COLLEGE OF BUSSINESS AND ECONOMICS

DEPARTEMENT OF ECONOMICS

ETHIOPIAN EXPORT POTENTIAL AND EFFICIENCY: A STOCHASTIC FRONTIER ANALYSIS APPROACH

A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY DEPATMENT OF ECONOMICS SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE MASTERS OF SCIENCE IN ECONOMICS (INTERNATIONAL ECONOMICS)

BY: GETINET KINDINEW

ADVISOR: WORKU GEBEYEHU (PhD)

April 1, 2023

Addis Ababa, Ethiopia

Declaration

I, the undersigned, declare that this research project (**Ethiopian Export Potential and Efficiency**) is my original work, which has not been submitted for any award in any other institution, and all sources of information used in the project have been properly recognized.

Declared by:

Getinet Kindinew Signature _____ Date _____

Confirmed by Advisor:

Worku Gebeyehu (PhD) Signature _____ Date _____

Certification

Addis Ababa University

School of graduate studies

This is to certify that the thesis prepared by Getinet Kindinew Tsega entitled "**Ethiopian Export Potential and Efficiency"** in partial fulfillment of the requirements for the Master of Science in Economics (International Economics) complies with University regulations and meets the accepted standards in terms of originality and quality.

Approved by the examining committee:

Examiner _____Signature _____ Date _____

Examiner _____Signature _____ Date _____

Advisor _____Signature _____ Date _____

Acknowledgement

First, I would like to acknowledge and appreciate my supervisor, Dr. Worku Gebeyehu for his invaluable, sage and insightful guidance and encouragement provided during the course of writing this thesis. Secondly, my deep and warmest appreciation extends to my family and friends for their unwavering support and encouragement to undertake and complete this study.

List of Tables

Abbreviation

AfCFTA	: African Continental Free Trade Agreement
AGOA	: African Growth and Opportunity Act
APEC	: Asia-Pacific Economic Cooperation
ASEAN	: Association of Southeast Asian Nations
COMESA	: Common Market for Eastern and Southern Africa
EU	: European Union
FDI	: Foreign Direct Investment
FTA / PTA	: Free (Preferential) Trade Agreement
GDP	: Gross Domestic Product
OLS	: Ordinary Least Square
SFGM	: Stochastic Frontier Gravity Model
U.A.E	: United Arab Emirates
US	: United States
WB	: World Bank
WTO	: World Trade Organization

Abstract

The main objectives of the study are to estimate the current level of efficiency, identify the causes of the inefficiency and analyze the possible impacts of country-specific-constraints on Ethiopia's export. This study used a stochastic frontier gravity model to estimate export efficiency and potential of Ethiopia's bilateral trade with its top 47 trading partners from 2007 to 2020. The findings reveals importing countries' GDP growth had a significantly positive effect, whilst the importing countries' populations had a significant negative effect on Ethiopia's export. Ethiopia's total arable land area which is used as a proxy to measure resource endowments, distance from other countries, and currency exchange rate are found to be statistically significant effects on export flows. On the contrary, Ethiopia's GDP, population growth and inflow of foreign direct investment appear to be statistically insignificant. Trade with APEC and COMESA member countries has a statistically significant impact in reducing Ethiopia's export inefficiency compared to other countries. Importer countries landlocked dummy variable happens to be statistically significant in reducing the inefficiency effect, whereas the coefficient of average tariff imposed by a partner nation is statistically insignificant. In general, empirical findings demonstrate that Ethiopia's actual export is far below the estimated efficient level, and thus there is a significant room to increase it. This finding suggest redemption of policy measures that enable the country to maximize the efficiency of the sector by tapping its potential, particularly through establishing integration with untapped markets potential in the Middle East and Asian countries.

Keywords: *Export, Export Efficiency, Export potential, Stochastic Frontier Gravity Model*

JEL Classification: *C23, C87, F14*

Contents

Chapter 1: Introduction

1.1 Background of the Study

Export is considered as one of the most essential contributing factors to a country's economic growth. Many developing countries implemented an import substitution policy for economic growth in the 1950s and 1960s. However, the strategy has not brought significant effect on economic progress. As a result of this, most of these countries moved toward export promotion strategy since the mid-1970s (Edwards S., 1993). Ethiopia has also adopted trade liberalization policy and has brought a relatively robust growth in export since 1992 though the growth was not stable due to, among other things, the world price fluctuations. The value of exports, which mainly composed of primary products, has shown a sign of a positive growth trend after 2003 after the government reformed several policies including fiscal, monetary and trade procedures that diversified exports (Hailegiorgis, 2012).

Despite the fact that there has been a controversy whether import or export strategy is important for economic growth, in reality export and import are expected to play a similar role for economic growth. A nation imports the necessary raw materials, capital goods and machineries and technologies to expand its production base and improve its trade performance , on the off chance that these products are not accessible locally (Lewoye, 2019). Additionally, a nation should export goods and services to meet the demand for foreign currency, improve the way of life of the people and diminish reliance on foreign loan and aid, which thus, can guarantee sustainable development. Thus, cooperation in world exchange progressively is considered as the absolute most significant device for the thriving of economic growth (Rahman, 2009).

Exports have become one of the channels through which nations could coordinate themselves into the worldwide market. For developing nations, exports open doors of employment opportunities and earnings to pay for the numerous items that they can't presently produce at home and for the cutting edge innovation that they need (Salvatore, 2014). Besides providing direct employment, source of incomes and foreign exchange, exports permit nations to address developmental challenge of smallness of homegrown markets on productivity by exposing these countries to the worldwide market with huge economies of scale, increased capacity utilization, greater innovative activities and product variety. Increasing export efficiency and realizing their

potential could offer countries the opportunity to achieve their economic growth & advancement program (Camara, 2020).

Ethiopia, being among the developing countries shares similar experience of intensely depending on exports of primary items and small proportion of finished and semi-finished manufacturing products, whose production is linked with high risks and uncertainty. These items frequently experience changes in prices, most of often downwards, and they are less responsive to economic growth of importing countries due to their nature of being inelastic both in demand and supply. The country's weakness of earning from export is raised from the broadly fluctuating export price and less enhanced traded of a couple of commodities to a couple of countries without cutting edge trade technique (Shiferaw, 2018).

Boosting exports is essential for Ethiopia to secure the badly needed inputs practically in all economic and social sectors including manufacturing, agriculture and health and diminish the current foreign trade imbalance. To this effect, government has implemented different strategies, procedures and plans since 1992 including a gradual open trade policy and export-led growth strategy, privatization of state owned enterprises, permitting private sectors to partake in financial sectors, canceling export related taxes and subsidizing domestic exporters by providing incentives of duty-free importation of fundamental raw materials (Shiferaw, 2018).

Following the initiation of the reform package, real export receipts tended to increase progressively and also saw significant diversification away from its dependence on few primary export products mainly coffee. In 1991, when the reform package was launched, coffee brought more than 55% of the countries' total export revenue but its share declined to 32.1 % by the end of 2020 (WB, 2020). While the shares of other goods such as vegetables, oilseeds, live trees, plants and cut flower have increased substantially. According to WB report of (2020), vegetables (21.9%), oil seeds (17.4%), and live trees, plants and cut flowers (8.6%) collectively contribute 80% of total export earnings of the country. Three decades later, even though remarkable growth was seen from flower and other products, much of the diversification is within the same sector. The overall result doesn't show a significant departure from the traditional, mono-crop dominated export sector.

In spite of the export sector being still overwhelmed by agricultural items, export revenue from the manufacturing sector has increased more significantly. However, it hasn't offered in excess

of 5% to GDP (WB, 2020). Be that as it could, in excess of 90% of the import expenditure is dispensed for products of manufacturing activities and expenditure for agricultural imports has shown a declining pattern falling to fewer than 3%. As per the new Home-grown Economic Agenda of Ethiopia (2020), the development model in the past decade has produced prominently more demand for foreign exchange than supply. However, its high portion is absorbed by large-scale public investment projects, while the foreign exchange revenue anticipated from the projects didn't materialize in time. Together with weak export growth, rising imports resulted in significant current account deficits and severe foreign exchange shortages.

Historically, on GTP I while the country had planned to increase foreign exchange earnings from its merchandize export from $2 billion in 2009/10 to $6.5 billion in 2014/15, the actual achievement fell short of the target and average performance stood at $3.1 billion and the trade balance has widened from 6.3 billion USD in 2009/10 to 13.4 billion USD in 2014/15. Similarly, during GTP II, merchandize export is set to grow at an annual average rate of 36.3 percent, and foreign exchange earnings is expected to pick up from 3.1 billion USD to about 13.9 billion dollars by the of end of the period. The overall share of merchandise export in GDP is expected to grow from 4.9 % in 2014/15 to 11.8 % by 2019/20. However, Ethiopia exports in 2020 were $7.67 billion, which constitute only 8.69% its GDP. While significant stride have been made, both GTP I and GTP II have not entirely been successful in stimulating exports.

The above statistics shows that there is a huge difference between the targeted and actual export performance. Understanding the country's potential, the extent to which this potential is being realized and fundamental reasons for low performance is necessary in order to develop strategic development plans and effectively implement them. Although many of them concentrated on its determinants, the export sector continues to be a subject of interest for scholars.

1.2 Statement of the Problem

Ethiopia continues to export very little and ranks among the countries with the lowest export to GDP ratios in the world. It also has the lowest good exports of any emerging nation of its size, and its manufacturing value added to the economy is less than one-third that of Sub-Saharan Africa. It has half exporting firms as Kenya (which has half the population of Ethiopia), and average exporter size is small (World Bank Group Report, 2014).

Furthermore, the total area of 1.1 million square kilometers, arable land as a share of land area of Ethiopia increased from 11.6 % in 1971 to 14.4 %, in 2020 growing at an average annual rate of 0.46% (WB, 2020). The theory of Ricardo describes land as a natural key that keeps the economy centered on capital accumulation. This theory stipulates that agricultural commodities especially that would require vast land area for cultivation and natural resources should be mainly produced and exported by developing countries (McAfee, 2006: 39). Ethiopia as a developing country and having such a huge and fertile land, should produce and export at least primary and semi-manufactured goods. But the reality doesn't support this theory. Even though, Ethiopia's potential is expected to be huge, yet it hasn't fully utilized its potential, perhaps because of inefficiency and weak effort for structural change.

Although export is a significant source of foreign exchange, that are gravely required, it is too little and less diversified to contribute for structural transformation, and highly vulnerable to shortfalls in domestic supply and changes in market demand. Ethiopia's manufacturing sector is still far from being the driving force of growth and structural change. From the mid-2010s onwards, the country sees some promising signals from the manufacturing sector to emerge from the stagnations and showing positive dynamics, yet plays a marginal role in employment creation, exports and output, and is short of stimulating domestic linkages. This sector basically has had two distinct features: first, a low level of industrialization in terms of the sector's share in GDP, export earnings, and competitiveness. Second, it is overwhelmed by small firms, low-value and technology products, and weak between sector and intra-sector linkages (Oqubay, 2018).

The report of WB (2020) shows, Ethiopia's total value of merchandise imports reached $ 13.2 billion which is by far greater than merchandise export valued almost $ 3.3 billion, the deficit touched $10.6 billion and Ethiopia had never financed its import from export only over years. Inefficiencies in the export sector not only result in greater reliance on outside resources and aids, but also limit imports that may be necessary for the growth of the economy. As a result of this, the country suffers from shortages of foreign currency to import the necessary inputs, capital goods and vital consumption goods; which in turn affects the production and export capacity of the country. To reduce the import and export imbalance, the country has been formulating a number of strategies to enlarge the volume and expand the number of destinations by considering the possible capacity of the country. Unfortunately, the trade deficit or

imbalance is widening. This shows that the country either does not have a huge potential as expected or is not efficiently exploiting its potential while trading with partner countries. This might be because of its institutional and infrastructural rigidities or its trading partners.

Earlier studies such as Lewoye (2019) looked at Ethiopia's trade potential using the conventional gravity model estimation; Mulugeta (2009) examinees the determinants of Ethiopia's trade flows using the standard gravity model; and Hussein (2008) examined the impact of Ethiopia's COMESA membership on its exports using the gravity modeling approach. Similarly, Gebrehiwot and Gebru (2015) explain Ethiopia's foreign trade potential based on a dynamic gravity generalized method of moment estimators and analyze the pattern of trade flows, predict the basic trade and export trade potentials of Ethiopia. These studies are focused on identifying export determinants and assessing its potential using the usual gravity OLS estimation method, which represents the data set's centered values. However, export potential refers to the greatest feasible export between trading partners, it is theoretically similar to a firm producing at the frontier, that can hypothetically be obtained when there is free trade policies (least resistance) given the current trade and institutional practices; and it reflects the upper sets not at the centered values as of OLS estimation (Drysdale et. al., 2000**;** Kalirajan, 2007).

Matias (2015) & Shiferaw (2018), to the best of my knowledge, conducted studies on export efficiency by utilizing the stochastic frontier gravity estimation approach in Ethiopian context. Even though the methodology they used was similar with this study, they have omitted potentially important explanatory variables. Similar to those studies, natural constraints (GDP, population of Ethiopia & trading partner countries and geographical distance between Ethiopia and these partner countries), total arable land and landlocked dummy variable are included. The formal annual average foreign exchange rate & average tariff rate imposed by importing countries, which are proxies as explicit beyond the border constraints variable of importing countries are left over in the earlier mentioned studies. Furthermore, foreign direct investment inflow, mostly directed towards the oil refining, mining, real estate, manufacturing and textile and renewable energy sectors. Dummy variable for trading agreements with up-to-dated data are also incorporated into the analysis. This distinguishes the study from the aforementioned studies and it analyzes the impact of these factors on export potential and (in) efficiency of Ethiopia. Therefore, following the work of Drysdale et al., (2000), Kalirajan and Singh (2008) and Miankhel (2015), SFGM approaches are used to deal with the upper bound of the data set.

