Comparative Assessment of the Potential Impact of African Continental Free Trade Area (AfCFTA) and World Trade Organization (WTO) Accession on the Ethiopian Economy

A Dissertation

Submitted to the National Graduate Institute for Policy Studies (GRIPS)

in Partial Fulfillment of the Requirements for the Degree of

Ph.D. in International Development Studies

by

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March, 2024

Abstract

The global economy's reliance on free trade has grown significantly, offering improved market access to many countries. Consequently, free trade agreements (FTAs) are proliferating worldwide. However, empirical studies on the economic impact of FTA accession remain contentious. Ethiopia signed the African Continental FTA (AfCFTA) in 2018 and is in ongoing negotiations to join the World Trade Organization (WTO). This dissertation assesses the potential impact of these free trade agreement accessions on trade, output, and welfare using simple trade indicators and a structural computable general equilibrium (CGE) model. We used trade indicators for our first study. The findings from these indicators reveal that fuel oil, light manufacturing, plastic, tobacco and beverage, and energy and extraction would face significant challenges. For our second study, we developed a world trade CGE model. The results of our policy experiments with scenarios involving mutual and unilateral reductions of tariff and non-tariff measures indicate that AfCFTA and WTO accession would positively affect Ethiopia's welfare. At the same time, these trade deals would bring contrasting consequences in trade. On the one hand, AfCFTA membership would significantly increase Ethiopian imports from AfCFTA regions while decreasing imports from non-AfCFTA regions. Conversely, it would boost Ethiopian exports to Southern Africa while showing minimal change to other AfCFTA and non-AfCFTA regions. By contrast, WTO membership would significantly increase Ethiopia’s imports from Asia and North Africa and decrease those from Europe, the rest of the world, and East Africa. It would increase exports to all regions, especially Europe, Asia, and the rest of the world. In terms of industrial output, while these two trade deals would largely favor agriculture, transport, and the meat and livestock sector and harm manufacturing sectors (especially the light manufacturing sector), the impact of WTO accession on the Ethiopian economy would be overwhelmingly larger than that of AfCFTA.

Comparing the predictions given by the trade indicators and the CGE model, we found similarities in predicting weak and strong sectors. The agriculture, meat and livestock, transport, and cereal sectors were identified as competitive and would expand under free trade by trade indicators and the CGE model. By contrast, the light manufacturing sector is identified as weak and predicted to face significant challenges under free trade. Given the winner and loser sectors from these agreements, the Ethiopian government should take measures that facilitate resource mobilization from the losing sectors to the emerging sectors.

Acknowledgment

Foremost, I express my profound gratitude to my supervisor, Professor Nobuhiro Hosoe, for his unwavering patience, profound knowledge, and scholarly guidance during my Ph.D. program. I consider myself truly fortunate to have him as my supervisor, benefiting immensely from his generous mentorship and the invaluable wisdom he has shared, for which I am eternally grateful. I would also like to express my gratitude to Professor Kenichi Kawasaki for his invaluable comments to improve the study. I also wish to express my gratitude to my Ph.D. dissertation committee members: Professor Ken Itakura, Professor Kazushi Takahashi, and Professor Chikako Yamauchi. Their valuable comments and suggestions have significantly enriched my dissertation. I am indebted to the National Graduate Institute for Policy Studies (GRIPS) for enabling me to realize my lifelong dream and the Government of Japan for its financial support through the MEXT scholarship. I also appreciate the professors at GRIPS for sharing their expertise and fostering stimulating intellectual discussions during my coursework. Equally, I am grateful to my classmates for their constant encouragement throughout my studies at GRIPS. Lastly, I would like to express my heartfelt love and gratitude to my family for their unwavering moral support during my Ph.D. journey.

DEDICATION

To my late mother

Asemach Asmare

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Acronyms and Abbreviations

AfCFTA	African Continental Free Trade Area
AMU	Arab Maghreb Union
ARCA	Additive Revealed Comparative Advantage
ASEAN	Association of Southeast Asian Nations
ATPSM	Agricultural Trade Policy Simulation Model
BRCA	Balassa Revealed Comparative Advantage
CES	Constant Elasticity of Substitution
CET	Constant Elasticity of Transformation
CGE	Computable General Equilibrium
COMESA	Common Market for Eastern and Southern Africa
DSGE	Dynamic Stochastic General Equilibrium
EAC	East African Community
ECCAS	Economic Community for Central African States
ECOWAS	Economic Community of Western African States
ERP	Effective Rate of Protection
EU	European Union
FTAs	Free Trade Areas
GSIM	Global Simulation Analysis of Industry-Level
GTAP	Global Trade Analysis Project
MERCOSUR	Southern America Free Trade Area
MoFED	Ministry of Finance and Economic Development of Ethiopia
NAFTA	North American Free Trade Agreement
Non-AfCFTA	Non-African Continental Free Trade Area Countries

NRP	Nominal Rate of Protection
NTMs	Non-tariff Measures
OAU	Organization of African Unity
RCA	Revealed Comparative Advantage
RTAs	Regional Free Trade Agreements
ROW	Rest of the World
SADC	Southern African Development Community
SAM	Social Accounting Matrix
SMART	Software for Market Analysis and Restrictions on Trade
SRCA	Symmetric Revealed Comparative Advantage
TBI	Trade balance Index
TPP	Trans-Pacific Partnership
TRIST	Tariff Reform Impact Simulation Tool
UNCTAD	United Nations Conference on Trade and Development
UNECA	United Nations Economic Commission for Africa
USD	US Dollar
USITC	United States International Trade Commission
WAEMU	West African Economic and Monetary Union
WTO	World Trade Organization
WWII	Second World War

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Chapter 1: Introduction

1.1. Background of the Study

For many years, international trade has played a pivotal role in the global economy acting as a fundamental pillar for economic growth and development across numerous countries. This profound influence has spurred the development of various multilateral and regional free trade agreements. Following the end of the Second World War (WW II), the General Agreement on Tariff and Trade (GATT) was formed to promote world trade at the global level. Since its establishment, several rounds of negotiations have been conducted to reduce trade barriers, resulting in a significant reduction. Despite its achievement, GATT had faced various setbacks, especially in negotiations to reduce tariffs on highly protected industries, such as agriculture. In addition, its scope was limited only to goods trade and lacked mechanisms to effectively resolve trade disputes among countries. Consequently, in 1995, following the conclusion of the Uruguay Round, the World Trade Organization (WTO) was established succeeding the GATT. Currently, the WTO is the largest group among all free trade agreements, consisting of 164 members and 25 observers, accounting for 98% of global trade (WTO, 2021).

Despite WTO's expansive reach, countries have increasingly favored establishing regional free trade agreements (RTAs), notably following the failure of the Doha negotiation round. Challenges in achieving consensus among countries, and the time-consuming and costly nature of global free trade agreements have driven this shift towards RTAs. Unlike global agreements, RTAs offer flexibility, allowing countries to exempt sensitive sectors from tariff reductions seen as globally uncompetitive. Moreover, RTAs are favored for facilitating deeper integration with specific countries, perceived as more beneficial compared to global ones. Consequently, for these reasons, the focus of free trade arrangements has shifted towards

smaller-scale ones, such as regional or bilateral agreements, which are easier to navigate and comply with.

WTO (2023) reports more than 360 RTAs worldwide. North American Free Trade Agreement (NAFTA), Mercosur, European Union (EU), Association of Southeast Asian Nations (ASEAN) Free Trade Area (AFTA), and Trans-Pacific Partnership (TPP) are among the famous regional trade agreements. In Africa, there are more than 30 RTAs, such as East African Community (EAC), the Economic Community for Central African States (ECCAS), the Economic Community of Western African States (ECOWAS), the Southern African Customs Union (SACU), the Southern African Development Community (SADC), West African Economic and Monetary Union (WAEMU), Arab Maghreb Union (AMU), and Common Market for Eastern and Southern Africa (COMESA). However, the implementation of these RTAs has been poor and not successful in achieving their target of promoting intra-regional trade (Hartzenberg, 2011; Yang & Gupta, 2005). These existing RTAs in Africa were formed by neighborhoods, and their market size is limited. As they often export agro-food products and import manufacturing, gains from trade cannot be exploited among members with industrial structures.

On top of these existing RTAs, Africa ratified the African Continental Free Trade Agreement (AfCFTA) in 2018, which aimed to create a unified and large market size for goods and services across the continent. The aspiration to establish a continental-level free trade area in Africa emerged in the 1960s following the continent's independence from European colonizers. The Organization of African Unity (OAU), founded in 1963 and later succeeded by the African Union in 2003, initiated the idea of creating a continent-wide free trade area, aiming to foster economic development and integration across the continent. Subsequently, in 1991, OAU members signed the Abuja treaty to establish the African Economic Community (AEC). The AEC represents a long-term initiative focused on developing a unified common market

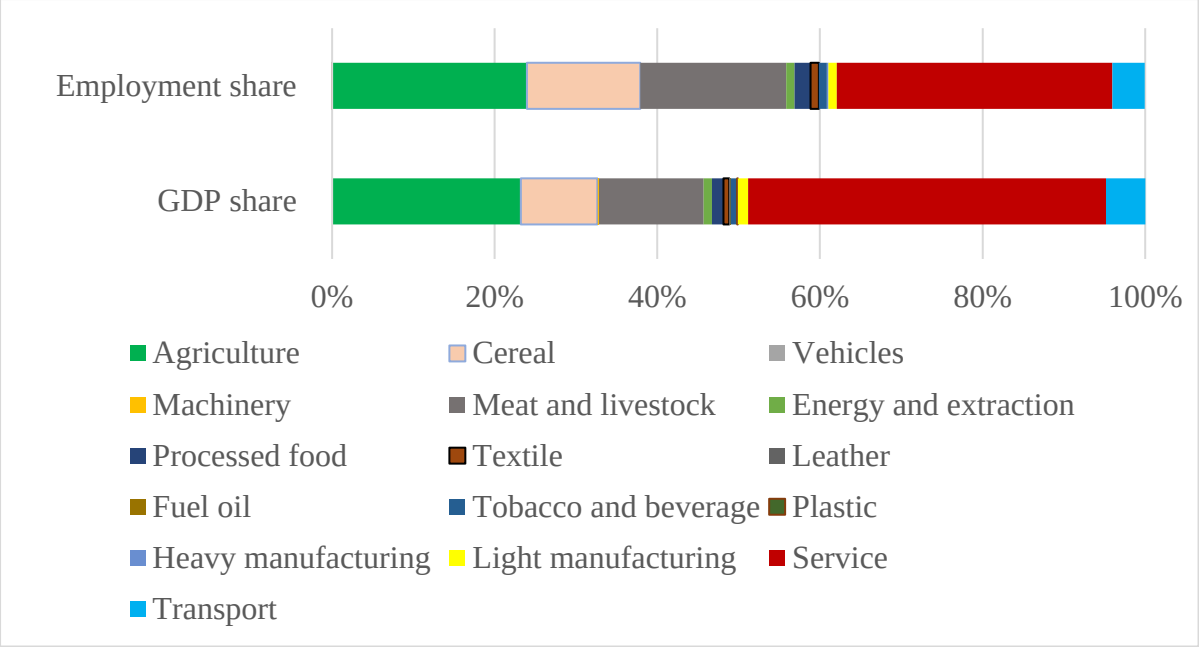
and currency by consolidating existing RTAs. Following extensive negotiations, African countries reached an agreement to establish the continent-wide free trade area, AfCFTA, envisaged as a significant step towards the realization of the African Economic Community. AfCFTA is the world's largest regional free trade agreement which connects 1.3 billion people in 55 countries. AfCFTA is implemented in two phases. Phase 1 covers the areas of trade in goods and services, and Phase 2 covers the areas of investment, intellectual property rights, and competition policy. During these two phases, tariffs on 97% tariff lines will be eliminated. The remaining 3% of product lines are allowed for countries to keep the tariff for sensitive sectors. As of February 2022, 46 of the 55 countries had deposited their instruments of ratification with the chair of the African Union Commission, and trade operations were formally launched in January 2022 (UNECA, 2023).

After abstaining from free trade memberships for a long time, Ethiopia has become one of the signatory members of AfCFTA. Additionally, the country has resumed negotiations to join the WTO, which paused in 2013. Ethiopia became an observer in the WTO in 1997 and commenced the accession process in 2003. However, the accession negotiations encountered a challenge primarily due to a disagreement over the prerequisites set by WTO members. WTO members asked Ethiopia to ease restrictions on service sectors, especially the financial sector and telecom centers, which the Ethiopian government refused. Additionally, the WTO urged Ethiopia to reduce trade barriers and reform various policies, including investment, pricing, and customs procedures. These stringent requirements prolonged Ethiopia's accession process, leading to a pause in negotiations in 2013 due to the inability to reach a consensus.

Following a change in leadership in 2018, Ethiopia embarked on a new trajectory, signing AfCFTA and reinitiating its negotiation process for WTO accession, which had been paused in 2013. The new administration unveiled a reform program called the “homegrown economic reform agenda” in 2020 (MoFED, 2020). This reform initiative placed considerable

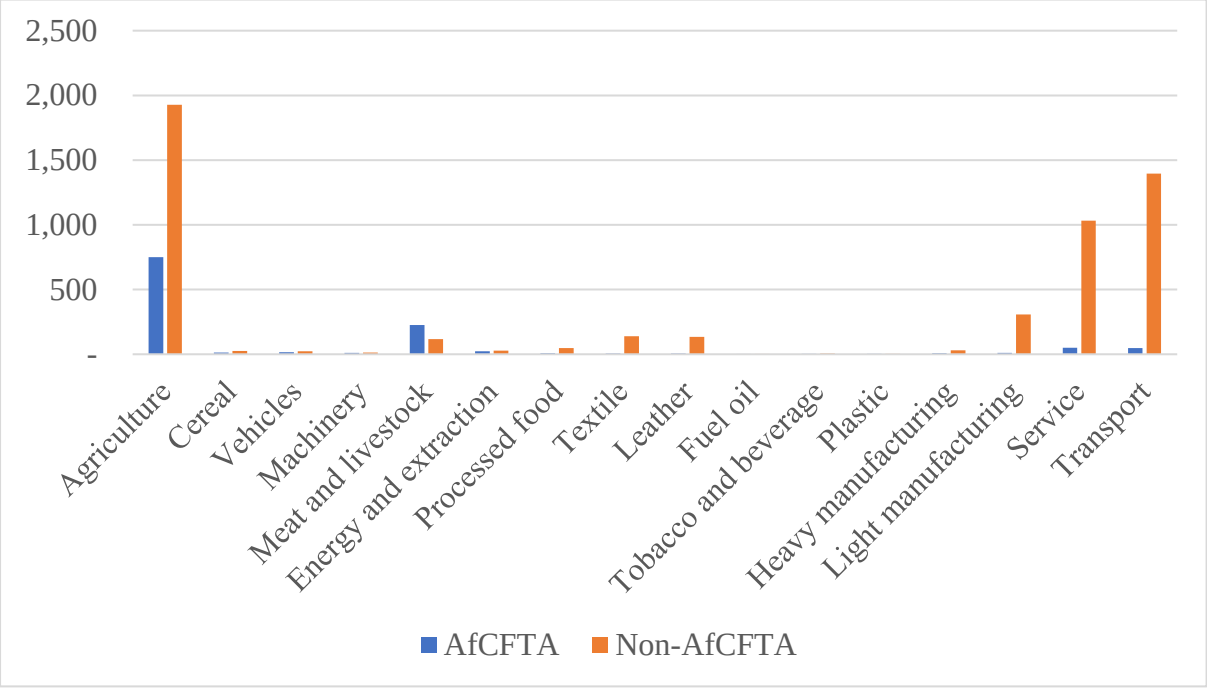
emphasis on regional integration as a fundamental pillar for driving the country's economic development. These decisions to join FTAs are expected to open up the economy which would have a substantial impact on the Ethiopian economy.

The Ethiopian economy is dominated by the service sector followed by the agriculture and meat and livestock sector (**Figure 1. 1**). The service sector contributes 44% of Ethiopia's gross domestic product, while the agriculture and meat and livestock sectors account for 23% and 13%, respectively. In terms of employment, the service sector leads with a 34% contribution followed by the agriculture and meat and livestock sectors which account for 24% and 18%, respectively. Ethiopia's export is dominated by agriculture, meat and livestock, service, and transport sector **(Figure 1. 2)**. The AfCFTA and WTO accession are expected to offer a gateway for their further expansion by unlocking new markets and reducing trade barriers. By contrast, it is feared that joining AfCFTA and WTO would negatively affect manufacturing sectors, such as light manufacturing, heavy manufacturing, textile, and leather, which are considered uncompetitive without protection and show the highest share in Ethiopian imports (**Figure 1. 3).** Further tariff reduction would overwhelm the imports, posing a severe challenge to the survival of local industries.



Source: Authors calculation from GTAP 10 database (base year = 2014)

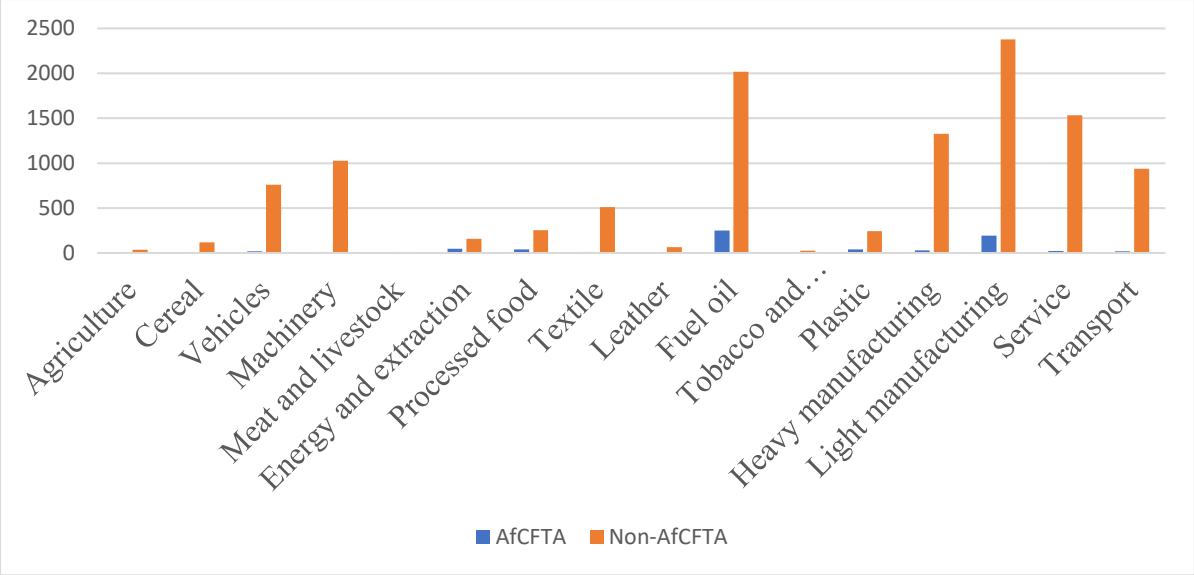
Figure 1. 1. Sectoral GDP and employment share of Ethiopia[1] [%]



Source: Authors calculation from GTAP 10 database (base year = 2014)

Figure 1. 2. Ethiopia's sectoral export by destination [Mil. USD]

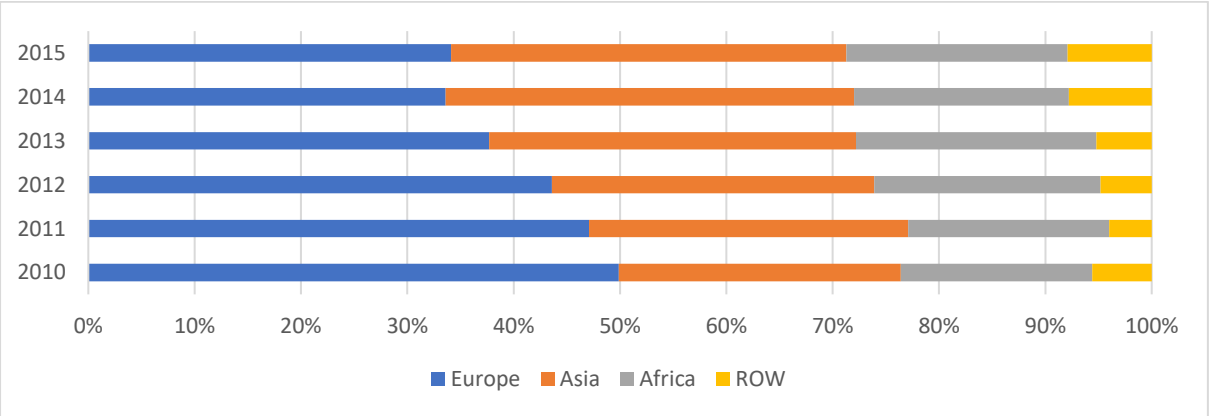
[1] Details of sectoral aggregation is shown in Appendix B.



Source: Authors calculation from GTAP 10 database (base year = 2014)

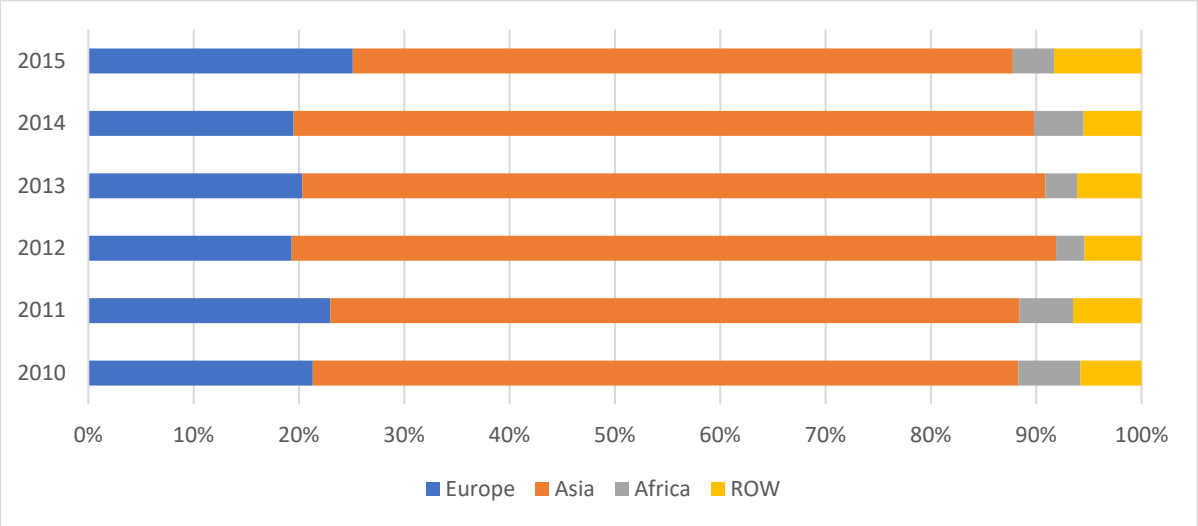
Figure 1. 3. Ethiopia's sectoral imports by source in [Mil. USD]

Ethiopia's trade is directed outside of Africa: Africa's share in Ethiopia's exports and imports is minimal. As the WTO accession promotes trade with non-African countries, its impact is expected to be larger than AfCFTA's. Among the non-African region, Ethiopia's exports were mainly directed to Europe but recently Asia has overtaken due to the increase in exports to China (**Figure 1. 4**). The imports are mainly from Asia, followed by Europe (**Figure 1. 5**).



