Economy-Wide Impacts of Export Price Changes in Ethiopia: A Recursive Dynamic Computable General Equilibrium Analysis

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This is to certify that the thesis prepared by Endalkachew Kabtamu, entitled: **'Economy-Wide Impacts of Export Price Changes in Ethiopia: A Recursive Dynamic Computable General Equilibrium Analysis'** and submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Economics (Economic Policy Analysis) fulfills with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

Ethiopia's export is largely dominated by primary commodities characterized by a high degree of price variability. Therefore, this study investigated the economy-wide impacts of export price changes using Recursive Dynamic Computable General Equilibrium model calibrated through 2009/10 Social Accounting Matrix of Ethiopia, developed by International Food and Poverty Research Institute in collaboration with Ethiopia Development Research Institute and University of Sussex. The study reveals increase in export price appreciates domestic currency, rises import demand, but reduces export demand together that worsens Ethiopia trade balance. The increase in export price also weakens investment demand, government income and saving, the overall and sectoral economic growth. It also rises factors return and household income and welfare. Conversely, decrease in export price depreciates domestic currency, which lead to low import, but, high export demand, which in turn leads to improved trade balance. It also increases investment demand, government income and saving, and the overall economic growth. However, decrease in export price results low factors return, household income and welfare. To reduce the negative impacts of export price changes in the overall economy, it is recommended that: a) the exchange rate policy of the country should managed-floating type, b) diversification and industrialization of export sector through integrating commodity policies into the country overall development strategy, and c) harness the income gains from commodity prices to facilitate wider-economic transformations and reduction of dependence on primary commodities export.

Key Words: Dynamic Computable General Equilibrium Model, Ethiopia, Exchange rate, Export price Changes, and Social Accounting Matrix.

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List of Acronyms

AEO	Africa Economic Outlook
AfDB	African Development Bank
ATPC	African Trade Policy Centers
CGE	Computable General Equilibrium
DCGE	Dynamic Computable General Equilibrium
EDRI	Ethiopia Development and Research Institute
EEO	Ethiopia Economic Outlook
ELG	Export Led Growth
IBRD	International Bank for Reconstruction and Development
IFPRI	International Food and Poverty Research Institute
IMF	International Monetary Fund
ITC	International Trade Classification
LLDCs	Land Locked Developing Countries
MFoAE	Ministry of Foreign Affairs of Ethiopia
MOFED	Ministry of Finance and Economic Development
NBE	National Bank of Ethiopia
NPC	National Plan Commissions
PEA	Partial Equilibrium Analysis
SIDA	Swedish International Development Cooperation Agency
SIDCS	Small Island Developing Countries
UN	United Nation
UNCTAD	United Nation Conference on Trade and Development
UNDP	United Nation Development Program
UNOHR	United Nation office of Higher Representatives for Land Locked states
WB	World Bank
WTO	World Trade Organization

Chapter One: Introduction

1.1. Background of the Study

The growing integration of countries into the global economy has brought a paradigm shift in the global economic situation. It promotes specialization, increase productivity, economies of scale, diffusion of knowledge and availability of technologies which enhance economic growth and poverty reduction (UNCTAD, 2008). Conversely, it has brought risks associated with external economic shocks through trade and capital flows, which increase trade imbalance, financial market volatility and less usefulness of domestic policy (IMF 2008; SIDA 2007).

LDCs particularly SSA countries is highly vulnerable to external shocks, which relies on primary commodity export (UNOHR, 2014). For most African countries, commodity export is the main source of foreign exchange, government revenue and income for household (Ehrhart and Guerineau, 2011). However, export of these countries is small in number and price depends on global commodity market situation (UN, 2012). LDCs such as Ethiopia, can affected by external economic shocks. Lulit *et al.* (2011) show the 2007-2009 global economic recession affected the volume and price of merchandize export in Ethiopia, which in turn reduce foreign currency earning and import volume. Equally, UNOHR (2009) shows global economic downturn adversely affected service export of Ethiopia, chiefly, tourism and transportation. In a nuthsell, Andrew *et al.*(2011) exhibit economic growth in LDCs decline during global economic recession due to fall in export demand and, it upsurges when export demand rise. Therefore, LDCs that rely on primary commodity export is significantly affected by external economic shocks.

Broda and Tille (2003) reveal LDCs are characterized by a high degree of export price volatility. Thus, considering the state of export price, the study is intended to investigate the economy-wide impacts of export price changes in Ethiopia. Ethiopia has set bright macroeconomic objectives in its GTP-II, which includes economic growth and poverty reduction that in turn leads to join lower middle-income countries by 2025 (UNDP 2017). Therefore, study that examine the impacts of export price changes within this setting has importance for economies that changes frequently. Moreover, it provides useful evidence for policy makers to reduce the vulnerability from export price shocks.

1.2 Problem Statement

The impacts of external economic shocks vary among countries depending on the degree of their openness.[1] Most developing countries, including SSA are small open economies which make them price taker in the global market (WB, 2008). Thus, its impact is strong in open, smaller and less diversified economies than advanced countries (UNOHR, 2014). For instance, Bourdet (2004) exhibit external economic shocks affect economic growth, saving, investment, trade balance and household welfare in Malawi and Burkina Faso. Equally, Wambugu (2012) reveal LDCs are challenged by external shocks which affected economic growth, poverty reduction efforts and causes unemployment, welfares lose, income inequality and low productivity. However, (Meyn and Kennan, 2009; CFC,2005) show the impacts of external economic shocks on LDCs economy has gotten concern in recent years while it was disregarded in the past.

The export structure of LDCs is dominated by a few semi-processed or unprocessed primary commodities (Agenor and Montiel, 2008). Moreover, they exhibit that trade shock is the sources of macroeconomic instability and variability of export price in these countries. Similarly, UN (2014) reveal export and import price volatility of LDCs causes variability of income due to the large share of import and export in domestic economic activities. For instance, WB (2013) indicate in the first quarter of 2013, Africa economic growth is declined due to low commodity price triggered by low global demand for primary commodities. The impacts of external economic shocks can transmit through FDI, aid, trade, remittance, capital market and banking sectors (Ho, 2016). But, many LDCs depends on aid from advanced countries, in this case the impacts of external shocks are large and substantial (Paul, 2010). Regarding Ethiopia, trade is an important transmission mechanism of external economic shocks (Getnet, 2010).

Ethiopia's export reveal a mixed performance owing to domestic and external factors. As measured by export value, it performs well in one period and it performs badly in another time. For instance, NBE (2009/10) shows the value of Ethiopia export decline by 1.2 percent point in 2008/9. Conversely, Geiger and Goh (2012) reveal the value of Ethiopia export increase by 14.8 percent in 2011/12. In addition, AEO (2016) show the value of Ethiopia export decrease by 8.5 percent in 2014 /15 FY due to fall in commodity export price. Therefore, it can be concluded that

[1] The measure of openness is trade share (sum of exports and imports to GDP ratio). By this measure, developing nations tends to be more open than major industrial countries (See: Agenor and Montiel, 2008).

Ethiopia export value is not increase or decrease constantly, rather, it changes in line with global economic conditions. Ethiopia export is an important source of foreign exchange income, which helps to achieve import needs of the country. UNDP (2017) show the export is vital to generate government revenue, which helps to finance public investment and leads economic growth and employment creation. However, ATPC (2006) exhibit Ethiopia major export items are primary commodities characterized by high price volatility, which exacerbate its vulnerability to external shocks. Given this, Ethiopia plan to become lower middle-income country by 2025 together with poverty reduction, narrowing of fiscal and trade imbalance and structural transformation of the economy. Therefore, a study which examines the impacts of export price shocks has importance to harmonize domestic economic objectives with global economic conditions.

Studies undertaken in Ethiopian regarding the impacts of export price shocks using CGE method are limited. Previous studies were focus on the determinants of export growth, role of export to economic growth and poverty reduction using PEA which cannot show the direct and indirect impacts of shocks.[2] Besides, as per the researcher knowledge, most studies focus on supply side of export shock by overlooking the demand side, export price changes. The only study carried out in Ethiopia using CGE method is by (Lulit, 2014; Robinson *et al*., 2010), which focus on the impacts of increase export price, which is not always the case for LDCs export price. That implies earlier studies fail to show the impacts of 2007-2009 economic crisis, which decreases the price of primary commodity. As a result, this study combines both increase and decrease export price to investigate its economy-wide impacts, which is vital to illustrate the situation of LDCs export price. To that end, an attempt is made to address the following research questions:

1. how macro and microeconomic variables responds to export price changes?
2. do export price changes affect export and import volume, as well as domestic supply?
3. what are the effects of export price changes on factors return, household income and welfare?

1.3 Objective of the Study

The general objective of the study is to examine the economy-wide impacts of export price changes in Ethiopia using a Recursive DCGE model. Particularly, the specific objective is to:

[2] PEA is based on ceteris paribus assumption which is used to analyze the impact of policy shocks on a particular industry where linkage with other industries is ignored (see: J. Bandara, 1998).

1. investigate the impacts of export price changes on vital macroeconomic indicators;
2. analyze the impacts of export price changes on export and import volume;
3. analyze the impacts of export price changes on household income and welfare; and,
4. illustrate the impacts of export price changes on industry output and supply.

1.4 Scope of the Study

The study is proposed to examine the economy-wide impacts of export price changes in Ethiopia particularly, on macroeconomic indicators, industry structure, factor income, household welfare, government and foreign saving, and export and import volume response to the price changes. To that end, a Recursive dynamic CGE model calibrated through the updated version of 2009/10 SAM of Ethiopia is used.

1.5 Significances of the Study

Limited studies were undertaken concerning the economy-wide impacts of export price changes in developing country context using DCGE method. However, most studies emphasis on advanced countries and even existed study focus on either increase or decrease export price. Therefore, examining the economy-wide impacts of export price changes will help countries to adopt anti-shocks strategy and harmonize domestic economic policy with global economic situations. Currently, many countries are gratified to forecast likely impacts of external economic shocks, and develop policy buffers as mediating strategy of these shocks. As a result, the findings of this study will provide valuable and quantified evidence to design development plans and policies in Ethiopia. Because, the study provides numerical values to the impacts of export price changes on key economic variables. In addition, knowing both the magnitude and direction of export price change impact is important to complement domestic economic policy with global economic conditions.

1.6 Limitation of the Study

The unavailability of an up-to-date SAM is the key problem confronted in the study. Moreover, the use of an outdated SAM through updating mechanisms of exogenous variables to forecast the future state of the economy is awkward because, the structure of the economy and demographic characteristics of households and institution may change in the meantime.

1.7 Organization of the Study

The rest of the study is organized into five sections as follow. Section two, reviews related theoretical and empirical literatures; section three provides an overview of Ethiopian economy; section four presents data and data sources, method of data analyses, and specification of CGE model; section five present analyses and discussion of simulation results; finally, section six presents conclusion and findings of the study, policy implications, and issues for future research.

Chapter Two: Literature Review

This section presents theoretical and empirical literature reviews. The first section presents the notion and theories of international trade, and the remaining section presents empirical literatures by organizing on the basis of the methodology used. As a result, studies undertaken using static CGE model are presented in one section and studies undertaken using dynamic CGE model are presented in another section. Moreover, at the end of this chapter empirical studies carried out in Ethiopia are reviewed.

2.1 The Notion of International Trade

International trade is concerned about the exchange of goods and services between independent countries. Most often, it focused on transactions that require the real movement of goods and services (Krugman and Obstfeld, 2003). Therefore, it is linked with import and export of goods and services among countries where export refers to goods and services which leave a country of origin for sale in another country. Conversely, import is goods and service that enter into another country for sale. Currently, there exists a mutual interdependence of global economy through trade among other channels. Many countries' open their economy to the ROW by removing trade barriers such as quotas and tariffs. Because, the expectation that trade will promote economic growth and society welafre.

The role of international trade as an engine of economic growth is known in mercantilisms era, though transaction is taken place in the past. Mercantilisms underlined that country should encourage export of goods and services to accoumulate wealth in the form of gold and silver but, they limit import of goods and services. As a result, mercantilisms principle of trade is a zero sum game, the gain of one country is at the cost of another country. Latter on, classical and neoclassical schools underlined that trade is an engine of economic growth based on free trade principle. Moreover, classical and neoclassical schools believe that all countries that participate in trade has benefited from trade. Although trade is understood as essential sources of growth, trade strategies adopted at present and earlier is different. For instance, now outward and inward oriented trade strategies, and a blend of the two strategies is applied in many countries which is different from the previous outward oriented trade strategy. Trade has an impact on macro and microeconomic variables of participating countries; for instance, it affected economic growth, poverty, employment and foreign exchange reserves. Conversely, it brought risks to countries

which includes hostile market entry policy, economic uncertainty, structural unemployment, environmental problem, dumping and export concentration (Drozdz and Miskinis, 2011; Hesbon, 2009). Generally, international trade involve export and import of commodity between country which have different resource endowment, preferences, and technology level.

2.2 Overview of International Trade Theories

Trade is not a miracle in human history, it was coined in prehistoric eras but, there was no consensus among scholars about the exact time when trade was commenced. However, in this section, attempt is made to understand a short overview of international trade theories beginning from mercantilisms to modern trade theory. Mercantilisms is assumed as a general framework by which international trade was understood from 16^{th} to 17^{th} century. Mercantilisms has a common view about the accumulations of gold and silver as an important source wealth and equate the wealth of nations with the quantity of precious metal it possessed (Dorobat, 2015; Bruce and Grant, 2013). Moreover, mercantilisms preferred export to get hard money, which is considered as the source of power and wealth. Similarly, mercantilisms advocate nation export must exceed its import, which leads to an inflow of precious metal (Magnusson, 2011).

Mercantilisms has laid the basis for the current thought on international trade as an important source of growth and accumulation of wealth. They also originate the idea of import and export which are vital to measure country term of trade. In addition, they support promotion of export similar to the current theory of export led growth hypothesis. However, the benefit of trade is not equally distributed among country or individual i.e. trade is a zero-sum game. However, after Adam Smith wrote his book entitled 'An Inquiry into the Nature and Causes of Wealth of Nations' in 1776, mercantilisms principle of trade has been criticized.[3] Smith assumes trade is gainful for countries which partake in trade based on absolute advantage principle (Schumacher, 2012). Smith theory of trade explain that if country is absolutely efficient in the production of commodity than another country, then, we can say that the country has an absolute advantage in the production of that commodity. Thus, trade benefits both parties through voluntary exchange and countries must specialize and export commodity in which it has complete cost advantage. As revealed by Nafziger (2006), absolute advantage theory of trade states that world welfare is

[3] Specialization is the result of change in costs, prices, and returns among countries. Country gains by trading what it produces most cheaply to people for whom production is costly or even impossible (See: E. Wayne Nafziger, 2006).

highest when country export products whose absolute cost is lower at home than abroad, and import goods whose absolute cost is lower at abroad than at home.[4]

An extension of absolute advantage is comparative advantage theory by David Ricardo around 1817 (Bjornskove, 2005). Absolute and comparative advantage theory of trade is opposing to mercantilisms trade principles. Absolute and comparative trade theory asserted that trade benefit all parties and support the principle of free trade without barrier that restrict imports and export of goods and services (Samuel *et al.*, 2003). Contrary, mercantilisms advocate government intervention and believe trade is zero-sum game. However, Smith's is unable to address, what would happen if countries did not have an absolute advantage from trade (Thirlwall, 2000). As a result, Ricardo's theory of trade reveal how countries could benefit from trade even if they did not have complete advantage. According to Ricardo, relative variation of cost of production determines trade relation between two countries i.e. difference in cost is the cause for trade (Schumacher, 2012). Comparative advantage theory of trade state that world welfare is maximized when each country export product whose relative cost are lower at home than abroad, and import goods whose relative costs are lower abroad than at home (Nafziger, 2006).

Ricardo's theory of trade underline each country should focus on the production and export of commodity that gives them relative advantage (Bjornskove, 2005; Thirlwall, 2000). In a nutshell, Ricardo's theory emphasis on variation in technology is the causes for variation in factor productivity. However, Ricardo is unable to explain why relative cost differs between countries (Lam, 2015). The failure of Ricardo to describe relative cost difference between countries provides chance for the development of modern theory of trade, which focus on difference in factor endowments as base for trade among countries (Wangwe, 1993). Modern (Neoclassical) trade theory is the result of two Swedish economists named "Eli Heckscher–Bertil Ohlin" or factor proportion theory (Lam, 2015). Todaro and Smith (2012) reveal factor endowment theory of trade is understood as Neoclassical model of free trade, which assume countries would concentrate on the production of commodities that make use of abundant factors of production.

[4]Absolute cost advantage is the ability of business to produce and sell better or service more than competitors, using the same amount of resources. But, comparative cost advantage is a ability to produce goods and services at a lower opportunity cost than its trade partners (http://www.economicsdiscussion.net/theories/theory-of-comparative-costs).

Neoclassical trade theory underline specialization and trade arise as result of difference in factors endowment, which indicate factors proportion endowment of countries is dissimilar. As a result, countries have different relative marginal cost of production that enforced to export commodity that employ abundant factors more intensively (Gandolfo, 2014). Therefore, Neoclassical model trade assume all nations could benefit from trade by specializing in products using abundant resources. Similarly, modern trade theory emphasize trade promotes economic growth and secure capital and consumption goods from other parts of the world (Todaro and Smith, 2012).

The assumptions of classical and neoclassical are not suitable for developing country situation and current economic relation among countries (Todaro and Smith, 2012). The market-oriented principle of trade together with full employment of factors is not exist presently. However, the world is characterized by unemployment, trade barriers, market failures, unequal gains from trade and non-competitive pricing policies. As a result, Smith, Ricardo's and Heckscher-Ohlin trade theory fail to provide validation for observed structure of current world trade. Moreover, Makarand (2014) reveal empirical data and observed facts are inconsistent with conventional and modern theory of trade. Scholars in the area try to relax the assumptions of trade theories and incorporate assumptions that fits to current world trade stance (Mark, 2000). Consequently, the new theory of trade arose based on economies of scale, imperfect competition, product variety, technological differences, nominal inflexibilities and trade between advanced country which reflect the pattern, structure and characteristics of current international trade (Brulhart, 2003).

As shown earlier, Lam (2015) reveal the new theory of trade is vital to explain patterns of trade among country as well as trade among developed and developing country and intra-industry trade. But, neoclassical theory of trade assume trade exists between country which has different factor endowment; therefore, it is effective to explain trade among industrialized and developing countries. For instance, developed country imports primary commodity from LDCs, and in return they export manufactured goods to LDCs. However, in reality the bulk of trade take place among developed country which has similar factor intensity, but not between developed and developing country (Dunn and Mutti, 2004). Therefore, new trade theory is central to explain the vast volume of intra-industry trade and share of world trade that takes place among similar country (Lame, 2015 Cited in Dicken 1998; Poon 1997). The new trade theory explains the pattern of trade between countries within the tradition of imperfect competition and economies of scale.

2.3 Developing Countries in International Trade

International trade has significant role in influencing the performance and prospects of economic and social variables of country in the world (UNCTAD, 2005). As a result, WTO enforce developing country to take trade reform through reducing trade barriers such as quota, tariff and export tax (UNCTAD, 2013). Trade provide market opportunity for producers and reduces cost of production for developing countries (Lamaj, 2015). Therefore, to ensure the benefits of trade, developing country involve in various trade agreements which are in tandem with domestic trade policy and strategy. Most often, many countries expect export is the driving force of economic growth, foreign exchange earning sources to reduce the balance of payment deficit, employment, and industrialization (Chhuor, 2017). To this end, developing country design export-led growth (ELG) based on the view that export is the key to economic growth and employment creation.

Export lead growth strategy underline overall growth of country is not achieved by labour and capital alone, also it requires an increase in export (Medina-Smith, 2001). The ELG objective is to provide producers incentive to increase export via various economic and government policies. In addition, ELG is planned to raise the ability of domestic commodity that competes at world market and provide the required forex to import strategic capital goods (AfDB, 2005). Because, Samen (2010) exhibit countries where the domestic market size is small, discovering the world largest market scale is contributing to economic growth. But there is argument which emphasize all exports are not enhance economic growth specially, country which export primary goods are prone to protracted incidents of economic downturn due to volatilities in price and fall in global demand (Tik, 2010). This implies cyclical boom and bust of primary commodity price affected exporter in LDCs.

LDCs are heavily depend on trade because, the share of merchandise export to national output is larger than developed countries (Todaro and Smith, 2012). Conversely, LDCs are price takers at international market for their primary commodity export in contrast to manufacturing commodity exporter advanced countries (Nafziger, 2006). This show LDCs face exogenous term of trade, meaning they have no power to set the price of import and export. As a result, volatility of commodity price affected the prevalence of poverty, since majority of poor households depend on primary commodity for their livelihoods (UN, 2012). For instance, from 141 total developing countries, primary commodity export accounts for more than 50 percent of income source to 95

of developing countries (Brown, 2008; cited in UN, 2012). Mostly, African and Latin American countries are more dependent on primary commodity export for forex earning and household livelihoods (UNCTAD, 2005).

The export earning of African countries depend on primary commodity price, which make the continent more vulnerable to market variability, income loss, investment volatility, indebtedness, poverty, and economic growth (UNCTAD, 2003; Cashin and Pattillo, 2000). For instance, CFC (2005) reveal out of 2.5 billion people engaged in agriculture, commodity export derives large part of income for nearly one billion people who live in LDCs. Moreover, CFC in the same year show primary commodity export accounts 70% of merchandise export for African countries and half of this countries derive 80% of their export income from primary commodity. Majority of population in LLDCs involve in commodity production for livelihoods, source of government revenue and foreign exchange income **(**IMF, 2016; Deaton and Miller, 1995).