1.3 Objective of the Study

The general objective of the study is to examine the Ethiopian export potential and efficiency with its top trading partner countries.

1.3.1 Specific Objectives of the study:

I. To estimate Ethiopia's bilateral export efficiency level with its major trading partners and the untapped export potential.

II. To identify factors those are responsible for the inefficiency of Ethiopia's exports.

1.4 Research Questions

The articulated research questions that are to be addressed are:

I. What is the current efficiency level of Ethiopian exports? Does the country have tangible untapped potential that could be tapped?

II. What are the factors that influence the Ethiopian export sector performance and contribute for inefficiency? What should be done to improve export efficiency?

1.5 Hypothesis of the Study

Estimation of export efficiency requires a hypothetical export frontier, which is the maximum possible export capacity when free trade is there. It implies assuming a country achieves its maximum trade potential, one might say that the country's exports are completely efficient. Based on earlier studies and literatures the following relationships are hypothesized.

I. Economic size (GDP) of exporting country & trading partners has a positive impact on Ethiopia's export potential and efficiency;

II. Population size has a positive effect on export potential and efficiency;

III. The performance and efficiency of Ethiopia's export have been positively affected by FDI inflow;

IV. Geographical distance between Ethiopia and trading partners has a negative effect.

V. The higher the imposed t ax rate by importing countries, which is an indicator of the level of beyond-the-border variable, impacts Ethiopia's export efficiency negatively.

VI. Trading partner membership to PTA will reduce export inefficiency.

1.6 Scope of the Study

This study is limited on the estimation of Ethiopian export potential and efficiency for the period of 2007 to 2020The top 47 destinations are selected based on the most recent value of export flows, which is the 2020 data, to partner countries.

1.7 Significance of the Study

Given the significance of international trade in the economic development events, it is fundamental to assess country's export potential and efficiency so as to suggest evidence based inputs for policy makers, exporter, participator researchers and other stakeholders to take calculated moves towards improving export efficiency of country. Even though a number of studies have used SFGM in other countries, except Matias (2015) and Shiferaw (2018), it's scarce in Ethiopia on this topic. Therefore, this work attempts to fill this gap and contributes to the subject in three different ways. First, it gives information on untapped export potential with particular partner countries considered in the study. Second, it provides an estimated export efficiency level with specific partner countries, which may help policymakers. Thirdly, it can be used as a reference for upcoming studies in this field.

1.8 Organization of the Paper

The remaining part of the paper is divided into four sections. The important theoretical and empirical literatures as well as the conceptual framework are briefly discussed in Chapter Two. The suggested methodology and data sources are discussed in Chapter Three; while the estimation and interpretation of results are covered in Chapter Four. Finally, conclusions and recommendations are presented in Chapter 5.

Chapter 2: Literature Review

Exchange of commodities and services across regions and national borders was deemed crucial in enhancing people's wellbeing before Adam Smith established economics as an organized discipline in 1776. The evolution and progress of the trading system has a lengthy history and the literature has gone through various doctrines and alterations. The relevant theories and empirical findings for this study are summarized as follows.

2.1 Theoretical Literature Review

There exists no single theory that can adequately describe the pattern of international trade. Several theories have been developed to explain the various ideas and concepts of the exchange of goods and services across global boundaries. Thus, one can argue that all traditional theories (of perfect competition) along with contemporary ones (of market imperfection) have contributed a lot to support the concept of globalization and allow countries to look international trade with different viewpoints. Among the different international trade theories, the Mercantilist's view, the Ricardian view, the Heckscher-Ohlin factor endowment theory and the new trade theories theoretical literature are reviewed as follows.

2.1.1 The Mercantilist's Views on Trade and Export

Mercantilists are a collection of merchants, bankers, philosophers, and government officials who adhere to the mercantile ideology. From the sixteenth through the eighteenth centuries, economic doctrine is a popular focus for this philosophy. This economic concept is the first to discover the explanation for the existence of international trade. The wealth and power of a country, according to mercantilist, is determined by its ability to export more than its import. They proposed that when a country's exports exceed its imports, it becomes wealthy (rich). As a result, the government had to do everything it could to boost exports while discouraging and restricting imports (particularly the import of luxury consumption goods), tariffs and other barriers to imports were erected, while exports were subsidized, resulting in a trade surplus that required government intervention (Salvator, 2014: 32).

Mercantilists further highlights that an inflow of bullion or precious metals occurs from the resultant export excess influenced nation's power and wealth. However, because all nations could not have an export surplus at the same time and the amount of gold and silver was fixed at any one time, one nation could only benefit at the expense of others. As a result, the

mercantilists taught economic nationalism, claiming that national interests were fundamentally in a conflict. The Mercantilists were criticized by classical economists such as Smith and Ricardo, as well as current researchers, for a variety of reasons. While not being widely practiced, the Mercantilist idea is still present, especially in the agricultural sector.

2.1.2 The Absolute Advantage theory on trade and export

Smith and the other classical economist began with the simple notion that in order for two nations to trade voluntarily, both nations must benefit. Smith explains how this trade occurs and where the advantages of the trade come from using his idea of absolute advantage. Based on absolute advantage theory, trade can occurs when one nation is more efficient (or has an absolute advantage over) than another in the production of one commodity but is less efficient (or has an absolute disadvantage with respect to) than the other nation in the production of a second commodity. Both nations can benefit by each specializing in the production of the commodity with which it has an absolute advantage and exchanging part of its output with the other nation for the commodity with which it has an absolute disadvantage. The most efficient use of resources is achieved by this process, and the output of both commodities rises which reflects the benefits of specialization in production that may be shared between the two countries through trade (Salvator, 2014).

Unlike mercantilists, Adam Smith believed that free trade would benefit all nations and strongly advocated a laissez-faire policy (i.e., as little government interference with the economic system as possible). Only a few exceptions to this laissez-faire and free trade policy were to be made-one of these was the safeguarding of industries important for national defense. Furthermore, Smith and his followers believed in the accumulation of human capital, physical capital, and natural resources rather than relying on precious metals like gold and silver for a country's success (See, Salvatore, 2014: 35).

2.1.3 The Comparative Advantage theory on Trade and Export

The other economist Ricardo appreciated Smith's persuasive aptitude in his argument for free trade, although he thought some of Smith's analyses should be improved. Mutually advantageous trade, according to Smith, requires each country to be the lowest-cost producer of at least one good that it may export to its trading partner. Ricardo questioned smith’s hypothesis, what if a country is more efficient in the production of all items than its trading

partner? Ricardo in his Principles of Political Economy and Taxation, published in 1817, introduced the law of comparative advantage, which presented a notion that demonstrated mutually beneficial trade could occur whether or not countries had an absolute advantage (Carbaugh, 2009).

The theory of comparative advantage implies that in the case of two goods, even if a nation had an absolute cost disadvantage in producing both goods, the immediate basis for trade was cost differences between nations, which were sustained by their inherent and acquired advantages. The nation that is less efficient should specialize in and export the good in which it is relatively less inefficient (where its absolute disadvantage is least). The more efficient nation should specialize on and export that good in which it is relatively more efficient -where its absolute advantage is greatest (Krugman et. al, 2010).

This theory is still one of the significant and accepted assumptions in economics, with numerous applications. Ricardo underlines that developing nations should focus on exporting simpler commodities and natural resources as well as agricultural commodities, especially those that need a lot of area to cultivate. The concept further asserts that trade between developed and developing nations is greater than trade between developed and developing nations. In this case, the idea fails because most international trade takes place between industrialized countries (McAfee, 2006).

Furthermore, it is based on a set of simplifying assumptions of only two nations and two commodities, free trade, perfect labor mobility within each nation but immobility between them, constant production costs, no transportation costs, no technological change, and the labor theory of value. Although assumptions one through six can be easily relaxed, assumption seven (that the labor theory of value holds true) is not valid and should not be used to explain comparative advantage. Besides, he assumed labor as the sole component of production ruled out an explanation of how trade affects the distribution of income among diverse factors of production within a country, as well as why some groups support free trade while others oppose it (Carbaugh, 2009).

2.1.4 Heckscher-Ohlin Theory on Trade and Export

The Heckscher-Ohlin theory hypothesizes that differences in available factors of production determine the pattern of international trade. According to the factor-endowment theory, a

country will export products that use a lot of its relatively abundant resource and import products that use a lot of its relatively scarce resource in production. International trade has been presented as a substitute for the mobility of factors of production because the items traded are factors of production. This concept stems from the reality that when a country exports a commodity, it is effectively exporting a factor of production in the form of a physical product to an importing country (McAfee, 2006).

It was previously demonstrated that disparities in relative commodity prices between two nations serve as the basis for comparative advantage, which, in turn, serves as the foundation for mutual beneficial trade. What has created such disparities in relative commodity prices, however, has remained a mystery. Factor endowment theory provides an answer to this topic, stating that disparities in indifference curves (tastes) and production borders are the reasons of discrepancies in relative commodity prices and comparative advantage between the two countries. Although there are additional elements that produce comparative advantage, the H-O theory emphasizes differences in relative abundance of factors of production in various nations as the fundamental determinant of relative commodity prices and comparative advantage. However, its erroneous assumptions that all labor is employed ignores the ideas of unemployment, as well as its unrealistic assumption that similar production exists, which ignores technology gaps. Simply expressed, the fact that resource prices do not fully equalize among countries can be explained in part by the fact that the assumptions behind the factor-endowment theory do not always hold true in practice (Carbaugh, 2009).

To conclude, the comparative advantage or factor endowment differences (H-O) theory bases on the assumptions of constant returns to scale and perfect competition. By contrast, the new trade theorists, developed in the late 1970s and early 1980s, relaxes the assumption of constant returns to scale and showed that increasing returns can drive trade flows between similar countries without differences in productivity or factor endowments. With increasing returns to scale, countries that are identical still have an incentive to trade with each other (Krugman et. al, 2010).

2.2 Empirical Review

Before we go into the empirical and methodological concerns, it is worth noting that existing research on Ethiopian export efficiency is not widely available. Aside from Ethiopia, several

scholars have used Stochastic Frontier model techniques to study countries' imports, exports, and trade efficiency over time using panel data in both developed and developing countries at the country-specific, regional, and trade agreement level. The empirical findings listed below are utilized as a reference for expected stimulation with hypotheses based on the traditional gravity and the SFGM.

Ogunkola (1998) used the gravity model using OLS to explore the benefits of enhanced trade in the Economic Community of West African States bloc. The results show the existence of trade potential in the Economic Community of West African States sub-region. The challenge with this approach is that inefficiency in export is entirely captured by the residual. However, as has been proven by the SFGM, the error term of the gravity model has a random component as well as a component that reflects inefficiencies in export. Similarly, Musonda (1997) investigates the extent and drivers of intra-industry trade among members of the PTA/COMESA regional trading bloc by utilizing the Grubel-Lloyd index. The results show that factors including distance, per capita income, language, a shared border, and enhanced regional communication networks influence member nations' intra-industry trade.

To estimate export efficiency, certain sections use a number of methodologies. Estimating the traditional gravity equation model with OLS and using the residual to estimate the efficiency or otherwise of a country's bilateral export is one such methodology. Positive residuals suggest that the GE's anticipated trade is less than what actually happens. Negative residuals indicate that expected trade exceeds actual trade. The remaining portion of the empirical literature review discussion will be devoted to the SFGM.

Deluna et.al (2013) examines the bilateral export performance and identify factors that influence Philippines merchandize exports and potential flows with its trading partners at the frontier for the period of 2009 to 2012 using a SFGM. The study's findings revealed that the Philippines' merchandise export flows to trading partners are significantly positively influenced by income, the importing partner's market size, and the geographical distance between them. Philippines trading partner's technical efficiency level ranged from 38 to 42 percent, with a standard deviation of 30, and Philippines potential export fluctuated over time. It also demonstrates that the Philippines' potential is enhanced by its membership in the ASEAN,

APEC, and WTO trading blocs. Reduced corruption, an open labor market, and language commonality with the importing countries all help and reduce the inefficiency.

Hassan (2017) examined the prime determinants and constraints of Bangladesh's export and its potential with top 40 trading partners using a panel data ranged 2008-2011. The result of SFGM and likelihood estimation technique indications that GDP, population, trade agreements and exchange-rate depreciation positively affect exports, whereas, the distance between Bangladesh and its partner countries and tariff levels negatively influenced exports to reach their potential level. Furthermore, the socio-political-institutional, 'behind-the-border' constraints, such as customs procedures, port inefficiencies and corruption, are restricting trade. It also revealed that there are huge variations in their export level, even among countries within the same trading blocs, despite trade agreements being established. He concludes removing the behind-the-border constraints and integrating more efficiently with the international market can realize the high level of untapped export potential of Bangladesh.

Noviyani et al., (2019) used a SFGM to evaluate Indonesian merchandise export efficiency with 62 trade partners. According to the findings of this study, Indonesian merchandise export flows with trade partners are significantly positively influenced by GDP and population, but significantly negatively influenced by bilateral distance. According to the result, Indonesia's average export efficiency to its trade partners increased from 51 percent in 2012 to 49.7 percent in 2016. Furthermore, the technical inefficiency model shows that business freedom, investment freedom, and landlocked dummy increased export inefficiency, while labor freedom, finance freedom, dummy variable contingent, and FTA decreased export inefficiency.

