EG	Government expenditures	1
36.	LS	Total labor supply (volume)	1
37.	PWEc	World price of export	3
38.	PWMc	World price of import	3
39.	THHhh	Inter household transfer	1
40.	TXAM	Total tax on imported tax	1
41.	Qinvbar	Base year quantity of fixed investment demand	1
42.	TGHg,h	Inter household transfer	1
43.	TGRg,r	Government to rest of the world transfer	1
44.	TRHrh	Rest of the world to household transfer	1
45.	TRGR,g	Rest of the word to government transfer	1
46.	WALRAS	Dummy variable (zero at equilibrium)	1
		Total:	18

3. Parameter

3.1. Production functions

ad_a	Efficiency parameter in the production function for activity a
bet_{fa}	Share of value added to factor f in activity a
ica_{ca}	Input-output coefficient
β_a	Share parameter of production factor for activity a (Cobb-Douglas production function)
int_{ca}	Quantity of aggregate intermediate input per unit of activity a
iva_a	Quantity of aggregate value add input per unit of activity

3.2. Other parameters

$\theta_{a,c}$	Yield of commodity c per unit of activity
η_f	Share of factor income received by household
$cwts_c$	Weights of commodity c in consumer price index
srh_h	Saving rate of a household
τ	The mark-up price
α_c^h	Budget share of commodities

3.3. Tax rates

tm_c	Import duties on good c
tyh_h	Direct tax rate on household h's income
tyf_f	Direct tax rate on firms' income
te_c	Export tax rate for commodity c
tq_c	Rate of sales tax for commodity c

3.4. Constant Elasticity Substitution(CES) function

β_c^t	Armington function shift parameter for commodity c
δ_c^t	Armington function share parameter for commodity c
ϕ_c^t	CES functions exponent for commodity c

3.5. Constant Elasticity of Transformation CET function

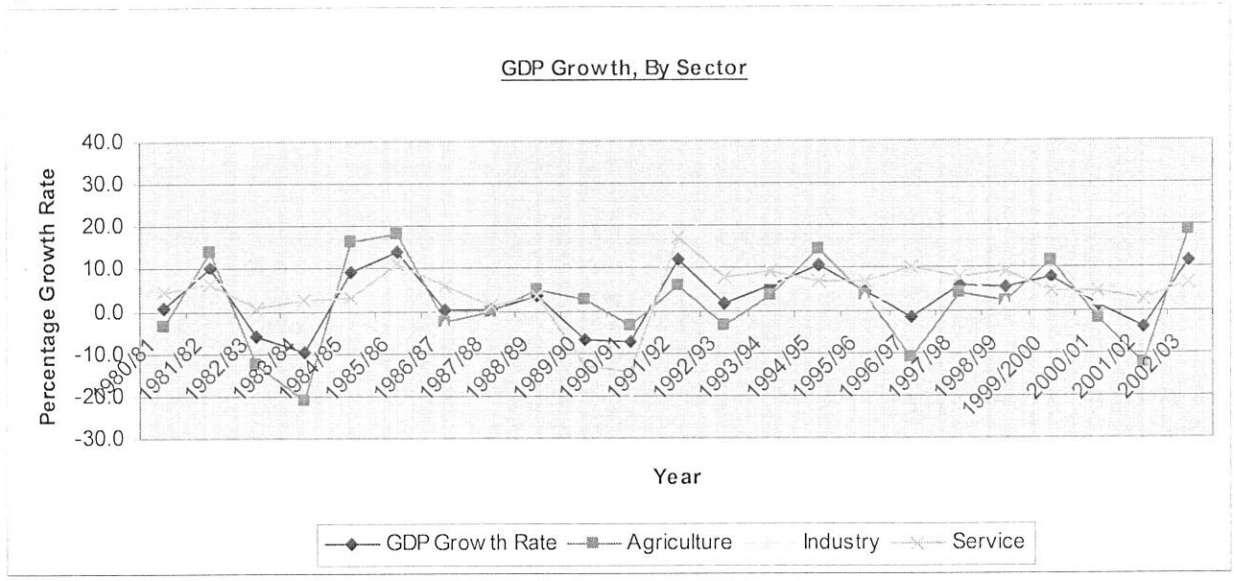
β_c^q	CET function shift parameter
δ_c^q	CET function share parameter
ϕ_c^q	CET function transformation parameter

4. Sets

a ∈A ={AAGR,A IND,A SER}	All activities (AAGR: Agriculture, AIND: Industry, ASER: Services)
c ∈ C ={CAGR,C IND,C SER}	All goods (CAGR: Agriculture, CIND: Industry, CSER: services)
f ∈ F ={L,K}	All factor (CAGR: Agriculture, CIND: Industry, CSER: services)
i∈ I={H,F,G,R}	All institution (H: Household, F: firm G: Government and R: Rest of the world)