WTO (2016) disclose price and demand fall for oil and commodity in 2015 leads to decline in export and import of developing countries. Moreover, WTO in the same year highlight the historical trade performance of Middle East, Latin America and African country depends on world economy situations. Therefore, this suggest if world economy is stable and demand for developing country export increase, trade performance of LDCs become better and vice versa. But, except for few industrializing economies in Asia and some dynamic developing country, exports of other developing countries still concentrate on a limited number of natural resources or manufactured products with low value-added (UN, 2012). As a result, LDCs are vulnerable to failing trade balance, volatile world prices as well as declining world trade (UNCTAD, 2008). Conversely, UNCTAD (2008) show imports of these countries increase due to the rise in income.

Todaro and Smith (2012) display the causes of primary commodity price volatility in developing countries. These are: first, compared to manufactured commodity, income elasticity of demand for primary commodity is low. This indicate unless there is continued and high degree of income growth in advanced countries, developing country export income is unsustainable. Second, price elasticity of demand for primary commodity is low which results in less revenue from export. Third, population growth rate of advanced country is near to replacement level hence, slight growth of demand is expected. Fourth, the growing of synthetic substitutes in advanced country

become the basis for competition in the world export market. Lastly, growing protection of agricultural commodity in developed country in the form of tariffs, quotas and non-tariff barriers have overwhelming effects on developing export income.

2.4 Empirical Literature Review

The impacts of external economic shocks have been studied using various quantitative and multi-sector equilibrium approaches. Some of them were undertaken using Vector Auto Regressive (VAR) approach and other studies were undertaken using cross countries panel data analysis. Moreover, many studies were also undertaken using DSGE and CGE methods. However, the findings of studies were mixed either due to methodological difference or the extent of shocks. Similarly, it is noted that negative external shocks have overwhelming effect from short to medium-run economic performance such as economic growth, employment and poverty. However, positive external shocks may or may not have positive effects on economic growth and other macroeconomic variables. The scope of this study is kept to review studies that scrutinized the impacts of export shocks using CGE approaches. Therefore, in this section the impacts of export demand shocks in various countries are reviewed. In doing so, effort is made to review the methodology, scope and the main findings of studies.

In LDCs, comprehensive studies undertaken to explain the impacts of external economic shock using CGE method are limited. Majority of existed studies were undertaken to examine the impacts of external shocks on poverty, economic growth, and employment, hence an economy-wide study that show the direct and indirect impacts of shocks are limited. Apart from Ethiopia, limited studies were undertaken in the economy-wide impacts of export shocks in particular or external economic shocks in general in developing countries. As a result, empirical studies which carried out on the economy-wide impacts of export shocks are relatively scarce. Most of the empirical studies were undertaken in developed country context and only a few studies were undertaken in developing country situation. Some of the empirical works that are reviewed in this study includes Carniero and Arabache (2002), Cassey *et al*. (2011), Rattso and Torvik (1998), Armin *et al.* (2015), Lofgren *et al*. (2006), Chhuor (2017), Lulit (2014) and Robinson *et al.* (2010). For the sake of brevity, empirical literatures are presented in separate section as static CGE, dynamic CGE model and studies undertaken in Ethiopia are presented.

2.4.1 Empirical Studies Using Static CGE

CGE model has wide application for analysis of policy issues such as economic impacts of trade liberalization, economic implications of oil discovery, comparative analysis of alternative policy options and many other applications. Similarly, scholars employed CGE model to analyze the economy-wide impacts of changes in export demand in different countries either for academic or policy purpose. Thus, the consequent subsections show studies undertaken using static CGE model in the area of export shocks.

A study by Cassey *et al.* (2011) examine the impacts of crop export shocks on the US economy using an Input-Output table and CGE model. In both cases, a 3% increase in the volume of crop export from the base run is simulated. Then, the result show the shock has positive impact in the US economy both in the I-O model and CGE model with slight difference in magnitude. Specifically, a 3% rise in the volume of crop leads to an increase in domestic prices of crops and rise in crop supply. The study also show labor is reallocated among sectors, labour is transferred from sector, which have lower demand for labour to sectors which have a higher demand for labour. Thus, the result reveal change in employment is zero, because of the fixed assumption of labor supply in the model. The result also show labour wage is increased caused by the rise in demand for labour in crop sector. As a result, market clearing wage is increased for all other sector and household income is increased following the rise in factors income. However, the study fail to not show what will happen if the demand for crop export decrease.

Armin *et al*. **(**2015) investigate the impacts of external economic shocks on commodity dependence economy of Burkina Faso, Ethiopia, and Mozambique using structural CGE model. For each country, one key export commodity which has a highest share of national total export is chosen i.e. cottom, coffee and, almunium from Burkinafaso, Ethiopia, and Mozambique was chosen, respectively. Then, the export price of each country commodity is increased by 10% from the base run. Finally, the result show increase in export price by 10% has a positive impact on GDP growth with slight magnitude variation, and rise in export price improve the current account balance of all countries. Similarly, rise in export price leads to an increase in the income of all households, however, the size of its impact on subsistence household is higher than capitalist and modern sectors. On the other hand, the increase in export price reduces private and government saving which leads to government borrowing. Nonetheless, this study fails to reveal

the impacts of decrease in commodity export price which is usually reflects the export price of developing countries' situation.

Another study by Chhuor (2017) examine the role of export orientation on agriculture and agro-industry of Canada using three simulation scenario. The first, second andd third scenario assume export demand shock, internal shock and combination of the first and second shocks, respectivey. Nonetheless, emphasis is given to review the first scenario which is related to the present study. As a result, the simulation assume a USD10 million increase for export demand of food, rubber and agricultural products of Canada. The result revea increase in export demand rises economic growth, investment, production and reduces unemployment rate. Similarly, government saving and taxes are increased, while government consumption is not increased. As Chhor clarify the impact of export demand shock on government consumption is the result of increase in the price index. Because, producers assume export is more profitable, hence reduce domestic supply. Similar to studies reviewed so far, this study also fails to investigate the economy-wide impacts of decrease in export demand.

Blake *et al*. (2001) aso scrutinize the impacts of agricultural trade liberalization in Uganda economy. The study is intended to analyze the impacts of Uruguay round and coffee price shocks on the overall economy of Uganda[5]. As a result, the price of coffee is allowed to increase by 2, 4, 6, 8 and 10% in each simulation, respectively. Accordingly, the result show for the first four simulations, coffee price shock has no impacts on the supply of coffee. On the other hand, the last experiment, a 10% increase in the price of coffee results in an increase in coffee supply by 2.32%. This reveal how low sensitive coffee supply to the change in coffee price in international market. In addition, the revenue from the increase in coffee price is distributed to agricultural and non-farm self employed households. Nevertheless, similar to previous studies reviewed so far, this study aso fails to show the impacts of decrease in coffee price which is assumed as a negative export price shock.

In a nutshell, empirical studies reviewed so far investigate the impacts of export demand shocks using either export price or volume simulation. All the reviewed studies have shown the impacts

[5]Uruguay Round is the 8th multilateral trade negotiations that lead to creation of WTO within the GATT framework. Its objective is to extend GATT trade rules to areas earlier exempted (agriculture, textiles) as too difficult to liberalize and growing important new areas previously not included (trade in services, intellectual property, investment policy trade distortions) (https://en.wikipedia.org/wiki/Uruguay_Round).

of increase in export price or volume in various countries using static CGE model. However, these studies fail to show the impacts of decrease in export price or volume. This is because, it is evident that the price or volume of export could not steadily increase, rather it may decline or stagnant, which is usually anticipated for developing country export. As a result, it is better to design alternative simulation design and conduct an experiment which provide consistent evidence on the impacts of export demand shocks for increase and decrease scenario based on observed export price or voume data.

2.4.2 Empirical Studies Using Dynamic CGE Method

This section presents empirical studies carried out by dynamic CGE model to investigate the impacts of export demand shocks on various country economy are reviewed. A limited study has been carried out to analyze the impacts of export demand shocks using dynamic CGE model, which helps to show the year to year behavior of economic agents based on adaptive expectation. In dynamic CGE model, variables are allowed to update the base run value throughout the simulation period using an updating mechanism. Some of the studies reviewed are presented in the subsequent subsections.

Ratso and Torvick (1998) investigated the impacts of export price shocks in Zimbabwe. To this end, the price of export is increased by 5% from the base run. In addition, the study is intended to analyze the impacts of export price rise on economic growth, growth structure and employment. The result exhibit a 5% rise in export price, increase real GDP growth by 1 percent relative to the base run value. It also increase export revenue and the supply of export by 1.4%. This implies increase in export price an incentive to producers to supply more goods and services. Moreover, the increase in the price of export rise private consumption and CPI by 2.1% and 2.4% from the base run, respectively. Similarly, a 5% increase in export price leads to increase in the share of construction, service, and export sector and import goods to GDP ratio by 0.1, 1.4, 1.5, and 1.2%, respectively. Finally, the increase in export price by 5% rises unskilled labor employment level nearly by 2% relative to the base run. However, the study fails to show the impacts of decrease in export price i.e. the simulation scenario is unable to show the impacts of decrease in export price. Moreover, the study neglects the impacts of increase in export price on poverty, household welfare, government and private saving, which become basic objectives of developing country policy maker.

Another study by Lofgren *et al*. (2006) examined the impacts of external economic shocks on poverty alleviation in Malawi. The study developed three simulation design, however, the one related to the present study is volatility of tobacco export price, main export commodity of Malawi. Then, the export price of tobacco is decreased by 25% from the base run. At industry level, the result show decrease in price of tobacco export reduce the volume of export and price of tobacco domestically. Moreover, export price of tobacco leads to transfer of factors from tobacco to other sectors. At the macro level, decrease in export price leads to increase the current account deficit, which in turn results depreciation of the exchange rate by 9%. In addition, decrease in tobacco export price reduce aggregate household consumption by 5% from the base run value. Conversely, decrease in export price of tobacco results in improvement of agricultural terms of trade. Households' whose income depends on fixed factor of smallholder sectors benefit from the decline in export price of tobacco. On the contrary, other household groups whose income depend on the agricultural sector are loser due to the fall in tobacco export price, which ranges between 7-10% decrease in household consumption. Thus, it is concluded that decrease in the price of export has more or less negative impact on Zimbabwe economy. Similar to other studies revised so far, this study also fails to examine the impacts of increase in export price.

A study carried out by Jemio *et al*. (2002) examined the impacts of macroeconomic shocks in Bolivia using four simulation scenarios. However, simulation design associated with the present study is term of trade shocks through 10% drop in world price of primary commodity export which includes agricultural commodity, mining products, petroleum and natural gas. The result show increase in export price worsens Bolivia terms of trade, and it reduces real absorptions and GDP growth. It reduces GDP growth rate by 2.5%, and it increases unemployment rate by 2.5% relative to base run scenario. Furthermore, decrease in export price increase government budget deficit. This suggest adverse shocks in export price of developing countries impacted the functioning of domestic economy as well as external balance. Similar to Lofgren *et al*. (2002), this study investigated the impacts of the decline in export price of agricultural commodities, hence it fails to show the impacts of increase export price in the Bolivian overall economy.

Carneiro and Arbache (2002) examine the impacts of trade on Brazilian labor market based on the presence of involuntary unemployment and exogenously fixed wage index assumptions. Three simulation scenarios were developed, however, among other designs, a 20% increase in

export price of sectors which employ more skilled labor in production is reviewed in the present study. The result reveal increase in export price reduces the inflation level by 0.26% and it increase real GDP by 0.53% relative to the base run. Conversely, government and household saving were reduced by 0.68% and 0.1%, respectively. In addition, increase in export price reduce indirect tax, fixed investment and tariff revenue. However, the increase in export price significantly rises real average income of households. The growth in real income of middle and higher-level household for both urban and rural household is higher than other household groups. The shock also increased unemployment rate of informal sector worker and high skill formal worker compared to low and middle skill worker in formal sector and skilled labour in informal sector. Generally, the study fails to show the impacts of decrease in export price on Brazilian economy similar to previous studies.

Studies revied so far, which are carried out using dynamic CGE method have studied the impacts of export price or demand shocks using export price or volume shocks. The result of the studies show increase in export price or volume has positive impacts on economic growth, employment, factor income, private and government saving, and current account balance apart from a few studies like Brazilian case. Similarly, decrease in export price or volume has overwhelming impacts on selected macro and sectoral economy of specific country. However, all the studies fail to show the impacts of export shocks that are more prevalent in developing countries situations. This is because, export shocks could be associated with the decline or rise of price and volume of export. because, export price and volume of developing country are not stable, rather it fluctuates from time to time. For a complete analysis, simulation design which incorporate the siutations LDCs export demand is crucial and provides reliable evidence about the impacts of export shocks on economic variables.

2.4.3 Empirical Studies in Ethiopia Using CGE Model

In Ethiopia, many studies in various topics have been undertaken using CGE model. However, studies that focus on the impacts of export demand shocks and undertaken using CGE model is limited. As per the researcher knowledge, studies undertaken using CGE model in the area of export price shocks in Ethiopia are by Lulit (2014) and Robinson *et al*. (2010).

Lulit (2014) illustrate implications of high commodity price on poverty reduction efforts of Ethiopia using dynamic CGE model. Among others, simulation design related to the present study is the devaluation of Ethiopian currency by 20% based on the assumption it will improve Ethiopia's export. The shock is introduced by a 20% equivalent increase for both export and import price of all tradable commodities at the same time. Then, the result disclosed increase in price of export rises export concentrated agricultural sectors, and it rises demand and price of factors. On the other hand, output in the service sector is decreased, which in turn reduced demand for professionals, capitals, administrator and unskilled labor which is highly employed within the service sector. In a nutshell, the overall impacts of increase in export price reduce factors income which in turn leads to cut in disposable income. In addition, the impact of increase export price on urban household is higher than rural household. As a result, the impact of increase export price on poverty is negative i.e. it increases the poverty level of households in all the simulation period relative to the base run.

Another study undertaken by Robinson *et al*. (2010) scrutinize implication of food production and price shocks for household welfare in Ethiopia using 6 simulations scenarios. Nonetheless, simulation scenario related to the present study is the increase in the world price of coffee and oilseeds which are assumed as the dominant export commodity of Ethiopia. The result exhibit increased in export price of coffee and oilseeds improve welfare of all households relative to the base run. Moreover, the gain to rural household is larger than urban households. The increase in the price of export also allows labour to move from other activities to high export agriculture activities which results decline in the output of all other agricultural activities. As a result, land rent and labour wage are improved through the increase their demand. conversely, others factors and capital payment are declines relative to base run.

In a nutshell, both studies fail to show the impacts of decrease in export price of Ethiopia, which is more expected to happen due to the fact that the demand for developing countries export is not increased steadily. The first study, which is carried out by Lulit (2014) overlooks the impacts of the shock on other macroeconomic variables which includes economic growth, private and government saving, current account balance, and other variables. Because, these variables are the fundamental objectives of policy makers in any country at the present time including Ethiopia. Similarly, Robinson *et al*. (2010) study fails to show the impacts of decrease in export price on

an economy of Ethiopia. Therefore, both studies fail to address the impacts of decrease in export price. But this study adhered to address the impacts of decrease in export price in Ethiopia.

Summary of Empirical Literatures

So far, empirical studies undertaken to analyze the impacts of export demand shocks using static or dynamic CGE model are reviewed. The simulation scenarios used in the static CGE model focus on one direction movement of price or volume of export. Similarly, studies undertaken using dynamic CGE model examine the impacts of export price or demand shocks using one-way movement of export price or volume (either increase or decrease). However, this study would fill the gap by designing simulation that reflect the situation of Ethiopia's export price in response to world demand change with sound justification for the choice of scenario.

The present study is different from previous studies that focus on similar topics (export price or volume shocks). It differs in terms of prediction time, it predicts the major macro-micro variable of Ethiopia up to 2022 (end of GTP-II). In addition, the present study developed scenarios with two situations, negative and positive export price shocks while the previous studies did not show. Because, the situation of LDCs export price cannot be explained by previous simulation, increase or decrease in the export price. Therefore, the present study exhibits the impacts of export price shocks by allowing the price of export to swing based on predicted export price data of Ethiopia.

In a nutshell, empirical literatures review show change in export price and demand affected various macro and microeconomic variables which includes GDP, structure of GDP, government and non-government institution income and saving, employment, and external balance of a specific country. However, there are variation across countries and sectors regarding the impacts of the shocks i.e. the impacts are country specific or sector specific.

Chapter Three: An Overview of Ethiopia Economy

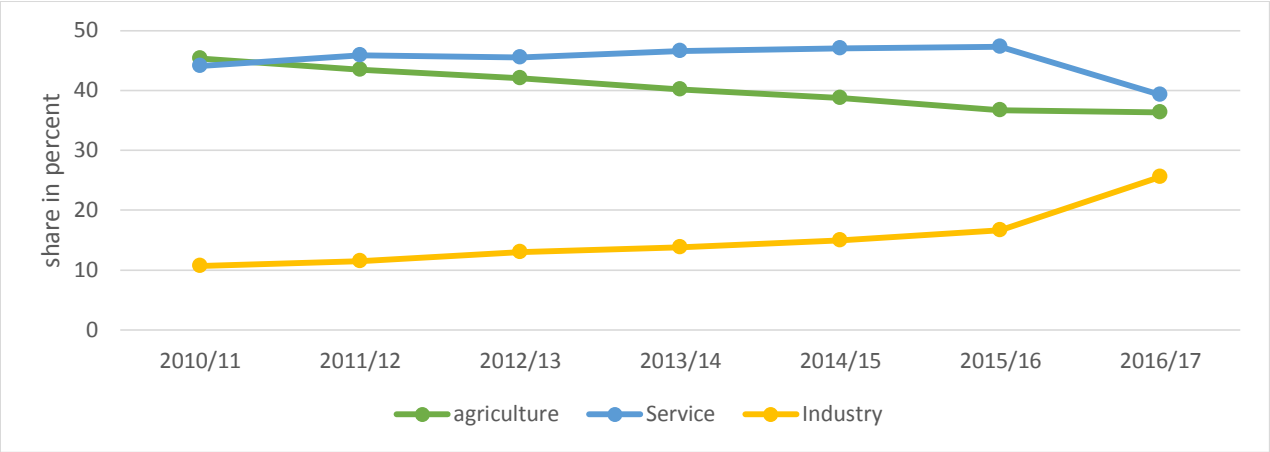
Ethiopia is the second most populous landlocked country in Africa next to Nigeria. Geologically, the country is located in eastern part of the continent, Horn of Africa. For the sake of brevity, this section illustrates the performance and structure of Ethiopia economy in the current regime with special focus on trade structure and performance.

3.1 Economic Growth, Inflation, Fiscal and External Balance

Ethiopia is planned to become lower middle-income economy in 2025 through designing prudent macroeconomic policy and huge public investment in infrastructure (NPC, 2016). In the previous decade, Ethiopia has registered rapid economic growth which enabled the country to be grouped under fastest growing economy in the world. For instance, between 2004 and 2011 the average annual growth rate is 10.4%, which is higher than the average growth rate of SSA, 5.5% (WB, 2012). However, the recorded growth rate is not sustainable for all year; for instance, it declines to 8.7% when drought occurs in 2014/15, and in the next year forecasted to 6.7% (IMF, 2015).

Ethiopia economy is comprised of agriculture, industry and service sector. The agriculture sector is considered as a driver to poverty reduction, employment, and export earnings of the country. However, its share and contribution to GDP growth recently declined and it became the second contributor of GDP next to the service sector. Regarding the industry sector, still its contribution to employment, export earnings and GDP growth is trivial (NPC, 2016). Nonetheless, its contribution to GDP improves in recent years; for instance, compared to its share in 2010/11 (10.7%), in 2016/17 its increases to 25.6% (NBE, 2017). Figure 3.1 shows the share of service, agriculture and industry sectors to GDP from 2010/11FY to 2016/17 FY. As the figure indicates, the share of agriculture sector to GDP has a declining trend, whereas industrial sector share is persistently shown an increasing trend. On the other hand, the share of service sector began to decline in 2016/17 FY though it is the leading sector in terms GDP share. The decline in the share of agriculture sector and the increase in the share of the industry sector could due to the structural transformation policy that Ethiopia currently follow.

Figure 3.1 Sectoral Share of GDP (2010/11-2016/17)FY



Source, NBE Annual Report (2010/11-2016/17) FY

So far, Ethiopia is considered as an economy with low inflation in SSA context with an average inflation rate of less than 5%. However, Ethiopia is no longer considered as a low inflation country where the general price level is raised to 45% in 2007 and 64% in 2008 (UNDP, 2014). This is the maximum general level of price observed in the country's history. Besides, Inflation is increased in 2012 where food inflation reached about 40% in September 2012. Nevertheless, well-coordinated monetary and fiscal policy stance together with a slowdown in world commodity prices led to a substantial decline in inflation (Mengesha, 2016). For instance, inflation is declining from 8.1% in 2013/14 to 7.4% in 2014/15 (NBE, 2015).

