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SCHOOL OF GRADUATE STUDIES

THE ECONOMY WIDE IMPACT OF COMESA FTA ON ETHIOPIA: A RECURSIVE DYNAMIC CGE MODEL

BY

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List of acronyms and abbreviation

ADLI	Agricultural Development Led Industrialization Strategy
ATC	Agreement on Textile and Cloth
CAFTA	Central America Free Trade Area
CGE	Computable General Equilibrium
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
COMESA	Common Market for Eastern and South Africa
CPI	Consumer Price Index
DPI	Domestic Producer price Index
EAC	East African Community
ECOWAS	Economic commission for Western and South Africa
EDRI	Ethiopian Development and Research Institute
EFY	Ethiopia Fiscal Year
EU	European Union
FTA	Free Trade Area
GAMS	General Algebraic Modeling System
GDP	Gross Domestic Product
GTP	Growth Transformation Plan
IFPRI	International Food Policy Research Institute
LES	Linear Expenditure System
MFN	Moist Favored Nation

MOFED	Ministry of Finance and economic development
MOT	Ministry Of Trade
NAFTA	North American Free Trade Agreement
NBE	National Bank of Ethiopia
PASDEP	Plan for Accelerated Plan for Accelerated Sustained Development to End Poverty
PTA	Preferential Trade Area
ROW	Rest of the World
RTA	Regional Trade Arrangement
SACU	South African Customs Union
SADC	South Africa Development Community
SAM	Social Accounting Matrix
SDPRP	Sustainable Development and Poverty Reduction Program
WTO	World Trade Organization

Abstract

This study examines the economy wide impact of COMESA FTA on Ethiopia. The analysis is made based on Ethiopian social accounting matrix (SAM) of 2005/06 constructed by EDRI. The study has utilized a recursive dynamic CGE model. The model is simulated for an import tariff reduction on different sectors using three different scenarios.

The main findings of the analysis are: in the first scenario, removal of import tariff on agriculture and non agricultural sector results in an increase of consumption expenditure of households, commodity output and GDP. On the other hand, government revenue, price of import and price of export declined. Moreover, domestic activity has mixed outcomes. There is some trade creation but no trade diversion effects induced by the tariff reduction. .

Mean while, under the second scenario removal of import tariff on agriculture sector only has no impact on Ethiopian economy. Furthermore, the removal of import tariff from non agricultural sector in the third scenario is resulted in similar outcomes as that of the first scenario.

Key word: Recursive dynamic CGE model, COMESA FTA, import tariff reduction, Ethiopia.

Chapter one

1. Introduction

Regional trade agreements in Africa have a long history with establishment of the South African Customs Union (SACU) in 1910 and the East African Community (EAC) in 1919 was the leading regional trade agreements. Since then a number of regional economic communities have been formed across the continent, particularly since the 1970s. Currently, there are about 13 regional economic groupings in Africa. Today there is no country in Africa that isn't a member of at least one regional economic group. As reflected in the number of regional agreements both in the continent and world- wide, therefore, the issue continues to occupy a center-stage in the economic agenda of countries (Geda and Kibert, 2002).

Among the regional grouping in Africa COMESA[1] (Common Market for Eastern and South Africa) is one of the regional trade agreement that was established in 1993. COMESA was formed based on 1978, Lusaka declaration, which states that the creation of a sub-regional economic community was recommended, beginning with a sub-regional Preferential Trade Area (PTA) which was gradually transformed over a ten-year period to a common market until the community had been established. Thus after meeting of Heads of State and Government was convened in Lusaka on 21st December 1981 at which the treaty establishing the PTA was signed and came into effect on 30th September 1982. The PTA was established to take advantage of a larger market size, to share the region's common heritage and destiny and to allow greater social and economic co-operation, with the ultimate objective being to create an economic community.

[1] COMESA member countries are Burundi, Comoros, Democratic Republic of the Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia and Zimbabwe.

The PTA Treaty envisaged its transformation into a Common Market and, in conformity with this, the Treaty establishing the Common Market for Eastern and Southern Africa, COMESA, was signed on 5th November 1993 in Kampala, Uganda. The vision of COMESA is to be a borderless region with a single currency, free mobility of people and factors of production, single market for investment, goods and services. The chosen strategy for achieving this is through trade and investment, creating a single market for goods and services (COMESA data base).

The COMESA FTA(Free trade area) was formed on 31st October, 2000 with nine of the member States namely Djibouti, Egypt, Kenya, Madagascar, Malawi, Mauritius, Sudan, Zambia and Zimbabwe eliminated their tariffs on COMESA originating products. Later on, Rwanda and Burundi joining the FTA in 2004 then the Comoros and Libya also join in 2006. Currently, COMESA has 14 FTA members out of 19 countries under COMESA.

Ethiopia is one of the founding members of COMESA. Ethiopia chaired the organization when the PTA transformed to COMESA. Now, Ethiopia made a 10% tariff reduction on goods coming from member countries. In recent years, different works have been done with COMESA related custom, banks and FTA Issue. In this study, we elaborate the economy wide impact of COMESA FTA on Ethiopia under different tariff reduction scenario using simulation analysis.

As many literatures indicate the formation of FTA results in trade creation, trade diversion and revenue loss. As the result, the economic impact of any FTA depends on the interaction of these three effects.

Recently, the formulation of FTA is fashionable phenomena all overall the world. Due to this most African countries became the member of different FTA. Ethiopia is now participating and negotiating in many regional blocks. Currently Ethiopia is a member of COMESA, even though it is not yet a member of the FTA. Hence, the study tries to address, what will be the consequence

(gain or loss) to Ethiopia and which sector is highly affected if Ethiopia becomes the member of COMESA FTA?

Related to FTA, there are few studies have been done using partial equilibrium analysis but a very little using general equilibrium analysis. Thus the study employs the general equilibrium analysis that explains more overall rounded economic phenomena and outcomes of being member of the FTA. Besides, the analysis of the study will contribute for making policy decision as to whether join or not any regional integration.

The General objective of the study is to examine the economy wide impact of joining COMESA FTA on Ethiopia.

The Specific objectives of the study are:

- To investigate the impact of COMESA FTA on consumer expenditure, producer output and government revenue in the next five years.
- To analyze the impact of COMESA FTA on macro variable like GDP and Export.
- To explain the effect COMESA FTA on trade creation and trade diversion.

If Ethiopia becomes the member of COMESA FTA, in short run, the impact will not be a fruitful. But in the long run, it may get important outcomes. This paper uses different scenario to show the impact of COMESA FTA. These are

Scenario 1.Total removal of import tariffs both in agricultural and non-agriculture sector.

Scenario 2. Removal of import tariffs for agriculture sector and to maintain the existing import tariff for non-agriculture sector.

Scenario 3. Removal of import tariffs for non agriculture sector and to maintain the existing import tariff for agriculture sector.

The study gives elaboration about the economy wide impact COMESA on Ethiopia which has been explained by some papers but most of the papers generalize using partial equilibrium analysis, they did not use the general equilibrium analysis. Therefore this study will fill the gap by explaining the impact of COMESA FTA using CGE (Computable General equilibrium) model, so it will be important input for future negotiation.

Geographically, this study confined only the eastern and south regional agreement of Africa. The CGE model employed in this analysis has also limitations such as it shows only one spot of time data base. As a result the outcomes of any shocks in tariff line, does not predict and does not explain in nominal values impact.

Chapter two

Literature Review

2.1 Overview of the Economy

The existing government came to power in May 1991; it has taken different economic reform programmes including the adoption of Agricultural Development Led Industrialization Strategy (ADLI), Sustainable Development and Poverty Reduction Program (SDPRP) and the Plan for Accelerated Sustained Development to End Poverty (PASDEP) and recently Growth transformation plan (GTP).

Thanks to those reforms programmed, macro developments in Ethiopia have been great. As the data reported by MOFED, in period 2009/10, the real GDP grew on average by 11.2% in the last five years. Based on this report agriculture and allied activities grew by 6%, industry grew by 10.2% and services grew by 14.5%. On the other hand, sectoral share of the different activities agricultural sector accounts for 41% of GDP, industry and services share are 13% and 46% of GDP respectively.

Regarding the demand side of GDP, the total consumption expenditure share of nominal GDP is 90.6%, domestic saving is 9.4% and gross capital formation is 23.7%. Ethiopian export grew by 25% and import grew by 30% on average in the previous years. According to national bank, Ethiopian export and import trend in the last five year is as follows:

Table: 2.1: Value of export and import (million dollar)

	2004/05	2005/06	2006/07	2007/08	2008/09	Average
Export	868.5	1000.3	1185.1	1465.7	1520.9	1208.1
Import	3143.4	4592.8	5126.2	6810.7	8467.7	5628.16
Trade balance	**-2274.9**	**-3592.5**	**-3941.1**	**-5345**	**-6946.8**	-4420.06

Source: NBE

In Recent years, Ethiopia has been engaging in different bilateral, regional and multilateral trade negotiation. Due to unilateral tariff reform measures taken, Ethiopia has reduced the tariffs rate over time. For instance before 1993 Ethiopia's highest tariff rate was 230% but now the highest tariff rate is 35%.

The total tax revenue collected as share of GDP is 8.6% in the year 2008/09.This amount has lower share to GDP. Particularly, one –third of tax revenue has been collected from direct and two-third from indirect tax with huge amount comes from import duties (taxes).The import tax revenue that has been collected by source of import regions is presented in the following table

Table 2.2: Import tax from different area

Year		***Import tax revenue sources of Ethiopia(value in million birr)***					
		Total Trade Taxes			**Customs Duties**		
		COMESA	EU	other[2]	COMESA	EU	Other
2004/05	Value	164	827	4755	65.9	322.5	1985.6
	Share (%)	2.9	14.4	82.7	2.8	13.6	83.6
2005/06	Value	231	1,043	5313	86	423	2273.2
	Share (%)	3.5	15.8	80.7	3.1	15.20	81.7
2006/07	Value	291	1,288	6610	99	485.4	2469.6
	Share (%)	3.6	15.7	80.7	3.2	15.90	80.9
2007/08	Value	401	1,622	9670	117.6	508.6	3104.7
	Share (%)	3.4	13.9	82.7	3.2	13.60	83.2

[2] Other indicates Asia and countries out of COMESA and EU, based on the figure, Ethiopia get higher revenue from other county in recent years.

2008/09	Value	420	1,280	10114	142.8	415.5	3084.5
	Share (%)	3.6	10.8	85.6	3.9	11.4	84.7

Source: MOFED and ERCA

From this table, one observes that customs revenues derived from EU and COMESA imports sources is 16.4 percent .Out of this, COMESA import only 2.9% on average. But the trend of COMESA import share to custom duties grew overtime.

2.2 Intra COMESA trades between member countries.

In general, low intra-regional trade is common feature to all African Regional Trade Arrangement. Two main factors are probably responsible for that. First, the potential for trade within African RTAs is small because of the relatively small economic size of the countries and the low levels of income. Second, countries often produce the same commodities and hence they lack the complementarities required for trading. In addition to that, lack of physical connectivity as well as the uncertainty generated by unstable economic and socio-political conditions further reduces the scope for regional trade (Asgedom Ferede and Hailu ,2003).

The Trade among COMESA Countries in the last five years is shown in the following table.

Table 2.3: Intra-COMESA Trade by Country (Millions of US$) 2004 - 2008

Country	2004		2005		2006		2007		2008	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Burundi	7.8	46.2	14.5	53.9	23.4	68.3	36.6	175.4	17.0	75.0
Comoros	0.1	7.7	0.1	6.6	0.7	15.2	0.2	2.8	0.2	8.9
Congo DR	30.5	277.2	38.8	188.2	68.8	350.2	188.1	665.8	511.3	718.7
Djibouti	8.4	31.0	62.8	84.0	7.8	8.4	31.7	108.0	2.8	62.0
Egypt	231.4	188.2	431.4	298.5	505.7	266.4	494.3	312.2	1,639.7	1,147.5
Eritrea	0.6	3.2	11.6	15.5	2.6	26.6	6.3	4.9	4.3	4.5
Ethiopia	18.2	47.9	95.0	192.1	100.0	391.1	123.8	213.7	152.4	324.0
Kenya	529.1	173.7	866.9	175.7	911.2	243.3	1,114.3	428.3	1,427.6	410.9
Libya	33.9	80.2	115.7	166.3	105.3	211.9	153.5	278.5	233.2	932.5
Madagascar	41.4	86.2	20.2	101.4	22.1	71.7	31.7	122.8	12.9	68.7

Malawi	100.8	74.3	44.7	177.6	76.3	180.9	183.7	140.0	283.9	596.6
Mauritius	57.1	85.3	56.1	72.8	57.1	99.1	75.4	120.8	82.0	140.8
Rwanda	26.8	33.6	28.7	141.0	36.2	336.9	50.7	264.9	207.9	408.2
Seychelles	0.3	22.6	0.6	21.0	0.5	23.7	0.7	26.0	1.9	48.5
Sudan	63.7	350.5	57.8	477.1	87.7	651.0	29.7	441.5	128.4	887.2
Swaziland	106.4	0.3	62.8	1.1	102.3	1.2	191.1	25.5	168.0	51.1
Uganda	146.4	435.8	181.3	565.0	234.2	450.4	367.2	515.9	532.9	570.6
Zambia	269.3	201.5	328.0	246.4	276.7	310.7	612.2	394.6	778.5	780.5
Zimbabwe	131.5	77.8	166.1	61.3	83.3	50.2	258.6	312.2	171.9	97.6
Total	**1,803.8**	**2,223.1**	**2,583.0**	**3,045.6**	**2,701.9**	**3,757.4**	**3,949.9**	**4,553.8**	**6,356.9**	**7,333.8**

Source: COMESA COMSTAT database

The percentage of intra-COMESA trade to total COMESA trade with the rest of the world has remained low on average at 4 percent for the last 4 years (COMESA Date base).Hence the trade between them was very low even though, it grows overtime.