Source: Compiled by the author from the National Bank of Ethiopia annual report

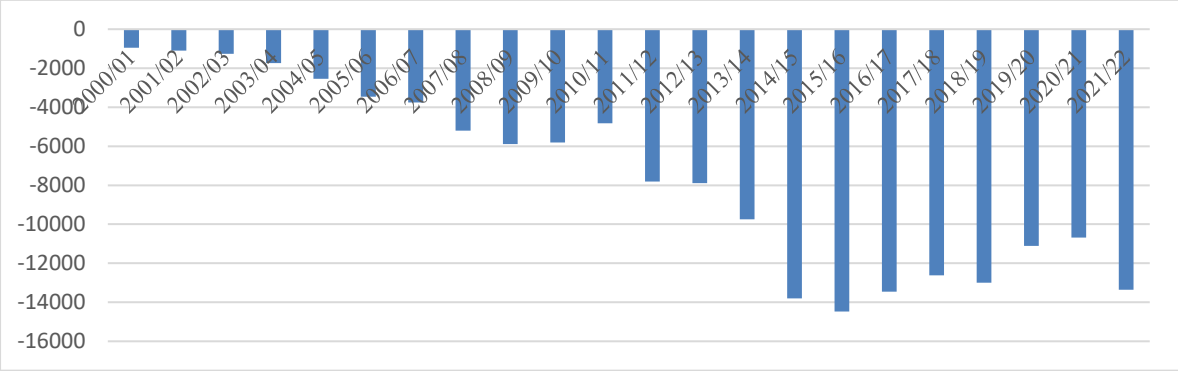
Figure 1. 4. Ethiopia's export share by destination [%]



Source: Compiled by the author from the National Bank of Ethiopia annual report

Figure 1. 5. Ethiopia's import share by destination [%]

Ethiopia faces a significant trade deficit, sparking concerns that joining FTAs may worsen it. The reduction of trade barriers tends to amplify the influx of imports, which could negatively impact local industries' output, employment, and welfare. Throughout the initial decade of the 2000s, the country experienced a pronounced escalation in its trade deficit (**Figure 1. 6**). Conversely, starting in 2010, the trade deficit exhibited fluctuations while maintaining an overall upward trend in comparison to preceding years.



Source: Compiled by the author from the National Bank of Ethiopia annual report

Figure 1. 6. Trend of trade balance of Ethiopia (Mil. USD)

Joining FTAs presents both advantages and concerns. They offer increased market access for imports and exports, augmenting productivity and attracting higher foreign direct investment. However, they also pose a risk to weak or sensitive industries, such as textile and leather. Ethiopia's commitment to join AfCFTA and WTO evokes a mix of hope and apprehension about its economic future. There are a few studies that examined the potential impact of AfCFTA. In the specific context of Ethiopia's WTO accession, no comprehensive assessment has been carried out, to the best of the author's knowledge. The World Bank (2020), Abrego et al. (2019), and Chauvin et al. (2016) are the studies that assessed the potential impact of AfCFTA. However, these studies have limitations. The studies conducted by the World Bank and Abrego et al. did not explore the impact at a sectoral level. Chauvin et al., while assessing at the sector level, used an outdated model that assumed tariff reduction across all products, disregarding the AfCFTA agreement's allowance for countries to exempt 3% of product lines considered sensitive from tariff reductions. Joining FTAs needs a series of studies that analyze the impact to maximize the gains and minimize the negative consequences. As Ethiopia has limited prior experience in FTAs, its entry into the WTO and AfCFTA entails both potential benefits and drawbacks. It is imperative to assess the impacts of these agreements on the Ethiopian economy, especially with good sectoral detail in the country's context. This gap underscores the need for studies to fill this critical void. Thus, we examine the impact on trade, output, and welfare using trade indicators and develop a static computable general equilibrium (CGE) model, which is one of the standard macroeconomic models employed for trade policy analysis.

1.2. Research Question and Objectives

The dissertation aims to answer the question, "How would the AfCFTA and WTO accession impact the Ethiopian economy (trade, output, and welfare)?", by using trade indicators in our first study and comparing the results with the CGE model in the second study. More specifically, the study has the following objectives:

1. To quantify the impact of AfCFTA on trade, output, and welfare.
2. To quantify the impact of WTO accession on trade, output, and welfare.
3. To compare and contrast the impact of WTO accession with AfCFTA accession on the Ethiopian economy.
4. To examine the relevance of trade indicators and the CGE model for trade policy analysis by comparing their results.
5. To forward the possible available recommendations based on the results.

1.3. Contributions

Our study made contributions to the trade policy literature in the following four points. First, despite being considered sensitive by the Ethiopian government and excluded from tariff reduction for AfCFTA accession, our study uncovered that the leather sector would expand under free trade. Second, our study discovered that the transport sector of Ethiopia would significantly expand under free trade, while many earlier studies found that free trade deals commonly favor goods sectors over service sectors. Third, our study highlighted that the benefits of joining WTO with unilateral reductions of trade barriers are larger than AfCFTA with mutual reduction. Fourth, our study revealed that AfCFTA would promote output and trade in industries, such as machinery and vehicles, which are unlikely to be found promising industries with high import penetration, while WTO accession would pose a significant negative impact on them. Weak industries are not necessarily always weak; different trade

deals would reveal different weak sectors. Fifth, our study found consistent predictions across the majority of sectors through both trade indicators and the CGE model. This underscores the relevance of both methods for trade policy analysis.

1.4. Organization of the Dissertation

The remainder of the paper is organized as follows. Chapter 2 covers literature on trade theories, trade policy analysis and evolving methodologies, and studies on AfCFTA and WTO impact. Chapter 3 presents the trade indicators study, our first study. We assessed the sectoral competitiveness of Ethiopia under free trade using the revealed comparative advantage and level of protection indicators, the most widely used trade indicators in trade policy analysis. Chapter 4 presents the CGE model study, our second study. We developed a static global CGE model drawing from the GTAP 10 database and 2014 social accounting matrix (SAM) data. We develop a wide range of scenarios that involve tariff and non-tariff measures (NTMs) reductions and conduct a simulation experiment to examine the impact of the AfCFTA and WTO accession on trade, output, and welfare. Chapter 5 provides a summary, conclusion, and policy implication of the study. In this chapter, we compare and summarize the results of the trade indicators and CGE model study. Moreover, we draw the implications of our study and forward possible recommendations.

The appendix sections provide technical details of our study. They are regional and sectoral aggregations based on the GTAP database for CGE model development, the background of our definition of the "excluded products" in each region, details of the CGE model, and the results of the sensitivity analysis of the CGE analysis in Chapter 4.

Chapter 2: Review of Related Literature

2.1. Introduction

The significance of international trade has expanded in today's global political economy, giving rise to the development of a multitude of trade theories, policies, evaluation methods, and theoretical and empirical studies. Several trade theories have been developed to analyze international trade and its economic impact. Mercantilism trade theory, classical trade theories such as absolute and comparative advantage, and new trade theories “new trade theory” and “strategic trade theory” are among the popular ones, each contributing to the development of the discourse. Countries choose different policies toward international trade. Some countries follow protectionist trade policies, while others follow free trade policies. Protectionist trade policies encompass measures that restrict international trade, such as tariff and non-tariff measures, often to secure stakeholders' interests within a small circle, such as major producers and incumbents. By contrast, free trade policies pursue gains from trade by promoting free trade by reducing tariff and non-tariff measures by often forming various regional and multilateral free trade areas.

The impact of protectionist and free trade policies on the economy has been a major debate among academia and policymakers. As a result, several empirical and theoretical studies have been conducted and various evaluation methods have been developed. These evaluation methods are categorized as ex-ante and ex-post evaluation methods. Ex-ante evaluation methods are used to evaluate the potential impact of trade policies before their implementation. These evaluation methods include trade indicators such as comparative advantage and level of protection indicators, macro-econometric models, and structural models, such as partial equilibrium and CGE models. Ex-post evaluation methods are applied to assess the impact of

trade policies using data covering before and after or with and without implementation of particular trade policies.

In this chapter, we review the literature on trade policies, particularly focusing on methodological approaches and empirical analyses of past free trade deals. These investigations serve to explore standard and effective approaches for trade policy analysis so that we can better analyze the impacts of coming free trade deals on Ethiopia. Section 2.2 provides an overview of the major international trade theories revolving around international trade. Section 2.3 elucidates the contending trade policies and devices of implementation of their assumptions at the global and regional levels while exploring methodologies widely used in trade policy analysis. Section 2.4 presents existing studies on the benefit of trade liberalization from the viewpoint of its impacts on economic growth. Sections 2.5 and 2.6 summarize existing studies on the impact of AfCFTA and GATT/WTO accession, respectively, to highlight the niche of our study for Ethiopia. Section 2.7 concludes the review.

2.2. International Trade Theories

Various theories have been developed to comprehensively understand international trade's economic implications. In the 16th century, the mercantilism trade theory marked the dawn of formal attempts to comprehend international trade. Subsequently, numerous theories have been developed. These major trade theories include the classical trade theory, the absolute advantage theory, the comparative advantage theories of Ricardo and the Heckscher-Ohlin trade theory, and new trade theories, "new trade theory" and the strategic trade theory. Theories have swung between protectionism and free trade. Mercantilism trade theory advocates employing protectionist measures like tariffs and trade barriers as the surefire way to reap the benefits of international trade (Vagii & Groenewegen, 2004; Viner, 1937). In the late eighteenth century, it faced severe criticism from leading classical trade theorists such as Adam

Smith, who advocated free trade. Smith's critique emphasized that free trade benefits countries while protectionism hampers gains (Smith, 1776). He introduced the theory of absolute advantage, stating that when one country excels in producing a commodity and another in a different product both countries can mutually benefit from trade. Smith argues that the division of labor and specialization in production yield economies of scale, ultimately resulting in enhanced efficiency and growth. However, Adam Smith's absolute advantage theory was criticized for overlooking the role of opportunity costs, potentially obscuring the wider trade benefits for countries lacking an absolute advantage in any industry. Subsequently, comparative advantage theory, pioneered by David Ricardo has emerged to analyze international trade. Comparative advantage theory posits that disparities in comparative production costs are the driving force behind international trade. Elaborating on the comparative advantage theory, the Heckscher-Ohlin trade theory was developed to better analyze international trade and its implications. Heckscher-Ohlin trade theory asserts that differences in factors like labor, land, and capital predominantly dictate trade patterns, leading countries to export goods embodying abundant factors and import those with scarcities. They imply the benefit of specialization to a field where they have advantages. To consume goods with and without comparative advantages, countries need exchanges, or, synonymously, trade.

In the late 20th century, the “new trade theory” and “strategic trade theory” emerged. “New trade theory” asserts that trade is influenced by increasing returns, product differentiation, and transportation costs rather than solely by comparative advantage. It suggests that firms can wield some influence over prices and have a degree of monopoly power. “Strategic trade theory” on the other hand, emphasizes that government involvement in international trade can improve the welfare of a country (Krugman, 1987). This theory asserts that government policies that support local firms, can result in expanded exports, thereby improving their international

competitiveness. Consequently, this proactive trade policy approach enables domestic firms to reap benefits by redirecting profits away from foreign companies and countries.

The trade theories summarized above form the foundation for the development of different trade policies and serve as the base for the protectionist and free trade proponents. Mercantilism serves as a foundation for protectionists, while classical trade theories serve as the foundation for free trade advocates. Protectionist and free trade proponents' main difference lies in their views regarding the impact of free trade on key industries. Protectionists argue that free trade can harm some key industries necessitating safeguards against foreign competition until these industries attain competitiveness. They also argue free trade, which relies on specialization according to a country's existing comparative advantage, overlooks the potential for countries to explore industries in which they lack a comparative advantage presently but could develop in the future (Redding, 1999). Protectionists call government to actively promote and support industries with the potential to compete on a global scale in the long term and call developing countries to adopt protectionist policies (Chang, 2002; List 1856). Proponents of infant industry protection policies contend that developed countries achieved their current status through the strategic use of protectionism and encourage developing countries to adopt similar policies to foster economic growth (Chang, 2002). Such an infant industry theory is in empirical controversy. While many studies found no positive effect (on Turkey by Krueger & Turann, 1982; on Brazil by Luzio & Greenstein, 1995; on the ethanol industry in Brazil by Rask, 1994; Ederington & McCalman, 2011) with a few supports (on Pakistan's manufacturing sectors by Kemal, 1979; on the South Korean automobile industry by Green, 1992).

Conversely, free trade proponents consider protectionist measures primarily as impediments that can result in resource misallocation and inefficient resource utilization that diminishes a country's ability to fully capitalize on the benefits of international trade. They argue that free trade prompts industries to concentrate on their comparative advantages, thus

enhancing efficiency and productivity, and leading to better welfare. Like the protectionism literature, the impact of free trade on output and welfare is debatable and inconclusive. Dehoyos & Iacovone's (2012) study on Mexico and Edmond et al.'s (2015) study on Taiwan found an increase in welfare and output as a result of free trade. By contrast, Batra's (1992) study on the US, and Mukhopadhyay & Thomassin's (2010) study on Korea and Japan found a welfare-decreasing impact of free trade. Irwin's (2000) examination of the US tinplate industries indicated that protection contributed to growth but did not necessarily enhance overall welfare.

2.3. Trade Policy Evaluation Methods

Recent trade policy analysis has prominently centered on assessing the impact of GATT/WTO and regional trade agreements (RTAs). Following the end of WWII, countries have focused on free trade to revitalize their economies. As a result, trade barriers were reduced, and multilateral institutions like the General Agreements on Tariff and Trade (GATT), subsequently replaced by WTO were established. Studies on the impact of GATT/WTO indicate a positive impact on trade and welfare (Goldstein & Tomz, 2007; Eicher & Henn, 2008; Chang et al., 2022). However, it is criticized for bringing a significant economic benefit limited only to industrialized countries (Gowa & Kim, 2005). In addition to the GATT/WTO, RTAs emerged as an alternative engine for advancing free trade and have shown a substantial increase. Among the RTAs, the North American Free Trade Agreement (NAFTA) (Caliedo & Paro, 2012; Lederman et al., 2005; Kose et al., 2004; US Chamber of Commerce, 2017; Burfisher et al., 2001), the European Union (EU) (Straathof et al., 2008; Ilzkovitz et al., 2007; and Badinger, 2005), the South American Common Market (MERCOSUR) (Connolly & Gunther, 1999; Bustos, 2011; and Diao & Somwaru, 2000), and the Association of Southeast Asian Nations (ASEAN) (Plummer & Yue, 2009; Elliot & Ikemoto, 2004; Kien, 2009; Okabe

& Urata, 2013; and Hapsari & Mangunsong, 2006) FTAs are some of the most popular ones. The impact of disintegration has also been a focal point in recent trade policy analysis. Key events, such as the United Kingdom's decision to exit from the European Union (Brexit) (Erken et al., 2018; OECD, 2016; Dhingra et al., 2017; Van Reenen, 2016), and the U.S. withdrawal from the Trans-Pacific Partnership (TPP) (Kawasaki, 2017; USITC, 2016; Chow et al., 2018; Ko, 2018), has been the main focus.

The impact of those trade policies is assessed before the implementation using ex-ante evaluation methods and after the implementation using ex-post evaluation methods. The ex-ante evaluation methods encompass different methods like simple trade indicators such as comparative advantage indicators and level of protection indicators, macroeconomic models such as dynamic stochastic general equilibrium (DSGE) models, and structural models such as partial equilibrium and computable equilibrium models. These theory-based structural models are employed to overcome a lack of data before the implementation of trade policies. By contrast, ex-post evaluation methods can exploit observed historical data by applying econometric methods. Incidentally, it should be noted that econometric methods are employed also for the construction of these structural models (Jorgenson, 2016) and the estimation of key parameters (Hertel et al., 2007).

2.3.1. Trade Indicators

Trade indicators are widely used to examine the potential impact of policy changes. Free trade encourages countries to specialize in production according to their comparative advantage (Redding, 1999). Thus, countries should be aware of their sectoral comparative advantage and disadvantage to get the best from their free trade negotiations. RCA indicators help them to identify sectors that have a comparative advantage and could thrive under free trade; they also indicate sectors that lack comparative advantage or might lose it under free

trade. Balassa (1965) introduced a revealed comparative advantage index to measure countries' comparative advantage. BRCA indicates the sectoral comparative advantage based on the observable trade pattern. It is calculated by comparing the country's export of a specific industry relative to the world's total export of that specific industry. A high BRCA index implies the sector is competitive and would benefit under free trade whereas, a low BRCA indicates the sector lacks comparative advantage and might decline under free trade. BRCA indexes give a hint about the sectors that countries should focus on to benefit from free trade by allocating their resources efficiently. In addition, it can also help countries find the best free trade partners that could benefit their economies depending on their comparative advantages and disadvantages. Since BRCA, several other comparative advantage indicators have been introduced and have been widely used for trade policy analysis.

After Balassa (1965), several studies employed RCAs for trade policy analysis (e.g., Batra & Khan (2005) on China and India; Irsahd & Xin (2017) on Pakistan; Utkulu & Seymen (2004) on Turkey and the EU; and Singh et al. (2020) India's agricultural products). In Ethiopia, only a few RCA analyses have been conducted. Rundassa et al. (2019) focused on the textile and apparel sector, revealing Ethiopia's comparative advantage in textiles but not apparel. Hunegnaw (2021) conducted an extensive investigation into Ethiopia's sectoral competitiveness, noting overall improvements in manufacturing categories, except for low-technology products like textiles, garments, and footwear. This study further highlighted that primary and low-technology manufactured goods exhibited a comparative advantage over other categories from 1996 to 2018. Alubel (2015) explored Ethiopia's leather industry's comparative advantages compared with Kenya, Egypt, and Tunisia. The results have indicated Ethiopia's relatively high RCA in hide and skin exports compared to these economies.

The other widely used trade indicators are the level of protection indicators: the nominal rate of protection (NRP) and the effective rate of protection (ERP). These indicators are tariff-

based and can provide an implication for free trade. NRP considers only the tariff on output, while ERP considers the tariff both on output and intermediate inputs. ERP was introduced for trade policy analysis by Balassa in 1965 to consider the effects of border barriers not only on imports, which compete with domestic output, but also on exports, which are used as input for domestic production. There are trade studies with ERP, such as Bloch & Soares (2019) on Brazil, Alayande (2020) on Nigeria's cement industry, Trinh (2012) on Vietnam, Haque & Siddiqui (2017) on Pakistan, and Marks (2011) on Laos. In the Ethiopian context, Gebreeyesus & Kebede (2017) used ERP to assess industry protection levels. Their findings highlight that sectors, such as textiles, apparel, leather, footwear, and processed food, experience higher levels of protection. In contrast, industries like chemicals and medicines, wood and paper products, and metal and mineral products receive relatively lower protection.

While trade indicators provide valuable insights into the potential effects of trade policies, the information they offer is limited. They can inform us about expected changes in trade patterns and which sectors may be most impacted by tariff reductions. However, they do not provide information about the magnitude of the change in trade, welfare, and output. We discuss these two types of trade indicators in detail in Chapter 3 and demonstrate predictions based on these indicators.

2.3.2. Partial Equilibrium Model

Countries may reduce tariffs on a single commodity or sector in their trade agreements and may wish to assess the impact on the economy. When we can limit our focus of analysis only to a certain sector/good, partial equilibrium models are widely chosen due to their simplicity, fewer data requirements, and ability to quantify the effect of the policy change on the economy. Various partial equilibrium models have been developed for trade policy analysis, such as the Takayama-Judge (1971) spatial and temporal price and allocation model, Software for Market Analysis and Restrictions on Trade (SMART) model (Chiunjira, 2020), Global

Simulation Analysis of Industry-Level Trade Policy (GSIM) (Francois & Hall, 2003), Tariff Reform Impact Simulation Tool (TRIST) (Breenton et al., 2009), Agricultural Trade Policy Simulation Model (ATPSM) (Vnazetti & Graham, 2002). While partial equilibrium models allow us to focus on a sector of our interest so that we can intricately model a particular market and/or apply standard econometric methods for the model estimation, they have some limitations of neglecting interactions between different markets. For example, a reduction of tariffs on automobile imports would promote its imports, subsequently increasing transport service supply and fuel demand, which would negatively and positively affect their prices, respectively. However, partial equilibrium models consider the automobile market only, ignoring the consequences for the transport service and fuel markets resulting from the automobile tariff reduction. When these inter-sectoral linkages play an important role in trade policy analysis, multi-sectoral models are called for.

2.3.3. Computable General Equilibrium (CGE) Model

Changes in trade policies, such as tariff reductions in specific sectors, can have widespread economic implications. The impact can extend beyond the targeted sector and affect the dynamics of production, consumption, and trade. For example, when tariffs on a commodity, say rice, are lowered, it stimulates an increased demand for rice owing to more affordable prices, potentially leading to decreased demand for other commodities such as corn or wheat. This tariff reduction can also influence firms' production decisions. Consequently, as a result of reduced tariffs on rice, the return from rice production declines, prompting firms to redirect their production to other sectors, such as corn and wheat. This shift results in increased production of corn and wheat and a corresponding reduction in rice production. In such cases, where a change in one market affects multiple sectors and markets, simplistic partial equilibrium models are inadequate for analysis. Instead, a more comprehensive model that can

effectively capture changes in the entire economy is necessary. Trade policies, especially FTAs, impact various sectors and countries simultaneously. To examine the profound impacts of such changes on various countries and markets, the CGE model is frequently employed, enabling policymakers and researchers to make informed decisions regarding these complex agreements.

CGE models operate based on the fundamental principles of supply and demand, illustrating how economic agents and activities respond to policy changes. It depicts a comprehensive framework from production to final demand, in which all economic agents and activities are interconnected, causing any policy adjustment to ripple throughout the entire system. Economic agents—typically households and firms—are assumed to be rational in their decision-making and maximize their benefits subject to their constraints. Households maximize utility, subject to income constraints. Households sell factors of production, such as land, capital, and labor, to earn income for their consumption, savings, and tax payments to the government. Firms aggregate factor inputs bought from households to form value-added using Cobb-Douglas technology and use it together with intermediate inputs bought from other firms to produce gross domestic output using the Leontief production function.

In many CGE models, markets are assumed to be perfectly competitive, both households and firms are price takers, and firms make no positive profit. Firms' production technology is often described by constant elasticity of substitution (CES) functions, where constant returns-to-scale is assumed for simplicity.[2] Firms decide to sell the gross output to the domestic market and the export market based on the constant elasticity of transformation (CET) function. The domestic supply is mixed with composite imports and further processed to produce Armington's (1969) composite goods. In a multi-country setup, the exports are further allocated among different destinations, while some parts are used for the exportation of

[2] Some CGE models account for imperfect competition with increasing-returns-to-scale production technology.

international transport services[3]. In the CGE model, imports and exports depend on Armington's elasticity of substitution. Policy changes like trade barrier increases or reductions can affect the demand for export and import depending on Armington's elasticity of substitution. For example, the tariff reduction by the home country decreases the import price of goods. This reduction of import price increases incentivizes the substitution of domestic goods for imported goods in the home country's consumption, where a higher Armington's substitution elasticity leads to a larger substitution effect. The home country's export supply depends on the foreign country's import demand, which can be stimulated by a tariff reduction abroad.