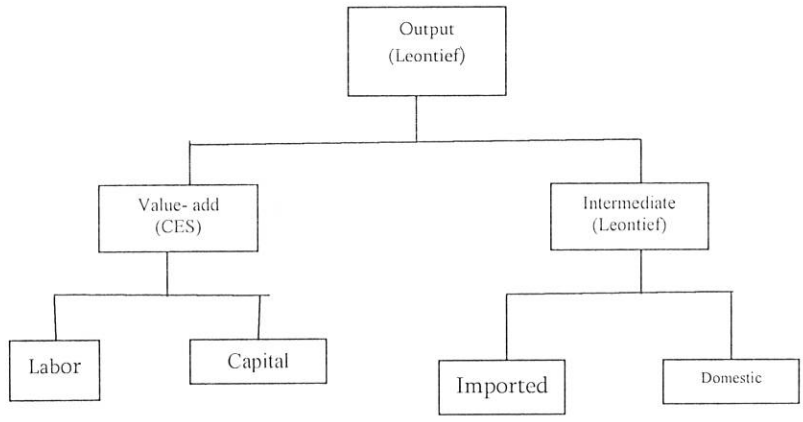
ANNEX III
Figures

Fig 1: Growth trend of gross domestic, agriculture, industry and service



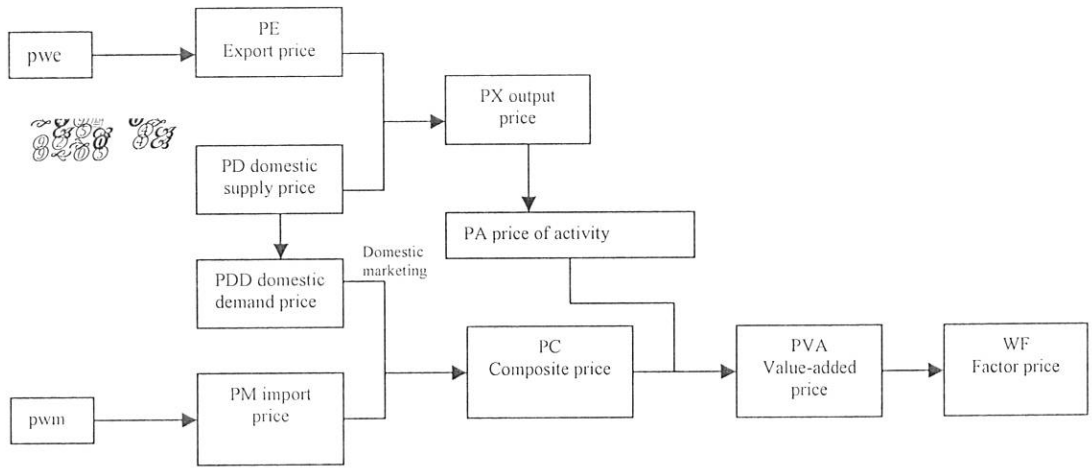
Source: - MoFED (2005)