The fiscal balance of Ethiopia is characterized by deficit for several years. For instance, in 2014/15 the government is confronted a deficit of ETB 30.8 billion, which is greater than ETB 27.3 billion deficits in the previous year. Similarly, in 2015/16 and 2016/17, the government has a deficit of ETB 16.5 and 18.7 billion, respectively. However, the government fiscal deficit trend has shown an improvement, even if it is in the track of a deficit so far. Despite fiscal deficit, the government revenue is exhibited 26.3% annual growth rate, and revenue to GDP ratio has also increased from 13.8% in 2013/14 to 15.1% in 2014/15 (NBE, 2015). The source of government revenue in Ethiopia is tax followed by non-tax revenue, and grant. Similarly, government expenditure is increased that counterbalance the increased in government revenue. For instance, government expenditure to GDP is 17.5 and 18.6% in 2013/14 and 2014/15, respectively. The

highest share of government expenditure in Ethiopia is allocated to infrastructure investment and poverty reduction projects (IMF, 2016; NBE, 2014).

The fiscal stance of Ethiopia is characterized by deficit even though its trend has declined to some extent recently. The IMF and NBE various year report indicate that the performance of the fiscal stance of Ethiopia is mixed. In many fiscal years, it shows an improvement over its preceding or succeeding years and in another year, it is worsened compared to its preceding or succeeding years. As exhibited on table 3.1, on average the primary fiscal balance in Ethiopia is improving over time. However, the overall fiscal balance is deteriorated. Table 3.1 shows total revenue and expenditure as percentage of GDP, fiscal balance with and without grant of Ethiopia from 2010/11-2016/17.

Table 3.1 The fiscal stance of Ethiopia (2010/11-2016/7)

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Total revenue	13.5	13.6	13.3	13.8	15.1	16.3	14.4
Tax revenue	11.5	11.9	11.9	12.5	13.4	13.5	11.8
Non-tax revenue	2	1.8	1.4	1.2	1.7	2.8	2.6
Grant	3.2	1.8	1.3	1.1	1.1	1	0.7
Total expenditure	18.4	17.8	17.5	17.5	18.6	20.2	18.5
Primary fiscal balance	-4.8	-4.1	-4.2	-3.7	-3	-4.1	-3.3
Overall fiscal balance	-1.6	-2.3	-2.9	-2.6	-1.9	-2.4	-3.4

Source, Various year report of IMF on Ethiopia economy

The twin of fiscal balance which describe the relative position of Ethiopia in the world is current account balance. The current account balance of the country is negative and it increases over time (NPC, 2016). For instance, current account as a ratio of GDP is -5.8, -6.1, -11, and -11.1% in 2012, 2013, 2014, and 2015 FY, respectively (EEO, 2018). This shows that the current account deficit of the country is widened over time. In value terms, in 2009/10 the current account deficit is amounted USD 1.2 billion, latter it widened to USD 8 billion in 2014/15. The current account balance of the country is deteriorating due to the widening of trade deficit and net service outflow (NBE, 2016). Equally, the trade balance of Ethiopia is in a deficit; for

instance, in 2012, 2013, 2014, 2015, and 2016, the trade balance of the country is USD -8.5, -9.1, -12, -13.8 and, 13.6, respectively (EEO, 2018). Overall, Ethiopia is in deficit, both current account and trade balance which suggests that its export can't finance its import.

3.2 Structure, Performance, and Direction of Ethiopia Trade

Trade exists between countries because no country is self-sufficient in everything. Trade is the best option to please the unmeet wants domestically through import from the ROW. Trade is assumed as an engine of inclusive economic growth and poverty reduction, which contributes a large to the attainment of sustainable development in low-income countries. As a result, trade is a vital source of finance to the private sector and the public sector (ITC, UNCTAD and WTO, 2016). Trade also serve as an effective means to facilitate diffusion of technologies, enhance competition and increase productivity (Reinert, 2007). Considering the vital role of trade in economic growth and structural change, the current regime of Ethiopia established strategic trade direction which can promote international trade as well as domestic trade in its growth and transformation plan.

Ethiopia's international trade policy has three main objectives (MFoAE, 2007). These are: (1) developing and ensuring varied international market for the country's products with special emphasis is given to agricultural products; (2) generating adequate foreign exchange which is vital to finance imports of capital goods, intermediate inputs, other goods and services that are required to the growth and development of the country; and (3) improving the efficacy and worldwide competitiveness of domestic producers by participation in the international market. In addition, Ethiopia in GTP-II is targeted to increase reliable market access and opportunities by signing regional free trade agreements (FTA) and WTO negotiation.

The export sector of Ethiopia is the main sources of foreign exchange earning which assists to finance economic growth, infrastructure development, private industrial investment, and reduce the country's dependence on external resources (NPC, 2016). In ADLI, GTP-I and GTP-II of the country, the export sector is expected to play a key role to increase output, technology transfer, reduce unemployment, and the country's dependence on external sources. Equally, in GTP-II, it is stated that the export sector will generate foreign exchanges which helps to finance imports of strategic goods. To this effect, Ethiopia follows a strategy of increasing exports to facilitate

economic growth and other objectives by taking the experiences of effective East Asian countries (WB, 2014). Consequently, the government of Ethiopia is dedicated to promote the export sector to enhance its role in the realization of rapid economic growth and structural transformation. To do so, the government has given an importance to promote the export sector by diversifying the narrow base export products through building industrial parks. Nonetheless, still the main export of Ethiopia is primary commodities that include; coffee, oil seeds, cut-flowers, fruits, vegetables and live-animals together that accounts more that 70 percent of total exports (Altenburg, 2017 and UNDP, 2014). Ethiopia also exports services which include; transportation, truisms, government goods and services, commercial services and other services. Table 3.2 illustrates the share of major merchandize exports of Ethiopia from (2012/13-2016/17).

Table 3.2 Export share of Ethiopia in percentage (2012/13-2016/17)

Export Item	2012/13	2014/15	2015/6	2016/17
Coffee	24	25.8	29	30.4
Oil seeds	14	16.9	19	12.1
Flowers	6	6.7	9	7.5
Leather & leather products	4	4.4	5	3.9
Pulses	8	7.3	9	9.6
Chat	9	9	10	9.4
Gold	19	10.6	11	7.2
Others	7	19.3	8	9.5

Source, NBE various year report about Ethiopia

As revealed on table 3.2, coffee is the main export item of Ethiopia followed by oil seeds, gold, pulse, chat, and cut-flowers. Similarly, Ethiopia also exports live animals, fruit and vegetables, meat and meat products and in recent years she began to export electricity to neighboring countries. In addition to the merchandise export, service export has got importance in Ethiopia export earnings. According to WB (2012), Ethiopia is one of few large, landlocked economies in the world which export more services than goods. This is evidenced by the fact that Ethiopia services export as a percentage of GDP is higher than the ratios achieved by countries at similar

levels of development. Ethiopia service exports are comprised of largely travel and transportation services and to some level communication, construction and insurance services export. Conversely, commuter and information services export is very low and they are near non-existent (WB, 2012).

The value of Ethiopia merchandize export is not stable (see table 3.3). For instance, in 2013-2014, the value of merchandise goods and services export growth is positive. However, a year after the growth in value of merchandise and service export is negative for two consecutive years. Similarly, in 2016-2017 export growth has shown a positive performance. Ethiopia's reliance on primary commodity causes high instability of export earnings and vulnerability to price fluctuation (UNDP, 2014). In 2012/13, the price of export declines by 15 percent due to the decline in international prices of primary commodities which in turn reduce export volume (WB, 2012). Specially, decline in the price of coffee and gold is severe and explains half of the low performance of the Ethiopian economy (IMF, 2015). In a nutshell, the export performance of Ethiopia, which includes merchandize and services export are mixed. The volume and income from export increases in some selected years, but, declined in other years. Generally, on average the performance of the sector is exhibited inclination towards improvement. However, it should be noted that the performance of the export sector of Ethiopia is closely linked to global economic conditions. That means, if the global economic performance is well, Ethiopia export value is also performing well and vice versa.

Table 3.3 Annual growth rate of Ethiopia export value (2013-2017)

	2013-14	2014-15	2015-16	2016-17
Merchandise goods	15	-9	-3	9
Services	15.8	-4.6	-2.3	1.0

Source, World Atlas trade data (various Years online data)

Concerning import, the main import item of Ethiopia includes; raw materials, semi-finished goods, fertilizers, fuel, capital goods, consumer goods, and other miscellaneous goods (NBE, 2015). These imports are critical in the Ethiopia development journey; because, they are strategic inputs for the attainment of the structural transformation and some of the inputs have no

substitute in the domestic economy. As a result, import as a ratio of GDP has shown a mixed trend. For instance, in 203/14, 2014/15 and 20115/16, import as a percentage of GDP is 24.9, 26.3 and 26.8 percent, respectively. However, in 2016/17 import as a percentage of GDP is declining to 23.6 percent (NBE, 2017). Table 3.4 shows the major import commodity of Ethiopia (2012/13-2016/17).

Table 3.4 The share of Ethiopia key imports (2012/13 – 2016/17)

Import	2012/13	2013/14	2014/15	2015/16	2016/17
Raw materials	1.3	1.2	1	0.9	0.8
Semi-finished goods	16.6	16.3	15.7	17.3	16.6
Fuel	19	18.8	12.4	8	11.5
Capital goods	33.4	35.3	41.8	40.8	38.2
Consumer goods	28	26.9	27.4	31.5	31
Miscellaneous	1.8	1.5	1.7	1.5	1.9

Source, compiled from NBE (various year report)

As revealed on table 3.4, capital goods import accounts the highest shares of Ethiopia import, nearly 38 percent on average. Similarly, consumer goods import accounts nearly 30 percent of imports on average. Semi-finished goods and fuels accounts the third and the fourth total import share (refer table 3.4). However, import of raw material and other miscellaneous goods is few which indicates that Ethiopia import has no domestic substitutes and these goods are mandatory to smooth domestic economic activities. Altogether, these import item accounts for more than 90 percent of the total import value. Once we discuss import and export structure and performance, the following section highlights trade direction of Ethiopia (both import and export partners).

According to NBE (various year reports), the main export destination of Ethiopia is Europe, which accounts 41.7, 47.1, 50, 41, 43.6, and 37.7 percent of the total export shares in 2008/09, 2009/10, 2010/11, 2011/12, 2012/13, and 2013/14 FY, respectively. By country, Germany, Switzerland, Netherland, and Italy are the major export destination of Ethiopia merchandize goods in Europe. Ethiopia exports to these countries includes; coffee, gold, textile and garment products, and flower. Asia on the other hand is the second biggest market for Ethiopia export

which accounts 35.5, 31.2, 26.5, 30, 30.3, and 34.5 percent of total export shares in 2008/09, 2009/10, 2010/11, 2011/12, 2012/13, and 2013/14 FY, respectively. By country, China, Saud Arabia, Israel and United Arab Emirate are the major export destination of Ethiopia to Asia. Ethiopia exports to these countries includes; oilseeds, leather and leather products, mineral products, natural gums and vegetables, coffee, meat and meat products, live-animals, pulses, foods and flower.

Ethiopia exports to Africa is trivial showing that commodity export in the continent is probably the same (primary commodities) otherwise other factors will explain. Africa is the third export destination of Ethiopia, which accounts for 16.6, 23, 18, 18.9, 21.3, and 22.6 percent of total export shares in 2008/09, 2009/10, 2010/11, 2011/12, 2012/13, and 2013/14 FY, respectively. However, the Ethiopia export destination in Africa improves over time as revealed by its share. By country, Sudan, Djibouti, and Somalia are the main export destination of Ethiopia within the continent. The export commodity of Ethiopia to these countries includes: vegetables, live-animals, chat, coffee, pulses, spices, textile, garments and fruits. Finally, America is the fourth export destination of Ethiopia, which takes 5.7, 4.4, 5.1, 3.4, 4.2, and 4.6 percent of total export shares in 2008/09, 2009/10, 2010/11, 2011/12, 2012/13, and 2013/14 FY, respectively (NBE, various years report). By country, United states of America and Canada are the major importer of Ethiopia products which includes; coffee, oilseeds, mineral products and leather and leather products.

The main destination of Ethiopia is becoming Asia after 2014/15, which accounts 38.4, 37.2, and 37.7 percent of total export shares in 2014/15, 201/16, and 2016/17 FY, respectively (NBE, various year report). Moreover, the trade partners of Ethiopia are increased by country compared to the previous year. China, Saud Arabia, United Arab Emirates, Japan, Israel, South Korea, India, Pakistan, Yemen, Hong Kong and Taiwan are major trade partners of Ethiopia which accounted for 86 percent of Ethiopia total exports to Asia. Currently, Europe becomes the second biggest importer of Ethiopia products which accounts 33.6, 34.1, and 32.4 of total export shares in 2014/15, 2015/16, and 2016/17 FY, respectively. Importers of Ethiopia products in Europe also increases by a country that include; Germany, Switzerland, Netherland, Belgium, Italy, United Kingdom, and France within the reviewed period.

Export destination in Africa and America has not changed in the reviewed period apart from the change in importer countries and export commodities. Throughout the period, African accounted for 20.2, 20.8, and 21.5 percent of Ethiopia total export destination in 2014/15, 2015/16, and 2016/17 FY, respectively. Somalia, Sudan, Kenya, Djibouti, and Nigeria overall account 89.5 percent of Ethiopia total exports to Africa. The major export item to these countries includes; chat, vegetables, live-animals, fruits, pulses, electricity, live coffee, spices, textile and garment, cereals, leather and leather products, tea, animal product and flower. This shows that compared to the previous years, trade partners and export commodities of Ethiopia has changed to some extent. For instance, new trade partners like Kenya, Nigeria and countries in Asia are emerging, and in terms of structure, electricity export to neighbor countries are underway. America in the review period accounted for 7 and 7.5 percent of total export shares by destination in 2014/15 and 2016/17 FY, respectively. However, export destination of Ethiopia in America is still dominated by USA and Canada that accounted for 94.5 percent of total export shares to the continent.

Regarding import origin of Ethiopia, Asia is the major import sources of Ethiopia followed by Europe. In 2012/13, 72.6 percent of Ethiopia imports are originated from Asia and 19.2 percent from Europe. Similarly, 66 percent of Ethiopia imports are originated from Asia and 20 percent from Europe in 2014/15 (NBE, 2015). The top exporters of Asia countries to Ethiopia includes; China, Saud Arabia, Japan, India, Indonesia, Malaysia, South Korea and Kuwait that altogether constituted 92.9 percent of total imports.

The main import commodities of Ethiopia from these countries includes; electric materials, metal and metal manufacturing, machinery and aircraft materials, road and motor vehicles, clothing, textiles and rubber products and petroleum products. By country, Italy, Turkey, Germany, Netherlands, Sweden, Belgium, France, Ukraine, Rumania and United Kingdom altogether constituted 86.5 percent of Ethiopia imports from Europe. Ethiopia import from Europe includes; machinery, aircraft materials, road and motor vehicles, electric materials, metal, metal manufacturing, telecoms apparatus, medical and pharmaceutical products, electric materials, fertilizers and food and live-animals (NBE, 2017).

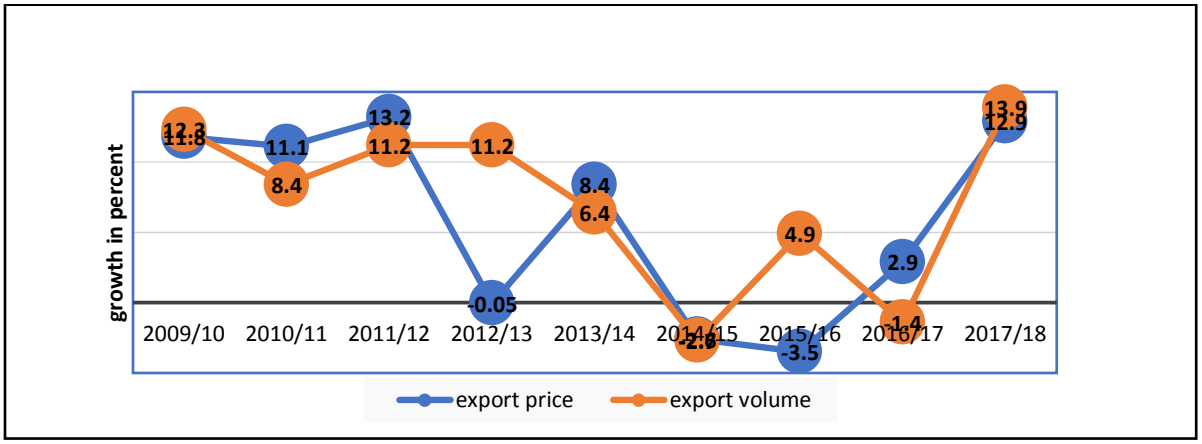
Ethiopia import from Africa accounted for 2.7 and 3.9 percent in 2014/15 and 2015/16 FY, respectively. Morocco, Egypt, South Africa, Kenya and Sudan are the main import sources of Ethiopia that together accounted 94.5 percent of total imports from the continent (NBE, 2015). The major import item from Africa includes, petroleum products, electrical materials, road and motor vehicles, metal and metal manufacturing, rubber products, soap and polish, machines and paper and paper products. Similarly, import from America accounts 5.3 and 8.3 percent of the total import shares of in 2014/15 and 2015/16 FY, respectively (NBE, 2016). USA, Brazil and Canada in total accounted 96 percent of total import shares of Ethiopia from America. Import items from these countries includes; machinery and aircraft materials, food, electrical materials, road and motor vehicles and fertilizers.

3.2 Export Price and Volume of Ethiopia at a Glimpse

Export price volatility is a key variable to explain economic variability in developing countries (Moreira, 2014). Because, export sector in these countries is the main sources of financing foreign exchange which helps to attain economic growth, other economic and non-economic objectives. Additionally, commodity export in developing countries is the source of income and livelihood for households. To this effect, variability in export price and volume causes unpredictability of income of households in these countries. Therefore, it can be concluded that developing countries face higher volatility than advanced countries because, they are specialized in agriculture and mineral production with low value addition. Williamson and Fraser (2009) also revealed that primary commodity export is experience greater price volatility than do manufactures or services export.

Export price and volume of Ethiopia is also unstable, due its high level of dependence on few and less diversified agricultural commodities. Ethiopia export is susceptible to internal shocks which includes; bad weather condition and external demand shocks (IMF, 2016). Ethiopia export items are semi processed or unprocessed products that have low value addition in global market. figure 3.2 exhibits growth of export price and volume (2009/10-2017/18) FY based on IMF forecast on for various years. The figure supports the view that commodity price and its volume is volatile.

Figure 3.2. Export price and volume growth of Ethiopia (2009/10-2017/18)



Source, IMF (various year forecast)

As exhibited on figure 3.2, the growth pattern of export price and volume are not persistent. In some years it become high and have positive growth rate and, in another year, it become negative as well. Moreover, the movement of export price and volume are anticyclical. Consequently, if the price of export rises, export volume declines and vice versa.

Chapter Four: Research Methodology

This section presents research methodology used in the study. As revised in chapter two, export shock has both direct and indirect economy-wide effects. To showcase the effect of export price shocks the study used a framework which comprise all sectors of the economy and inter-sectoral transmission channels of the shocks. Thus, CGE model is an economy-wide equilibrium model hence, chosen as a method of analysis in the study. The succeeding sections present source of data, method of data analysis and closure rules used in the study.

4.1 Data and Data Sources

The study is depended on secondary data obtained from various institutions. Accordingly, the SAM database is obtained from IFPRI; data related to economic growth, inflation, government consumption and saving were collected from NBE. Moreover, population and labour force growth data are accessed from WDI website, and data related to export and import are collected from NBE and accessed from IFM annual report about Ethiopia economy. However, the main database of the study is 2009/10 SAM of Ethiopia constructed by IFPRI in collaboration with EDRI and University of Sussex.

SAM describe an economy by activity, commodity, factor, and institution accounts which help to show the interaction of the economy on demand and supply side (EDRI, 2009; Chowdhury and Kirkpatrick, 2005). In general, SAM is an accounting framework which assign number to all expenditure and income flows between activities, factors, and institutions within domestic economy, and the ROW (Breisinger *et al.*, 2009). Besides, McDonald *et al.* (1997), underscored that SAM is an important tool to provide information about social and economic related issues. A vital condition SAM needs to satisfy is that corresponding row and column total of SAM must be balanced i.e. the total spending equal to total income (Burfisher, 2016). In an open economy, SAM comprises six main accounts which include; activity, commodity, factor, institution, and saving-investment accounts (EDRI, 2009). Similarly, 2009/10 SAM of Ethiopia includes all these six accounts which would be discussed in subsequent subsections.

The activity account shows the domestic industry that involves in the production of goods and services where its column represents all expenditures on inputs and taxes paid on production, and the row total of the activity account shows total sales which are allocated to both final and

intermediate demand (Burfisher, 2016). In 2009/10 SAM of Ethiopia, there are 113 activities, however, results are aggregated into agriculture, industry and service sector at analysis section of this study. On the other hand, commodity account shows the total supply and demand for goods and services in value terms. Supply includes domestic production, import, indirect taxes and marketing margins while demand includes intermediate input use, final consumption, investment demand, government consumption and export demand (Breisinger *et al.*, 2010). Marketing margins are payments made to domestic activities, ROW and various taxes associated with trade flows and transportation costs.[6] There are 64 commodities in commodity account of 2009/10 Ethiopia SAM but, for the sake of brevity results are grouped into agriculture, industry, and service sectors at analysis section.

