Addis Ababa University, Ethiopian Journal of Business and Economics, EJBE Vol. 9, No 2,
DOI: https://dx.doi.org/10.4314/ejeb.v9i2.2, p-ISSN: 2311-9772, e-ISSN: 2410-2393
Available online: http://ejol.aau.edu.et/index.php/ejbe and https://www.ajol.info/index.php/ejbe

Does agricultural free trade benefit Ethiopia and Sudan? CGE Model Approach

Maregu Minuyelet[1] and Solomon Tsehay[2]

Abstract

It has been argued that trading among neighbors under a free trade arrangement benefits country. Recognizing this, Ethiopia and Sudan formed a free trade agreement. Hence, this paper has tried to examine the impact of unilateral agricultural policies that augment the productivity of agricultural goods under free trade and the free mobility of labor on the economies of Ethiopia and Sudan. The 2011 social accounting matrices of Ethiopia and Sudan have been used, and a regional social accounting matrix that comprises both economies has been constructed. The Stage CGE model has been applied, and two separate simulations have been considered. The first simulation presumes an improvement in the agricultural sector of Ethiopia while keeping the agricultural sector of Sudan as it is, and the second scenario dwells on enhancing the agricultural sectors of Sudan while keeping the agricultural sector of Ethiopia as it is. The result of the first simulation revealed that the agricultural sectors of Ethiopia increased while the industrial sector and the agricultural sector of Sudan were negatively affected. The result further revealed that the industrial sector of Sudan has improved. The second scenario revealed that the agricultural sectors of Sudan increased while the agricultural and industrial sectors of Ethiopia were negatively affected. The thus study recommends that while Sudan and Ethiopia engage in a free trade area, they have to formulate agricultural policies together in a bid to reduce the negative effects of agricultural policies on the industrial sector of Ethiopia and the income of Sudan households.

Keywords: Agriculture, free trade, CGE, Ethiopia, Sudan

[1]*Debre Markos University; Email: maregu300@gmail.com*

[2] *Addis Ababa University, Email: tsehaysol2015@gmail.com*

Introduction

Nations (or firms in different nations) trade with each other because they benefit from it. Other motives may be involved, of course, but the basic motivation for international trade is the benefit or gain to the participants. The gain from international trade, like the gain from all trade, arises because specialization enables resources to be allocated to their most productive uses in each trading nation. Everyone recognizes that it would be foolish for a town or a province to try to be self-sufficient, but we often fail to recognize that the benefits of specialization and the division of labor also exist in international trade. The political boundaries that divide geographic areas into nations do not change the fundamental nature of trade, nor do they remove the benefits it confers on the trading partners (Robert M. Dunn & John H. Mutti, 2004).

Foreign trade has increasingly become a keystone of economic prosperity in many countries around the world. In principle, both export and import trades are equally important. A country must import the required inputs, capital items, and appropriate technologies to broaden its production base and foster export growth. Imports of consumer goods are also essential to meet the growing demand at home. Export trade, on the other hand, is crucial to fill the foreign exchange gap of a country and hence to increase import capacity and reduce dependence on foreign aid. For that reason, increased participation in world trade is considered the single most important tool for rapid economic growth and development **(**see Abebe, 2012).

Free trade between neighboring countries has been considered a potent tool for economic growth and development. Indeed, trade encourages production and efficiency and reduces poverty through broadening the production base, facilitating export diversification, enhancing competitiveness, and encouraging innovations **(**Dollar and Kray, 2002; Winters et al., 2004). It has been acknowledged that trade transfers advanced technologies, knowledge, and innovations between countries and, in turn, promotes growth and development (Grossman and Helpman, 1991; and Sala-i-Martin et al., 1995). Moreover, the flow of goods and services between countries promotes social and political relations and enhances peace between nations (McDonald et al., 2008; Fearon, 1995; and Gartzke, 1999).

Ethiopia shares its largest border with Sudan, which facilitates the movement of goods and services between the two countries on both formal and informal levels. The history of trade relations between Sudan and Ethiopia is very old. In the last decades, the trade between the two countries has witnessed sharp progress, particularly after the establishment of COMESA, as both countries are the main members of the treaty. Ethiopia and Sudan signed a bilateral trade agreement in 2002 to foster free trade by eliminating barriers to trade and promoting free competition. Since then, the trade flow between the two countries has increased considerably. Furthermore, the 1999 advent of oil in Sudan raised the bilateral trade between Ethiopia and Sudan, as most of Ethiopia's oil imports originated mainly from Sudan (see Ebaidalla Mahjoub Ebaidalla, 2016).

It is a clear fact that free trade benefits member countries. This could be evidenced by the benefits that members derive from existing regional integrations like the EU, NAFTA, etc. In addition to falling under the same regional blocks, Ethiopia and Sudan shared the longest border that facilitates trade and the mobility of production factors. What makes the matter more interesting is that these countries have different production and consumption patterns, which could act as an engine for trade to happen between them. For instance, Ethiopia produces exportable agricultural products that are heavily consumed by the Sudanese economy, namely coffee, cut flowers, other vegetables, dried legumes, onions, pepper, tanned sheep hides, and tanned goat hides. Sudan also produces and exports major agricultural goods to the rest of the world, which are consumed by Ethiopian households, such as tanned goat hides, onions, tanned sheep hides, and prepared cotton.

The trade pattern of Sudan and Ethiopia reveals that there is room for further cooperation in agricultural trade. This is substantiated by the fact that Sudan imports only 30% of the total import of coffee ($25.2 million). The remaining 70% is from Uganda at a relatively higher price of $56.9, import 33% of total dried legumes from Ethiopia, and the remaining is from other nations. Furthermore, Ethiopia accounts for 64% of total Sudan imports, with the remaining 36% coming from elsewhere. The same potential for trade is also revealed in the Ethiopian case. Ethiopia only imports 38%, 96%, 35%, and 12% of tanned goat hides, onions, tanned sheep hides, and prepared cotton, respectively, from Sudan, and the remaining is from others.