Fig.2: the nested production function in Ethiopian CGE model



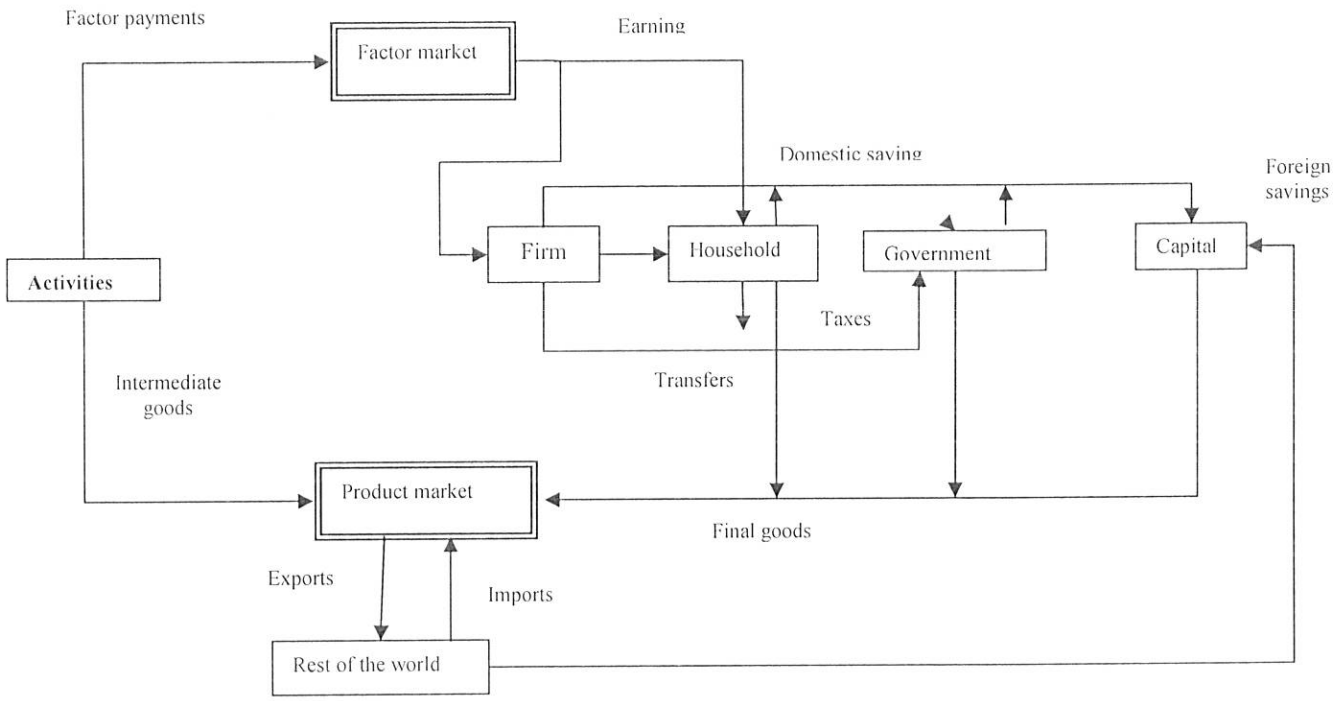
Source devised by authors

Fig. 3: price transmission mechanism in the CGE model



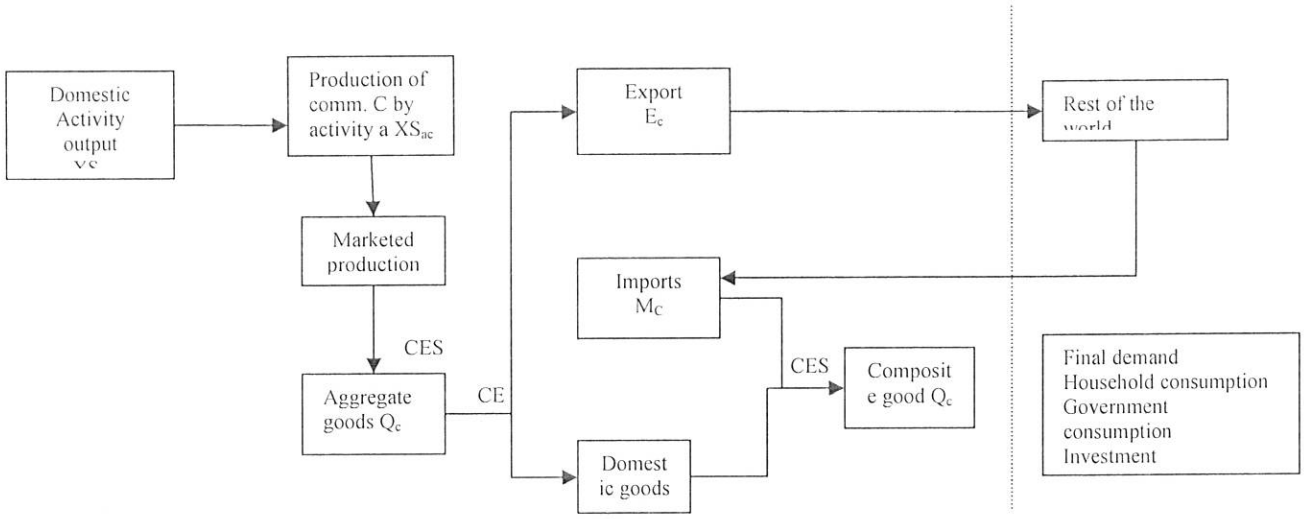
Source devised by authors

Fig4. Income flow of Ethiopian CGE model



Source devised by authors

Fig.5: Flow of goods in Ethiopian CGE modeling



Source devised by authors

Annex IV
GAMS code for Ethiopian CGE model

GAMS Rev 143 Intel/MS Windows 01/25/07 23:40:23 Page 1
ETHIOPIAN CGE MODEL
C o m p i l a t i o n