Revenues received from the sales of gross domestic output are used to pay for factors of production, intermediate inputs, and taxes. Armington's composite goods are used for household consumption, government consumption, investment, and intermediate uses. The government is assumed to collect income tax from households, production tax from firms, and import and export taxes, and to use them for consumption and government savings. When a shock is introduced, the model undergoes a computational process to determine the equilibrium prices and quantities for all economic agents. This process generates quantitative results that illustrate the consequences of policy changes.

There are two types of CGE models: static and dynamic. They differ in their underlying assumptions, timeframes, behavioral considerations, and intended applications. Static CGE models are characterized by their static nature and assumptions (they provide a snapshot of the economy within a specific time when adjustments are made smoothly and do not account for future changes). On the other hand, dynamic CGE models account for changes in the economy over time and are particularly useful for analyzing the long-term effects of policy changes. In

[3] In the transportation sector, the gross output is also used to produce international transport service. International trade service is produced with transport service exported from all regions with a Cobb-Douglas production function and used for international shipping. See the GTAP Manual for its details (Hertel, 1997).

this case, savings and investment behavior are elaborated to describe the evolution of stock variables, especially capital, over time.

CGE modeling for policy analysis dates back to Johansen's (1960) multi-sectoral growth model for Norway. Since then, extensive refinements and advancements have transformed CGE modeling into a sophisticated field. Nowadays, it is a primary tool for assessing the impacts of various economic policies, including those related to climate, energy, public finance, fiscal reform, and international trade. Other than the aforementioned CGE studies on RTAs/FTAs, numerous studies used the CGE model for trade policy analysis (Hosoe, 2021; Plummer & Yue, 2009; Lee & Kim 2012; Goulder & Eichengreen, 1992; Kehoe, 2003; Ianchovichina & Martin, 2004). By contrast, in Ethiopia, there are a limited number of studies conducted using the CGE model. Gebreegizhaber et al. (2016) used the CGE model to study climate change impact. Dorosh et al. (2018) used it to examine the role of agriculture on structural change and inequality in Ethiopia. Borojo (2015) used this to assess the economic impact of investment in infrastructure on electricity. Only a handful of studies have examined the impact of FTAs on the Ethiopian economy (Ben et al., 2006; World Bank, 2020; Abrego et al., 2019; Chauvin et al., 2016). These studies, however, have their own set of limitations. The World Bank (2020) and Abrego et al. (2019) did not explore the sector-specific effects of the AfCFTA, while Chauvin et al. (2016), studied at sectoral level but relied on outdated data that may underestimate the true impact. Additionally, a noticeable gap exists in the literature regarding the potential impact of Ethiopia's accession to the WTO, despite the country being on the brink of joining this global trade organization. This absence of research leaves a significant knowledge void that needs addressing in light of Ethiopia's evolving trade agreements.

The widespread use of CGE models can be attributed to their unique capacity to uncover both the direct and indirect effects of policy changes (Cheong, 2010), as well as their

ability to generate precise and easily interpretable quantitative results (Plummer et al., 2010). However, despite its wide use in estimating the potential impact of trade policies, the CGE model has its limitations. The data requirements for CGE analysis of FTAs are extensive and the model's results could be sensitive to assumptions about parameters that are chosen in an ad hoc manner due to lack of good estimates (Plummer et al., 2009; Hosoe et al., 2004). It is also criticized for its poor performance in predicting trade outcomes and a "black box" operation (Kehoe, 2003).

2.3.4. Other Models

DSGE models are used to forecast the impact of policy changes on the economy. Unlike CGE models which usually distinguish several sectors, DSGE models are often a single-sector model or distinguish only a few sectors. They are mostly used by the central banks to forecast the impact of policy changes for the short-run business cycle analysis. For trade policy analysis, a handful of studies employed DSGE models (see Hunt et al, 2020; Jinlinag, 2022; Gust et al, 2010; Dix-Carneiro, 2014; Agur, 2010).

In trade policy analysis, a gravity model is a tool widely adopted for assessing the impact of trade policies on the economy. The gravity model is inspired by the physics concept of the gravity model. Initially, its analysis revolved around the economic size (typically GDP) and the distance between trading countries as a significant determinant of trade relations. However, other factors such as language and culture have been incorporated over time to make the model more realistic. Since Tinbergen's (1962) initial use of the gravity model for trade policy analysis, many studies have employed it to assess the effects of trade policies on the economy (Bayer & Bergstrand, 2007; Subramanian & Wei, 2003; Busse et al., 2012; Karemera et al., 1999; Anderson et al., 2001).

2.4. Trade Liberalization and Economic Growth

The relationship between trade liberalization and economic growth has been a major topic of debate. Though free trade is believed to promote economic growth by classical economic theories, empirical results yield ambiguous results, with no definite conclusion. A handful of case studies have indicated that trade liberalization promotes economic growth **(**Wacziarg, & Welch, 2008; Gnangnon, 2018; Ben-David & Lowey, 1998; Asfaw, 2014; Das & Paul, 2014; Brueckner & Lederman, 2015; Shahbaz, 2012; Karras, 2003). Wacziarg, & Welch's (2008) study indicated that trade liberalization has a significant impact on economic growth, investment, and GDP. According to their study, over the 1950-98 period, countries that liberalized their trade regimes experienced average annual growth rates of 1.5 percentage points higher than before liberalization. The investment growth rates rose by 1.5-2.0 percentage points and the average trade-to-GDP ratio rose by 5 percentage points than before the liberalization. Gnangnon's (2018) study on 150 countries from 1995 to 2015 found a positive impact of trade liberalization on economic growth. Ben-David & Lowey's (1998) study indicated that liberalization reduces the income gap between the liberalizing country and other wealthier countries and liberalization generates a positive impact on the steady-state growth of all the trading countries. Asfaw (2014) found openness to intranational trade promotes both economic growth and investment in the study that covered 47 sub-Saharan African countries. Das & Paul's (2014) study encompassed 12 emerging countries from Asia indicates that openness has a strong positive effect on economic growth. Brueckner & Lederman, 2015 on Sub-Saharan Africa found a significant positive effect of trade openness on economic growth. Shahbaz's (2012) study indicated that trade openness significantly promotes economic growth in the long run. Karras's (2003) study using two-panel data sets—one on 56 countries covering the period 1951-1998, and another on 105 countries over 1960-1997— found a positive effect of trade openness on economic growth.

By contrast, other studies found no relationship or a negative impact of trade openness on economic growth, especially in developing countries (Dowrick & Golley, 2004; Sarkar, 2008; Sarkar & Bhattacharyya, 2005; Siddiqui, 2016; Ulasan, 2015; Vlastou, 2010; Yanikkaya, 2002). Dowrick & Golley's (2004) study indicates that trade openness has promoted economic growth in developed countries mostly with little benefit to less developing countries, especially to countries that export primary/raw materials. Similarly, Siddiqui's (2016) study on the impact of free trade on developing countries indicated that the impact on welfare and output is insignificant. Sarkar's (2008) study indicated that the majority of least developing countries (LDCs) including the East Asian countries experienced no positive long-term relationship between openness and growth during 1961-2002. Sarkar, & Bhattacharyya's (2005) study on Korea and India found no meaningful relationship between trade openness and GDP growth. Ulasan (2014) indicated that trade openness does not promote economic growth. Vlastou's (2010) study on 34 African countries found a negative effect of trade openness on the economy of these countries. Yanikkaya's (2002) study indicated that trade liberalization doesn't have a direct relationship with economic growth, but protectionism is positively associated with growth, especially for developing countries.

2.5. AfCFTA and its Economic Impact

Many studies have examined the potential economic impact of AfCFTA, with the majority predicting a positive trade impact (Africa Development Bank, 2019; World Bank, 2020; Chauvin et al., 2016). Africa Development Bank (2019) using a CGE model indicated that tariff and NTM reductions under AfCFTA would boost the continent's trade. Similarly, the World Bank (2020) used a CGE model and predicted that AfCFTA would boost the continent's trade both within and outside Africa. Chauvin et al. (2016) also indicate that AfCFTA would have a significant intra-trade increasing impact but trade with non-Africa

countries would decrease. The study has further indicated that as more liberalization measures are implemented, the gains tend to grow more substantially. In contrast to these continent-wide examinations, some studies predicted a negative trade effect in some countries. For example, Shinyekwa (2020) using the WITS-SMART simulation model predicted that AfCFTA would lead to positive trade effects in Burundi, Uganda, and Kenya, while Tanzania and Rwanda are predicted to experience a negative trade effect. Mabali (2022) predicted that AfCFTA is unlikely to boost Chad's trade due to product similarity and infrastructure deficit.

Increases in trade, with some exceptions, would lead to increases in output and improvements in welfare. World Bank's (2020) study predicted that AfCFTA is expected to boost the continent's sectoral output by 211 billion USD by the year 2035. According to the study, sector-wise, natural resources and services are expected to see the most significant increase in output (1.7%), followed by manufacturing (1.2%), while agriculture would decline by 0.5% relative to the baseline in 2035. Abrego et al. (2019) predicted a significant potential welfare gain in most African countries as a result of AfCFTA. Their study further indicates that NTM reductions result in more significant benefits than tariff reduction alone, while the gains are high under both tariff and NTM reduction. Chauvin et al. (2016) predicted that all countries would experience an increase in welfare as a result of AfCFTA. Mhonyera & Meyer (2023) found a welfare-improving effect of AfCFTA on Nigeria and South Africa. By contrast, Shinyekwa's (2020) study found AfCFTA's negative welfare impact on Kenya, Tanzania, and Rwanda as a result of high tariff revenue loss, while Uganda and Burundi experienced positive effects.

2.6. WTO and its Impact on Members' Economy

Most previous empirical studies examining the economic impact of the WTO have reported a positive impact on trade. Studies by Helpman et al. (2004), Liu (2004), Kurihara (2012), Brotto et al. (2021), and Larch et al. (2019), using a gravity model, revealed a significant and positive increase in trade resulting from WTO accession. Chang & Lee (2011), using a nonparametric method, have also found the positive effect of WTO accession on trade. Nevertheless, there are a few exceptions in the literature (e.g., Roy, 2011) that show WTO accession did not increase trade. Roy (2011) argues that previous studies reporting a positive effect of WTO accession have failed to consider the inclusion of zero trade, implement proper controls for multilateral resistance, and provide a precise membership definition. By addressing these factors, Roy contends that WTO accession does not lead to an increase in trade.

Several studies on the WTO accession's impact on output and welfare indicate a positive impact. A gravity model study by Felbermayr et al. (2019) indicated that there is a strong welfare-increasing effect of WTO accession. Jensen & Tarr (2007) studied Kazakhstan's WTO accession using a CGE model and predicted a significant welfare-increasing effect as a result of the accession. Rutherford & Tarr (2008) used a CGE model and showed that Russia would improve its welfare due to WTO accession. Ianchovichna & Martin (2001) found that China's WTO accession would bring an insignificant impact on output growth. By contrast, Chen & Ravlion (2004) in their CGE study found a mixed welfare impact on China, rural households' welfare declined while urban households benefited as a result of its WTO accession. The welfare deterioration of the rural households is due to price falls of agricultural products as a result of the accession.

The impact of GATT/WTO accession on developing countries appears non-uniform. Subramanian and Wei (2003) used a gravity model and revealed a substantial trade-increasing effect for developed countries but a limited impact on developing ones. Developed

countries experienced a 65% increase in trade post-accession, while developing countries did not observe significant growth. New member developing countries, however, saw a 32% increase in trade. On the contrary, Chemutai and Escaith (2017), using a difference-in-difference methodology, found a larger impact of WTO membership on trade and GDP in developing countries. Chang et al. (2022) used a gravity model to find that the WTO accession has led to a substantial improvement in welfare and that the gains depend on the development stages, where developed countries gain more than developing countries. The gains from GATT/WTO accession depend on the level of reforms undertaken by acceded countries. Countries that undertook substantial reforms while accession experienced a significant positive impact on trade and economic growth compared to countries that acceded with fewer reforms and automatically (Tang & Wei, 2009; Allee & Scalera, 2012).

2.7. Conclusion

The studies summarized above introduce the main trade theories evolving in the field of international trade and trade policy analysis with an emphasis on the AfCFTA and WTO accession impacts. Although free trade is believed to promote economic growth by classical economic theories, empirical results yield ambiguous results, with no definite conclusion. While most of the studies indicate a positive impact on developed country economies, the impact on the developing country is sometimes controversial. Free trade is pursued by forming regional FTAs and multilateral institutions (GATT/WTO). Most studies on the impact of GATT/WTO indicate a positive impact on trade, welfare, and production. On the other hand, studies on regional FTAs, including AfCFTA, show a positive impact on trade and production but a mixed impact on welfare, and employment. While protectionist policies have witnessed a decline in recent times, they continue to endure in the global trade landscape. Recent occurrences of protectionism, such as the US-China trade war, Brexit, and the US decision not

to join the TPP, indicate the ongoing persistence of protectionist policies, although studies on disintegration mostly indicate their significant negative impact.

The decision to join FTAs demands a thorough analysis of its consequences. For countries like Ethiopia, lacking prior experience in FTA accession, multiple studies illustrating the potential impact are crucially needed. However, there is a significant scarcity of studies, particularly regarding WTO accession. To bridge this gap in the literature, we assess Ethiopia's potential impact of Ethiopia's AfCFTA and WTO accession using trade indicators in Chapter 3 and develop a CGE model in Chapter 4.

Chapter 3: Trade Indicators Study

3.1. Introduction

Free trade deals, both bilateral and multilateral free trade agreements (FTAs), have become increasingly common worldwide. Consequently, assessing their economic impact has become a standard practice. Assessing the potential impact of joining free trade areas on the Ethiopian economy, it is particularly important to predict impacts on sectoral trade, output, and welfare by two means: estimating the competitiveness of a sector in the status quo and gauging the trade barriers to be removed under free trade. Negative views often arise when weak but large industries are found in an economy. In Ethiopia, manufacturing sectors, particularly the food and beverage, textile, leather, and chemical sectors, are considered incompetent (Makonnen & Lulie, 2014; Alemu & Zerihun, 2005; Africa Development Bank Group, 2014). Notably, textile and leather are labeled as "sensitive sectors" demanding protective measures in the recent negotiations in the African Continental Free Trade Agreement (The Reporter Newspaper, 2023). In contrast, the agricultural sector is viewed as competitive and is expected to encounter minimal challenges from free trade (Ben et al., 2006). We need answers, firmly based on empirical evidence, to these concerns.

Various methodologies have been developed to evaluate the potential effects of free trade on trade, output, and welfare. As assessments are made before free trade starts, we cannot rely on sophisticated econometric methods with rich data but on simple trade indicators and theory-based structural simulation models, such as general equilibrium models computed with past data in recent years. The trade indicators encompass indicators of comparative advantage, and level of protection indicators (nominal rates of protection, and effective rates of protection). Comparative advantage indicators help to identify sectors that are likely to expand under a free trade scenario, while level of protection indicators help to predict sectors that may experience increased imports.

The classical trade theory predicts that trade patterns are influenced by disparities in relative productivity across countries. Countries tend to export goods with a comparative advantage, while importing goods lacking such an advantage. Balassa (1965) made a pioneering contribution to assessing countries' comparative advantage by introducing the Revealed Comparative Advantage (RCA) index. Balassa's RCA, BRCA hereafter, measures the country's sectoral comparative advantage by comparing a country's export profile with the global average. Lafay (1992) proposed its improvement by introducing the Trade Balance Index (TBI), a comprehensive measure that considers both the import and export data. Alternative RCA indexes are also proposed for mathematical and statistical convenience: the Additive Revealed Comparative Advantage (ARCA) by Hoen & Oosterhaven (2006) and the Symmetric Revealed Comparative Advantage (SRCA) by Laursen (2015). Each of these indexes has a unique approach and calculation methodology, enabling us to assess countries' comparative advantages in international trade.

While they capture the initial situation before free trade, a post-free trade situation needs to be inferred by intuition. For example, a high RCA suggests a competitive industry, leading to the inference that the industry, currently constrained by tariffs imposed by trade partners, would likely experience enhanced visibility of its competitiveness, resulting in further growth in exports and output. However, this straightforward narrative is rarely realized due to the presence of many other factors, such as a country's tariff protection, inter-sectoral linkages within the domestic economy, and interactions among members of an FTA. Missing these indirect and hidden factors, such simple indicators tend to fail in precisely predicting the consequence of free trade. Among these factors, the level of protection plays the most important role in predicting the direct impact of tariff removals on domestic industries. For these purposes, the level of protection indicators, NRP and ERP, are employed. The NRP

means tariff protection provided for a sector to lift its output price. The ERP indicates the extent of protection granted to the industry not only on output but also on intermediate inputs.

The objective of this chapter is twofold. Firstly, we examine Ethiopia's sectoral competitiveness for free trade using trade indicators. We identify sectors with potential competitiveness using comparative advantage indicator indexes and with benefits of border barrier protection using the level of protection indicators. Then, we identify sectors that would expand or decline under free trade by combining these two results. Secondly, the predictions by these data-oriented trade indicators will be compared with those by a structural model, a computable general equilibrium model, in Chapter 4 to examine the relevance of these different approaches for trade policy analysis as discussed in Chapter 5.

This introductory section is followed by Section 3.2, which describes the comparative advantage indicators, and Section 3.3, which discusses the level of protection indicators. Section 3.4 shows the data source. Section 3.5 discusses the results. Section 3.6 concludes the study.

3.2. Comparative Advantage Indicators

3.2.1. Balassa's Revealed Comparative Advantage

The BRCA index is calculated by comparing the share of a specific product's exports in a country's total exports with the share of the same product's exports in the total global exports.

It is calculated as follows:

$$BRCA_{cg} = \left(\frac{X_{cg}}{X_c}\right) \Big/ \left(\frac{X_{wg}}{X_w}\right)$$

Where

X_{cg} : exports of good g by country c

X_c : total exports of country c

X_{wg} : world exports of good g

X_w : total world exports

The BRCA value ranges from 0 to positive infinity. A country is said to have a revealed comparative advantage if the value of the index exceeds 1, which implies the country exports more than the world average. Conversely, if the index falls below 1, it indicates a revealed comparative disadvantage for the country.

3.2.2. Symmetric Revealed Comparative Advantage

The asymmetric criticism of BRCA prompted the development of symmetric RCA. Laursen (2015) transformed the asymmetric form of BRCA to a symmetric form as shown in the following formula.

$$SRCA_{cg} = \frac{BRCA_{cg} - 1}{BRCA_{cg} + 1}$$

Where,

$BRCA_{cg}$: Balassa's RCA of good g in country c

The SRCA values range from -1 to 1. A positive SRCA value indicates a country has a comparative advantage in a specific sector, implying that it exports more than the world average. Conversely, a negative SRCA value indicates a lack of comparative advantage in that sector, indicating that the country's exports are lower than the world average.

3.2.3. Additive Revealed Comparative Advantage

The additive RCA considers the difference in the share of a country's total exports of a particular sector in its total exports and the share of world exports of the same sector in total world exports. It is calculated using the following formula:

$$ARCA_{cg} = \frac{X_{cg}}{X_c} - \frac{X_{wg}}{X_w}$$

Where,

X_{cg} : exports of good g by country c

X_c : total exports of country c

X_{wg} : world exports of good g

X_w : total world exports

The ARCA index values range from -1 to 1. A value of zero indicates that the sector's export share is equivalent to that of the reference countries. If the index exceeds zero, it signifies that the country has a revealed comparative advantage, whereas a value below zero indicates a revealed comparative disadvantage for the country.

3.2.4. Trade Balance Index

The trade balance index is calculated by considering the net value of trade, which includes imports and exports, normalized by total trade (i.e., the sum of exports and imports). It is calculated as follows:

$$TBI_{cg} = \frac{(X_{cg} - M_{cg})}{X_{cg} + M_{cg}}$$

Where

X_{cg} : Exports of good g by country c

M_{cg} : Imports of good g by country c

The TBI index values range from -1 to +1. A positive TBI value indicates the country's comparative advantage, while a negative TBI value signifies a comparative disadvantage.

3.3. Level of Protection Indicators

3.3.1. Nominal Rates of Protection

NRPs are tariff rates imposed on the output. They indicate the extent to which domestic producers are protected from international competition through tariffs. A higher NRP value signifies a heightened level of trade protectionism (higher prices on imported goods to safeguard domestic industries). Sectors protected with higher tariffs are expected to face greater challenges when exposed to free trade. These industries are more likely to experience negative consequences as they encounter increased competition from foreign counterparts. Conversely, sectors with lower tariffs are expected to be less affected, as they are relatively less protected and open to international competition.

3.3.2. Effective Rates of Protection

ERP provides valuable insight into the degree of protection granted to domestic industries through tariffs applied to both final products and intermediate inputs. It quantifies the percentage change in the value-added of a particular industry when subject to tariffs, as compared to operating under free trade. It is calculated using the following formula:

$$ERP_j = \frac{V_j - V^*_j}{V^*_j} * 100$$

Where,

V_j : Value added under tariff (before trade liberalization)

V^*_j : Value added without tariff (after trade liberalization)

To calculate V_j and V^*_j we used the following formula:

$$V_j = Z_j - X_j$$

$$V^*_j = Z^*_j - X^*_j$$

Where,

Z_j : Output of the jth good with tariff

X_j : Intermediate inputs used by the jth sector J with tariff

Z^*_j : Output of the jth good under free trade

X^*_j: Intermediate inputs used by the jth sector under free trade

While output and intermediate input under tariff are observed, those under free trade are hypothetical and thus need to be calculated by removing the effects of tariffs on them using the following formula:

$$Z^*_j = \frac{Z_j}{1+T_j}$$

$$X^*_j = \frac{X_j}{1+T_j}$$

Where

T_j : tariff rate on the jth sector

A positive ERP indicates that the sector benefits from the protection system resulting in resource gain from other less protected sectors compared to free trade (Balassa and Associates, 1982). However, sectors with a high positive ERP would face challenges from international markets once the protection is removed in a free trade environment (Diakantoni & Escaith, 2014). By contrast, a negative ERP arises when tariffs on intermediate inputs exceed tariffs on final outputs. This situation reduces competitiveness for sectors operating under the protective tariff regime.

3.4. Data Source

The data for our analysis is developed from the GTAP 10 database (2014 base year). We aggregated sectors and regions in the GTAP 10 database to obtain the export, import, output, and intermediate inputs as well as the tariff data, which are necessary for our trade indicators analysis.

3.5. Results

The results from the four comparative advantage indicators show similar outcomes for sectors with the highest comparative advantage (**Table 3. 1**). BRCA, SRCA, and ARCA report that agriculture, meat and livestock, leather, transport, cereal, and service sectors demonstrate a comparative advantage; TBI shows a slight difference. The validation of the transport sector's comparative advantage necessitates careful deliberation. This result is attributed partly to the prevailing dominance of Ethiopian Airlines in the African air transport market, which significantly strengthens Ethiopia's overall comparative advantage in the transport sector. However, as a landlocked country, Ethiopia has been compelled to establish resilient ground transportation systems to mitigate the significant expenses associated with storing goods at ports for prolonged durations. This necessity has consequently catalyzed the growth of robust transport sectors within the nation.

In contrast to these top sectors, the results for sectors with a comparative disadvantage differ across the indicators. This unreliability seems to stem from the nature of these indicators, which largely rely on data on exports, which are observed in the less competitive sectors rarely or only in a limited amount. BRCA and SRCA indicate that fuel oil, plastic, and heavy manufacturing are the sectors that lack comparative advantage the most and would be significantly negatively impacted under free trade. ARCA indicates that heavy manufacturing, fuel oil, and vehicles lack comparative advantages and would face significant challenges under free trade. TBI, which uniquely exploits data both in exports and imports, indicates that only the agriculture, transport, leather, and meat and livestock sectors possess a comparative advantage. Conversely, fuel oil, plastic, and machinery are identified as sectors lacking comparative advantage and are projected to experience substantial declines under free trade.