Factor account indicates the sources of factors income and how factors payments are distributed to institutions (Breisinger *et al*., 2010). Factor account in 2009/10 SAM of Ethiopia has 16 primary factors of production but, aggregated into skilled, semiskilled, unskilled and agriculture labour, capital, land and livestock. Institution account shows all income, expenditure and transfers among households, government, firms and the ROW. The ROW account denotes trade and investment flows between Ethiopia and its trading regions (Burfisher, 2016; Breisinger *et al*., 2010). In 2009/10 SAM of Ethiopia household account has 12 sub-accounts based on agro ecological zone, income level and area of residency. However, results are grouped into urban poor, urban non-poor, rural poor and rural non-poor households. Government and enterprise accounts are single institution. However, there are three tax accounts in 2009/10 SAM of Ethiopia, which includes direct tax, sales tax and import tax. Finally, Savings-Investment account shows supply of savings available for investment and demand of funds for investment (Burfisher, 2016). There is one saving-investment account in 2009/10 SAM of Ethiopia.

The initial SAM of Ethiopia is recalibrated to the base run level using updating mechanisms to reflect the current situation of Ethiopian economy without changing its structure. The average growth rate of selected exogenous variables from 2010-2017 are chosen and simulated with the base scenario in the dynamic CGE model. Consequently, the result replicates 2017/18 average economic growth rate of 9.8 percent and average sectoral share of GDP, i.e. agriculture 40

[6]Trade margin describes insurance and freight charges incurred when goods are shipped by air, sea or overland from exporter to importer country. Exporter margin-exclusive price is called free on board (fob) price. Importer margin-inclusive price is called cif price. The difference between cif and fob values is the trade margin (Burfisher, 2016).

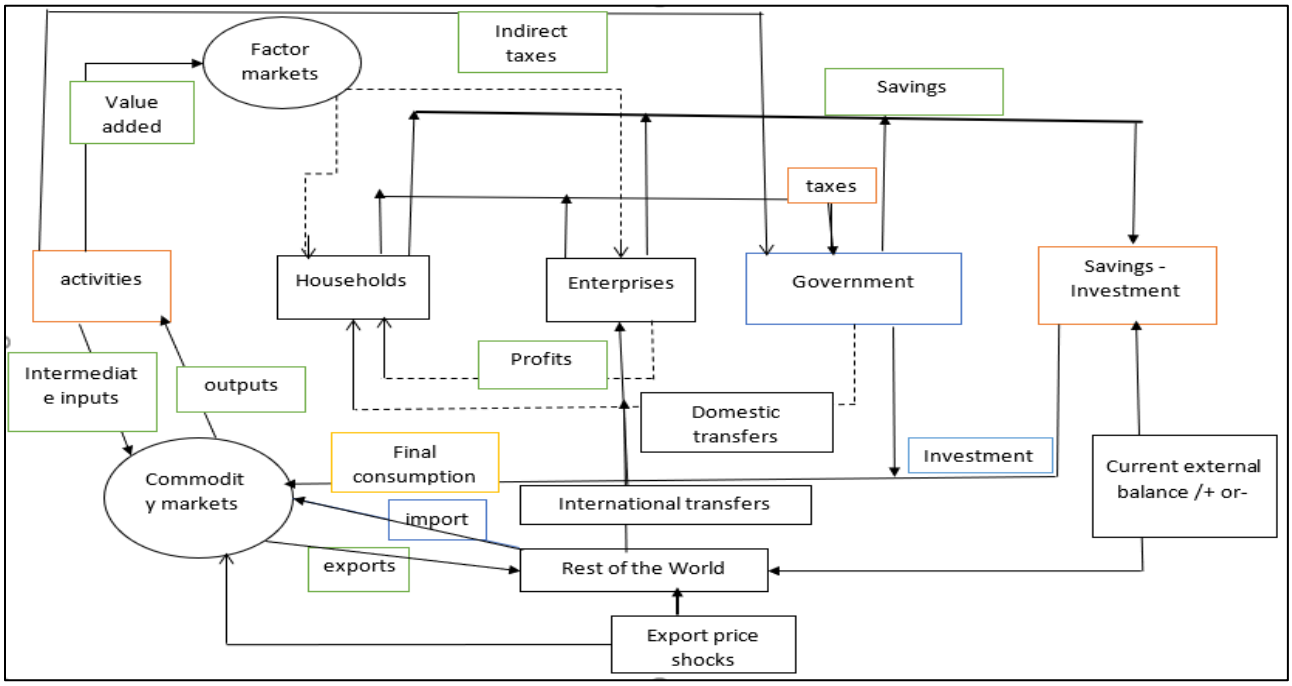
percent, industry 15 percent, and service 45 percent. To realize that, the growth rate of the population is assumed 3 percent, government consumption 9.4 percent, depreciation rate of capital 6 percent, direct tax 3 percent, foreign saving 6 percent, government saving 5 percent, household and enterprise propensity to save 4 percent. Moreover, labour productivity and TFP growth are sector specific but, the average growth rate is given as 2.7 and 5.4 percent, respectively. Finally, the economy is expected to grow following the base run economic paths from 2010-2022 fiscal year.

4.2 Theoretical Framework

Identifying the entry points of policy shocks and how it affects the behaviour and interactions of various economic agents within the economic system is the first step to develop theoretical framework in CGE model (Bellu, 2011). Accordingly, looking to the SAM structure and circular flow diagram, the impacts of export price changes would be transmitted through the ROW and commodity account. This shows that export price shocks directly affected commodity and the ROW accounts. However, unlike PEA the impacts of the shock are not limited to these accounts only, it directly or indirectly affects other accounts which in turn affect the ROW and commodity account through feedback effect.

As shown on figure 4.1, export price change affects commodity account which export goods and service to the ROW. Thus, the change in export price affect exporter decision to sale at domestic or foreign market which in turn affect domestic sale and export volume. Moreover, it will also affect the demand for value added and intermediate demand, and income of institution as well as the government income. The change in government revenue will limit transfers to institutions and saving. The pool of saving available for investment in turn determine the level of investment demand for commodity. Similarly, export price change affects the ROW specially, international transfers and external balance of the country through exchange rate. The exchange rate might appreciate or depreciate in response to export price change that in turn affect the trade balance and balance of payment account as well as the investment-saving balance of the country. Nevertheless, Saving-Investment determine the level of investment in the country and affect commodity account through commodity demand. As a result, commodity account in turn affects the level of export to the ROW.

Figure 4.1 Conceptual framework of CGE model



Source, Bellu (2011)

In a nutshell, the transmission channels of export price shocks to the economy are complex and all economic variables are directly or indirectly affected. Nonetheless, the main transmission channel of export price shock is exchange rate since as displayed in the equation of export price, it directly affects exchange rate. Accordingly, the circular flow diagram of the economy shows the backward and forward linkages of the various economic agents in the economy system and the transmission mechanism of shocks as shown on figure 4.1. This implies that the impacts of export price change in CGE model includes both the direct and indirect impacts shocks.

4.3 Method of Data Analysis

The use of CGE modeling is a suitable method to analyze the economy-wide impacts of exogenous changes or policy induced shock. The model is vital to provide a numerical framework in empirical analysis and evaluation of various economic policies. It is also important to show the interactions of various economic agents and systems in a structured manner (Ermias *et al.*, 2011; Hosoe *et al.*, 2010). Frequently, the model is used to examine the effects of exogenous shocks or to measure the contribution of sectors to the wider economy (Nana *et al.*, 2009). In this study a recursive dynamic CGE model is used which is an extension of the IFPRI static CGE model, developed by Lofgren *et al*. (2002). The model solves the static CGE model

sequentially through exogenous and endogenous variables updating procedures (Rossouw, 2004). For instance, updating the capital stock to simulate investment and depreciation, labour stock to simulate population growth, and productivity parameter to simulate advance in technology. The present study used a recursive dynamic CGE model based on the assumption that economic agents in Ethiopia have an adaptive expectation type.

As documented in Robinson *et al.* (1998), the recursive DCGE model has two parts, static (with in-period) and between period (dynamic) CGE model. The within-period model is solved once at a time where all markets are expected to clear. The between period model, however, provides the necessary intertemporal linkages and shifts of sectoral demand and supply functions. Conversely, the static model could not show the adjustment path of the economy between two states in time (Lofgren and Bonilla, 2006; Rossouw, 2004). The dynamic model on the other hand, attempts to relate the intertemporal behavior of agents through adjustment mechanism. The subsequent sub-sections present the specifications of the two models.

4.2.1 The Static (Within-Period) Model

The working of the standard CGE model is based on Neoclassical economic traditions where the equilibrium of the economy is determined by market-driven adjustments to the relative price of factors and outputs (Lofgren *et al*., 2002). The model is written in the form of simultaneous linear and non-linear equations that explain the behavior of institutions and structure of economic systems which includes, price, production, trade, institution, and system constraint blocks. The model specification used in this study is taken from Lofgren *et al*. (2002), and all equations, notation, and specification are annexed at appendix A and B. However, export price and government income equations are modified due the fact that export and factor income are not taxed in Ethiopia. Accordingly, the subsequent subsections present the static CGE model and the macroeconomic closures rules chosen in the study.

Price Block

The price block comprises equations that relate prices with other endogenous or exogenous price and non-price models (Lofgren and Bonilla, 2006; Lofgren *et al.*, 2002). In a nutshell, price block shows the process of price formation by producers and consumers to reach at the domestic demand prices. Producer price is the sale price received by producers, and it has two options, to

sell output at domestic or foreign market. Once the export tax is added to producer price it gives export price. The interactions of producer decision to sell the output at domestic or foreign market determine the supply price of output. Finally, adding all transaction cost incurred to producer price give domestic demand price (Zerayehu, 2013; Brisinger, 2009). Conversely, consumers have two options i.e. to consume imported or domestically produced commodities. Therefore, consumers will pay domestic demand price if they consume domestic commodities or they will pay import prices plus their transaction costs and tariffs if they consume imported commodities. As a result, the interactions of consumer choice to consume either imported or domestic commodities will determine composite commodity price. Finally, adding sales tax to composite prices results in the final market prices.

Production and Trade Block

Production block in CGE model is shown by multi-level nested structure. At the top of technology nest, aggregate intermediate and value added are combined to produce gross output. Production function at this nest includes constant elasticity of substitution (CES), Cobb Douglas (CD) production function, and Leontief production functions (Lofgren *et al.*, 2002). However, the modeler can also specify technology nest at the disaggregated level to determine the level of intermediate inputs and value-added of primary factors (Zerayehu, 2013).[7] Considering the structure of the Ethiopia economy, Leontief technology is used at the top of technology nest for the present study. It is known that at the lower level of technology nest, while value added of each activity is specified as a CES functions of factors, intermediate demand of each production activity is specified as a Leontief technology of each activities value added.

Trade block shows tradable goods and services at domestic and international markets. Therefore, activities output can be sold in domestic or foreign markets or consumed at home. Commodities are assumed as imperfect substitutes to each other (Lofgren *et al*., 2002). Domestically sold and exported output has an imperfect transformability captured by the constant elasticity of transformation (CET). Similarly, imports from the ROW and output sold in domestic markets are

[7] Leontief function is used if the modeler assumes no substitutability between factors of production and intermediate inputs (Lofgren, et; al, 2002).

imperfect substitutes captured by a CES aggregation function. Accordingly, the Armington (composite supply) function shows the CES between import and domestic output.

Institution Block

The institution block shows the expenditure and income sources of household, enterprises, government, and the ROW. It also contains equations that show the behaviors of institutions as well as their spending and income sources. For instance, the sources of income for households are factors payment, transfer from households and other institutions. On the other hand, households would spend their income on consumption, tax payment, transfer to other institutions, and the residual would be saved (Lofgren *et al.*, 2002). Similarly, enterprise receive income from factors return and transfers, and spend on tax payment, transfer to institutions, and the residual is saved. Conversely, the main source of income to the government is tax, collected from various institutions, and spend on consumption, transfers to households, and other institutions. Lastly, the ROW account receives income from transfers between the ROW and domestic institutions, and income from factors.

System Constraint Blocks and Macroeconomic Closures

There are various system constraints in the behavioral equations of CGE model that restrict the objectives of institutions (Zerayehu, 2013). System constraint equation shows the mechanisms how equilibrium can achieve in goods and factor markets. When the demand and supply of goods are equal, it ensured equilibrium of goods market. The aggregate demand for goods is the sum of consumption, investment, export and transaction services demand. Conversely, aggregate supply includes both domestic production and imported commodities. Likewise, equilibrium in factor market occurs when factors demand and supply are equal. Therefore, CGE model closure rules are needed that need to be satisfied by an economic system which includes government, external and saving-investment balance (IMF, 2008). Moreover, the choice of closure depends on modelers question to address and structure of the economy being studied. In this study, closure rules suitable to Ethiopia economy situation and study objectives are chosen as presented in the subsequent paragraphs.

Factors market closure: factor market closure imposes equality between total factor demand and supply. The study assumed factor supply is fixed and free mobility across activities while its

economy-wide wage is flexible, which equalize demand and supply of factors. Since, Dynamic CGE model is covered from medium to long term time period, in this case factors are assumed fully employed and mobile across sectors.

External Balance Closure: it requires equality between country spending and earning of foreign exchanges. Considering the study objective, the study assumes flexible exchange rate and fixed foreign saving. Because, change in export price allowed the exchange rate to vary accordingly. This implies, exchange rate is equilibrating variable of external balance.

Government Balance Closure: it imposes equality between current government revenue and sum of current government expenditure and saving. Considering the fiscal stance of Ethiopia, the study assumes flexible government saving and fixed direct tax rate.

Saving-Investment Balance Closure: it requires equality between total saving and investment. Total saving is the sum of household, government and foreign saving. Similarly, total investment is the sum of gross fixed capital formation and stock changes (Lofgren *et al.*, 2002). In this study 'investment-driven' saving closure is chosen where investment adjustment factor is equilibrating variable, whereas domestic no-government and foreign institutions saving rate is fixed.

4.2.2 The Between-Period (Dynamic) CGE Model

The equations in the between period CGE model update exogenous variables, which includes rate of capital accumulation, investment, labour, land, TFP, and other exogenous variables. This is because, as documented in Thurlow (2008), across the path of time several policy independent changes will occur. Therefore, to examine the effects of exogenous variables in relation to factors growth and productivity changes, the static CGE model must update to recursive DCGE model (Lofgren and Bonilla, 2006). Labor supply is exogenously determined by population growth rate, whereas capital accumulation is endogenously determined through the interaction of saving and investment. The stock of capital available is determined by past period capital and investment spending and distributed to sectors based on their initial share of total capital income (Thurlow, 2008). The capital accumulation equation describes the law of motion of capital stock as specified in equation (1).

$$K_{t+1} = (1 - \delta)K_t + I_{t+1} \qquad (1)$$

Where, K_t is capital accumulation, δ is depreciation rate, K_{t+1} is current capital stock, and I_{t+1} is investment. In equation (1), investment adds to the capital stock while depreciation reduces capital accumulation process (Decaluwe *et al*., 2004). Conversely, labour supply is an endogenous given variable determined by population growth rate (ng) and current total labour supply (LS_t) as shown in equation (2).

$$LS_{t+1} = (1 + ng)LS_t \qquad (2)$$

The between-period CGE model equation that includes capital accumulation and investment equations are annexed at appendix C.

4.3 Household Welfare Measurement

Equivalent variation (EV) and compensating variation (CV) are the two important methods of measuring social welfare. These concepts were first introduced in economics literature by Hicks (1939) as an alternative to consumer surplus. In CGE model, they are used as monetary measures of the welfare effects of various policy shocks. Wainwright (2007) explains that EV and CV as follows: EV measures how much money the consumer is willing to sacrifice to avoid prices from changing; and CV measures how much money the consumer need to be given (or taken from him) to get back to the same level of utility had before the price change. Mostly, they are considered as willingness to pay or to accept to change in income and prices resulting from changes in policies (Sadoulet and Janvry, 1995). The decision to use either CV or EV as appropriate measures of welfares depends on the situations being involved (Wambugu, 2012). CV is appropriate if the modeler is interested to design compensation schemes with new prices. However, EV is used if the modeler is interested to measure the WTP of societies for price changes. As a result, in this study EV is chosen to measure households' welfare loss or gain from world export price changes. Moreover, positive and negative EV are assumed as welfare gain and loss, respectively.

Chapter Five: Results and Discussions

5.1 Benchmark Structure of Ethiopian Economy

As noted in chapter four, SAM is vital database which provide information about sectoral and institutional structure of an economy. Thus, this section gives an overview of the benchmark structure of Ethiopian economy using 2009/10 SAM, mostly GDP and its structure, share of factors, factors income, household expenditure and import and export structure. Ethiopia GDP from supply side is the sum of agriculture, industry and service sectors. Table 5.1 show the share of agriculture, industry and service sectors to GDP and value added in billions of ETB. Accordingly, agriculture, service and industry sectors accounted for ETB 174.3 (49.1%), 144.5 (40.7%), and 36.2 (10.2%) billions of the value added of GDP, respectively. This suggest, agriculture sector accounted the lion's share of Ethiopian economy followed by service sector. But, the contribution of industry sector to overall economy is minimal, which is nearly 10%.

Table 5.1 Benchmark structure of GDP at factor cost

Sector	Value for GDP (Birr)	Share (%)
Agriculture	174.3	49.1
Industry	36.2	10.2
Service	144.5	40.7
GDP at factor cost	355.0	100.0

Source, Author computation based on 2009/10 SAM of Ethiopia

The sum of private and government consumption, Investment and net export give GDP at market price, using final demand approach as shown in table 5.2. Particularly, private consumption accounted the highest share of national income, which is equal to ETB 338.6 billion or 88.3% of GDP. Regarding investment, its value is equal to ETB 87.3 billion or it accounts 22.3% of GDP. Government consumption is equal to ETB 31.8 billion, which is equivalent to 8.29% of GDP. The value of Ethiopia's export is equal to ETB 52.1 billion (13.59% of GDP). However, the value of import demand is ETB 126.5 billion or 32.99%of GDP. Therefore, import demand

exceeds export demand, which indicate Ethiopia is at trade deficit. Finally, domestic absorption, which is the sum of private and government consumption and investment demand is ETB 457.7 billion, which exceeds GDP at market price by net export amount.

Table 5.2 Benchmark structure of GDP at Market Price

GDP Component	Value (billions of ETB)	(% of GDP)
Private Consumption	338.6	88.32
Fixed Investment	85.5	22.3
Depreciation of Capital Stock	1.8	0.47
Government Current Consumption	31.8	8.29
Export	52.1	13.59
Import	-126.5	32.99
GDP at Market Price	383.4	100
Indirect Tax	28.4	7.41

Source, Author computation based on 2009/10 SAM of Ethiopia

The activity sector employee factors such as labour, capital, land and livestock in its production process. Accordingly, table 5.3 show the share of factors in activities such as agriculture, service and industry. The agricultural sector is largely employed agriculture labour, unskilled labour, land and livestock. Capital and semiskilled labour are trivially employed but, skilled labour is not employed in agriculture sector at all. Regarding industry sector, it chiefly employed semiskilled labour (35.7%) and capital (51.7%), whereas skilled and unskilled labour is minimally employed. Conversely, agricultural labour, land, and livestock are not employed in industry sector. Lastly, the service sector employed reasonably high semiskilled and skilled labour but, less capital and unskilled labour, and nothing agriculture labour, land and livestock. Basically, the service sector employed less factors compared to agriculture and industry sectors. Therefore, it is undoubtedly concluded that within sector's proportion of factors in agricultural sector is higher than industry and service sectors.

Table 5.3 The Within Sector Factors Proportion (%)

Factors	Agriculture	Industry	Service
Skilled labour	-	5.1	12.9
Semi-skilled labour	2.0	35.7	28.2
Unskilled labour	17.9	7.6	4.0
Agriculture labour	33.2	-	-
Capital	7.2	51.6	7.2
Land	23.1	-	-
Livestock	16.6	-	-

Source, Author computation based on 2009/10 SAM of Ethiopia

The 2009/10 SAM of Ethiopia has household account, which in turn divided into various sub-accounts. However, for the sake of brevity, households in this study are grouped into rural poor, urban poor, rural non-poor and urban non-poor households. The source of income to household is factors income and transfer from institutions. Regarding government transfer, 95% is allocated to rural poor households and the remaining 5% for urban poor households. However, factors return is the main source of income to all households as shown in table 5.4. Because, households are assumed as owner of factors of productions hence, the share of income from factor depends on who supply more factors.

As exhibited in table 5.4, the lion's share of skilled labour income is received by rural (52.3%) and urban (44.3%) non-poor households. However, income from skilled labour to rural (1.8%) and urban (1.6%) poor households is minimal. The highest share of income from semiskilled labour is allocated to rural non-poor households (76.7%) and rural poor households (15.9%). Conversely, its shares to urban poor and non-poor households is minimal. The highest share of unskilled labour income is allocated to rural non-poor (67.6%) and poor households (21.5%) whereas the minimum to urban poor (2.2%) and non-poor (8.7%) households. Income from agriculture labour, land, and livestock is totally allocated to rural poor and non-poor households

with maximum share to rural non-poor households. The share of capital income is allocated to rural and urban non-poor households while smallest share to rural and urban poor households.

Table 5.4 share of factors' income to households' (%)

Factor	Rural Poor	Rural Non-poor	Urban Poor	Urban Non-poor
Skilled labour	1.8	52.3	1.6	44.3
Semi-skilled labour	15.9	76.7	1.3	6.1
Unskilled labour	21.5	67.6	2.2	8.7
Agriculture labour	35.5	64.5	-	-
capital	5.7	79.4	1.4	13.5
land	35.4	64.6	-	-
livestock	35.5	64.5	-	-

Source, Author computation based on 2009/10 SAM of Ethiopia

Household spend their income on agriculture, industry and service commodity, which the expenditure share is depicted in table 5.6. Rural poor and non-poor households spend maximum share of their income on industry and service commodity, while lowest share on agriculture commodity. This is because, most rural households produced home consumption agricultural commodity, which understate expenditure on agriculture commodity which could result wrong profile of rural household living condition. Conversely, urban poor and non-poor households spend on the three commodities.