Ethiopia export and import share to COMESA Countries is very low which is 2.39% and 4.41% respectively, but it growth over time.

2.3 Theoretical review

2.3.1 Definition of Free trade area (FTA)

Free trade area is a type of trade block, a designated group of countries that have agreed to eliminate tariffs, quotas among them but retaining restrictions on imports from non-member countries and preferences on most (if not all) goods and services traded between them. It can be considered as the second stage of economic integration, Weaver (2001).

Under a free trade policy, prices are reflections of true supply and demand, and are the sole determinant of resource allocation.

2.3.2 Features of Free trade area

Free trade areas have the following features:

- Trade of goods without taxes (including tariffs) or other trade barriers (e.g ,quotas on imports or subsidies for producers) between members of the free trade area.
- Trade in services without taxes or other trade barriers between members of the FTA.
- The absence of "trade-distorting" policies (such as taxes, subsidies, regulations, or laws) that give some firms, households, or factors of production an advantage over others .
- Free access to markets .
- Free access to market information.
- Inability of firms to distort markets through government-imposed monopoly or oligopoly power.
- The free movement of labor between and within countries.

2.3.3 Economic literature behind FTA

The value of free trade was first observed and documented by Adam Smith in his book the wealth of Nations, in 1776. Later, David Ricardo made a case for free trade by presenting a specialized economic proof featuring a single factor of production with constant productivity of labor in two goods, but with relative productivity between the goods different across two countries. Ricardo's model demonstrated the benefits of trading through specialization—states could acquire more than their labor alone would permit them to produce. This basic model ultimately led to the formation of one of the fundamental laws of economics: The Law of Comparative Advantage. The Law of Comparative Advantage states that each member in a group of trading partners should specialize and produce the goods in which they possess lowest opportunity costs relative to other trading partners. This specialization permits trading partners to then exchange their

goods produced as a function of specialization. Under a policy of free trade, trade via specialization maximizes labor, wealth and quantity of goods produce, exceeding what an equal number of autarkic states could produce (Wikipedia, 2011).

Many classical liberals, especially in the 19th and early 20th century Britain (e.g. John Stuart Mill) and in the United States for much of the 20th century (e.g. Cordell Hull), believed that free trade promoted peace. The British economist John Maynard Keynes (1883–1946) was brought up on this belief, which underpinned his criticism of the Treaty of Versailles in 1919 for the damage it did to the interdependent European economy. After a brief flirtation with protectionism in the early 1930s, he came again to favour free trade so long as it was combined with internationally coordinated domestic economic policies to promote high levels of employment and international economic institutions that meant that the interests of countries were not pitted against each other. In these circumstances, 'the wisdom of Adam Smith' again applied, he said. Some degree of Protectionism is nevertheless the norm throughout the world. In most developed nations, controversial agricultural tariffs are maintained. From 1820 to 1980, the average tariffs on manufactures in twelve industrial countries ranged from 11 to 32%. In the developing world, average tariffs on manufactured goods are approximately 34 % (Wikipedia 2010).

Currently, the World Bank believes that, at most, rates of 20% can be allowed by developing nations; but Ha-Joon Chang believes higher levels may be justified because the productivity gap between developing and developed nations is much higher than the productivity gap which industrial countries faced. A general feature is that the underdeveloped nations of today are not in the same position that the developed nations were in when they had a similar level of technology, because they are weak players in a competitive system; the developed nations have always been strong players, although formerly at an overall lower level. If the main defense of tariffs is to

stimulate infant industries, a tariff must be high enough to allow domestic manufactured goods to compete for the tariff to be possibly successful. This theory, known as import substitution industrialization, is largely considered to be ineffective for currently developing nations and studies by the World Bank have determined that export-oriented industrialization policies correlate with higher economic growth as observed with the Four Asian Tigers. These assessments are based mainly on theory and observational study of correlations, and thus suffer from a number of weaknesses such as small sample size and numerous confounding variables.

2.4 Empirical review

There is different FTA in the world, for instance Mercosur[3] , NAFTA[4] (North American Free Trade Agreement), CAFTA[5], East Asia, EU[6]-CIS[7], ECOWAS[8] and SADC[9] (South Africa development community) from different continent. The impacts of these FTA on member countries have analysis by different scholar. This section will discuss the empirical findings of some studies.

Morely and Pinero (2006), analyzed the impact of CAFTA on growth in the case of El Salvador. El Salvador was the first country in Central America to ratify in CAFTA agreement (December

[3] Mercosor member countries are Brazil, Argentina, Paraguay, and Uruguay, Other L. American nations with associate status (Bolivia, Chile, Venezuela, and Mexico).

[4] NAFTA FTA members are US, Canada and Mexico.

[5] CAFTA: Free trade between US and five central America countries

[6] EU :European union

[7] CIS: Common wealth independent state

[8] ECOWAS: Economic community of West African States

[9] SADC member countries are Angola, Botswana , Democratic republic of the Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique , Namibia, South Africa , Sudan, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe

2004). Even before, CAFTA El Salvador has already significantly reduced barriers to import. Over the course of time in the 1990s, the average tariff rate was cut by almost two third so that by 1999 the country has the second lowest tariff level and smallest tariffs depression in central America .That means the CAFTA does not represent a significance change in direction in general tariff policy, on average, of course can hide significant difference in protections a cross sectors. The analysis used static and recursive CGE model specification using five simulation scenarios. The simulation used in the study is that when the economy without CAFTA and with CAFTA along different sector specific tariff reduction. The results indicate trade liberalization under CAFTA has positive effect on the growth rate of the economy, but the effect is small with the growth rising only 0.2% per year over the base year scenario. On the other hand ,simulation results also shows under sectoral level, trade liberalization under CAFTA increases production ,import and export in all sectors. One might have thought that unilaterally reducing tariff barriers might increase import and crowding out domestic production. While that may happen in particular sector, it does not happen in agriculture; instead resources move into areas where they are more productive. The conclusion of this study is that CAFTA will enhance growth prospect for El Salvador under different sector. In addition, CAFTA created employment for unskilled both in rural and urban by attracting foreign investment.

Ando (2009) examined the impact of FTA in East Asia using CGE model. The scenario built on the liberalization of trade in goods and also considers other possible aspects of FTA such as various trade and investment facilitation and technical assistance to developing countries in the region. The scenarios are five, which are Full liberalization with agriculture and non-agriculture and Full liberalization plus other trade facilitation measures. The study concludes that trade liberalization of course important, trade facilitation and technical assistance in addition to trade

liberalization is even more beneficial to member countries. The results also demonstrated greater effect in scenario of partial liberalization of trade in agriculture sector than full liberalization of both non agriculture and agriculture. In some countries the exclusion of the agriculture sector from trade liberalization worsens terms of trade and intensified inefficiency in resource allocation, resulting in deterioration of economic welfare .Thus it is important to improve market access in agriculture sector in addition to other sectors. The effect of FDI was not considered in the simulation.

Francios and Manchin (2009), on their part, investigated the economic impact of potential free trade between European and common wealth of independent states using CGE model. The CGE model takes different underlying industry specific market structure and elasticities into account. Furthermore, the model incorporate estimated non tariff trade barriers to trade in services. The results are compared to a baseline that incorporates recent development in trade policy environment that is phase-out of ATC[10], enlargement of the EU and CIS accession to the WTO[11]. The analysis take the agricultural liberalization ,liberalization in industry tariffs and liberalization in services trade as well as trade facilitation measure into account. The result shows, there is important heterogeneity in the impact of FTA on individual countries, this indicate that the CIS as a whole would experience a negative income effect if the FTA would be limited only to trade in goods. This is due to strong trade diversion effects. The CIS have high tariffs and these would remain against the third countries under FTA .This implies that the CIS would mostly likely to benefit from FTA with the EU, if it would incorporates deeper forms of integration is not being

[10] ATC: Agreement on textile and cloth

[11] WTO: World trade organization

limited to liberalization of tariff in goods, or if it is accompanied by a general reduction in CIS tariffs against third countries.

Ferede, Asgedom , Haile(2003), also studies The implication of COMESA Free trade area on Ethiopia. The methodology used under this study is partial equilibrium analysis. The scenarios formulated are reducing and /or eliminating tariff on import of commodities originating from the COMESA member countries .Furthermore, the model considered three actors, that are home country (Ethiopia), the trade partner of COMESA member countries taken together as single and rest of the world .The paper has estimated the trade effect of COMESA FTA on consumption, trade diversion and trade creation. The result shows: 85 commodities are imported from COMESA member countries .Of the 85 commodities, 48 of them are identified as commodities that have no welfare effect implying that COMESA member countries are not competitive producers of these commodities relative to the rest of world. Again out of 85 commodities, 31 of them are found to have consumption effect only. Specifically, 5 of the thirty-one commodities are agricultural and the rest are manufacturing .On the other hand, out of 85 commodities 12 of them are classified as commodities having trade diversion with consumption effect. Only one commodity out of the twelve which is agriculture good has both consumption and trade diversion effects. And the rest 11 are manufacturing goods. Out of 85 commodities imported from COMESA, 5 commodities have trade creation with consumption effect, one commodity from agriculture and 4 commodities from manufacturing. Under this model, it would not possible to assess the impact of this trade arrangement on investment or any other related macro variables. Hence, regional integration through complete elimination of tariff has different impacts on different sectors of the manufacturing activities.

On those commodities where COMESA member countries are efficient and are the main suppliers before any trade arrangement, the model estimates consumption effect only, resulting from reduced prices on imported commodities. According to these results, there appears to be an expansion of manufacturing imports by about 0.03% of GDP or 0.15 % of the total value of imports. As a result, consumption has expanded marginally by about 0.002% of GDP. This would benefit domestic consumers considerably. It is so since price of imports falls, quantity demanded increases for normal goods and hence consumers enjoy more goods at reduced prices. In agriculture sector, the net welfare effect depends on the relative magnitudes of the gain in consumers and the loss in tariff revenue. Since the loss in tariff revenue is offset by the gain in consumers, the net welfare effect increases in consumption, which is positive. In fact, the welfare has increased by about 0.002% of GDP.

Mercusur FTA by Philippidis and Sanjuan, 2007 that indicates: Free trade area is resulted in trade creation that outweighs trade diversion in that yielding a welfare gain to Mercusur. This welfare gains are magnified by additional returns to scale in imperfectly competitive sectors and capital accumulation effects resulting in further macro growth.

NAFTA FTA has made some reforms under the FTA: for instance Mexico has got benefits by the phaseout over 15 years of most barriers in the US to agricultural export.US, Canada and Mexico have received national treatment for investors and rights to have anti-dumping penalties reviewed(Australia and Us trade issues paper ,chapter three).

In the case of Africa, most FTA is not so much effective due to several reasons. This is mainly due to overlapping of the membership, poor private sector participation, lack of infrastructure and product similarity. However, positive achievements have been observed in some FTAs like

SADC and ECOWAS. As Yongzheng Yang and Sanjeev Gupta *(*2007) shows that SADC has significantly improved FDI due to trade diversion effect.

Deme (2007): also found regional integration schemes have succeeded in increasing trade flows between member countries under ECOWAS.

Chapter three

Model specification

3.1 Data base

3.1.1 Social accounting matrix (SAM)

The construction of a Computable General Equilibrium (CGE) model is usually based on a social accounting matrix (SAM) that describes the initial state of the economy (Anneb, 2006).

Presentation of an aggregate SAM for the economy is a useful way to set the stage for discussing the equations of the core model. A SAM is the synthesis of two well-known ideas in economics. The first derives from the input-output figure, which portrays the system of inter industry linkages in the economy. The purchase of an intermediate input by one sector represents the sale of that same input by another sector. While this transaction is entered in a single cell in the input-output figure, it appears in the accounts of the two different sectors using traditional double-entry bookkeeping. The SAM generalizes the input-output idea that one sectors' purchase is another sector's sale to include all transactions in the economy, not just inter industry flows. Any flow of money from, say, a household to a productive sector (representing the purchase of that sector's output by the household), or from a household to the government (representing tax payments), is recorded in the SAM as an expenditure by some actor (the column) to some other actor as a receipt (the row).The second idea embodied in the SAM, derived from national income accounting, is that income always equals expenditure. Although true for the economy as a whole, the SAM requires a balance in the accounts of every factor in the economy. More technically, a SAM is a square matrix in which each account is represented by row and column. In the SAM, incomes appear along the rows, and expenditures down the columns; thus the budget constraints

require that the row sum must equal the column sum (Robinson, Yu´nez-Naude, -Ojeda,D. Lewis, Devarajan,1999).