Table 3. 1. Results of Comparative Advantage Indicators and Ranking

Sector	BRCA	SRCA	ARCA	TBI	Ranking			
					BRCA	SRCA	ARCA	TBI
Agriculture	23.076	0.917	0.399	0.964	1	1	1	1
Transport	6.079	0.717	0.188	0.203	2	2	2	3
Meat and livestock	3.648	0.570	0.039	0.883	3	3	3	2
Leather	1.989	0.331	0.011	0.196	4	4	5	4
Cereal	1.297	0.129	0.001	-0.573	5	5	6	6
Service	1.135	0.063	0.020	-0.179	6	6	4	5
Textile	0.595	-0.254	-0.015	-0.673	7	7	8	8
Processed food	0.290	-0.551	-0.021	-0.734	8	8	9	10
Light manufacturing	0.230	-0.626	-0.166	-0.812	9	9	16	11
Energy and extraction	0.173	-0.705	-0.038	-0.673	10	10	11	8
Tobacco and beverage	0.171	-0.708	-0.006	-0.662	11	11	7	7
Machinery	0.064	-0.880	-0.059	-0.956	12	12	12	14
Vehicles	0.063	-0.882	-0.089	-0.917	13	13	13	12
Plastic	0.044	-0.916	-0.021	-0.966	14	14	9	15

Heavy manufacturing	0.042	-0.920	-0.141	-0.951	15	15	15	13
Fuel oil	0.000	-1.000	-0.101	-1.000	16	16	14	16

Source: Author's calculation from GTAP database 10 (base year = 2014)

Note: Sectors are sorted by the BRCA ranking.

Turning to the predictions offered by NRP and ERP, we find large discrepancies between them. According to NRPs, textile, leather, tobacco and beverage, meat and livestock, and agriculture sectors are highly protected by tariffs, compared with other sectors (**Table 3. 2).** Removing such strong protections would lower their output prices significantly and thus negatively affect their value-added under free trade. Relatively lower protections are granted to the service, transport, fuel oil, and cereal sectors. However, it is worth noting that the NRPs do not consider the potential benefits that could arise from tariff removals on inputs, which may limit the prediction power of NRPs. The ERP analysis, which considers protections on inputs additionally, indicates that the fuel oil, light manufacturing, and plastic industries receive substantial levels of protection and would face significant challenges once free trade removes strong protections on them. Fuel oil and light manufacturing, which are predicted to be less affected by NRP, emerged in ERPs as the top two sectors impacted under free trade. The leather and textile sectors are predicted by NRPs to face a significant impact but by ERPs only a marginal impact. The agriculture, meat and livestock, and transport sectors are predicted to face moderate challenges under free trade, which is consistent with the RCA-based predictions (**Table 3. 2**). Conversely, the vehicles, machinery, and textile sectors are the least protected sectors and thus predicted to face marginal challenges under free trade, while the RCAs predict their negative prospects under free trade.

Table 3. 2. Results of NRP, ERP, and Ranking

Sector	NRP	ERP	Ranking	
			NRP	ERP
Fuel oil	2	2542	14	1
Light manufacturing	10	651	11	2
Plastic	16	190	5	3
Processed food	15	187	7	4
Energy and extraction	15	177	7	5
Tobacco and beverage	31	114	3	6
Meat and livestock	17	32	4	7
Agriculture	16	22	5	8
Cereal	5	9	13	9
Service	0	-1	15	10
Transport	0	-1	15	10
Leather	33	-253	1	12
Heavy manufacturing	12	-384	9	13
Textile	32	-471	2	14
Machinery	7	-747	12	15
Vehicles	11	-902	10	16

Source: Author's calculation from GTAP 10 database (base year = 2014).

Note: Sectors are sorted by the ERP ranking.

Comparing the results of RCA and the level of protection indicators, using the rankings of BRCA and ERP, we find consistent predictions in some sectors, which are located along the -45-degree line in **Figure 3. 1**. Both BRCA and ERP predict significant challenges for fuel oil, light manufacturing, plastic, tobacco and beverage, and energy and extraction. The effects on other sectors remain uncertain, making confident predictions challenging. Around the northeastern corner, BRCA predicts a significant challenge in heavy manufacturing, textile, vehicles, and machinery. Meanwhile, ERP predicts only moderate challenges by tariff removals for these sectors. The agriculture, meat and livestock, and transport sectors are found competitive under BRCA, while ERP predicts moderate challenges under free trade. Examination of "sensitive sectors"– leather and textiles – uncovers intriguing disparities in the analyses. BRCA designates leather as competitive, while textiles are deemed less competitive. In contrast, ERP predicts relatively minimal challenges for both sectors under free trade.

It should be noted that the observed competitiveness, indicated by RCAs, may be attributed either to the innate strength of a sector or to the protection conferred by tariffs on imports. We cannot distinguish them given the observed trade patterns. For example, although the agriculture and meat and livestock sectors are found competitive by BRCA, they are moderately protected as indicated by ERP. Similarly, the light manufacturing and processed food sectors show moderate competitiveness under strong protections. BRCA might be reporting disguised competitiveness for them. ERP, as well as NRP, measures protections granted to a sector, assuming foreign goods are perfectly substitutable with domestic goods. As they are not necessarily fully substitutable (Armington, 1969), the actual impacts of tariff removals would depend on the degree of import penetration and export dependency in a sector. These measurements are accessible and indicative, but not perfect. Due to this potential bias, we need a CGE simulation for comprehensive analysis.

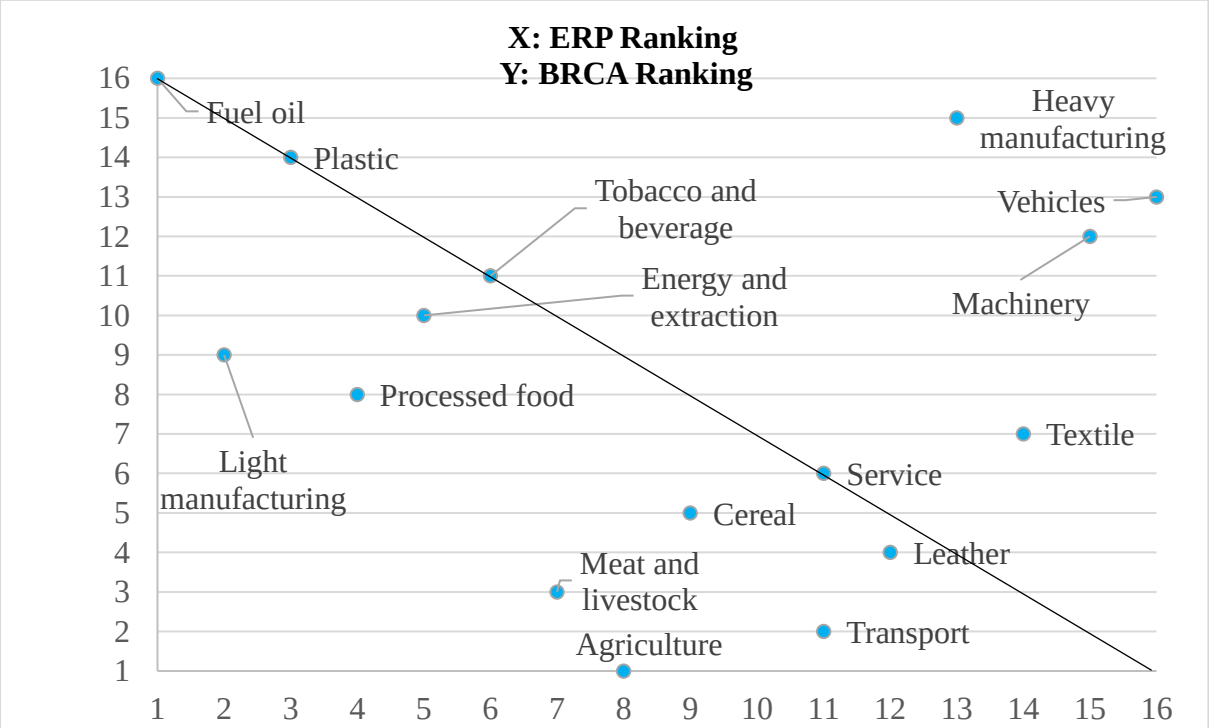


Figure 3. 1. Predictions by BRCA and ERP

3.6. Conclusion

We used the trade indicators to examine the potential impact of joining FTAs on the Ethiopian economy. They provide clues for us to predict consequences in trade and subsequently output by sector. The findings of the RCA indicators exhibit consistent predictions for sectors showcasing strong comparative advantages. Agriculture, transport, meat and livestock, and leather sectors possess a comparative advantage across all indicators. The results for sectors with a comparative disadvantage differ across the indicators. Both BRCA and SRCA result indicates that fuel oil, plastic, and heavy manufacturing lack comparative advantage. ARCA result indicates that heavy manufacturing, fuel oil, and vehicles lack comparative advantages. TBI indicates fuel oil, plastic, and machinery lack comparative advantage. Level of protection indicators (ERP/NRP) reveals notable inconsistency in the prediction. NRP indicates leather, textile, and tobacco and beverage are highly protected, and predicted to suffer under free trade, consistent with previous studies. Conversely, transport, service, and fuel oil are less protected and are expected to face minimal challenges. On the other hand, the ERP result has shown fuel oil, light manufacturing, and plastic are highly protected and would face significant challenges under free trade. Vehicles, machinery, textile, and heavy manufacturing are less protected, and their ERP result signifies that they face marginal challenges under free trade.

The predictions derived from BRCA and ERP demonstrate certain commonalities in identifying weak sectors. Fuel oil, light manufacturing, plastic, tobacco and beverage, and energy and extraction are predicted to face significant challenges by both BRCA and ERP. They, however, bring different predictions in some key sectors in Ethiopia. The agriculture sector, which is often regarded as competitive in Ethiopia (Ben et al., 2006), is found indeed competitive by BRCA but predicted by ERP to face moderate challenges. The textile and

leather sectors, which are regarded as “sensitive sectors" in prior studies, are predicted by ERP to experience minimal challenges. Meanwhile, the weakness of the textile sector found by BRCA aligns with earlier studies; but that of the leather sector diverges from those.

While we used simple trade indicators to predict sectoral trade and output, welfare impacts are not considered in this study. As welfare gains are generated through trade volume changes, both in exports and imports, welfare consequences cannot be predicted by our prediction confined to sectoral trade but by a macroeconomic analysis. This macroeconomic analysis is often conducted by using a computable general equilibrium (CGE) model for the world economy. The next chapter will present the development and simulation results of two critical trade deals for Ethiopia, AfCFTA and WTO accession, and the concluding chapter will synthesize the results with simple trade indicators and those with a CGE model.

Chapter 4: CGE Model Study

4.1. Introduction

After declining to join free trade agreements for years, Ethiopia joined the African Continental Free Trade Area (AfCFTA) and resumed its negotiations (suspended in 2013) to join the WTO. These decisions to open up the economy and join free trade areas are expected to benefit the Ethiopian economy by providing better market access and reducing input costs. These decisions have sparked widespread concerns about the benefit to the Ethiopian economy. One concern is the possibility that the Ethiopian manufacturing industry might not be able to compete with the imports that would flow into the country under free trade (Makonnen & Lulie, 2014). Alemu & Zerihun (2005) examined the production costs of Ethiopian industries and found that the textile, chemical, leather, and food and beverage sectors were weak. Similarly, Africa Development Bank Group (2014) found that the food and beverage, textile, leather, and chemical sectors could not compete under tariff reduction. Another concern is the capacity of Ethiopia's products to compete in the international market. Both Alem (2020) and Ethiopian Business Review (2014) argue that Ethiopia's problems stem not from a lack of access to the international market but from the inability to produce the required quality and quantity. Indeed, Ethiopia has not succeeded in exploiting concessional market access opportunities offered by the US (the Africa Growth and Opportunity Act) and by the EU (the Everything But Arms scheme). Moreover, as Ethiopia's trade is mainly directed outside Africa (**Table 4. 1**), AfCFTA accession would bring only limited gains. Ethiopia's accession to WTO and AfCFTA might increase imports significantly but exports only a little, which would harm the Ethiopian economy.

Table 4. 1. Ethiopia's Import and Export by Direction [%]

Region*	Import share	Export share
West Africa	0.1	0.6
Central Africa	0.0	0.3
North Africa	2.1	1.6
East Africa	2.5	2.2
Southern Africa	1.1	13.7
Europe	24.5	31.9
Asia	63.3	31.1
Rest of the world	6.4	18.6

Source: GTAP 10 database (base year = 2014)

Note: Regional classifications are explained in the methodology part.

As stated in the preceding concerns, Ethiopia imports a large number of manufactured goods, mostly from non-AfCFTA regions (**Table 4. 2**). Though their tariffs and nontariff measures (NTMs) are not higher than those in other sectors, the manufacturing sector is expected to be hit hard by AfCFTA and WTO accession due to the resulting large penetration of imported manufactured goods. Ethiopia's exports are dominated by agriculture, service, and transport (**Table 4. 3)**. Ethiopia's agricultural exports in particular face high tariff and nontariff barriers, especially in non-AfCFTA regions, and thus would benefit more from the WTO than the AfCFTA.

Table 4. 2. Ethiopia's Imports, Tariffs, and NTMs on Ethiopia's Imports by Sector and Source

	Imports [mil. USD]			Tariff [%]			NTMs [% in Ad Valorem Equivalent]		
Sector	All	AfCFTA	non-AfCFTA	All	AfCFTA	non-AfCFTA	All	AfCFTA	non-AfCFTA
Agriculture	40	5	35	16	18	16	1	0	2
Cereal	120	1	118	5	5	5	1	0	1
Vehicles	777	19	759	11	20	10	2	1	0
Machinery	1,037	10	1,027	7	9	7	2	1	2
Meat and livestock	17	4	13	16	16	17	0	0	1
Energy and extraction	202	46	156	14	13	14	0	0	0
Processed food	295	41	254	15	17	15	6	2	1
Textile	524	13	511	32	28	32	4	2	1
Leather	66	2	65	34	30	34	0	1	2
Fuel oil	2,271	251	2,019	2	2	2	4	7	0
Tobacco and beverage	28	3	24	31	32	31	13	11	0
Plastic	282	39	243	16	12	17	0	0	1
Heavy manufacturing	1,355	30	1,325	11	17	11	3	1	2
Light manufacturing	2,568	192	2,377	10	10	10	1	1	0
Service	1,554	22	1,532	0	0	0	0	0	0
Transport	957	18	939	0	0	0	0	0	0

Source: Authors calculation from GTAP 10 database (base year = 2014) and UNCTAD database (2020)

Table 4. 3. Ethiopia's Exports, Tariffs, and NTMs on Ethiopia's Exports by Sector and Destination

Sector	Exports [mil. USD]			Tariff [%]			NTMs [% in AVE]		
	All	AfCFTA	non-AfCFTA	All	AfCFTA	non-AfCFTA	All	AfCFTA	non-AfCFTA
Agriculture	2,677	749	1,927	7	1	10	2	0	1
Cereal	39	14	25	0	0	0	1	0	0
Vehicles	38	15	24	5	13	0	0	0	1
Machinery	26	11	14	5	8	2	2	0	1
Meat and livestock	343	227	116	1	1	2	1	0	0
Energy and extraction	52	23	28	9	18	0	0	0	0
Processed food	56	8	48	1	4	1	1	1	6
Textile	143	5	139	1	5	1	1	0	4
Leather	140	5	134	1	4	1	2	0	0
Fuel oil	0	0	0	0	0	0	0	0	3
Tobacco and beverage	8	3	5	3	8	0	0	0	9
Plastic	6	3	4	7	15	1	1	0	0
Heavy manufacturing	39	8	31	2	6	1	2	0	2
Light manufacturing	319	11	308	0	6	0	0	0	1
Service	1,082	50	1,032	0	0	0	0	0	0
Transport	1,444	48	1,397	0	0	0	0	0	0

Source: Authors calculation from GTAP 10 database (base year = 2014) and UNCTAD database (2020)

Other than those cost-based assessments of industrial competitiveness, only a few studies have directly assessed the impact of Ethiopia's free trade agreements. Those studies used multi-sectoral computable general equilibrium (CGE) models because free trade deals involve simultaneous and heterogeneous changes among multiple markets, which cannot be fully described by other models, such as the partial equilibrium model (Plummer et al., 2010). World Bank (2020) investigated the impact of AfCFTA by assuming tariff removal on 97% of product lines and a 50% reduction of NTMs and the findings indicate that Ethiopia's exports and imports would increase by 17.4% and 17.2%, respectively. The study also indicated that Ethiopia would gain a 2.4% increase in welfare by reducing both tariffs and NTMs but only a 0.1% increase by reducing tariffs alone. Abrego et al. (2019) also predicted a small gain for Ethiopia from AfCFTA, well below Africa's median, assuming full tariff elimination and a 35% reduction in non-trade measures. While these two studies did not examine the impacts of AfCFTA by sector, Chauvin et al. (2016) employed a CGE model for AfCFTA experiments assuming tariff abolition and 50% NTMs reduction and indicated that Ethiopia would increase imports and exports to achieve an improvement in term of a trade by 1.25% and welfare by 3.69%. Ethiopia's agro-food sector would benefit from the AfCFTA; in contrast, the manufacturing, vegetable oil and fats, and energy sectors would be negatively affected. In trade, meat and services exports would significantly increase, whereas cereals and transport exports would fall. In imports, energy and textiles increase.

Many studies have assessed the impacts of the WTO accession, such as Eromenko (2010) for Ukraine, Ianchovichina & Martin (2001) for China, and Farajzadeh et al. (2017) for Iran, and consistently predicted improvements in welfare and GDP through increases in trade. In contrast to these CGE assessments, empirically, the effect of WTO accession on trade has been controversial. Rose (2004) used data on IMF's direction of trade from 1948

to1999 and found that joining WTO did not increase trade. Subramanian & Wei (2007) found that WTO has increased world trade substantially. Roy (2011), using data from 1960 to 2000, similar to Rose (2004), found no evidence of WTO membership increasing trade. The impact of WTO accession may not be as straightforward as the trade theory predicts. In the particular context of Ethiopia's WTO accession, no assessment has been conducted, to the best of the author's knowledge. Ben et al. (2006) investigated the effects of the Economic Partnership Agreement with the European Union, which can indicate the impact of WTO accession on Ethiopia because the EU is one of Ethiopia's largest trade partners (exports and imports share are 31.9% and 24.5%, respectively). When assuming a 100% unilateral tariff reduction on all imports by Ethiopia, they found that Ethiopia's total imports from Europe would increase by 33% and that Ethiopia would gain in welfare worth 19 million USD, only 0.003% of Ethiopia's GDP.

Many of those previous studies focused on the macroeconomic impact of AfCFTA and WTO membership in each economy/region but put less emphasis on country-specific matters, particularly at the sectoral level. Moreover, they did not consider the exemption of tariff removal on specific goods, which is allowed for 3% of product lines in the AfCFTA. (Hereafter, we call them as "excluded products".) The exemption would reduce the gains from free trade on the consumer side but mitigate negative impacts on vulnerable sectors on the producer side. And, some past studies were made on dated data. Chauvin et al. (2016) constructed a world trade CGE model using GTAP 8 database, whose base year is 2007; more recent GTAP 10 allows us to simulate free trade deals with the reference year of 2014. As we have experienced a remarkable trade explosion in the global economy, AfCFTA and WTO accession can increase intra-Africa and inter-regional trade much larger than those predicted by earlier studies.

Given the gap between achievements in the literature and the currently ongoing two trade deals that Ethiopia faces, we developed a world trade CGE model and assessed their impacts quantitatively. AfCFTA is simulated by mutual tariff abolition and NTM reduction among the AfCFTA members, where we considered cases with and without exemption of tariff abolition for specific products designated for each member. We simulated Ethiopia's WTO accession, assuming 50% unilateral tariff and NTM reductions against all regions, by considering the experience of China and Vietnam's WTO accession.[4] We then examined the impacts of these trade deals on trade, welfare, and sectoral outputs.

This introductory section is followed by Section 4.2, which describes the methodology of our research. Section 4.3 provides details of our simulation scenarios, and Section 4.4 examines the simulation results. Section 4.5 concludes the study by drawing policy implications.

4.2. Methodology

Our CGE model distinguishes eight regions: Ethiopia, West Africa, Central Africa, North Africa, East Africa, "Southern Africa"[5], Asia, Europe, and the rest of the world (ROW)[6]. The sectors in the GTAP 10 database are aggregated into 16 sectors: agriculture, cereal, vehicles, machinery, meat and livestock, energy and extraction, plastic, tobacco and beverage, fuel-oil, processed food, textile, leather, heavy manufacturing, light

[4] When China acceded to the WTO, it reduced the average tariff rate by almost 60 % from 21.4 % to 7.9 % (Ianchovichina & World Bank, 2004). Similarly, Vietnam reduced the average tariff rate by 25 % from 23.3 to 17.4 % (Cling et al., 2008).

[5] "Southern Africa" does not refer a country of the Republic of South Africa but a region that encompass eight countries in southern Africa. Similarly, "Central Africa" does not refer a country of the Central African Republic but a region with five countries, including the Central African Republic. Details of regional aggregation are provided Appendix A.

[6] Countries included in each region are shown in the Appendix Table A1. The sectoral aggregation is also provided in the Appendix Table B1. Eritrea is the only country that didn't sign the AfCFTA agreement. But due to lack of separate data for this country in the GTAP database, we aggregated it into East Africa, an AfCFTA member region as a whole. As of 2023, the WTO has 164-member countries, 25 observers, and 14 non-member countries; Ethiopia is not supposed to cut border barriers against the last two groups in its WTO accession. However, as the last two groups have little significance in trade with Ethiopia, we assume all trade partners are the full WTO members, for the sake of simplicity.

manufacturing, service, and transport. This sectoral aggregation is chosen to describe major industries in Africa well while accommodating "excluded sectors" whose tariff abolition is exempted under AfCFTA provisions.

The model is constructed based on the standard CGE model by Hosoe et al. (2010) with a nested constant elasticity of substitution/transformation (CES/CET) structure. The production process starts at the bottom of **Figure 4. 1 .** Capital, skilled labor, unskilled labor, and land, which are imperfectly substitutable with each other, are aggregated to produce value-added with a Cobb–Douglas type production function. For the production of gross domestic output, we employ a Leontief-type production function, which aggregates value-added and intermediate inputs. Gross domestic output is transformed into composite exports and domestic goods with a CET production function. Composite exports are further transformed into exports to each destination country with a CET function. Similarly, imports from various source countries are combined with domestic goods to produce composite imports. Composite imports and domestic goods are combined into Armington's (1969) composite goods. We assume a constant elasticity of substitution (CES) function for these aggregation processes.