Irfan and Sami (2016) use panel data from 2006 to 2015 to examine the efficiency of Pakistan's bilateral exports to ten main export destination nations using the SFGM estimate technique. The findings reveal that the income of the importing countries significantly positively impact Pakistan's bilateral export flows to its trading partners. Importing countries' population or market size has a negative and insignificant impact on export flows, and the distance between them is also negatively correlated and affected. The mean technical efficiency was found to be quite poor, implying that actual observed export flows differ significantly from potential export flows projected using the gravity equation. Technical efficiency was determined to be in the range of 49 percent to 57 percent, with China being the most efficient at 57 percent.

For the period 2000-2013, Barma (2017) assessed the effectiveness of India's agricultural bilateral exports to 112 trade partners. He revealed that India's bilateral agricultural exports are positively influenced by GDP, population, and business freedom, but negatively influenced by distance and landlocked, real exchange rate and trade freedom, and free from corruption, using panel data and the stochastic frontier Gravity model and maximum likelihood estimation. Finally, the effectiveness of agricultural exports varied greatly amongst trading partners, regions, and trading blocs. Similarly, Nasir and Kalirajan (2014) used the SFGM to investigate the export performance of developed Asian economies in modern services such as computer and information, business, and telecommunications. The findings revealed that South Asia's and ASEAN's service export potential was lower than that of established countries in Europe and North America. The quantity of graduates and the quality of ICT infrastructure were shown to be major variables in increasing the services export potential of emerging countries. To compete with developed countries, it was advised that these countries remove behind-the-border barriers and adopt cutting-edge technologies.

In the SFGM framework, Miankhel (2015) conducted an empirical estimation to investigate the presence of institutional, socio-economic, and political behind-the-border trade constraints in Pakistan for the years 2006-08 and 2009-11. His findings demonstrate the existence of behind-the-border constraints which then impose transaction costs on potential exporters. The empirical findings also show that Pakistan is not fully exploiting its export potential with its neighbors. By reducing political barriers to regional trade with India and the CARs, liberalizing trade with neighboring countries, and focusing on the region, Pakistan can smooth consumption across borders and insulate the region from future shocks.

Using a comparative approach, Kelkar and Kalirajan (2020) studied whether India achieved its potential efficiency in merchandize export using the stochastic frontier gravity model approach. The authors measured the overall impact of the ‘behind the border’ constraints towards achieving their export efficiency. The authors result indicates that India achieved reasonable growth in merchandise export efficiency during the period 2001 to 2019. Nevertheless, the gap between India’s actual merchandise exports and potential merchandise exports is still quite large, around 20% on average. They recommend paying serious attention to improve export efficiency by reducing the domestic constraints, poor infrastructure that are hindering India from realizing its export potential. In addition, the rigid and complex bureaucratic hurdles should be removed and

made easier by digitalization. These important factors are needed to close the gap between the actual and potential exports.

To analyze a free trade agreement between India and China, Kalirajan and Paudel (2015) employed the SFGM, an export panel data set from 1995 to 2010, the Maximum likelihood estimation technique, and a counterfactual approach. According to the findings, India accomplished 68 percent of her export potential with China at current tariff rates and currency rates, whereas China covered 86 percent of her export potential with India. The removal of all tariffs increased China's and India's export potential by 20% and 28%, respectively.

Likewise, Kalirajan and Singh (2008) analyze the export performance of China and India. A sample size of 77 trading partner countries for the period of 2000-03 was used by applying the stochastic frontier gravity model to internalize the ability of the maximum possible exports given on the determinants of exports including the existing behind and beyond the border constraints. The study concluded that China had higher realized export potential as compared to India. The study demonstrated that the Indian export sector is less competitive due to behind-the- border constraints such as multiple procedures of ports and customs that complicate the export process as well as the inadequate domestic infrastructure development. Conversely, China's exports have increased due to a reduction in behind-the-border constraints. They suggested that rather than introducing new constraints, India can successfully nurture its comparative advantage in the service sector by relaxing behind-the-border constraints.

Using panel data from Ethiopia's 45 trading partners from 2001 to 2012, Matias (2015) used a stochastic frontier analysis of gravity model to examine the gap between actual and potential exports, as well as the extent to which country-specific social, political, and institutional factors have influenced the export gap. His empirical findings revealed that Ethiopia’s exports are much below their frontier levels, with country-specific socio-political-institutional restrictions having a significant impact. His research highlights the need for Ethiopia to move beyond its current trade policies in order to fully realize its export potential. It is especially important to eliminate internal barriers including those related to the institutional and legal framework, bureaucracy, politics, macroeconomic policy, human resource capabilities, and infrastructure.

Similarly, Gebrehiwot and Gebru (2015) explain Ethiopia's foreign trade potential using a dynamic gravity generalized method of moment estimators to evaluate trade flow patterns and

anticipate Ethiopia's basic trade and export trade potentials. They discovered that all of the traditional gravity variables are significant, but Ethiopia's trade potential has yet to be achieved, and they identify the Asian, European, and African countries with the greatest trade potential. According to their findings, Ethiopia's untapped trade potential can be realized through export diversification, infrastructural developments and bilateral negotiations.

Shiferaw (2018) assessed Ethiopian export efficiency, using a SFA model with panel data to determine if countries operated at the frontier with their main trading partners for the period 2006 to 2017. The finding shows that Ethiopia's actual export volume is much lower than the expected efficient level, implying that Ethiopia's exports have a lot of space to increase. In recent years, agricultural export efficiency has improved while manufacturing export efficiency has dropped. Furthermore, he examines the factors that determine export efficiency, concentrating on Ethiopia's exports to its major trading partners. Population and GDP have a significant and positive impact on Ethiopia's export industry, according to the estimated coefficient of determinants. He recommends a redemption policy that allows the country to enhance sector efficiency by employing all available resources.

Despite the fact that several researchers conducted studies on export in Ethiopia at various time, they are primarily concentrated on export performance and determinants. However, to the best of my knowledge, with the exception of Shiferaw (2018) and Matias (2015) no other study has used the SFGM to assess bilateral export potential and efficiency. The literatures on the subject are scarce in Ethiopia. In addition, they focused on natural and explicit beyond-the-border constraints by ignoring the effect of behind-the-border constraints, which arise due to socio-economic, institutional and political factors in the home country, as a source of exporting efficiency barriers. According to Kalirajan and Singh (2008), three factors influence bilateral export. First, natural constraints such as distance and transportation costs; Second, behind the border constraints related to institutional and infrastructure limitations of exporting countries; and finally, beyond the border constraints related to importing countries explicit tariff and exchange rate constraints. This indicates that the gap between what countries is actually exporting and should have been potentially export.

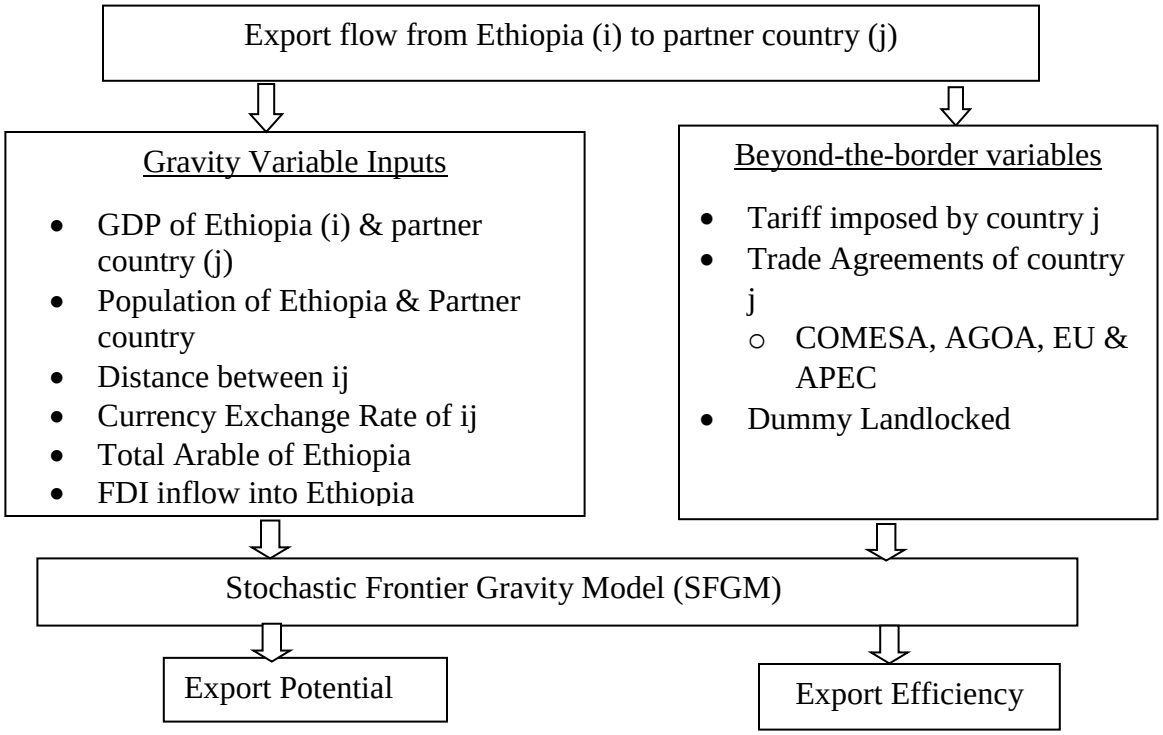
Hence, this study contributes to the empirical literature by estimating the level of bilateral export potential and efficiency of Ethiopia using latest available data by utilizing the SFGM

framework. SFGM has an advantage over the standard gravity model in that it can make empirical trade potential estimation more consistent with theoretical trade potential conceptualization. It also has an advantage of being able to make empirical export potential estimation more consistent with theoretical export potential conceptualization.

2.3 Conceptual Framework of the study

This conceptual framework, which is based on the study's objectives, identifies the key factors in the model based on the literature and their relevance to Ethiopia's trade. These variable includes GDP as a proxy for income, total population as a proxy for market size, distance between Ethiopia and partners country as a proxy for transportation costs, currency exchange rate, total arable land of Ethiopia, and FDI inflow. Beyond the border factor's, mainly average tariff rate imposed by importing countries are also included. Furthermore, dummy variables for regional and international trade agreements is used a proxy for man-made constraint's and landlocked as a proxy for natural constraints are also incorporated.

Figure 1: Diagrammatical presentation of the conceptual framework



Chapter 3: Methodology of the Study

3.1 Analytical Framework of the Study

The analytical framework of this study is based on the classic Newtonian gravity equation and is followed by an international trade analysis. The study uses stochastic frontier estimating methodology to supplement the universal gravity method of estimation.

3.1.1 The Gravity Model of the Study

Gravity models, is initiated based on traditional trade theories particularly the Ricardo's, and Heckscher-Ohlin models further expanded it by including important variables that capture scale economies, product differentiation and heterogeneity of exporting countries in the context of the new trade theory of imperfect competition. Some of the evolutions are reviewed in the context of this specific study as follows.

The Gravity Model is based on Isaac Newton's 1687 law of universal gravitation in physics, which quantified the gravitational force between two masses in relation to the distance between them, i.e.

$$Fij = \mathrm{G}\frac{\mathrm{MiMj}}{D^2ij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where: Fij represents Gravity force between two bodies (i and j);

Mi Mj stands for masses of the two objects (i and j)

Dij represents the distance between the bodies (i and j)

G indicates gravity constant

Sixty years ago, Tinbergen, J. (1962, as cited in Deluna et.al, 2013 and Mutethia, 2019) used an analogy with Newton's universal law of gravitation to describe the patterns of bilateral aggregate trade flows between two countries Yi and Yj as proportional to the gross domestic products of those countries and inversely proportional to the distance between them. This relationship can be specified as

$$Xij = \mathrm{A}\frac{Yi^{\alpha}Yj^{\beta}}{Dij^{\Upsilon}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Where X_{ij} – the values of bilateral trade flows between country i and j

YiYj - gross domestic product of country i and j represent as economic size

D_{ij} – represents the distance between country i and j used as a proxy for transportation cost

A -constant term

α, β and ϒ- represent the two countries GDP elasticity's and ϒ represent the elasticity of distance

Other variables such as population, trade agreements, and other natural and artificial trade barriers were added into Equation (2) to assess the factors that contribute for efficiency of exports. Despite its usefulness, the gravity model first faced resistance since it lacked a solid theoretical foundation. Anderson (1979) developed the first theoretical foundation for the gravity model, starting with the development of a gravity equation based on a demand function of imports with constant elasticity of substitution, in which each country produces and sells differentiated products which are imperfect substitutes in the international market, thus combining the model with microeconomic foundations. Bergstrand (1985) then worked with a gravity equation that was derived from a general equilibrium model of international trade with differentiated products. The gravity model has also received major theoretical backing from Helpman and Krugman (1985), who established a scheme with differentiated products and scale economies within the context of monopolistic competition.

To demonstrate its consistency with the H-O model, Deardorff (1995) shaped gravity equations with Cobb-Douglas and CES type preferences. He obtained a general conclusion that supported the use of gravity equations to explain international trade due to differences in resource endowments. Eaton and Kortum (2002) suggested a Ricardian model of international trade that takes into account technology differences between countries as well as natural and man-made geographical barriers. In an attempt to address the "border puzzle", of Anderson and Wincoop (2003), which reveals that barriers lower the volume of interaction between countries. Helpman, Melitz and Rubinstein (2008) built a version of international trade with heterogeneous firms more recently.

Having the above theories and revolutions, there is no need to assume a direct proportionality between the explanatory variables and the variable to be explained in the gravity model specified in Equation of (2). As a result, the exponents, α, β and ϒ can have values other than 1.