Table 5.5 Households expenditure share of commodities (%)

Commodity	Rural poor	Rural non-poor	Urban poor	Urban non-poor
Agriculture commodity	9.7	5.5	43.8	23.5
Industry commodity	48.7	47.9	35.4	47.0
Service commodity	41.6	46.6	20.8	29.6

Source, Author computation based on 2009/10 SAM of Ethiopia

The succeeding subsections provide an overview of import and export structure of Ethiopian. As shown in table 5.6, agricultural and industry sector accounted for 26.7 and 23.3% of Ethiopia's total exports, respectively. However, service sector takes the lion's share of Ethiopia's export, which accounted 50% of total exports. The export of Ethiopia is dominated by few commodities (transport service, coffee, metal and metal products, oilseeds, hotel and catering, communication, and business service) together that accounted 80% of the total exports. However, the contribution of milk, dairy, poultry and wood product is trivial together they account 0.2% of total export.

Table 5.6 the structure of Ethiopia export (share in %)

Commodity	Share (%)	Commodity	Share (%)
Pulses and oilseeds	7.07	Leather products	2.33
Vegetables and fruits	0.48	Chemical	1.22
Chat	2.53	Metal and metal products	8.61
Coffee	12.13	Vehicles & transport equipment	0.86
Flowers	0.69	Electronic equipment	1.44
Other crops	1.35	Wholesale and retail trade	2.20
cattle	1.32	Hotel and catering	2.90
Milk, dairy & animal products	0.71	Transport	36.59
Grain milling & Sugar refining	3.71	Communication	2.77
Another food & tea processing	0.53	Financial and Business service	4.44
Beverages	1.23	Real estate & other private service	1.12
Textiles and clothing	2.18		

Source, Author computation based on 2009/10 SAM of Ethiopia

Ethiopia's import is dominated by industry commodity, which accounted 68.4% of the total imports as shown in table 5.7. Moreover, import of Ethiopia service accounted 24.7% of the total imports. Lastly, agricultural import compared to industry and service is minimal, accounted 7% of total imports of the country.

Table 5.7 The structure of Ethiopia import (share in %)

Commodity	share	Commodity	Share
Pulse	0.9	Petroleum and other mining	13.7
Tobacco	0.1	Textile and clothes	4.3
Other crops	0.7	Vegetable products	1.5
Wheat	5.3	chemicals	8.5
Trade and communication	1.0	Metal and nonmetals products	11.8
Hotel and catering	1.0	Machinery	6.6
Transport service	17.7	Vehicles and transport equipment	6.1
Financial and business service	5.0	Paper and publishing	1.6
Fertilizer	2.9	Electronic equipment	7.0
Other manufacturing	1.0	Other industry imports	3.4

Source, Author computation based on 2009/10 SAM of Ethiopia

At disaggregate level, transport service, petroleum, metal and nonmetal products, chemicals, electronic equipment, machinery, vehicle and transport equipment, wheat, financial and business service and fertilizer are the main import items of Ethiopia as revealed in table 5.7. On the other hand, other manufacturing, other crops, trade, pulse, tobacco and other industry import in Ethiopia is minimal. This implies that intermediate input, capital goods and food stuff are the key import components of Ethiopia.

5.2 Simulation Designs

Simulation design is vital element of CGE modeling to analyze the impacts of shocks relative to the base run scenario. The base run scenario assumes business persist as usual, absence of shocks to economic system. In contrast, simulation scenario assumes shocks or changes to economic system. Empirical literatures and economic theories show export price and volume variability can explain export demand changes. In this study, export price change is chosen as an exogenous variable to design simulation scenario. This is because, relative to export volume, export price is expected to respond quickly to external economic shocks. In addition, export volume can't respond to external shocks due to fixed supply assumption in the short run. However, price of

export may increase, decrease or remain unchanged in response to external shocks in the short run. The increase in export price is presumed as positive shock while, decrease in export price is as negative shock.

5.2.1 Base Case Scenario

In dynamic CGE model, growth in the economy is restructured by exogenously given variables without introducing shocks. As a result, the baseline scenario assumes business persists as usual with the continuation of historical growth from 2010-2022. Therefore, the impacts of the entire simulation scenarios designed in the study is assessed by considering the baseline scenario as a reference point or counterfactual.

5.2.2 Simulation Scenario

Changes in export price may high, low or unchanged depending on demand for Ethiopia export. Accordingly, two export price simulations are designed based on IMF forecast and GTP-II target of the government regarding Ethiopia export. The government of Ethiopia is envisioned to rise export value by 29% at the end of GTP-II (IMF, 2015). Assuming the target export value in GTP-II is resulting from export price rise, the first simulation, denoted by EXPR1 assume high and a 29% increase in export price. The second simulation, which is denoted by EXPR2 assume low export price growth based on IMF projection about Ethiopia export price. EXPR2 is considered as negative export price shock, hence, the price is low relative to base run scenario (5.2%).[8] Thus, EXPR2 is simulated by a 3% decrease in export price of Ethiopia. For the purpose of brevity table 5.8 summarizes simulation designs used in the study.

Table 5. 8 Simulation Design Summary (%)

	EXPR1: High Export Price	EXPR3: Low Export Price
Export price (%)	29	3

Source, IMF various years forecast and Government GTP-II target

[8] The base run level export price in the study is computed by taking the average export price of Ethiopia from 2010-2107 based on IMF projection data.

5.3 Analysis of Simulation Results

This section investigates the impact of export price changes on macroeconomy and industry variables of Ethiopia based on the succeeding assumptions. (a) The unit of measurement used in the SAM is billions of ETBs. (b) The initial value presented in the table denotes both value and quantity recorded in 2009/10 SAM. (c) The base run scenario show the actual performance of the economy that would occur in the absence of external shocks if growth rate of exogenous variables is extension of current growth paths. (d) EXPR1 and EXPR2 represents simulation scenarios to increase and decrease in export price, respectively.

5.3.1 Impacts on Macroeconomic Indicators

The impacts of export price changes on macroeconomic indicators of Ethiopia are presented in table 5.9, which include absorption, private consumption, government consumption, gross capital formation, export and import demand, economic growth, exchange rate, income and saving of government, and foreign saving.[9] Comparing initial value with base run, most macroeconomic indicators exhibit improvement in base run scenario. This indicates, the overall performance of the economy rises relative to the initial value if the economy is allowed to grow by base run scenario or no shocks are introduced into the economy. However, government saving declines in base run scenario relative to initial value suggesting that government income is less than its spending. Similarly, real exchange rate appreciates in base run relative to the initial level. Likewise, export and import demand increases in base run scenario compared to the initial level. As a result, in the base scenario, the gap between import and export demand is widen relative to the initial level. Nonetheless, while export price shocks are introduced into the model, the base run value of all macroeconomic indicators turns into a new value. Accordingly, deviation from the base run value is the impact of export price changes, shocks introduced in the model.

[9] Absorption is total spending made by households, enterprise and government for commodities within a country. Adding net export to absorption gives GDP at market price, and subtracting net indirect taxes from GDP at market price gives GDP at factor cost.

Table 5.9 Impacts on macroeconomic indicators (% change from initial value)

Indicator	Initial Value	BASE	EXPR1	EXPR2
Absorption	457.74	9.9	16.31	9.58
Private Consumption	338.61	10.18	19.63	9.73
Gross capital Formation	85.49	9.86	1.68	9.19
Government Consumption	31.82	7.45	9.4	9.4
Export demand	52.14	25.1	23.85	24.24
Import demand	-126.51	17.66	38.03	16.36
GDP at Market price	383.36	9.68	8.14	9.65
GDP at Factor cost	354.95	10.02	9.72	9.93
Real exchange rate	90.85	-6.59	-17.21	-5.70
Nominal exchange rate	100	-7.07	-24.65	-6.04
GDP Growth	100	10	9.7	9.9
Government income	67.78	3.66	-2.23	4.14
Foreign Saving	21.7	4.8	6.0	6.0
Government Saving	35.49	-5.02	-13.21	-3.70

Source, Author simulation using DCGE Model

Aggregate private consumption demand rises relative to the base run in response to 29% increase in export price. It is apparent that households are the main producers of commodities in many developing countries including in Ethiopia. Thus, increase in export price enlarges household income, which in turn leads to rise in aggregate household consumption demand to imported and domestically produced commodities. Conversely, decrease in export price diminishes aggregate household consumption demand caused by the fall in income. In general, the result is in line with the findings of Bazhenova (2016), Rattso and Torvik (1998), Carniero and Arabache (2002), and Blake *et al*. (2001) where increase in export price upsurge household consumption demand while decrease in export price reduces household consumption demand. Regarding government

spending, it rises relative to the base run (nearly by 2 percentage point) in response to both simulations, it could due to the closure role chosen in the study.

Concerning investment demand, it declines in response to 29% increase in export price compared to the base run. This indicates increase in export price is not an impulse to investment growth in Ethiopia, due to one of the resulting reasons. First, increase in export price reduces government saving, which reduces saving pool available for investment and leads to decline in investment. Second, investment sector demand intermediate input in its production, however, due to the increase in export price the cost of intermediate input rises, which in turn results in decline in investment demand. However, decrease in export price rises investment demand triggered by low intermediate input cost and increase government saving but, less than the base run. Overall, the result of this study in this regard is in line with the findings of Bazhenova (2016), Abdelbag *et al*. (2010), and Carniero and Arabache (2002). Adding private and government consumption, and gross capital formation together provide absorption. The net effect of export price changes on absorption depends on its effect on private consumption. Because, the impacts of export price changes on private consumption outweighs its impact on investment demand in all scenarios. Accordingly, increase in export price results in rise in absorption while, decrease in export price results in decline in absorption relative to the base run scenario.

The demand for Ethiopia's export declines due the increase in export price relative to base run. Nonetheless, export demand rises due to the decrease in export price compared to EXPR1, but it is less than the base run. The negative effect of increase in export price on export demand is prompted by appreciation of exchange rate which lead to decrease in Ethiopia export demand. Conversely, decrease in export price upsurges the demand for export but, less than the base run through exchange rate depreciation. Concerning import, increase in export price lead to rise in import demand through appreciation of the exchange rate, however, decrease in export price reduces import demand via depreciation of the exchange rate. The result is consistent with the findings of Szeto *et al*. (2003) and Dorosh *et al*. (2009), which shows export price is inversely related to export demand but, positively related to import demand. In a nutshell, two possible statements can clarify the inverse relationship between export price and trade balance. First, increase in export price leads to appreciation of domestic currency, which rises import, but reduces export demand. Second, increase in export price rises household income, which in turn

increases import demand. As a result, the net effect of income and price together worsen trade balance of Ethiopia. Similarly, decrease in export price leads to depreciation of the domestic currency, which rises export, but reduce import demand. Moreover, decrease in export price leads to fall in household income which in turn reduces import demand. Therefore, the overall impact of decrease in export price is improvement of the trade balance of Ethiopia.

It is obvious that adding net export on absorption gives GDP at market price. Therefore, increase in export price reduces GDP at market price relative to the base run, and decrease in export price reverts GDP at market price to its base run. Lastly, deducting indirect tax from GDP at market price gives GDP at factor cost, which is also affected by export price changes as shown in table 5.9. The growth rate of the overall economy is fall by 0.3 percentage point in response to the increase in export price, but it returns to its base run rate in response to the decrease in export price scenario with 0.1 percentage point deviation from the base run rate. The negative impacts of increase in export price on GDP and its growth rate is partly explained by the rise in import demand and the fall in investment demand. Regarding exchange rate, increase in export price appreciates both the nominal and real exchange rate of Ethiopia relative to the base run. On the other hand, decrease in export price depreciates both the nominal and real exchange rate of relative to the base run. The result regarding exchange rate is comparable to the findings of Daza *et, al.* (2014), which reveal increase in export price appreciates exchange rate, while decrease in export price depreciates the exchange rate.

Government income is also affected by export price changes; because the price change affected the various sources of government revenue. The increase in export price reduces government revenue substantially compared to the base run level. On the other hand, decrease in export price rises government revenue relative to the base run. The result is conflicting to numerous empirical studies which reveal increase in export price rises government revenue, while decrease in export price reduces government revenue, may due to one of the following reasons. Firstly, as noted earlier, increase in export price rises institution income, yet direct tax rate is assumed fixed, which reduces government revenue collected from the growing institution income. Secondly, the fall in investment demand and production due to the increase in export price may reduce income of government collected from activities tax. Thirdly, export tax in Ethiopia is trivial, excluding of semi-processed leathers, as a result, increase in export price inspire producers to sell their

product at foreign market, which leads to decline in domestic sales tax. Finally, if the above three descriptions can't elucidate, increase in export price may reduce government tax collection effort through the "Dutch Disease Effect" while enjoying revenue from booming commodity price. The result is consistent with the findings of Carniero and Arabache (2002), who exhibit that increase in export price reduces government saving and taxes. The reverse is true for decrease in export price of commodity. Regarding government saving, the residual of government expenditure less of government income is also affected by export price changes. Accordingly, increase in export price reduces government saving while decrease in export price rises government saving relative to the base run. Alternatively, its movement is in line with government revenue. Finally, relative to the initial level, foreign saving rises in the base run by 4.8%. Similarly, foreign saving rises by 1.2 percentage point for all simulation scenario from the base run.

In a nutshell, export price changes have mixed impacts on the macro economy performance of Ethiopia. An increase in export price has negative impacts on macro-economic performance by reducing domestic production and increasing import demand. In this regard, the impact of export price is passed through exchange rate appreciation, which have expenditure switching effects from domestic to foreign commodities. Conversely, decrease in export price has positive effects on macro-economic performance by enhancing domestic production and reducing import demand. In this respect, the impact of export price is transmitted by exchange rate depreciation which have expenditure switching effects from foreign to the domestic commodities.

5.3.2 Impacts on Industry and Sectoral Output

In this section, the impacts of export price changes on agriculture, industry and service sub sectors performance are investigated. As a result, table 5.10 revealed the impacts of export price changes on sectoral output by combining production activities into agriculture, industry and service sectors. Comparing the initial and base value of the three sectors, the level of output in each sector show increment in base run compared to the initial level. In addition, the percentage change in industry and service sector exceeds agricultural sector percentage change. Similarly, output level of the three sector differs from the base run level if the price of export changes as summarized in table 5.10.

An increase in export price results in reduction of all sectors output relative to the base run level. On the other hand, decrease in export price results in increase in output level relative to the base run level apart from industry sector, but it reverts nearly to the base run. As a result, the result suggests that increase in export price can't improve output level of all sectors; because, export price changes have switching effect of consumer demand between imported and domestic commodities. That means increase in export price rises import demand and shifts consumers to consume imported commodities, which results decline in domestic production. Equally, decrease in export price reduces import demand and shifts consumers to consume domestic commodities, which results rise in domestic production. The institution behind the industry sector is that Ethiopia import is mostly strategic goods which have not domestic substitutes. This implies that import demand for industry commodity is unresponsive to the decrease in export price which in turn doesn't affect output of the industry sector domestically.

Table 5.10 Impacts on Sectoral output (% change from initial value)

Sector	Initial Value	Base	EXPR1	EXPR2
Agriculture	174.26	4.38	3.17	4.52
Industry	36.20	17.43	14.65	17.36
Service	144.55	8.41	7.43	8.59

Source, Author simulation using DCGE Model

In open economy, increase in export price will leads to smaller increase in domestic production. Because, some of the additional domestic demand will falls on import, which in turn results in reduction of domestic production. Based on results from the simulation, the impacts of export price changes on domestic output is not immediate (it begins after two years lag) i.e. in the first two-year, the base run and price scenarios have the same impact on sectoral output. The result in this regard is in line with the assumption that supply is sticky in the short-run, it delays the impacts of export price shocks on output.

5.3.3 Impacts on Export Volume and Domestic Supply

This section investigated the impacts of export price changes on export volume and domestic supply response of Ethiopia. Table 5.11 exhibits the impacts of export price changes on export volume as annexed at appendix D. Ethiopia's export items can be grouped into agriculture, industry, and service sectors based on the SAM aggregation to make analysis simple. Concerning agricultural sector, apart from flower, vegetable and fruits, export volume rises in the base run relative to the initial level. Similarly, export volume of industry sector rises nearly by 50% in the base run compared to initial level except leather products. Regarding service sector, its export volume upsurges in the base run relative to initial level for all commodities. However, once the price of export changes, its impact on export volume deviates from the base run level. Importantly, the impacts of export price changes on export volume is commodity specific.

The volume of agricultural export declines as export price increase more than the base run scenario, except flower, vegetables and fruits. Similarly, decrease in export price doesn't improve the volume of agricultural export. However, export volume of vegetables and fruits rises in response to the increase in export price but, decline in response to the decrease in export price. Moreover, export volume of flower declines in all price scenario relative to the base run. Consistent with economic theories, the result suggests, the export volume of most agricultural commodity is unresponsive to price changes. As result, considering on average, export volume of agricultural commodity is not determined by the price elasticity of commodities. Regarding industry, increase in export price has mixed impacts on export volume of industry apart from leather products. The volume of other industry export declines if the price of export increases, and it rises if the price of export decrease. The volume of leather products export declines in response to all price scenarios perhaps owing to weak linkages with local rawhide providers or the presence of quality leather product exporters compared to Ethiopia.

Industry export volume is not highly swinging similar to agriculture in response to world price changes, since the price elasticity of demand for industrial commodity is more elastic compared to agriculture. The service export volume witnesses a mixed result similar to the industry sector. For instance, private service, real estate, communication, transport, and trade subsectors export volume declines in response to the increase in export price, and decline in response to the decrease in export price. Conversely, export volume of hotels and catering rises in response to

the increase in export price and its volume falls due the decrease in export price. Similarly, it is observed that the increase in export price deteriorates financial and business services export volume, and decrease in export price results rises export volume.

It is evident that changes in export price can't only affect the volume of export, it will also affect the supply of commodity in domestic market. As a result, table 5.12 summarizes the tradeable commodities domestic supply responses to export price changes as annexed at appendix E. Comparing initial and base run, the domestic supply of all commodity rises in the base run. However, changes in export price deviates the domestic supply of commodities from the base run, which is actually the impact of the shock. Consequently, domestic supply of some tradable agricultural commodity doesn't respond to price change i.e. domestic supply is price inelastic. For instance, the supply of coffee, chat and flower doesn't respond to price changes. However, the domestic supply agricultural commodities such as oilseeds and pulses, other crops, animal and animal products rises if the price export price decreases, and supply decline if the price of export increases. Regarding other agriculture commodity, domestic supply moves pro-cyclical to export price (supply rises if export price increase, and falls if export price decrease). Thus, it can conclude that, domestic supply elasticity of agricultural commodities varies among commodities perhaps due to time lag to adjust production level in response to export price changes.

Compared to agriculture, deviations of industry and service supply in response to export price changes is higher as well as immediate. It is due the fact that agriculture is nature dependent, which implies we can't adjust production level instantly until second-round season, but we can adjust industry and service sector production level instantly in response to export price changes. Domestic supply of industry and manufacturing commodities rises if export price decreases, and declines if export price increases. This indicates that selling at domestic market is profitable to producers if export price decreases, but, selling at foreign market is profitable to producers if the price of export is increases. Regarding service, its price elasticity of domestic supply show mixed result. The domestic supply of wholesale and retail trade, hotels and catering, real estate and private business service is upsurges if the price of export increases, and declines if export price decreases. Nonetheless, the domestic supply of communication, financial, transport and business service declines if export price increases and rises if export price decreases.

To conclude that export volume of most agricultural commodities is inelastic to the changes in export price apart from few commodities. Conversely, the domestic supply of some agricultural commodity declines if the price of export increases; and rises if the price of export decreases. Therefore, the export volume and domestic supply of agricultural commodity move pro-cyclical to export price but, the movements are commodity specific. Moreover, the domestic supply of agricultural commodity is fairly elastic to price changes compared to export volume. Similarly, industry export and domestic supply responds to export price changes, but it is not as volatile as agriculture. Most industry commodity export and domestic supply decline if the price of export increases and vice versa. The impact of export price change on service sector is pro-cyclical to export price, but its impacts is commodity specific. The result supports the view that producers face tradeoff between selling at domestic market or foreign market or between output and price.

5.3.4 Impacts on Import Volume

This section examines the impacts of export price changes on import volume. As discussed earlier, export price changes affected import demand at aggregate level, but now, commodity specific impacts of export price changes are examined as revealed in table 5.13, which is annexed at appendix F.

The volume of import increases in the base run relative to the initial level. Based on simulation result, the price of import declines in base run relative to initial level, which in turn rises import demand. For most commodity, increase in export price boosts import demand compared to base run. Two effects arise from export price increases, price and income effects. The price effect is the result of decline in import price through appreciation of ETB, which results import cheaper and induces import demand. The second effect is the income effect through rising households' income as export price increases. However, increase in export price is not results rise in import demand for all commodity; some commodities import demand decline such as machineries, fertilizer, and other mining. However, decrease in export price results in decline in import volume of majority commodity relative to base run except fertilizer, machinery and other mining. Because, decrease in export price depreciates ETB which make import expensive and reduces households' income; as a result, price and income effect together reduces of import volume. The result show that an increase and decrease in export price significantly rises and reduces import volume, respectively through price and income effects.