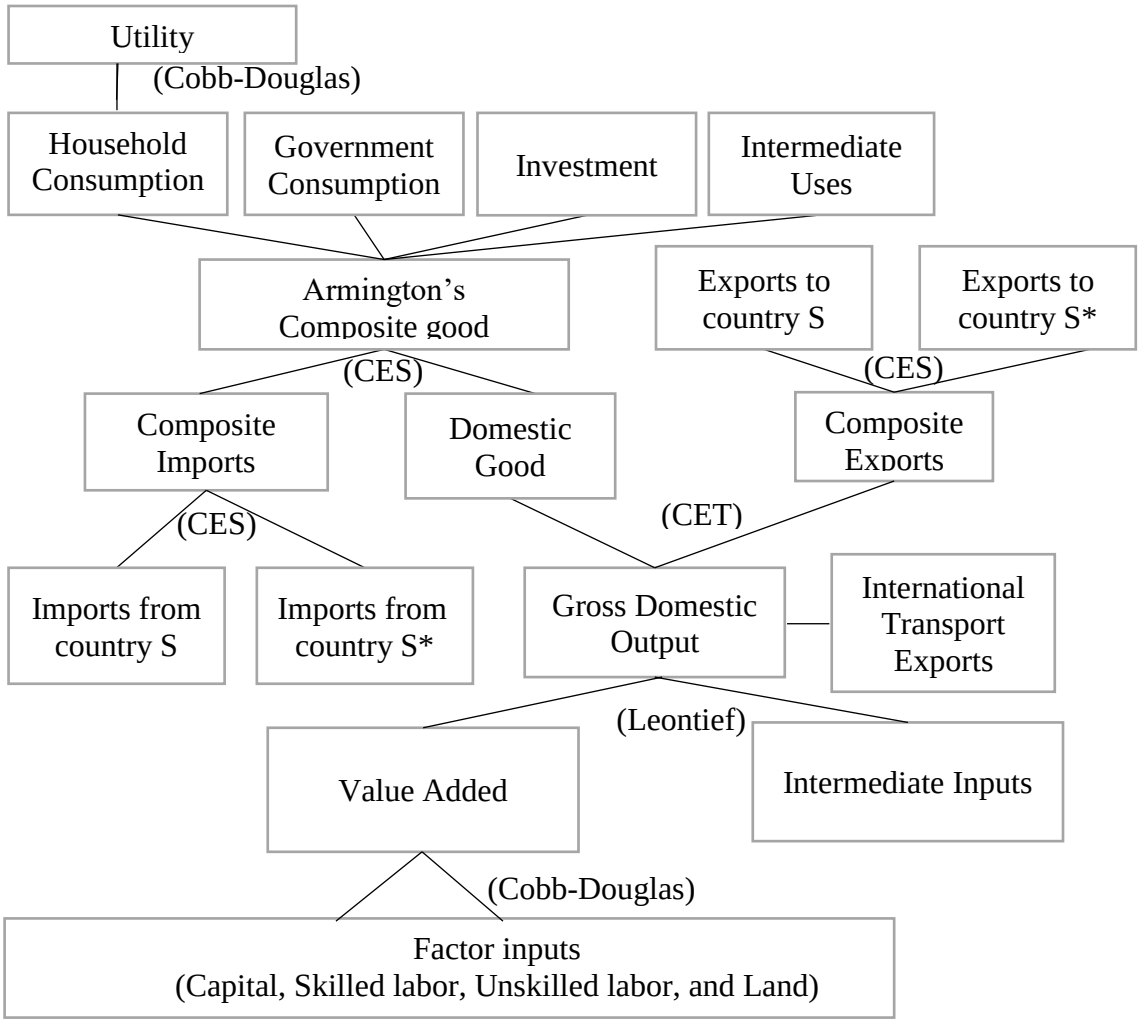


Figure 4. 1. Structure of the Model

Departing from Hosoe et al. (2010), we incorporate NTMs in international trade in the form of iceberg costs. Denote the loss rate $QTloss_{i,r,s}$ for the i-th good shipped from the r-th region to the s-th region; only a fraction of goods (1- $QTloss_{i,r,s}$) arrives at the destination. To calibrate NTMs in goods, we calculated the weighted average of NTMs using the 2020 ad-valorem equivalent measures $\tau_{i,r,s}^{NTM}$ for the i-th good shipped from the r-th region to the s-th region, released by UNCTAD (2020).[7] Using the NTM data, we compute the loss rate, $QTloss_{i,r,s} = \tau_{i,r,s}^{NTM}/(\tau_{i,r,s}^{NTM} + 1)$. As NTMs tend to be smaller than the tariff in most commodities (**Table 4. 2** and **Table 4. 3**), the reduction in NTMs would have a smaller effect than the tariff reduction[8].

In the final demand, a Cobb–Douglas type utility function is assumed behind the consumption of the representative household in each region. The changes in household consumption are used to evaluate welfare impacts resulting from trade liberalization. Government consumption and investment uses of goods are determined proportionately to the total tax revenues and savings, respectively. The tax revenues are generated by household income tax, sectoral production tax, and ad valorem import tariffs and export tax. A tariff reduction decreases government revenues and leads to a decrease in government consumption and savings. Household and government savings are determined by a constant propensity to save; foreign savings, or current account deficits, are assumed to be constant in the rest of the world's currency term, whereas foreign exchange rates are flexibly adjusted.

[7] See, Kee and Nicita (2022) for details of the estimation method.
[8] The regional and sectoral coverage of the NTM barrier estimates by UNCTAD is limited. As the NTM database is under construction for many African countries, estimates of NTM barriers on trade between Ethiopia and these African regions are often found small or zero (i.e., not statistically significant).

Factor markets are assumed to be in full employment in each country, and all factors but land are assumed to be mobile across sectors.[9] Unskilled labor is chosen as a numeraire, and its price is fixed. Markets are assumed to be perfectly competitive for the sake of simplicity. The model is calibrated to the GTAP 10 database (2014 base year) and the abovementioned NTM database by UNCTAD (2020) with elasticity parameters provided by the same database[10].

4.3. Simulation Scenarios

4.3.1. The AfCFTA Scenario

To assess the impact of AfCFTA, we simulated mutual tariff abolition (Scenario A1) and NTM reduction (Scenario A2) among AfCFTA members and their combination (Scenario A3), as summarized in **Table 4. 4**. As members are allowed to exclude products, though only as few as 3 % of product lines, from tariff abolition, we consider such exclusion in Scenario A4 to highlight its effects. Based on the literature, we assumed that the excluded products were textiles and in Ethiopia; vehicles and plastic in East Africa; cereal and machinery in West Africa; fuel oil and machinery in Southern Africa; and agriculture in North Africa. However, we did not choose excluded products for Central Africa due to a lack of data[11].

[9] Land includes farmland and natural resources in the GTAP Database. We also conducted the same simulation with an alternative assumption with land mobility across sectors. Results are shown in the Appendix F.
[10] The results of the sensitivity analysis with respect to the Armington elasticity parameter are shown in the Appendix E.
[11] Detail explanation on selection of "excluded sectors' in each region is shown in the Appendix D.

Table 4. 4. AfCFTA Tariff and NTMs Reduction Scenarios

	Tariff abolition	NTM reduction by 50 %	exclusion of selected products from tariff abolition
A1_tariff	Yes	-	-
A2_NTM	-	Yes	-
A3_tariff_NTM	Yes	Yes	-
A4_tariff_NTM_Sens	Yes	Yes	Yes

4.3.2. The WTO Scenario

The WTO requires countries applying for WTO membership to lower trade barriers to an equitable level, although there are no specific benchmarks on tariff or NTM reductions set by the WTO; benchmarks are left to negotiations between the applicant and the working party members. In many past WTO accession cases, countries cut tariffs and NTMs by 25–60%. For instance, China decreased its weighted average tariff rate from 21.4% to 7.9% and its non-tariff measures rate from 9.3% to 5% for its WTO accession (Ianchovichina & World Bank, 2004). Similarly, Vietnam reduced tariff rates by 25%, from 23.3% to 17.4% (Cling et al., 2008). Based on these references, we assumed a 50% unilateral tariff and NTM reduction by Ethiopia in the following three scenarios, which are designed to clarify the individual and combined effects of tariff and NTM reductions (**Table 4. 5**).[12]

[12] Given the uncertainty regarding WTO deals, we also simulate a case where WTO members also cut tariffs by 10%. Results are provided in the Appendix F.

Table 4. 5. Tariff and NTMs Reduction Under the WTO Scenario

	Tariff reduction by 50%	NTM reduction by 50%
W1_tariff	Yes	-
W2_NTM	-	Yes
W3_tariff_NTM	Yes	Yes

4.4. Simulation Results

4.4.1. AfCFTA Accession

4.4.1.1. Impact on Trade

The tariff reduction under Scenario A1 would increase imports by Ethiopia in several sectors. Among them, two sectors, energy and extraction, and light manufacturing, would show a marked increase **(Figure 4. 2).**[13] Imports of energy and extraction would increase by 32 million USD from the baseline owing to the removal of the moderately high tariffs (**Table 4. 2**). Light manufacturing imports would rise by 25 million USD. Although Ethiopia's light manufacturing tariff is not so high, 10%, a large amount of initial light manufacturing imports from AfCFTA members would make its import changes significant. Among Ethiopia's two excluded products, textile imports would increase by 12 million USD, while leather imports would increase only a little.

[13] All the results in the table are taken from the simulation results unless and otherwise it is stated.

Under Scenario A2, the NTMs reduction, imports of light manufacturing and processed food would increase compared to other sectors **(Figure 4. 2)**. Light manufacturing**,** and processed food imports would each increase by 2 million USD. The textile and leather sectors**,** classified as "excluded products" from tariff abolition in Ethiopia, would experience slight changes. Textile import would increase by 1 million USD, while leather import would remain unchanged. Scenario A3 demonstrates the combined impact of tariff abolition and NTM reduction. The exclusion of the two "excluded products" from tariff abolition under Scenario A4 would reduce the imports of textiles by 15 million USD, from 13 million USD in Scenario 3 (without exclusion). That exclusion would reduce leather imports to the pre-AfCFTA level, although the impact of leather tariff removal would not be sizable under Scenario 3 (without exclusion).

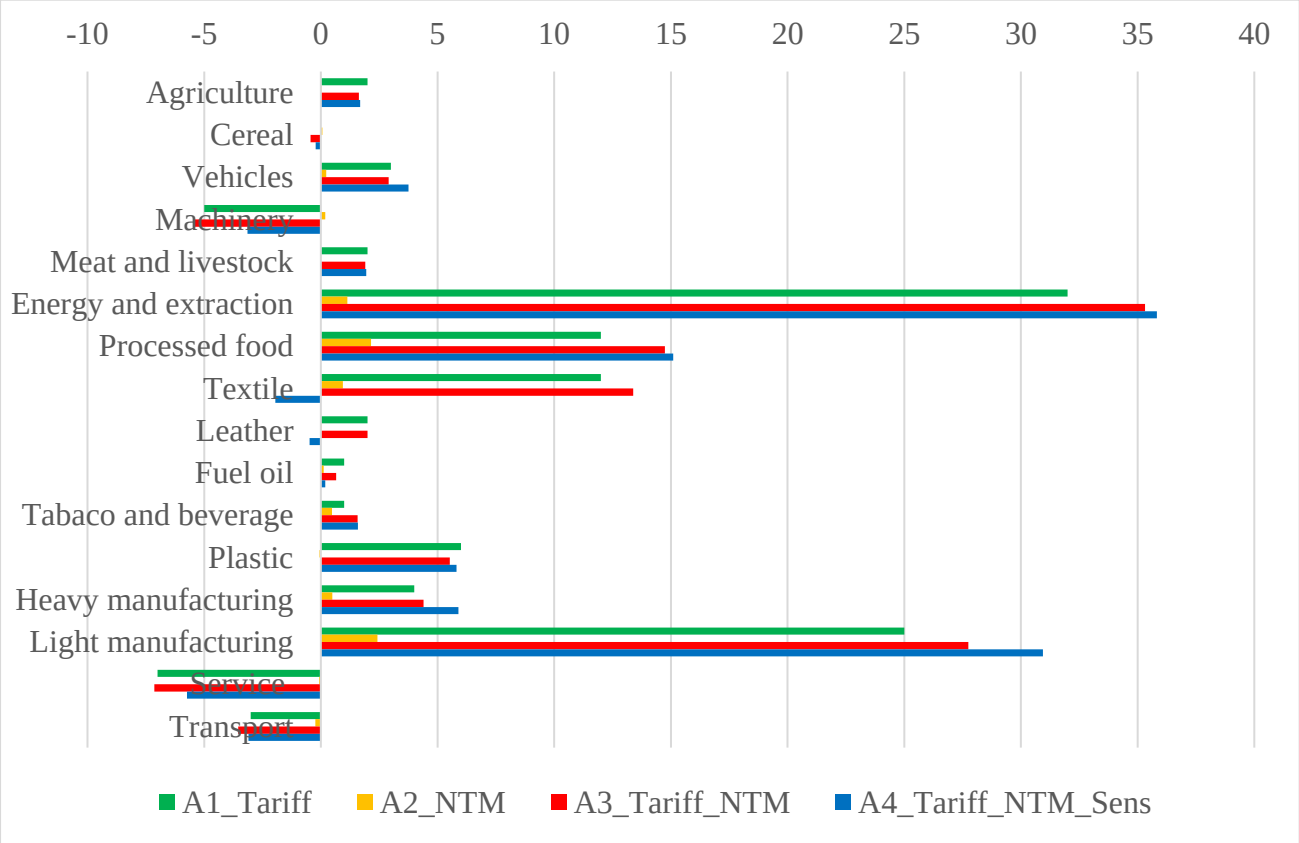


Figure 4. 2. Impacts of AfCFTA on Ethiopia's Sectoral Imports [Changes from the baseline in mil. USD]

Under AfCFTA, among the AfCFTA regions, Ethiopia's imports from North Africa, Southern Africa, and East Africa would increase significantly, but only marginally from Central Africa and West Africa **(Figure 4. 3).** North Africa, Southern Africa, and East Africa are the major sources of imported goods that are predicted to grow in **Figure 4. 2**, i.e., energy and extraction, light manufacturing, processed food, and textiles. As Ethiopia's textile imports were mostly sourced from North Africa and East Africa before the trade liberalization, the exclusion of textiles from tariff abolition in Scenario A4 would close their export opportunity window. Textile imports, which showed an increase of 13 million USD from East Africa and 8 million USD from North Africa under Scenario A3, would be eroded to 1 million USD and 0 million USD, respectively. In contrast, as seen in the sectoral imports, the exclusion of leather products would not cause a visible impact. In total, AfCFTA would promote a large amount of Ethiopia's imports from AfCFTA regions and decrease its imports from non-AfCFTA regions severely, leading to a substantial import diversion.

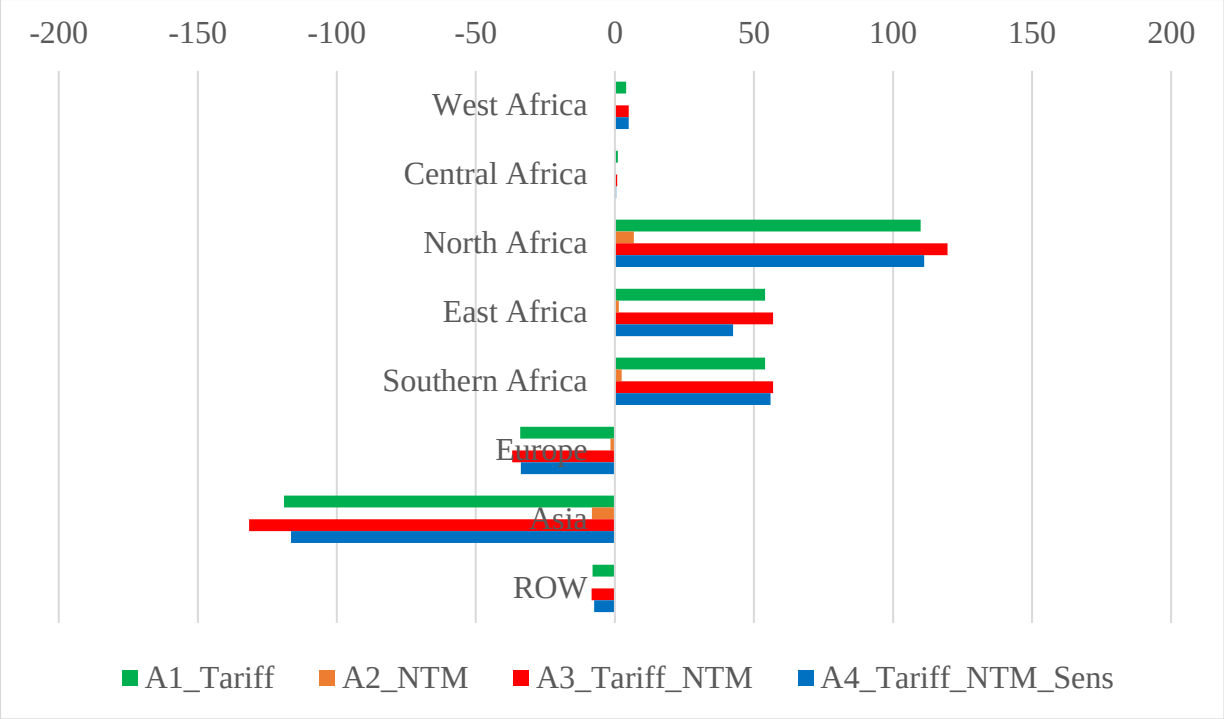


Figure 4. 3. Impacts of AfCFTA on Ethiopia's Bilateral Imports [Changes from the baseline in mil. USD]

Under Scenario A1, Ethiopia's exports would significantly increase in agriculture, energy and extraction, and meat and livestock sectors (**Figure 4. 4**). Exports of the energy and extraction sector, which produces gold, tantalum, potash, and gemstones (such as diamonds, sapphires, and opal), would significantly increase by 24 million USD. This increase is driven mainly by exports to Southern and West Africa, where tariffs were initially high. For example, energy and extraction sector exports face high initial tariffs by AfCFTA countries **(Table 4. 3)**. Agriculture, and meat and livestock exports would increase by 22 million and 9 million USD, respectively; they face marginal tariffs by AfCFTA members but are dominant in exports, exceeding 80% of Ethiopia's total exports to AfCFTA members. Tariff abolition would promote their exports mainly to Southern Africa and North Africa.

Under Scenario A2, with the NTM reduction, only agriculture would show a marginal export increase. Unlike tariff elimination, NTMs on energy and extraction exports to other AfCFTA regions are small; thus, NTM reduction would have a minor impact. Under Scenario A4, the exclusion of "excluded sectors" from tariff abolition would decrease Ethiopia's agriculture and machinery exports by 3 million USD, against which Southern Africa and West Africa keep the tariffs unchanged. However, the exports of other sectors would show only a little difference from their results in Scenario 3, the combined impacts of tariff abolition and NTM reduction.

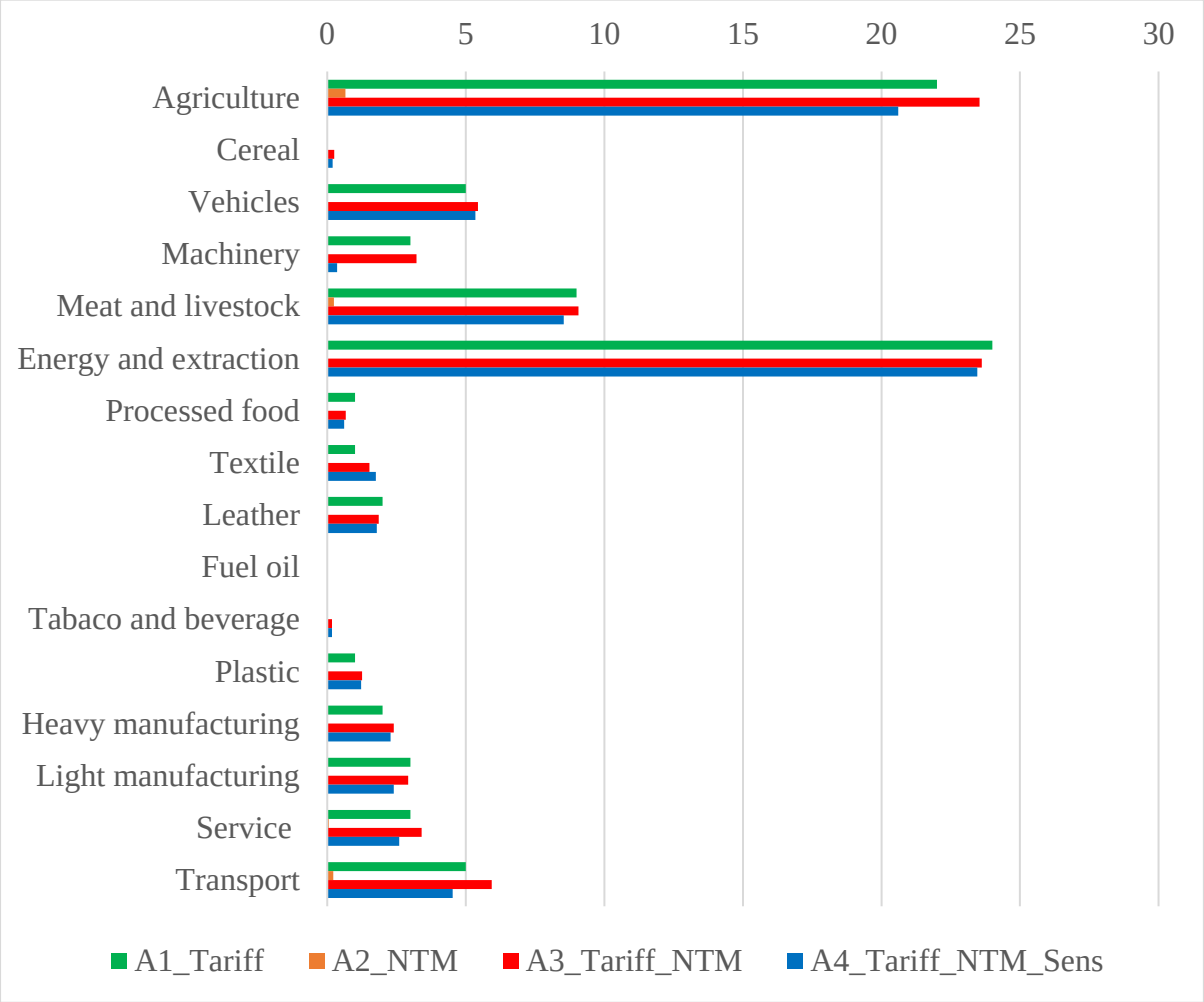


Figure 4. 4. Impacts of AfCFTA on Sectoral Export of Ethiopia [Changes from baseline in mil. USD]

The tariff abolition and NTM reduction under AfCFTA would facilitate Ethiopia's exports, mainly in agriculture, energy and extraction, and meat and livestock (**Figure 4. 4**), to other AfCFTA regions, especially Southern Africa (**Figure 4. 5**). The exports to Southern Africa would increase both under tariff abolition and NTM reduction. In contrast to imports, Ethiopia's exports to non-AfCFTA regions would be affected little by the AfCFTA border barrier reduction.

