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THE ECONOMY - WIDE IMPACT OF CONTINENTAL FREE TRADE AREA (CFTA) ON ETHIOPIA: A RECURSIVE DYNAMIC COMPUTABLE GENERAL EQUILIBRIUM APPROACH

BY

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List of acronyms

AU	African Union
CAFTA	Central America Free Trade Area
CGE	Computable General Equilibrium
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CFTA	Continental Free Trade Area
COMESA	Common Market for Eastern and South Africa
CM	Common Market
CEN–SAD	Community of Sahel–Saharan States
CPI	Consumer Price Index
DPI	Domestic Producer price Index
EAC	East African Community
ECA	Economic commission for Africa
ECOWAS	Economic commission for Western and South Africa
ECCAS	Economic Community of Central African States
EDRI	Ethiopian Development and Research Institute

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
IGAD	Intergovernmental Authority on Development
MOFED	Ministry of Finance and economic development
NBE	National Bank of Ethiopia
OAU	Organization African Union
PTA	Preferential Trade Area
PU	Political Union
RTA	Regional Trade Arrangement
SACU	South African Customs Union
SADC	South Africa Development Community
SAM	Social Accounting Matrix
UNCTAD	United nation Conference on Trade and Development
UNECA	United nation Economic Commission for Africa
WTO	World Trade Organization

Abstract

This study examines the economy wide impact of CFTA on Ethiopia. The analysis is made based on Ethiopian social accounting matrix (SAM) of 2009/10 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 scenarios involve joining CFTA at one time, in 2016, or through phases, a 25% tariff removal each year from 2016-2019. Another scenario involves excluding strategic sectors from the CFTA.

The impact of CFTA result shows, Government revenue also decreases as tariff revenue is an important source of revenue for the Ethiopian government. GDP and trade balance are, however, positively affected. The increase in GDP might be associated to the increase in disaggregated production. The larger increase in exports as compared to the increase in imports leads to an improvement in trade balance. Household consumption expenditure also increases. This might be due to the availability of cheap consumption commodities from abroad due to the removal of tariff. On the other hand, our results show a decrease in investment which might be attributed to the inability of domestic producers to compete with foreign suppliers at a lower price.

Our findings also show that protection of strategic sectors benefits only producers in these sectors. Exclusion of strategic sectors from CFTA helps producers face less competition as the price of imported commodities will include tariffs. Protection of strategic sectors will also increase government revenue. The impact of protecting strategic sectors on the overall economy, however, is negative, which is it results in a decrease in GDP.

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

CHAPTER ONE

INTRODUCTION

1.1. Background

Early 1990s, many countries in Africa have made significant progress in opening up their economy to external competition through trade. At the same time, with the creation or expansion of a number of regional trading arrangement in other parts of the world, several African nations have also worked towards this, resulting in the establishment or renewal of such trading arrangement in Africa too. Currently, eight Sub Regional Economic Communities (RECs) are recognized by African Union (AU) which form the building blocks of the African Economic Community overarching framework for continental economic integration (UNECA, 2012).

The Continental integration has figured high on the African agenda ever since African countries gained political independence and started deliberation on a united Africa in all spheres of the society. Trade has had been the motor of economic, social and political integration for many countries prior to the establishment of Africa's first regional body-the Organization African Unity (OAU) in 1963 (UNCTAD, 2015).

Pan-African negotiations for a Continental Free Trade Area (CFTA) were launched in June 2015 with the indicative target date for conclusion set for 2017. This is consistent with the African Union Action Plan for "Boosting Intra-African Trade and the Establishment of a CFTA" was endorsed in 2012, the 18th African Union (AU) Summit of African Heads of States and Governments. The formulation of CFTA provides such a framework and is in line with the goal

of the Abuja Treaty Establishing the African Economic Community which was signed in 1991 and entered in force in 1994 (UNECA,2012).

The main objectives of the CFTA are to create a single continental market for goods and services, with free movement of business persons and investments, and, thus pave the way for accelerating the establishment of a Customs Union. It will also expand intra-African trade through better harmonization and coordination of trade liberalization, facilitation, instruments across the RECs and across Africa in general. The CFTA is also expected to enhance competitiveness at the industry and enterprise levels through exploitation of opportunities for scale production, continental market access and better reallocation of resources (AU, 2012).

The CFTA negotiations, covering both goods and services, would be based on consolidation of regional FTA processes into the CFTA. This implies the negotiations between the Tripartite Free Trade Area (TFTA), which is among COMESA, EAC and SADC and other RECs (ECA and AU, 2014). This will bring together fifty-four African countries with a combined population of more than one billion people and a combined gross domestic product of more than US $3.4 trillion. Such a market creates opportunities for scale production for producers in the continent (Mevel and Karingi, 2012).

According to World Trade Organization (WTO), the level of intra-African trade in 2012 was 12.8% which is very low compared to other regions in the world which is 40% in North American and 63% in EU. The share of Africa's total exports in global trade flows is 3.5% which is also extremely low compared to other regions (WTO, 2012).

Due to low intra-African trade compared to other regions , the Action Plan that Member States will be implementing in order to enhance the level of intra-African trade from current levels of

about 10-13% to 25% or more within the next decade. Therefore, this makes intra-African trade an important driver of economic development (AU, 2012).

According to some estimates, the opening of the regional market to African goods and service will increase intra-African trade significantly. It has been estimated, for instance, that the removal of tariffs on intra-African trade could raise the total African trade share from about 10.2 percent to 15.5 percent from 2010 to 2022. With enhanced trade facilitation measures, the gains would double to reach 21.9 percent (Mevel and Karingi, 2012). Moreover, the gain would also be greater if informal traders are better integrated into formal trade channels.

1.2. Statement of the Problem

With the view that free trade promotes economic welfare, most developed and developing countries in the world are becoming members of regional integration schemes. Many countries are also considering RIAs as one of the main policy issues (De Melo and Panagariya, 1993).

The year 2015 offers an historical opportunity for a major step to be taken towards the integration of the African continent – the launch of negotiations for a Continental Free Trade Area (CFTA). This is in line with the January 2012 Decision taken at the 18th Ordinary Session of the African Union Assembly of Heads of State and Government to begin negotiation for a CFTA by 2015 with 2017 as the indicative date for the finalization of the essential core of an agreement. (UNECA, 2012).

The CFTA is recognized in the African Union's Agenda 2063 as an important milestone towards the ultimate goal of creating an African Common Market of nearly 1 billion people and the realization of an African Economic Community as envisaged in the Abuja Treaty and the

Constitutive Act of the African Union. The CFTA also provides a strategic foundation for Africa's effective integration into the global economy (UNECA, 2012).

Related to CFTA, there are few studies have been done using general equilibrium analysis in Africa as the whole, but there is no study assess the economic impact of if Ethiopia entering into the CFTA 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 CFTA. The study investigates the impact of Continental Free Trade Area (CFTA) on the overall economy using dynamic recursive CGE model. The writer used the 2009/10 Ethiopian SAM prepared by EDRI will be very important source of data for such analysis.

1.3. Objectives of the study

1.3.1. The general objectives of the study are:

The general objective of the study is to provide quantitative estimates of the impact of Continental Free Trade Area (CFTA) on the Ethiopian economy.

1.3.2. The specific objectives of the study are:

a. To provide an analysis of the revenue implications to Ethiopia and quantify the potential losses from trade taxes as a consequence of joining into the CFTA;
b. To investigate the impact of CFTA on household consumption expenditure;
c. To analyze the effects on the Ethiopian macro economy accounts such as GDP, Export, Import , Investment and Export and Export price,

1.4 Simulations of the study

This paper presents the results of CGE-based simulations of the impact of CFTA on overall Ethiopian economy using three set of scenarios.

Simulation 1: This assumes that the status quo continues which is baseline scenario. That is, no FTA for any product at all.

Simulation 2: Gradual removal of tariff for all products. Since the simulation runs for 4 years between 2016 and 2019, a yearly 25% tariff removal on all products is considered. That is 25% in 2016, 50% in 2017, 75% in 2018 and 100% in 2019.

Simulation 3: One time complete abolishment of tariff in the year 2016 for all products.

Simulation 4: One time complete removal of tariff in the year 2016 for all products except textile, cloth, and leather which are considered by the government as strategic sectors.

1.5 Significance of the Study

Trade policy is one of the key issues policy makers face. Decision has to be made whether to liberalize trade and join economic agreements. The results from this analysis can give valuable input for policy decision whether join or not any regional integration.