In recognition of such realities and to tap the benefits of free trade, there are initiatives in both countries to promote trade and investment. The first all-weather road connecting Azezo-Metema-Humera and Port Sudan is now operational. The road connecting the Benishangul Region's Kurmuk to Sudan's Kurmuk-Demazen is on the verge of completion. A new road from Gonder-Humera to Lugdi as a new addition to the road network (Ventures Africa) is under construction (Ministry of Trade and Industry). Trade between Ethiopia and Sudan will not only have welfare effects through reduced prices emanating from low transaction costs but will also have a spillover effect through gains that come from factor mobility. Furthermore, the countries may engage in trading based on comparative advantage so that they act together in the international market in order to maximize gains from the rest of the world.

These instigate research questions that require looking at the possible effects of forming a trade hub that promotes free trade and free mobility of production factors between Ethiopia and Sudan using economic wide modeling. There are few studies that have been conducted so far on the issue. But almost all of them have used a gravity model that failed to show the full picture of the aforementioned effects **(**see Abebe, 2012; Ebaidalla et al., 2016). So, the following are the research questions: So, what benefits do both Sudan and Ethiopia gain from trading among themselves based on their production characteristics? Would the benefits from forming such a trade hub benefit both Sudan and Ethiopia fairly under a labor mobility scheme?

Therefore, the major objective of the study is to examine the impact of agricultural policies and forming agriculture free trade between Ethiopia and Sudan on the economies of both nations with the following specific questions: The first is to identify who gets more benefit from trading among themselves. Second, to examine agriculture products in which both nations will benefit by reducing imports from the rest of the world and importing from one of them that has the ability to produce more using abundant resources; and third, to analyze the impact of agricultural free trade on the macroeconomics of the nation.

Literature Review

Theoretical Literature

Two Swedish economists, Eli Heckscher and Bertil Ohlin, are credited with developing the factor proportions theory of trade. Their early contributions were published in Swedish and received little attention from English-speaking economists until Ohlin's book, Inter-regional and International Trade, was published in 1933. Let us begin with one of Ohlin's examples: why does Denmark export cheese to the United States while importing wheat from the United States?

The Heckscher–Ohlin model (hereafter referred to as the H–O model) that answers this question rests upon two key ideas that differ from the classical approach. First, rather than focusing on the single input of labor, the H–O model allows for additional inputs and recognizes that different goods require these inputs in different proportions. For example, both land and labor are necessary to produce either cheese or wheat, but cheese production requires relatively more labor and wheat production requires relatively more land. In fact, we assume that cheese is always the more labor-intensive good, regardless of what the relative costs of land and labor happen to be in a country. Second, differences across countries in technology are no longer assumed, but the H–O model distinguishes countries by the availability of factors of production, that is, by their factor endowments. Although the United States has both more land and more labor than Denmark, it has relatively more land than labor. Ohlin concluded that the United States will have a comparative advantage in producing wheat, the good that requires relatively more land in production.

The factor proportions, or Heckscher–Ohlin theorem, imply that trade should occur primarily between pairs of countries with very different relative factor endowments. The theory is most successful in explaining trade between many industrialized and developing countries. It states that the industrialized countries import skilled labor and land-intensive tropical products from less developed countries (LDCs) and export skilled labor and temperate-climate land-intensive goods to them. A far larger volume of trade occurs not between industrialized and developing countries but among industrialized countries that often have similar relative factor endowments. The H–O theorem is far less applicable in explaining these trade flows because the factor content of what is traded turns out to be quite similar. One type of machinery may be imported and another type

exported, but both machines have similar capital and labor input requirements. Such trade is more difficult to relate to our familiar principles of comparative advantage and differences in opportunity costs of production. Even when two countries have the same factor endowments and use the same production technologies, there may still be a basis for gains from trade due to economies of scale in production. Specialization in production may allow a country to achieve lower costs per unit of output **(**Robert M. Dunn & John H. Mutti, 2004).

Michael Porter's theory of the competitive advantage of nations provides a sophisticated tool for analyzing competitiveness with all its implications. Porter's theory contributes to understanding the competitive advantage of nations in international trade and production. Its core, however, focuses upon individual industries, or clusters of industries, in which the principles of competitive advantage are applied. His theory begins with individual industries and builds up to the economy as a whole. Since firms, not nations, compete in international markets, understanding the way firms create and sustain competitive advantage is the key to explaining what role the nation plays in the process. Therefore, the essence of his argument is that "the home nation influences the ability of its firms to succeed in particular industries". Given this interdependence, it appears that in order to draw conclusions on the competitiveness of a particular industry, consideration of the different facets of the competitive diamond of the whole nation is needed. Michael Porter considers the competitiveness of a country as a function of four major determinants: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry.

Even though these determinants influence the existence of competitive advantage in an entire nation, their nature suggests that they are more specific to a particular industry than typical of a country. The reason for this is that in Porter's theory, the basic unit of analysis for understanding competition is the industry. "The industry is the arena in which the competitive advantage is won or lost." Therefore, seeking to isolate the competitive advantage of a nation means explaining the role played by national attributes such as a nation's economic environment, institutions, and policies for promoting firms' ability to compete in a particular industry (Porter, M., 1990).

The mercantilists maintained that the way for a nation to become rich and powerful was to export more than it imported. The resulting export surplus would then be settled by an inflow of bullion,

or precious metals, primarily gold and silver. The more gold and silver a nation had, the richer and more powerful it was. Thus, the government had to do all in its power to stimulate the nation's exports and discourage and restrict imports (particularly the import of luxury consumption goods). However, since all nations could not simultaneously have an export surplus and the amount of gold and silver was fixed at any particular point in time, one nation could only gain at the expense of other nations.

According to Adam Smith, trade between two nations is based on absolute advantage. When one nation is more efficient than (or has an absolute advantage over) another in the production of one commodity but is less efficient than (or has an absolute disadvantage with respect to) the other nation in producing a second commodity, both nations can gain by each specializing in the production of the commodity of its absolute advantage and exchanging part of its output with the other nation for the commodity of its absolute disadvantage. Through this process, resources are utilized in the most efficient way, and the output of both commodities will rise. This increase in the output of both commodities measures the gains from specialization in production that are available to be divided between the two nations through trade.