These are the GDP elasticity of the exporting country, GDP elasticity of the importing country and the elasticity of distance respectively are used in the gravity model of trade. A linear relationship is obtained by taking the natural logarithm of this equation and adding the error term. The Ordinary Least Squares (OLS) regression technique has historically been used to estimate this; the coefficients can be interpreted as elasticity's.

$$\text{Log (Xij)} = \text{Log A} + \alpha \text{ Log (Yi)} + \beta \text{ Log (Yj)} - \Upsilon \text{ Log (Dij)} + \varepsilon ij \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Anderson (1979) established the foundation for a gravity model of trade flows based on homothetic preferences for trade commodities across countries and the constant elasticity of substitution preferences. Deluna et.al (2013), rewrite Anderson's specification of aggregated trade flows as

$$\mathbf{Xij} = \frac{\mathbf{Yi\ \delta i\ \delta j\ Yj}}{\sum \mathbf{Yj\ \delta j}} \frac{\mathbf{1}}{\mathbf{f(Dij)}} \left[\sum \frac{\mathbf{Yj\ \delta j}}{\sum\ \mathbf{\delta j Yj}} \frac{\mathbf{1}}{\mathbf{f(Dij)}}\right]^{-\mathbf{1}} \boldsymbol{\varepsilon ij} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Where, Xij represents exports of country i to j; Yi & Yj the incomes in country i and j respectively; Dij is distance between country i and j; δ_j-is the share of expenditure on all traded goods and services in total expenditure of country, $\delta_i = F$ (Yi Ni), where Ni is population in country i respectively. The last term εij represents random disturbances showing the influence of the omitted variables and statistical errors.

3.1.2 Inherent Bias of the Gravity Model Concept

The term shown in square brackets, $\left[\sum_j \frac{\mathbf{Yj\ \delta j}}{\sum \mathbf{Yj\ \delta j}} \frac{\mathbf{1}}{\mathbf{f(dij)}}\right]^{-\mathbf{1}}$ in the preceding equation (4) is commonly removed in the standard gravity equation used for empirical work, but it is crucial and this study also considers it as well. Anderson (1979) defines the term as the economic distance between countries i and j in terms of the trade weighted average of the economic distance between all points in the system. The exclusion of this term in empirical research leads to estimation bias. Therefore, the expected value of the error term is no longer zero, (E (eij) ≠ 0), and the normality assumption of OLS is violated. According to Deluna et al. (2013), the omission of this error term resulted in a heteroskedastic result, which leads estimates to be inconsistent. As a result, OLS estimate of these gravity equations will be biased and resulted in a loss of efficiency.

Apart from violating the OLS normality assumption, OLS estimation of these traditional gravity models provide values at the mean of the observation or sample country in our case. This is an issue for determining export potential because it necessitates defining the upper bound. The

concept of stochastic production frontier analysis was introduced into the gravity model to solve these issues. Export potential is conceptually similar to a firm producing at the frontier in this situation.

In addition, if we consider the conventional gravity model, it is also arguable that trade costs are dependent not only on geographical distance between countries but also on other factors emanating from the existing infrastructural, institutional, socio-economic, and political rigidities in both exporting and importing countries. These latter costs are defined as economic distance in the literature (Anderson, 1979). Thus, the conventional gravity model given above has omitted these potentially important explanatory variables. Furthermore, this inherent omitted variable bias is overlooked by OLS estimation.

From Equation (3) above, behind and beyond the border constraints are not expected to have a significant impact on export flows from the exporting country. The impact of behind-the-border and beyond-the-border constraints on exporting country export flows is merged with the statistical error term. According to Kalirajan and Singh (2008), export flows are affected by (i) natural constraints, which include geographic distance and transport costs; (ii) behind the border constraints, such as socio-political, institutional and infrastructural rigidities in exporting countries; and (iii) beyond the border constraints, such as socio-political, institutional and infrastructure rigidities in importing countries. Its detail can be presented in the next sub-section.

3.1.3 Stochastic Frontier Gravity Model (SFGM) Concept

Kalirajan (2007) drawing on the 'error decomposition' analysis, introduced the SFGM to incorporate the overall impact of the behind the border constraints in the augmented conventional gravity model to estimate export potential. The combination of the theoretical framework of the standard Newtonian Gravity model and its subsequent adaptation to global trade analysis as well as the Stochastic Frontier Production Function estimation, addresses the inherent bias of the conventional gravity model of trade and augment the gravity model that enables prediction of exports potential. SFGM splits the error term (εij) into a random error term (υij) and a human-factor inefficiency term (μij). To remove the inherent bias of problem of the conventional gravity model, the composite error term is included and which take in to account the impact of other unobservable variables influencing exports costs. It is expressed as

$$Xijt = f(Yijt;\beta)\exp^{(\upsilon ijt-\mu ijt)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

If we multiply both side by natural logarithm, we get

$$\ln Xijt = \ln f(Yijt;\beta) + \upsilon ijt - \mu ijt \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where Xijt - is the actual export between country i (Ethiopia in our case) and partner countries j recorded at year f(Yijt) indicates the function of factors affecting the maximum export potential; β is unknown parameter to be estimated; υijt is a double-sided error term which are assumed to be independently and identically distributed (iid) with mean zero and variance δ^2_{υ}, N (0, δ^2_{υ}) captures the influence on trade flows of other variables, including measurement errors and implicit beyond the border constraints that are not under the control of the exporting country and are assumed to be randomly distributed across observations in the sample.

μi is a single-sided error term measuring inefficiency of export which captures the domestic factors of the exporting country that hinder the exporting country's actual exports reaching from its fullest predicted potential exports. It is assumed to be independently distributed as a non-negative half normal distribution or exponential distribution (μ, δ^2_{μ}). When its value is 0, it indicates the actual exports and potential exports are the same, then there are no behind the border constraints. When it is other than 0 but less than 1, it indicates that the effects of behind the border constraints actually impede exports from reaching their potential level by the value of "μ_i". Thus, the term "μ_i" represents the difference between potential and actual exports values, or inefficiency level which is a function of factors that are within the exporting countries' control, in our case, Ethiopia.

Furthermore the term beyond the border constraint can be divided into explicit and implicit. Explicit beyond the border constraints are observable, can be measured from applied tariffs and exchange rate of importing countries (Kalirajan and Singh 2008; Miankhel 2015). However, identifying and measuring implicit beyond the border constraints that emanate from institutional and policy rigidities of importing countries are very difficult for researchers.

Miankhel (2015) addresses the issue of implicit beyond the border constraints, which are specific to the exporting country with respect to specific importing country, and with the assumption that they affect the exporting countries uniformly. He demonstrates the trade balance equation of Anderson (1979) with the theoretical framework of the gravity model. He indicates that the implicit beyond the border constraints may probably reduce planned

expenditures of export if the exporting countries are not taking measures to overcome these constraints through conforming to, or initiating certain measures for example, through multilateral and bilateral negotiations, for becoming more efficient to a considerable extent.

Exporting countries have to become more efficient by removing behind-the-border constraints in order to overcome importing countries' implicit beyond-the-border constraints and realize their export potential. Behind the border constraints could arise due to socio-economic, institutional, and political factors in the home country. Among other things, large government size, weak and inefficient institutions in the home country in terms of custom and regulatory environments, port inefficiency, and political influences has been found to affect export flows (Miankhel, 2015).

It could also be owing to the elite's resistance to introducing institutional changes, which would be caused by the retention of faulty institutions caused by rent-seeking individuals through lobbying. Furthermore, these costs could be incurred as a result of certain institutions' policies aimed at accomplishing policy objectives. The combined effects of behind the border constraints which are interpreted as an 'economic distance' factor referred by Anderson (1979) and Roemer (1977) can be restraining export flows. Following the methodology given above, behind the border constraints and explicit beyond the border constraints are captured in to the gravity equation as μ_i and export weighted effective applied tariffs, respectively.

Thus, apart from the geographical distance constraint, there are also country-specific constraints which arise due to social–political and institutional factors in home and partner countries that need to be included clearly into the standard gravity model. Unfortunately, most of the empirical studies in Ethiopia do not consider this constraint into their trade model. Unless these constraints are measured, their sources are identified and corrected by appropriate policies, there will always be deviation between actual and potential trade. Drawing on Kalirajan (2007), the procedures developed for estimating stochastic frontier production functions, which do not require the researchers to have information on the exact components of (μ_i), can be used to estimate the impact of behind the border constraints and explicit beyond the border constraints of export for a given level of implicit beyond the border constraints.

Hence, term μ_i as re-defined by Aigner et al. (1977) reflects the fact that each country lies on or below its frontier f (Yi;β + υi), with all deviation coming from factors under the country's

control, and the frontier itself can vary randomly across country's or even over time for the same country. This implies that the frontier is stochastic by itself, with the disturbance term υi greater or smaller than zero being the result of favorable and unfavorable external events. However, μi can have other distributions such as gamma and exponential functions. The mean of this distribution is assumed to be a function of country-specific explanatory variables.

The suggested method of estimating the gravity model has its own benefits. First, it does not suffer from a loss of efficiency estimation (Kalirajan, 2007). It indicates how important behind the border constraints are in limiting exports from its potential. Second, it isolates the economic distance bias term, which causes heteroscedasticity and non-normality, from the statistical error term. This isolation property will allow us to assess the effectiveness of behind the border constraints as major export constraints by demonstrating whether total variations from the mean in the potential exports are due to random factors or country-specific behind the border constraints. Which is mathematically, $\boldsymbol{\delta^2 = \delta_u^2 + \delta_v^2}$.

Similarly, the share of the variation due to the behind-the-border or country-specific institutional, socio-economic, and political conditions to total export variations attributed both to behind-the-border and beyond-the-border constraints are captured as a coefficient of gamma (γ), $\gamma = {}^{\boldsymbol{\delta_u^2}}/_{\boldsymbol{\delta^2}}$. The higher and significant estimation value of gamma suggests that the country-specific behind the border constraints, which are not captured by the other explanatory variables in the model, are accountable for a bulky share of the mean total variation in the model (Hajivand et al., 2020). It also shows that the use of SFGM is appropriate for the sample (Irfan and Sami, 2016).

Third, it generates potential export estimates that are closer to frictionless export estimates due to the fact that this approach represents the upper limits of data, which comes from the economies that have most liberalized their trade restrictions (Armstrong et al., 2008). Finally, it has significant theoretical and trade policy implications for increasing the performance of the socio-political-institutional factors to achieve free trade (Kalirajan, 2007).

3.1.4 Export Potential and Efficiency Estimation

The concept of country's export potential is similar to that of a firm producing at the frontier. When a firm produces at the frontier, it has attained economic efficiency, which is composed of both technical and allocated efficiency. It is thus suggested that a country is trading in the most

efficient manner when it reaches its trade potential. Given the current trade, transportation and institutional practices, export potential can be defined as the export achieved when there is the least resistance (least inefficiencies) to trade (Drysdale et. al., 2000; Kalirajan, 2000; Armstrong, 2007). To put it another way, export potential is the maximum feasible value of exports that might hypothetically be achieved given the most open (efficient) trade policies already in place. Based on this logic, the country's achieved export efficiency can be defined as the ratio of actual to potential exports. Once obtaining mean actual export and efficiency score from the SFGM, we proceed to assess mean export potential.

Export efficiency can be defined as the ratio of actual export to potential export (when there is no man-made factor that negatively affects performance, $\mathbf{X^{\star}ijt}$ as follows:

$$X^{\star}ijt = f(Yijt; \beta)\ \exp(\upsilon ijt) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(7)}$$

$$\textbf{Export Efficiency } (\mathbf{EEijt}) = \frac{\textbf{actual export}}{\textbf{potential export}} = \frac{\mathbf{f(\ Yi;\beta)exp(\upsilon ijt - \mu ijt)}}{\mathbf{f(\ Yijt;\beta)exp(\upsilon ijt)}} = \mathbf{exp(-\mu ijt)} \ldots\ldots\ldots\ldots \text{(8)}$$

Where $\mu ijt \geq 0$, and $\mathbf{0 \leq EEijt \leq 1}$, 1 indicates efficient while 0 implies fully inefficient with the extent of having no export.

The average export efficiency is derived once the year-specific export efficiencies have been calculated. The explanatory variables that determine the behind the border domestic constraints that restrict the exporting country's actual exports from reaching its potential exports are then regressed on this term.

3.2 Econometric Model Specification and Estimation Technique

Bilateral export flows have traditionally been estimated using cross sectional data, but cross sectional and time series data produce biased results due to heterogeneity. Panel data estimation has many advantages over cross-sectional and time series estimation because it controls individual heterogeneity, reduces collinearity among explanatory variables through a high degree of freedom, and improves the efficiency of econometric estimates (Hsiao C, 2007: 45). Even though there are several alternative methods in measuring export efficiency and potential, each method has its own advantages and disadvantage over the other. Even though the argument is continued over which method is appropriate, the literature indicates many advantages for SFGM over the conventional gravity model.