1.6 Organization of the Study

The paper is organized in five chapters. Chapter one is the introduction part which includes background, statement of the problem, objectives, simulation of the study and significance of the study. Chapter two reviews both the theoretical and empirical literature. Chapter three discuss SAM and model specification. Chapter four presents simulation results. The last chapter, chapter five, will have conclusion and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Regional economic integration arrangements

The theory of regional integration arrangement can be regarded as the commercial policy of discriminatively reducing or eliminating trade barriers only between the states joining together (Salvatore, 2004). Regional integration arrangements (RIAs), in general, are mechanisms where countries together form free trade areas or customs union, offering the member's preferential trade access to each other's markets (Venables, 2000).

As international trade and investment levels continue to rise, the level of economic integration between various groups of nations is also deepening. Although it is rare that relationships between countries follow so precise a pattern, formal economic integration takes place in stages, beginning with the lowering and removal of barriers to trade and culminating in the creation of an economic union. Generally, there are five regional trade integration arrangements: These stages are summarized below:

1. **Preferential Tariff Agreement (PTA)**

It is the simplest forms of regional trade arrangement. Under this arrangement, import tariffs on trade among member countries are reduced relative to those on trade with non member countries.

2. Free Trade Agreement(FTA)

In this case, countries agree not only to reduce but also to eliminate import tariffs as well as import quotas between signatory countries. These agreements can be limited to a few sectors or can encompass all aspects of international trade. In this arrangement, rules of origin[1] will work. Examples of FTA are: The ASEAN Free Trade Agreement (AFTA) and the North American Free Trade Areas (NAFTA).

3. A customs union(CU)

A customs union builds on a free trade area by, in addition to removing internal barriers to trade, also requiring participating nations to harmonize their external trade policy. This includes establishing a common external tariff (CET) and import quotas on products entering the region from third-party countries, as well as possibly establishing common trade remedy policies such as anti-dumping and countervail measures. Countries with an established customs union no longer require rules of origin, since any product entering the CU area would be subject to the same tariff rates and/or import quotas regardless of the point of entry. The elimination of the need for rules of origin is the chief benefit of a customs union over a free trade area. To maintain rules of origin requires extensive documentation by all FTA member countries as well as enforcement of those rules at borders within the free trade area. This is a costly process and can lead to disputes over interpretation of the rules as well as other delays. A CU would result in significant administrative cost savings and efficiency gains.

[1] Rules of origin are the criteria needed to determine the national source of a product. Their importance is derived from the fact that duties and restrictions in several cases depend upon the source of imports.

4. **Common Market(CM)**

A common market represents a major step towards significant economic integration. In addition to containing the provisions of a customs union, a common market removes all barriers to the mobility of people, capital and other resources within the area in question. Establishing a common market typically requires significant policy harmonization in a number of areas. Free movement of labour, for example, necessitates agreement on worker qualifications and certifications.

5. **Economic Union (EU)**

The deepest form of economic integration, an economic union adds to a common market the need to harmonize a number of key policy areas. Most notably, economic unions require formally coordinated monetary and fiscal policies. An economic union frequently includes the use of a common currency and a unified monetary policy. Example is the European Union (EU) where economic and monetary integration has created a single market with a common euro currency.

6. **Political Union (PU)**

Represents the potentially most advanced form of integration with a common government and were the sovereignty of member country is significantly reduced. Only found within nation states, such as federations where there is a central government and regions having a level of autonomy. (Holden, 2003).

2.1.2 Regional Economic Communities (RECs) in Africa

Regional integration in Africa is not a new phenomenon. Initiatives on the continent date back to when the South African Customs Union (SACU) was set up in 1990 and before that the East African Community (EAC) in 1919 (UNECA,2012).

The Regional Economic Communities (RECs) have developed individually and have differing roles and structures. Generally, the purpose of the RECs is to facilitate regional economic integration between members of the individual regions and through the wider African Economic Community (AEC). The AU recognizes eight RECs[2] in Africa. These are the following:

- Arab Maghreb Union (UMA)
- Common Market for Eastern and Southern Africa (COMESA)
- Community of Sahel–Saharan States (CEN–SAD)
- East African Community (EAC)
- Economic Community of Central African States (ECCAS)

[2] **CEN-SAD:** Benin, Burkina Faso, Cape Verde; Central African Republic, Comoros, Côte d'Ivoire, Chad, Djibouti, Egypt, Eritrea, Gambia, Ghana, Guinea-Bissau, Guinea, Kenya, Liberia, Libya, Mali, Mauritania, Morocco, Niger, Nigeria, São Tomé & Príncipe, Senegal, Sierra Leone, Somalia, Sudan, Togo, Tunisia.

COMESA: Burundi; Comoros; Democratic Republics of Congo; Djibouti; Egypt; Eritrea; Ethiopia; Kenya; Libya; Madagascar; Malawi; Mauritius; Rwanda; Seychelles; Sudan; Swaziland; Uganda; Zambia; Zimbabwe.

EAC: Burundi, Kenya, Rwanda, Tanzania, Uganda.

ECCAS: Angola; Burundi; Cameroon; Central African Republic; Chad; Democratic Republic of Congo; Equatorial Guinea; Gabon; Republic of Congo; São Tomé and Príncipe.

ECOWAS: Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo.

IGAD: Djibouti; Eritrea; Ethiopia; Kenya; Somalia; Sudan; Uganda.

SADC: Angola; Botswana; Democratic Republic of Congo; Lesotho; Madagascar; Malawi; Mauritius; Mozambique; Namibia; Seychelles; South Africa; Swaziland; Tanzania; Zambia; Zimbabwe.

UMA: Algeria, Libya, Mauritania, Morocco, Tunisia.

- Economic Community of West African States (ECOWAS)
- Intergovernmental Authority on Development (IGAD)
- Southern African Development Community (SADC)

2.1.3 Overview of Continental free trade areas

In the post independence period, integration has been a core element of the development strategy of African countries. The pursuit of integration at regional and continental levels aims at overcoming the colonial legacy of the fragmentation of Africa into small and weak economies, and at harnessing the economies of scale and other benefits of a large integrated market. Unity and integration have also been targeted towards empowering Africa to take its rightful position in the global economy and polity.

Long before the creation of the OAU in 1963, African Heads of States and Governments had recognized the indispensable need for economic, social and cultural integration in order to accelerate the transformation, collaboration and sustained development of the continent (AU BIAT Publications, 2012).

Their determination and commitments from the OAU summits of 1973, 1976, 1980 right to Abuja 1991 paved the way for the establishment of an African Economic Community (AEC) that aimed at merging all the regional economic communities in Africa into a continental-wide economic and monetary union.

The Abuja Treaty establishing the AEC was signed in 1991 and entered in forced in 1994. One of the primary objectives of the treaty establishing the AECs is "to promote economic, social and cultural development and integration of African economies in order to increase economic self-reliance and promote an endogenous and self-sustained development" as quoted in Article 4 (1) (a) of the 1994 Abuja Treaty (Kenneth, 2015).

The Africa regional integration roadmap considers the Regional Economic Communities (RECs) as the building blocks of the AECs. The AEC is to be formed in six phases over 34 years. The six phases of the African union Continental integration Agenda as follows (UNCA, 2012).

- **Phase 1 (5 years):**
    - ❖ Strengthen existing RECs and create new RESs in regions where they do not exist.
- **Phase 2 (8 years):**
    - ❖ Ensure consolidation within each REC, with a focus on liberalizing tariffs, removing non-tariff barriers etc
- **Phase 3 (10 years):**
    - ❖ Setup in each REC a FTA and CU(with a common external tariff and single territory)
- **Phase 4 (2 years)**
    - ❖ Coordinate and harmonize tariff and non-tariff system among the RECs with view to establishing a continental custom union.
- **Phase 5 (4 years):**
    - ❖ Setup on African common market
- **Phase 6 (5 years):**
    - ❖ Establish the AEC, including an African Monetary Union and a Pan-African Parliament

2.2. Empirical Review

2.2.1 Overview of the Ethiopian economy

The Ethiopian economy continued to register a notable growth. In 2014/15, the real GDP grew by 10.2 percent. The growth of the economy has also been remarkable compared to the 4.4 percent growth estimated for Sub - Saharan Africa in 2015. In 2014/15, the agricultural sector depicted a moderate growth rate of 6.4 percent and the share of agriculture in GDP in 2014/15 went down to 38.8 percent from 40.1 percent a year earlier. Industrial sector showed a 21.6 percent growth and accounted for 15.2 percent of GDP.

Service sector has also become relatively a dominant sector in Ethiopia since it overtook the agricultural sector in 2010/11. In 2014/15, its growth rate was 10.2 percent; and its share in GDP rose to about 46.6 percent. The Ethiopian economy is projected to grow by 11 percent in 2015/16 in contrast to 3.8 and 5.1 percent growth by IMF for the world and SSA respectively (NBE, 2014/15).