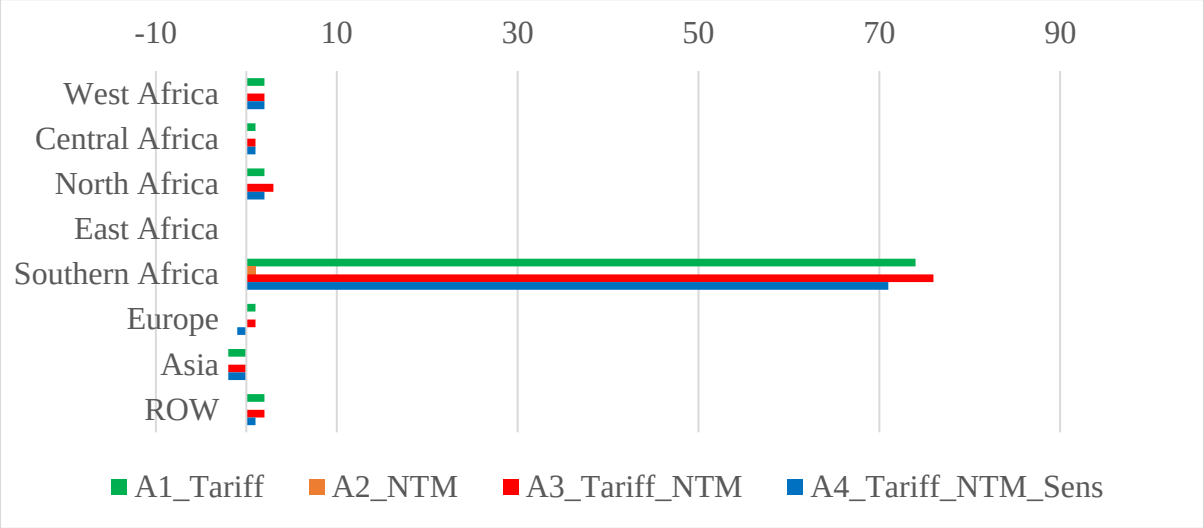


Figure 4. 5. Impacts of AfCFTA on Ethiopia's Bilateral Export [Changes from Baseline in mil. USD]

Generally, tariff and NTM reduction under AfCFTA would significantly boost intra-AfCFTA trade **(Table 4. 6).** Under Scenario A3, tariff abolition and NTM reduction, Ethiopia and Central Africa would increase exports to almost all destinations, including non-AfCFTA regions. On the other hand, West Africa, North Africa, and Southern Africa would boost exports to the AfCFTA members, switching their export destinations from non-AfCFTA members. Ethiopia, West Africa, and Central Africa would shift their import source from non-AfCFTA to the AfCFTA regions. North Africa and Southern Africa would increase imports from almost all regions due to the appreciation of their currencies against those non-AfCFTA regions.

Table 4. 6. Bilateral Trade Changes Under Scenario A3 [Changes from the baseline in mil. USD]

Exporter	Importer								
	Ethiopia	West Africa	Central Africa	North Africa	East Africa	Southern Africa	Europe	Asia	ROW
Ethiopia		2	1	3	0	76	1	-2	2
West Africa	5	1633	447	103	18	330	-435	-422	-131
Central Africa	1	40	73	28	10	82	215	478	112
North Africa	120	641	387	389	29	77	-584	-314	-106
East Africa	57	13	251	7	-10	12	-34	-53	-11
Southern Africa	57	946	1533	166	480	111	-850	-1257	-325
Europe	-37	-438	-951	109	-56	363	505	-14	32
Asia	-132	-990	-966	63	-208	527	338	442	259
ROW	-8	-137	-298	45	-12	148	73	53	47
Total Imports (column)	62	1711	478	913	251	1726	-769	-1089	-121
Total Exports (row)	83	1549	1038	638	232	862	-487	-665	-90
Total Trade Change [% of base GDP]	0.28	0.47	0.64	0.23	0.23	0.57	-0.01	-0.01	0.00

4.4.1.2. Impact on Output and Welfare

Our simulation results provide direct implications to the abovementioned concerns about the weak sectors; their output would generally decline under the tariff and NTM reduction. Scenario A1 would bring positive impacts on output in agriculture (20 mil. USD, 0.2% increase from the base), meat and livestock (6 mil. USD, 0.1% increase from the base), and machinery (6 mil. USD, 0.5% increase from the base) **(Figure 4. 6).** These increases are attributable to their export rise **(Figure 4. 4),** with only a moderate or negative increase in their imports (**Figure 4. 2),** as discussed above. In contrast, the light manufacturing and service sectors would suffer significantly under tariff abolition. The light manufacturing sector is projected to experience a decrease of 24 mil. USD (0.4% reduction from the base), while the service sector is expected to see a decrease of 43 mil. USD (0.1% reduction from the base). The decrease in the light manufacturing sector is due to the increased imports from the other AfCFTA regions. The service sector would not experience direct impacts from tariff abolition. However, it suffers indirectly due to a decrease in supply resulting from reduced government consumption, driven by the decline in tariff revenue following tariff abolition. The processed food and textiles sectors would slightly decrease their output due to the negative effect of their import increase. As the energy and extraction sector would see an increase in both imports and exports, the total impacts on output would be almost neutral.

Under Scenario A2, the NTM reduction would favor only the agriculture sector slightly. On the negative side, the NTM reduction would result in a slight reduction in light manufacturing, energy and extraction, and processed food production. They would face sharp increases in imports by the large NTM reduction in Ethiopia or only a slight increase in exports. As NTM barriers tend to be higher than tariff barriers, NTM reductions would impact trade and

output more. Scenario A3 shows the total impacts of tariff abolition and NTM reduction. Our simulation results show that some of the concerns discussed in the introduction part are generally consistent with our results. The manufacturing, food, textile, and leather sectors were feared to be hit hard by the tariff and NTM reduction. Sectors, except for the leather sector, which shows an increase, show a decrease under the tariff and NTMs reduction. Scenario A4 demonstrates a protective effect of exclusion of the "excluded sectors" from tariff reduction. While the textile sector is predicted to shrink by 5 million USD in Scenario A3, the protection would increase the textile output by 11 million USD to 6 million USD in Scenario A4. By contrast, the protective effect on the leather output would be smaller, increasing its output only by 1 million USD.

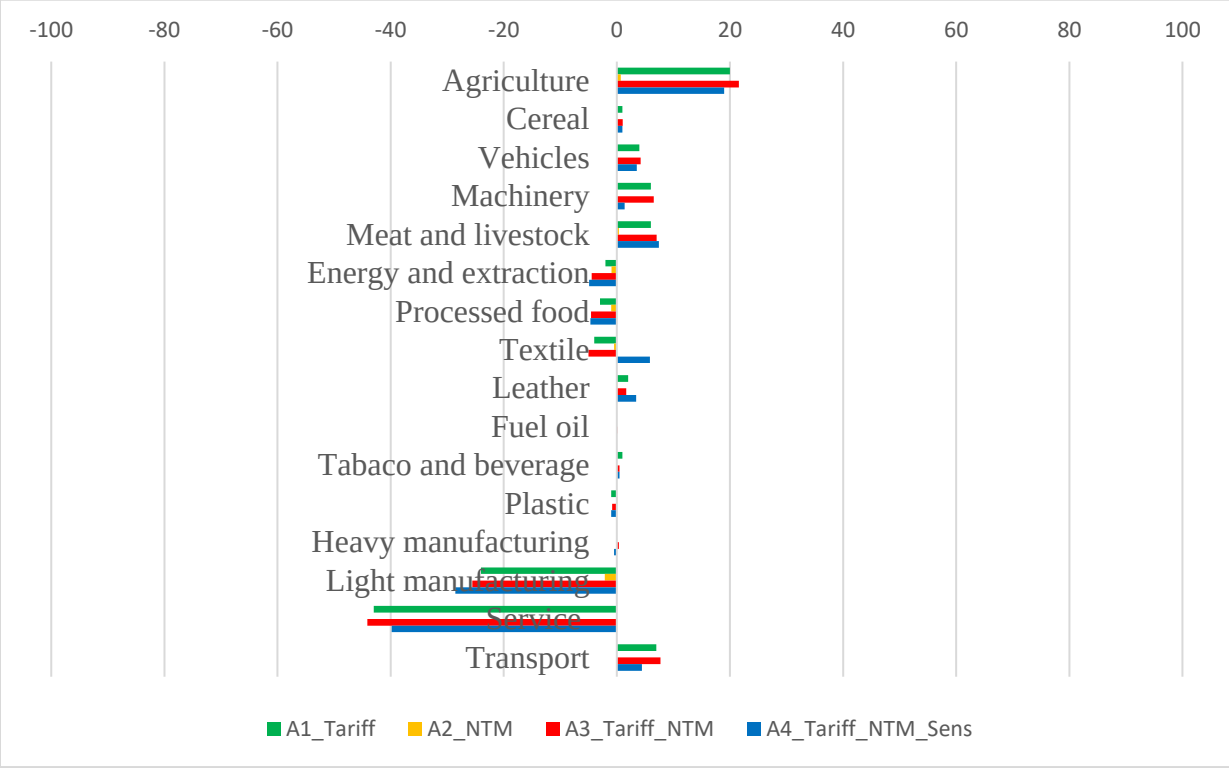


Figure 4. 6. Impact of AfCFTA on the Sectoral Output of Ethiopia [Changes from Baseline in mil. USD]

All AfCFTA member regions would benefit from abolishing tariffs and reducing NTMs under AfCFTA (**Figure 4. 7**). Reflecting the difference between border barriers created by tariffs and NTMs, gains from tariff abolition tend to be larger than those from NTMs reduction in all AfCFTA members. Ethiopia would enjoy a welfare gain, measured in Hicksian equivalent variations, as large as 0.1 % of its baseline GDP from the tariff abolition (Scenario A1) and 0.01 % from the NTM reduction (Scenario A2). As Cerdiero & Komaromi (2017), and Frankel & Romer (1999) demonstrated, regions with a larger trade change (relative to their GDP) would tend to gain larger (**Table 4. 6).** Under Scenario A3, demonstrating the combined impact of tariff abolition and NTM reduction, Central Africa would gain the most, followed by West Africa and Southern Africa. Ethiopia would enjoy the second least gain by 0.1 %**.** While some variations, all members would gain positively and thus have no incentive to leave the deal in light of their welfare gains. By contrast, non-AfCFTA members would suffer from the formation of AfCFTA, only marginally. The excluded products under Scenario A4 would slightly reduce the welfare gains predicted in Scenario A3. Though slight, Ethiopia's loss from exclusion is the largest among the AfCFTA members.

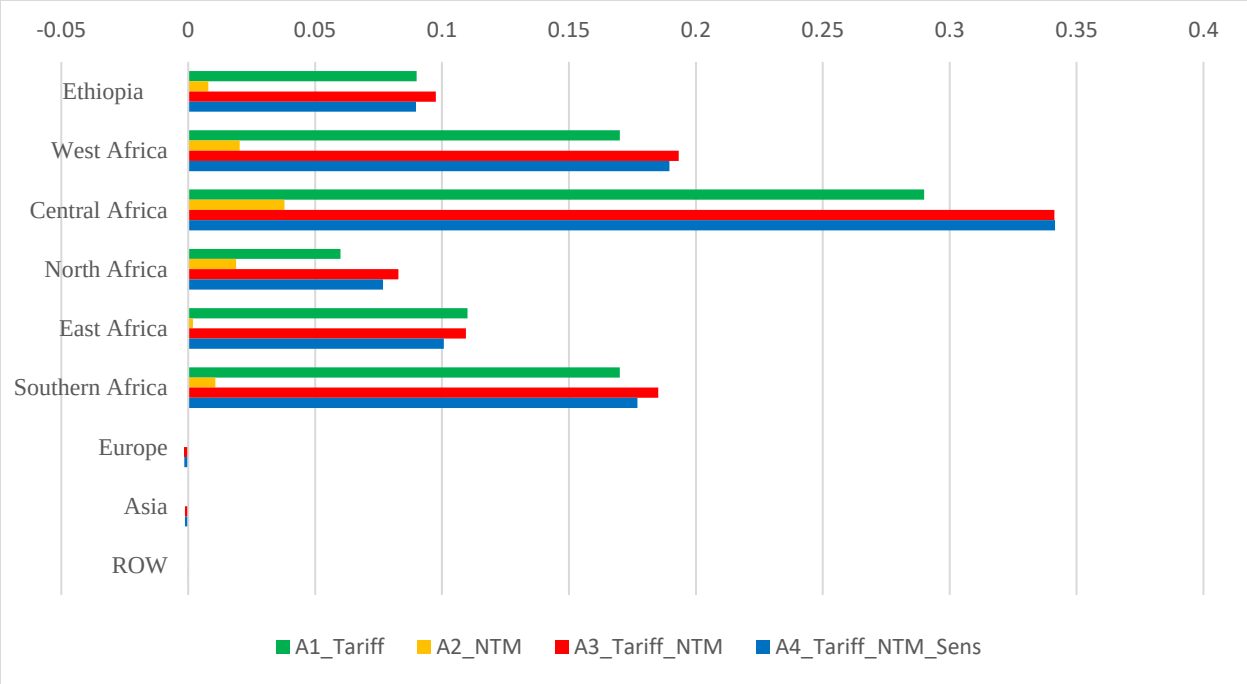


Figure 4. 7. Impact of AfCFTA on Welfare at the Regional Level [Equivalent variations, in % of the Baseline GDP]

4.4.2. WTO Accession

4.4.2.1. Impact on Trade

Ethiopia's unilateral tariff reduction for the WTO accession under Scenario W1 would increase its imports of textile, light manufacturing, and heavy manufacturing products markedly (**Figure 4. 8**). Textile imports would rise by 166 million USD, owing to the reduction of its second highest tariffs of 32% among all products in trade-weighted average tariff rates (**Table 4. 2**). Light and heavy manufacturing imports would rise by 70 million USD and 42 million USD, respectively. These goods are subject to moderate tariff rates (10% for light manufacturing

and 11% for heavy manufacturing), and their imports comprise one-third of total imports (**Table 4. 2**). They are combined to bring large import increases.

Under Scenario W2, assuming NTM reductions, would positively impact not only imports of those three products but also imports of machinery, vehicles, and processed food, whose NTM barriers are high (2%, 2%, and 6%, respectively). As the impact of tariff abolition is large, the total impacts of WTO in Scenario W3 tend to be close to those in Scenario W1.

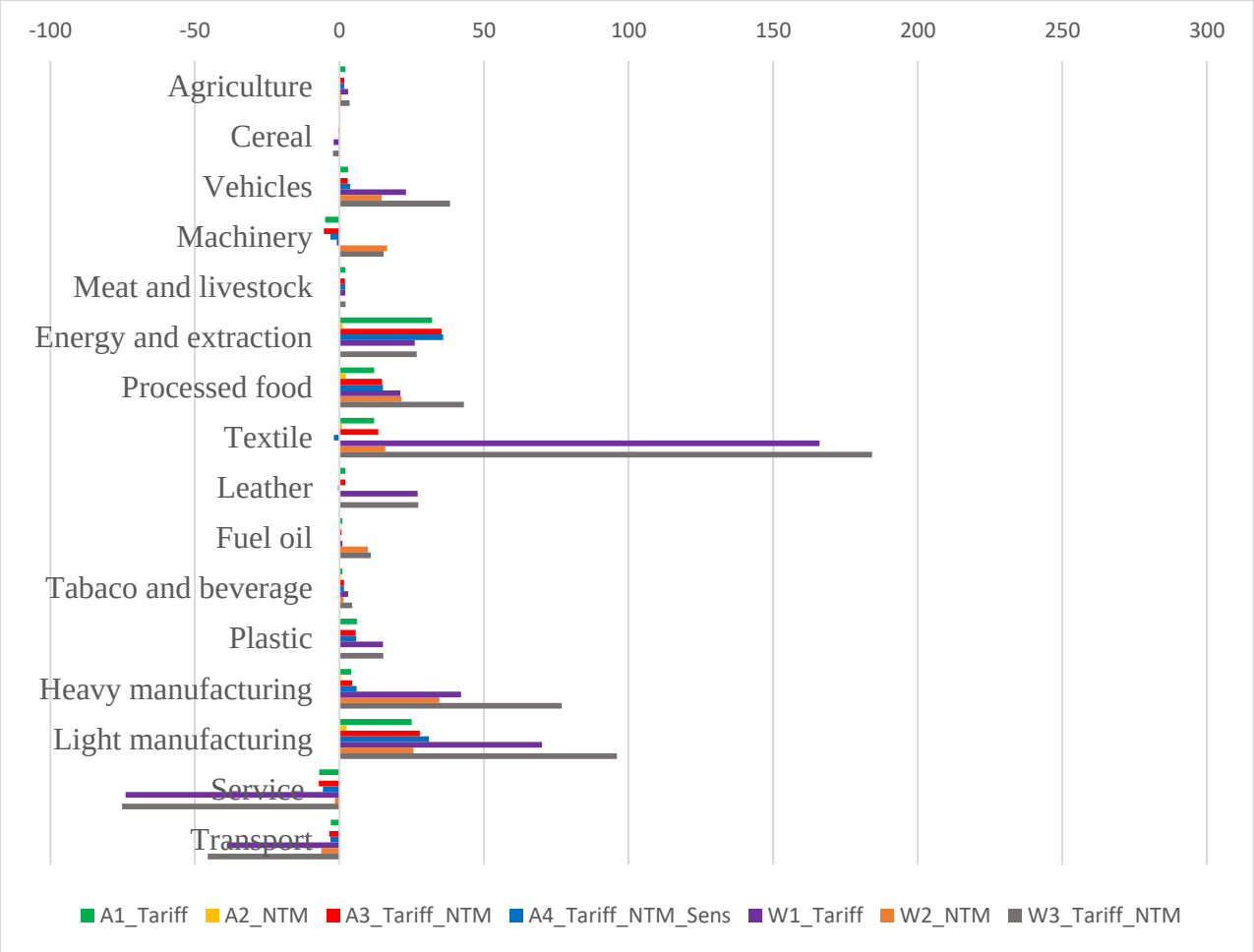


Figure 4. 8. Sectoral Import Change of Ethiopia under AfCFTA and WTO [Changes from the Baseline in mil. USD

Tariff reductions under Scenario W1 would increase imports from Asia significantly (**Figure 4.9**). The increase is mainly attributable to imports of textiles (116 million USD), light manufacturing (52 million USD), and vehicles (33 million USD). As Ethiopia's vehicle tariff rates are higher for Asia than for Europe and the ROW, the tariff reduction would increase imports, particularly from Asia, reducing imports from Europe and the ROW. Imports from the AfCFTA regions would be little affected.

Under Scenario W2, Ethiopia's imports from Europe and Asia would increase mainly in light manufacturing, heavy manufacturing, textile, vehicles, and machinery, whereas imports from East Africa would decline significantly. On the other hand, the decrease in imports from East Africa is due to fuel oil imports. Initially, Ethiopia was importing fuel oil from East Africa and set low NTMs in it compared to fuel oil imports from other regions. The NTM reduction under the WTO accession would favor fuel oil imports from other regions, such as North Africa, and negatively affect the imports from East Africa. As the impact of tariff abolition dominates that of NTM reduction, the results of Scenario W3 tend to be qualitatively similar to those of Scenario W1 but quantitatively larger.

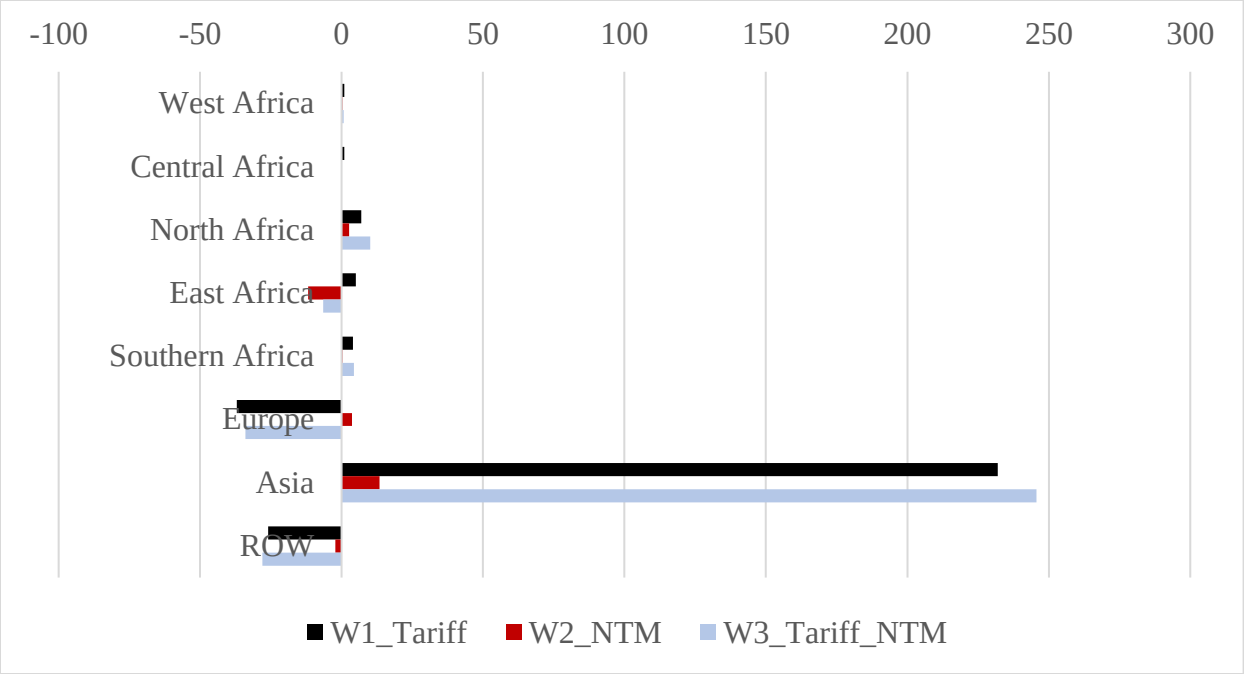


Figure 4. 9. Impacts of WTO on the Bilateral Import of Ethiopia [Changes from Baseline in mil. USD]

As none of Ethiopia's trade partners conduct tariff or NTM reductions under the WTO scenarios, Ethiopia's export increase would be driven mainly by the depreciation of the Ethiopian home currency, caused by the import increases by lowering Ethiopia's own border barriers. This depreciation effect would promote Ethiopia's exports by and large in all products. WTO accession Scenarios W1–W3 indicate that exports of agriculture, transport, and service, which are originally major products in Ethiopia's exports, would increase particularly, followed by light manufacturing and meat and livestock **(Figure 4. 10).** One notable exception is leather. This sector was supposed to be a non-competitive sector as one of two "excluded sectors" and predicted in AfCFTA simulations to play a marginal role in exports. In the WTO accession, leather exports would show a comparable increase to the abovementioned export products, mainly to Asia, Europe, and the ROW.