The base run structure of the Ethiopian economy is represented by the 2005/06(1998 EFY[12]) SAM. The Ethiopian SAM distinguishes 42 production activities, 61 commodity groups, 5 primary factors, 2 household groups, 17 tax instruments as well as aggregate accounts for trade margins, transport margins, government, investment, and the rest of the world.

This SAMs have four major types of accounts: activities, commodities, factors of production, and institutions (households, enterprises, government and the Rest of World), including an aggregate savings-investment account. The activity accounts show the value of commodities (goods and services) produced by each activity and the cost of inputs into each production activity consisting of intermediate input purchases along with payments to primary factors of production (EDRI,2009).

Commodity accounts show the components of total supply in value terms (domestic production, imports, indirect taxes and marketing margins) and total demand (intermediate input use, final consumption, investment demand, government consumption and exports). Factor accounts describe the sources of factor income (value added in each production activity) and how these factor payments are further distributed to the various institutions in the economy (households of different types, government and the Rest of World). Accounts for institutions record all income and expenditures of institutions, including transfers between institutions. Savings of the different institutions and investment expenditures on commodities are given in the savings-investment account[13].

[12] Ethiopia fiscal year

[13] IBID

Ethiopian economic situation based on the macro SAM, the share of GDP generated by each sector, is determined by each sectors contribution to total value-added. Ethiopia is largely an agricultural economy with 48 percent of total GDP at factor cost being generated within the agricultural sectors. Among the non-agriculture sectors, services are important source of value-added with a share of GDP about 40.4 percent, manufacturing sector is only 4.7% and other industries contributes 6.8%. On the other hand, the most labor intensive sector is agriculture, where about 75.4 percent of the sector's value-added is paid to labor. Meanwhile capital intensive, where only 24.6 percent of the sector's value-added is paid to capital-land. By contrast, the most capital intensive sectors are Services and the "Other Industries", which are 61.4% and 9.8% respectively. The trade shares shed light on the structure of imports and exports. Like several sub-Saharan countries, Ethiopia relies on exports of primary product which share 41 percent and transport services are 27.5%. A large share of imports accounting machinery, transport, and electronic & Other Equipment which account for 26.8% and the share of petroleum product and transport services are 12.1% and 17.1% respectively. Lastly, the total trade deficit in EFY 1998 (2005/06) was 30.24 billion birr, accounting for about 22.8 percent of the GDP[14].

[14] IBID

Table 3.1 Base run statistics

Description	Agriculture	Manufacturing	Services	Other industries
Import intensity[15]	4.14%	67.06%	16.6%	0.52%
Import share	5.41%	70.5%	23.84%	0.24%
Export Intensity[2]	8.05%	7.37%	9.28%	0.4%
Export share	46.43%	16.97%	35.97%	0.63%
Value added share to the GDP	48.1%	4.7%	40.4%	6.8%
Intermediate Demand	5.2%	37.22%	20.67%	36.89%
Labour share to Production output	75.4%	41.4%	23%	26.7%
Capital and land share to Production output	24.6%	58.6%	77%	73.3%

**EDRI, 2009(Some of them calculated by own using EDRI SAM)*

In this study, we capture the export and import of Ethiopia in separate way as COMESA and Rest of the world.

3.1.2 Tariff reform in Ethiopia

In August 1993, the Ethiopian government embarked on a comprehensive trade reform program aimed at eliminating quantitative restrictions and gradually reducing the level and dispersion of tariff rates**.** There are no preferential tariffs except for imports from COMESA member countries, for which a 10% reduction of MFN[16] tariffs apply. As result of the reforms tariff rates narrowed down from pre-reform 0-230% to 0-80% in 1993 and then, in subsequent reforms it reaches, to 0-35% in 2003. Due to these reform measures, the average weighted tariff rate declined from 41.6% prior to the reform to 17.5% in 2003.

[15]Import intensity is share of import in domestic demand and export intensity is share of exports in domestic production .(calculated by Dorosh and Thurow

[16] Moist favor nation

Table 3.2 Tariff reform in Ethiopia

Description	Pre reform period	Aug 93 amend 1st	Jan 96 amend 2nd	Dec 96 amend 3rd	Jan 98 amend 4th	Dec 98 amend 5th	Jan 2003 amend 6th
Maximum Tariff Rate	230	80	60	50	50	40	35
Number of Tax Exemption	327	138	169	170	168	167	179
Simple Aver.Tariff Rate	79.1	35.0	28.8	24.3	24.3	20.0	20.0
Weighted Aver.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	5
Specific Items	157	4	4	4	4	3	-
Total Number of Items	1821	5332	5294	5295	5486	5426	5608

Source: MOFED

*The paper does not capture 2007 amendment, because the 2005/06 SAM does not include the amendment it.

The reform also reduced the tariff bands from 23 (include zero rate) to 6. The tariff bands range from 5% to 35% (plus zero rate); they are 5, 10, 20, 30 and 35% respectively.

On the export side, duties on all exports other than coffee (the main export product) were removed. The coffee export duties were initially unified at 6.5%, but eliminated in 2002.

Import is prohibited for five items, including opium, ethyl alcohol and other similar spirits and worn clothing and textile articles or rags. These prohibitions are put in place for health reasons and for preventing illegal traders from importing contraband classified as used clothing and rags.

3.2 Description of the Model

The model presented in this paper is used at its core of static model used by the International Food Policy Research Institute (IFPRI) as described in Lofgren *et al*. (2002). The model is

recursive dynamic computable general equilibrium which is an extension of the IFPRI static model developed by Thurlow (2008).

The model belongs to the recursive dynamic CGE model, shows that the behavior of its agents is based on adaptive expectations[17], rather than on the forward looking expectations that underlie alternative inter-temporal optimization models. Since a recursive model is solved one period at a time, it is possible to separate the within-period component and on the other hand the between-period component which implies the dynamics part of the model (Thurlow.2008).

3.2.1 Within –period specification

The within-period component describes a one-period static CGE model. The following description of this model is divided into the production and prices, commodity flow and the generation of institutional incomes and demand. Equilibrium is maintained through a series of system constraints, all these issues will be discussed as follows. Then explanation on the model closure relevant to the Ethiopia economy will follow.

3.2.1.1 Production and prices

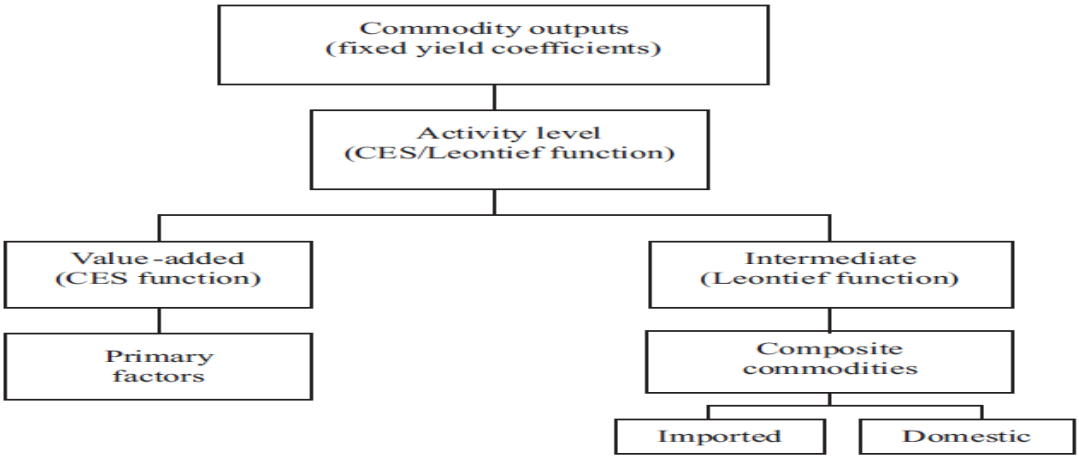
The model combines primary factors with intermediate commodities to determine a level of output. The factors of production identified in the model include capital, land and labour. The technology underlying production is depicted for a single producer. The main feature listed as follows:

- Producers in the model make decisions in order to maximize profits subject to constant returns to scale.

[17] Adaptive expectation means economic agent is myopic behavior depend only on current and past states of the economy.

- The choice between factors is being governed by a constant elasticity of substitution (CES) function.
- Producers respond to changes in relative factor returns by smoothly substituting between available factors so as to derive a final value-added composite.
- Profit maximization implies that the factors receive income where marginal revenue equals marginal cost based on endogenous relative prices.
- The factors are combined with fixed-share intermediate input using a Leontief specification.
- The use of fixed-shares reflects the belief that the required combination of intermediates per unit of output, and the ratio of intermediates to value added, is determined by technology rather than by the decision- making producers.
- The final price of an activity's output is derived from the price of value-added and intermediates, together with any producer taxes or subsidies that may be imposed by the government per unit of output.
- Individual activities to produce more than a single commodity and conversely, for a single commodity to be produced by more than one activity.
- Consumer price index (CPI) is exogenous and domestic producer price index (DPI) is endogenous variable.

Figure3.1 Production Technology



Source: Lofgren (2002)

3.2.1.2 Commodity flow

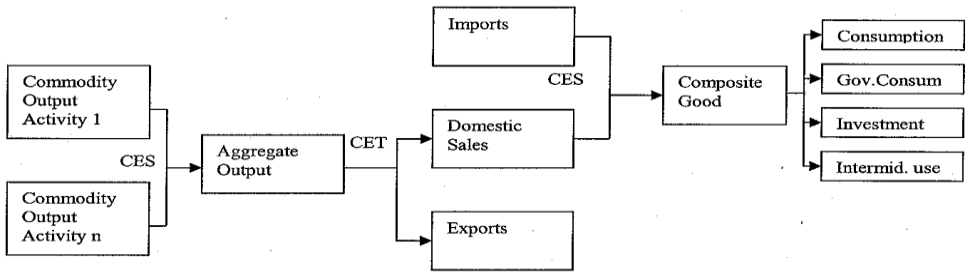
It shows the flow of a single commodity from being supplied to the market to its final demand.

The main features are follows:

- The supply of a particular commodity from each producer is combined to derive aggregate commodity output.
- The aggregate commodity output is governed by a CES function which allows demanders to substitute between the different producers supplying a particular commodity, in order to maximize consumption subject to relative supply prices.
- The decision of producers is governed by a constant elasticity of transformation (CET) function, which distinguishes between exported and domestic goods, and by doing so, captures any time or quality differences between the two products.
- Profit maximization drives producers to sell in those markets where they can achieve the highest returns.

- Domestically produced commodities that are not exported are supplied to the domestic market.
- Substitution possibilities exist between imported and domestic goods under a CES Armington specification. It takes place both in final and intermediates.
- The Armington elasticities vary across sectors, with lower elasticities reflecting greater differences between domestic and imported goods.
- Small country assumption[18], Ethiopia is assumed to face infinitely elastic world supply at fixed world prices.
- The final ratio of imports to domestic goods is determined by the cost minimizing decision-making of domestic demanders based on the relative prices of imports and domestic goods (both of which include relevant taxes.

Figure 3.2 Flow of marketed commodities



Source: Morley and pineiro (2006)

3.2.1.3 Institutions and Domestic demand

The model distinguishes between various institutions based on the Ethiopian SAM, including enterprises, the government, households and Rest of the world.

[18] Small country assumption means no power to affect the world price, so the country is world price taker.

- Enterprises are getting of capital income from transfer to household after having paid corporate taxes and saved.
- Based on macro SAM, Households are divided into four income divisions as rural-poor, rural-non poor, urban-poor and urban-non poor. Households within each income category are assumed to have identical preferences, and are therefore modeled as 'representative' consumers. Consumer preferences are represented by a linear expenditure system (LES) of demand, which is derived from the maximization of a Stone-Geary utility function subject to a household budget constraint.
- Government earns most of its income from direct and indirect taxes, and then spends it on consumption and transfers to households. Both of these payments are fixed in real terms. Government have both revenue and expenditure part.

Domestic demand is the sum of household consumption demand for home and marketed commodity, investment demand, government consumption demand, transaction demand for service inputs and intermediate consumption demand.

3.2.1.4 System constraint

Equilibrium in the goods market requires that demand for commodities equal supply. Aggregate demand for each commodity comprises household and government consumption spending, investment spending, and export and transaction services demand. Supply includes both domestic production and imported commodities. Equilibrium is attained through the endogenous interaction of domestic and foreign prices, and the effect that shifts in relative prices have on sectoral production and employment, and hence institutional incomes and demand. The supply of this factor is responsive to changes in real wage, which adjust to ensure that demand and supply are equal in equilibrium (Thurlow, 2004).