This is an applied CGE with structural feature designed and calibrated by the researcher in assessing the impact of WTO accession on Ethiopian economy. The GAMS code follows AUTA modeling system which is pioneered by Burnand Decalwe (2005). The original model is formulated as an optimization model, but it is really a square system of nonlinear equations. In this version, we formulate the model directly as a square system using the model type MCP = Mixed complimentarily program. The project is made for the partial fulfillment of master of economics at Addis Ababa University.

```
16 *.....SETS IN THE MODEL.....
18      set AC global set
19              / LAB    labor
20              CAP      capital
21              LAD      land
22              HHD      household
23              FIRM     enterprise
24              GOV      government
25              ROW      rest of the world
26              DTAX     direct tax
27              MTAX     import tax
28              ETAX     export tax
29              AAGR     agricultural activity
30              AIND     nonagricultural activity
31              ASER     service activity
32              CAGR     agricultural commodity
33              CIND      industrial commodity
34              CSER     service commodity
35              S-I      saving investment
36              TOTAL    Total account in SAM /
37
38              ACNT (AC)        all element in AC except TOTAL
40              A (AC) activity                  / AAGR          agri-activity
41                                                 AIND          Ind- activity
42                                                 ASER           service activity/
43
44              C (AC) commodity  / CAGR  agricultural commodity
45                                  CIND  industrial commodity
46                                  CSER  service commodity /
48      CE(C) exported commodity / CAGR  agricultural commodity
49                                 CIND  industrial commodity
50                                 CSER  service commodity /
51
52      CM(C) imported commodities / CAGR  agri-commodity
53                                   CIND          ind-commodity
54                                   CSER          serv-commodity /
55
56      F (AC) factor              / LAB   labor
57                                   CAP   capital/
59
61      I (AC) institution         / HHD   household
62                                   FIRM  enterprise
63                                   GOV   government
64                                   ROW   rest of the world /
65
66      H (i) household            / HHD   household
67                                   FIRM  firm /;
75              ALIAS (AC, ACP), (C, CP), (F, FP), (I, IP);
76              ACNT (AC) =YES; ACNT ('TOTAL') = (NO); ALIAS
(ACNT, ACNTP);
79 *..... Parameters.....
80
81 PARAMETERS
82 *price block parameters
84      ica(c,a)        input-output coefficient
85      tm(c)           import duties on good c
86      theta (a,c)     yield of commodity c per unit of activity
87      te(c)           export subsidy rate for commodity c
88      tq(c)           rate of sales tax for commodity c
90 *production block parameters
91
92      ad (a)          efficiency parameter in the production fun for a
93      bet (f,a)       share of value-added to factor f in activity a
94      shry(h,f)       share parameter of household income form firms
95      tyh(h)          direct tax on household h's income
96      cwts(c)         weighs of commodity c in consumer price index
99 *foreign block parameters
100
101     betat(C)        CET function shift parameter
102     betaq(C)        Armington function shift parameter for commodity c
```

```
gammat(C)       CET function share parameter
gammaq(C)       Armington function share parameter for commodity c
shyt(C)         CET function transfromation parameter
shyq(C)         CES functions exponent for commodity c
tr(I,IP)        transfer form firms I to IP
beta(c,h)       share of consumption of a household on commodity c

*other exogenous variables

qinvbar(c)      base-year quantity of investment demand for commodity c
qg(c)           Consumption of commodity c by government
pwe(C)          export price for c (foreign currency)
pwm(C)          import price for c (foreign currency)

*.....variables.....
*price block variables

PVA (A)         Value added price for activity a
PM(C)           domestic price of imported good c
PA (A)          out put per unit of activity a
PE(C)           domestic price of exported good c
PC(C)           consumer price of composite good c
PD(C)           domestic price of good including taxes
cpi             consumer price index

*Special variables
LS(F)           Total labor supply(volume)
PX(C)           producer price for commodity
EG              Government expenditure
*Production block variables

XS(A)           Output of activity a (volume)
CI(C,A)         Total intermediate consumption of activity a (volume)
QX(C)           quantity of domestic output of commodity c
MPS(h)          Marginal propensity to save
EXR             exchange rate

*Income and saving block

HYF(H,f)        income of household form factor labor
YH(H)           income of household
YG              Government income
M(C)            Imports in good C (volume)
EX(C)           Exports in good c (volume)
WF (F)          average price of factor f(average wage)
QF (F, A)       quantity of factor demand for activity a
IADJ            investment adjustment factor
CON(c,H)        Household h's consumption of good c (volume)
INV(C)          Investment demand for good (volume)
D(c)            Demand for domestic good (volume)
Q(C)            Quantity of good supplied domestically (Composite good
supply) (Volume)
WDIST           wage distortion
FSAV            Foreign saving
WALRAS          dummy variable (zero at equilibrium);

*---------- EQUATIONS BLOCK.....
EQUATIONS

*Equation of the model (DECLEARATION PART) +++++++
*PRICE BLOCK