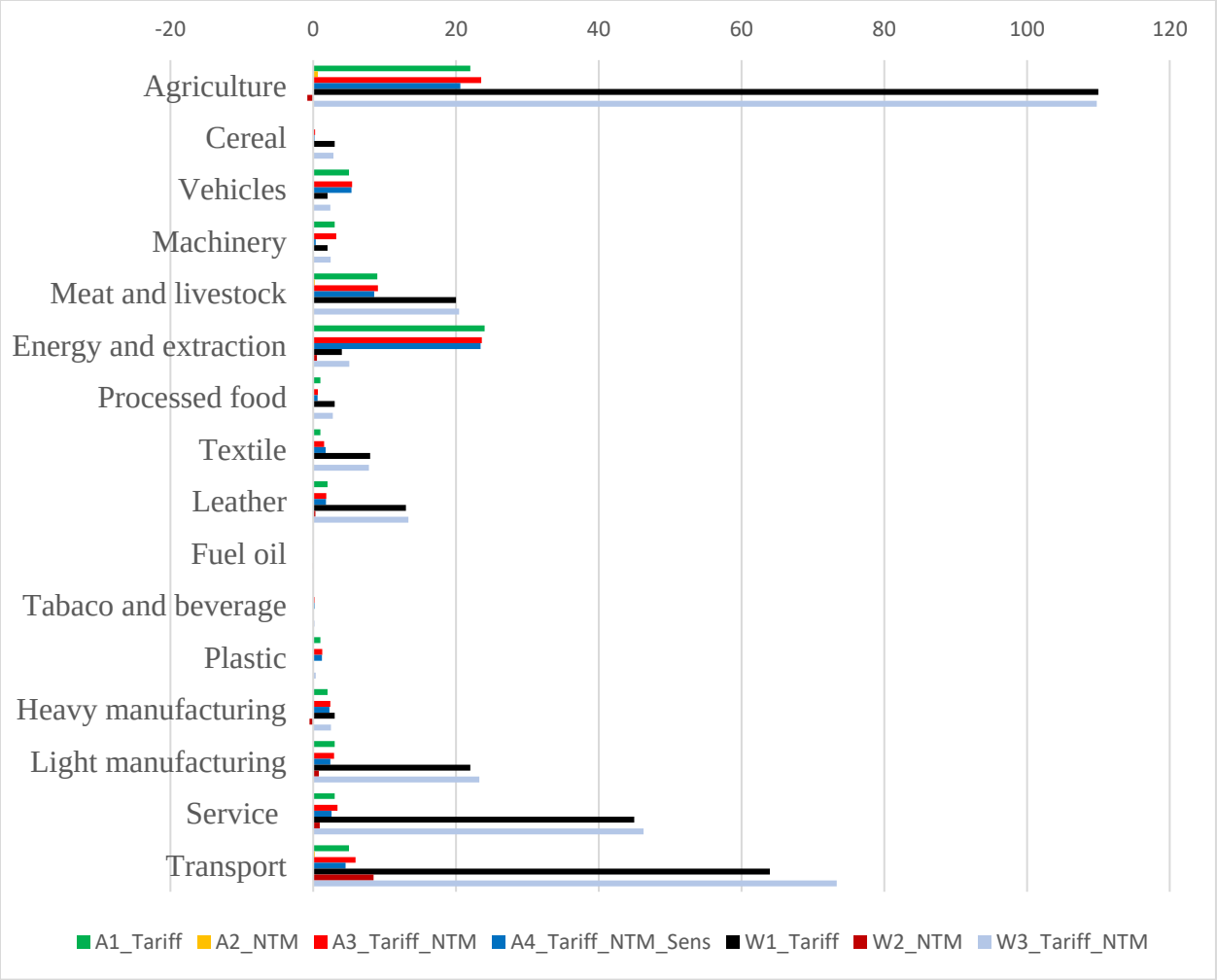


Figure 4. 10. Sectoral Export Change of Ethiopia under AfCFTA and WTO [Changes from the Baseline in mil. USD]

As seen in the sectoral export changes, the impact of WTO accession is found far larger than that of the AfCFTA formation, because the depreciation effect occurs almost universally against all regions, including non-AfCFTA regions, to which 82 % of Ethiopia's exports are directed **(Figure 4. 11).**

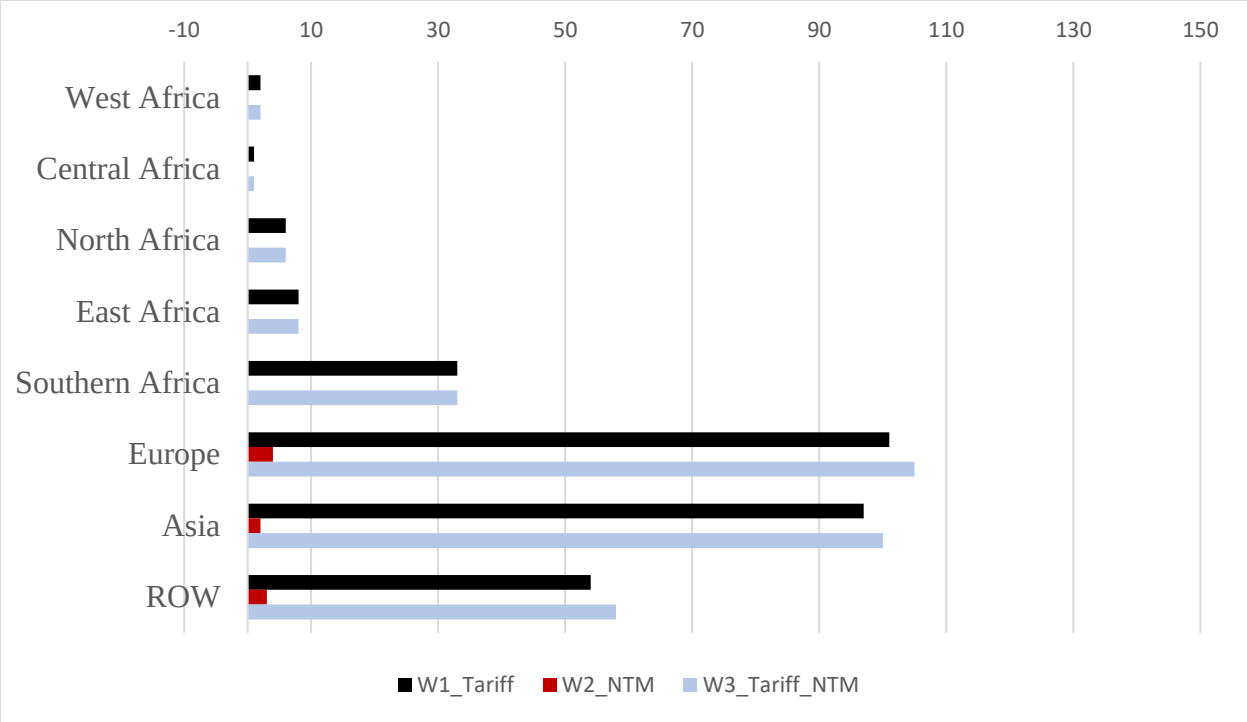


Figure 4. 11. Impact of WTO on the Bilateral Export of Ethiopia [Changes from Baseline in mil. USD]

4.4.2.2. Impact on Output and Welfare

Under the WTO accession scenarios, the agriculture and transport sector would experience a notable output increase **(Figure 4. 12).** Under Scenario W3, agriculture would experience an increase of 103 mil. USD (0.8% from the base), while transport would increase by 74 mil. USD (1.3% from the base). Conversely, service would decrease by 199 mil. USD (0.5% from the base), light manufacturing would decrease by 78 mil. USD (1.4% from the base), heavy manufacturing is projected to decrease by 34 mil. USD (5.9% from the base), and textile output would decrease by 102 mil. USD (4.6% from the base). As for the "excluded sectors" ––though the exclusion is applied only in AfCFTA––, the textile sector would suffer, while the leather sector would experience a slight change.

Comparatively, agriculture, transport, and meat and livestock would gain under both trade deals and larger by the WTO accession. On the negative side, processed food, and light manufacturing would suffer consistently in both trade deals, though more deeply from WTO accession. The cereal sector would be affected little under AfCFTA but would grow under WTO. Their contrasting results request us to examine the impact of different trade deals carefully by sector.

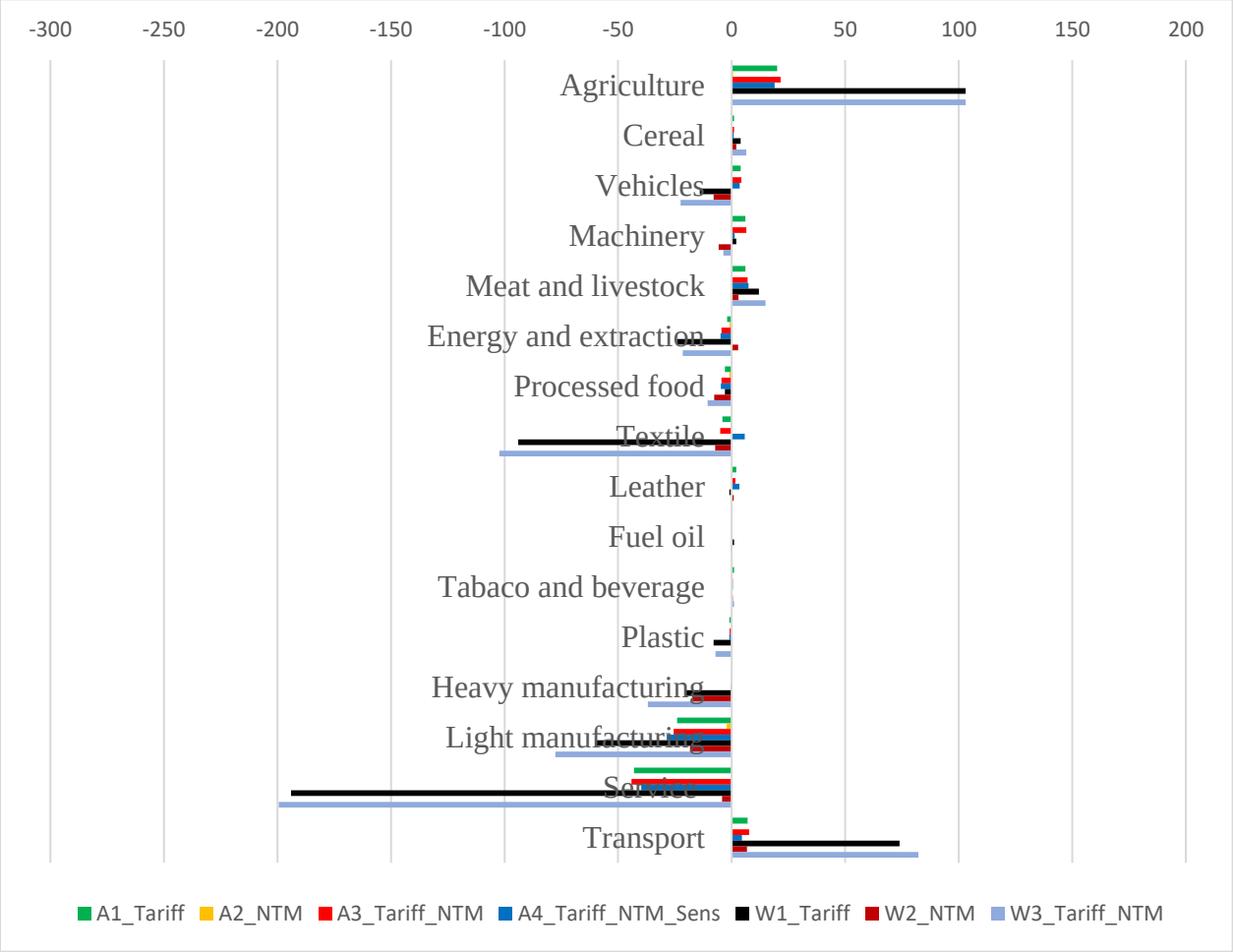


Figure 4. 12. Output Change under AfCFTA and WTO [Changes from baseline in mil. USD]

As the WTO accession is unilateral trade liberalization by Ethiopia, a large welfare increase would be brought to Ethiopia, but little to the other regions. Under Scenario W1, Ethiopia's welfare would increase by 0.3%, which is larger than its gains from tariff abolition in AfCFTA Scenario A1 shown in **Figure 4. 7**. Under Scenario W2, Ethiopia's welfare would improve by 0.1%, which is 10 times larger than the gains from NTM reductions in AfCFTA Scenario A2. Under Scenario W3, with tariff and NTM reductions, Ethiopia would experience immense improvements in welfare by recording 0.4%, which is four times larger than the full AfCFTA Scenario A3.

4.5. Conclusion

We used a world trade CGE model to examine the impact of joining AfCFTA and WTO on trade, output, and welfare in Ethiopia and its trade partners within and outside Africa. The results of the simulations indicate that membership in both trade agreements would substantially increase Ethiopia's trade and welfare, with WTO accession yielding greater benefits than AfCFTA. The results of a trade simulation indicate that AfCFTA membership would increase imports of energy and extraction, light manufacturing, and processed food. AfCFTA membership would significantly increase Ethiopian imports from AfCFTA regions but would reduce imports from non-AfCFTA. Additionally, AfCFTA membership would substantially enhance exports in all sectors, notably agriculture, energy and extraction, and meat and livestock, leading to increased exports across all AfCFTA regions but minimally affecting exports to non-AfCFTA regions. In contrast to AfCFTA membership, WTO accession would increase imports in the textile, light manufacturing, heavy manufacturing, and processed food sectors, with a significant portion coming from Asia, but decrease imports from East Africa. In terms of exports

from Ethiopia, WTO accession would benefit agriculture, transport, and service exports, with increased exports to all regions, particularly Europe, Asia, and the ROW.

The findings on output indicate that AfCFTA would benefit the agriculture, transport, meat and livestock, and machinery sectors, and would negatively affect service, light manufacturing, energy and extraction, and processed food production. WTO accession would increase in output of the agriculture, transport, and meat and livestock sectors but decrease the output of the service, textile, light manufacturing, and heavy manufacturing sectors considerably. Agriculture, transport, and meat and livestock would benefit from both trade agreements, with larger gains expected from the WTO accession than from AfCFTA. However, service, light manufacturing, processed food, and energy and extraction sectors would consistently suffer under both trade agreements, with the negative impact of the WTO accession expected to be more severe than that of AfCFTA.

Chapter 5: Conclusion, Policy Implication, and Recommendation

5.1. Summary and Synthesis

This dissertation examined the potential impact of the two ongoing free trade agreements (WTO and AfCFTA) on the Ethiopian economy using trade indicators and a world trade CGE model. In Chapter 2, we summarized the literature on the FTA impact analysis related to our study by showing their major findings and niches that need further investigation. In Chapter 3, we examined the sectoral competitiveness of Ethiopia using several major trade indicators and identified sectors that would expand and decline under free trade. In Chapter 4, we assessed the potential impact of AfCFTA and WTO accessions on Ethiopia's trade, output, and welfare using a world trade CGE model. We found that Ethiopia would experience an increase in trade and welfare resulting from these accessions and see output growth in a few sectors with high growth potential, such as agriculture, meat and livestock, and transport.

Comparing the results of trade indicators and the CGE analysis, we found consistent predictions in certain sectors (**Table 5. 1**). The transport, leather, and cereal sectors are predicted to expand under free trade in both approaches; the agriculture, and meat and livestock sectors would also tend to expand. Sectors, such as processed food, light manufacturing, energy and extraction, and fuel oil, are predicted to suffer consistently. For their prediction, a simple trade indicator approach may suffice. However, the predictions for the other sectors occasionally flip under different approaches and different trade deals. In these cases, a comprehensive macroeconomic approach with a CGE model is required.

Table 5. 1. Comparison of Sectoral Predictions by Trade Indicators and the CGE Model

Sector	Prediction by Trade indicators		Predicted Output Changes by the CGE Model	
	BRCA	ERP	A3_tariff_NTM	W3_tariff_NTM
Agriculture	✔	Δ	✔	✔
Transport	✔	✔	✔	✔
Meat and livestock	✔	Δ	✔	✔
Leather	✔	✔	✔	✔
Cereal	✔	✔	✔	✔
Service	✔	✔	✕	✕
Textile	✕	✔	✕	✕
Processed food	✕	✕	✕	✕
Light manufacturing	✕	✕	✕	✕
Energy and extraction	✕	✕	✕	✕
Tobacco and beverage	✕	Δ	✔	✔
Machinery	✕	✔	✔	✕
Vehicles	✕	✔	✔	✕
Plastic	✕	✕	✕	✕
Heavy manufacturing	✕	✔	✕	✕
Fuel oil	✕	✕	✕	✕

Source: Compiled from the results with trade indicators (Chapter 3) and the CGE model (Chapter 4).

Note: ✔: Indicates expansion

✕ : Decline

Δ: Moderate change

Regarding the prediction of welfare impact, which can be made only by our CGE simulations, joining AfCFTA and WTO would improve Ethiopian welfare. Based on the results of the trade indicators and the CGE model, methodologically, we can conclude that both trade indicators and CGE models should be used complementarily. While a CGE model offers a quantitative assessment of the impact of trade agreements, trade indicators help to identify sectors with comparative advantages and disadvantages.

5.2. Policy Implications and Recommendations

The results of our trade indicators and CGE model in Chapter 3 and Chapter 4 imply the impacts of Ethiopian trade policy changes: how FTA accession would impact the Ethiopian economy (trade, sectoral output, and welfare). Based on our study results, we draw the following policy implications and recommendations. Our study reveals the presence of winners and losers across various industries. Notably, the agriculture, transport, meat and livestock, leather, and cereal sectors demonstrate potential for expansion under free trade agreements. Negative views on free trade are often based on a pessimistic prospect for some weak or sensitive sectors. In Ethiopia, despite the leather sector being considered sensitive and thus excluded from tariff reduction, our findings suggest it would indeed experience growth under both AfCFTA and WTO accession. Our analysis underscores the benefits Ethiopia stands to gain from joining both AfCFTA and the WTO, with the latter offering even greater potential gains. However, it is important to acknowledge that alongside the overall gains, there are multiple negative impacts on specific sectors in the economy, such as light manufacturing, textile, and processed food, which are adversely affected by trade liberalization.

In light of our findings, to maximize the gains from the growing sectors, the Ethiopian government should take strategic measures aimed at facilitating their expansion. These measures may include the establishment of integrated agro-industrial parks, investment in infrastructure to ensure smoother transportation of products and inputs, augmentation of productivity and efficiency, enhancement of value-addition, improvement in product quality, branding of exports, and integration into the global value chain. Additionally, providing financial incentives to these rising sectors and creating a favorable regulatory environment that promotes investment and innovation would also increase Ethiopia's benefits. Investing in workforce development and providing training for workers and managers of small and medium enterprises to acquire essential skills would mitigate losses in the declining sectors and enhance gains in expanding sectors. To optimize the benefits derived from AfCFTA, it is recommended that the Ethiopian government remove the leather sector from the exclusion list. This strategic action will enable the sector to fully capitalize on trade liberalization, effectively access new markets, and consequently enhance overall economic growth and welfare. Despite the decision to join the WTO resting within the discretion of Ethiopia, our analysis indicates that it would present an extraordinary opportunity for the country, and Ethiopia should join. To mitigate the potential negative impacts, the Ethiopian government should provide industry- and micro-level policy support tailored to affected groups while concurrently pursuing improvements in resource efficiency in the macroeconomy through trade liberalization initiatives. This comprehensive approach will effectively address negative sectoral impacts while maximizing the broader benefits of AfCFTA and WTO accession for Ethiopia's economy.

5.3. Limitations of the Study

Our study has three limitations. First, in the AfCFTA impact analysis, while we assume a 50% NTM reduction from all AfCFTA members, the NTM estimates for East African and Southern African regions are not available, and we didn't consider them in the analysis. Their exclusion could result in some bias on the accuracy of our study as the NTM barriers might remain high against Ethiopian exports. A few alternative NTM estimates, such as Kravchenko et al. (2022) have become available. Investigations based on such new data may bring more precise estimates of trade impacts. The second limitation lies in the list of "excluded sectors" from tariff reduction for the AfCFTA analysis. Due to the absence of specific lists from countries outlining their sensitive sectors for tariff exclusion, we relied on existing literature to identify these sectors. Once countries present their list of excluded sectors, studies incorporating NTM estimates and "excluded sectors" would greatly enhance the accuracy and generalizability of our analysis and findings. Lastly, the other limitation is on the tariff and NTM reduction assumptions on our WTO impact analysis. In our WTO accession impact assessment, we assumed the tariff and NTMs reduction considering the experience of China and Vietnam's WTO accession. We assumed a 50% unilateral tariff reduction and a 50% unilateral NTM reduction. However, Ethiopia's accession might entail a tariff reduction either greater than or less than the assumed 50% tariff and NTMs reduction and it would be worthwhile to assess once Ethiopia provides its detailed tariff and NTMs reduction plan. Moreover, our study assumed unilateral tariff reduction by Ethiopia's side only. However, it is customary that countries that join the WTO get tariff and NTM reductions from other member countries. Thus, assessing the WTO impact once the negotiation process concludes would be worthwhile.

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Appendixes

Appendix A: Regional Aggregation

We aggregated the regions in the GTAP10 database in to eight regions. The aggregations were made for the convenience of our AfCFTA and WTO analysis. With the exception of the rest of the world (ROW), all other regions were aggregated based on geographical location. ROW represents a mixture of South America, North America, Australia, Oceania, and the Caribbean, with relatively lower trade relations with Ethiopia, except for the United States. East Africa encompasses countries located in the eastern part of Africa. Central Africa includes countries in the central region; West Africa comprises countries in the western region; North Africa comprises countries in the northern region; and Southern Africa comprises countries in the southern part of the continent. Asian countries were grouped under Asia, while Europe comprises all European countries as shown in Table A.1.

Table A. 1. Regional Aggregation

Regions	List of countries
Ethiopia	Ethiopia
East Africa	Kenya, Rwanda, Sudan, Uganda, Tanzania, Rest of Eastern Africa
Central Africa	Angola, Cameroon, Central Africa, South Central Africa
West Africa	Benin, Burkina Faso, Cote d'Ivoire, Ghana, Guinea, Nigeria, Senegal, Togo, Rest of western Africa
North Africa	Egypt, Morocco, Tunisia, Rest of North Africa
Southern Africa	Malawi, Mozambique, Zambia, Zimbabwe, Botswana, Namibia, South Africa, Rest of South Africa Customs
Europe	Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden, Russia, the rest of the former Soviet Union, Armenia, Georgia, Azerbaijan, the Rest of Europe, the Rest of Eastern Europe, Belarus, Albania
Asia	China, Hongkong, Japan, Korea Republic, Mongolia, Taiwan, the rest of east Asia, Brunei, Cambodia, Indonesia, Lao PDR, Pakistan, Malaysia, Philippines, Singapore, Thailand, Vietnam, the Rest of southeast Asia, Bangladesh, India, Nepal, Sri Lanka, the rest of South Asia, Bahrain, Iran, Israel, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Turkey, Kazakhstan, Kirgizstan, Tajikistan
ROW	Australia, New Zealand, rest of Oceania, Canada, USA, Mexico, rest of North America, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, the rest of South America, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador, the Rest of Central America, the Dominican Republic, Jamaica, Puerto Rico, Trinidad, and Tobago, Rest of the Caribbean

Source: Author's aggregation from the GTAP 10 database

Appendix B: Sectoral Aggregation

We aggregated the sectors in the GTAP database in to 16 sectors. This selection of aggregation was chosen for the convenience of our sectoral analysis and to accommodate the "excluded sectors" in each region of AfCFTA.

Table A. 2. Sectoral Aggregation

Sectors	Original GTAP Sectors
Agriculture	Sugarcane, sugar beet, plant-based fibers, forestry, fishing, fruits, vegetable, nuts, oil seeds, Stimulants, cut flower, flower seeds
Meat and livestock	Bovine cattle, sheep and goats, Animal products nec, raw milk, wool, silk-worm cocoons, Bovine meat products, meat products nec, Dairy products,
Vehicles	Motor vehicles and parts, Transport equipment's nec
Machinery	Machinery and equipment's nec
Cereals	Paddy Rice, Wheat, Cereal grains nec,
Energy and extraction	Coal, mineral nec, coal products, mineral products, gas
Leather	Leather products
Textile	Textiles, wearing apparel
Processed food	Food products nec, sugar, processed rice, vegetable oils and fats
Fuel oil	Petroleum, fuel, oil
Light manufacturing	Wood products, paper products, publishing, chemical products, pharmaceutical products, ferrous metals, metals nec, metal products, manufactures nec,
Plastic	Rubber and plastic products
Heavy manufacturing	Computer, electronic and optic, electrical equipment,
Service	Dwellings, human health and social work, education, public administration and defense, Recreational and other services, business services, warehousing and supporting activities communication, electricity, real estate activities, insurance, financial services, construction, water, gas manufacture and distribution, accommodation food and service, trade
Tobacco and beverage	Beverages and tobacco products
Transport	Transport nec, water transport, air transport

Source: Author's aggregation from GTAP 10 database

Appendix C: Selection of "Excluded' Products

To select "excluded" products in each region, we reviewed different literatures, articles, and newspapers. The following are the literatures and data's we primarily used for the selection.