The system constraint includes factor market, composite commodity market, and current account balance for the rest of the world, government balance and saving –investment balance.

3.2.1.5 Model closure

The study selects the model closure that expresses the Ethiopian economy. These are the following.

I. **External balance**: the level of foreign savings is fixed in foreign currency terms. In the context of a trade shock, joining the COMESA FTA, any widening of the trade deficit due to growth in imports exceeding growth in exports must therefore be offset through an overall reduction of spending on imports from all sources together with an overall increase in export earnings. This response is implicitly affected through a real exchange rate adjustment (current times Ethiopia use devaluation policy). Therefore the study use flexible exchange rate and fixed foreign saving.

II. **Government balance**: real expenditures and tax rates are fixed and government savings are flexible. Accordingly, the budget balance adjustments done by the government through a change in direct and indirect tax receipts, these are policy measures. Thus the study chooses government saving to be flexible and fixed tax rates.

III. **Savings-investment balance**: the savings rates of non government institutions are fixed, and investment adjusts to ensure that savings equals investment in equilibrium. Hence, an increase in government dis-saving implicitly “crowds out” investment by drawing down the amount of loan able funds available to the private sector. Therefore the study chooses the investment is saving driven closure.

At the end, the consumer price index is chosen as the numéraire, such that all prices in the model are relative to the weighted unit price of households' initial consumption bundle. The model is homogenous of degree zero in prices, implying that a doubling of all prices does not alter the real allocation of resources. Accordingly, the model cannot capture interactions between the financial and real sectors of the economy.

3.2.2 Between-period specification

The static model described has not able to account the second period effect .For instance change in capital on current investment depends upon the previous availability of capital. Therefore to solve this problem, the study use IFPRI model by Throw (2008), that extend static model into dynamic recursive dynamic model.

The dynamic model updates the parameter; it mainly focuses on capital formation, demographic and technological changes. The dynamic model is described as follows

- The process of capital accumulation is modeled endogenously, with previous-period investment generating new capital stock for the subsequent period. Although the allocation of new capital across sectors is influenced by each sector's initial share of aggregate capital income, the final sectoral allocation of capital in the current period is dependent on the capital depreciation rate and on sectoral profit-rate differentials from the previous period.
- Population growth is exogenously imposed on the model based on separately calculated growth projections. It is assumed that a growing population generates a higher level of consumption demand and therefore raises the supernumerary income level of household consumption. There is assumed to be no change in the marginal rate of consumption for

commodities, implying that new consumers have the same preferences as existing consumers.

- Factor-specific productivity growth is imposed exogenously on the model based on observed trends for labour and capital.
- Growth in real government consumption and transfer spending is also exogenously determined between periods, since within-period government spending is fixed in real terms.

The dynamic model incorporates the following six equations in addition to the static model.

Capital Accumulation and Allocation Equations

$$AWF_{ft}^{a} = \sum_{a} \left[\left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}} \right) \cdot WF_{ft} \cdot WFDIST_{fat} \right] \quad (1)$$

$$\eta_{fat}^{a} = \left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}} \right) \cdot \left(\beta^{a} \cdot \left(\frac{WF_{f,t} \cdot WFDIST_{fat}}{AWF_{ft}^{a}} - 1 \right) + 1 \right) \quad (2)$$

$$\Delta K_{fat}^{a} = \eta_{fat}^{a} \cdot \left(\frac{\sum_{c} PQ_{ct} \cdot QINV_{ct}}{PK_{ft}} \right) \quad (3)$$

$$PK_{ft} = \sum_{c} PQ_{ct} \cdot \frac{QINV_{ct}}{\sum_{c'} QINV_{c't}} \quad (4)$$

$$QF_{fat+1} = QF_{fat} \cdot \left(1 + \frac{\Delta K_{fat}^{a}}{QF_{fat}} - \upsilon_{f} \right) \quad (5)$$

$$QFS_{f\,t+1} = QFS_{ft} \cdot \left(1 + \frac{\sum_{a} \Delta K_{fat}}{QFS_{ft}} - \upsilon_{f} \right) \quad (6)$$

Source: Lofgren (2002).

The dynamic model is solved as a series of equilibrium, each one representing a single year. By imposing the above policy-independent dynamic adjustments, the model produces a projected base year growth path. Policy changes can then be expressed in terms of change in relevant exogenous parameters, in our case, the change in import tariff rate and the model is re-solved for a new series of equilibriums. Differences between the policy- influenced new growth path and the base case growth path can then be interpreted as the economy- wide impact of the simulated policy.

Chapter four

Model result

This paper uses recursive dynamic CGE model. The model solves the system of equations for all endogenous variables for consecutive periods of time. In each of our simulations we run the model from its 2005 base, using the observed values for all exogenous variable up to 2010, by shocking the tariff introduced by COMESA after 2011.The simulation is applied on each scenario up to 2015 and presents the results in the form of rates (growth) of all endogenous variable of interest from initial 2005. The model was used to examine the impact COMESA FTA on overall Ethiopian economy using three set of scenario. These are total removal of import tariff on agriculture and non-agriculture sector, removal of import tariff from agricultural sector only and removal of tariff from non- agricultural sector only. There is also base scenario which projects the Ethiopian economy without COMESA FTA. It provides a counter factual for other simulation. For each scenario, the impact of the policy shock is the difference between that of counterfactual and policy shocks.

Scenario one: Total removal of import tariff in all sector

The results are summarized as follows. These are:

1. Household consumption expenditure, production and government revenue.
2. Macro variables specifically GDP, Export and Import.
3. Trade creation and Trade diversion

4.1. Household consumption expenditure, production and government revenue.

I. **Household consumption expenditure**: Before we explain effect on household consumption expenditure, there is a need to classify household into four agro ecological zone. These are humid cereals, humid enset, drought prone and pastoralist. The effect of the tariff shock on consumption expenditure is shown as follows:

Table 4.1 Household consumption expenditure (%)

Household in agro ecological zone	INITIAL	BASE	FTA
hh-hc-pr[19]	9340.599	8.406156	8.487448
hh-hc-np	30751.03	7.966377	7.981481
hh-ho-pr[20]	5076.877	7.038605	7.079534
hh-ho-np	13134.49	7.04993	7.044719
hh-dp-pr[21]	5559.928	6.0235	6.124498
hh-dp-np	12000.03	6.753548	6.763645
hh-pa-pr[22]	1160.985	5.63769	5.686591
hh-pa-np	5875.666	6.449857	6.438519

Source: CGE result

From table 4.1, the growth of household consumption expenditure increase in humid cereals area from 8.4% to 8.5% and from 7.97% to 7.98% for poor and non-poor households respectively. The growth of household consumption expenditure in humid enset also increase from 7.03% to 7.08% for poor but decrease for non- poor from 7.05% to 7.04%. Meanwhile, households living in draught prone area also increase their consumption expenditure from 6.02% to 6.12% and from

[19] Household in humid cereals (poor)

[20] Household in humid in enset(poor)

[21] Household in draught prone(poor)

[22] Household in pastoralist(poor)

6.75% to 6.76% for poor and non-poor households respectively. Lastly, for the poor households in pastoralist agro ecological zone, consumption expenditure increased from 5.63% to 5.68% but for non-poor household the consumption expenditure decrease from 6.45% to 6.44%.

Even if consumption expenditure of household in pastoralist area is partly declined, actually the household who lives in border of Ethiopia (such as Somalia and Afar people) have access to selected import product from border trade scheme established by Ethiopia government and the neighbors countries government (Sudan, Djibouti and Kenya). Hence, the non poor are not significantly affected by being the FTA membership.

In general, the consumption expenditure increase for most of agro ecological zone due to joining COMESA FTA .The main reason for this outcome is that the increment in quantity of import results in a decrease in the prices of elastic demand product. In addition, new products are also supplied to Ethiopia market due to FTA schemes. Thus, consumption expenditure of households increases for both the existing product as well as the newly introduced product. But the increment is very small since the share of COMESA trade to Ethiopian economy is very less.

Further more; the trends of consumption expenditure pattern from 2011 up to 2015 are also enhanced (Annex 1). The consumption expenditure increases within each years for humid cereals (poor and non poor), humid enset (poor), draught prone (poor and non poor) and pastoralist (poor). But for humid enset (non poor) and pastoralist (non poor) the consumption expenditures decreases.

II. Production output and factor of production demand.

i. Domestic Activity

The study results indicated that the impact of COMESA FTA have mixed outcomes on production. We can classify the outcome into three categories. These are the activities that exhibited decrease, increase and no change as the results of this shocks. See annex 2 for detailed.

A. Decrease in domestic activity

The activity which decreases due to tariff reduction are teff, wheat ,pulse ,oilseed ,fruit ,other crops ,cattle ,poultry ,animal product ,fisheries and forestry from agricultural sector[23]. The main reason for this result is that there is substitution of import food product for domestic one .For example: teff and wheat are food items which could be substituted by imported food items. Meanwhile, other tradeable agricultural items like pulse ,oilseed, fruit, cattle ,poultry, milk ,animal product, fisheries and forestry are highly affected by competition from COMESA countries export .This is due to the fact that product similarities between COMESA member countries and Ethiopia. On the other hand, industrial activity such as: Mining, dairy product, grain milling, sugar refining, wood, nonmetal, machine and other manufacturing also decreased. This happens due to the industrial sector[24] in our country are at their early stage of development. This implies that industries do not produce at least cost. Therefore, they do not resist the competition from COMESA member countries. In addition , the services sector[25] mainly

[23]Agricultural sector includes teff ,barely, wheat maize ,sorghum ,pulses ,oilseed ,enset, vegetables ,fruit, cotton ,sugar ,tea ,chat ,coffee, tobacco, flower, other crops, cattle, milk, poultry, animal product ,fisheries and forstries.

[24] Industrial sector includes mining, dairy product, vegetable product, grain milling, meat product, prepared tea, prepared sugar, food ,beverage, prepared tobacco ,textile ,cloth ,leather ,wood ,paper ,chemical ,nonmetal ,metal, machine ,vehicles, electric equipment and other manufacturing.

[25] Service sector includes electricity, water supply, construction, trade, hotel, transport, communication, finical services, business services, real estate, other services, public administration, education and health.

construction and business services also decrease .This may be due to the spillover effect of other services like the reduction of government spending on construction and an increase in investment on other sector (like electricity and water supply).Moreover, business services do not have access to loan because the government have allocated high fund on electricity ,real estate ,public administration and water supply.

B. Increase in domestic activity

Domestic activities of agriculture product such as: barely, maize, sorghum, vegetable and tea increased. This is due to the fact that they are trade able products. They have got higher market access due to COMESA FTA. From the industrial sector: vegetable product ,milling ,tea processing ,food product, beverages, tobacco processing, textile ,cloth ,leather, paper, chemical, metal, vehicles and electric equipment also increased. These industrial activities are highly supported by government under different schemes such as domestic tax relief and land access .Hence, this production grows much higher than other activities. Similarly, services sector such as electricity, water supply, hotel, transport, communication, finical, real estate, health, education and public administration are increased. This sector grows in recent years due to excess demand for the services by COMESA member countries. For example, Sudan and Djibouti are in need of electric supply from Ethiopia.

C. No change in domestic activity

The activities such as enset, cotton, sugar, chat, tobacco, coffee and flower are not changed in terms of production from base scenario. These domestic activity are not sold to COMESA countries rather, they are exported to non COMESA countries. For instance, coffee and flowers are more demanded by Europe, Asia and America.

In general, the results of joining COMESA FTA will be summarized in terms of sectoral production as given in the table below.

Table 4.2: Domestic activity by sector (% change)

Sectors	Initial	Base	FTA
Agriculture	59976.59	8.116979	8.241771
Non agriculture	319846	13.98059	14.29235
Total	191627.2	11.07	11.13

Source: own calculation based on CGE results

Table 4.2 indicates domestic agricultural activity increased from 8.11% to 8.24% and non agriculture also increased from 13.98% to 14.29%.The overall impact of joining COMESA FTA will increase growth in domestic activity from 11.07% to 11.3%.

ii. Commodity output

Under commodity part, the paper shows the quantity of marketed output from 2011 up to 2015 in different sectors. It is indicated as follows.

Table 4.3: Quantity of marketed output (value) by sector.