According to the law of comparative advantage, even if one nation is less efficient than (has an absolute disadvantage with respect to) the other nation in the production of both commodities, there is still a basis for mutually beneficial trade. The first nation should specialize in the production and export of the commodity in which its absolute disadvantage is smaller (this is the commodity of its comparative advantage) and import the commodity in which its absolute disadvantage is greater (this is the commodity of its comparative disadvantage) **(**Robert M. Dunn & John H. Mutti, 2004).

Empirical Literature Review

Although traditional trade theory emphasizes the international exchange of one set of goods for another (inter-industry trade) due to comparative advantage (dissimilar countries), much of international trade involves the two-way exchange of goods within industries (intra-industry trade) between developed nations (similar countries). This apparent disconnect between theory and data

was documented in a number of early empirical studies, which examined the extent of intra-industry trade (e.g., Grubel and Lloyd, 1975) and the volume of trade between similar countries (e.g., Linder, 1961). This empirical evidence was a key motivation for the new trade theory. There was literature following Krugman (1979) that explained these features of international trade in terms of consumer love of variety and increasing returns to scale. Firms manufacture differentiated products and concentrate production in a single location, while consumers spread their expenditures across all varieties, giving rise to two-way trade even if countries are identical. Although not the only explanation for intra-industry trade between similar countries (see Davis 1997), the combination of consumer love of variety and increasing returns to scale provided an entirely new intellectual framework for thinking about the causes and consequences of international trade.

In the HO model, the volume of trade is increasing as the extent of dissimilarity between countries increases. Factor endowments, whereas in the new trade theory the volume of trade is increasing due to the similarity of countries sizes. Indeed, new trade theory provides rigorous theoretical foundations for the so-called gravity equation, in which the volume of trade between two countries is proportional to the product of their sizes and measures of trade frictions. Although the gravity equation has been known for some time to provide an extremely successful empirical explanation for bilateral patterns of international trade (classic early treatments include Tinbergen (1962) and Linnemann (1966)), it initially suffered from a lack of theoretical foundations (Redding, 2008).

Khoso et al. (2011) investigated the welfare impact of SAFTA on the economy of Pakistan in general and South Asia in particular. This research analyzes the potential economic costs and benefits of Pak-India trade in exporting various consumer goods, and the simulation results presented and analyzed here demonstrate the importance of experimental designs and the usefulness of the global CGE modeling framework for examining the impacts of different types of trade policy reforms for Pakistan. Although the GTAP model cannot capture the dynamic effects of trade liberalization, it is a useful tool for generating comparative static results for a variety of trade reform scenarios. It also identifies the industries that will expand and those that will contract, as well as the size of these changes as a result of various trade liberalization scenarios. The results suggest that Pakistan would experience the highest welfare gain under the combined policy reform

of the SAFTA plus 15 percent uniform external tariffs, while the SAFTA on its own gives the second highest welfare gains. SAFTA allows the participating countries to achieve larger economies of scale in production, attain specialization, increase competitiveness, and diversify their export basket, thus assisting domestic economic reform. Therefore, harmonizing economic policies among neighboring countries must receive higher priority in the policy-making process.

Using a GTAP CGE model/database, this paper assesses the possible effects of a free trade agreement (FTA) between the MERCOSUR and the European Union (EU). The study takes into consideration the most important recent free trade agreements signed among the Latin American countries, as well as the latest European Union enlargements. With a 2004+ benchmark base scenario where tariffs were updated by the addition of information on trade agreements just signed by Latin American countries, two different policy simulations are addressed: (i) full liberalization and (ii) liberalization excluding sensitive products. The global CGE model allows for the analysis of direct and indirect socio-economic impacts on subscriber countries as well as on other countries in the region. From the point of view of the MERCOSUR countries, the results suggest that the FTA would be beneficial to foster their exports, especially in the case of light manufacturers. Imports to MERCOSUR from the EU would increase, particularly in heavy manufacturing sectors. In terms of GDP, the results remain positive in the case of all the MERCOSUR countries in all simulated scenarios. However, welfare implications are unevenly distributed in favor of all the MERCOSUR countries in the simulated scenarios. The inclusion of sensitive products in the agreements seems to reduce the magnitude of the results but does not change the direction of the impacts. In any case, active public policies to mitigate the negative effects on sectors, enhance positive impacts, and seize dynamic opportunities towards sustainable development must be undertaken. The main conclusion points out a potential complementary trade relationship between these two regions (Boyer and Schuschny, 2010).

Almost ten years after Marrakech's agreements, and as Doha's Ministerial Conference launched a new round of multilateral negotiations, the stakes of trade policies are still very complex. Numerous new preferential agreements are in the works, while the perspectives of multilateral liberalization remain unclear. In this context, delivering a rigorous and detailed quantitative analysis of a large scope of trade agreements is most useful, both for policymakers and for the

public debate. This is the reason why the CEPII has decided to develop and maintain, in collaboration with the ITC (International Trade Centre, UNCTAD, WTO, Geneva), a multi-sector, multi-region, computable general equilibrium (CGE) model, nicknamed MIRAGE, devoted to trade policy analysis. Trade agreements can involve substantial changes in prices, in the allocation of resources, and in income that are frequently strongly contrasted across sectors and countries. Based on a robust and widely accepted model of agents' behavior, CGE models are able to provide a detailed description of the impact of such shocks on the economy. A number of robust and well-identified mechanisms are quantified in a single, rigorous, and consistent framework. Such an analysis makes it possible to put forward the main mechanisms and to give their sign and their order of magnitude.

During the last two decades, an extensive literature has been devoted to applying CGE modeling to the study of trade policies (see CEPII, 2000, for a survey). Compared to the pure Walrasian tradition models, several major improvements have been achieved, in particular thanks to the studies about the expected impact of the European Single Market, NAFTA, and the Uruguay Round. Since Harris (1984), imperfect competition and horizontal product differentiation are commonly incorporated, notably based on the formalizations proposed by Smith and Venables (1988) and by Harrison et al. (1997). Numerous studies, particularly after Baldwin (1989), have gone beyond the static framework in order to describe adjustment periods and the corresponding dynamic effects. Lastly, the nineties witnessed the increasing spread of the GTAP database (Global Trade Analysis Project, Purdue University), which marked the sharing of the heavy data work required for this kind of models, making their access far easier (Bchir et al., 2002).