5.3.5 Impacts on Factors Return, Households Income and Expenditure

This section investigates the impacts of export price changes on factors return, household income and expenditure. The first section, explains the impact of export price changes on factors income ass demonstrated in table 5.14. Conversely, the successive subsection scrutinizes the impacts of export price changes on household income and expenditure as shown in table 5.15, and figure 5.1, respectively.

Impacts on Factors Return

It is evident that factors income and demand are expected to be affected by export price changes through factor demand and supply as well as output prices adjustment. The various factors that exist in the SAM are aggregated into capital, land, livestock and labour groups for the sake of brevity. Comparing initial and base run, all factors income is improved in the base run relative to initial level of income. Conversely, if export price changes are introduced, the income of all factors deviates from the base run as summarized in table 5.14.

Table 5.11 Impacts on factors return (% change from the initial)

Factors	INITIAL	BASE	EXPR1	EXPR2
Skilled labour	20.5	11.6	23.5	12.9
Semiskilled labour	57.1	8.3	18.6	7.8
Unskilled labour	39.4	10.3	13.7	10.2
Agriculture labour	57.1	10.5	10.4	10.4
Capital	110.3	12.6	20.3	12.0
Land	39.8	10.7	11.2	10.5
Livestock	30.9	12.8	12.1	12.7

Source, Author simulation using DCGE Model

The immediate impact of export price changes is on factor price through adjustment of factor demand. Based on the simulation result, increase in export prices rises factors price and decrease in export price reduces factors prices except income for livestock. Therefore, high export price

rises factors income while low export price reduces factors income apart from livestock. Livestock income and price are negatively related to export price. Capital in Ethiopia is more of imported goods hence its volume increase if the price of export rises and vice versa. As a result, high export price could cause substitution of livestock by capital which in turn reduces income and price of livestock. Conversely, weakening of export price discourages producers to import capital goods which in turn rises the demand and price of livestock. The return for labour and land is in line with others factors income because most of the time, labour and land are used compliment with other factors.

Impacts on Households Income

Household account recorded in the SAM are aggregated into four groups for the sake of brevity. It is obvious that commodity export is the main sources of income for households in developing countries. Therefore, increase in export price would improve household income while decline in export price reduce household income. Table 5.17 reveals that the impacts of export price change on income of various household groups. So far, empirical studies show that the impacts of export price on household income work through changes on relative price, wage and employment. In the base run, all household real income is increased compared to the initial level. Therefore, households' income improves in the base run relative to the initial level if exogenous economic variables is allowed to grow by base run growth rate trajectories. Conversely, changes in export price from the base run deviates the real income of institutions.

Table 5.12 Impacts on household income (% change from initial value)

Households	INITIAL	BASE	EXPR1	EXPR2
Rural Poor Household	73.93	10.14	13.26	9.96
Rural Nonpoor Household	261.08	10.62	16.21	10.38
Urban Poor Household	3.83	9.89	16.83	9.71
Urban Nonpoor Household	35.54	9.77	17.46	9.92

Source, Author simulation using DCGE Model

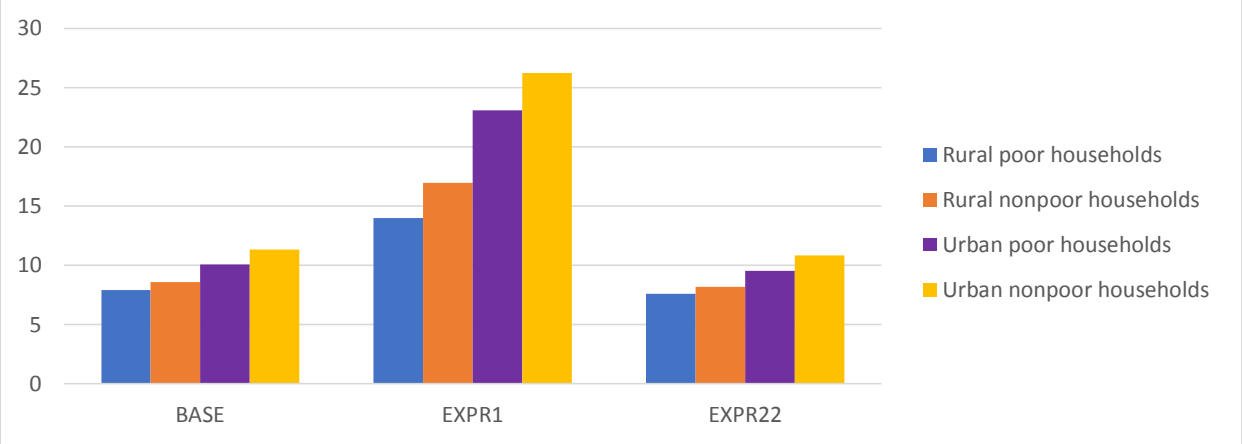
As shown in table 5.15, increase in export price improve households' income, however, decrease in export price reduces household income relative to base run except urban non-poor household.

This is because, the main source of income to urban non-poor household is skilled and semiskilled labour, typically employed in the service sector. Conversely, income of households employed in agriculture and industry sector is affected by export price variation. As noted earlier, the main source of household income is factors return. Accordingly, increase in export price leads to upsurge of factors income and households will divide the income based on their initial factors' income share. On the contrary, decrease in the price of export diminishes factors income which in turn reduce household income. Generally, the observed difference between households' income is the result of variation on initial factor income share.

Impacts on Households Expenditure

It is evident that any changes that affect household income can also affect expenditure. As a result, export price changes would affect household expenditure as labeled in figure 5.1. Comparing the initial and base run, the real expenditure of household increases in the base run which is the direct effects of the increase income. However, the percentage change increase in urban household real consumption is bigger than rural households relative to their initial level.

Figure 5.1 Impacts on Households Expenditure (%change)



Source, Author simulation using DCGE Model

As shown on figure 5.1, increase in export price lead to an increase in household real expenditure nearly by 50% from the base run. This implies that the increase expenditure is allied with income through product and factors price adjustment mechanisms. On the other hand, decrease in export price reduces the real consumption expenditure of all households relative to the base run.

5.3.6 Impacts on Households Welfare

The section investigates the impacts of export price changes on well-being of various household groups. Accordingly, Equivalent Variation (EV) is chosen as a measure of household welfare in the study. If the value of EV is positive for a given price changes, it is assumed as welfare gains for household. Conversely, if the value of EV is negative, it is assumed as welfare loss to household due export price shocks. Therefore, table 5.16 illustrates the impacts of export price changes on various household welfare. Comparing the initial and base run EV, the welfare of all household upsurges in the base run relative to initial welfare level. Nonetheless, comparing the percentage changes, rural poor and noon-poor households have low level of welfare gains than urban and rural non-poor household.

Table 5.13 Impacts on household welfare using EV (% change from Initial)

Household	INITIAL	BASE	EXPR1	EXPR2
Rural Poor Household	14.036	10.934	19.41	10.472
Rural Nonpoor Household	47.592	11.976	24.776	11.364
Urban Poor Household	3.43	11.74	30.86	11.08
Urban Nonpoor Household	27.04	13.41	36.08	12.74

Source, Author simulation using DCGE Model

As revealed in table 5.16, rise in export price considerably improves the welfare of all household more than base run scenario. However, fall in export price reduces the welfare of all household relative to the base run. Households' welfare is improved due to growth in income and expenditure resulting from the increase in export price. On average export price, the welfare of households is reasonably increasing relative to the base run. In a nutshell, increase in export price is beneficial to all household welfare while decline in export price is detrimental to all household welfare.

Chapter Six: Conclusions and Policy Implications

6.1 Conclusions

The study examines economy-wide impacts of export price changes in Ethiopia using Recursive Dynamic Computable General Equilibrium model. To do so, standard IFPRI CGE model is used which is calibrated through 2009/10 SAM of Ethiopia. Two simulation scenarios are designed (increase and decrease in export price relative to the base run). Various macroeconomic plans have undertaken in Ethiopia to achieve its economic and social objectives. However, the topical current plan of the country is GTP-II targeted to sustain economic growth together with reducing poverty, income inequality and trade deficit and other objectives. On the top of this, the export of Ethiopia is dominated by few unprocessed or semi-processed commodities with low value addition in the global market. For that reason, income from export is unstable, and vulnerable to the state of world economic conditions that have effect on other economic objectives of the country. Studies show that export price changes have implications on macro and microeconomic variables though mixed results are arose. Moreover, various study result show that the impacts of export price shock depend on the extents of the shocks introduced.

The increase in export price of Ethiopia leads to appreciation of the domestic currency which in turn rises import demand but, reduce export demand. As a result, the interaction of the two effects worsen the trade balance of the country. However, the impact of increase in export price on export and import demand is commodity specific. An increase in the price of export weakens investment demand through rising the cost of investment. Similarly, high export price reduces government income and saving. Government revenue may decline due the fall in investment demand or tax collection effort of government while enjoying commodity price boom. Relative to the base run, government spending and foreign saving are increased by the same percentage points to all simulations. Economic growth slightly declines due to the increase in export price through its negative effect on investment and export demand. The increase in price of export also affects the supply of tradable commodities sold in domestic market, yet the results are mixed. Thus, some commodity such as coffee, hotel and catering, real estate services and wholesale and retail trade domestic supply are increased while others commodity supply is declined. Moreover, the increase in export price, rises factors return via adjustment of factor price which in turn

improve income and expenditure of household. Finally, the increase in export price results welfare gains to all household groups.

However, decrease in export price depreciate domestic currency. However, depreciation of ETB reduces import demand and it rises export demand. By and large, decrease in export price improves the trade balance of Ethiopia. Moreover, decrease in export price improves investment demand and it rises government income saving. Similarly, decrease in export price reasonably rises economic growth through its impacts on investment and export demand. Decrease in export price also increases the supply of tradable commodity sold in the domestic market though the results are commodity specific. For instance, the supply of coffee, flower, and chat are fixed regardless of the export price. Conversely, the supply of some tradable commodity declines while others commodity supply rises. Finally, decrease in export price reduces factors return that in turn decreases income and expenditure of households. As a result, the wellbeing of households worsens due to the decrease in export price

In a nutshell, changes in export price have both advantages and disadvantages. Above all, some of the results are contradictory to policy objectives while others are not. For instance, increase in export price cannot stimulate economic growth, investment, and it cannot improve trade balance and government revenue. Besides, increase in export price rise factors and households' income, and it improves their welfare. On the other hand, decrease in export price increase investment, economic growth, government revenue and improve the trade balance. However, it reduces factors and households' income and their welfare. Therefore, to harmonize the benefits and drawbacks of export price changes, appropriate policy tools is necessitated.

6.2 Policy Implications

Considering the simulation result and empirical reviews, the study identifies the following recommendation as mediating strategies of export price changes.

- ☞ Exchange rate is the main transmission mechanisms of export price shocks. Therefore, the exchange rate policy is more likely to be at the center of the policy response together with other policies. As a result, the government of Ethiopia should stick to the current exchange rate policy, managed-floating. If price of export increases, the exchange rate should be devaluated which helps to maintain trade balance, economic growth, investment, and

government balance. However, households' income and welfare lose should be remunerated via 'growth trickle down' and increasing investment from high commodity revenue. Similarly, if export price decrease, the exchange rate should be revaluated which will improve trade balance, investment, economic growth and government revenue. Conversely, it will reduce households' income and welfare but, through 'growth trickle down' and investment expansion households' income will be maintained.

- ☞ Diversification and industrialization of commodity export is vital to reduce the adverse impacts of export price shocks. Ethiopia's export price is highly volatile that depends on the state of global economic condition. Therefore, it needs diversification or broadening of export base of the country than relying on few and less diversified commodities. What is desirable for competitiveness in the international market is the volume of real export which in turn has tendency to increases specialization and innovation of Ethiopia.
- ☞ Adding value on export commodities and transforming from entirely agriculture to industry dependent economy over time is the best option to resolve the impacts of export price shocks. Because, industry export price is more or less stable relative to agricultural commodities. It can be achieved by integrating commodity policies into the country's overall development strategy and plans.
- ☞ It is also better to harness the income gains from commodity exports to facilitate wider economic transformations and reduction of dependence on primary commodity export.
- ☞ Finally, get ready for the possibility of price fall or rise and its major impact on households' income, government revenue, trade balance, and overall economy.

6.3 Issues for Further Study

The study is attempted to illustrate the economy-wide impacts of export price changes in Ethiopia. The price of export assumed in the study is not commodity specific. However, in reality the price of all commodity is not fluctuates or fluctuation of price is not equal among commodity. Therefore, empirical result obtained from the model could mislead to generalize the impacts of export price changes in Ethiopia. Accordingly, it will better if another study is undertaken to show the economy wide impacts of commodity specific world price fluctuations.

References

Abdelbag E., Elgaili E. and Salih A. (2010), ***Impacts of Exchange Rate Reforms on Sudan's Economy: Applied General Equilibrium Analysis:*** African Journal of Agricultural Research Vol. 5(6), pp. 442-448.

Adam B., Andrew M. and Oliver M., (2001), ***The Impact on Uganda of Agricultural Trade Liberalization***: Credit Research Paper No.01/07: Center for Research in Economic Development and International trade, University of Nottingham.

AEO (2016), ***Ethiopia chapter*****:** African Economic Outlook 2016.

AfDB (2016), ***African Economic Outlook***: Case of Ethiopia, AfDB.

AfDB (2005): ***Are Exports the Engine of Economic Growth? An Application of Cointegration* and Causality Analysis for Egypt, 1977-2003**: AfDB Economic Research Working Paper Series, AfDB.

Altenburg T. (2017), ***Industrial Policy in Ethiopia***: Discussion Paper 2/2010, Bonn: GDI.

Alimi N. and Aflouk (2017), ***Terms of Trade Shocks and Macroeconomic Volatility Developing Countries: Panel Smooth Transition Regression Models***. Journal of International Trade and Development, 26(5), pp.534-551.

Andrew B., Chris P., Catherine P., Martin S., Nikola S. and Hans W. (2011), ***Global Shocks and, the Impact on Low-Income Countries***: ***Lessons from the Global Financial Crisis***: IMF Working Paper (11/27): Washington Dc, IMF.

Andrew J., David W. and Abdul R. (2001***), Comparing the Economic Impact of an Export Shock in Two Modeling Frameworks***. Oxford, 33(4), pp. 623-638.

Amon M. (2002), ***The Impacts of Trade on the Brazilian Labour Market:*** A CGE Approach. Journal of Economics Library.

Amon M. (2001), ***External Shocks and Domestic Poverty Alleviation:*** Simulation with A CGE Model of Malawi: TMD Discussion Paper No.71, Washington, D.C, IFPRI.

Amon M. (1998), ***Economic Openness, Trade Restrictions and External Shocks: Modeling Short-Run Effects of in Sub-Saharan Africa***. Journal of Economics Library, Volume 15, pp.257-286.

Armin R., Troster B., Staritz C., and Raza W. (2015), ***Commodity Dependence and price Volatility in Least Developed Countries:*** A Structuralist Computable General Equilibrium with Applications to Burkina Faso, Ethiopia and Mozambique: Working Paper 52. Vienna, Austrian Foundation for Development Research.

ATPC (2006), ***Assessing the Consequences of the Economic Partnership Agreement on the Ethiopian Economy:*** ATPC Work in Progress No.47, Economic Commission for Africa.

Bazhenova O. and Bazhenova Y. (2016), ***Modeling the Impacts of External Shocks on Economy of Ukraine***: DSGE Approach, Ikonomika, Vol.91(1).

Bellu G. (2011), ***Analyzing Policy Impacts and International Price Shocks:*** Alternative Computable General Equilibrium (CGE) Models for an Aid-Dependent Less Industrialized Countries: S.L.

Bjornskove C. (2005), ***Basics of International Economics***, Arhus: Ventus Publishing APS.

Bourdet Y. (2004), ***External Shocks, Exchange Rate Regime and Growth in Burkina Faso and Mal***, S.l.: SIDA.

Broda C. and Tille C. (2003), ***Current Issues in Economics and Finance***: Coping with Terms of Trade Shocks in Developing Countries: Federal Reserve Bank of New York, Vol.9 (11).

Brulhart M. (2003), ***Scale Economies, Intra-Industry Trade and Industry Location in the "New Trade Theory"***: Trinity Economic Technical Paper Series No. 95/4, Dublin, JEL Classification: F12, F15.

Brue S. and Grant R. (2013***), The Evolutions of Economic Thought:*** 8th ed., Cengage Learning.

Burfisher M. (2016), ***Introduction to CGE Models***: 2nd ed. New York, Cambridge University press.

Breisinger M. (2009), ***Social Accounting Matrices and Multiplier Analysis: An Introduction with Exercise:*** Food Security in Practice Technical Guide 5., Washington, DC: IFPRI.

Carniero G. and Arabache S. (2002), ***The Impacts of Trade on the Brazilian Labor Market:*** A CGE Model Approach, JEL Classification, University of Brasilia, Brazil.

Cassey *A.*, Holland D, and Razack A. (2011), ***Comparing the Economic Impact of an Export Shock in Two Modeling Frameworks:*** Vol. 33, No. 4 (2011), pp. 623-638, Oxford University Press.

Cashin P. and Pattillo C. (2000), ***The Duration of Terms of Trade Shocks in SubSaharan Africa***: Are they Short Lived or Long lived? IMF Working paper 00/72, Washington DCe, IMF.

CFC (2005), ***Overview of the Situation of Commodities, in Developing Countries***: 11th Meeting of Intergovernmental Follow-Up and Coordination Committee on Economic Cooperation Among Developing Countries (IFCC-XI) 21-23 March 2005. Havana, Cuba, CFC.

Chowdhury A. and Kirkpatrick C. (2005), ***Development Policy and Planning***: An Introduction to Models and Techniques: 1st ed. London, Routledge.

Chhuor S. (2017), ***Potential Roles of Export Orientation of Cambodia's Agriculture and Agro Industry***: An Application of CGE Analysis: Journal of Economic Structures, 6(27).

Davis B., Biddel E. and Samuels J. (2003), ***A Companion to the History of Economics Thought:*** 1st ed., Cornwell: Blackwell.

Decaluwe B., Chockburn J. and Annabil N. (2004), ***Sequential Dynamic CGE Model for Poverty Analysis:*** Cirpee, Laval University.

Dervis K., De Melo J. and Robinson S. (1998), ***General Equilibrium Models for Development Policy:*** Washington, DC: WB.

Dorobat, (2015), ***A Brief History of International Trade Thought***: From Pre-Doctrinal Contribution to the 21st Century Heterodox International Economics. The Journal of Philosophical-Economics, VIII (2), pp. 106-137.

Dorosh P., Robinson S. and Ahmed H. (2009), ***Economic Implication of Foreign Exchange Rationing in Ethiopia***: ESSP2 Discussion Paper 009; Development Strategy and Governance Division, IFPRI– Ethiopia Strategy Support Program 2, Ethiopia.

Drozdz J. and Miskinis A. (2011), ***Benefits and Threats of Free Trade***: Publishing House of Wrocław University of Economics, Wrocław.

Dunn, R. M. and Mutti, J. H. (2004), ***International Economics***: 6th Edition, Routledge Publishers, New York, pp 212

Ehrhart H. and Guerineau S. (2011), **The impact of high and volatile commodity prices on public finances: Evidence from developing countries,** Paris, France, Banque de France, Franc Zone and Development Financing Studies Division.

EDRI (2009), ***Ethiopian Input-Output Table and Social Accounting Matrix:*** Addis Ababa, Ethiopia, EDRI.

Ermias E., Seneshaw T., Eyasu T., Debowicz D., Dorosh P, and Robinson R. (20011), ***Ethiopia's Growth and Transformation Plan:*** A Computable General Equilibrium Analysis of Alternative Financing Options. Development Strategy and Governance Division, IFPRI, Ethiopia Strategy Support Program II, Ethiopia.

Ethiopian Economic Outlook (2018), ***Ethiopia Economy Data***: Addis Ababa, https://www.focuseconomics.com/countries/ethiopia

Galesi A. and Lombardi J. (2009), ***External Shocks and International Inflation Linkages A Global VAR Analysis***: Working Paper Series No. 1062, European Central Bank.

Gandolfo G. (2014), ***International Trade Theory and Policy***: 2nd ed., Rome, Italy: Springer.

Ganesh N., Kel S. and Rob H. (2009), ***Economic Impacts of Immigration***: Scenarios Using Computable General Equilibrium Model of the New Zealand Economy: Working Paper Series, Wellington: New Zealand Government Department of Labour.

Geiger M. and Goh C. (2012), ***Ethiopia Economic Update:*** Overcoming Inflation, Raising Competitiveness: WB.

Getnet A. (20100, ***Global Financial Crisis Discussion Series Paper 16***: Ethiopia Phase2, Westminster Bridge Road, ODI.

Gersovitz M. and Paxson C. (1990), ***The Economies of Africa and the Prices of their Exports***: Princeton Studies in International Finance No.68, Princeton University.

Gunning C. (1999), ***Trade Shocks***: Theory and Evidences. S.l., s, n.

Hesbon K. (2009), ***The Impact of International Trade on Economic Growth in Developing Countries*** (Export for Rapid Economic Growth), A Case Study of Kenya: Master Thesis for the Award MA in Economics, Nairobi: University of Nairobi.

Ho S. (2016), ***Global Economic and Financial Crisis:*** Exploring the Transmission Channels and Impacts on Sub-Saharan African Economies, Pretoria, University of South Africa.

Hosoe N., Gasawa N. and Hashimoto H. (2010), ***Text Book of Computable General Equilibrium Modeling***: Programming and Simulation. First ed. Macmillan, Palgrave.