The deficit in merchandise trade during 2014/15 stood at USD 13.4 billion, widened by 29.1 percent relative to the preceding fiscal year mainly due to the significant growth in total import bills coupled with low performance in the growth of total export proceeds. In the review period, export to GDP ratio went down and import to GDP ratios went up by 4.6 and 26.5 percentage points, respectively from 6 percent and 25 percent of last year.

Total export proceeds, including electricity, amounted to USD 3 billion down by 8.5 percent vis-à-vis the previous fiscal year. Total merchandise imports in 2014/15 increased by 20 percent over last year and reached USD 16.5 billion as a result of a rise in imports of capital goods, consumer goods, semi-finished goods and raw materials. Hence, import GDP ratio is estimated to have increased to 26.3 percent from 24.9 percent in 2013/14 (NBE, 2014/15).

The share of tax revenue in total domestic revenue in 2010/11 has also shown improvement. As a share of GDP, the actual tax revenue collected during the 2010/11 was 11.5 percent. This tax revenue performance represents a slight increase compared with the previous year which is 11.3 percent.

Out of the total tax revenue collected during 2010/11, about one-third was raised from direct taxes (Birr 19.6 billion) while about two-thirds came from indirect taxes (Birr 39.4 billion). Most of the indirect taxes were raised from foreign trade taxes (about 60%) while domestic indirect taxes contributed the rest (about 40%) (MOFED, 2010/11).

The import tax revenue that has been collected by source of import regions is presented in the following table:

Table2.1 : Import value for the last four years by regions and countries (2011-2014)

Years		CIF VALUE IN BILLION BIRR				
		Africa	**China**	**USA**	**ROW**	**CIF Total**
2011	value	7,092	28,492	7,213	106,500	149,299
	Share (%)	4.6	19.1	4.8	71.3	100
2012	value	9,784	43,464	6,913	148,813	208,974
	Share (%)	4.7	20.8	3.31	71.2	100
2013	value	6,694	55,486	9,679	134,048	205,908
	Share (%)	3.3	26.9	4.7	65.1	100
2014	value	9,159	101,091	13,193	173,041	296,485
	Share (%)	3.1	34.1	4.4	58.4	100
Average	value	8,182	57,133	9,249	140,600	215,167
	Share (%)	3.9	25.2	4.3	66.5	100

Source: own computation based on Ethiopia Revenue and Custom Authority.

The above table depicted 25.2 percent import came from china, 3.9percent from Africa, 4.3 percent from China and 66.5 percent from rest of the world. The Ethiopia Revenue and Custom Authority data clearly shows that the share imported products from African Countries small and declining over time.

Table2.2 : Ethiopia duty tax revenue by source of imports (Million birr)

Years		IMPORT DUTY TAX IN Million BIRR				
		Africa	China	USA	ROW	Import Duty Tax Total
2011	value	299,473,946.97	1,560,871,800.98	161,741,122.93	2,947,069,922.29	4,969,156,793.17
	Share (%)	6.1	31.4	3.3	59.3	100
2012	value	507,495,951.68	4,768,030,152.86	446,204,786.33	6,796,025,772.62	12,517,756,663.49
	Share (%)	4.1	38.1	3.6	54.3	100
2013	value	560,936,602.06	5,647,927,210.73	531,531,552.83	7,463,532,431.97	14,203,927,797.59
	Share (%)	3.9	39.8	3.7	52.6	100
2014	value	680,037,012.26	4,555,455,155.53	588,532,347.99	11,396,019,338.63	17,220,043,854.41
	Share (%)	3.9	26.5	3.4	66.2	100
Average	value	511,985,878.24	4,133,071,080.03	432,002,452.52	7,150,661,866.38	12,227,721,277.17
	Share (%)	4.5	33.9	3.5	58.1	100

Source: Source: own computation based on Ethiopia Revenue and Custom Authority.

The tables above revels that between the reference years 2011-2014, on average about 4.5 percent of import duty taxes was collected from Africa ,33.9 percent from China,3.5 percent from United State and rest import share came from other part of the world, which is it account 58.1 percent.

2.2.2 Intra Africa trades between member countries.

The level of African merchandise trade (exports and imports) with the world rose from $251 billion in 1996 to $1,151 billion in 2011. In 2011, exports and imports for Africa totalled $582 billion and $569 billion respectively. The level of intra-African trade has grown in nominal terms, rising from $45.9 billion in 1995 to $130.1 billion in 2011. As a share of the value of African world trade, intra-African trade rose steadily from 19.3 per cent in 1995, to a peak of 22.4 per cent in 1997 but thereafter fell to 11.3 per cent in 2011. These declining numbers can be

attributed to a faster rate of growth in African trade with the rest of the world rather than among themselves. (UNCTAD, 2013).

2.2.3 The Economic Impact of Free Trade Area

Since the 1960s, regional economic integration has been a goal pursued by most middle-income countries. For some, it was a means to take advantage of geographical proximity to enlarged markets (Foxley, 2010). Regional trade initiatives increase in all parts of the world, for instance Asia (ASEAN[3]), America (NAFTA[4]), Africa (COMESA) and European Union (EU-South Africa). This section will discuss the empirical findings of some studies.

The study analyses the impact of free trade agreement (FTA) on India and the Association of South East Asian Nation (ASEAN) members using the computable general equilibrium (CGE). Under full liberalization India would experience a 1.07% fall in GDP. Among the ASEAN members, the highest increases in GDP are experienced by Myanmar (3.18%) and Indonesia (1.08%). Among the bigger countries, Singapore and Malaysia show increases in GDP of 0.61% and 0.54%, respectively. Cambodia, the Lao People's Democratic Republic and the Philippines experience falls in GDP (Sikdar and Nag, 2011).

North American Free Trade Agreement (NAFTA) has also affected the growth of trade and financial flows between Canada and the United States (Cardarelli and Kose, 2004). U.S. exports to NAFTA partners climbed nearly 90 percent, twice the increase in its exports to the rest of the

[3] ASEAN: List of members Myanmar, Indonesia, Singapore, Malaysia, the Lao People's Democratic Republic, Philippines, Viet Nam, Thailand, Cambodia and Brunei Darussalem.

[4] NAFTA: Canada, Mexico, and United States

world (Kose, 2003). DFAIT (2003) documents the increase in trade and financial flows between Canada and Mexico after the inception of NAFTA.

South Africa and the European Union (EU) negotiated a free trade agreement (FTA) in 1999, after more than two years of contentious negotiations. Because of South Africa's predominance in the sub region, the implementation of this agreement will have an impact on trade flows in the rest of Southern Africa. The South Africa-EU FTA will also affect other regional trade initiatives. We find that an FTA between the EU and South Africa has a much bigger impact on South Africa than on the EU. South African real GDP increases by 0.41 percent and real absorption increases by 0.28 percent, whereas there are only negligible changes for the EU.

The total exports from South Africa to the EU increase by 4.6 percent, there are large gains in formerly protected sectors. For example, food processing exports increase by 32.6 percent, forest & fisheries by 14.8 percent, and fruits & vegetables by 8.6 percent. Exports from the EU to South Africa increase by 4.3 percent with the biggest gains in apparel (26.6 percent), textiles (11.8 percent), and food processing (11.6 percent). With the exception of Botswana, the other SADC countries also benefits from the bilateral FTA between EU and South Africa (Robinson and Lewis, 2001).

The study analyses the impact of COMESA FTA on Ethiopia economy using computable general equilibrium (CGE). Joining COMESA FTA result domestic agricultural activity increased from 8.11% to 8.24% and non agriculture also increased from 13.98% to 14.29%. Government revenue reduced by 4.8%. 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. The export grows from 16.86% in base scenario to 17.44% and growth in import also increases from 10.76% to 11.1 %.(Mussie, 2011).

The study investigates the impact of Economic Partnership Agreements (EPA) on the Ethiopian economy. The scenarios involve joining EPA at one time, in 2011, or through phases, a 20% tariff removal each year from 2011-2015. Another scenario involves excluding strategic sectors from the EPA. The growth rates of both GDP at factor cost and GDP at market price have increased in all the simulations. The impact has been found to be significant on traded commodities. Particularly, the price of machineries, vehicles and equipments will decrease. The government revenue and investment also decreases as the result of EPA while import and export increased (Meseret, 2011).

The establishment of a continental FTA will lead to a significant growth of Intra-Africa trade and assist Africa to use trade more effectively as an engine of growth and sustainable development. It is worth noting that between 2000 and 2010, the creation of the COMESA FTA led to a six-fold increase in intra-COMESA trade. The realization of the Tripartite FTA is expected to lead to further growth of intra-African Trade while the continental FTA will build on these existing successes and enable Africa to participate in global trade as an effective and respected partner.