Sector	Year	2011	2012	2013	2014	2015
Agriculture sector	Base	41479.08	44610.57	48104.41	51807.6	55931.38
	FTA	41698.2	44877.24	48416.5	52148.06	56279.21
Industrial sector	Base	48017.22	54464.17	61697.53	69637.78	78332.95
	FTA	50428.06	57292.7	64994.69	73466.65	82770.09
Services sector	Base	204694.6	229567.1	258113.3	290770.1	328096.3
	FTA	205513.7	230058	258078.1	290064.2	326584.6

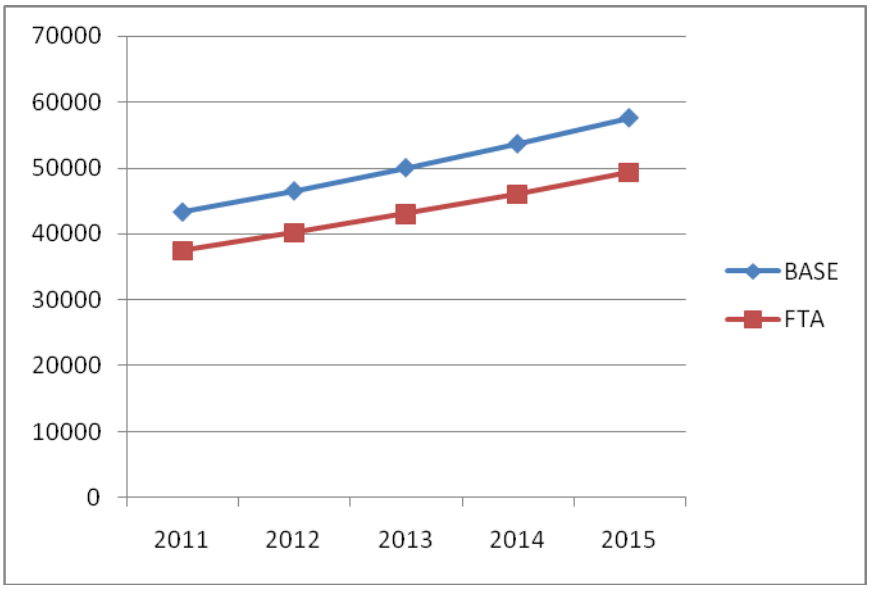
Source: own calculation based on CGE results

As indicate in table 4.3 ,agriculture sector increase to 41.6 billion birr in 2011,44.9 billion birr in 2012 ,48.4 billion birr in 2013 ,52.1 billion birr in 2014 and 56.3 billion birr in 2015 from base scenario of 41.5,44.6,48.1,51.8,55.9 billion birr respectively. Thus, the agriculture sector have got market access both domestically and COMESA countries. Similarly, the industrial sector would also grow in quantity of market output; in 2011 the output increases from base 48 billion to 50.4 billion birr, in 2012 from 54.5 billion to 57.3 billion birr, in 2013 from 61.7 billion to 64 .99 billion, in 2014 from 69.6 billion to 73.46 billion birr and in 2015 from 78.3 billion to 82.7 billion birr. The industry outcomes will also increase for next five years; it shows positive result by join COMESA FTA. Meanwhile, the service sector shows an increment for the first two years but in 2013 to 2015, it will reduce. This may arise from the combined effects of two reasons. These are: First the business services of wholesalers and retailer will diminish due to the FTA membership which induces their profit margin to decline. The adverse effect which has been realized is because of the largest proportion of business service in the sector. Second hotels have been built in recent years. Hence, the market may be saturated in near future.

iii. Government revenue

By joining COMESA FTA, import tariff becomes zero for COMESA member countries. These results indicate negative effect on government revenue.

Fig 4.1 Government revenue



The figure shows government revenue reduced from base 43.4 billion to 37.4 billion birr in 2011; from 46.6 billion to 40.1 billion birr in 2012; from 50 million to 43 billion birr in 2013; from 53.7 to 46 billion birr in 2014 and from 57.6 to 49.3 billion birr in 2015.In general, joining COMESA FTA reduces the government income by 4.8%(Annex 3).

4.2. Macro variables specifically GDP, Export and Import.

I.GDP

Removal of all tariffs from COMESA countries in all sector results in the GDP of the countries to increase from 10.47% to 10.52% at market price and from 10.66% to 10.69% at factor cost[26]. These happen due to the growth in private consumption. Mean while export grows from 16.86% in base scenario to 17.44% and growth in import also increase from 10.76% to 11.1%.

[26] Factor cost means: measuring GDP using income approach. This includes all factor payments.

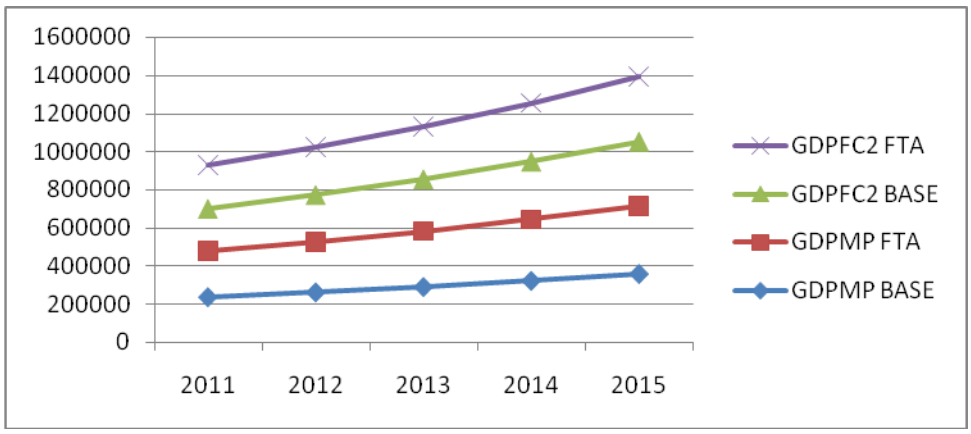
Table 4.4 GDP result (% change)

Macro variables	INITIAL	BASE	FTA
ABSORP[27]	162219.9	9.6785	9.727
PRVCON[28]	110384.8	8.982	9.2623
EXPORTS	16530.9	16.8659	17.4421
IMPORTS	-46708.7	10.7639	11.097
GDPMP	132042.1	10.4683	10.5241
GDPFC	122324.8	10.6586	10.6898

Source: CGE results

Alternatively, the growth trends of this GDP variable for the next five years are shown in figure below.

Figure 4.2 GDP growth paths for the next five years.



As indicated in figure 4.2, the GDP increases in each years both at market price and factor cost.That is, GDP at market price increased from birr 240 billion to birr 359 billion and GDP at factor cost is also enhanced from birr 224 billion to birr 337 billion for considered period of the

[27] Absorption

[28] Private consumption

shock. Furthermore, export increases from birr 45.4 billion to birr 82.5 billion and import increases from birr 84.1 billion to birr 133.8 billion for the same period.

II.Price of export and import

The prices of exports and imports for all sector would decrease. Because there is higher quantity import that results from excess supply.This is inturn induced by the cheaper prices resulted from removal of tariff. Mean while export becomes cheap partly due to the decline in the price of raw material used for production of exportables and partly because of removal of tariffs on Ethiopian exports from the recepient FTA member country.Therfore ,the prices of import and export would decline.See the table below.

Table 4.5 Price export(%change)

	Price of export			
Sectors	INITIAL	BASE	FTA	% (decrease)
Agriculture sector	59.1816	55.6936	54.8229	-0.87
Industrial sector	15	15.6277	15.3232	-0.3
Services sector	5	4.479	4.418	-0.06

Source: own calculation based on CGE results

From table 4.5 , agricultural, industrial and service sectors decline on average by 1.56%, 0.3% and 0.06% respectively over the shock period(Annex 5).

Table 4.6 Price of import(%change)

	Price of import			
Sectors	INITIAL	BASE	FTA	% (decrease)
Agriculture sector	140.214	120.1587	110.4745	-9.68%
Industrial sector	23.3582	19.7769	17.7051	-2.07%
Services sector	6	5.3748	5.3016	-0.07%

Source: own calculation based on CGE results

As shown in table 4.6 , price of import would decline by higher amount relative to price of export.Agriculture commodities import price would decline by 9.68%,industrial commodities import price would decrease by 2.07% and Serviecs sector reduced by 0.07% (Annex 6).

III.Exchange rate

Similarily , the exchange rate is deperciated from 9.69% to 10.6% due to tariff shocks (Annex 7).The result shows that an increase in both export and import.This outcome contradicts with the theories.It might be due to the exhange rate depreciation does not have much influence on import. This is explained by an articles written by Dorosh and Ahmed which indicates that Ethiopian economy needs further devaluation to see the effect of exchange rate shock as long as the real exchange rate is overvalued by 26.3% in 2009. Hence, import substition strategy should be developed to curb this import increment.

4.3. Trade creation and Trade diversion

Trade creation means the shift in domestic consumption from high cost domestic source to a lower cost foreign partner and trade diversion means the shift from a lowest cost world sources to higher cost partner country.

The study explains trade creation effect by comparing quantity of domestic market output with quantity of import. Based on this calculation, elimination of tariffs on imported goods from COMESA countries; create some trade for agriculture and industrial sector, see Annex 8 for the details.

Trade creation is realized in agricultural outputs such as wheat, pulse, other crops, poultry and fish. Industrial outputs such as mining, wood, non-metal, machine and other manufacturing also show trade creation. In both sector, domestic output will decline and quantity of import rises for the specified product. But the services output are not totally affected by trade creation.

Trade diversion effect is explored by comparing the quantity import from COMESA with EU and ROW. The results show that there is no trade diversion effect since the exports of COMESA countries, EU and ROW are differ in product types. The COMESA countries export agricultural products where as EU and ROW export non-agricultural products. Hence, there is export dissimilarity among them (for detail see annex 9).

Scenario two

The second scenario of the study is removal of import tariff for agriculture sector and maintaining the existing import tariff for non-agriculture sector. According to the Ethiopian SAM 2005/06, Ethiopia imported some agricultural product such as wheat, maize, pulses, vegetable ,fruit, tea, coffee processed ,poultry, milk, cotton, animal product forestry and fisheries. Most of them are imports from Asia and EU countries. From the same SAM, it is observed that the import tariff was collected only from tea product among agricultural commodities which is very small that is birr 269,000. On the other hand, import tariff was not collected from all other agricultural products. Therefore, the removal of agriculture tariff and maintaining of non agriculture has no effect on all sectors of the economy both in terms of commodity and activity.

Scenario three

The third scenario addresses removal of import tariff for non-agriculture sector only. The result of this scenario is similar to the first scenario. Specifically, outcomes of all macro variables, government revenue and household consumption expenditure are synonymous to the first scenario. Finally, this result confirms that only removal of non-agriculture tariff has significant impact on the economy.

Therefore, there is no significant difference on Ethiopian economy whether the country joins COMESA FTA with all sector tariff reduction or only with non-agriculture sector tariff removal.

Chapter five

Conclusion and policy implication

5.1 Conclusion

In this study, we have attempted to examine the economy wide impact of COMESA –FTA on Ethiopia using a recursive dynamic CGE model approach. For this purpose EDRI 2005/06 SAM is used as a data base. Due to the FTA Ethiopia reduce their import tariff to zero for COMESA member country. In this the process, Ethiopia got both positive and negative impact on different economic activities.

The paper tried to see the impact of this COMESA FTA on household expenditure, production of domestic activity and marketed output, government revenue, macro variable like GDP, export, import, trade creation and diversion using three different scenarios over the next five consecutive years from 2011 up to 2015.

The first scenario was removal of import tariff in all sectors, the findings of the result showed:

- Consumption expenditure will increase overtime in humid cereals, humid enset(poor), draught prone and pastoralist (poor) agro ecological zone but it will decline for the pastoralist (non-poor) and humid enset (non poor) because these areas are near to border with bilateral FTA schemes.
- From production side, domestic activity showed mixed results .While, Some agricultural products (teff, wheat etc) and industrial products (dairy product, machine, non metal) decline; tradable product like tea, vegetable and sorghum etc from agriculture sector and textile, leather etc from industrial sector and most of service sector rises. There is no change in domestic activities of the sectors whose the products are not exported to

COMESA markets. On the other hand, the commodity output will rise for the next consecutive five years in all sectors.

- The government revenue will decrease overtime due to this tariff reduction on COMESA FTA members .On average the government revenue decline by 4.8%.
- From Macro variables, GDP increases over time. It will increase on average from base scenario of 10.47% to 10.52 % at market price and from 10.66% to 10.69% at factor cost. These happen due to an increase in growth of private consumption and quantity of export. On the other hand, the quantity of export grows from 16.86% at base scenario to 17.44% for consecutive five years and quantities of imports also increase from 10.76% to 11.1%.
- Prices of exports and prices of imports decreased due to joining COMESA FTA in all sectors. The finding showed import prices declined higher amount relative to export prices.
- Real exchange rate is found to depreciate on average from 9.69% at base scenario to 10.6%.This result was contradictory with theory but some literature argue Ethiopia's current exchange rate is overvalued, thus further devaluation will needed to see effect of exchange rate on the Ethiopian economy.
- Trade creation and diversion are the important issues addressed in this study. Through is some trade creation in agriculture and industry, no trade creation is observed in services sector. Meanwhile, no trade diversion occurred due to tariff reduction because there is export dissimilarity between COMESA member countries and out of COMESA countries.