Brazil remains a fairly closed economy with small trade flows relative to its share of world income. This paper explores the effects of three possible policy reforms to strengthen Brazil's integration into global trade: a reduction in import tariffs, fewer local content requirements, and a full zero-rating of exports in indirect taxes. A simulation analysis using the OECD Multi-Region Trade CGE model suggests that current policies are holding back exports, production, and investment in Brazil. The model simulations suggest significant scope for trade policy reforms to strengthen industrial development and export competitiveness. Results also show that the expansion of investment and production would be accompanied by significant employment gains. Moreover,

employment growth is higher for low-skilled occupations, implying that a major trade and tax policy reform aiming at liberalizing trade flows would particularly help those at the lower end of the income distribution (Araújo, S., & Flaig, D. 2016).

Research Methods

The social accounting matrix (SAM) is a comprehensive, disaggregated, consistent, and complete data system that captures the interdependence that exists within a socioeconomic system. Alternatively, the SAM can be used as a conceptual framework to explore the impact of exogenous changes in such variables as exports, certain categories of government expenditures, and investment on the whole interdependent socioeconomic system, e.g., the resulting structure of production, factorial, and household income distributions. As such, the SAM becomes the basis for simple multiplier analysis and the building and calibration of a variety of applied general equilibrium models. The chosen taxonomy and the level of disaggregation depend critically on the questions that the SAM methodologies are expected to answer. If the SAM is to be used to explore issues related to income distribution, then the household account is to be broken down into a number of relatively homogeneous household groups reflecting the socioeconomic characteristics of the country or region under consideration. On the other hand, if the purpose of the SAM is to analyze inter-sectoral linkages, then a relatively detailed sectoral disaggregation of production activities using such criteria as characteristics of the good or service produced and type of technology employed in production is called for (Erik Thorbeck, 2000).

SAM Construction Procedure

Since Ethiopia and Sudan share the longest border, it could be possible to consider them as single countries given that they adopt the same economic policy and allow mobility of labor, goods, and services. This could be achieved in the long run. This therefore enables us to construct a single SAM from the 2011 SAMs of Ethiopia and Sudan. The construction of the grand SAM in 2011 involved merging and splitting the accounts of the SAM of individual countries. This again requires adjustments to be made on different accounts.

The first adjustment will occur on the activity-commodity accounts whose amendment itself calls for an adjustment on the commodity-row sub matrix. In the usual country-specific SAM, activities

pay for commodities, which are composed of imported and domestically produced goods. However, in this grand SAM, all commodities of the two economies shall be considered domestically produced ones, so that the flow of income from commodities to the rest of the world account has been splintered. Hence, each commodity account of Ethiopia and Sudan has paid for domestic activities in their own economies as well as those of the other country. Consequently, the rest of the world account has been reduced by the same amount as the payment made to the activity account of the other country.

The other major amendment will be made to the way remittances are going to be accounted for in the regional SAM. This is because the two countries are so small that there is a very small amount of transfer from one government to the other. But, since two countries are neighbors, there is a high flow of remittances from one economy to the other. For instance, Sudan is one of the countries from which Ethiopia earns its remittance. Therefore, the remittance account shall be split into intra-household transfers between Ethiopian and Sudanese. Such adjustment at the end of the day enables us to produce the grand SAM of 2011 of two economies. Indeed, we are going to have a single government account, and uniform tax accounts will be created. For such an end, the tax structures of the two economies shall be adjusted in a bid to have a similar tax type.

Stage CGE model

The Stage CGE model is characterized by several distinctive features. First, the model allows for a generalized treatment of trade relationships by incorporating provisions for non-traded exports and imports, i.e., commodities that are imported and domestically produced; non-competitive imports, i.e., commodities that are imported but not domestically produced; commodities that are exported and consumed domestically; and commodities that are exported but not consumed domestically. Second, the model allows the relaxation of the small country assumption for exported commodities that do not face perfectly elastic demand on the world market. Third, the model allows for the simple modeling of multiple product activities through the assumption of fixed proportions of commodity outputs by activities, with commodities differentiated by the activities that produce them. Hence, the numbers of commodity and activity accounts are not necessarily the same. Fourth, (value-added) production technologies can be specified as expenditures, which are represented by Stone-Geary utility functions. The model is designed for

calibration using a reduced form of a SAM that broadly conforms to the UN System of National Accounts (SNA).

The Stage CGE model is a member of the class of single-country CGE models that are descendants of the approach to CGE modeling. The model is a SAM-based CGE model, wherein the SAM serves to identify the agents in the economy and provides the database with which the model is calibrated. As the model is SAM-based, it contains the important assumption of the law of one price, i.e., prices are common across the rows of the SAM. The behavioral relationships in this model are a mix of non-linear and linear relationships that govern how the model's agents will respond to exogenously determined changes in the model's parameters or variables. Table 3.5 summarizes these behavioral relationships with reference to the submatrices of the SAM.

Households are assumed to choose the bundles of commodities they consume so as to maximize utility using Stone-Geary. For a developing country, a Stone-Geary function may be generally preferable since it allows for subsistence consumption expenditures, which is an arguably realistic assumption when there are substantial numbers of very poor consumers. The households choose their consumption bundles from a set of 'composite' commodities that are aggregates of domestically produced and imported commodities. These 'composite' commodities are formed as Constant Elasticity of Substitution (CES) aggregates that embody the presumption that domestically produced and imported commodities are imperfect substitutes. Taking the first order condition of the Lagrangian maximization problem yields the optimal ratios of imported and domestic commodities, which are determined by the relative prices of the imported and domestic commodities. This is the so-called Armington effect (Armington, 1969), which allows for product differentiation via the assumption of imperfect substitution (see Devarajan et al., 1994). The assumption has the advantage of rendering the model practical by avoiding the extreme specialization and price fluctuations associated with other trade assumptions, e.g., the Salter/Swan or Australian models. In this model, the country is assumed to be a price taker for all imported commodities.