This study, inspired by the proposal of Armstrong (2007), includes core explanatory variables, such as gross domestic product, population, geographical distance and currency exchange rate between Ethiopia & trading partners, total arable land of Ethiopia and foreign direct investment inflow to Ethiopia. Whereas, human factors such as tax rates, various preferential trade agreements and country-specific indicator variable (landlocked) of partner countries in the sample are also included as factors affecting export efficiency of Ethiopia. The time-invariant explanatory variables and a vector of time varying export stimulating and resisting variables are presented in the model as follows.

$$\ln Xijt = \beta_o + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP\_jt + \beta_3 \ln Pop\_it + \beta_4 \ln Pop\_jt + \beta_5 \ln Arable\ Land_{it} + \beta_6 \ln FDI_{it} + \beta_7 Dist_{ij} + \beta_8 \ln ER_{ijt} + (-\mu ijt + \upsilon ijt) \quad (9)$$

Where: Xijt represent the monetary value of aggregated bilateral export of Ethiopia (i) to her trading partner (j) at year t; GDP_it & GDP_jt of Ethiopia and of trading partner during year t respectively; population of Ethiopia and trading partner (Pop_it, Pop_jt) during year t; ER_ijt is the ratio of exchange rate of Ethiopian currency per US Dollar and that of partner trading country's currency per US Dollar over time; the geographical distances (in Kilometer) from capital city of Ethiopia to trading partner city as a proxy for transportation cost. Landlocked is a trading partner natural specific characteristics represented by as a dummy variable with value one if partner country are landlocked, and zero otherwise.

There is an opportunity to include complementarity variables to indicate the inefficiency of export, based on different scholar's finding. This paper selects man-made export resistance and policy variables. Namely; trade agreements, regional blocks, and tariffs rate as a proxy for the inefficiency. The resultant export inefficiency effect (μijt) that may capture the importing country-specific factors but contribute to Ethiopia's export inefficiency could be expressed in the below equation as:

$$\mu ijt = \delta_0 + \delta_1 \ln AvT\_jt + \delta_2 D\_COMESA_j + \delta_3 D\_AGOA_j + \delta_4 D\_EUj + \delta_5 D\_APECj + \delta_2 Landlocked_j + \upsilon ijt \quad (10)$$

where: δ_0 is intercept term; AvT is the average tax rate of all products imposed on exporting country's export by those selected trading partners in period t. Rationally the higher the tax rate, the less trade between the two countries, which is positively correlated with inefficiency. The preferential trade agreements of sample countries' membership to COMESA, EU & APEC

indicate importing country belongs to trade blocs, and Ethiopia's export to those trading block members likewise expected to reduces export inefficiency. Ethiopia has also been a significant beneficiary of AGOA, which was enacted in 2000 and remains inforce up to the suspension of Ethiopia as an AGOA beneficiary in the recent year, allows to access the U.S market under preferential terms; δi are measurable parameters in the model.

Pitt and Lee (1981) and Kalirajan (1981), two early empirical publications that attempted to explain the problem of inefficiency effects using a two-stage method, were criticized by Battese and Coelli (1995). They contend that, the first stage predicts observation-specific inefficiency estimates under the assumption that inefficiency effects are distributed identically. The second stage regress the inefficiency estimates that are obtained from the first stage on the vector of inefficiency determinants. However, this approach contradicts the assumption of identically distributed inefficiency effects in the stochastic frontier. To address this issue, Battese and coelli (1995) proposed the maximum likelihood methods for the technical inefficiency effects involved in stochastic frontier functions.

According to Wang and Schmidt (2002) the fundamental problem of the two-stage procedure is that it ignores resistance variables in the first stage, which has an impact on the ultimate inefficiency estimations. As a result, the omitted variable bias problem is further aggravated by explanatory variables that contribute to exporting country export inefficiency over time is not being included in the first stage. To overcome the potential of ignoring unobservable resistances and the resulting heteroscedastic error problem, this paper proposed to estimate in a single-stage estimation in which both parameters of the stochastic frontier as well as inefficiency equations are estimated simultaneously.

The stochastic frontier analysis does not require for prior knowledge of the magnitude and direction of the effects of the explanatory variables in the export equation, nor does it require for prior knowledge of the impacts of export resistance variables. To assure the validity of the obtained efficiency estimations, these variables can be confirmed following post-estimation result (Kaushal, 2022). In addition, Kumar and Prabhakar (2017) and Kaushal (2022) indicated that the single-stage estimation approach may also tolerate non-monotonic (consistently increasing and never decreasing or consistently decreasing and never increasing in value) export efficiency effects of exogenous variables. Following Irhami (2007), Kumar and Prabhakar

(2017), Mutethia (2019) and Kaushal (2022) this study uses a single-stage estimation procedure of SFGM which is a combination of equation (9) and (10) simultaneously using the Battese and Coelli (1995) estimation approach. The model is estimated using STATA 15 package.

3.3 Data and Measurement of Variables

This study used a panel data of exports of 47 top Ethiopia's export destination trading partner countries for the period ranged from 2007 to 2020. The destination countries are chosen and ordered based on the recent (2020) export flow values of Ethiopia to those countries and most complete data of variables. According UNCOMTRADE database report of 2020, from Ethiopia's total export values, above 96.6 percent was exported to these selected countries. Among the selected countries 17 countries are from Asia which cover above 61 percent; followed by Europe (15), Africa (11), North America (**2**) and Oceania (**2**) countries.

Variables, Data Sources and Expected Results

Bilateral Exports Values (Xijt): is the annual aggregated export values of Ethiopia to each 47 major export destination countries sourced from International Monetary Fund Direction of Trade data base and used as a dependent variable. The factors affecting export efficiency on this study include economic scale, population size, geographical distance, bilateral exchange rate, total arable land & foreign direct investment inflows in to Ethiopia. Furthermore, natural and man-made resistance variables are included to explain export inefficiency.

A. Stochastic Gravity Variables:

Gross Domestic product: It represents the total volume of production and income of a nation over a specific period of time. Exports flow and GDP are positively correlated; as a result, the predicted GDP coefficient is expected to be positive. The higher the income of importing country, more will be the demand for importing goods, and higher will be the exports from other country, in our case, Ethiopia. The data are collected from WDI database.

Population size: The theoretical foundations derived by Anderson (1979) and Helpman (1985) justify the inclusion of population as an independent variable. A positive effect would be the expected result for developing economies as they tend to be specialized in labor-intensive exports and also higher production capacity. Its negative effect could be due to more consumption capacity (absorption effect). The same explanation holds true for the importing country. More populous countries can import less (self-sufficiency) or import more (excess

demand). Even though the population effect in the literature is inconsistent, in this study it is expected that population has a positive effect the estimated population coefficient of both home and trading partner are expected to have positive impact on our export. The data is obtained from WDI data base World Bank.

Arable land (in hectares): as defined by Food and Agricultural Organization is land under temporary agricultural crops, the land under temporary meadows for mowing or pasture, the land under temporary market and kitchen gardens, and the land temporarily unplanted (less than five years). Export performance and efficiency is determined by production capacity that affect the level and competitiveness of a country in a global market mainly include the nature and extent of resource endowments of a country. The H-O factor endowment theory shows that countries with an abundance of one or more of the factors of production (in our case, land) will specialize in commodities that require much of the abundant resources.

Similarly, Ricardo stipulates that agricultural commodities especially those commodities that would require vast land area for cultivation and natural resources should be mainly produced and exported by developing countries. Ethiopia as a developing country and having a huge and fertile land should produce and export at least primary and semi-manufactured goods. However, the reality doesn't support this theory. Therefore, inclusion of arable land of Ethiopia as a main variable in this study is quite important to analyze its impact on export efficiency. It is expected that there is a positive relationship. The data is sourced from World Bank Group, World Development Indicator Database (2020).

FDI inflow: This variable is also used to examine the contribution of FDI inflow to Ethiopia's export sector efficiency. Ethiopia's cheap and abundant labor, privileged access to high-income markets, and growing domestic and regional markets add to its attraction as a FDI host country. According to Ethiopia's Ministry of Foreign Affairs report, Ethiopia ranked among Africa's top 5 FDI destinations in 2021 with 4.3 billion US dollars which mainly originated from China, Turkey, India, Saudi Arabia, Netherlands, and United Kingdom. FDI is assumed to promote export-led growth by supporting the host economy's processing and manufacturing industries, and linkages between domestic and foreign firms. Thus, a significant positive relationship is expected.

Distance (Dist ij): Exports are significantly affected by the transportation cost. Since the calculations of these costs are complex, geographical distance is used as proxy. Its impact on

export flow is expected to be negative; the longer the distance, the higher will be the trade costs, lower the exports volume between trading countries. Even with modern transport technology, distances (cost of trade) still significantly affect trade flows among countries (Noviyani et al., 2019). Data is extracted from CEPII, Research and Expertise on the World Economy.

Bilateral exchange rate (ERijt): Insertion of average exchange rate of currencies of trading partner remains useful to capture the currency movements of trading partner & explain the export flows at bilateral level. The data are sourced from International Financial Statistics database and calculated by the researcher. For the purpose of this study exchange rate is defined as the ratio of Ethiopia's birr (ETB) per US dollar to importing country's currency per US dollar (Kaushal, 2022). It's expected to be positive as a country's currency depreciates relative to its trading partner, it will boost the competitiveness of the domestic goods and hence increases exports. Conversely, an appreciation of real exchange rate reduces the competitiveness of home goods in international markets. Therefore, it is expected to be positively correlated to bilateral export between the two partner countries i.e. an increase in the ratio is showing a depreciation of ETB which may have positive effect on the exports. Mathematically,

$$ERijt = \frac{\text{Annual average of ETB per US Dollar}}{\text{Annual average of importing country local currency per US Dollar}}$$

B. Inefficiency effect variables

This study includes trading partner's natural specific characteristics such as tariff rate and membership with different regional and international agreements' dummy variables. To capture the importing countries explicit beyond-the-border constraints, average tax rate of all products ($Tariff_{jt}$) imposed by the importing countries (j) at time t is incorporated. Hence the higher the tax rate, the less trade between the two countries, which is positively correlated with the inefficiency of export. The data is compiled from the WB database. It is possible that despite import tariff, trading partner country may impose non-tariff barriers that create trade inefficiency contrary to the above expectation but it's not the scope of this study.

Even though the implicit beyond-the-border constraints are not controlled by exporting countries, it will be useful to capture and reduce its impact through bilateral, regional and multilateral negotiations. Therefore, this study incorporates the dummy variable COMESA,

AGOA, EU and APEC membership of trading partner countries as a proxies to minimize its impact on our export efficiency. It takes value of 1 if partner country (j) is a member of COMESA & AGOA, 0 otherwise and expected that Ethiopia's and its trading partner membership significantly reduces its export inefficiency. On the other hand, Ethiopia's exports to EU and APEC member countries will help to reduce the country's export inefficiency since their GDP are higher. The data is be obtained from WTO database.

Landlocked: it is a dummy variable that takes the value of 1 if partner country j is landlocked and the value of zero, otherwise. The geographical feature of being landlocked lowers trade because it tends to increase the transportation cost. Similar to the finding of Ravishankar and Stack (2014) and Camara (2020), this study will expect negative relationship.

Chapter 4: Presentation of results and discussion

This chapter presents the descriptive statistics of the data and followed by empirical and analytical interpretation of results. Results of the econometric estimation of the stochastic frontier gravity model and a discussion of the result are also concluded in this section.

4.1 Statistical Summary Result and Analysis

The dependent and independent variables data collected from various international data sources are summarized in this section. Accordingly the Statistical summaries are provided in the following table.

Table 1 Summary statistics for the Stochastic Frontier Models

Variable	Obs	Mean	Std. Dev.	Min	Max
Export value in Thousands of US Dollar	658	36653.84	55262.39	0.424	446959.1
GDP of Ethiopia in Millions of US Dollar	658	56868.1	27170.51	19707.62	107645.1
GDP of partners in Millions of US Dollar	658	1326581	2960583	847.9189	2.14E+07
Population of Ethiopia in Millions	658	97.13693	10.71849	80.67434	114.9636
Population of partners in Millions	658	106.3951	266.1644	0.805456	1410.929
Arable Land of Ethiopia in Millions of Hectares	658	15.27665	0.856688	13.606	16.1951
FDI Inflow to Ethiopia in Millions of US Dollar	658	1716.997	1424.573	108.5375	4142.938
Distance from Ethiopia partner country in km (air travel, bird fly)	658	5394.17	3187.503	375	14325
Currency exchange rate	658	77.82326	323.6257	0.020328	3485.794
Average tariff imposed by partners in %	658	6.220091	4.487102	0.04	27.82

Source: Computed by STATA 15 Software

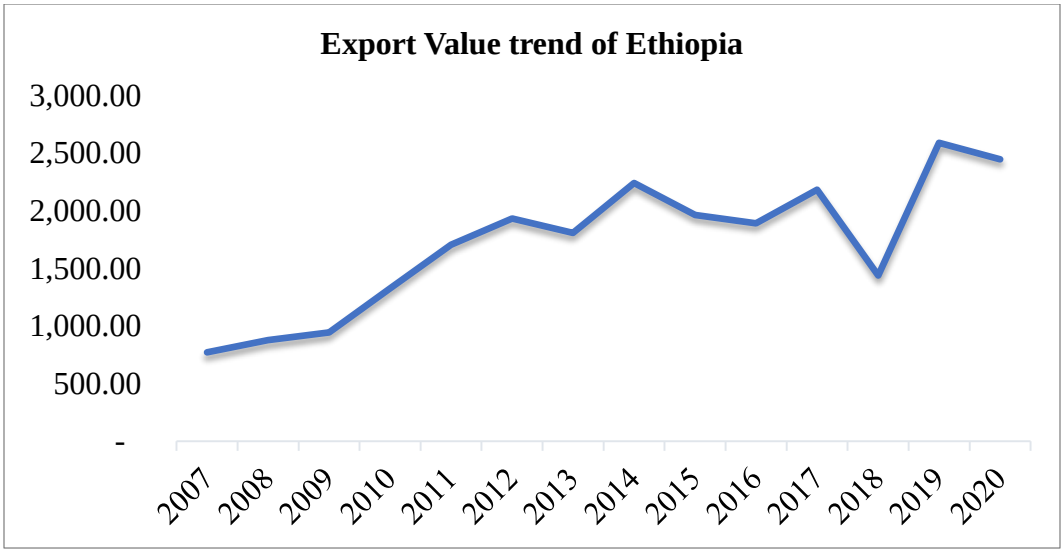
The data collected from top 47 export destination of Ethiopia's partner countries are used in this analysis. During this period, Ethiopia exported to small sized economies of 847.9 million US Dollars GDP to large scale economies which reaches above 21.4 trillion US dollars in GDP of the partner countries during the specified periods. Similarly, our country's GDP also is raised from 19.7 billion US dollar which is registered in 2007 to 107.6 billion US dollars which is recorded in 2020. Whereas Ethiopia gets a minimum export value of 424 US dollar with Latvia

in 2016 to the highest 446.9 million US dollar with China from 2016. On the other hand, the population also grew from 80.6 million in 2007 to above 114.9 million in 2020.