PRIM(C)  Price of imported commodity
PRVA (A)        Price of value add
PRAC (A)        Price of activity
PRCM(C)         Price of commodity
PREX(C)         Price of exported commodity
PNORM           consumer Price index (Normalization)
ABSOB(C)        absorption for commodity c

* PRODUCTION BLOCK++++++++++++

PRODFUN (A)     Out put from activity a
TINCO(C, A)     Total intermediate consumption
LDFA (F, A)     Labor demand for activity a
OUTPUTFN(C)     out put of commodity c

* INCOME AND SAVING BLOCK++++++++++++

GVIN            Government income
HHTIN (h)       Households Total income
CAB             Current account balance
* DEMAND BLOCK ++++++++++++++++++
```

```
HHCO(C,h)       Household consumption
INVC(C)         investment on commodities
FACTTRNS (h,f)  transfer form factor f to household h

* FOREIGN TRADE BLOCK++++++++++++++++++++++

EXGO            total government expenditure
OUTR(C)         Output transformation function for commodity c
EXDMT(C)        Export-domestic supply ratio for commodity c
DCAR(C)         Composite supply (arming ton) function for commodity c
IMDR(C)         Import-domestic ratio for commodity c
EXPCOMB(C)      Export to domestic equilibrium
EMPOCOMB(C)     Import to domestic commodity ratio

* EQULIBRIUM

FACTEQ (F)      Factor equilibrium condition for market
COMEQ(C)        Market equilibrium condition for commodity c
SVINV           saving investment balance;

*ALGEBRICE EQUATIONS OF THE MODEL.....
* PRICE BLOCK

PRAC (A)..      PA (A)          =E= SUM(c, PX(C)*theta (A, C));
PRIM(C)..       PM(C)           =E= (1+tm(c))*exr*pwm(c);
PREX(C)..       PE(C)           =E= (1-te(c))*pwe(c)*exr;
ABSOB(C)..      Pc(C)*Q(C)      =E= (PD(C)*D(C) + (PM(C)*M(C))*(1 +
tq(C)));
PRCM(C)..       PX(C)*QX(C)     =E= PD(C)*D(C) + (PE(C)*EX(C));
PRVA (A)..      PVA (A)         =E= PA (A)-SUM(C, PC(C)*ica(C, A));

* PRODUCTION BLOCK**********

PRODFUN (A)..   XS (A)          =E= ad (a)*PROD (F, QF (F, A) **bet
(F, A));
LDFA (F, A)..   WF (F)*wdist (F, A) =E= bet (F, A)*PVA (A)*XS (A)/QF
(f,A);
TINCO(C,A)..    CI(C, A)        =E= ica (C, A)*XS (A);
OUTPUTFN(C)..   QX(C)           =E= SUM (A,theta(A,C)*XS(A));
OUTR(C)..       QX(C)   =E= betat(C)*(gammat(C)*EX(C) **shyt(C) +
                (1-gammat(C))*D(C) **shyt(C)) ** (1/shyt(C));
EXDMT(C)..      X(C)/D(C)       =E=(PE(C)/PD(C)*(1-
gammat(C))/gammat(C)) ** (1/ (shyt(C)-1));
expcomb(c)..    QX(C)   =E= D(C) +EX(C);
DCAR(C)..       Q(C)    =E= betaq(C)*(gammaq(C)*M(C) ** (-shyq(C))
                + (1-gammaq(C))*D(C) ** (-shyq(C))) ** (-1/shyq(C));
IMDR(C)..       M(C)/D(C)   =E=  ((PD(C)/PM(C))*(gammaq(C)/  (1-
gammaq(C))))** (1/ (1 + shyq(C)));
empcomb(C)..    Q(C)            =E= D(C) + M(C);

* INCOME AND SAVING BLOCK**********

FACTTRNS (h,f).. HYF(h,f)=E=shry(h,F)*SUM(A,     WF(F)*WDIST(F,A)
*QF(F, A));
HHTIN (h)..     YH (h)  =E= sum(F,hYF(h,f))+ tr(h,'hhd') +tr(h,'firm') +
tr(h,'row')*exr + tr(h,'gov');
HHCO(C, H)..    CON(C,H)        =E=     beta(C,H)*(1-MPS(H))*(1-
tyh(H))*YH(H)/Pc(C);
GVIN..          YG              =E=  SUM  (H,  tyh(h)*YH(H))+
tr('gov','row')*exr+ SUM(C, tq(C)*(PD(C)*D(C) + (PM(C)*M(C))))
+ SUM(C, tm(C)*EXR*pwm(C)*M(C)) + SUM(C, te(C)*EXR*pwe(C)*EX(C));
EXGO..          EG  =E=  SUM(C,  PC(C)*qg(c))  +tr  ('hhd','gov')  +
tr('row','gov')*exr;

INVC(C)..       INV(C)  =E= qinvbar(c)*IADJ;

*SYSTEM CONSTRAINT BLOCK+++++++++++++++

FACTEQ (F)..    SUM (A, QF (F, A)) =E= LS (F);
COMEQ(C)..      Q(C) =E= SUM (A, CI(C, A)) + SUM (H, CON(C, H)) +
qg(C) +INV(C);
CAB..           SUM(C, PWE(C)*EX(C)) +EXR*FSAV + tr ('hhd','row') +
tr('gov','row');
=E= tr('row','hhd')+ tr('row','gov') + SUM(C,PWM(C)*M(C ));
SVINV..         SUM  (H,  MPS  (H)*(1-tyh  (h))*YH  (h))  +  (YG-EG)
+EXR*FSAV
                =E= SUM(C, PC(C)*INV(C)) +WALRAS;
PNORM..         CPI =E= SUM(c,cwts(c)*PC(C));

*.....MODEL.....

MODEL ECGE ETHIOPIAN CGE MODEL /all/;
```

```
307 *.....SOCIAL ACCOUNTING MATRIX.....
308
309
310 TABLE SAM (AC, ACP) social accounting matrix
311
312                 LAB         CAP         HHD         FIRM        GOV         ROW         DTAX
        MTAX        ETAX
313     LAB
314     CAP
315     HHD         32771                   1942        20964       1034        3117
316     FIRM                    35387
317     GOV                                                                     2659        5556
        3601        169
318     ROW                                 95                      548
319     DTAX                                2360        3196
320     MTAX
321     ETAX
322     AAGR
323     AIND
324     ASER
325     CAGR                                31821                               3433
326     CIND                                13841                               525
327     CSER                                4629                    7203        4060
328     S-I                                 5140        11227       3200        2818
329     TOTAL
331                 + AAGR                  AIND        ASER        CAGR        CIND        CSER
        S-I         TOTAL
332     LAB         21324       3704        7743
333     CAP         15063       7507        12817
334     HHD
335     FIRM
336     GOV
337     ROW                                                         646         12470       2853
338     DTAX
339     MTAX                                                        102         3138        361
340     ETAX                                                        169
341     AAGR                                                        34795       7121
342     AIND                                                                    15461
343     ASER                                                        5044        3257        31301
344     CAGR        1882        349         198
        3073
345     CIND        2001        2482        4886
        17712
346     CSER        1646        1419        13958
        1600
347     S-I
348     TOTAL
349;
351     PARAMETER
352
353     tdiff(AC) column minus row total for account ac;