Hamouda H., Karingi S., Ouedraogo B., Oulmane N. and Sadni-Jallab M. (2006***), Assessing the Consequences of the Economic Partnership Agreement on the Ethiopian Economy***: ATPC Working in Progress No. 43, ATPC, ECA.

IBRD (2008), ***Africa at a Turning Point?*** Growth, Aid and External Shocks, Washington, DC; WB.

IMF (2016), ***Regional Economic Outlook (Sub-Saharan Africa Time for a Policy Reset):*** World Economic and Financial Surveys, 0258-7440, Washington, Dc: IMF.

IMF (2008), ***Poverty and Social Impact Analysis by the IMF***: Review of Methodology and Selected Evidence, Washington, DC: IMF.

IFPRI (2002), ***A Standard Computable General Equilibrium (CGE) Model in GAMS***. Microcomputers in Policy Research N.W, Washington, DC: IFPRI, pp.16-17.

Izurieta A. (n.d.), ***World Economic Vulnerability Monitor:*** Trade Shock Analysis, Measuring The impacts of the Global Shocks on Trade Balances Via Price and Demand Effects, S.l.: UNDESA.

Jan Sue W. (2004), ***CGE Models and their Use in Economy wide Policy Analysis:*** Technical Note No.6, S.L, s.n.

Jemio M., Carlos L., Weibelt and Manfred (2002), ***Macroeconomic Impacts of External Shocks and Anti-Shocks Policies in Bolivia***: A CGE Analysis: Kiel Working paper, No.1100

Jolanta D. and Algirdas M. (2011), ***Benefits and Threats of Free Trade***: Ekonomia Economics, 2(14), pp. 41-48.

Kaban G (2001), ***Global Economic Integration:*** Opportunity and Challenges- A Summary of Bank Symposium, Kansas: FRB of Kansas City.

Krugman P. and Obstfeld M. (2003), ***International Economics Theory and Policy***, 6th ed: Pearson Education INC.,

Lamaj J. (2015), ***The Impact of International trade and Competition Market on Developing*** Countries: Bari, Italy, s.n.

Lam T. (2015), ***A Review of modern International Trade Theories:*** American Journal of Economics, Finance and Management, 1(16), pp. 604-614.

Lofgren *H.,* Chulu O., Sichinga O., Simtowe F., Tchale H., Tseka R., and Wobst P. (2001), ***External Shocks and Domestic Poverty Alleviation: Simulations with A CGE Model of Malawi****:* Trade and Macroeconomics Division IFPRI, Washington, DC, USA.

Lofgren H. and Bonilla C. (2006), ***MAMS:*** An Economy Wide Model for Analysis of MDG, Country Strategies an Application to Latin America and Caribbean: S.l., s.n.

Lofgren H., Harris R. and Robinson S. (2002), ***A Standard CGE Model in GAMS***: Washington DC: IFPRI.

Lulit M. (2014), ***Implications of High Commodity Prices on Poverty Reduction in Ethiopia and Policy Option Under an Agriculture-Led Development Strategy:*** AGRODEP Working Paper 0007. s. l., IFPRI.

Lulit M., Emezat H. and Zelalem H. (2011), ***Study on the Human Dimension of the financial Crisis in Ethiopia***: Final Report: Addis Ababa, Ethiopia, UNFPA.

Magnusson L. (2011), ***Mercantilism:*** International Relations, Volume II.

Makarand (2014), ***Theories of International Trade:*** An Overview S.N.

Marin W. (2001), ***Trade Policies, Developing Countries, and Globalization***: Development Research Group: World Bank.

Mark N. (2000), ***International Macroeconomics and Finance:*** Theory and Empirical Methods, Blackwell.

McDonaldet S., Kirsten F. and Zyl J. (1997), ***A Social Accounting matrix for Modeling Agricultural Policy Reform in South Africa***, Agrekon, 36(4), pp. 513-533.

Medina-Smith J. (2001), ***Is the Export-Led Growth Hypothesis valid for Developing Countries?*** A Case Study of Costa Rica: UNCTAD Policy Issues in International Trade and Commodity Study Series No. 7, Geneva and New York: UNCTAD.

Mengesha Y. (2016), ***Pulses Sector Investment Profile:*** International Trade Centre 2016.

Meyn M. and Kennan J. (2009), ***The Implications of the Global Financial Crisis for Developing Countries' Export Volumes and Values:*** Working paper 305, London, SE17JD: ODI.

MFoFAE (2007), ***Foreign Trade Promotion Manual for Ethiopia Diplomatic Missions***: Economic and Business Affairs General-Directorate, Addis Ababa, MOFA.

Miller R. and Deaton A. (1995), ***International Commodity Prices, Macroeconomic Performance and Politics in Sub-Saharan Africa:*** Princeton Studies on International Finance No. 79: New Jersey: Princeton University.

Montiel J. and Angor R. (2008), ***Development Macroeconomics***: 3rd ed., New Jersey, Princeton University Press.

Moreira R. (2014), ***Commodities Price Volatility, Expected Inflation and GDP Levels:*** An Application for a Net- Exporting Economy: Procedia Economic and Finance, Volume 14, pp. 435-444.

Murphy T. and Langdana F. (2014), ***The Origins of International Trade Theory***: International Trade and Global Macro Policy: New York: Springer, p.8.

Nafziger W. (2006), ***Development Economics, 4th ed:*** Cambridge University Press, New York.

National Plan Commission (2016), ***Growth and Transformation Plan-II:*** Volume I Main Text, Addis Ababa, Ethiopia, FDRE.

NBE (2009/10-2016/17), Annual Report About Ethiopia: NBE.

Norman V., Romain R. and Jaume V. (2007), ***Macroeconomic Volatility and Welfare in Developing Countries***: AN Introduction, The World Bank Economic review, 21(3), pp. 343-357.

Obstfeld P. (2003), ***International Economics Theory and Policy***: 6th ed., Boston, USA: Pearson Education Inc.

Pattillo P. (2000), ***The Duration of Terms of Trade Shocks in Sub Saharan Africa***: S.l., s.n.

Paul I. (2010), ***The Global Financial Crisis: Origin, Contagion and Impacts on Ethiopia***: Journal Basic and Applied Sciences, 2(1), pp. 1-22.

Rattso J. and Torvik R. (1998), ***Economic openness, trade restrictions and external shocks:*** modelling short run effects in Sub-Saharan Africa: Norwegian University of Science and Technology, N-7055 Dragvoll, Norway.

Reinert K. (2007), ***Ethiopia in the World Economy***: Trade, Private Capital Flows, and Migration: Indian University Press, Vol. 53, No. 3 (Spring, 2007), pp. 65-89, Accessed from: URL: http://www.jstor.org/stable/4187793: 24-03-2018 12:05 UTC.

Rober M. and Mutti H. (2004), ***International Economics***:6th ed., London and New York, Routledge.

Robinson S., Willenbockel D., Hashim A. and Dorosh P. (2010), ***Implications of food production and Price shocks for household welfare in Ethiopia****:* a general equilibrium analysis: EDRI, MPRA Paper No. 39533

Robichaud V. (2001), Calculating Equivalent and Compensating Variations in CGE Models.

Robinson D. (2009), ***Assessing the Impact of the Global Financial Crisis on World Prices and Trade in Developing Countries***: Analysis with a World Trade Model: Brighton, s.n.

Rossoun R. (2004), ***General Equilibrium Modelling in South Africa***: An Overview and Appraisal: Master Thesis, Potchefstroom, North West University.

Sadoult E. and De Janvry A. (1995), ***Quantitative Development Policy Analysis:*** Johns Hopkins University Press, Baltimore and London.

Samen S. (2010), ***A Primer on Export Diversification:*** Key Concepts, Theoretical Underpinnings and Empirical Evidences, S.l., WB.

Samuel K. Bernard A., Jonathan E. and J. Bradford J. (2003), "***Plants and productivity in international trade":*** The American Economic Review, 93 (4), 1268-1290.

Schumacher R. (2012a), ***Adam Smith's Theory of Absolute Advantage and the Use of Doxography In the History of Economics:*** University of Potsdam, Germany, Erasmus Journal for Philosophy and Economics, 5(2), pp. 54-80.

Schumacher R. (2012b), ***Free Trade, Absolute and Comparative Advantage:*** A critical Comparison of Two Major Theories of International Trade: Welt Trends Thesis 16. Potsdam, University Verlag Potsdam.

Shangquan G. (2000), ***Economic Globalization:*** Trend, Risk and Risk Prevention: Journal of Economics Library, P.I.

SIDA (2007), **Least Developed Countries and World Trade**, 2nd Edition, SIDA Studies NO.9

Szeto L., Gardiner P., Gray G. and Hargreaves D. (2003), ***A Comparison of the NZTM and FPS Models of the NZ Economy:*** New Zealand Treasury, Working Paper 03/25, New Zealand.

Tanzi V. (2007), ***Fiscal Responses of Exogenous Shocks in Developing Countries***: available at http://www.jstor.org/stable/1818742 Accessed time: 25-11-2017 09:04 UTC.

Thirlwall A. (2000), ***Trade, Trade Liberalization and Economic Growth***: Theory and Evidence, Abidjan: AfDB.

Thurlow J. (2008), ***A Recursive Dynamic CGE Model and Microsimulation Poverty Model for South Africa:*** Washington, DC., IFPRI.

Tik J. (2010), ***Saving the Golden Goose:*** Why Export Driven Growth Model Still Work for Malaysia: Stanford Journal of International Relations: XI (no.1.30), pp. 24-30.

Tille C. (2003), ***Comping with Terms of Trade Shocks in Developing Countries***: Current Issues in Economics and Finance, 9(11).

Todaro M. and Smith M. (2012), **Economic Development**: 11th ed., S.l., Adson Wesley.

UNCTAD (2003), ***Economic Development in Africa:*** Trade Performance and Commodity Dependence Geneva and New York, UN.

UNCTAD (2007), ***The Economics and Political Economy of International Trade Cooperation:*** World Trade Report, S.l.: UNCTAD.

UNCTAD (2008), ***Globalization for Development:*** The International Trade Perspectives: New York and Geneva, UN.

UNCTAD (2011), **Global crises and the commodity dependence of the least developing countries: Impacts, challenges and the way forward;** Fourth United Nations Conference on the least Developed countries (LDC-IV), Istanbul, Turk.

UNCTAD (2013), Prospects for Building Resilience to External Shocks and Mitigating their impact on Trade and Development: Geneva, UN.

UNDP (2017), ***Manufacturing Export Performance in Ethiopia***: UNDP, Ethiopia.

UN (2012a), ***Commodity Dependence and International Commodity Prices***: S.l., UN.

UN (2012b), ***The United Nations in Ethiopia***: Transforming Ethiopia Together, Addis Ababa: UN.

UN (2014), ***World Economic Situation and Prospects*** 2014: New York: UN.

UNOHR (2014), ***The Vulnerability of Landlocked Developing Countries to External Shocks*** Vienna: UN.

Wainwright K. (2007), ***CV and EV***: Measuring the Welfare Effects of an Economic Change.

Wangwe S. (1993), ***New Trade Theories and Developing Countries***: Policy and Technological Implications: UN/Intech Working Paper No.7, S.l. UN.

Wambugu N. (2012), ***The Impact of External Shocks on Economic Growth and Welfare in Kenya:*** A CGE Analysis: Thesis Submitted for the Requirement for the Degree of Doctor of Philosophy in Economics to School of Economics, Nairobi, UON.

WB (2008), ***Africa at a Turning Point? Growth, Aid and External Shocks***: WB, Washington DC.

WB (2012), ***Ethiopian Economic Update***: Overcoming Inflation, Raising Competitiveness: WB.

WB (2013), ***Africa Pulse***: An analysis of issues shaping Africa's economic future: Volume 8, WB.

WB (2014), ***Ethiopia Economic Update***: Overcoming Inflation, Raising Competitiveness: WB.

WTO (2016), ***World Trade Statistical Review***: S.L., WTO.

Zerayehu S. (2013), ***Economic Transformation and Sectoral Growth Options in Ethiopia***: Considerations for Achieving Middle Income Country Status: A Thesis Submitted in Partial Fulfillment of the Requirements for the Award of Doctor of Philosophy in Economics of the University of Nairobi.

Appendixes

Appendix A: CGE Model Sets, Parameters, and Variables

Sets			
Symbol	**Explanation**	**Symbol**	**Explanation**
$a \in A$	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	$f \in F(= F)$	A set of 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
$c \in CM$ (□ *C)*	Aggregate imported commodities	$h \in H(\subset INSDNG)$	Households
Parameters			
Symbol	**Explanation**	**Symbol**	**Explanation**
$cwts_c$	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	ta_a	Tax rate for activity a

	unit of c'		
$inta_a$	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 VAT tax
pwe_c	Export price (foreign currency)	$trnsfr_{i\,f}$	Transfer from factor f to institution i
pwm_c	Import price (foreign currency)	δ_c^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_{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_c^q	Armington function share parameter	ρ_a^{va}	CES value-added function exponent
δ	Capital depreciation rate	η_{ft}^a	Sector share of new capital

te_c	Export tax		
Exogenous Variables			
Symbol	**Explanation**	**Symbol**	**Explanation**
$\overline{CPI}$	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 factor	$\overline{WFDIST}_{fa}$	Wage distortion factor for factor f in activity a
$\overline{IADJ}$	Investment adjustment factor		
Endogenous Variables			
Symbol	**Explanation**	**Symbol**	**Explanation**
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_c	Quantity of imports of commodity c
QF_{fa}	Quantity demanded of factor f from activity a		
MPS_i	Marginal propensity to	QQ_c	Quantity of goods

	save for domestic non-government institution (exogenous variable)		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_c	Export price (domestic currency)	$QXAC_{ac}$	Quantity of output of commodity c from activity a
$PINTA_a$	aggregate intermediate input price for activity a	$\mathrm{RWF_f}$	Real average factor price
PK_{ft}	Unit price of capital in time period t	$TABS$	Total nominal absorption
PMc	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_c	Quantity of exports	ΔK^a_{fat}	Quantity of new capital by activity a for time period t

Appendix B: Within Period CGE Model Equations

Price Block Equations	
$PM_c = pwm_c.(1+tm_c).EXR + \sum_{c' \in CT} PQ_{c'}.icm_{c'c}$ c∈ CM $\begin{bmatrix} import \\ price \\ (LCU) \end{bmatrix} = \begin{bmatrix} tariff - \\ adjustment \end{bmatrix} . \begin{bmatrix} exchange\ rate \\ (LUC per\ FCU) \end{bmatrix} + \begin{bmatrix} cost\ of\ trade \\ inputs\ per \\ import\ unit \end{bmatrix}$ import price	(1)
$PE_c = pwe_c.EXR - \sum_{c' \in CT} PQ_{c'}.ice_{c'c}$ c ∈ CE export price $\begin{bmatrix} \text{export} \\ \text{price} \\ \text{(LCU)} \end{bmatrix} = \begin{bmatrix} \text{export} \\ \text{price} \\ \text{(FCU)} \end{bmatrix} . \begin{bmatrix} \text{exchange rate} \\ \text{(LCU per FCU)} \end{bmatrix} - \begin{bmatrix} \text{cost of trade} \\ \text{inputs per} \\ \text{export unit} \end{bmatrix}$	(2)
$PDD_c = PDS_c + \sum_{c' \in CT} PQ_{c'}.icd_{c'c}$ $c \in CD$ demand price for domestic non-traded commodity $\begin{bmatrix} \text{domestic} \\ \text{demand price} \end{bmatrix} = \begin{bmatrix} \text{domestic} \\ \text{supply price} \end{bmatrix} + \begin{bmatrix} \text{cost of trade} \\ \text{inputs per units of} \\ \text{domestic sales} \end{bmatrix}$	(3)
$PQ_c.(1-tq_c).QQ_c = PDD_c.QD_c + PM_c.QM_c$ $c \in (CD \cup CM$ absorption $\begin{bmatrix} absorption \\ (at\ demand \\ prices\ net\ of \\ sales\ tax \end{bmatrix} = \begin{bmatrix} domestic\ demand \\ price\ times \\ domestic\ sales \\ quantity \end{bmatrix} + \begin{bmatrix} import\ price \\ times \\ import\ quantity \end{bmatrix}$	(4)
$PX_c.QX_c = PDS_c.QD_c + PE_c.QE_c$ c ∈ CX marketed output value $\begin{bmatrix} \text{Producer price} \\ \text{times marketed} \\ \text{output quantity} \end{bmatrix} = \begin{bmatrix} \text{domesic supply} \\ \text{price times} \\ \text{domestic sales} \\ \text{quantity} \end{bmatrix} + \begin{bmatrix} \text{export price} \\ \text{times export quantity} \end{bmatrix}$	(5)
$PA_a = \sum_{c \in C} PXAC_{ac}.\theta_{ac}$ $a \in A$ activity price $\begin{bmatrix} activity \\ price \end{bmatrix} = \begin{bmatrix} producer \\ price\ times \\ yields \end{bmatrix}$	(6)
$PINTA_a = \sum_{c \in C} PQ_c.ica_{ca}$ $a \in A$ activity specific aggregate $\begin{bmatrix} aggregate \\ intermediate \\ input\ price \end{bmatrix} = \begin{bmatrix} intermediate\ input\ cost \\ per\ unit\ of\ aggregate \\ intermediate\ input \end{bmatrix}$	(7)
$PA_a.(1-ta_a).QA_a = PVA_a.QVA_a + PINTA_a.QINTA_a,$ $a \in A$ activity revenue and cost	(8)

$\begin{bmatrix}\text{actitvity price}\\ \text{(net of taxes)}\\ \text{times activity level}\end{bmatrix} = \begin{bmatrix}\text{value}-\text{added}\\ \text{price times}\\ \text{quantity}\end{bmatrix} + \begin{bmatrix}\text{aggregate}\\ \text{intermediate}\\ \text{input price}\\ \text{times quantity}\end{bmatrix}$	
$\overline{CPI} = \sum_{c\in C} PQ_c.cwts_c$ consumer price index $\begin{bmatrix}consumer\\ price\ index\end{bmatrix} = \begin{bmatrix}prices\ times\\ weights\end{bmatrix}$	(9)
$DPI = \sum_{c\in C} PDS_c.dwts_c$ producer price index $\begin{bmatrix}\text{producer price index}\\ \text{for non tradeable outputs}\end{bmatrix} = \begin{bmatrix}\text{prices times}\\ \text{weights}\end{bmatrix}$	(10)
Production and Trade Block Equations	
$QVA_a = inva_a.QA_a \quad a \in ALEO$ Leontief technology demand for aggregate value added $\begin{bmatrix}demand\ for\\ value\ added\end{bmatrix} = f\begin{bmatrix}activity\\ level\end{bmatrix}$	(11)
$QINTA_a = inta_a.QA_a \quad a \in ALE$ Leontief technology demand for aggregate intermediate input $\begin{bmatrix}demand\ for\ aggreagte\\ intermediate\ input\end{bmatrix} = f\begin{bmatrix}activity\\ level\end{bmatrix}$	(12)
$QVA_a = \alpha_a^{va}.\left(\sum_{f\in F}\delta_{fa}^{va}.QF_{fa}^{\frac{1}{-\rho_a^{va}}}\right)^{\frac{-1}{\rho_a^{va}}}$ Value added and factor demand $\begin{bmatrix}quantity\ of\ aggregate\\ value\ added\end{bmatrix} = CES\begin{bmatrix}factors\\ inputs\end{bmatrix}$	(13)
$WF_f.\overline{WFDIST_{fa}} = PVA_a(1-tva_a).QVA_a.\left(\sum_{f\in f'}\delta_{fa}^{va}\,QF_{fa}^{-p_a^{va}}\right)^{-1}.\delta_{fa}^{va}.QF_{fa}^{-\rho_a^{va}-1}\ a \in A\ and\ f \in F$ factor demand $\begin{bmatrix}marginal\ cost\ of\\ factor\ f\ in\ activity\ a\end{bmatrix} = \begin{bmatrix}marginal\ revenue\ product\\ of\ factor\ f\ in\ activity\ a\end{bmatrix}$	(14)
$QINT_{ca} = ica_{ca}.QINTA_a \quad c \in C,\ a \in A$ Disaggregated intermediate input demand $\begin{bmatrix}intermediate\\ demand\\ for\ commodity\ c\\ from\ activvity\ a\end{bmatrix} = f\begin{bmatrix}aggregate\ intermediate\\ input\ quantity\\ from\\ activity\ a\end{bmatrix}$	(15)
$QXAC_{ac} + \sum_{h\in H} QHA_{ach} = \theta_{ac}.QA_a \quad a \in A\ and\ c \in CX$ $\begin{bmatrix}market\ quantity\\ commodity\ c\\ from\ activity\ a\end{bmatrix} + \begin{bmatrix}household\ home\\ consumption\\ of\ commoodity\ c\\ from\ activity\ a\end{bmatrix} = \begin{bmatrix}productionof\\ comodity\ c\\ from\ activitiya\end{bmatrix}$ Commodity	(16)