Domestic production has a two-stage production process. In the first stage, aggregate-intermediate and aggregate value added (primary inputs) are combined using CES or Leontief technologies. At

the top level, aggregate intermediate inputs are combined with aggregate primary inputs to produce the outputs of activities. If a CES specification is chosen, then the proportions of aggregate intermediates and aggregate primary inputs vary with the composite prices of the aggregates, and if a Leontief specification is chosen, then aggregate intermediates and aggregate primary inputs are in fixed proportions. At the second level, aggregate intermediate inputs are generated using Leontief technology such that intermediate input demands are in fixed proportions relative to the aggregate intermediate inputs of each activity. At the second level, primary inputs are combined to form aggregate value added using CES technologies, with the optimal ratios of primary inputs being determined by relative factor prices.

Though the activities are coming from a single source in Ethiopian and Sudan SAM, the model has a specification that allows capturing activities that come from different sources. The activities are defined as multi-product activities with the assumption that the proportionate combinations of commodity outputs produced by each activity or industry remain constant. As a result of this, for any given vector of commodities demanded, there is a unique vector of activity outputs that must be produced. The vector of commodities demanded is determined by the domestic demand for domestically produced commodities and the export demand for domestically produced commodities. Using the assumption of imperfect transformation between domestic demand and export demand in the form of a constant elasticity of transformation (CET) function, the optimal distribution of domestically produced commodities between the domestic and export markets is determined by the relative prices on the alternative markets. The model can be specified as a small country, i.e., a price taker, on all export markets, or selected export commodities can be deemed to face downward-sloping export demand functions, i.e., a large country assumption.

The other behavioral relationships in the model are generally linear. All the tax rates are considered variables with various adjustments and/or scaling factors that are declared as variables or parameters according to how the user wishes to vary tax rates. Relative tax rates can also be adjusted by the settings chosen by the user. Similar adjustment and/or scaling factors are available for a number of key parameters, e.g., household and enterprise savings rates and inter-institutional transfers. Second, technology changes can be captured through changes in the activity-specific efficiency variables, adjustments, and/or scaling factors. Third, the proportions of current

expenditure on commodities defined to constitute subsistence consumption can be varied. Fourth, although a substantial proportion of the submatrices relating to transfers, especially with the rest of the world, contain zero entries, the model allows changes in such transfers. For instance, aid transfers to the government from the rest of the world may be defined as equal to zero in the database, but they can be made positive or even negative for model simulations.

Results and Discussion

This section contains the main results of the simulation when the factor productivity of agriculture increases by 0.9% in Ethiopia and decreases by 0.9% in Sudan, and when the factor productivity increases by 0.9% in Sudan and decreases by 0.9% in Ethiopia. The first part shows the macro effects of investment, import, export, GDP, and supply, while the latter sections reveal the micro effects of the simulation.

Table 1

Simulation Result on Macro Level (%)

Variables	Simu-1	Simu-2
Investment	0.36	-0.41
Import	0.64	-0.63
Export	0.35	0.003
Gross Domestic Product	0.42	-0.42
Supply	0.39	-0.38

Source: Authors' computations

It has been learned that Ethiopia and Sudan have general trade deficits of USD 4.1 and USD 4.3 million, respectively. The total export earnings and import payments of Ethiopia are USD 4.9 billion and USD 9 billion, respectively, from agriculture products (cereals), services, and industry products, and the only sector that has a positive trade surplus is the agricultural sector. The same story goes to Sudan, where the country earned total export earnings of USD 7.83 million and expended USD 12.13 million on imports. In Ethiopia, the agricultural sector is the only one that has a positive trade surplus.

The results of the simulation from the free trade agreement between Ethiopia and Sudan show that a 0.9% positive increment on the total factor productivity of the agricultural sector in Ethiopia and a 0.9% reduction of the total factor productivity of the agricultural sector in Sudan have positive marginal effects. In terms of magnitude, investment increased by 0.36%, GDP increased by 0.42%, supply increased by 0.39%, and Ethiopian import and export transactions increased by 0.64% and 0.35%, respectively. On the other hand, in Sudan, the marginal effects lead to a 0.41% decline in investment, a 0.42% decline in GDP, a 0.38% decline in supply, a 0.63% decline in import transactions, and an increase in export transactions of 0.03%.

Table 2

Simulation Result on Domestic Production of Cereals and Industry Products (%)

	Simu-1	Simu-2
Commodity Cereal in Ethiopia	0.82	-0.82
Commodity Cereal in Sudan	-0.52	0.46
Commodity Cloth in Ethiopia	-39.77	128.94
Commodity Textile in Sudan	-37.99	84.30
Commodity Textile in Ethiopia	0.02	1.29

Source: Authors' computations

Ethiopia uses labor-intensive technology for the production of cereals and services and uses relatively capital-intensive technology for the production of industrial products, while in Sudan all cereal (agriculture product), service, and industrial products use relatively capital-intensive technology.

When there is a 0.9% positive shock (increment) in the factor productivity of agriculture in Ethiopia and a 0.9% reduction in the factor productivity of agriculture in Sudan, the production of agriculture (cereals) increases by 0.82% in Ethiopia. Following factor productivity of agriculture increment in Ethiopia, reduction in Sudan by 0.9%, and existence of free mobility of labor between

both nations, a number of workers migrate from Sudan to Ethiopia and/or shift labor from agriculture to the industry sector in Sudan. This results in a 0.82% decrease in agricultural product production (cereals) in Sudan, and thus migration and labor shifts have a significant impact on the 0.82% decrease in cereal production in Sudan. The same is true when there is a 0.9 percent positive increment in factor productivity of agriculture in Sudan and a 0.9 percent reduction in factor productivity of agricultural production in Ethiopia, which leads to an increase in the production of agriculture products (cereals) in Sudan while decreasing in Ethiopia by 0.52%, due to labor migration from Ethiopia to Sudan to get higher wage payments.