- ✓ In the case of Ethiopia, the textile and leather sectors are selected as "excluded" sectors based on the report from the ministry of trade and regional integration available at https://www.thereporterethiopia.com/30467/
- ✓ In the case of West Africa and Southern Africa, the choice of "excluded" products was made after we referred to the list of sensitive products from Ramdoo (2014) study. Then we chose cereal and machinery in west Africa, fuel oil, and machinery in southern Africa as "excluded" sectors after we compared the volume of the import in each member country using the data from the UNCOMTRADE.
- ✓ In deciding the "excluded' sectors for East Africa, we first took the list of sensitive products the East African community considered when they signed an agreement with the EU in 2015. Then we selected plastic and vehicles as "excluded" after we compared the volume of the import in each member country using the data from the UNCOMTRADE.
- ✓ For North Africa, we referred to the study by Dadush & Myachenkova (2018) assessing the European Union - North Africa trade agreement. In their study, they pointed out that agriculture is the most protected and sensitive sector in the area. Accordingly, we chose the agriculture sector as "excluded sector" for the AfCFTA analysis.

Appendix D: Set, Parameters, Variables, and Model Equations

Sets

i_u	Sectors
h_u	Factors (Capital, SkLab, UnSkLab, Land)
$h_{mob,j,r}$	Mobile factors (SkLab, UnSkLab, Capital)
$h_{imm,j,r}$	Immobile factors (Land)
mm_i	Transportation sector (Transport)
reg	Regions (Ethiopia, West Africa, Central Africa, North Africa, East Africa, Southern Africa, Europe, Asia, ROW)
$r_{Afcftae}$	AfCFTA Regions (Ethiopia, West Africa, Central Africa, North Africa, East Africa, Southern Africa)
r_{Afcfta}	AfCFTA without Ethiopia (West Africa, Central Africa, North Africa, East Africa, Southern Africa)
$r_{non-Afcftae}$	Non-AfCFTA regions (Europe, Asia, ROW)

Parameters

$ax_{i,j,r}$	Input requirement coefficient of the i-th intermediate input
$ay_{j,r}$	Input requirement coefficient of the j-th composite good
$\alpha_{i,r}$	Share coefficient for the i-th good consumption in the utility function
$\beta_{h,j,r}$	Share coefficient for the h-th factor used by j-th firm in composite factor production
$b_{j,r}$	Scaling coefficient in the j-th composite factor production function
$\mu_{i,r}$	Share of the i-th good in government expenditure

$\lambda_{i,r}$	Expenditure share of the i-th good in total investment
ss_r^p	Average propensity for savings by the household
ss_r^g	Average propensity for savings by the government
$\gamma_{i,r}$	Scaling coefficient in the i-th Armington composite good production function,
σf_j	substitution elasticity between labor and capital
$\delta m_{i,r}$, $\delta d_{i,r}$	Input share coefficients in the i-th Armington composite good production function
$\sigma_{i,r}$	Elasticity of substitution in the i-th Armington composite good
$\theta_{i,r}$	Scaling coefficient in the i-th good transformation function,
$\mathcal{PP}_{i,s,r}$	Share parameter in composite import func.
$\omega_{i,r}$	Scale parameter in composite import func.
$\mathcal{P}_{i,r,s}$	Share parameter in composite export func.
ב	Scale parameter in international transport func.
$\aleph_{i,r}$	Share parameter in international transport func.
$\dot{\xi}d_{i,r}$, $\dot{\xi}e_{i,r}$	Share par. in transformation func.

Endogenous Variables

$Y_{j,r}$	Composite factor
$F_{h,j,r}$	The h-th factor input by the j-th firm
$X_{i,j,r}$	Intermediate input
$Z_{j,r}$	Output of the j-th good
$X_{i,r}^p$	Household consumption of the i-th good

$X_{i,r}^{g}$	Government consumption
$X_{i,r}^{v}$	Investment demand
$QE_{i,r}$	Exports
$QM_{i,r}$	Imports
$Q_{i,r}$	Armington's composite good
$D_{i,r}$	Domestic good
$P_{h,j,r}^{f}$	The h-th factor price
$P_{j,r}^{y}$	Composite factor price
$P_{j,r}^{z}$	Supply price of the i-th good
$P_{i,r}^{q}$	Armington's composite good price
$pqe_{i,r}$	Export price in local currency
$pqm_{i,r}$	Import price in local currency
$pd_{i,r}$	The i-th domestic good price
$\varepsilon_{r,s}$	Exchange rate
$QT_{i,r,s}$	Imports or exports from r to s country
$pqt_{i,r,s}$	Import or export price from r to s country
S_{r}^{p}	Private saving
S_{r}^{g}	Government saving
T_{r}^{d}	Direct tax
$\tau z_{j,r}$	Production tax
$T_{h,j,r}^{f}$	Factor input tax

$T^{e}_{i,r,s}$	Export subsidies
$T^{m}_{i,r,s}$	Import tariff
$QTS_{i,r}$	Export of transport services
QQT	Aggregate international transport
$pqqt$	Price of international transport

Exogenous Variables

$FF_{h,j,r}$	Endowments of the h-th factor for the household
SF_r	Foreign saving equivalent in foreign currency
T^{d}_{r}	Direct tax rate
$\tau z_{j,r}$	Production tax rate on the j-th good
$\tau m_{i,r,s}$	Import tariff rate on the i-th good

Model Equations

Composite factor aggregation function

$$Y_{j,r} = b_{j,r} \prod_h F_{h,j,r}^{\beta_{h,j,r}} \quad \text{if} \quad \sigma f_j = 1$$

$$= b_{j,r} \left(\sum_h \beta_{h,j,r} \; F_{h,j,r}^{\frac{\sigma f_j - 1}{\sigma f_j}} \right)^{\frac{\sigma f_j}{\sigma f_j - 1}} \quad \text{if} \quad \sigma f_j \neq 1$$

Factor demand function

$$F_{h,j,r} = \frac{\beta_{h,j,r} \, P^{y}_{j,r}}{P^{f}_{h,j,r} \, (1+ \tau^{f}_{h,j,r})} Y_{j,r} \quad \text{if} \quad \sigma f_j = 1$$

$$= \left\{ \frac{b_{j,r}^{\frac{\sigma f_j - 1}{\sigma f_j}} \beta_{h,j,r} P_{j,r}^{y}}{\left(1+\tau_{h,j,r}^{f}\right) P_{h,j,r}^{f}} \right\}^{\sigma f_j} Y_{j,r} \quad \text{if} \quad \sigma f_j \neq 1$$

Intermediate demand function

$X_{i,j,r} = \alpha x_{i,j,r} \, Z_{j,r}$

Composite factor demand function

$Y_{j,r} = \alpha y_{j,r} \, Z_{j,r}$

Transformation function

$P_{j,r}^{z} = \alpha y_{j,r} \, P_{j,r}^{y} + \sum_i \alpha x_{i,j,r} \, P_{i,r}^{q}$

Equation of direct tax

$$T_r^d = \tau_r^d \sum_{h,j} P_{h,j,r}^{f} \, FF_{h,j,r}$$

Equation of production tax

$T_{j,r}^{z} = \tau_{j,r}^{z} \, P_{j,r}^{z} \, Z_{j,r}$

Equation of factor tax

$T_{h,j,r}^{f} = \tau_{h,j,r}^{f} \, P_{h,j,r}^{f} \, F_{h,j,r}$

Equation of import tax revenue;

$T_{i,r,s}^{m} = \tau_{i,r,s}^{m} \left((1+ \tau_{i,r,s}^{e}) \, \varepsilon_{r,s} \, pqt_{i,r,s} + \tau_{i,r,s}^{s} \, pqqt \, \varepsilon_{ROW,s} \right) QT_{i,r,s}$

Equation of export subsidy revenue

$T_{i,r,s}^{e} = \tau_{i,r,s}^{e} \, pqt_{i,r,s} \, QT_{i,r,s}$

Government demand function

$$X_{i,r}^{g} = \frac{\mu_{i,r}}{P_{i,r}^{q}} \left(T_r^d + \sum_j T_{j,r}^{z} + \sum_{j,s} T_{j,s,r}^{m} + \sum_{h,j} T_{h,j,r}^{f} + \sum_{j,s} T_{j,r,s}^{e} - S_r^g \right)$$

Investment behavior

$$X_{i,r}^{v} = \frac{\lambda_{i,r}}{P_{i,r}^{q}} (S_r^p + S_r^g + \varepsilon_{\mathrm{ROW},r}\, S_r^f)$$

Private saving:

$$S_r^p = ss_r^p \sum_{h,j} P_{h,j,r}^f \; FF_{h,j,r}$$

Government saving

$$S_r^g = ss_r^g (T_r^d + \sum_j T_{j,r}^z + \sum_{j,s} T_{j,s,r}^m + \sum_{h,j} T_{h,j,r}^f + \sum_{i,s} T_{i,r,s}^e)$$

Household consumption

$$X_{i,r}^p = \frac{\alpha_{i,r}}{P_{i,r}^q} (\sum_{h,j} P_{h,j,r}^f \; FF_{h,j,r} - S_r^p - T_r^d)$$

Balance of payments equation

$$\sum_{i,s}\left(1 + \tau_{i,r,s}^e\right) \varepsilon_{r,ROW}\, pqt_{i,r,s}\, QT_{i,r,s} + \sum_i \varepsilon_{r,ROW}\, (1+\tau_{i,r}^z)\, P_{i,r}^z\, QTS_{i,r} + S_r^f$$

$$= \sum_{i,s}\left(\tau_{i,s,r}^s pqqt + (1 + \tau_{i,s,r}^e)\, pqt_{i,s,r}\, \varepsilon_{s,ROW}\right) QT_{i,s,r}$$

Equation of import demand function

$$QM_{i,r} = \left(\frac{\gamma_{i,r}^{\frac{\sigma d_i - 1}{\sigma d_i}} \; \delta m_{i,r}\, pq_{i,r}}{pqm_{i,r}} \right)^{\sigma d_i} Q_{i,r}$$

Equation of domestic good demand function

$$D_{i,r} = \left(\frac{\gamma_{i,r}^{\frac{\sigma d_i - 1}{\sigma d_i}} \; \delta d_{i,r}\, Pq_{i,r}}{Pd_{i,r}} \right)^{\sigma d_i} Q_{i,r}$$

Composite import function

$$QM_{i,r} = \omega_{i,r} \left(\sum_s \mathrm{PP}_{i,s,r} \; (1 - QTloss_{i,s,r})\, QT_{i,s,r}^{\frac{\sigma m_i - 1}{\sigma m_i}} \right)^{\frac{\sigma m_i}{\sigma m_i - 1}}$$

Composite import demand function

$$QT_{i,s,r} = \left(\frac{\omega_{i,r}^{\frac{\sigma m_i - 1}{\sigma m_i}} \, \text{PP}_{i,s,r} \, pqm_{i,r}}{\left((1+\tau^{e}_{i,s,r}) \, pqt_{i,s,r} \;\varepsilon_{s,r} + \tau^{s}_{i,s,r} \, pqqt \, \varepsilon_{\text{ROW},r}\right) (1+\tau^{m}_{i,s,r})} \right)^{\sigma m_i} (1 - QTloss_{i,s,r})^{\sigma m_i - 1} \, QM_{i,r}$$

Transformation function

$$Z_{i,r} - QTS_{i,r} = \theta_{i,r} \left(\dot{\xi} e_{i,r} \, QE_{i,r}^{\frac{\sigma d_i + 1}{\sigma d_i}} + \dot{\xi} d_{i,r} \, D_{i,r}^{\frac{\sigma d_i + 1}{\sigma d_i}} \right)^{\frac{\sigma d_i}{\sigma d_i + 1}}$$

Equation of export supply function

$$pqe_{i,r} = \left(\frac{QE_{i,r}}{Z_{i,r} - QTS_{i,r}} \right)^{1/\sigma d_i} \theta_{i,r}^{\frac{\sigma d_i + 1}{\sigma d_i}} \, \dot{\xi} \text{e}_{i,r} \, (1+\tau^{z}_{i,r}) \, P^{z}_{i,r}$$

Domestic good supply function

$$Pd_{i,r} = \left(\frac{D_{i,r}}{Z_{i,r} - QTS_{i,r}} \right)^{1/\sigma d_i} \theta_{i,r}^{\frac{\sigma d_i + 1}{\sigma d_i}} \, \dot{\xi} \text{d}_{i,r} \, (1+\tau^{z}_{i,r}) \, P^{z}_{i,r}$$

Export price in local currency

$$QE_{i,r} = \hbar_{i,r} \left(\sum_s \text{P}_{i,r,s} \; QT_{i,r,s}^{\frac{\sigma m_i + 1}{\sigma m_i}} \right)^{\frac{\sigma m_i}{\sigma m_i + 1}}$$

Equation of composite export supply function

$$QT_{i,r,s} = \left(\frac{\hbar_{i,r}^{\frac{\sigma m_i + 1}{\sigma m_i}} \, \text{P}_{i,r,s} \, \text{pqe}_{i,r}}{\text{pqt}_{i,r,s}} \right)^{-\sigma m_i} \; QE_{i,r}$$

Production of international transport service (TRS)

$$QQT = \text{ב} \prod_r QTS_{TRS,r}^{\aleph_{i,r}}$$

Supply of transport services

$$QTS_{i,r} = \frac{\aleph_{i,r} \, pqqt}{(1+\tau^{z}_{i,r}) \, P^{z}_{i,r} \, \varepsilon_{r,ROW}} \, QQT$$

Market-clearing condition of international transport service

$$QQT = \sum_{i,r,rr} \tau^{s}_{i,r,rr} \; QT_{i,r,rr}$$

Market clearing cond. for composite good

$Q_{i,r} = X^{p}_{i,r} + X^{g}_{i,r} + X^{v}_{i,r} + \sum_j X_{i,j,r}$

Factor market-clearing conditions

$\sum_j F_{h,j,r} = \sum_j FF_{h,j,r}$

$F_{h\_imm,j,r} = F^{0}_{h\_imm,j,r}$ h_{imm}: immobile factors (capital and land)

$pf_{h\_mob,j,r} = pf_{h\_mob,i,r}$ h_{mob}: mobile factors (skilled and unskilled labor)

Exchange rate arbitrage condition

$\varepsilon_{r,s} = \varepsilon_{r,rr} \; \varepsilon_{rr,s}$

Appendix E: Sensitivity Analysis with Respect to Armington's Elasticity

The simulation result of a CGE analysis can be impacted by the assumption of key parameters, particularly the elasticity of substitution/transformation. To check the robustness of the results of our study, we conduct a sensitivity analysis with a 50 percent reduction and increase in Armington elasticity compared to the baseline case. We used the A3_tariff_NTM scenario and W3_tariff_NTM scenario for our simulation experiment. The results of import, export, output, and welfare on AfCFTA and WTO accession change proportionately when the shock is introduced as shown in the following tables. A larger Armington elasticity would bring a larger impact on those key variables. The findings are qualitatively robust in all cases but two. They are the AfCFTA impact on cereal imports (Table A.3); and the WTO impact on cereal import (Table A.7) and leather output (Table A.9). For these sectors, we need to carefully interpret their results.

Table A. 3. Import Change with 50% Lower/higher Armington Elasticity under AfCFTA Accession [change in mil. USD]

Sector	50% lower	Baseline	50% higher
Agriculture	1	2	2
Cereal	0	0	-1
Vehicles	2	3	3
Machinery	-4	-5	-8
Meat and livestock	1	2	2
Energy and extraction	21	35	51
Processed food	11	15	17
Textile	8	13	19
Leather	1	2	3
Fuel oil	0	1	1
Tabaco and beverage	1	2	2
Plastic	5	6	6
Heavy manufacturing	3	4	5
Light manufacturing	21	28	30
Service	-5	-7	-10
Transport	-2	-4	-5

Table A. 4. Export Change with 50% Lower/higher Armington Elasticity under AfCFTA Accession [change in mil. USD]

Sector	50% lower	Baseline	50% higher
Agriculture	20	24	27
Cereal	0	0	0
Vehicles	4	5	7
Machinery	2	3	4
Meat and livestock	7	9	10
Energy and extraction	14	24	32
Processed food	0	1	1
Textile	1	2	2
Leather	1	2	2
Fuel oil	0	0	0
Tabaco and beverage	0	0	0
Plastic	1	1	2
Heavy manufacturing	2	2	3
Light manufacturing	2	3	4
Service	2	3	5
Transport	4	6	9

Table A. 5. Output Change with 50% Lower/higher Armington Elasticity under AfCFTA Accession [change in mil. USD]

Sector	50% lower	Baseline	50% higher
Agriculture	19	22	25
Cereal	1	1	1
Vehicles	2	4	6
Machinery	4	7	9
Meat and livestock	6	7	8
Energy and extraction	-3	-4	-7
Processed food	-3	-5	-5
Textile	-2	-5	-8
Leather	1	2	2
Fuel oil	0	0	0
Tabaco and beverage	0	0	1
Plastic	-1	-1	0
Heavy manufacturing	0	0	1
Light manufacturing	-20	-26	-27
Service	-37	-44	-51
Transport	5	8	12

Table A. 6. Welfare Change with 50% Lower/higher Armington Elasticity under AfCFTA Accession [change in %]

Region	50% lower	Baseline	50% higher
Ethiopia	0.07	0.10	0.12
West Africa	0.15	0.19	0.22
Central Africa	0.27	0.34	0.39
North Africa	0.06	0.08	0.10
East Africa	0.09	0.11	0.12
Southern Africa	0.15	0.19	0.21
Europe	0.00	0.00	0.00
Asia	0.00	0.00	0.00
ROW	0.00	0.00	0.00

Table A. 7. Import Change with 50% Lower/higher Armington Elasticity under WTO Accession [change in mil. USD]

Sector	50% lower	Baseline	50% higher
Agriculture	2	4	4
Cereal	-3	-2	-2
Vehicles	28	38	44
Machinery	8	15	19
Meat and livestock	1	2	2
Energy and extraction	18	27	31
Processed food	34	43	48
Textile	137	184	207
Leather	20	27	31
Fuel oil	8	11	12
Tabaco and beverage	3	4	5
Plastic	12	15	17
Heavy manufacturing	62	77	84
Light manufacturing	67	96	110
Service	-62	-75	-81
Transport	-36	-46	-50

Table A. 8. Export Change with 50% Lower/higher Armington Elasticity under WTO Accession [change in mil. USD]

Sector	50% lower	Baseline	50% higher
Agriculture	95	110	117
Cereal	2	3	3
Vehicles	2	2	2
Machinery	2	2	3
Meat and livestock	17	20	22
Energy and extraction	4	5	5
Processed food	2	3	3
Textile	8	8	7
Leather	11	13	14
Fuel oil	0	0	0
Tabaco and beverage	0	0	0
Plastic	0	0	0
Heavy manufacturing	2	2	2
Light manufacturing	20	23	25
Service	39	46	50
Transport	58	73	81

Table A. 9. Output Change with 50% Lower/higher Armington Elasticity under WTO Accession [change in mil. USD]

Sector	50% lower	Baseline	50% higher
Agriculture	89	103	110
Cereal	5	6	7
Vehicles	-15	-22	-26
Machinery	1	-4	-6
Meat and livestock	13	15	16
Energy and extraction	-15	-22	-25
Processed food	-9	-11	-12
Textile	-75	-102	-116
Leather	2	0	-1
Fuel oil	0	0	0
Tabaco and beverage	1	1	1
Plastic	-5	-7	-8
Heavy manufacturing	-29	-37	-40
Light manufacturing	-54	-78	-89
Service	-180	-199	-208
Transport	71	82	88

Table A. 10. Welfare Change with 50% Lower/higher Armington Elasticity under WTO Accession [change in %]

Region	50% lower	Baseline	50% higher
Ethiopia	0.3	0.4	0.4
West Africa	0.00	0.00	0.00
Central Africa	0.00	0.00	0.00
North Africa	0.00	0.00	0.00
East Africa	-0.02	-0.02	-0.01
Southern Africa	0.01	0.01	0.00
Europe	0.00	0.00	0.00
Asia	0.00	0.00	0.00
ROW	0.00	0.00	0.00

Appendix F: Sensitivity analysis with tariff reduction and mobile land assumption

The simulation result of a CGE analysis can be impacted by the assumption of tariff reduction and factor mobility. The study was done with the assumption of unilateral tariff reduction for the WTO accession and land (farmland and natural resource) immobility across sectors. To check the robustness of the results of our study, we conduct a sensitivity analysis by assuming mutual tariff reduction (50% tariff reduction by Ethiopia as assumed in Scenario W3 and 10% tariff reduction by WTO members) and land mobility (with the unilateral tariff reduction as assumed in Scenario W3). We used Scenario W3 for these additional simulation experiments. The results of output and welfare are shown in the following Tables A.11 and A.12. When we assume an additional tariff cut by WTO members, the predicted output changes are found generally larger but qualitatively the same. That is, agriculture would expand more; service and light manufacturing transport would decline deeper. Welfare would show a modest increase of 0.423%, larger than the gain under unilateral tariff reduction (0.394%). When we employ an alternative factor market assumption, sectoral output changes are found the qualitatively same, except for the cereal output. The resulting welfare change is estimated at 0.395%, marginally higher than the gain from unilateral tariff reduction (0.394%), thanks to the assumption that allows more flexible resource reallocation among sectors.

Table A. 11. Output Changes by unilateral, mutual tariff reduction, and land mobility assumption under WTO Accession [change in mil. USD]

Sector	Unilateral tariff reduction (W3_tariff_NTM)	Mutual tariff reduction	Mobile land assumption
Agriculture	103	122	131
Cereal	6	6	-2
Vehicles	-22	-24	-23
Machinery	-4	-6	-4
Meat and livestock	15	14	3
Energy and extraction	-22	-21	-24
Processed food	-11	-10	-11
Textile	-102	-104	-103
Leather	0	-1	-1
Fuel oil	0	0	0
Tabaco and beverage	1	1	1
Plastic	-7	-7	-7
Heavy manufacturing	-37	-39	-37
Light manufacturing	-78	-88	-81
Service	-199	-220	-211
Transport	82	74	79

Table A. 12. Welfare changes by unilateral, mutual tariff reduction, and land mobility assumption under WTO Accession [change in %]

Regions	Unilateral tariff reduction (W3_tariff_NTM)	Mutual tariff reduction	Mobile land assumption
Ethiopia	0.394	0.423	0.395
West Africa	0.000	0.000	0.000
Central Africa	0.000	0.000	0.000
North Africa	0.000	0.000	0.000
East Africa	0.000	0.000	0.000
Southern Africa	0.000	0.000	0.000
Europe	0.000	0.000	0.000
Asia	0.000	0.000	0.000
ROW	0.000	0.000	0.000