Within two African regional groups, global average protection is nearly as high as the continental average: 7.7 per cent within COMESA, EAC, SADC and IGAD FTA group (S-E) FTA group; 8.2 per cent within the ECOWAS, CENSAD, ECCAS and UMA FTA or N-W-C FTA group and 8.7 per cent for Africa as a whole. There is a very high level of protection currently inhibiting trade between the two groupings. The N-W-C FTA group imposes an average global tariff of 16.5 per cent to its imports from the S-E FTA group. The establishing FTAs in the two regions simultaneously would reduce Africa's global protection by 68.7 per cent. This means that intra-African average trade protection will fall from 8.7 per cent to 2.7 per cent. This would stimulate trade flows between the two regional blocks. However, the

establishing regional FTAs may not be enough to stimulate optimal trade. As the result the integration should move from the regional FTAs to the continental FTA.(ECA and AU,2012).

In 2012, the United Nations Economic Commission for Africa (UNECA) used a multi-sector and multi-country CGE MIRAGE dynamic model to estimate the economic impacts and trade Policy effects of creating the envisaged pan-African CFTA. Their empirical results presented three main findings:

Firstly, the results projected that eliminating high tariff barriers established across African boarders with the establishment of the CFTA would likely result in an rise in intra-African trade exports by US$ 25.3 billion (a 4.0 percent increase) in 2022 and a likely increase in total African exports by US$ 17.6 billion (a 2.8 percent increase) from the baseline level where the CFTA is not set up. Again, African exports to the rest of the world were estimated to decrease by US$ 9.4 billion therefore boosting intra-African trade by US$ 34.6 billion (or 52.3 percent), in 2022. This shows a net trade creation effect of the CFTA.

Secondly, their findings showed a surge in economic gains of the CFTA if complemented with effective trade-facilitation measures that would address the prevalent excessive cost of customs procedures and port handling services within regions. According to ECA's projections trade facilitation measures alone, if ameliorated in the course of establishing the CFTA, would result in a rise of Africa's intra-African trade by two fold over the twelve year period (with an increase from 10.2% to 21.9% between 2010 and 2022).

And thirdly, given the potential economic benefits Africa stands to gain from the CFTA, these gains may not be distributed equitably across the continent. The downside realities of fragmented and divergent levels of trade protection, unequal income distribution, differences in economic

sizes and policies, as well as the relative revenue losses due to tariff elimination may differ between African countries.

These trade increases translate into income gains. UNECA projections by 2022 estimate significant increments in trade gains with expected real income to rise by US$ 203.4 million (0.14 percent) from a relative baseline within all African regional FTAs as a whole.

For the continent as a whole, the results of the CGE model clearly show positive trade and real income gains from the elimination of tariff barriers on goods across Africa through the establishment of a CFTA. However, the downside is that the distribution of income gains is not expected to be equitable among countries. This can partly be explained by economic size differences, lack of a diversified export base, extremely heterogeneous trade and protection structures, as well as tariff revenue losses associated with trade liberalization.

CHAPTER THREE

MODEL SPECIFICATION

3.1 Data base

3.1.1 Social accounting matrix (SAM)

A social accounting matrix (SAM) can be defined as an organized matrix representation of all transactions and transfers between different production activities, factors of production, and institutions (households, corporate sector, and government) within the economy and with respect to the rest of the world. A SAM is thus a comprehensive accounting frame work within which the full circular flow of income from production to factor incomes, household income to household consumption, and back to production is captured. All the transactions in the economy are presented in the form of a matrix in a SAM.

A SAM is a square matrix where the columns represent expenditure and the rows represent receipts. Each cell shows the payment from the account of its column to the account of its row. The major principle in SAM is double entry accounting which equalizes row total (total revenue) with column total (total expenditure).

SAM represents the economy of a nation for a given period of time, usually one year (Lofgren et al, 2002). It is an important modeling device particularly in studies involving CGE. For this reason, countries are constructing their own SAM to conduct economy-wide analysis that trace the impacts of policy changes and shocks emanating from the world economy on the macro

economy; the sectoral structure of production, employment, and trade; and on household income and poverty (EDRI, 2009).

SAM is an extension of the input-output (IO) table. The IO table captures the interdependence among various producing and demanding sectors of the economy as they interact as each other's customers. For instance, industries purchase material inputs from other industries and labor and capital inputs from households, while households purchase final goods from industries. Hence, an IO table provides a systematic description of each sector's interdependence by tracing the flows of goods and services from one sector of the economy to all other sectors (inter-sectoral flows) and to itself (intra-sectoral flows).

The SAM on the other hand is an extension of the IO table. In addition to the income and expenditure flows of industries and their outputs (goods & services or commodities), the SAM also contains detailed information on different institutions. For instance, not only do households earn incomes from the sale of factors of production like labor and capital to industries, but they also receive transfer payments from the government (in the form of safety net assistance, social security paychecks, and pensions) and from the rest of the world (in the form of remittances). Moreover, households also pay taxes to the government, purchase final goods, and save or dis-save.

Similarly, the government receives revenue from households and enterprises in the form of taxes and dividend (from public enterprises), and official transfer payments from the rest of the world in the form of grants and development assistance. It also uses this revenue to finance recurrent consumption expenditures, transfers to households and the rest of the world. Finally, the SAM also contains the investment and savings, and the rest of the world accounts. The SAM therefore

incorporates institutional and structural details that capture all transfers and real transactions between industries and institutions in an economy (EDRI, 2009).

3. 2 Description of CGE Model

General equilibrium, which dates back to Leon Walras (1834-1910), is one of the crowning intellectual achievements of economics. It recognizes that there are many markets and that they interact in complex ways so that everything depends on everything else. Demand for any one good depends on the prices of all other goods and on income. Income, in turn, depends on wages, profits, and rents, which depend on technology, factor supplies and production, the last of which, in its turn, depends on sales (i.e., demand). Prices depend on wages and profits and vice versa. CGE models specify all their economic relationships in mathematical terms and put them together in a form that allows the model to predict the change in variables such as prices, output and economic welfare resulting from a change in economic policies, given information about technology (the inputs required to produce a unit of output), policies and consumer preferences

A CGE model is one of the most rigorous, cutting-edge quantitative methods to evaluate the impact of economic and policy shocks particularly policy reforms in the economy as a whole. CGE modeling reproduces in the most possible realistic manner- the structure of the whole economy and therefore the nature of all existing economic transactions among diverse economic agents (productive sectors, households, and the government, among others). Moreover, CGE analysis, in comparison to other available techniques (Partial equilibrium model), captures a wider set of economic impacts derived from a shock or the implementation of a specific policy reform. In that sense, the CGE approach is especially useful when the expected effects of policy implementation are complex and materialize through different transmission channels.

The basic difference between the two is on the assumption which is Partial equilibrium model assessing the impact of an economic or policy shock affecting two or more interconnected markets, assuming the rest of the economy remains fixed (*ceteris-paribus* condition). This quantitative approach is very effective –in terms of time and data requirements- when the policy shock to be evaluated is expected to have effects limited to specific sectors/markets. On the other side, CGE models are better equipped to evaluate policy shocks whose impacts are expected to be complex, transmitted by different channels, and materialize not only in one but various rounds (e.g. trade and fiscal policy reform).

CGE models are broadly divided in to two: static and dynamic. Static CGE models show one time effects of policy changes. Static CGE models are unable to account for growth or second round effects (Annabi et al, 2004, and Thurlow, 2004). For example, the impact of changes in current investment on future capital is not taken in to consideration in static CGE models while Dynamic CGE models are developed to solve this problem.

Dynamic CGE models are again divided in to two: truly dynamic (intertemporal) and sequential dynamic (recursive) models (Annabi, Cockburn, and Decaluwe, 2004). The basic difference between the two is the assumption on economic agents: truly dynamic models assume economic agents have perfect foresight[5] about the future, while recursive dynamic CGE model assumes adaptive expectations[6].

[5] Perfect foresight means they know all about the future and react to future changes in prices or forward looking expectations that underlie alternative inter-temporal optimization models.

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

A recursive dynamic CGE model is a "series of static CGE models that are linked between periods by an exogenous and endogenous variable updating procedure". Capital stock is updated endogenously depending on previous outcomes while population growth and technological changes are exogenously updated. The recursive dynamic CGE model is a series of static CGE models, we can have both the within period (one period static) component, and the between periods (dynamic) component (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.