The second scenario was removal of import tariff on commodities produced by the agricultural sector. The finding of the result shows that there is no impact on Ethiopia

economy. As indicated in Ethiopian SAM 2005/06, the only product which import tariff was collected is tea.

The third scenario was removal import tariff on commodities produced by the industrial sector, the outcomes of this scenario is identical to first scenario.

In general all results show that joining COMESA FTA have little effect on Ethiopia's economy in short run because the share was only 2.39% for exports and 4.41% for imports. In the long run, Ethiopia might get more benefits by expanding the share of exports to and imports from COMESA countries.

5.2 Policy implication

This study identifies the following policy implications that are relevant for Ethiopia's future negotiations with COMESA FTA member countries.

Firstly, joining COMESA FTA by removal all tariff only on agriculture commodities has no impact on Ethiopian economy. Therefore before becoming member of COMESA FTA by removing all or industrial sector import tariffs, careful investigation performance of the industrial sector has to be made visa vis the COMESA FTA member before signing the agreement.

Secondly, government revenue will negatively affected by this FTA. Thus, the government budget contribution of import tariff should substitute by domestic tax like expanding the extent of value added tax to different regional states. The other important suggestion is that properly collect all domestic tax efficiently. Furthermore, there should be a comprehensive and comparative analysis regarding the relation between FTA and government revenue in the short run and long run with regard to how it is possible to compensate the revenue loss.

Thirdly, increase the agricultural productivity both for domestic food security and fulfill the highly demanded foreign currency.

Fourthly, to fully benefit from joining COMESA FTA, Ethiopia has to strength its domestic industries and diversifies its exports .This objective could be achieved through the following method:

- Improve the capacity of the existing industries by transferring the state owned firms to private sector or by giving incentives to increase productivity and competiveness.
- Strengthen the already existing support for foreign investors in which the country has comparative advantage, such as textile and leather industries that employ higher amount of labor.
- Increase access to infrastructure such as electric power, telecommunication, water supply and transportation facilities.
- Intensify the industrial sector exports in addition to the usual exports of agriculture products.

Fifth, put in place an appropriate policy frame work, such as fiscal policy, monetary policy and trade policy.

Sixth, place highly equipped skilled manpower that is responsible for trade policy formulation, analysis, monitoring and evaluation to follow up each activity under FTA in appropriate institutions.

Seventh, exhaustively use the ongoing international initiatives, trade related technical assistance and capacity building to improve the method of tax collection, and negotiation skill in the country.

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Appendix

Annex 1: Household expenditure value (millions of birr) in each year

	2011	2011	2012	2012	2013	2013	2014	2014	2015	2015
	BASE	FTA	BASE	FTA	BASE	FTA	BASE	FTA	BASE	FTA
hh-hc-pr	15208.29	15396.776	16435.84	16644.66	17817.62	18036.25644	19303.64798	19505.07	20936.99	21094.52
hh-hc-np	47925.36	47857.568	51642.21	51693.06	55954.54	56105.43503	60742.36177	60908.07	66182.76	66275.41
hh-ho-pr	7409.397	7454.6191	7966.177	8017.621	8596.511	8650.213132	9276.157833	9325.334	10023.08	10061.47
hh-ho-np	19011.35	18908.601	20426.5	20366.31	22072.16	22049.74233	23892.98351	23886.57	25958.35	25945.72
hh-dp-pr	7746.459	7832.0458	8219.062	8318.187	8752.669	8861.272061	9336.80004	9444.139	9979.081	10074.55
hh-dp-np	17165.46	17133.548	18356.33	18361.84	19744.25	19780.41996	21299.63127	21341.3	23067.76	23089.59
hh-pa-pr	1630.66	1640.1513	1713.807	1724.529	1804.836	1816.256736	1902.757853	1913.757	2009.166	2018.486
hh-pa-np	8409.413	8370.0889	8934.158	8910.15	9538.742	9528.063991	10212.50868	10206.18	10977.61	10965.93

Annex 2: Domestic Production activity (%)

	INITIAL	BASE	FTA
ateff-hc	3164.97	8.51	8.53
ateff-ho	350.47	6.16	6.12
ateff-dp	1464.43	3.64	3.67
ateff-pa	34.36	0.66	0.59
abarl-hc	1693.74	10.11	10.18
abarl-ho	153.61	7.79	7.78
abarl-dp	660.48	7.68	7.76
abarl-pa	33.91	2.07	2.04
awhea-hc	2989.17	11.78	11.62
awhea-ho	337.52	9.82	9.62
awhea-dp	956.76	8.03	7.87
awhea-pa	73.63	5.5	5.28
amaiz-hc	3189.26	8.07	8.13
amaiz-ho	502.17	6.17	6.2
amaiz-dp	1004.63	4.78	4.83
amaiz-pa	329.49	2.33	2.32
asorg-hc	1270.27	9.63	9.68
asorg-ho	77.29	7.75	7.8
asorg-dp	841.88	6.68	6.73
asorg-pa	292.45	4.26	4.27
apuls-hc	2425.11	9.45	9.44
apuls-ho	453.08	7.25	7.2
apuls-dp	1054.42	5.13	5.13
apuls-pa	121.2	8.24	8.16
aoils-hc	1130.34	9.4	9.39
aoils-ho	4.58	7.69	7.69

Annex 2 continued

aoils-pa	56.82	4.28	4.28
avege-hc	752.84	9.01	9.05
avege-ho	474.95	6.97	7
avege-dp	253	5.57	5.61
avege-pa	149.48	2.96	2.95
afrui-hc	92.78	11.75	11.74
afrui-ho	119.98	9.65	9.63
afrui-dp	18.51	8.21	8.2
afrui-pa	18.4	5.53	5.48
anset-hc	877.55	10.37	10.37
anset-ho	1020.93	8.65	8.65
acott-hc	401.04	10.15	10.15
acott-dp	171.87	5.85	5.85
asugr-hc	137.33	10.17	10.17
asugr-ho	173.17	8.46	8.45
asugr-dp	28.03	6.74	6.73
asugr-pa	11.45	5.01	5.01
ateal-hc	15.89	7.94	10.46
achat-hc	376.11	8.99	8.99
achat-ho	155.7	7.29	7.29
achat-dp	53.06	5.59	5.59
achat-pa	1365.26	3.89	3.89
atoba-ho	18.91	5.47	5.47
acoff-hc	2705.96	10.43	10.42
acoff-ho	1374.99	8.7	8.7
acoff-dp	73.9	6.98	6.98
acoff-pa	507.34	5.25	5.25
aflow-hc	144.98	9.01	9
aocrp-hc	1414.14	9.58	9.48
aocrp-ho	315.27	8.28	8.22
aocrp-dp	957.1	8.2	8.09
aocrp-pa	161.2	6.52	6.41
acatt-hc	3560.11	8.51	8.38
acatt-ho	1246.68	6.74	6.67
acatt-dp	1443.55	4.64	4.44
acatt-pa	390.42	2.7	2.54
amilk-hc	4242.21	9.54	9.45
amilk-ho	1610.28	7.75	7.71
amilk-dp	1308.98	5.61	5.44
amilk-pa	752.44	3.65	3.51

Annex 2 continued

apoul-hc	246.61	9.29	9.18
apoul-ho	95.62	7.5	7.45
apoul-dp	130.64	5.37	5.19
apoul-pa	34.17	3.41	3.27
aaprd-hc	1185.56	11.49	12.77
aaprd-ho	298.49	9.64	10.93
aaprd-dp	704.24	7.43	8.53
aaprd-pa	236.97	5.4	6.5
Afish	42.86	36.45	36.38
Afore	6207.91	7.87	7.84
Aomin	735.59	17.43	17.11
Adair	4111.41	8.12	8
Avprd	8.41	9.4	10.07
Agmll	655.35	12.54	12.42
Amsrv	873.12	9.95	10.08
Apsgr	1159.73	9.52	9.52
Aptea	131.73	9.67	11.06
Afood	2478.55	8.28	8.89
Abeve	1834.78	10.62	10.96
Aptob	219.14	11.29	12.13
Atext	1349.88	13.4	13.83
Aclth	353.85	13.14	13.59
Aleat	1065.56	15.88	19.58
Awood	107.85	15.01	14.26
Apapr	699.74	14.44	15.43
Achem	1609.13	15.92	17.56
Anmet	1167.76	13.86	12.84
Ametl	1963.92	21.55	22.72
Amach	15.32	13.76	13.31
Avehe	410.85	12.15	12.47
Aeequ	304.59	14.33	15.88
Aoman	1590.08	13.19	12.38
Aelec	1474.49	10.61	10.83
Awatr	1571.06	10.07	10.2
Acons	23717.22	13.56	13.11
Atrad	26047.8	11.21	11.55
Ahotl	8254.24	10.43	10.63
Atran	8633.52	11.89	11.99
Acomm	1624.54	10.75	10.88
Afsrv	3457.68	13.09	13.23

Annex 2 continued

Absrv	448.87	48.86	47.59
Areal	10146.35	12.6	12.7
Aosrv	2922.12	8.91	9.02
Apadm	10428.19	5.76	5.77
Aeduc	5236.44	6.47	6.53
Aheal	1409.95	6.61	6.69
Total	191627.2	11.07	11.13

Annex 3: Government revenue

	2011	2012	2013	2014	2015
BASE	43398	46591	50100	53731	57651
FTA	37438	40107	43024	46043	49321

Annex 4: GDP for the next five years

		2011	2012	2013	2014	2015
ABSORP	BASE	279876	306611.7	336837.7	370540.4	408621.439
ABSORP	FTA	282118	308893.4	339075.1	372623.5	410429.907
PRVCON	BASE	187186.6	202170.3	219294.7	238644.8	260890.178
PRVCON	FTA	191231.2	206895.6	224802.5	244854.5	267676.995
FIXINV	BASE	66461.74	76948.89	88713.68	101653.2	115995.254
FIXINV	FTA	64659.16	74505.26	85443.27	97526.66	111016.904
EXPORTS	BASE	42675.38	49567.46	57735.36	67329.23	78555.247
EXPORTS	FTA	45397.27	52608.33	61090.31	70991.41	82515.618
IMPORTS	BASE	-84141.8	-93293.1	-103844	-115953	-129831.69
IMPORTS	FTA	-86863	-96333	-107198	-119613	-133789.705
GDPMP	BASE	238409.6	262886	290728.7	321916.9	357344.996
GDPMP	FTA	240652.3	265168.7	292967.4	324001.8	359155.82
GDPFC2	BASE	223111.1	246301.8	272840.1	302726.9	336795.105
GDPFC2	FTA	224718.4	247915.6	274361.1	304030.4	337746.911

Annex 5 : Price of export

		INITIAL	BASE	FTA
Cpuls	Rowcom	36.6224	33.4662	32.9829
Cocrp	Rowcom	20.5592	20.2321	19.8804
Cpoul	Rowcom	1	0.9038	0.8912
Cfish	Rowcom	1	1.0915	1.0684
Cdair	Rowcom	1	0.9085	0.8956
Cgmll	Rowcom	1	0.931	0.9168
Cpsgr	Rowcom	1	1.2334	1.2025
Cptea	Rowcom	1	0.9654	0.9494
Cfood	Rowcom	1	0.9337	0.9194
Cbeve	Rowcom	1	1.1568	1.1301
Cptob	Rowcom	1	1.8085	1.7455
Ctext	Rowcom	1	0.934	0.9197
Cclth	Rowcom	1	1.0465	1.0259
Cleat	Rowcom	1	0.9462	0.9312
Cwood	Rowcom	1	0.9268	0.9129
Cpapr	Rowcom	1	0.9274	0.9135
Cmetl	Rowcom	1	1.0373	1.0173
Cvehe	Rowcom	1	0.9339	0.9196
Ceequ	Rowcom	1	0.9383	0.9238
Ctrad	Rowcom	1	0.8958	0.8836
Ctran	Rowcom	1	0.8958	0.8836
Ccomm	Rowcom	1	0.8958	0.8836
Cfsrv	Rowcom	1	0.8958	0.8836
Cbsrv	Rowcom	1	0.8958	0.8836

Annex 6: Price of import

		INITIAL	BASE	FTA
Cwhea	Rowcom	21.271	18.7098	18.4696
Cpuls	Rowcom	39.5695	34.8399	34.3911
Cteal	Rowcom	48.8185	40.5103	31.799
Cocrp	Rowcom	26.4849	22.4692	22.2161
Cpoul	Rowcom	1.0376	0.9218	0.9095
Cfish	Rowcom	0.7159	0.5932	0.5871
Comin	Rowcom	1.3166	1.1145	1.1021
Cmeat	Rowcom	1	1	1
Cdair	Rowcom	1.0584	0.9361	0.9239
Cvprd	Rowcom	1.4598	1.2135	1.2009
Cgmll	Rowcom	1.1339	0.986	0.9739
Cpsgr	Rowcom	1.5534	1.2695	1.2573