354 *in section we start by balancing the SAM using the GAMS code before analysis.
355
356     SAM ('TOTAL', ACNTP)    = SUM (ACNT, SAM (ACNT, ACNTP));
357     SAM (ACNT,'TOTAL')      = SUM (ACNTP, SAM (ACNT, ACNTP));
358     tdiff (ACNT)            =SAM('TOTAL',ACNT) -SAM (ACNT,'TOTAL');
359
360 DISPLAY SAM, tdiff;
361
364 *ASSIGNMENTS FOR PARAMETERS AND VARIABLES==========
365
366 PARAMETERS
367
368 *initialization of the model
370
371     PVA0 (A),       PA0 (A),        PM0(C),         PE0(C),
        PC0(C),
372     Q0(C),          QX0(c),         PD0(C),         D0(c),
        EX0(C),
373     WF0 (F), wdist0 (F, A),         CI0(C, A),      M0(C),          QF0     (F,
A),
374     HYF0 (h,f),     YH0(H),         CON0(c,H),      MPS0(H),
        cxr0,
375     IADJ0,          INV0(C), YG0,   EG0,            LS0 (F),
376     FSAV0,          PX0(C),         XS0 (A),        CPI0,
379
380 *FACTOR DEMADN AND PRICE
381
382     LABOR (A) QUANTITY OF LABOR DEMAND BY ACTIVITY (NUMBER)
383                                     /AAGR 21324, AIND 3704, ASER 7743/
384                     wfa(F,A)  wage for factor f in activity a (only for calibration)
385                     cgap(f,a)  cost gap between factor and SAM value;
388 *defining factor employment and supply
```

```
389
390                         QF0 ('LAB', A) =   LABOR (A);
391                         QF0 ('CAP', A) =   SAM ('CAP', A);
392                          LS0 (F)       =   SUM (A, QF0 (F, A));
393
394 *COMPUING ACTIVITY SPECIFIC WAGE
395
397             WFA (F, A) = SAM (F, A)/QF0 (F, A);
398
399 * average wage which is obtained form total factor income and total labor both for all
activities
400
401             WF0 (F) = SUM (A, SAM (F, A))/SUM (A, QF0 (F, A));
403
404 * COMUTING WAGE DISTORTION FACTORS
405
406             wdist0 (F, A) =WFA (F, A)/WF0 (F);
407             cgap (F, A) = WF0 (F)*wdist0 (f,a)*QF0(F,A)-SAM(F,A);
409             DISPLAY cgap, WFA;
410
411 *.....PRICE BLOCK OF PARAMETER ASSIGNMENT.....
413      PARAMETERS
414
415     SIGQ(C)          Elasticity of substitution between domestic and imported
goods
416     SIGT(C)          elasticity of transformation between domestic sales and export;
417
418     EXR0 = 1;
419     PA0 (A) = 1;
420     PD0(C) = 1;
421     PE0(C) = 1;
422     PM0(C) = 1;
423     PX0(C) = 1;
424
425             PVA0 (A) = SUM (F, SAM (F, A))/ (SAM (A,'TOTAL')/PA0 (A));
426             te(C) = 0;
427             pwe(C) = PE0(C)/ ((1 + te(C))*EXR0);
428
429             tm(C) = SAM ('MTAX', C)/SAM ('ROW', C);
430
431             tq(C) = SAM ('DTAX', C)/ (SAM ('MTAX', C) + SAM ('ROW', C)
432                                 + SUM (A, SAM (A, C)) - SAM(C,'ROW'));
433
434             PC0(C) = 1 + tq(C);
435
437 *SYSTEM CONSTRAINT BLOCK+++++++++++++++
438
439             XS0 (A)          = SAM ('TOTAL', A)/PA0 (A);
440             D0(C)            =(SUM (A, SAM (A, C))-SAM(C,'ROW'))/PD0(C);
441             EX0(C)           = SAM(C,'ROW')/PE0(C);
442             M0(C)            = (SAM ('ROW', C) +SAM ('MTAX',C))/PM0(C);
443             QX0(C)           = SUM (A, SAM (A, C))/PX0(C);
444                                      CI0(C, A)  = SAM(C, A)/PC0(C);
445             EG0              = SAM ('TOTAL','GOV')-SAM ('S-I','GOV');
446             FSAV0            = SAM ('S-I','ROW')/exr0;
447             MPS0 (h) = SAM ('S-I', H) / (SAM ('TOTAL', H) - SAM ('DTAX', H));
448             CON0(c,H)         = SAM(C,h)/Pc0(C);
449             INV0(C)          = SAM(C,'S-I')/Pc0(C);
450             HYF0 (h,f)       = SAM(h,f);
451             YG0              = SAM ('GOV','TOTAL');
452             YH0 (H)          = SAM ('TOTAL', H);
453             qg(C)            = SAM(c,'GOV')/PC0(C);
454             qinvbar(C)       = SAM(C,'S-I')/PC0(C);
455             IADJ0            = 1;
456             tr(i,'GOV')      = SAM(i,'GOV');
457             tr(i,'ROW')      = SAM(i,'ROW')/EXR0;
458             tr(i,h)          = sam(i,h);
459
460 *******production and commodity block**********************
462             Q0(c) = (SAM ('TOTAL', C) - SAM(C,'ROW'))/PC0(C);
463             ica(c,a)    = (SAM(C,A)/PC0(C)) / XS0(A);
464             theta (a,c) = (SAM(A,C)/PX0(C)) / XS0(A);
465             pwm(c)    = PM0(C) / (exr0*(1 + tm(C)));
466             bet (f,a)   = SAM(F,A) / SUM(FP, SAM(FP,A));
467             ad (a)      = XS0 (A) / PROD (F, QF0 (F, A) **bet (F, A));
468             sigq(c)     = 2.0;
469             sigt(c)     = 0.7;
470             shyt(c)     = 1/sigt(C) + 1;
471             shyq(c)     = 1/sigq(C) - 1;
472             gammat(c) = 1/ (1 + (PD0(C)/PE0(C))*(Ex0(C)/D0(C)) ** (shyt(C)-1));
473             betat(c)    = QX0(c) / (gammat(C)*EX0(C) **shyt(c)
474                           + (1-gammat(c))*D0(C) **shyt(c))**(1/shyt(c));
475             gammaq(c) = 1/ (1 + (PD0(C)/PM0(C))*(D0(C)/M0(C)) **(1+shyq(c)));
476             betaq(c)          = Q0(C) / (gammaq(c)*M0(C)**(-shyq(c))
```

```
                                + (1-gammaq(c))*D0(C)**(-shyq(c)))**(-1/shyq(c) );
        tyh(h)      = SAM('DTAX',h)/ SAM('TOTAL',h);
        cwts(c)     = SUM (H, SAM(C, H)) / SUM ((CP, H), SAM (CP,H));
        CPI0        = SUM(C, cwts(c)*PC0(C));
        shry(h,f)   = SAM(h,f) / SAM('TOTAL',f);
        beta(c,h)   = sam(c,h)*(1-sam(h ,h)/SUM(Cp, SAM(Cp,'hhd')))
                      /(SUM(CP, SAM(CP,'hhd')));
* INTALIZATON OF PARAMETERS AND VARIABLES**********

        PVA.L(A) = PVA0(A); PA.L(A) = PA0(A);
        PM.L(C) = PM0(C); PE.L(C) = PE0(C);
        PC.L(C) = PC0(C); PX.L(C) = PX0(C);
        MPS.L(H) = MPS0(H); EG.L = EG0;
        EXR.L = EXR0; Q.L(C) = Q0(C);
        QX.L(C) = QX0(C); PD.L(C) = PD0(C);
        D.L(C) = D0(C); EX.L(C) = EX0(C);
        XS.L(A) = XS0(A); WF.L(F) = WF0(F);
        WDIST.L(F,A) = wdist0(F,A); CI.L(C,A) = CI0(C,A);
        M.L(C) = M0(C); QF.L(F,A) = QF0(F,A);
        HYF.L(H,F) = HYF0(H,F); YH.L(H) = YH0(H);
        CON.L(C,H) = CON0(C,H); INV.L(C) = INV0(C);