production and allocation	
$QA_c = \alpha_c^{ac}.\left(\sum_{a\in A}\delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ae}}\right)^{-\frac{1}{p_c^{ac}-1}} \quad c \in CX$ output aggregation $\begin{bmatrix} aggrgate\ markated \\ production\ of \\ commodity\ c \end{bmatrix} = CES \begin{bmatrix} activity\ specific \\ marketed \\ production\ of \\ commodity\ c \end{bmatrix}$ function	(17)
$PXAC_{ac} = PX_c.QX_c\left(\sum_{a\in A}\delta_{ac}^{ac}.QXAC_{ac}^{-\rho_c^{ac}}\right)^{-1}.\delta_{ac}^{ac}.QXAC_{ac}^{-p_c^{ac}-1}, a \in A\ \&\ c \in CX$ $\begin{bmatrix} marginal\ cost\ of com- \\ modity\ c\ from\ activity\ a \end{bmatrix} = \begin{bmatrix} marginal\ revenue\ product\ of \\ commodity\ c\ from\ activity\ a \end{bmatrix}$ First order condition for output aggregation function	(18)
$QX_c = \alpha_c^t.\left(\delta_c^t.QE_c^{\rho_c^t} + (1-\delta_c^t).QD_c^{\rho_c^t}\right)^{\frac{1}{p_c^t}} \quad c \in (CE \cap CD)$ output transformation $\begin{bmatrix} aggregate\ marketed \\ domestic\ output \end{bmatrix} = CET \begin{bmatrix} export\ quantity, domestic \\ sales\ of\ domestic\ output \end{bmatrix}$ function	(19)
$\frac{QE_c}{QD_c} = \left(\frac{PE_c}{PDS_c}.\frac{1-\delta_c^t}{\delta_c^t}\right)^{\frac{1}{\rho_c^t-1}} \quad c \in (CE \cap CD)$ Export-domestic supply ratio $\begin{bmatrix} export-domestic \\ supply\ ration \end{bmatrix} = f\begin{bmatrix} export-domestic \\ price\ ratio \end{bmatrix}$	(20)
$QX_c = QD_c + QE_c, \quad c \in (CD \cap CEN) \cup (CE \cap CDN)$ output transformation non-exported commodities $\begin{bmatrix} aggeragate\ matketed \\ domestic\ output \end{bmatrix} = \begin{bmatrix} domestic\ market \\ sales\ of\ domestic\ output \\ for[for\ C \in (CD \cap CEN)] \end{bmatrix} + \begin{bmatrix} export \\ [for(CE \\ \cap CDN)] \end{bmatrix}$	(21)
$QQ_c = \alpha_c^q.\left(\delta_c^q.QM_c^{-\rho_c^q} + (1-\delta_c^q).QD_c^{-\rho_c^q}\right)^{\frac{1}{p_c^q}} \quad c \in (CM \cap CD)$ Composite supply or Armington function $\begin{bmatrix} composite \\ supply \end{bmatrix} = f\begin{bmatrix} import\ qauntity, domestic \\ use\ of\ domestic\ output \end{bmatrix}$	(22)
$\frac{QM_c}{QD_c} = \left(\frac{PDD_c}{PM_c}.\frac{\delta_c^q}{1-\delta_c^q}\right)^{\frac{1}{1+\rho_c^q}} \quad c \in (CM \cap CD)$ Import-domestic demand ratio $\begin{bmatrix} import-domestic \\ demand\ ratio \end{bmatrix} = f\begin{bmatrix} domestic\ import \\ price\ ratio \end{bmatrix}$	(23)
$QQ_c = QD_c + QD_c, \quad c \in (CD \cap CMN) \cup (CM \cap CDN)$ composite supply for non-imported outputs and non-produced imports $\begin{bmatrix} composite \\ supply \end{bmatrix} = \begin{bmatrix} domestic\ use\ of\ market \\ domestic\ output[for \\ C \in (CD \cap CMN)] \end{bmatrix} + \begin{bmatrix} import \\ [for\ c \in (CM \\ \cap CDN)] \end{bmatrix}$	(24)
$QT_c = \sum_{c'\in C''}(icm_{cc'}.QM_{cc'} + ice_{cc'}.QE_{c'} + icd_{cc'}.QD_{c'})\ c \in CT$ demand for transaction services	(25)

$\begin{bmatrix} demand\ for \\ transactions \\ services \end{bmatrix} = \begin{bmatrix} sum\ of\ demands \\ for\ imports, exports \\ and\ sales \end{bmatrix}$	
Institution Block Equations	
$Yf_f = \sum_{a \in A} WF_f . \overline{WFDIST_{fa}} . QF_{fa} \quad f \in F$ factor income $\begin{bmatrix} income\ of \\ factor\ f \end{bmatrix} = \begin{bmatrix} sum\ of\ activity\ payments \\ (activity\ specific\ wages \\ times\ employment\ leveles) \end{bmatrix}$	(26)
$YIF_{if} = shif_{if} . \left[(1 - tf_f) . YF_f - trnsfr_{rowf} . EXR \right] \ i \in INSD \ \& \ f \in F$ institutional factors income $\begin{bmatrix} income\ of \\ institution\ i \\ from\ factor\ f \end{bmatrix} = \begin{bmatrix} share\ of\ income \\ of\ factor\ f\ to \\ institution\ i \end{bmatrix} . \begin{bmatrix} income\ of\ factor\ f \\ (net\ of\ tax\ and \\ transfer\ to\ ROW) \end{bmatrix}$	(27)
$YI_i = \sum_{f \in F} YIF_{if} + \sum_{i' \in INSDNG'} TRII_{ii'} + trnsfr_{igov} . \overline{CPI} + trnsfr_{irow} . EXR \quad i \in INSDNG$ Income of domestic non-government institutions $\begin{bmatrix} income\ of \\ institution\ i \end{bmatrix} = \begin{bmatrix} factor \\ income \end{bmatrix} + \begin{bmatrix} transfers\ from \\ other\ domestic \\ non\ government \\ institutions \end{bmatrix} + \begin{bmatrix} transfers \\ from \\ government \end{bmatrix} + \begin{bmatrix} transfers \\ from \\ the\ ROW \end{bmatrix}$	(28)
$TRII_{ii'} = SHii_{ii'} . (1 - MPS_{i'}) . (1 - INS_{i'}) . YI_{i'} \quad i \in INSDNG \ \& \ i'$ intra-institutional transfers $\begin{bmatrix} trnasfer\ from \\ institution\ i'to\ i \end{bmatrix} = \begin{bmatrix} share\ of\ net\ income \\ of\ institution\ i' \\ transfered\ to\ i \end{bmatrix} . \begin{bmatrix} income\ of\ institution \\ i' . net\ of\ saving\ and \\ direct\ taxes \end{bmatrix}$	(29)
$EH_h = (1 - \sum_{i \in INSDNG} shii_{ih}) . (1 - MPS_h) . (1 - TINS_h) . YI_h \quad h \in H$ Household consumption expenditure $\begin{bmatrix} household\ income \\ disposable\ for \\ consumption \end{bmatrix} = \begin{bmatrix} household\ income, net\ of\ direct \\ taxes, svings, and\ transfers\ to \\ other\ non - government\ institutions \end{bmatrix}$	(30)
$PQ_c . QH_{ch} = PQ_c . \gamma_{ch}^m + \beta_{ch}^m . \left(EH_h - \sum_{c' \in C} PQ_{c'} . \gamma_{c'h}^m - \sum_{\alpha \in A} \sum_{c' \in C} PXAC_{ac'} . \gamma_{ac'h}^h \right)$ $c \in C \ and \ h \in H$ Household consumption spending on marketed commodities $\begin{bmatrix} \text{household consumption} \\ \text{spending on marketed} \\ \text{commodity c} \end{bmatrix} = f \begin{bmatrix} total\ household \\ consumption \\ spending, market\ price\ of\ c, \\ and\ othere \\ commodity\ prices\ (market\ and\ home) \end{bmatrix}$	(31)
$PXAC_{ac} . QHA_{ach} =$ $PXAC_{ac} . \gamma_{ach}^h + \beta_{ach}^h . \left(EH_h - \sum_{c' \in C} PQ_{c'} . \gamma_{c'h}^m - \sum_{\alpha \in A} \sum_{c' \in C} PQ_{c'} . \gamma_{c'h}^m \right) \ a \in A, c \in C \ and \ h \in H$ Household consumption spending on home commodities	(32)

$\begin{bmatrix} household \\ consumption \\ spending\ on\ home \\ commodity\ c\ from \\ activity\ a \end{bmatrix} = f \begin{bmatrix} total\ household \\ consumption\ spending \\ ,producer\ price, and \\ other\ commodity\ prices \\ (market\ and\ home) \end{bmatrix}$	
$QINV_c = \overline{IADJ}.\overline{qinv_c}$ $\quad c \in C$ investment demand $\begin{bmatrix} fixed\ investment \\ demand\ for \\ commodity\ c \end{bmatrix} = \begin{bmatrix} adjustment\ factor \\ times \\ base\ year\ fixed \\ investment \end{bmatrix}$	(33)
$QG_c = \overline{GADJ}.\overline{qg_c}$ $\quad c \in C$ government consumption demand $\begin{bmatrix} government \\ consumption \\ demand\ for \\ commodity\ c \end{bmatrix} = \begin{bmatrix} adjustment\ factor \\ times \\ base\ year\ government \\ consumption \end{bmatrix}$	(34)
$YG = \sum_{i \in INSDNG} TINS_i.YI_i + \sum_{c \in CM} tm_c.pwm_c.QM_c.EXR + \sum_{c \in C} tq_c.PQ_c.QQ_c + \sum_{f \in F} YIF_{gov\,f} + trnsfr_{gov\,row}.EXR$ $\begin{bmatrix} government \\ revenue \end{bmatrix} = \begin{bmatrix} direct\ taxes \\ from \\ institutions \end{bmatrix} + \begin{bmatrix} value \\ added \\ tax \end{bmatrix} + \begin{bmatrix} import \\ tariffs \end{bmatrix} + \begin{bmatrix} sales \\ taxes \end{bmatrix} + \begin{bmatrix} transfers \\ from \\ ROW \end{bmatrix}$	(35)
$EG = \sum_{c \in C} PQ_c.GQ_c + \sum_{i \in INSDNG} trnsfr_{i\,gov}.\overline{CPI}$ government expenditure $\begin{bmatrix} government \\ spending \end{bmatrix} = \begin{bmatrix} government \\ consumption \end{bmatrix} + \begin{bmatrix} transfers\ to\ domestic \\ non-government \\ institutions \end{bmatrix}$	(36)

System Constraint Block Equations

$\sum_{\alpha \in A} QF_{fa} = \overline{QFS_s}$ $\quad f \in F$ factor market $\begin{bmatrix} demand\ for \\ factor\ f \end{bmatrix} = \begin{bmatrix} supply\ of \\ factor\ f \end{bmatrix}$	(37)
$QQ_c = \sum_{\alpha \in A} QINT_{ca} + \sum_{h \in H} QH_{ch} + QG_c + QINV_c + qdst_c + QT_c \quad c \in C$ composite commodity market $\begin{bmatrix} composite \\ supply \end{bmatrix} = \begin{bmatrix} intermediate \\ use \end{bmatrix} + \begin{bmatrix} household \\ consumption \end{bmatrix} + \begin{bmatrix} government \\ consumption \end{bmatrix} + \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix} + \begin{bmatrix} trade \\ input\ use \end{bmatrix}$	(38)
$\sum_{c \in CM} pwm_c.QM_c + \sum_{f \in F} trnsfr_{rowf} = \sum_{c \in CE} pwe_c.QE_c + \sum_{i \in INSD} trnsfr_{i\,row} + \overline{FSAV}$ Current account balance for the ROW in FCU	(39)

$\begin{bmatrix} import \\ spending \end{bmatrix} + \begin{bmatrix} factor \\ transfers \\ to\ ROW \end{bmatrix} = \begin{bmatrix} export \\ revenue \end{bmatrix} + \begin{bmatrix} institutional \\ transfres \\ from\ ROW \end{bmatrix} + \begin{bmatrix} foreign \\ saving \end{bmatrix}$	
$YG = EG + GSAV$ government balance $\begin{bmatrix} government \\ revenue \end{bmatrix} = \begin{bmatrix} government \\ expenditures \end{bmatrix} + \begin{bmatrix} government \\ savings \end{bmatrix}$	(40)
$TINS_i = \overline{tins_i}.(1 + \overline{TINSADJ}.tins_{01i}) + \overline{DTINS}.t_i \quad i \in INSDNG$ direct institutional tax rates $\begin{bmatrix} direct\ tax \\ rate\ for \\ institution\ i \end{bmatrix} = \begin{bmatrix} base\ rate\ adjusted \\ for\ scaling\ for \\ selected\ institutions \end{bmatrix} + \begin{bmatrix} point\ change \\ for\ selected \\ institutions \end{bmatrix}$	(41)
$MPS_i = \overline{mps_i}.(1 + \overline{MPSADJ}.mps01_i) + DMPS.mps01_i\ i \in INSDNG$ institutional saving rates $\begin{bmatrix} savings \\ rates\ for \\ institution\ i \end{bmatrix} = \begin{bmatrix} base\ rate\ adjusted \\ for\ scalinf\ for \\ selected\ institutions \end{bmatrix} + \begin{bmatrix} point\ change \\ for\ selected \\ institutions \end{bmatrix}$	(42)
$\sum_{i \in INSDNG} MPS_i.(1 - TINS_i).YI_i + GSAV + EXR.\overline{FSAV} = \sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c$ saving-investment balance $\begin{bmatrix} non-gover \\ ment\ savings \end{bmatrix} = \begin{bmatrix} government \\ savings \end{bmatrix} = \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix}$	(43)
$TABS = \sum_{h \in H} \sum_{c \in C} PQ_c.QH_{ch} + \sum_{\alpha \in A} \sum_{c \in C} \sum_{h \in H} PXAC_{ac}.QHA_{ach} + \sum_{c \in C} PQ_c.QG_c + \sum_{c \in C} PQ_c + QINV_c + \sum_{c \in C} PQ_c.qdst_c$ Total absorption $\begin{bmatrix} total \\ absorption \end{bmatrix} = \begin{bmatrix} household \\ market \\ consumption \end{bmatrix} + \begin{bmatrix} household \\ home \\ consuption \end{bmatrix} + \begin{bmatrix} government \\ consuption \end{bmatrix} + \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix}$	(44)
$INVSHR.TABS = \sum_{c \in C} PQ_c.QINV_c + \sum_{c \in C} PQ_c.qdst_c$ ratio of investment to absorption $\begin{bmatrix} investment \\ absorption \\ ratio \end{bmatrix}.\begin{bmatrix} total \\ absorption \end{bmatrix} = \begin{bmatrix} fixed \\ investment \end{bmatrix} + \begin{bmatrix} stock \\ change \end{bmatrix}$	(45)
$GORSHR.TABS = \sum_{c \in} PQ_c QG_c$ ratio of government consumption to absorption $\begin{bmatrix} governmen \\ consuption - \\ absorption \\ ratio \end{bmatrix}.\begin{bmatrix} total \\ absorption \end{bmatrix} = \begin{bmatrix} government \\ consuption \end{bmatrix}$	**(**46)

Appendix C: Between Period CGE Model Equations

Capital Accumulation and Allocation Equations	
$AWF_{ft}^{a} = \sum \left[\left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}} \right) . WF_{ft} . WFDIST_{fat} \right]$; $\begin{bmatrix} \text{average capital} \\ \text{rental rate} \end{bmatrix} = \begin{bmatrix} weighted\ sum\ of\ sectors' \\ capital\ rental\ rats \end{bmatrix}$ where, f is capital	(47)
$\eta_{fat}^{a} = \left(\frac{QF_{fat}}{\sum_{a'} QF_{fa't}} \right) . \left(\beta^{a} . \left(\frac{WF_{ft} . WFDIST_{fat}}{AWF_{ft}^{a}} - 1 \right) + 1 \right)$; $\begin{bmatrix} \text{share of} \\ \text{new capital} \end{bmatrix} = \begin{bmatrix} Share\ of\ existing \\ capital \end{bmatrix} . \begin{bmatrix} capital\ rental \\ rate\ ratio \end{bmatrix}$	(48)
$\Delta K_{fat}^{a} = \eta_{fat}^{a} . \left[\frac{\sum_{a} PQ_{ct} . QINV_{ct}}{PK_{ft}} \right]$; $\begin{bmatrix} \text{quantity of new} \\ \text{capital by sector} \end{bmatrix} = \begin{bmatrix} Share\ of\ new \\ capital \end{bmatrix} . \begin{bmatrix} total\ quantity\ of \\ new\ capital \end{bmatrix}$	(49)
$PK_{ft} = \sum_{c} PQ_{ct} \frac{QINV_{ct}}{\sum_{c'} QINV_{c't}}$; $\begin{bmatrix} \text{unit price} \\ \text{of capital} \end{bmatrix} = \begin{bmatrix} weightedmarket\ price\ of \\ investment\ commodities \end{bmatrix}$	(50)
$QF_{fat+1} = QF_{fat} . \left[1 + \frac{\Delta K_{fat}^{a}}{QF_{fat}} - V_{f} \right]$; $\begin{bmatrix} \text{average capital} \\ \text{rental rate} \end{bmatrix} = \begin{bmatrix} weighted\ sum\ of\ sectors' \\ capital\ rental\ rates \end{bmatrix}$	(51)
$QFS_{ft+1} = QFS_{ft} . \left[1 + \frac{\Delta K_{fat}^{a}}{QFS_{ft}} - V_{f} \right]$; $\begin{bmatrix} \text{average capital} \\ \text{rental rate} \end{bmatrix} = \begin{bmatrix} weighted\ sum\ of\ sectors' \\ capital\ rental\ rates \end{bmatrix}$	(52)

Appendix D: Table 5.13 Impacts on Export Volume (from initial values)

	INITIAL	BASE	EXPR1	EXPR2
Oilseeds and pulses	44.9	-8.85	-12.55	-9.24
Vegetables and fruits	5.2	3.19	9.27	2.56
Chat	1.43	-29.89	-47.54	-29.21
Coffee	6.82	-4.67	-11	-3.95
Flower	0.93	4.88	4.7	4.93
Other crops	8.84	-10.82	-16.8	-10.84
Cattel and animal products	0.98	-22.25	-16.12	-22.22
Milk and dairy	0.05	-55.71	-67.46	-55.09
Poultry	0.05	-7.01	-3.23	-7.06
Fish	0.15	-4.59	-10.06	-4.43
Grain milling	0.66	25.14	49.17	23.08
Sugar refining	0.07	63.71	45.04	67.23
Tea processing	0.06	7.01	14.53	8.83
Other food processing	0.16	1.38	7.46	3.83
Beverages	0.14	39.2	24.75	38.79
Tobacco processing	0.05	43.62	28.86	42.38
Textiles and clothes	0.95	105.09	107.21	108.25
Leather products	1.02	-11.28	-24.54	-10.85
Wood products	0.01	46.76	13.9	47.15
Paper and paper publishing	0.35	66.53	80.32	62.9
Chemical	0.5	46.52	88.64	44.25
Metal and metal products	2.87	71.6	67.03	68.73
Vehicles and transport equipment	0.4	30.67	58.45	27.61
Electronic equipment	0.65	42.07	41.19	40.71
Wholesale and retail trade	1.15	20.3	19.74	19.81
Hotels and catering	1.51	8.81	11.21	8.56
Transport	19.08	8.06	1.76	7.87
Communication	1.45	9.76	5.97	9.6
Financial and business services	2.32	1.26	-17.27	0.3
Real state service	0.37	8.57	5.83	8.32
Other private services	0.22	3.24	0.3	2.92

Source, DCGE Model simulation result

Appendix E: Domestic supply of tradable commodity (%change from initial) (table 5.14)

Commodities	INITIAL	BASE	EXPR1	EXPR2
Oil seeds and pulses	15.13	18.84	14.99	18.90
Chat	7.12	8.42	8.36	8.36
Coffee	13.68	16.92	17.09	17.09
Flower	0.29	0.38	0.38	0.38
Other crops	7.55	9.10	5.48	9.22
Animal and animal products	48.93	62.08	61.62	61.97
Other agriculture products	6.03	8.74	10.38	8.65
Industry and manufacturing	17.34	50.08	46.30	49.09
Wholesale and retail trade	53.18	117.41	126.67	114.89
Hotel and catering	11.06	17.31	19.68	17.11
Transportation service	15.73	24.04	18.36	23.87
Communication service	2.46	4.22	4.04	4.19
Financial service	5.99	10.05	9.59	9.98
Business service	1.33	0.91	0.39	0.87
Real estate service	26.59	44.21	45.29	43.63
Other private service	6.58	9.48	9.64	9.36

Source, Author simulation Using DCGE Model

Appendix F: Table 5.15 Impacts on Import Volume (%change from the initial value)

Import Commodities	INITIAL	BASE	EXPR1	EXPR2
Wheat	92.41	34.27	83.63	30.69
Pulses	10.09	34.64	95.5	31.46
Other crops	13.38	39.05	94.03	35.56
Other mining	1.86	18.2	12.13	17.28
Foods stuff	1.43	22.09	58.61	19.02
Textiles	4.38	21.14	48.93	18.55
Clothes	3.07	8.79	31.59	7.5
Paper and paper products	2.27	14.48	36.22	13.2
Petroleum	20.92	11.43	12.06	11.08
Fertilizer	4.74	6.23	3.13	6.46
Chemicals	12.42	14.72	32.04	13.75
non-metal products	5.27	14.47	19.36	13.09
Metals products	13.08	24.46	25.98	22.88
Machinery	8.88	9.91	2.52	9.24
vehicles and vehicle equipment	8.78	13.09	21.03	12.42
Electronic equipment	10.68	14.57	32.36	13.66
other manufacturing	1.66	8.32	64.77	6.02
Trade and communication	1.17	16.36	34.2	15.18
Hotel and catering	1.28	10.64	17.68	10.18
Transport service	22.42	16.58	26.74	15.93
Financial service	1.23	15.93	32.12	15.25
Business service	5.09	15.32	21.64	15.02

Source, Author simulation Using DCGE Model