Annex6: continued

Cptea	Rowcom	1.2349	1.055	1.0369
Cfood	Rowcom	1.1559	1.0034	0.7395
Cbeve	Rowcom	1.5369	1.2637	1.2513
Cptob	Rowcom	1.7371	1.3961	1.1388
Ctext	Rowcom	1.1544	1.002	0.8617
Cclth	Rowcom	1.4158	1.1819	0.9887
Cwood	Rowcom	1.1315	0.9866	0.9297
Cchem	Rowcom	1.2651	1.076	0.9669
Cnmet	Rowcom	1.6476	1.3432	1.1063
Cmetl	Rowcom	1.3523	1.131	1.027
Cmach	Rowcom	1.1994	1.0336	0.9376
Cvehe	Rowcom	1.1425	0.9917	0.8718
Ceequ	Rowcom	1.1268	0.9755	0.791
Coman	Rowcom	1.0525	0.9321	0.7019
Ctrad	Rowcom	1	0.8958	0.8836
Chotl	Rowcom	1	0.8958	0.8836
Ctran	Rowcom	1	0.8958	0.8836
Ccomm	Rowcom	1	0.8958	0.8836
Cfsrv	Rowcom	1	0.8958	0.8836
Cbsrv	Rowcom	1	0.8958	0.8836

Annex 7: Macro table

	INITIAL	BASE	FTA
QABSTOT	158181.3	155.77	156.91
QHTOT	110384.8	136.35	142.49
QETOT	13923.5	384.88	402
QMTOT	60718.7	176.95	186.71
REXR	7.63	-9.69	-10.6
NEXR	100	-10.42	-11.64

Annex 8: Trade creation

					Quantity of import				
	Domestic marketed output					rowcom	rowcom	rowcom	
	INITIAL	BASE	FTA			INITIAL	BASE	FTA	
Cteff	219.085	7.042	7.067		cwhea	0.2347	13.0214	13.7275	0.7061
Cbarl	126.432	9.294	9.362		cpuls	0.3896	9.8545	10.429	0.5745
cwhea	222.433	10.793	10.629	-0.164	cteal	0.0001	22.7101	-3.012	-25.7221
Cmaiz	363.004	6.959	7.006		ctoba				
Csorg	257.043	8.062	8.111		cocrp	0.4695	10.1935	10.8281	0.6346
Cpuls	110.692	8.164	8.151	-0.013	cpoul	0.8859	9.2739	9.8199	0.546
Coils	75.852	8.123	8.122		cfish	1.6754	3.511	3.7278	0.2168
Cvege	91.414	7.453	7.482		ccoal				
Cfrui	40.346	10.119	10.103		cngas				
Cnset	21.145	9.472	9.471		comin	1.0924	11.2881	10.2301	-1.058
Ccott	8.6	8.992	8.996		cdair	11.5331	11.7749	13.3748	1.5999
Csugr	137.587	8.935	8.933		cvprd	255.3911	9.4324	9.6891	0.2567
Cteal	0.48	7.938	10.457	2.519	cgmll	16.8183	5.4955	6.4328	0.9373
Cchat	10.628	5.356	5.355		cpsgr	0.1926	6.8219	7.0831	0.2612
Ctoba	0.3	5.466	5.467		cptea	0.0046	9.1408	7.4878	-1.653
Ccoff	17.136	9.391	9.39		cfood	24.5355	8.2811	12.1288	3.8477
Cflow	1	9.006	9.005		cbeve	0.0567	8.5844	8.3779	-0.2065
Cocrp	138.513	8.822	8.725	-0.097	cptob	0.0104	8.4568	10.5325	2.0757
Ccatt	6640.756	7.118	6.988		ctext	5.2043	6.9974	6.8356	-0.1618
Cmilk	7913.899	8.107	8.007		cclth	7.4155	7.6988	6.8363	-0.8625
Cpoul	507.039	7.681	7.565	-0.116	cleat				
Caprd	2425.264	9.654	10.875		cwood	11.7602	11.859	11.001	-0.858
Cfish	42.864	36.452	36.384	-0.068	cpapr				
Cfore	6207.914	7.865	7.843		cptrl				
comin	735.593	17.431	17.105	-0.326	cfert				
Cdair	4111.414	8.116	7.996	-0.12	cchem	225.5629	8.2399	9.0513	0.8114
Cvprd	8.412	9.399	10.07	0.671	cnmet	24.6775	9.7653	13.6383	3.873
Cgmll	655.345	12.538	12.417	-0.121	cmetl	57.3752	12.7422	13.6348	0.8926
Cmsrv	873.124	9.947	10.082	0.135	cmach	78.85	12.9301	12.7314	-0.1987
Cpsgr	1159.73	9.515	9.52	0.005	cvehe	9.4421	10.4969	10.481	-0.0159
Cptea	131.727	9.67	11.061	1.391	ceequ	74.754	9.4472	10.3209	0.8737
Cfood	2478.548	8.277	8.89	0.613	coman	12.0924	8.4493	15.9433	7.494
Cbeve	1834.778	10.62	10.958	0.338	ctrad	26.986	9.7442	10.155	0.4108
Cptob	219.139	11.29	12.132	0.842	chotl	123.5955	9.8579	10.0562	0.1983
Ctext	1349.879	13.403	13.833	0.43	ctran	447.5332	10.5269	10.808	0.2811
Cclth	353.853	13.14	13.586	0.446	ccomm	0.2693	9.8309	10.0731	0.2422

Annex8: continued

Cleat	1065.557	15.879	19.581		cfsrv	16.9228	8.2989	8.3751	0.0762
cwood	107.85	15.013	14.256	-0.757	cbsrv	1592.392	11.1956	11.4339	0.2383
Cpapr	699.74	14.443	15.433						
cchem	1609.133	15.924	17.56	1.636					
cnmet	1167.757	13.862	12.84	-1.022					
Cmetl	1963.924	21.554	22.717	1.163					
cmach	15.324	13.764	13.307	-0.457					
Cvehe	410.85	12.148	12.466	0.318					
ceequ	304.593	14.332	15.882	1.55					
coman	1590.083	13.193	12.379	-0.814					
Celec	1474.487	10.609	10.826						
Cwatr	1571.062	10.072	10.198						
Ccons	23717.22	13.564	13.111						
Ctrad	26047.8	11.206	11.551	0.345					
Chotl	8254.242	10.427	10.629	0.202					
Ctran	8633.52	11.894	11.987	0.093					
ccomm	1624.542	10.746	10.882	0.136					
Cfsrv	3457.676	13.095	13.226	0.131					
Cbsrv	448.871	48.855	47.589	-1.266					
Creal	10146.35	12.603	12.704						
Cosrv	2922.116	8.913	9.016						
Cpadm	10428.19	5.763	5.768						
Ceduc	5236.439	6.467	6.527						
Cheal	1409.945	6.613	6.686						

Annex 9: Trade diversion

	Quantity of import total(%)								
	Row	Row	Row	rowcom	Rowcom	rowcom	roweu	roweu	roweu
	INITIAL	BASE	FTA	INITIAL	BASE	FTA	INITIAL	BASE	FTA
Cwhea	73.9041	13.0214	13.0214	0.2347	13.0214	13.7275	3.8196	13.0214	13.0214
Cpuls	4.8899	9.8545	9.8545	0.3896	9.8545	10.429	2.3804	9.8545	9.8545
Cteal	0.0253	22.7101	22.7101	0.0001	22.7101	-3.012	0.0012	22.7101	22.7101
Ctoba	0.0764	14.0429	14.0429				0.4294	14.0429	14.0429
Cocrp	5.8926	10.1935	10.1935	0.4695	10.1935	10.8281	2.8686	10.1935	10.1935
Cpoul	0.1745	9.2739	9.2739	0.8859	9.2739	9.8199	3.9816	9.2739	9.2739
Cfish	1.4243	3.511	3.511	1.6754	3.511	3.7278	1.4992	3.511	3.511
Ccoal	11.0515	15.9065	15.9065						
Cngas	24.2078	8.332	8.332						
Comin	12.3806	11.2881	11.2881	1.0924	11.2881	10.2301	22.9406	11.2881	11.2881
Cdair	2.2725	11.7749	11.7749	11.5331	11.7749	13.3748	51.8368	11.7749	11.7749
Cvprd	85.1304	9.4324	9.4324	255.3911	9.4324	9.6891	227.0143	9.4324	9.4324

Annex9: continued

Cgmll	64.4702	5.4955	5.4955	16.8183	5.4955	6.4328	12.1466	5.4955	5.4955
Cpsgr	309.189	6.8219	6.8219	0.1926	6.8219	7.0831	7.1328	6.8219	6.8219
Cptea	1.4422	9.1408	9.1408	0.0046	9.1408	7.4878	0.0744	9.1408	9.1408
Cfood	297.7379	8.2811	8.2811	24.5355	8.2811	12.1288	135.5717	8.2811	8.2811
Cbeve	85.1511	8.5844	8.5844	0.0567	8.5844	8.3779	97.7434	8.5844	8.5844
Cptob	6.9447	8.4568	8.4568	0.0104	8.4568	10.5325	59.0717	8.4568	8.4568
Ctext	1603.308	6.9974	6.9974	5.2043	6.9974	6.8356	28.2667	6.9974	6.9974
Cclth	1058.001	7.6988	7.6988	7.4155	7.6988	6.8363	45.539	7.6988	7.6988
Cleat	24.8115	4.6441	4.6441				106.9725	4.6441	4.6441
Cwood	217.5292	11.859	11.859	11.7602	11.859	11.001	130.3234	11.859	11.859
Cpapr	656.9526	8.0908	8.0908				68.5334	8.0908	8.0908
Cptrl	8365.142	12.1662	12.1662						
Cfert	1760.236	9.0729	9.0729						
Cchem	3222.78	8.2399	8.2399	225.5629	8.2399	9.0513	1552.722	8.2399	8.2399
Cnmet	231.433	9.7653	9.7653	24.6775	9.7653	13.6383	100.1791	9.7653	9.7653
Cmetl	3434.91	12.7422	12.7422	57.3752	12.7422	13.6348	1238.878	12.7422	12.7422
Cmach	2860.131	12.9301	12.9301	78.85	12.9301	12.7314	2291.793	12.9301	12.9301
Cvehe	3493.053	10.4969	10.4969	9.4421	10.4969	10.481	1019.593	10.4969	10.4969
Ceequ	2719.611	9.4472	9.4472	74.754	9.4472	10.3209	1746.531	9.4472	9.4472
Coman	349.6257	8.4493	8.4493	12.0924	8.4493	15.9433	125.9552	8.4493	8.4493
Ctrad	18.5529	9.7442	9.7442	26.986	9.7442	10.155	38.7924	9.7442	9.7442
Chotl	88.9888	9.8579	9.8579	123.5955	9.8579	10.0562	281.7978	9.8579	9.8579
Ctran	5967.109	10.5269	10.5269	447.5332	10.5269	10.808	1044.244	10.5269	10.5269
Ccomm				0.2693	9.8309	10.0731	302.6126	9.8309	9.8309
Cfsrv	191.7912	8.2989	8.2989	16.9228	8.2989	8.3751	355.3778	8.2989	8.2989
Cbsrv	84.7017	11.1956	11.1956	1592.392	11.1956	11.4339	16.9403	11.1956	11.1956

Annex 10: CGE model sets, parameter, variables and equations

Table A1. CGE model sets, parameters, and variables

Symbol	Explanation	Symbol	Explanation
Sets			
$a \in A$	Activities	$c \in CMN(\subset C)$	Commodities not in *CM*
$a \in ALEO(\subset A)$	Activities with a Leontief function at the top of the technology nest	$c \in CT(\subset C)$	Transaction service commodities
$c \in C$	Commodities	$c \in CX(\subset C)$	Commodities with domestic production
$c \in CD(\subset C)$	Commodities with domestic sales of domestic output	$f \in F$	Factors
$c \in CDN(\subset C)$	Commodities not in *CD*	$i \in INS$	Institutions (domestic and rest of world)
$c \in CE(\subset C)$	Exported commodities	$i \in INSD(\subset INS)$	Domestic institutions
$c \in CEN(\subset C)$	Commodities not in *CE*	$i \in INSDNG(\subset INSD)$	Domestic non-government institutions
$c \in CM(\subset C)$	Aggregate imported commodities	$h \in H(\subset INSDNG)$	Households
Parameters			
$cwts_c$	Weight of commodity c in the CPI	$qdst_c$	Quantity of stock change
$dwts_c$	Weight of commodity c in the producer price index	$\overline{qg}_c$	Base-year quantity of government demand
ica_{ca}	Quantity of c as intermediate input per unit of activity a	$\overline{qinv}_c$	Base-year quantity of private investment demand
$icd_{cc'}$	Quantity of commodity c as trade input per unit of c' produced and sold domestically	$shif_{if}$	Share for domestic institution i in income of factor f
$ice_{cc'}$	Quantity of commodity c as trade input per exported unit of c'	$shii_{ii'}$	Share of net income of i' to i (i' ∈ INSDNG'; i ∈ INSDNG)
$icm_{cc'}$	Quantity of commodity c as trade input per imported unit of c'	ta_a	Tax rate for activity a
$inta_a$	Quantity of aggregate intermediate input per activity unit	$\overline{tins}_i$	Exogenous direct tax rate for domestic institution i
iva_a	Quantity of aggregate intermediate input per activity unit	$tins01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates
$\overline{mps}_i$	Base savings rate for domestic institution i	tm_c	Import tariff rate
$mps01_i$	0-1 parameter with 1 for institutions with potentially flexed direct tax rates	tq_c	Rate of sales tax
pwe_c	Export price (foreign currency)	$trnsfr_{if}$	Transfer from factor f to institution i
pwm_c	Import price (foreign currency)		