        LS.L(F) = LS0(F); YG.L = YG0;
        FSAV.L = FSAV0; IADJ.L = IADJ0;
        CPI.L = CPI0;
    DISPLAY
        ad,     bet,    tm,     theta,  cwts,   shry,   tyh,
        ica,    tc,     qg,     tq,     beta,   qinvbar,
        betaq,  betat,  gammaq, gammat, shyq,
        shyt,   pwe,    pwm,    sigq,   sigt,   tr;

        IADJ.L,         MPS.L,  EG.L,   FSAV.L, EXR.L,
        PA.L,           PD.L,   PE.L,   PM.L,   PC.L,
        PVA.L,          PX.L,   XS.L,   D.L,    EX.L,
        QF.L,           LS.L,   CON.L,  CI.L,   INV.L,
        Q.L,            QX.L,   WF.L,   HYF.L, YH.L,
        WDIST.L,        M.L,    YG.L,   CPI.L;

**in this section the researcher selects from the many closure of CGE modeling, flex/fixed pricing on domestic **price of output and unemployment in labor market
*SAVINGS-INVESTMENT BALANCE
    SCALARS

    SICLOS  savings-investment closure /1/
*in this section (if SICLOS = 1, savings is investment-driven, and *if SICLOS = 2, investment is savings-driven)

IF (SICLOS EQ 1,
*Investment-driven savings—MPS ('HHD') is flexible, permitting the savings value to adjust
    IADJ.FX         = IADJ0;
    MPS.FX (h)      = MPS0 (h);
    MPS.LO ('HHD')  = -INF;
    MPS.UP ('HHD')  = +INF;
    MPS.L ('HHD')   = MPS0 ('HHD'));

IF (SICLOS EQ 2,
*Savings-driven investment—IADJ is flexible, permitting
*investment quantities and the investment value to adjust

    MPS.FX (h)      = MPS0 (h);
    IADJ.LO         = -INF;
    IADJ.UP         = +INF;
    IADJ.L          = IADJ0 ;);


*FACTOR MARKETS CLOSURES
*for each factor, fix (A + 1) quantity and-or price variables

    SCALARS

CAPCLOS closure for capital market /2/

*Select 1 or 2
*if CAPCLOS = 1, capital is mobile and fully employed and if CAPCLOS = 2, capital is activity-specific and fully employed
    *for this model due to abundance of labor in the economy
*labor is mobile between activity and fixed wage and wage distortion adjust to equilibrate the market equality

LABCLOS closure for labor market /2/

*Select 1 or 2
*if LABCLOS = 1, labor is mobile and fully employed and if LABCLOS = 2, labor is mobile and unemployed *  (fixed wages)
```

```
583
584 IF (CAPCLOS EQ 1,
585
586         *Capital is fully employed and mobile. WF ("CAP") is the market-clearing
587         *variable for the unified capital market
588
589                 WDIST.FX ('CAP', A)         = WDIST0 ('CAP', A);
590                 WF.LO ('CAP')               = -INF;
591                 WF.UP ('CAP')               = +INF;
592                 WF.L ('CAP')                = WF0 ('CAP');
594                 QF.LO ('CAP', A)            = -INF;
595                 QF.UP ('CAP', A)            = +INF;
596                 QF.L ('CAP', A) = QF0 ('CAP', A);
597                 QF.FX ('CAP', A) = QF0 ('CAP', A) ;);
598
600         IF (CAPCLOS EQ 2,
602 *Capital is fully employed and activity-specific.
603 *WFDIST ('CAP', A) is the market-clearing variable, one for
604 *each segment of the capital market
605
606         WDIST.LO ('CAP', A) = -INF;
607          WDIST.UP ('CAP', A) = +INF;
608         WDIST.L ('CAP', A) = WDIST0 ('CAP', A);
609         WF.FX ('CAP') = WF0 ('CAP');
610         QF.FX ('CAP', A) = QF0 ('CAP', A);
611         QF.LO ('CAP', A) = -INF;
612         QF.UP ('CAP', A) = +INF;
613         QF.L ('CAP', A) = QF0 ('CAP', A) ;);
614
615
616         IF (LABCLOS EQ 1,
617
618 *Labor is fully employed and mobile. WF ('LAB') is the market-clearing
619 *variable for the unified capital market
620
621         WDIST.FX ('LAB', A) = WDIST0 ('LAB', A);
622         WF.LO ('LAB') = -INF;
623         WF.UP ('LAB') = +INF;
624         WF.L ('LAB') = WF0 ('LAB');
625         QF.LO ('LAB', A) = -INF;
626         QF.UP ('LAB', A) = +INF;
627         QF.L ('LAB', A) = QF0 ('LAB', A);
628         QF.FX ('LAB', A) = QF0 ('LAB', A) ;);
629
631         IF (LABCLOS EQ 2,
632
633 *Labor is unemployed and mobile. For each activity, the wage,
634 *WFDIST ('LAB',A)*WF('LAB'), is fixed. QFS('LAB') is the market-clearing
635 *variable for the unified labor market
636
637         WDIST.FX ('LAB', A) = WDIST0 ('LAB', A);
638         WF.FX ('LAB') = WF0 ('LAB');
639         QF.LO ('LAB',A) = -INF;
640         QF.UP ('LAB',A) = +INF;
641         QF.L ('LAB',A) = QF0('LAB',A);
642         QF.LO ('LAB',A) = -INF;
643         QF.UP ('LAB', A) = +INF;
644         QF.L ('LAB', A) = QF0 ('LAB', A) ;);
647 *THE FOREIGN EXCHANGE MARKET
648
649 SCALARS
650 ROWCLOS rest-of-world closure /1/
651
652 *Select 1 or 2
653 *if ROWCLOS = 1, exchange rate is flexible and if ROWCLOS = 2, foreign savings is
flexible
655
657 IF (ROWCLOS EQ 1,
659 *Foreign savings is fixed. A flexible exchange rate clears
660 *the current account of the balance of payments
661
662         FSAV.L = FSAV0;
663         EXR.LO = -INF;
664         EXR.UP = +INF;
665         EXR.L = EXR0 ;);
667
668 IF (ROWCLOS EQ 2,
669
670 *the exchange rate is fixed. Flexible foreign savings clears
671 *the current account of the balance of payments
672
673         EXR.L = EXR0;
674         FSAV.LO = -INF;
675         FSAV.UP = +INF;
```

```
676       FSAV.L = FSAV0 ;);
677
678 DISPLAY SICLOS, CAPCLOS, LABCLOS, ROWCLOS;
679
680                   *SOLVE                    STATEMENT                    FOR
BASE==========================================
683 ECGE.HOLDFIXED = 0 ;
684
685 SET SIM simulations
687       /BASE             base simulation
688       pwmder            import tariff rate decrease /
691       ACGDP             GDP items
693       / GDPMP1          GDP at market prices (from spending side)
695       PRVCON            private consumption
696       GOVCON            government consumption
697       INVEST            investment
698       EXP               exports of goods and services
699       IMP               imports of goods and services
700       NDTAX             net direct taxes
701       GDPFC             GDP at factor prices
702       GDPMP2            GDP at market prices (from income side)