Ethiopia total arable land also increased from 13.6 million hectares to 16.2 million hectares. Even though currently Ethiopia's FDI is declining, during the specified period, it tended to upsurge from 108.5 million US dollars in 2007 to 4.1billion US dollars in 2020. Regarding to the geographical distance of our partners, Ethiopia exports to neighboring country Djibouti located 375 kilo meters to New Zealand far away about 14,325 kilo meters from the capital city of Ethiopia. Most importantly, the average tariff imposed by our partner country was ranged from the lowest 4 percent to the highest 27.8 percent during this period.

On the other hand, Fig 2 shows the trend in export value flow of Ethiopia which is collected from selected from partner countries, increased from USD 772.9 Million in 2007 to almost USD 2,592.20 in 2020 during the study period. However, some negative fluctuations may also be observed in export values, mainly have shown a significant declining trend during 2017-2018.

Figure 2: The trend of Actual Export value of Ethiopia during the study period of 2007- 2020



Source: Own computation based on compiled data during the study period of 2007-2020

4.2 Stochastic Frontier Estimates of Gravity Model

Following the concept of stochastic frontier production function, this paper simultaneously estimates the gravity model in Equation (10) and the export inefficiency model in Equation (11) in one-step approach. The estimation results are provided as follows.

4.2.1 Maximum likelihood estimation result

Equations (10) and (11) are estimated using the Stochastic Frontier Gravity Model to measure the Ethiopia's exports efficiency for the years 2007-2020. Following the methodology of Kumbhakhar et al., (1991) and Reifschneider and Stevenson (1991) to estimate all the parameters simultaneously in a single step procedure, both equations are estimated simultaneously in this analysis. This idea was consistent with assumption that inefficiencies are identically and independently distributed. The estimation provides the export efficiency scores of all trading partners which is the major objective of the study. Thus, to obtain the parameters of the model, ML random-effects time-varying inefficiency effects model (truncated-normal) of Battese and Coelli (1995) are executed using STATA 15 computer program. Results of the estimation are presented in Table (2) below.

Table 2 Maximum likelihood estimates of the Stochastic Frontier Trade Gravity Model

Inefficiency effects model (truncated-normal)	Number of obs	=	658
Group variable: c_id	Number of groups	=	47
Time variable: yr	Obs per group: min	=	14
	avg	=	14
	max	=	14
	Prob > chi2	=	0.0000
Log likelihood = -1009.9088	Wald chi2 (8)	=	681.62

Variables	Coef.	Std. Err.	P-Value
Frontier			
GDP_it	0.536943	0.609558 ns	0.378
GDP_jt	0.8008354	0.0495678***	0.000
POP_it	-1.174164	3.348235ns	0.726
logPOP_jt	-0.0986299	0.0469288**	0.036
logArableland_it	6.774381	2.64507**	0.01
logFDI_inflow	-0.1440862	0.0908698 ns	0.113
logDist_ij	-1.670591	0.085522***	0.000
logER_ijt	0.0361465	0.0198651*	0.069
_cons	-88.64072	37.35981**	0.018
Mu (Inefficiency)			
logAvT_jt	-0.0637351	0.3937252 ns	0.871
D_COMESA j	-1.598297	0.5852397***	0.006
D_AGOA	3.755272	0.962268***	0.000
D_EU j	1.208511	0.6819069*	0.076
D_APEC j	-1.712914	0.8415558**	0.042
D_Landlockedj	-3.716151	1.837433**	0.043

_cons	-1.164328	1.398143 ns	0.405
Usigma			
_cons	1.247955	0.2600124***	0.000
Vsigma			
_cons	-0.8920513	0.1736819***	0.000
sigma_u	1.866337	0.2426354***	0.000
sigma_v	0.6401673	0.0555927***	0.000
lambda	2.915389	0.2369428***	0.000

***, **, * represent significance level at, 1%, 5% and 10%, respectively; ns represents no statistical significance of the estimate coefficient.

4.2.2 Goodness-of-Fit Test for Stochastic Frontier Model

As stated on the methodology, the model was estimated using maximum likelihood function which was proposed by Aigner et al. (1977). To check the suitability of stochastic frontier gravity model for the sampled dataset via specific variance parameters, i.e. Gamma (γ), ($\gamma = {}^{\delta_u^2}/_{\delta^2}$), sigma squared ($\boldsymbol{\delta^2}$), ($\boldsymbol{\delta^2 = \delta_u^2 + \delta_v^2}$) and mu (μ). The term Gamma (γ) is the ratio of the variation caused by the effects of country-specific behind the border domestic constraints to the total variation of exports. It accounts for the proportion of the total export that is accounted by technical (in) efficiency which lies between 1 and 0; where 0 indicates that all deviations from the frontier come due to the noise effect while 1 indicates that all deviations from the frontier are due to inefficiency effects. In this study, Gamma (γ) = $\boldsymbol{\delta_u^2/\delta_v^2}$ = nearly 0.894431, which indicates over 89.4 percent of the deviations from the frontier is due to the inefficiency (mu), provides sufficient justification for the SFGM analysis in this study.

The summary of the SFGM estimation result shows that GDP and population of the importing, arable land of Ethiopia, geographical distance and currency exchange rate are statistically significant in the study of explaining Ethiopia's export flows. The result agrees with the theory of large economies tend to import more because of their higher incomes and also tends to export more because of their large variety of output or production; so, the larger the economy, larger will be the trade (Krugman, 2012). The result also indicates that Ethiopia's bilateral export flows will increase on average by 8% with 1% increase in GDP of importing countries in the sample. A similar conclusion is provided by Noviyani et al., (2019) and Kaushal (2022).

The estimated parameter for population of the exporting country, Ethiopia, and the export partner countries in the sample were found to be negative and contradict with the standard trade gravity model theory of international trade. Even though the gravity model assumes the importing countries' population as a proxy for market size, the coefficient is found to be statistically significant negative result in this analysis. This shows that Ethiopia's bilateral export flows will decrease on average by 9.8% with 1% increase in population of importing countries in the sample. The possible reason for negative coefficient may be due to the recent year observed sluggish economic growth and higher global inflation and other reasons which resulted in less demand of import in the world and our major export destination partners like US, China and most of EU countries, which leads to Ethiopia's export to decline significantly. However, the population coefficient of Ethiopia is statistically insignificant.

The study also reveals that the estimated FDI inflow coefficient is statistically insignificant in explaining Ethiopia's export efficiency, despite the popular assumption that FDI inflow has a favorable impact on the host country's export. This is possibly a result of the fact that Ethiopia's exports are mostly dependent on primary agricultural products, yet FDI inflow is concentrated in the manufacturing sector. It makes sense in light of this situation that FDI inflow has no significant impact on the nation's export efficiency. This does not, however, necessarily imply that the FDI inflow is completely unimportant. This study's findings are consistent with the analysis of Teamrat & Ying (2022).

The standard gravity model which used proxy's geographical distance as a cost of doing trade includes the transportation and communication barriers. As presumed, the estimated parameter coefficient of distance in this study was found to be statistically significant. It indicates that Ethiopia's bilateral export flow will increase by 1.6 % with 1% decrease in distance of partner country in the sample during the specified period. The estimated coefficient of distance result in this study is similar with the empirical finds of (see, Deluna et.al (2013), Irfan, A., and Sami, A. (2016)), conclusion that the higher the distance among trading partners, the lower will be the trade volume as transportation cost increases which is very high in countries like Ethiopia were landlocked countries. Therefore, geographical distance is a good proxy for economic distance in the case of Ethiopia for the specified period in this analysis.

Ethiopia's currency exchange rate depreciation relative to its partner economy has a favorable impact on exports, as predicted by the theoretical relationship established between exports and exchange rates. Ethiopia's exports are more competitive than the domestic market of the partner economy due to the depreciation of the Birr, its currency, which enables foreign countries to import more per US Dollar. According to the finding of this study, exports typically increase by 3.6% for every percentage point that the value of the ETB declines with a 10 percent significant level. Similar conclusions are also reported in the research of Kaush (2020).

The summary of inefficiency model estimation results captured in Table 3 shows all the coefficients related to preferential trade agreements except the coefficient of AGOA and EU dummy variables are statistically significant and negative as expected by the gravity theory. It is important to note that the coefficients in this equation capture the inefficiency effects. The negative sign of the dummy variable for COMESA membership and export APEC member countries' dummy variable implies lower inefficiency compared to the countries in the sample that are not members of the respective trade associations. Remaining other thing constant, Ethiopia's export to its COMESA partners was more efficient by 1.598% compared to exports to non-COMESA countries in the sample. Similarly, export to APEC countries is found to be more efficient by 1.71 than exports to other countries in the sample. Export to EU countries and to the US market through AGOA negotiation are found to be significant but not negative as expected in terms of reducing inefficiency of export flows. This may be the result of recent trade and investment relationships with the Asian countries, which open up large markets, as well as development support, primarily from China's government. Similar to this, the estimated coefficient for the average export tariff imposed by partner countries is found to be insignificant, that could be because of countries to which Ethiopia exports its commodities typically have lower average tariffs.

Landlocked coefficient is also negative and statistically significant effect. Ethiopia's lack of access to oceans and sea ports and trading with landlocked countries' increases transportation costs which may lower export flows. Thus, trading with countries access to oceans and sea ports reduce our export inefficiency by around 3.72 compared to landlocked countries in the sample. In general, Table 3 shows the computed export inefficiency, employing widely used Battese and Coelli's (1995) specification of the SF estimation technique. Findings suggest that Ethiopia's has been successfully increasing exports to the COMESA & APEC member nations.

4.2.3 Estimated Export Efficiency per Country and Region

The estimated export efficiencies shown in the table below are predicated from STATA outcome based on Equation 9 and the extended result is attached in annex I. During the study period, the technical inefficiency scores reveal that Ethiopia is not exhibiting 100% export efficiency to any of its trade partners and technical efficiency has been changing across countries and over time. With factors considered in the model, Ethiopia's export performance with its main trading partners is poor and that it has a better potential to boost.

Table 3 Summary of estimated Export Efficiency of Countries for the period 2007-2020

country	**2009**	**2016**	**2020**	**Ave**	country	**2009**	**2016**	**2020**	**Ave**
Jordan	77.42	64.79	61.88	70.39	Turkey	45.29	24.13	28.29	38.43
USA	66.1	70.42	70.53	68.53	UK	51.28	29.46	20.46	35.82
Switzerland	82.11	76.58	7.23	67.71	India	34.17	41.54	24.77	35.18
China	79.55	72.24	32.21	66.21	Togo	31.47	68.37	68.18	31.95
Viet Nam	64.38	79.04	78.88	64.89	Malaysia	26.24	34.22	65.54	28.13
Sudan	73.59	54.76	56.92	64.71	Sweden	32.58	27.46	11.77	27.54
China, Hong Kong	45.33	68.46	58.55	64.21	Somalia	1.75	18.89	80.59	26.55
New Zealand	63.88	65.74	55.1	61.38	South Africa	16.31	25.81	15.06	24.09
Belgium	50.23	62.22	66.33	60.49	Russian Federation	6.18	34.22	25.3	23.67
Israel	58.65	47.3	46	53.13	Greece	19.77	26.53	10.35	22.59
Australia	51.43	57.49	47.07	52.53	Bulgaria	12.14	16.96	15.2	22.08
Pakistan	50.33	68.9	40.75	52.24	France	13.49	24.72	14.38	21.19
Japan	16.37	55.99	60.52	51.92	Portugal	6.27	27.61	22.62	17.59
Djibouti	50.5	36.66	50.23	51.8	Senegal	4.59	13.47	37.93	16.49
U.A.E	54.72	46.1	55.36	49.63	Latvia	20.63	0.02	30.49	15.61
Germany	39.43	52.55	44.86	49.63	Finland	6.16	16.3	11.96	15.5
Rep. of Korea	40.32	64.89	63.18	49.01	Kenya	8.5	18.76	5.22	14.36
Yemen	55.64	35.39	55.81	48.76	Egypt	15.78	5.61	4.14	13.08
Indonesia	16.54	60.16	51.62	48.25	Spain	11.48	7.59	17.34	12.41
Canada	52.89	49.93	48.01	46.68	Norway	4.97	15.54	18.69	11.67
Singapore	65.25	37.79	74.6	43.6	Zambia	2.9	7.37	23.95	9.31
Netherlands	44.4	30.82	72.96	41.9	Nigeria	0.48	5.63	9.81	6.25
Saudi Arabia	46.24	41.85	38.17	41.74	Tanzania	2.1	0.79	5.89	4.23
Italy	46.79	33.15	25.31	39.21					
Average						35.46	38.81	38.94	37.92

Source: Own Computation based on the maximum likelihood estimates of the SFGM

Furthermore, the overall estimated mean efficiency for the period under review was nearly 37.92 percent which is by far below the country's potential. Switzerland had the highest efficiency, at 82.11 percent, in 2009; Latvia had the lowest efficiency, just 0.02 percent, in 2016. For the purpose of our analysis, the average technical export efficiency is classified as highest (60-70), medium (41-54), low (20-40) and very low (below 20) percent. Ethiopia achieved relatively highest average technical efficiently with Jordan, which was recorded 70.39 percent, followed by USA (68.35), Switzerland (67.71), china (66.21), Viet Nam (64.89), Sudan (64.71), China, Hong Kong (64.21), New Zealand (61.38) and Belgium (60.49) percent.