The net effect of efficiency or increment of factor productivity in agriculture is relatively higher in Sudan than Ethiopia. Because the wage or salary scale in Sudan to pay for labor is higher than in Ethiopia, which leads to a greater number of laborers migrating from Ethiopia to Sudan, and hence the reduction of agriculture production in Ethiopia is higher than the increment of agriculture production in Sudan. Thus, the marginal effect of a positive shock or increment on factor productivity in agriculture is higher in Sudan than Ethiopia.

When we increase and decrease factor productivity of agriculture by 0.9% in Ethiopia and Sudan, respectively, the manpower shifts from industry to the productive agriculture sector in Ethiopia. And then the production of clothes in Ethiopia decreased by 39.77% while that in Sudan increased by 128.94%. This is because efficiency in Ethiopia in the production of agricultural products leads to a shift of labor from the agriculture sector in Sudan to the industrial sector because Sudan has a relatively better wage rate in the industrial sector than the efficient agriculture sector wage rate in Ethiopia.

When we impose policy change (simulation) by increasing the factor productivity of agriculture in Ethiopia, the marginal effect on the economy will be that the production of Ethiopian textiles will increase only by 0.02% from existing production in Ethiopia and by 1.29% from existing production in Sudan. This came from the fact that labor shifted from the industry sector to the agriculture sector in Ethiopia and from the agriculture sector to the industry sector in Sudan. When there is policy change (simulation) by increasing the factor productivity of agriculture in Sudan, there is a higher number of workers migrating from Ethiopia to Sudan to work in the agriculture

sector. Because of a higher salary scale and abundant human power, the salary came to decline until it reached equilibrium, and due to some labor offloading and shifting to another industry sector in Sudan, the production of textiles increased by 84.30%.

Table 3

Simulation Result on Purchase Price of Composite Commodity and Industry Products (%)

Variables	Simu-1	Simu-2
Commodity Cereal in Ethiopia	-0.46	0.46
Commodity Cereal in Sudan	1.14	-1.09
Commodity Textile in Ethiopia	0.03	-0.03
Commodity Textile in Sudan	0.03	-0.04
Commodity Cloth in Ethiopia	0.20	-0.20

Source: Authors' computations

As shown in Table 3, when there is a 0.9% positive shock (increment) in the factor productivity of agriculture in Ethiopia and a 0.9% reduction in the factor productivity of agriculture in Sudan, this leads to an increase in agriculture production (cereals) in Ethiopia. Then, the supply of the product increased, and then the price of the product decreased by 0.46% in Ethiopia. Accordingly, labor shifts from the industrial sector to the agriculture sector in Ethiopia, which leads the production of industrial products in Ethiopia to decrease and the supply of textiles and cloth to decrease. Hence, the price of cloth and textiles in Ethiopia increased by 0.03% and 0.20%, respectively, while in Sudan the production of agriculture (cereals) decreased. This is due to labor shifts from the agriculture sector to the industrial sector in Sudan, which has led to a decrease in the supply of agricultural products and an increase in the supply of textiles and cloth. Hence, the price of agricultural products increased by 0.46%, while the price of textiles and cloth decreased by 0.03% and 0.20%, respectively.

If there is a 0.9% positive shock (increment) in the factor productivity of agriculture in Sudan and a 0.9% reduction in the factor productivity of agriculture in Ethiopia, the production of agricultural and industrial products will increase. This implies that the supply of agriculture products and textiles in Sudan increases, resulting in the price of agriculture products (cereals) and textiles decreasing by 1.09% and 0.04%, respectively. On the other hand, in Ethiopia, it causes the

production of cereals, textiles, and cloth to decrease, resulting in a shortage of supply in agricultural and industrial products. This caused the price of cereals and textiles to increase by 1.14% and 0.03%, respectively, in Ethiopia. The net effect of efficiency increases in both nations on the price of the product is higher in Sudan than Ethiopia, which means that the price of cereal (agriculture) products is more sensitive in Sudan than Ethiopia when the efficiency of agriculture increases in Sudan and decreases in Ethiopia by 0.9% each.

Table 4

Simulation Result on Income to Factor of Production

Factor of production	Simu-1	Simu-2
Labor Ethiopia	0.58	-0.59
Labor Sudan	0.26	-0.25
Capital Ethiopia	0.65	-0.63
Capital Sudan	0.14	-0.10
Land Ethiopia	0.24	-0.25
Land Sudan	0.26	-0.25

Source: Authors' computations

Ethiopia and Sudan generated income from labor payment, capital payment, government social transfer, and rest of the world foreign transfer, of which payment for labor and foreign transfer from ROW cover a high share of the total income of urban and rural households in Ethiopia. And even Sudan, which uses relatively capital-intensive technology, labor payments, and social transfers from the government, covers a relatively high share of household income. As we can see from the SAM characterization, Ethiopia uses labor-intensive technology for the production of cereals and services, while Sudan uses capital-intensive technology for the production of cereals, services, and industry products, relative to Ethiopia.

As shown in Table 4, when there is a 0.9% positive shock in Ethiopia and a 0.9% reduction in Sudan, the production of agriculture in Ethiopia increases and more factors of production are demanded. This results in the income of labor, capital, and land increasing by 0.58%, 0.65%, and 0.24%, respectively. In Sudan, the income from labor, capital, and land decreases by 0.59%,

0.63%, and 0.25%, respectively. This is because, as factor productivity in agriculture increased by 0.9% in Ethiopia and decreased by 0.9% in Sudan, the factor of production in the agriculture sector in Sudan offloaded and shifted to industrial products, which led to an excess of factor of production in the industrial sector of Sudan and a decrease in the factor of production payment.

When there is a 0.9% positive shock in Sudan and a reduction in Ethiopia, the production in Sudan increases and more factors of production are demanded. However, the income from labor, capital, and land still decreases by 0.25%, 0.10%, and 0.25%, respectively. Because Sudan has a higher wage scale for labor than Ethiopia, a large portion of the labor force migrates from Ethiopia to Sudan. The factor income of Ethiopia increases by 0.26%, 0.14%, and 0.26% for labor, capital, and land, respectively.