703       GDPGAP            gap bt alternative calculations for GDP at market prices /;
707       ACGDP1            (ACGDP) components of GDP at market prices
708
709       / PRVCON          private consumption
712       GOVCON            government consumption
713       INVEST            investment
714       EXP               exports of goods and services
715       IMP               imports of goods and services /
718
719 *solving the CGES using MCP (mixed complementarily program);
723       SOLVE ECGE USING MCP;
724
725       PARAMETERS
726
727       pwmagrsim(SIM)          Import tariff rate (experiment par.)
728       PWEREP(C, SIM)          export price for commodity c (value add)
729       PVAREP (A, SIM)         export price for commodity c (value used)
730       PAREP (A, SIM)          government expenditures
731       PMREP(C, SIM)           import price for c (domestic currency)
732       PEREP(C, SIM)           export price for c (domestic currency)
733       PCREP(C, SIM)           composite commodity price for c
734       PXREP(C, SIM)           producer price for commodity c
735       EGREP (SIM)             government expenditure
736       FSAVREP (SIM)           foreign savings (foreign currency)
737       EXRREP (SIM)            exchange rate (dom. cur. per unit of for. cur.)
738       QREP(C, SIM)            quantity of domestic output of commodity c
739       QXREP(C, SIM)     quantity of goods supplied domestically ("composite Supply")
740       PDREP(C, SIM)           domestic price of domestic output c
741       DREP(C, SIM)            quantity sold domestically of domestic output c
742       EXREP(C, SIM)           quantity of exports for commodity c
743       XSREP (A, SIM)          level of activity a
744       WFREP (F, SIM)          average price of factor f
745       WDISTREP (F, A, SIM)    wage distortion factor for factor f in activity a
746       CIREP(C, A, SIM)  quantity of commodity c as intermediate Input for activity
747       MREP(C, SIM)            quantity of imports for commodity c
748       QFREP (F, A, SIM)       demand for factor f from activity a
749       HYFREP (H, F, SIM)      income of household h from factor f
750       YHREP (H, SIM)          income of household h
751       CONREP(C, H, SIM)       consumption of commodity c by household h
752       INVREP(C, SIM)          quantity of investment by commodity of origin c
753       LSREP (F, SIM)          supply of factor f for sim
754       YGREP (SIM)             government revenue
755       IADJREP (SIM)           investment adjustment factor
756       WFAREP (F, A, SIM)      price of factor f for activity a
757       WALRASREP (SIM)         dummy variable (zero at equilibrium)
758       GDPREP (*, SIM)         nominal GDP data
759       CPIREP (SIM)            Consumer price index;
763 pwmagrSIM('BASE') = pwm('CAGR') ;
764 pwmagrSIM('pwmder') = 0.50*pwm('CAGR') ;
765
766 DISPLAY pwmAGRSIM ;
767
768 LOOP (SIM, pwm('CAGR')          = pwmAGRSIM(SIM);
771          PWEREP(C, SIM)  = PWE(C); EGREP (SIM) = EG.L;
772          EXRREP (SIM)    = EXR.L; FSAVREP (SIM) = FSAV.L;
773          IADJREP (SIM)   = IADJ.L; PAREP (A, SIM) = PA.L (A);
774          PDREP(C, SIM)   = PD.L(C); PEREP(C, SIM) = PE.L(C);
775          PMREP(C, SIM)   = PM.L(C); PCREP(C, SIM) = PC.L(C);
776          PVAREP (A, SIM) = PVA.L (A); PXREP(C, SIM) = PX.L(C);
777          XSREP (A, SIM)  = XS.L (A); DREP(C, SIM) = D.L(C);
778          EXREP(C, SIM)   = EX.L(C); QFREP (F, A, SIM) = QF.L (F, A);
779          LSREP (F, SIM)  = LS.L (F); CONREP(C, H, SIM) = CON.L(C, H);
780          CIREP(C, A, SIM) = CI.L(C, A); INVREP(C, SIM) = INV.L(C);
```

```
781                 MREP(C, SIM)      = M.L(C); QREP(C, SIM) = Q.L(C);
782                 QXREP(C, SIM)     = QX.L(C); WFREP (F, SIM) = WF.L (F);
783                 WFAREP (F, A, SIM) = WF.L (F)*WDIST.L (F, A);
784                 WDISTREP (F, A, SIM)= WDIST.L (F, A); YGREP (SIM) = YG.L;
785                 YHREP (H, SIM)    = YH.L (H); HYFREP (H, F, SIM) = HYF.L (H,F);
786                 WALRASREP (SIM)           = WALRAS.L; CPIREP (SIM) = CPI.L;
787
788 *GDP data
104
789
790                 GDPREP ('PRVCON', SIM)  = SUM ((C,H), PC.L(C)*CON.L(C,H)) ;
791                 GDPREP ('GOVCON', SIM) = SUM(C, PC.L(C)*qg(C));
792                 GDPREP ('INVEST', SIM)    = SUM(C, PC.L(C)*INV.L(C));
793                 GDPREP ('EXP', SIM)       = SUM(C, EXR.L*pwe(C)*EX.L(C));
794                 GDPREP ('IMP', SIM)       = - SUM(C, EXR.L*pwm(C)*M.L(C));
795       GDPREP('GDPFC',SIM)      = SUM((F,A),WF.L(F)*WDIST.L(F,A)*QF.L(F,A));
796       GDPREP ('DTAX', SIM) = SUM(C, (PD.L(C)*D.L(C) + (PM.L(C)*M.L(C)))
797                                   + SUM(C(C), tm(C)*EXR.L*pwm(C)*M.L(C))
798                                   + SUM(C(C), EXR.L*pwe(C)*EX.L(C)) ;);
799
800 * the data processing will take place for each scenario by changing the value of the syntax
in line 746.
801
802       GDPREP ('GDPMP1', SIM)  = SUM (A CGDP1, GDPREP (ACGDP1, SIM));
803       GDPREP ('GDPMP2', SIM)  = GDPREP ('GDPFC', SIM) + G DPREP ('DTAX',
SIM);
804       GDPREP ('GDPGAP', SIM) =GDPREP ('GDPMP1', SIM) - GDPREP
('GDPMP2', SIM);
805
806
807       OPTION QFREP: 3:1:1, CONREP: 3:1:1, CIREP: 3:1:1, WFAREP: 3:1:1,
808       WFAREP: 3:1:1, WDISTREP: 3:1:1, hYFREP:3:1:1 ;
810
812 DISPLAYS
813
814 PWEREP, EGREP, EXRREP, FSAVREP, IADJREP, PAREP, PDREP, PEREP,
YGREP,
815 PMREP, PCREP, PVAREP, PXREP, QREP, DREP, EXREP, QFREP, LSREP,
816 INVREP, MREP, QXREP, WFREP, WFAREP, WDISTREP, CIREP, CONREP,
817 HYFREP, YHREP, GDPREP, WALRASREP, CPIREP;
                COMPILATION TIME = 0.000 SECONDS 3 Mb WIN220-143 June 19, 2007
```

Declaration

I the undersigned, declare that this thesis is my original work and has not been presented in any other University and that all source of materials used for the thesis have been duly acknowledged.

Declared By

Name Solomon Lemma

Signature _____

Date _____

Confirmed by Advisor:

Name Alemayehu Geda

Signature _____

Date _____