Whereas the estimated average technical efficiency with Portugal, Senegal, Latvia, Finland, Kenya, Egypt, Spain, Norway, Zambia, Nigeria and Tanzania was below 20 implying very low performing partner countries. Among included neighboring countries the analysis, other than Sudan (64.71%) and Djibouti (51.8%), export efficiency with Somalia (26.55%) and Kenya (14.36%) relatively records lower export efficiency during the study period. In general, from the sampled 47 countries 37 countries technical efficiency estimation result shows below 50 percent. Furthermore, the regional classification estimation result is summarized on annex 2. The extended estimation result is attached in annex II.

Table 4 Summary of estimated Export Efficiency of Countries for the period 2007-2020

	2007	2014	2017	2020	AVERAGE
COMESA	34.62	36.65	30.47	28.09	30.65
AGOA	16.21	18.93	30.82	24.49	19.06
EU	31.06	32.55	29.45	28.00	29.35
APEC	48.26	55.34	57.10	56.24	51.46
OTHER	47.83	49.64	42.54	41.59	45.04
TOTAL	35.60	38.62	38.08	35.68	35.11

Source: Own Computation based on the maximum likelihood estimates of the SFGM

The average export efficiency in 2014 was 49.64%, which is higher than the average technical efficiency and relatively the highest among the regions. Additionally, trade with ASEAN member countries is relatively more efficient (51.46%), followed by COMESA, EU and the US market of AGOA (30.65, 29.35, and 19.06) percent respectively. Countries that are not included in the aforementioned trade membership are labeled as "OTHER" and its mean technical efficiency shows 45.04%, which is higher than the overall mean efficiency scores in this study. Ethiopia's export to APEC countries has a number of advantages due to their strategic location,

which account for more than a third of the world's population (2.6 billion), about 60 % of the world's GDP, 47 % of the volume of global trade, and 70 percent of the growth of the world economy.

The export efficiency estimation result of this study from AGOA of US peaks in 2017 (30.82%) and swings with the average efficiency failing to achieve just 19.06%. Ethiopia's export through AGOA over the past two decades, become one of the main Sub-Saharan African garment exporters to the United States. For instance, in 2020, out of the $ 525 million actual export value, half are exported to the United States market with duty-free due to AGOA. Although the trend indicates that Ethiopia's exports under AGOA expanded quickly, with an average annual growth rate of 43%, they still only make up around 9.4% of the country's total exports. Additionally, the suspension of Ethiopia as an AGOA beneficiary is anticipated to affect the development strategy for export-led economic growth.

4.2.4 Estimated Export Potential per Country

Trade (export) potential is the maximum level of export given the current level of determinants and the least level of restrictions within the economic system. It is also defined as the trade that could have been achieved at the optimum trade frontier with open and frictionless trade possible (Miankhel, 2015). Using the estimated stochastic frontier gravity model coefficients and the mean actual observed data, the export potential was calculated and shown on Table 5 as follows.

Table 5: Estimated Export Potential per Country

COUNTRY	MEAN ACTUAL	AVE EFF. (%)	MEAN POT.	GAP	COUNTRY	MEAN ACTUAL	AVE EFF. (%)	MEAN POT.	GAP
CHINA	224.64	66.21	339.30	114.65	TANZANIA	2.39	4.23	56.40	54.01
SAUDI ARABIA	135.71	41.74	325.15	189.44	PAKISTAN	26.87	52.24	51.44	24.57
GERMANY	121.36	49.63	244.54	123.18	YEMEN	23.93	48.76	49.07	25.15
USA	143.07	68.53	208.78	65.71	VEIT NAM	27.57	64.89	42.49	14.92
U.A.E	92.07	49.63	185.52	93.45	RUSSIAN	9.49	23.67	40.12	30.62
SOMALIA	47.83	26.55	180.16	132.33	INDONESIA	19.10	48.25	39.58	20.48
ITALY	62.36	39.21	159.03	96.68	SWEDEN	10.74	27.54	39.01	28.26
SWITZERLAND	99.85	67.71	147.47	47.62	GREECE	8.36	22.59	37.03	28.66
KENYA	19.19	14.36	133.63	114.44	JORDAN	19.68	70.39	27.95	8.28

ISRAEL	70.29	53.13	32.29	62.01	CHINA, HONG KONG	17.91	64.21	27.90	9.99
INDIA	44.93	35.18	127.71	82.78	AUSTRALIA	14.58	52.53	27.75	13.17
FRANCE	25.46	21.19	120.15	94.69	NORWAY	3.04	11.67	26.04	23.00
TURKEY	42.07	38.43	109.48	67.41	SINGAPORE	11.30	43.60	25.93	14.62
DJIBOUTI	54.29	51.80	104.79	50.51	CANADA	10.18	46.68	21.80	11.62
NETHERLANDS	43.86	41.90	104.66	60.81	PORTUGAL	3.63	17.59	20.66	17.03
SUDAN	67.21	64.71	103.87	36.65	FINLAND	3.16	15.50	20.38	17.22
NIGERIA	6.46	6.25	103.33	96.88	MALAYSIA	5.31	28.13	18.89	13.58
JAPAN	53.39	51.92	102.84	49.45	ZAMBIA	1.19	9.31	12.83	11.64
UK	36.79	35.82	102.69	65.90	BULGARIA	2.67	22.08	12.12	9.44
EGYPT	10.49	13.08	80.21	69.72	TOGO	3.19	31.95	9.98	6.79
BELGIUM	43.50	60.49	71.91	28.41	SENEGAL	0.94	16.49	5.70	4.76
SPAIN	8.39	12.41	67.58	59.19	NEW ZEALAND	3.16	61.38	5.16	1.99
SOUTH AFRICA	14.19	24.09	58.92	44.73	LATVIA	0.78	15.61	4.98	4.20
REP. OF KOREA	28.24	49.01	57.62	29.38					
TOTAL						1,495.64		3,371.64	1,876

Source: Own Computation based on the maximum likelihood estimates of the SFGM

Table 5 shows Ethiopia's average unexploited export potential and gaps with the selected countries during the study period. Generally, all countries in the sample posed large export potential and revealed large deviation of the actual export flows which is ranged from USD 4.98 to USD 339.30 million. However, the highest export potential appears with China, Saudi Arabia, Germany, USA, UAE, Somalia, Italy and other countries of the sampled countries. Furthermore, substantial export gap is seen with Saudi Arabia, Somalia, Germany, China and Kenya. It also reveals large unexploited export potential with neighboring countries mainly with Somalia, Kenya, Djibouti and Sudan. In general, Ethiopia's export efficiency is operating relatively near to the frontier with Jordan, USA, Switzerland, China, Viet Nam, Sudan, China, Hong Kong, New Zealand and Belgium. Whereas operating far below the frontier that suggest an immense opportunity to enhance export with Portugal, Senegal, Latvia, Finland, Kenya, Egypt, Spain, Norway, Zambia, Nigeria and Tanzania.

Chapter 5: Conclusion and Recommendation

This paper aimed at estimating the bilateral exports' efficiency and potential of Ethiopia to its 47 major trading partners by adopting SFGM for the years 2007-2020 using maximum likelihood estimation technique of Battese and Coelli (1995).

5.1 Summary and conclusion of the finding

The results of the SFGM of the study shows Ethiopia's bilateral export flows increase with increase in GDP and decrease with increase in the importing countries' population. Whereas exporting country GDP and population are found to be insignificant. Geographical distance which is used as a proxy for cost of doing trade including the transportation and communication barriers adversely affects Ethiopia's exports. Surprisingly inflow of FDI into Ethiopia is also found to be statistically insignificant.

The finding also validates the depreciation of our currency relative to partner countries to have a favorable impact on exports as predicted in a formal market. However, exchange rate misalignment is shown by the parallel (black) market. In Ethiopia, black market exchange is considered to be larger than the formal market for foreign exchange even conduct larger volumes of foreign currency transactions than some commercial banks. During the study's end period, in 2020, the official exchange rate of the dollar to birr rose to 34.93 with the birr devaluing by 20.15% from the previous year. While the black-market exchange rate for the same period has ranged between 48-53 birr per dollar, a premium of 37-52% over the official rate depending on the location. Nowadays, the transfer system has been modified by local businessmen to transfer money from one country to another, outside formal financial institutions. Businessmen's are using informal channels because they can't access foreign exchange through commercial banks and go to the black market to convert local currency to US$ at very expensive rates. Thus, the underground markets negatively influence legitimate businesses and end-up with numerous direct and indirect effects on the same to exchange rate and economy.

Regarding to trade negotiations, Ethiopia's trade with APEC and COMESA countries are resulted statistically significant to reduce the inefficiency compared to the other countries in the sample that are not members of the respective trade association. This result supports the finding of the effects of tariff rates as PTA are expected to reduce the tariff rates and have positive contribution on exports. However, trading with EU membership countries are not reducing the

inefficiency; might be due to the recent trade cooperation with Asian countries. It is important to note that just because members of AGOA are permitted to export to the US market, doesn't necessarily mean they are also able to trade freely with one another. Therefore, Ethiopia has to improve its trading relations on a bilateral, regional and multilateral level.

This study also includes landlocked dummy which has a negative effect on the inefficiency. The efficiency of exports to landlocked countries will be more inefficient compared to countries access to oceans and sea ports, because transportation costs are relatively more expensive by road or air compared to sea transportation. Even though Ethiopia has no a direct access to oceans and sea ports, majority of international trade (90 to 95%) is carried out through Djibouti as a gateway with most of the goods essentially transported to and from the port by trucks. In general, yet Ethiopia has not exhibiting 100 percent efficiency with any of countries, revealed large deviation of the actual export flows and has a large unexploited export potential.

5.2 Policy recommendation

Based on the result of this study, the following policy implications are drawn. Firstly, Ethiopian trade policy has to take the initiative to make exporting a national priority sector, giving it additional attention that improve export efficiency in countries where it is very far from the frontier. To avoid relying on export markets in usual export destination countries, this might be a new market alternative for Ethiopian exports. Even though Ethiopia was one of the AGOA member nations that benefited from the agreement before it was suspended, the outcome is less than what may be expected considering our country's potential and resources.

Furthermore, Ethiopia should work to join regional trade agreements at the continental level and even has aspired to towards the WTO accession with genuine trade integration (with less commitments on tariff reductions, currency devaluation, etc.). To take advantage of its significant market access, Ethiopia should participate actively in the recent African Continental Free Trade Agreement (AfCFTA). The elimination of non-tariff trade obstacles should be prioritized as they prevent regional trade from reaching its full potential. To achieve this goal the platforms provided by Ethiopia's COMESA membership and the forthcoming AfCFTA should be effectively utilized.

Second, Ethiopia has to focus on other countries in addition to its current export destinations since they will become future hubs of economic growth and have untapped potential. The

discovery that there is significant export potential—particularly with China, the United Arab Emirates, Saudi Arabia, and other Middle East and Asian nations—indicate that more work has to be done to establish bilateral and multilateral trade partnerships and agreements. It should be the principal goal of all officials and diplomatic representatives. Thirdly, in order to maximize the benefits that might be achieved from the establishment of such an agreement, the government has to review the existing trade agreements. Moreover, the strategic effort must be strengthen by removing infrastructural, institutional and other rigidities through participation in trade talks, mainly with bordering countries.

It is necessary to raise the quality of the existing export products and begin to compete on the level of quality of its current exports goods (rather than merely price), which will lessen its exposure to rapidly fluctuating global pricing. By doing this, we may begin to encourage the gradual transition in production and exports, and realizing our untapped potential, and boost export efficiency above the prevailing level.

5.3 Limitation of the Study

Model and variable specification greatly affects the estimates obtained from stochastic frontier models. It is difficult to ascertain all the variables that may affect Ethiopia's export potential and efficiency but exclusion of an important variable may result in a biased results. It is obvious that some key institutional factors that may affect Ethiopia's trade, in our case export, mainly customs processes, ease of doing business, economic freedom indices, etc. have been omitted from the viewpoint of the specific objective of this analysis.

Secondly, a key limitation of this study is the use of aggregate data sourced from various international organizations. This is a common challenge in a country level analysis. It is arguable that decisions regarding exports are often made at industry or firm level hence aggregation at country level may result in to specification errors that might be transmitted to the result of a final efficiency score. Last but not least, despite the fact that stochastic frontier analysis have recently gained popularity in the field of efficiency analysis, there are less post-estimation tests to examine the validity of the SF model contrary to conventional regression models.

As mentioned by Karagiannis & Tzouvelekas (2009), many studies employed various model formulations of the stochastic frontier analysis and the temporal patterns of technical

inefficiency models and came to various findings on the individual performance using same data. The question of which model specification best matches the data naturally arises despite the fact that each model has its own advantages and disadvantages compared to the others. But selecting a specific model for the measurement of technical efficiency lacks any scientific or economic support. Regardless of the afore-mentioned key challenges and limitations, this paper plays an important role.