Table 5

Simulation Result on Income of Household

Household	Simu-1	Simu-2
Household Urban Ethiopia	0.50	-0.49
Household Urban Sudan	0.37	-0.35
Household Rural Ethiopia	0.49	-0.49
Household Rural Sudan	0.30	-0.28

Source: Authors' own computations

Households in rural Ethiopia received 94%, 0.56%, 0%, and 5.7% of their total income from labor payment, capital payment, government social transfer, and rest of the world foreign transfer, respectively. This implies that the major share of household rural income, about 94%, is generated from labor payments, and household urban in Ethiopia also received 97.7%, 1.87%, 1.06%, and 0% of their total income from the rest of the world through foreign transfer, capital, labor, and government, and implies that household rural received the major share of their income from the rest of the world and capital. While in Sudan, 47.82%, 11.21%, 28.66%, and 12.31% of the total income of urban households and 81.88%, 12.42%, 4.80%, and 0.9% of total household rural income were received from labor, government, capital, and the rest of the world, respectively.

As shown in Table 5, following 0.9% efficiency in Ethiopia, the production increased and the economy demanded more labor and capital, which led the income of urban and rural households to increase by 0.5% and 0.49%, respectively, while in Sudan it decreased by 0.49% each. This is due to the fact that agricultural productivity increased by 0.9% in Ethiopia and decreased by 0.9% in Sudan. The labor force in the agriculture sector in Sudan offloads and shifts to the industrial sector of Sudan, which leads to an excess amount of factor of production in industrial products in Sudan and results in the payment for factor of production decreasing and hence the income of households decreasing simultaneously.

Besides, when factor productivity in agriculture increases by 0.9% in Sudan and decreases by 0.9% in Ethiopia, the production of the product obviously increases, but the income of households in urban and rural Sudan decreases by 0.35% and 0.28%, respectively, while in Ethiopia it increases by 0.37% and 0.30%. Because Sudan has a higher wage scale for labor than Ethiopia, the labor force migrates from Ethiopia to Sudan in large numbers, increasing Ethiopia's factor income and, as a result, the income of Ethiopian households increase by 0.26%, 0.14%, and 0.26% for labor, capital, and land respectively, until the wage rate is at equilibrium due to abundant labor force that came from Ethiopia, the wage decreases from normal scale in Sudan, and then offloads labor force to the industrial sector. This results in a decline in income for both agriculture and the industrial sector in Sudan.

Table 6

Simulation Result on Price of Factor of Production

Factor of production	Simu-1	Simu-2
Land Ethiopia	0.24	-0.25
Land Sudan	0.70	-0.74
Labor Ethiopia	0.58	-0.59
Labor Sudan	0.26	-0.25
Capital Ethiopia	0.65	-0.63
Capital Sudan	0.14	-0.10

Source: Authors' Computations

As shown in Table 4.6, when there is a 0.9% increase in factor productivity of agriculture in Ethiopia and a decrease in Sudan, this leads to an increase in the production of agriculture products in Ethiopia and a higher factor of production demand in Ethiopia. Hence, the price of land, labor, and capital increased by 0.24%, 0.58%, and 0.65%, respectively, while in Sudan they decreased by 0.25%, 0.59%, and 0.63%, respectively. This is due to the fact that increased efficiency in Ethiopia and decreased efficiency in Sudan cause the factor of production to shift from the agriculture sector to the non-agriculture sector in Sudan, where excess quantities of the factor of production are available, resulting in a decrease in the price of the factor of production in Sudan. When there is a 0.9% increment on the factor of productivity of agriculture in Sudan and a decrease in Ethiopia, the production of agriculture in Sudan obviously increases, and more factor of production is demanded. However, since there is free labor mobility and a high salary scale in Sudan, more workers migrate from Ethiopia to Sudan. As a result, there is an excess of labor available in Sudan's agriculture sector, and labor prices fall, resulting in a number of labor shifts from the agriculture sector to Sudan's industrial sector. This in turn results in the price of factors of production in Sudan, i.e., land, capital, and labor, decreasing by 0.74%, 0.25%, and 0.10%, respectively, while in Ethiopia they increased by 0.70%, 0.26%, and 0.14%, respectively.

Conclusion and Implications

This study is conducted with the objective of examining the impact of agriculture free trade between Ethiopia and Sudan in light of the economic benefit of the bilateral trade. From the simulation results presented in the previous section, we obtained strong evidence that free trade between Ethiopia and Sudan does not secure the economic benefit of both nations. Hence, our study focused on free trade agreements based on their product characteristics, specifically agricultural products. The simulation of agricultural product specialization (Cereal products in our SAM) in Ethiopia produced positive results. Ethiopia uses labor-intensive technology for both the production of agricultural products and service activities and capital-intensive technology, relatively, for industrial products. Sudan uses relatively capital-intensive technology for the production of agricultural products, services, and industry products.

Our results demonstrate that the existence of agricultural free trade between Ethiopia and Sudan and a 0.9% positive shock in Ethiopia lead to an increase in cereal production of 0.82% in Ethiopia and a decrease of 0.82 in Sudan. Furthermore, there is a 0.9% positive shock in Sudan, with cereal production increasing by 0.46 but decreasing by 0.52 in Ethiopia. Hence, the net effect of the shock on cereal production is relatively higher in Sudan than Ethiopia. The shock in Ethiopia has a marginal effect on the price of cereal production in Ethiopia and Sudan, decreasing and increasing by 0.46% each, and the shock in Sudan has also had a marginal effect on the price of cereal products in Ethiopia and Sudan, increasing and decreasing by 1.14% and 1.04%, respectively. This implies that the net effect of simulation on price is relatively higher in Sudan than Ethiopia. However, regardless of whether Ethiopia's efficiency increases or decreases, Sudan produces more textiles and cloth than Ethiopia.