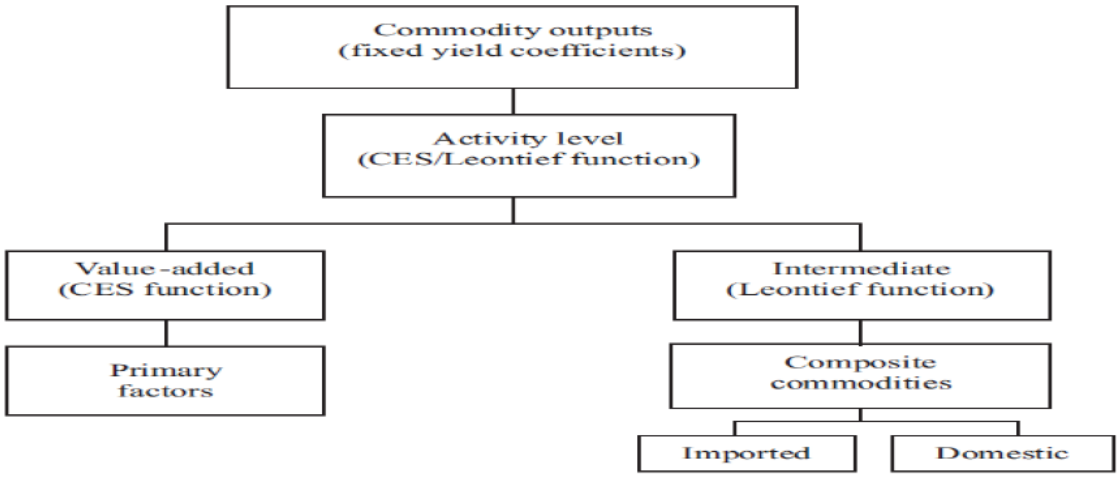
3.2.1.1 Production and prices

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.
- 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.

Figure 3.1 Production Technology



Source: Lofgren (2002)

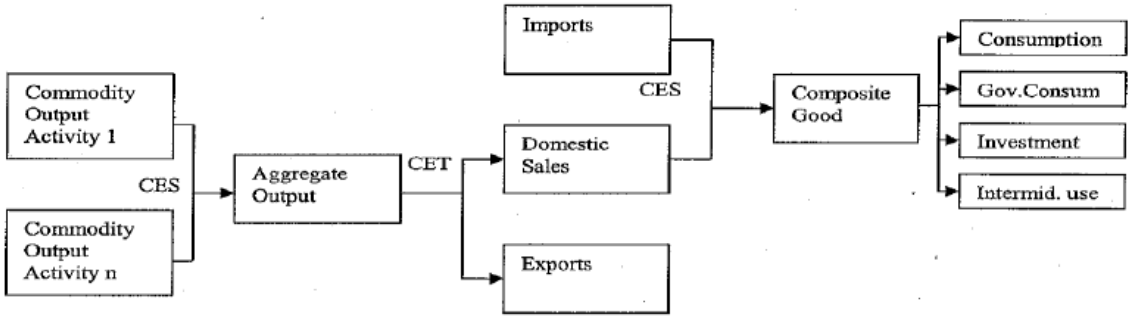
3.2.1.2 Commodity flow

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 elasticity varies across sectors, with lower elasticity reflecting greater differences between domestic and imported goods.
- Small country[7] assumption, 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.

[7] 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

Closure rules are chosen due to their appropriateness to the economy being examined and the objective of the study. In the model used for the present study, the following closure rules were adopted:

I. **External balance**: the level of foreign savings is fixed in foreign currency terms. In the context of a trade shock, joining the CFTA, 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.

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, this particular 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

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

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

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

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

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

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

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 AND DISCUSSION

4.1 Simulations

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 2009 base. The simulation is applied on each scenario from 2016 up to 2019. This section presents the results of CGE-based simulations of the impact of CFTA on overall Ethiopian economy using three set of scenarios.

Simulation 1: This assumes that the status quo continues which is baseline scenario. That is, no FTA for any product at all.

Simulation 2: Gradual removal of tariff for all products. Since the simulation runs for 4 years between 2016 and 2019, a yearly 25% tariff removal on all products is considered. That is 25% in 2016, 50% in 2017, 75% in 2018 and 100% in 2019. This simulation is considered because it might be difficult for the government to eliminate all tariffs at one time.

Simulation 3: One time complete abolishment of tariff in the year 2016 for all products.

Simulation 4: One time complete removal of tariff in the year 2016 for all products except textile, cloth, and leather which are considered by the government as strategic sectors. In Growth and Transformation Plan (GTP), Textile and apparel products, and leather and leather products are will receive special support to make the sectors competitive. As the result, the investigator avoided these sectors from the simulation by keeping as sensitive sectors.

4.1.1 Impact on macro variables

In table 5.1 summarizes the results of three simulations on the some macro variables. GDP is one of the important macro variables. We have two variables for GDP: GDP at factor cost (GDPFC2) and GDP at market prices (GDPM2). PRVCON is private consumption, import and export, ABSORP is absorption, FIXINV is fixed investment, and GOVCON is government consumption.

Table 4.1 Impact on selected macro variables (% change of real values)

Macro variables	INITIAL	Base	Sim1	Sim2	Sim3
ABSORP	457.7370	8.4984	8.5141	8.5242	8.5229
PRVCON	338.6106	7.4679	7.5059	7.5294	7.5263
FIXINV	85.4902	10.3683	10.3216	10.2945	10.2985
GOVCON	31.8192	12.9861	12.9861	12.9861	12.9861
EXPORTS	52.1375	18.4678	18.6352	18.7508	18.7432
IMPORTS	-126.5102	12.1053	12.2189	12.2976	12.2924
GDPMP2	383.3643	9.1727	9.1904	9.2018	9.2004
GDPFC2	354.9523	9.9606	9.9859	10.0044	10.0017

Source: CGE simulation result

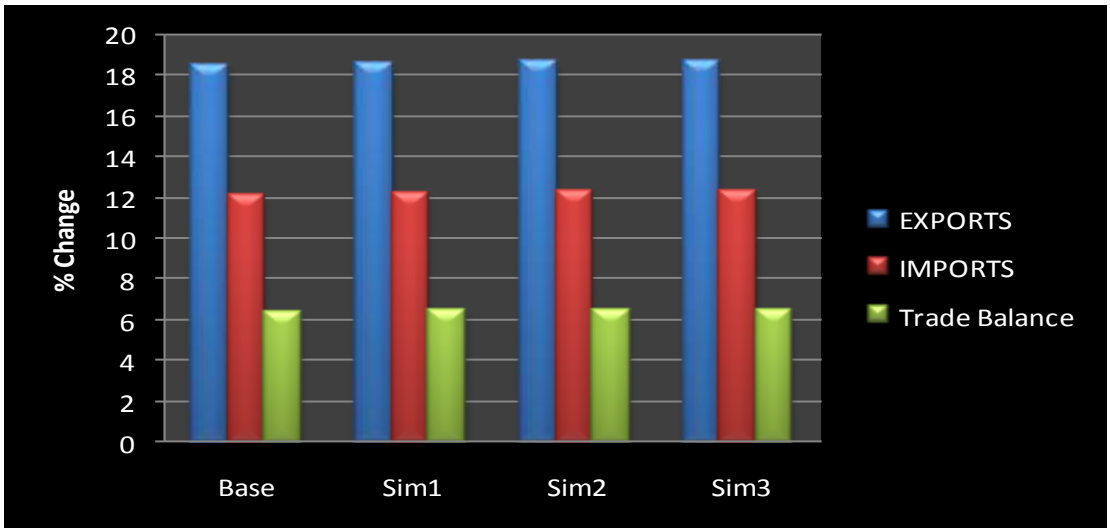
4.1.2 The effect on Growth Domestic products (GDP)

The growth rates of both GDPFC2 and GDPMP2 have increased in all the simulations. Removal of all tariffs from African countries in all sector results in the GDP of the countries to increase from 9.1727% to 9.1904% at market price and from 9.9606% to 9.9859% at factor cost in simulation one, from 9.1727% to 9.2018% at market price and from 9.9606% to 10.0044% at factor cost in simulation two and finally from 9.1727% to 9.2004% at market price and from 9.9606 % to10.0017% in simulation three. The highest GDP registered when Ethiopia removes all the tariff line at once in at market price as well as at factor cost.

4.1.3 The effect on import and export

In all scenarios both aggregate import and export increased as the result of joining continental free trade area. The export grows from 18.46% to 18.63% at scenario one, from 18.46% to18.75% in scenario two and 18.46% to 18.74%. The import grow from the base of 12.10% to 12.21% at scenario one, from 12.10% to12.29% at scenario two and from 12.10% to12.29%. The intuition is when tariff removal reduces the price of imports as a result; there will be a higher demand for imports. The increase in imports might contribute to an increase in exports which is an input in the production of goods and services increase. The increase in exports, however, is greater than the increase in imports. This will lead to an improvement in trade balance. See the figure below.