Table A1 continued. CGE model sets, parameters, and variables

Symbol	Explanation	Symbol	Explanation
Greek Symbols			
α_a^a	Efficiency parameter in the CES activity function	δ_{cr}^t	CET function share parameter
α_a^{va}	Efficiency parameter in the CES value-added function	δ_{fa}^{va}	CES value-added function share parameter for factor *f* in activity *a*
α_c^{ac}	Shift parameter for domestic commodity aggregation function	γ_{ch}^m	Subsistence consumption of marketed commodity c for household h
α_c^q	Armington function shift parameter	θ_{ac}	Yield of output c per unit of activity a
α_c^t	CET function shift parameter	ρ_a^a	CES production function exponent
β^a	Capital sectoral mobility factor	ρ_a^{va}	CES value-added function exponent
β_{ch}^m	Marginal share of consumption spending on marketed commodity c for household h	ρ_c^{ac}	Domestic commodity aggregation function exponent
δ_a^a	CES activity function share parameter	ρ_c^q	Armington function exponent
δ_{ac}^{ac}	Share parameter for domestic commodity aggregation function	ρ_c^t	CET function exponent
δ_{cr}^q	Armington function share parameter	η_{fat}^a	Sector share of new capital
υ_f	Capital depreciation rate	QF_{fa}	Quantity demanded of factor f
Exogenous Variables			
$\overline{CPI}$	Consumer price index	$\overline{MPSADJ}$	Savings rate scaling factor (= 0 for base)
$\overline{DTINS}$	Change in domestic institution tax share (= 0 for base; exogenous variable)	$\overline{QFS}_f$	Quantity supplied of factor
$\overline{FSAV}$	Foreign savings (FCU)	$\overline{TINSADJ}$	Direct tax scaling factor (= 0 for base; exogenous variable)
$\overline{GADJ}$	Government consumption adjustment	$\overline{WFDIST}_{fa}$	Wage distortion factor for factor f in activity a
$\overline{IADJ}$	Investment adjustment factor		
Endogenous Variables			
AWF_{ft}^a	Average capital rental rate in time period t	QG_c	Government consumption demand for commodity
$DMPS$	Change in domestic institution savings rates (= 0 for base; exogenous variable)	QH_{ch}	Quantity consumed of commodity c by household h
DPI	Producer price index for domestically marketed output	QHA_{ach}	Quantity of household home consumption of commodity c from activity a for household h
EG	Government expenditures	$QINTA_a$	Quantity of aggregate intermediate input
EH_h	Consumption spending for household	$QINT_{ca}$	Quantity of commodity c as intermediate input to activity a
EXR	Exchange rate (LCU per unit of FCU)	$QINV_c$	Quantity of investment demand for commodity
$GSAV$	Government savings	QM_{cr}	Quantity of imports of commodity c

Table A1 continued. CGE model sets, parameters, and variables

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

Table A2. CGE model equations

Production and Price Equations	
$QINT_{ca} = ica_{ca} \cdot QINTA_a$	(1)
$PINTA_a = \sum_{c \in C} PQ_c \cdot ica_{ca}$	(2)
$QVA_a = \alpha_a^{va} \cdot \left(\sum_{f \in F} \delta_{fa}^{va} \cdot \alpha_{fa}^{vaf} \cdot QF_{fa}^{-\rho_a^{va}} \right)^{-\frac{1}{\rho_a^{va}}}$	(3)
$W_f \cdot \overline{WFDIST}_{fa} = PVA_a \cdot QVA_a \cdot \left(\sum_{f \in F'} \delta_{fa}^{va} \cdot \alpha_{fa}^{vaf} \cdot QF_{fa}^{-\rho_a^{va}} \right)^{-1} \cdot \delta_{fa}^{va} \cdot \alpha_{fa}^{vaf} \cdot QF_{fa}^{-\rho_a^{va}-1}$	(4)
$QF_{fa} = \alpha_{fa}^{van} \cdot \left(\sum_{f' \in F} \delta_{ff'a}^{van} \cdot QF_{f'a}^{-\rho_{fa}^{van}} \right)^{-\frac{1}{\rho_{fa}^{van}}}$	(5)
$W_{f'} \cdot WFDIST_{f'a} = W_f \cdot WFDIST_{fa} \cdot QF_{fa} \cdot \left(\sum_{f'' \in F} \delta_{ff''a}^{van} \cdot QF_{f''a}^{-\rho_{fa}^{van}} \right)^{-1} \cdot \delta_{ff'a}^{van} \cdot QF_{f'a}^{-\rho_{fa}^{van}-1}$	(6)
$QVA_a = iva_a \cdot QA_a$	(7)
$QINTA_a = inta_a \cdot QA_a$	(8)
$PA_a \cdot (1 - ta_a) \cdot QA_a = PVA_a \cdot QVA_a + PINTA_a \cdot QINTA_a$	(9)
$QXAC_{ac} = \theta_{ac} \cdot QA_a$	(10)
$PA_a = \sum_{c \in C} PXAC_{ac} \cdot \theta_{ac}$	(11)
$QX_c = \alpha_c^{ac} \cdot \left(\sum_{a \in A} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{-\frac{1}{\rho_c^{ac}-1}}$	(12)
$PXAC_{ac} = PX_c \cdot QX_c \left(\sum_{a \in A'} \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}} \right)^{-1} \cdot \delta_{ac}^{ac} \cdot QXAC_{ac}^{-\rho_c^{ac}-1}$	(13)
$PE_{cr} = pwe_{cr} \cdot EXR - \sum_{c' \in CT} PQ_c \cdot ice_{c'c}$	(14)
$QX_c = \alpha_c^t \cdot \left(\sum_r \delta_{cr}^t \cdot QE_{cr}^{\rho_c^t} + (1 - \sum_r \delta_{cr}^t) \cdot QD_c^{\rho_c^t} \right)^{\frac{1}{\rho_c^t}}$	(15)
$\frac{QE_{cr}}{QD_c} = \left(\frac{PE_{cr}}{PDS_c} \cdot \frac{1 - \sum_r \delta_{cr}^t}{\delta_c^t} \right)^{\frac{1}{\rho_c^t - 1}}$	(16)

Table A3. CGE model equations (continued)

$QX_c = QD_c + \sum_r QE_{cr}$	(17)
$PX_c \cdot QX_c = PDS_c \cdot QD_c + \sum_r PE_{cr} \cdot QE_{cr}$	(18)
$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'} \cdot icd_{c'c}$	(19)
$PM_{cr} = pwm_{cr} \cdot (1 + tm_{cr}) \cdot EXR + \sum_{c' \in CT} PQ_{c'} \cdot icm_{c'c}$	(20)
$QQ_c = \alpha_c^q \cdot \left(\sum_r \delta_{cr}^q \cdot QM_{cr}^{-\rho_c^q} + (1 - \sum_r \delta_{cr}^q) \cdot QD_c^{-\rho_c^q} \right)^{-\frac{1}{\rho_c^q}}$	(21)
$\frac{QM_{cr}}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_c^q}{1 - \sum_r \delta_{cr}^q} \right)^{\frac{1}{1+\rho_c^q}}$	(22)
$QQ_c = QD_c + \sum_r QM_{cr}$	(23)
$PQ_c \cdot (1 - tq_c) \cdot QQ_c = PDD_c \cdot QD_c + \sum_r PM_{cr} \cdot QM_{cr}$	(24)
$QT_c = \sum_{c' \in C'} icm_{cc'} \cdot QM_{c'} + ice_{cc'} \cdot QE_{c'} + icd_{cc'} \cdot QD_{c'}$	(25)
$\overline{CPI} = \sum_{c \in C} PQ_c \cdot cwts_c$	(26)
$DPI = \sum_{c \in C} PDS_c \cdot dwts_c$	(27)
Institutional Incomes and Domestic Demand Equations	
$YF_f = \sum_{a \in A} WF_f \cdot \overline{WFDIST}_{fa} \cdot QF_{fa}$	(28)
$YIF_{if} = shif_{if} \cdot \left[YF_f - trnsfr_{rowf} \cdot EXR \right]$	(29)
$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{igov} \cdot \overline{CPI} + trnsfr_{irow} \cdot EXR$	(30)
$TRII_{ii'} = shii_{ii'} \cdot (1 - MPS_{i'}) \cdot (1 - \overline{tins}_{i'}) \cdot YI_{i'}$	(31)
$EH_h = \left(1 - \sum_{i \in INSDNG} shii_{ih} \right) \cdot (1 - MPS_h) \cdot (1 - \overline{tins}_h) \cdot YI_h$	(32)
$PQ_c \cdot QH_{ch} = PQ_c \cdot \gamma_{ch}^m + \beta_{ch}^m \cdot \left(EH_h - \sum_{c' \in C} PQ_{c'} \cdot \gamma_{c'h}^m \right)$	(33)
$QINV_c = IADJ \cdot \overline{qinv}_c$	(34)
$QG_c = \overline{GADJ} \cdot \overline{qg}_c$	(35)

Table A3. CGE Model Equations (continued)

$EG = \sum_{c \in C} PQ_c \cdot QG_c + \sum_{i \in INSDNG} trnsfr_{i\,gov} \cdot \overline{CPI}$	(36)
System Constraints and Macroeconomic Closures	
$YG = \sum_{i \in INSDNG} \overline{tins_i} \cdot YI_i + \sum_{c \in CMNR} tm_c \cdot pwm_c \cdot QM_c \cdot EXR + \sum_{c \in C} tq_c \cdot PQ_c \cdot QQ_c + \sum_{f \in F} YF_{gov\,f} + trnsfr_{gov\,row} \cdot EXR$	(37)
$QQ_c = \sum_{a \in A} QINT_{c\,a} + \sum_{h \in H} QH_{c\,h} + QG_c + QINV_c + qdst_c + QT_c$	(38)
$\sum_{a \in A} QF_{f\,a} = QFS_f$	(39)
$YG = EG + GSAV$	(40)
$\sum_{r\,c \in CMNR} pwm_{cr} \cdot QM_{cr} + \sum_{f \in F} trnsfr_{row\,f} = \sum_{r\,c \in CENR} pwe_{cr} \cdot QE_{cr} + \sum_{i \in INSD} trnsfr_{i\,row} + FSAV$	(41)
$\sum_{i \in INSDNG} MPS_i \cdot \left(1 - \overline{tins_i}\right) \cdot YI_i + GSAV + EXR \cdot FSAV = \sum_{c \in C} PQ_c \cdot QINV_c + \sum_{c \in C} PQ_c \cdot qdst_c$	(42)
$MPS_i = \overline{mps_i} \cdot \left(1 + MPSADJ\right)$	(43)
Capital Accumulation and Allocation Equations	
$AWF_{f\,t}^{a} = \sum_{a} \left[\left(\frac{QF_{f\,a\,t}}{\sum_{a'} QF_{f\,a'\,t}} \right) \cdot WF_{f\,t} \cdot WFDIST_{f\,a\,t} \right]$	(44)
$\eta_{f\,a\,t}^{a} = \left(\frac{QF_{f\,a\,t}}{\sum_{a'} QF_{f\,a'\,t}} \right) \cdot \left(\beta^{a} \cdot \left(\frac{WF_{f,t} \cdot WFDIST_{f\,a\,t}}{AWF_{f\,t}^{a}} - 1 \right) + 1 \right)$	(45)
$\Delta K_{f\,a\,t}^{a} = \eta_{f\,a\,t}^{a} \cdot \left(\frac{\sum_{c} PQ_{c\,t} \cdot QINV_{c\,t}}{PK_{f\,t}} \right)$	(46)
$PK_{f\,t} = \sum_{c} PQ_{c\,t} \cdot \frac{QINV_{c\,t}}{\sum_{c'} QINV_{c'\,t}}$	(47)
$QF_{f\,a\,t+1} = QF_{f\,a\,t} \cdot \left(1 + \frac{\Delta K_{f\,a\,t}^{a}}{QF_{f\,a\,t}} - \upsilon_f \right)$	(48)
$QFS_{f\,t+1} = QFS_{f\,t} \cdot \left(1 + \frac{\sum_{a} \Delta K_{f\,a\,t}}{QFS_{f\,t}} - \upsilon_f \right)$	(49)