Given the above empirical results, the conclusion is that Ethiopia and Sudan free trade agreement has contributed to the growth in the bilateral trade (export), by specialization of cereal/agricultural products in Ethiopia over Sudan and industry products in Sudan over Ethiopia. This ascertained both trade partners benefited for agricultural free trade if and only if the efficiency increase in Ethiopia on production of Cereals from such trade Ethiopia is more benefited than Sudan. Both nations also can benefit for industrial free trade if and only if the efficiency increase in Sudan on production of industrial products and from such trade Sudan is more benefited than Ethiopia.

The following implications seem relevant to the findings of this study: The empirical results show that agricultural free trade between these countries fosters trade (export) and secures the economic benefit of both Ethiopia and Sudan if and only if Ethiopia focuses on the production of agricultural products and reduces the production of industrial products, while Sudan should reduce agricultural production and focus on industrial products rather than Ethiopia. Sudan increased its imports of agricultural products from Ethiopia by reducing imports from the rest of the world, and Ethiopia increased its imports of industrial products from Sudan and reduced imports from the rest of the world. Therefore, Ethiopia should negotiate a new agricultural free trade agreement with Sudan to increase trade (export) flows. Ethiopia should be cautious in its agricultural sector while formulating agricultural policies. Besides, Ethiopia and Sudan should formulate agricultural

policies together to mitigate the negative impacts of unilateral agricultural policies on member countries.

References

Abebe Eshetu. (2012). Bilateral Trade Between Ethiopia and Sudan: Does FTA Make Them Better? A thesis for partial fulfilment of Degree of masters Arts in Addis Ababa, Ethiopia.

Araújo, S., & Flaig, D. (2016). Quantifying the effects of trade liberalisation in Brazil: a Computable General Equilibrium Model (CGE) simulation.

Armington, Paul S., 1969. "A Theory of Demand for Products Distinguished by Place of Production" IMF Staff Papers, v16, n1, pp. 159-176.

Baldwin, R. (1989). The growth effects of 1992. *Economic policy*, *4*(9), 247-281.Barker. (1977, P. 177). – International Trade and Theory,Bakers vartity Hypothesis on income effect.

Bchir, M. H., Decreux, Y., Guérin, J. L., & Jean, S. (2002). Key Assumptions in AGE Trade Models: An Assessment using the Mirage Model.

Boyer, I., & Schuschny, A. R. (2010). *Quantitative assessment of a free trade agreement between MERCOSUR and the European Union*. ECLAC.

Davis, D. R. (1997). Critical evidence on comparative advantage? North-North trade in a multilateral world. *Journal of Political Economy*, *105*(5), 1051-1060.

Devarajan, P., Scaramuzzino, D. A., & Morrow, J. S. (1994). Ankyrin binds to two distinct cytoplasmic domains of Na, K-ATPase alpha subunit. *Proceedings of the National Academy of Sciences*, *91*(8), 2965-2969.

Dollar and Kray. (2002). "Growth is Good for the Poor"J. of Economic Growth 7(3): 195-225.

Ebaidalla Mahjoub Ebaidalla. (2016). Trade Between Egypt, Sudan and Ethiopia: - Prospect and challenges For Trilateral, Trade Integration, working paper 1057.

ErikThorbecke H. E.Babcock Professor of Economics and Food Economics,Cornell University. (27 August to 2 September 2000). the use of SAM in modeling. Paper Prepared for the 26th General Conference of The International Association for Research in Income and Wealth Cracow. Poland.

Fearon, J. D. (1995). Rationalist explanations for war. *International organization*, *49*(3), 379-414.

Gartzke, E. (1999). War is in the Error Term. *International Organization*, *53*(3), 567-587.

Grossman, G. and Helpman. E . (1991). "Quality Ladders in the Theory of EconomicGrowth,"Review of Economic Studies, 58, pp. 43-61.

Grubel, H. G., & Lloyd, P. J. (1975). *Intra-industry trade: the theory and measurement of international trade in differentiated products* (Vol. 12). London: Macmillan.

Harris, R. (1984). Applied general equilibrium analysis of small open economies with scale economies and imperfect competition. *The American Economic Review*, *74*(5), 1016-1032.

Harrison, G. W., Rutherford, T. F., & Tarr, D. G. (1997). Quantifying the Uruguay round. *The Economic Journal*, *107*(444), 1405-1430.

Khoso, I., Ram, N., Shah, A. A., Shafiq, K., & Shaikh, F. M. (2011). Analysis of welfare effects of South Asia Free Trade Agreement (SAFTA) on Pakistan's economy by using CGE model. *Asian Social Science*, *7*(1), 92-101.

Krugman, P. (1979). A model of balance-of-payments crises. *Journal of money, credit and banking*, *11*(3), 311-325.

Linder, S. B. (1961). *An essay on trade and transformation* (pp. 82-109). Stockholm: Almqvist & Wiksell.

Linnemann, H. (1966). *An econometric study of international trade flows* (No. 42). Amsterdam, North-Holland.

McDonald, S., Robinson, S., & Thierfelder, K. (2008). Asian growth and trade poles: India, China, and East and Southeast Asia. *World Development*, *36*(2), 210-234.

Porter, M. (1990). - The Competitive Advantage of Nations, The Free Press, A Division of McMillan, Inc. , New York.

Redding, S. (2008). Empirical approaches to international trade. *New Palgrave Dictionary of Economics. Palgrave Macmillan, Basingstoke.*

Robert M. Dunn & John H. Mutti. (2004). - Patterns of trade and the gains from trade,Insights from classical theory.Page.17. New York: by Routledge.

Robert M. Dunn & John H. Mutti. (2004). Inernational Economics (6th edition):Factor proportions as a determinant of trade, page 52.

Sala-i-Martin, X. X., & Barro, R. J. (1995). *Technological diffusion, convergence, and growth* (No. 735). Center discussion paper.

Smith, A., & Venables, A. J. (1988). Completing the internal market in the European Community: Some industry simulations. *European economic review*, *32*(7), 1501-1525.

Tinbergen, J. (1962). Shaping the world economy; suggestions for an international economic policy.

Winters, L. A., McCulloch, N., & McKay, A. (2004). Trade liberalization and poverty: the evidence so far. *Journal of economic literature*, *42*(1), 72-115.