Figure 4.1 Percentage change in Import, Export and trade Balance



Source: own calculation based on CGE results

4.3 Price of export and import

The prices of exports and imports for all sectors would decrease. Because there is higher quantity import that result from excess supply. This is in turn 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 exportable and partly because of removal of tariffs on Ethiopian exports from the recipient FTA member country. Therefore, the prices of import and export would decline.

Table 4.2 Price export (%change)

sectors	Sim1	Sim2	Sim3
Agriculture sector	-0.02	-0.04	-0.04
Industrial sector	-0.06	-0.12	-0.11
Services sector	-0.01	-0.03	-0.03

Source: own calculation based on CGE results

From table 4.3, for simulation one the export in agricultural, industrial and service sectors decline on average by 0.02%, 0.06% and 0.01% in respectively from the base. While for simulation two agricultural, industrial and service sectors decline on average by 0.04%, 0.12% and 0.03% in respectively and finally for the last simulation agricultural, industrial and service sectors decline on average by 0.04%, 0.11% and 0.03% in respectively.

Table4.3 Price import (% change)

Sectors	Sim1	Sim2	Sim3
Agriculture sector	-0.12	-0.18	-0.18
Industrial sector	-0.09	-0.15	-0.14
Services sector	-0.01	-0.03	-0.03

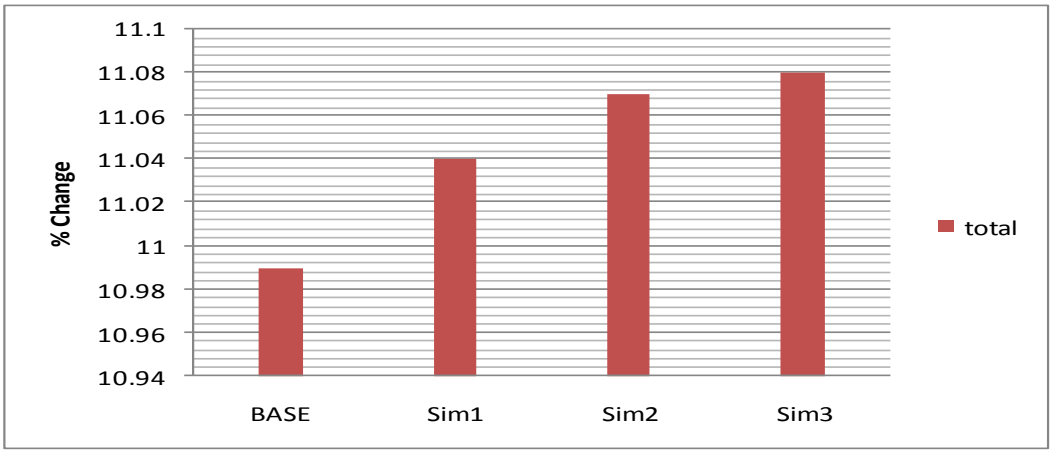
Source: own calculation based on CGE results

From table 4.4, for simulation one the import of agricultural, industrial and service sectors decline on average by 0.12%, 0.09% and 0.01% in respectively from the base. While for simulation two agricultural, industrial and service sectors decline on average by 0.18%, 0.15% and 0.03% in respectively and finally for the last simulation agricultural, industrial and service sectors decline on average by 0.18%, 0.14% and 0.03% in respectively.

4.4 Disaggregated Activity Production Levels (% change)

The growth in GDP might be explained by the increase in disaggregated activity production levels. We can compare table5.1 with figure 2 below. The trend in total disaggregated activity production level is similar with the trend in GDP. The growth rates of both GDP and disaggregated activity production levels increase in all simulations. Both also have highest percentage increases in simulation three and the lowest in simulation one.

Figure 4.2 Total activity production level in percentage change



Source: CGE simulation result

4.5 Impact on Government revenue

Tax is an important part of government revenue. Joining to FTA removal of tariff, it leads to the decrease in government revenue. Our simulation results also show this.

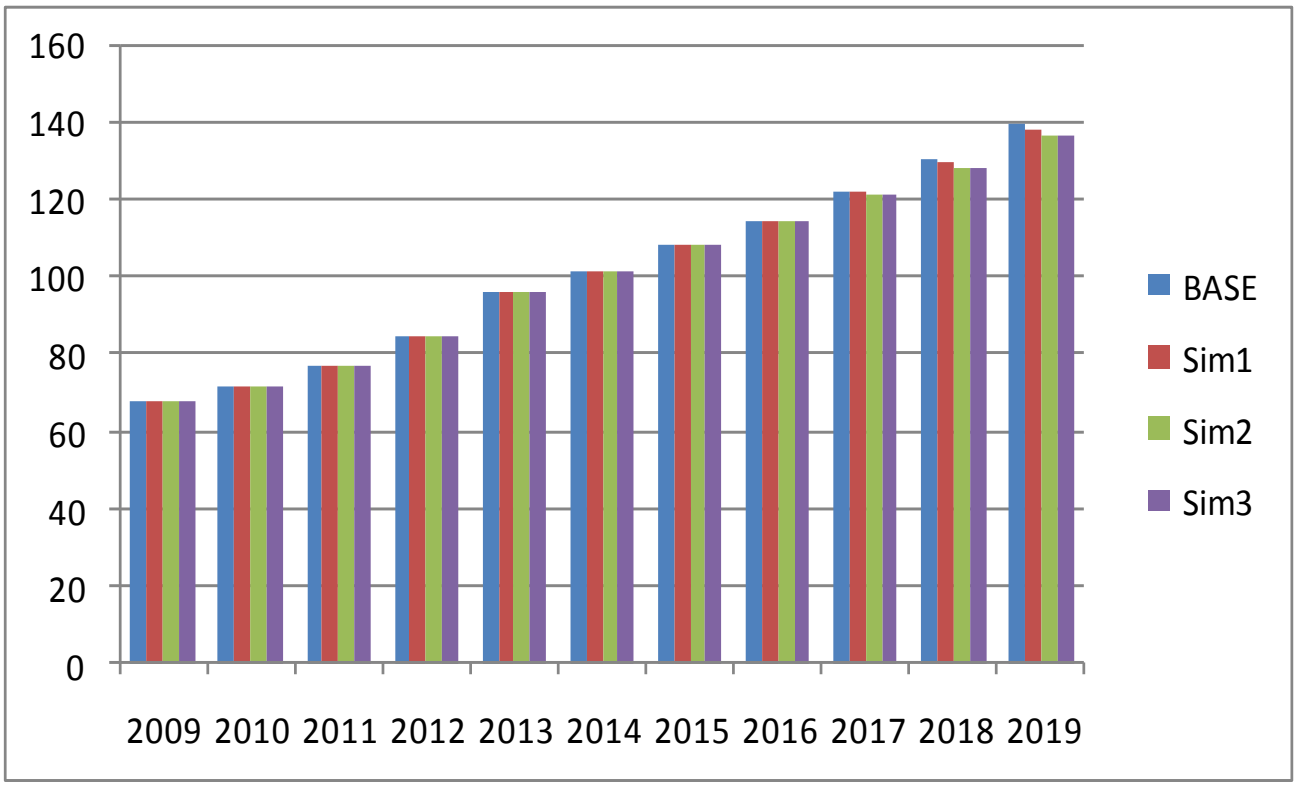
Table4.4: The government revenue change over time in billion birr

Simulations	2009	2016	2017	2018	2019
BASE	67.7794	114.6331	122.1052	130.3983	139.7143
Sim1	67.7794	114.4774	121.5982	129.2981	137.7273
Sim2	67.7794	114.0056	120.7818	128.2896	136.7064
Sim3	67.7794	114.0147	120.7998	128.3146	136.7450

Source: CGE simulation result

The table and figure shows that when we compare simulations 1 to 3 from the baseline simulation. Up to 2015, government revenue is the same for all simulation, which is before any tariff shock implementation. However, the value of government revenue is differing for all the simulations since 2016. The highest decrease in government revenue is brought by simulation 2, which is one time complete abolishment of tariff in the year 2016 for all products emanate from African countries. Simulation 3 leaves textile, cloth, and leather out of FTA as sensitive sectors. There will be a slight change in government revenue in simulation 3 compare to Simulation2. This clearly indicates that when we protect the strategic sectors there will be a slight change in government revenue. However, in simulation one is not the same case as other simulations because here tariff reduction in phase by phase, which is start tariff reduction by 25% in 2016, 50% in 2017, 75$ in 2018 and 100 in 2019. The government revenue decrease from the base 114.633 to 114.477, 122.105 to 121.598, 130,398 to 129.298 and 139.714 to 137.727 in 2016,2017,2018,2019 respectively.

Figure 4.3 The government revenue change over time



Source: CGE simulation result

4.6 Impact on Household consumption expenditure

The table below show, the impacts of household consumption expenditure in six agro ecological zone for both poor and non poor is increasing in general and no variation among each zone on household consumption expenditure. The highest household consumption expenditure registered in simulation2, which is 100% tariff reduction and lowest registered in simulation 1. The reason for high household consumption expenditure on simulation 2 implies that a 100% tariff reduction led to decrease the price of import. As the result the household spend their money more in consume goods than saving. Finally, the increment in Household consumption expenditure is very small since the share of Africa trade to Ethiopian economy is very less.

Table 4.5 Household consumption expenditure (% change)

Household in agro ecological zone	INITIAL	BASE	Sim1	Sim2	Sim3
hh-hc-pr	28.029	4.218	4.253	4.268	4.267
hh-hc-np	101.665	5.493	5.537	5.561	5.558
hh-ho-pr	14.887	4.881	4.928	4.952	4.950
hh-ho-np	39.579	5.782	5.832	5.862	5.858
hh-dp-pr	17.131	4.931	4.975	4.996	4.994
hh-dp-np	37.934	5.690	5.739	5.766	5.763
hh-pa-pr	3.593	4.248	4.295	4.318	4.316
hh-pa-np	18.067	5.340	5.390	5.419	5.415
hh-nf-pr	6.541	6.555	6.613	6.648	6.644
hh-nf-np	40.725	5.866	5.930	5.969	5.965
hh-lu-pr	3.426	5.336	5.392	5.426	5.423
hh-lu-np	27.036	2.663	2.723	2.760	2.757

Source: CGE simulation result

CHAPTER FIVE

CONCLUSION AND POLICY IMPLICATION

5.1 Conclusion

In this study, we have attempted to examine the economy wide impact of Continental free trade area (CFTA) on Ethiopia using a recursive dynamic CGE model approach. For this purpose EDRI 2009/10 SAM is used as a data base. Ethiopia got small mixed results are found, which is some are positive and other negative impact on different economic activities.

The paper tried to see the impact of this CFTA on selected macro variable like GDP, export and import, production of domestic activity, import and export price, government revenue and finally household consumption expenditure using three different scenarios over the next four consecutive years from 2016 up to 2019.

Due to the CFTA, GDP showed an increase in all the three scenarios. The results shows highest increase in GDP was registered when the tariff rate is removed for all products. For instance, it will increase from 9.96 to 10.04 at factor cost in simlation2. These happen due to an increase in growth of private consumption and export.

Prices of exports and prices of imports decreased due to joining CFTA in all sectors. The finding showed import prices declined higher amount relative to export prices. The CFTA also increased both imports and exports. The increase in imports is because of the decrease in import price when tariff is removed. On the other hand, increase in exports, due to the increase in imports of input which could be used in the production process.

Government revenue has decreased due to the elimination of tariff. This is because; tariff revenue is a very important source of government revenue. Its removal implies there is no more government income from tariff. The highest decrease in government revenue is brought by the complete abolishment of tariff in 2016 for all products. The other impact of is on households consumption expenditure. It is found that household consumption increased for both the poor and the non-poor in each agro ecological zone.

5.2 Policy Implications

Depending on the findings, the study identifies the following policy implications that are relevant for Ethiopia‘s future negotiations with CFTA member countries.

- The volume of Ethiopia‘s trade with other African members is very small due to similarity in import and export structures. This implies that diversification in export should put in place to benefit from the continental free trade area.
- One of the negative impacts of CFTA is loss of government revenue. In countries like Ethiopia, where tariff revenue is the significant contributor to government income, policy should be put in place to compensate this loss in government revenue. The policy option could include broadening the domestic tax base; properly collect all domestic tax efficiently and creating simpler and more efficient tax administration. They also tend to provide electronic filing and payment systems, which reduce the tax burden for firms while lightening their administrative requirements.
- The importance of protecting strategic sectors should be investigated before excluding them from the CFTA. Sometimes, this action could only benefit those sectors while the

overall economy is affected negatively. Our findings show that GDP increases by a higher percentage when these sectors are not protected.

- CFTA would benefit the consumers. Consumers will be beneficial at the cost of producers. Our results show an increase in private consumption while investment decreases. The decrease in investment might be because of the low tariffs have would weakened the capacity of the domestic industries to compete with low cost imports. So that, policy makers have to compensate the producers by making special incentive privilege.

- According to some estimates, removal of tariffs on intra-African trade could raise their share in total African trade from about 10.2 percent to 15.5 percent from 2010 to 2022. With enhanced trade facilitation measures the gains would double, to reach 21.9 percent. This clearly implies non tariff barriers have greater impact in total African trade. The result in this study also indicates removal of tariff have is small impact on Ethiopian economy in general. As the result, further study should put in place on Non-tariff barriers.

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Appendices

Appendices 1: Macro variables indicators (% change)

	INITIAL	BASE	Sim1	Sim2	Sim3
ABSORP	457.73695	8.49839	8.51406	8.52417	8.52291
PRVCON	338.61057	7.46792	7.50594	7.52941	7.52628
FIXINV	85.49023	10.36834	10.3216	10.29451	10.29849
GOVCON	31.81923	12.98611	12.98611	12.98611	12.98611
EXPORT	52.13754	18.46781	18.63518	18.75083	18.74322
IMPORTS	-126.51021	12.1053	12.21887	12.29758	12.29239
GDPMP2	383.36428	9.17268	9.19038	9.20179	9.20036
GDPFC2	354.95228	9.96059	9.98588	10.00438	10.00171

Appendices 2: Disaggregated activity production level (% change)

Activity	INITIAL	BASE	Sim1	Sim2	Sim3
ateff-hc	9.43	8.2	8.22	8.23	8.23
ateff-ho	0.83	1.82	1.82	1.83	1.83
ateff-dp	3.92	4.95	4.96	4.98	4.97
ateff-pa	0.06	-7.2	-7.2	-7.2	-7.2
abarl-hc	5.96	10.13	10.14	10.15	10.15
abarl-ho	0.46	4.85	4.86	4.86	4.86
abarl-dp	1.99	5.89	5.9	5.91	5.91
abarl-pa	0.07	-5.51	-5.51	-5.51	-5.51
awhea-hc	10.12	10.07	10.02	9.99	9.99
awhea-ho	0.95	5.18	5.13	5.1	5.1
awhea-dp	4.23	16.23	16.2	16.17	16.17
awhea-pa	0.15	-3	-3.06	-3.09	-3.09
amaiz-hc	9.63	7.4	7.41	7.42	7.42
amaiz-ho	1.12	-0.19	-0.18	-0.18	-0.18
amaiz-dp	3.16	6.75	6.76	6.77	6.76
amaiz-pa	0.81	0.34	0.35	0.35	0.35
asorg-hc	4.48	10.96	10.97	10.98	10.98
asorg-ho	0.2	2.63	2.65	2.65	2.65
asorg-dp	2.39	3.16	3.17	3.18	3.18
asorg-pa	0.95	6.32	6.33	6.34	6.33
apuls-hc	7.29	5.93	5.92	5.92	5.92
apuls-ho	1.62	9.93	9.92	9.92	9.92
apuls-dp	3.39	6.86	6.86	6.86	6.86

apuls-pa	0.45	10.03	10.02	10.01	10.01
aoils-hc	3.02	6.52	6.52	6.52	6.52
aoils-ho	0.01	6.53	6.53	6.53	6.53
aoils-dp	1.77	6.39	6.39	6.39	6.39
aoils-pa	0.15	6.39	6.39	6.39	6.39
avege-hc	2.04	3.66	3.68	3.68	3.68
avege-ho	1.67	9.83	9.85	9.86	9.86
avege-dp	0.78	4.92	4.93	4.95	4.94
avege-pa	0.55	9.38	9.39	9.39	9.39
afrui-hc	0.29	4.25	4.26	4.25	4.26
afrui-ho	0.5	10.41	10.41	10.41	10.41
afrui-dp	0.07	5.52	5.52	5.52	5.52
afrui-pa	0.08	9.99	9.98	9.98	9.98
anset-hc	2.79	8.76	8.76	8.76	8.76
anset-ho	3.25	8.76	8.76	8.76	8.76
acott-hc	1.16	7.78	7.78	7.78	7.78
acott-dp	0.5	7.69	7.69	7.69	7.69
asugr-hc	0.4	8.09	8.09	8.09	8.09
asugr-ho	0.51	8.09	8.09	8.09	8.09
asugr-dp	0.08	8	8	8	8
asugr-pa	0.03	8	8	8	8
ateal-hc	0.11	9.15	9.15	9.14	9.14
achat-hc	1.37	6.12	6.12	6.12	6.12
achat-ho	0.57	6.12	6.12	6.12	6.12
achat-dp	0.19	6.03	6.03	6.03	6.03
achat-pa	5.02	6.03	6.03	6.03	6.03
atoba-ho	0.05	3.53	3.53	3.53	3.53
acoff-hc	8.08	7.49	7.49	7.49	7.49
acoff-ho	4.02	7.47	7.47	7.47	7.47
acoff-dp	0.21	7.37	7.37	7.37	7.37
acoff-pa	1.47	7.37	7.37	7.37	7.37
aflow-hc	0.36	6.95	6.95	6.95	6.95
aocrp-hc	3.93	4.48	4.47	4.46	4.46
aocrp-ho	1.16	12.53	12.52	12.52	12.52
aocrp-dp	3.18	6.18	6.17	6.16	6.16
aocrp-pa	0.64	11.39	11.38	11.37	11.37
acatt-hc	10.16	4.27	4.28	4.29	4.29
acatt-ho	3.2	4.18	4.19	4.19	4.19
acatt-dp	3.75	3.99	4	4.01	4
acatt-pa	0.96	4.12	4.13	4.14	4.14
amilk-hc	13.19	3.5	3.49	3.48	3.48

amilk-ho	4.5	3.38	3.38	3.37	3.37
amilk-dp	3.62	3.28	3.27	3.26	3.26
amilk-pa	2.03	3.3	3.29	3.29	3.29
apoul-hc	0.72	4.57	4.58	4.59	4.59
apoul-ho	0.26	4.53	4.54	4.54	4.54
apoul-dp	0.36	4.27	4.28	4.29	4.29
apoul-pa	0.09	4.5	4.51	4.52	4.52
aaprd-hc	3.36	2.96	2.95	2.93	2.95
aaprd-ho	0.78	2.89	2.88	2.87	2.88
aaprd-dp	1.91	2.55	2.54	2.53	2.54
aaprd-pa	0.61	2.73	2.72	2.71	2.72
afish	0.18	-2.49	-2.53	-2.57	-2.56
afore	16.46	5	4.99	4.99	4.99
aomin	2.57	3.08	3.08	3.08	3.08
adair	12.05	1.97	1.94	1.91	1.91
avprd	0.02	8.65	8.71	8.74	8.74
agmll	2.05	7.01	6.95	6.9	6.91
amsrv	2.32	7.16	7.16	7.17	7.17
apsgr	2.74	8.77	8.71	8.67	8.68
aptea	0.41	8.82	8.9	8.93	8.93
afood	6.66	9.28	9.26	9.24	9.24
abeve	5.05	9.5	9.47	9.45	9.46
aptob	0.64	12.38	12.13	11.98	12.01
atext	4.6	11.42	11.4	11.38	11.38
aclth	1.17	39.57	39.39	39.16	38.53
aleat	2.69	-2.15	-2.32	-2.46	-2.36
awood	0.32	14.14	13.99	13.87	13.89
apapr	2.06	58.7	59.43	59.98	60.08
achem	3.15	6.48	6.38	6.35	6.39
anmet	2.29	-5.15	-6.18	-6.69	-6.69
ametl	7.08	7.15	7.05	6.98	6.99
amach	0.03	10.17	10.15	10.13	10.14
avehe	0.81	12.03	12.08	12.11	12.11
aeequ	0.81	6.72	6.69	6.67	6.68
aoman	6.12	7.58	7.41	7.3	7.31
aelec	3.58	14.23	14.36	14.46	14.47
awatr	3.92	9	9.02	9.03	9.03
acons	85.1	10.42	10.39	10.37	10.37
atrad	90.02	12.06	12.05	12.05	12.05
ahotl	40.9	7.49	7.51	7.53	7.53
atran	24.6	13.36	13.3	13.24	13.25

acomm	4.03	11.21	11.2	11.19	11.19
afsrv	10.5	11.23	11.26	11.29	11.3
absrv	1.41	14.55	14.17	13.88	13.92
areal	37.01	9.5	9.52	9.53	9.53
aosrv	6.86	7.39	7.4	7.4	7.4
apadm	20.64	12.92	12.92	12.92	12.92
aeduc	11.08	12.08	12.08	12.08	12.08
aheal	3.23	11.44	11.44	11.44	11.44
total	598.36	10.99	11.04	11.07	11.08

Appendices 3: Government revenue

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
BASE	67.78	71.83	76.72	84.88	95.83	101.62	107.85	114.63	122.11	130.40	139.71
Sim1	67.78	71.83	76.72	84.88	95.83	101.62	107.85	114.48	121.60	129.30	137.73
Sim2	67.78	71.83	76.72	84.88	95.83	101.62	107.85	114.01	120.78	128.29	136.71
Sim3	67.78	71.83	76.72	84.88	95.83	101.62	107.85	114.01	120.80	128.31	136.74

Appendices 4: Import price (% change)

sectors	BASE	Sim1	Sim2	Sim3
Agriculture	-4.41	-4.53	-4.59	-4.59
Industries	-4.43	-4.52	-4.58	-4.57
services	-4.38	-4.39	-4.40	-4.40

Appendices 5: Export price (% change)

sectors	BASE	Sim1	Sim2	Sim3
Agriculture sector	-4.33	-4.35	-4.37	-4.37
Industrial sector	-4.07	-4.13	-4.19	-4.18
Services sector	-4.38	-4.39	-4.40	-4.40

Appendices 6: Household consumption

Household in agro ecological zone	INITIAL	BASE	Sim1	Sim2	Sim3
hh-hc-pr	28.029	4.218	4.253	4.268	4.267
hh-hc-np	101.665	5.493	5.537	5.561	5.558
hh-ho-pr	14.887	4.881	4.928	4.952	4.950
hh-ho-np	39.579	5.782	5.832	5.862	5.858
hh-dp-pr	17.131	4.931	4.975	4.996	4.994

hh-dp-np	37.934	5.690	5.739	5.766	5.763
hh-pa-pr	3.593	4.248	4.295	4.318	4.316
hh-pa-np	18.067	5.340	5.390	5.419	5.415
hh-nf-pr	6.541	6.555	6.613	6.648	6.644
hh-nf-np	40.725	5.866	5.930	5.969	5.965
hh-lu-pr	3.426	5.336	5.392	5.426	5.423
hh-lu-np	27.036	2.663	2.723	2.760	2.757

Appendices 7: CGE model sets, parameter, variables and equation

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)
$QF_{fa} = \alpha_{fa}^{vam} \cdot \left(\sum_{f' \in F} \delta_{ff'a}^{vam} \cdot QF_{f'a}^{-\rho_{fa}^{vam}} \right)^{\frac{1}{\rho_{fa}^{vam}}}$	(5)
$W_{f'} \cdot WFDIST_{f'a} = W_f \cdot WFDIST_{fa} \cdot QF_{fa} \cdot \left(\sum_{f' \in F} \delta_{ff'a}^{vam} \cdot QF_{f'a}^{-\rho_{fa}^{vam}} \right)^{-1} \cdot \delta_{ff'a}^{vam} \cdot QF_{f'a}^{-\rho_{fa}^{vam}-1}$	(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)
$PDD_c = PDS_c + \sum_{c' \in CI} PQ_{c'} \cdot icd_{c'c}$	(19)
$PM_{cr} = pwm_{cr} \cdot (1+tm_{cr}) \cdot EXR + \sum_{c' \in CI} PQ_{c'} \cdot icm_{c'c}$	(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)
$\frac{QM_{cr}}{QD_c} = \left(\frac{PDD_c}{PM_c} \cdot \frac{\delta_{cr}^q}{1 - \sum_r \delta_{cr}^q} \right)^{\frac{1}{1+\rho_c^q}}$	(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)
$\overline{CPI} = \sum_{c \in \bar{C}} PQ_c \cdot cwts_c$	(26)
$DPI = \sum_{c \in \bar{C}} PDS_c \cdot dwts_c$	(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)
$\sum_{r \in CMNR} pwm_{cr} \cdot QM_{cr} + \sum_{f \in F} trnsfr_{row\,f} = \sum_{r \in CENR} pwe_{cr} \cdot QE_{cr} + \sum_{i \in INSD} trnsfr_{i\,row} + FSAV$	(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)