5.4 The study gap and proposal for future research

A strong export sector is essential for achieving rapid and export-led economic growth, to formation competitive manufacturing sectors, creation of jobs, and the reduction of poverty. Therefore, research that identifies the best and most practical strategies will remain crucial to improve export sector efficiency. Future research in this field will greatly benefit from the use of disaggregate data and analysis from a specific sector viewpoint, which is suggested as a way to enhance this study.

The home grown plan, which will span from 2020/21 through 2029/30, identifies important growth sectors. Along with the typical export goods like coffee, flowers, leather goods, and footwear, attention is being paid to the abundance of diverse natural resources including gemstones, energy, and metallic minerals. Future research, for instance, should look into stochastic frontier gravity model analysis relevant to a particular sector. In addition to the suggestions above, it is recommended that researchers should have to include additional pertinent behind and beyond-the-border variables that might have an impact on the export inefficiency in this research field.

Reference

Aigner, D.J., Lovell, C.A.K. and Schmidt, P. (1977). Formulation and Estimation of Stochastic Frontier Production Function Models. *Journal of Economics, 6, 21-37.* Anderson, J.E. (1979). A Theoretical Foundation for the Gravity Equation. The American *Economic Review Vol. 69, No. 1 (Mar., 1979), pp. 106-116*

Anderson, James, E. and Eric van Wincoop (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review, 93(1):170-192*

Armstrong S. 2008. Asian Trade Structures and Trade Potential: An initial analysis of South and East Asian Trade. *Paper presented at the Conference on the Micro-Economic Foundation of Economic Policy Performance in Asia, 3-4 April, New Delhi.*

Armstrong S. 2007. Measuring Trade and Trade potential Survey: *Asia Pacific Economic Paper No. 368*

Barma, T. (2017). Efficiency of India's Agricultural Exports: A Stochastic Panel Analysis. *South Asia Economic Journal, 18(2), 276–295.*

Battese, G.E. and Coelli, T.J. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics 20, 325–332 (1995).*

Battese, G.E. and Corra, G.S. (1977). Estimation of a Production Frontier Model: With Application to the Pastoral Zone off Eastern Australia. *Australian Journal of Agricultural Economics, 21, 169-179.*

Battese, G.E. and Coelli, T.J. (1988). Prediction of Firm-Level Technical Efficiencies with a Generalized Frontier Production Function & Panel Data. *Journal of Econometrics, 38, 387-399.*

Bergstrand, Jeffrey H, 1985. The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence. *The Review of Economics and Statistics, MIT Press, vol. 67(3), pages 474-481.*

Camara K. Obeng (2020). Export Efficiency and Diversification in Ghana: *African Economic Research Consortium, Nairobi, Kenya. 12th November, 2020.*

Carbaugh, Robert J. (2009). International Economics, 12th edition.

Deardorff, A.V. (1995). Determinants of Bilateral Trade: Does Gravity Work in a Neo-Classic World? *National Bureau for Economic Research Working Paper 5377.*

Deluna, Roperto Jr and Cruz, Edgardo (2013). Philippine Export Efficiency and Potential.

Dewi Solikhah Noviyani, Widyastutik and Tony Irawan, (2019). Indonesian Export Efficiency: A SFGM Approach. *IJSRSET, ISSN: 2456-3307, Volume 6 Issue 1, pp. 488-497.*

Drysdale, P.D., Y. Huang and K. Kalirajan. (2000). China's Trade Efficiency: Measurement and Determinants.

Drysdale, P., Huang, Y., & Kalirajan, K. P. (2000). China's trade efficiency: measurement and determinants'. APEC and liberalization of the Chinese economy, *Asia Pacific Press, Canberra, 259-71.*

Eaton, J. and Kortum, S. (2002). Technology, Geography & Trade. *Econometrica, 70, 1741-79.*

Edwards, S. (1993). Openness, Trade Liberalization and Growth in Developing Countries. *Journal of Economic Literature, 31(3), 1358–1393.*

Elhanan Helpman & Marc Melitz & Yona Rubinstein, (2008). Estimating Trade Flows: Trading Partners and Trading Volumes. *The Quarterly Journal of Economics, Oxford University Press, vol. 123(2): 441-487.*

Gebrehiwot, G. and Gebru, B. (2015). Ethiopia's foreign trade potential: inferences from a dynamic gravity approach, *Int. J. Economics and Business Research, Vol. 9, No. 4:355-375*

Helmers, C. and Pasteels, J.M. (2005) Assessing Bilateral Trade Potential at the Commodity Level: an Operational Approach, ITC Working Paper, Geneva, Switzerland.

Helpman, E. and Krugman, P. (1985). Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy. MIT Press, Cambridge.

Hailegiorgis Biramo (2012). The Effect of Export-Led Growth Strategy on the Ethiopian Economy: *American Journal of Economics.*

Hajivand et al., (2020). An Application of Stochastic Frontier Gravity Approach (The case of Iran's Potential Agricultural Exports. *International Journal of Analysis and Applications Volume 18, Number 3 (2020), 482-492*

Hassan M.T. (2017). An analysis of prime determinants and constraints of Bangladesh's export market: Stochastic frontier gravity model approach

Hsiao Cheng (2007). Panel data analysis—advantages and challenges.

Hung- Jen Wang and Peter Schmidt, (2002). One-Step and Two-Step Estimation of the Effects of Exogenous Variables on Technical Efficiency Levels. *Journal of Productivity Analysis 18, 129–144 (2002).*

Hussein, M. (2008). The Impact of Ethiopia's COMESA Membership on its Exports: An Augmented Gravity Modeling Approach.

Irfan, A., and Sami, A. (2016). Pakistan's Exports Efficiency: An Application of the Stochastic Frontier Gravity Model. *Abasyn Journal of Social Sciences*

Irhami (2007). Stochastic Gravity Model and Trade Efficiency for Indonesia. *Economics and Finance in Indonesia Vol. 55 (2) page 177-199*

Karagiannis, G., & Tzouvelekas, V. (2009). Parametric measurement of time-varying technical inefficiency: Results from competing models. *Agricultural Economics Review, 10, 50–79.*

Kalirajan, K.P., (2000). Indian Ocean Rim Association for Regional Cooperation (IORARC): Impact on Australia's trade. *Journal of Economic Integration, Center for Economic Integration, Vol. 15, pages 533-547.*

Kaliappa Kalirajan (2007). Regional Cooperation and Bilateral Trade Flows: An Empirical Measurement of Resistance. *The International Trade Journal, 21:2, 85-107.*

Kaliappa Kalirajan & Kanhaiya Singh (2008). A Comparative Analysis of China's and India's Recent Export Performances. *Asian Economic Papers, MIT Press, vol. 7(1), pages 1-28, winter.*

Kalirajan, Kaliappa and Paudel, Ramesh. 2015. India's Trade Deficit with China: Will Free Trade Agreement Work for India? *Global Economy Journal, vol. 15, no. 4, 2015, pp. 485-505.*

Kalirajan K (1981). An econometric analysis of yield variability in paddy production. *Canadian Journal of Agricultural Economics 29:283-294*

Krugman P. (2012). International economics: Theory and policy, 9/E. Pearson Education

India.

Kumar, S., & Prabhakar, P. (2017). India's trade potential and free trade agreements: A stochastic frontier gravity approach. *Global Economy Journal, 17(1).*

Kumbhakar, S.C., Ghosh, S. and McGuckin, J.T. (1991). A Generalized Production Frontier Approach for Estimating Determinants of Inefficiency in US Dairy Farms. *Journal of Business and Economic Statistics, 9, 279-286.*

Leena Ajit Kaushal (2022). Impact of regional trade agreements on export efficiency – A case study of India, *Cogent Economics & Finance, 10:1, 2008090*

Lewoye Bantie (2019). Determinants and Potentials of Foreign Trade in Ethiopia: A Gravity Model Approach.

Matias Assefa (2015). Unlocking export potential and the influence of country specific characteristics: evidence from Ethiopia. *Ethiopian Journal of Development Research, Vol.37 No.2 (2015)*

Miankhel, Adil Khan (2015). Pakistan's Potential Trade and behind the border Constraints. PSSP Working paper 31. *International Food Policy Research Institute*

Mulugeta, A. (2009). Modeling the Determinants of Ethiopia's Trade Flows

Mutethia G.R. (2019). Export Potential and efficiency in Kenya: An application of the stochastic Frontier Gravity Model

Musonda, F.M. (1997). Intra-industry trade between members of the COMESA regional trading arrangement, *AERC research paper 64, Nairobi: African Economic Research Consortium*

Nasir, Shahbaz; Kalirajan, Kaliappa. (2014). Modern Services Export Performances among Emerging and Developed Asian Economies. *Asian Development Bank.*

Ogunkola, E.O. (1998). An empirical evaluation of trade potential in the economic community of West African States, *AERC research paper 84, Nairobi: African Economic Research Consortium*

Oqubay A. (2018). The Structure and Performance of the Ethiopian Manufacturing Sector, *Working Paper Series No 299, African Development Bank, Abidjan, Côte d'Ivoire*

Paul Krugman, Maurice Obstfeld, Marc J. Melitz (2010). International Economics Theory and Policy, *9th edition.*

Pitt, M. and Lee, L. (1981) The Measurement and Sources of Technical Efficiency in the Indonesian Weaving Industry. *Journal of Development Economics, 9, 43-64.*

R. Preston McAfee (2006). Introduction to Economic Analysis, *California Institute of Technology*

Rahman, M.M. (2009). Australia's Global Trade Potential: Evidence from the Gravity Model.

Ravishankar, G., & Stack, M. (2014). The Gravity Model and Trade Efficiency: SF Analysis of Eastern European Countries' Potential Trade. *The World Economy, 37(5), 690–704.*

Roemer, J. E. (1977). The effect of sphere of influence and economic distance on the commodity composition of trade in manufactures, *The Review of Economics and Statistics, MIT Press, vol. 59(3), pages 318–27.*

Raghuvir Kelkar & Kaliappa Kalirajan (2020). Has India achieved its potential efficiency in merchandise exports? *ASARC Working Paper 2020/09. The Australian National University, Australia South Asia Research Centre.*

Salvatore, Dominick (2014). International Economics: Trade and Finance (Ed. 11th). Singapore: John Wiley & Sons.

Shiferaw G. 2018. Ethiopian Export Efficiency: A Stochastic Frontier Analysis Approach

Teamrat Kahssay Gebremariam & Sun Ying (2022). The foreign direct investment-Export performance nexus: An ARDL based empirical evidence from Ethiopia, *Cogent Economics & Finance, 10:1, 2009089,*

Tinbergen, J. (1962) Shaping the World Economy: Suggestions for an International Economic Policy. The Twentieth Century Fund, New York.

World Bank (2020). World Development Indicators Database.

World Bank Group (2014): 3rd Ethiopia Economic Update: Strengthening Export Performance through improved competitiveness.

Zhou, Yingjun (2020). Analysis of Chinese international trade potential under the background of the belt and road initiative.

Annex 1: Estimated Export Efficiency of Countries for the period 2007-2020

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Ave
Jordan	73.9	75.9	77.4	73.2	75.5	74.2	75.6	76.1	72.0	64.8	66.9	56.6	61.6	61.9	70.4
USA	74.4	70.1	66.1	66.3	64.0	63.7	68.1	69.3	72.6	70.4	72.0	59.3	72.6	70.5	68.5
Switzerland	80.0	82.0	82.1	82.0	80.2	80.5	80.6	79.6	79.1	76.6	76.2	57.2	4.7	7.2	67.7
China	70.4	69.9	79.6	76.0	76.3	72.7	73.9	76.7	71.1	72.2	67.2	47.1	41.6	32.2	66.2
Viet Nam	37.0	33.5	64.4	46.9	46.7	78.7	73.7	74.8	58.9	79.0	81.4	79.5	75.1	78.9	64.9
Sudan	74.0	72.7	73.6	69.8	67.2	76.0	69.0	65.5	60.0	54.8	59.3	50.3	56.9	56.9	64.7
China, Hong Kong	60.7	64.1	45.3	60.2	75.2	75.9	78.9	72.1	71.7	68.5	66.5	54.7	46.6	58.6	64.2
New Zealand	58.6	64.5	63.9	59.0	67.5	64.2	64.7	66.4	65.3	65.7	62.3	44.9	57.1	55.1	61.4
Belgium	51.5	57.1	50.2	64.5	67.4	63.2	60.5	62.6	63.6	62.2	66.2	49.0	62.6	66.3	60.5
Israel	51.5	60.6	58.7	55.1	55.7	50.4	55.0	60.8	55.4	47.3	48.9	48.6	49.8	46.0	53.1
Australia	44.8	51.1	51.4	57.6	52.7	57.8	56.6	58.7	59.3	57.5	59.8	32.3	48.8	47.1	52.5
Pakistan	61.5	61.1	50.3	65.7	45.3	65.2	68.4	63.0	62.0	68.9	48.0	22.2	9.0	40.8	52.2
Japan	66.1	53.6	16.4	32.4	39.9	48.6	55.1	65.1	59.9	56.0	58.3	49.1	65.8	60.5	51.9
Djibouti	64.5	61.4	50.5	56.2	54.3	55.2	54.8	43.2	45.7	36.7	52.4	44.7	55.3	50.2	51.8
U.A.E	48.6	55.8	54.7	62.3	50.1	38.5	41.1	50.1	44.6	46.1	51.8	44.7	51.2	55.4	49.6
Germany	37.4	38.1	39.4	61.2	67.8	59.4	52.5	58.4	58.5	52.6	50.4	26.2	48.0	44.9	49.6
Rep. of Korea	9.0	25.2	40.3	37.1	47.7	48.5	54.7	62.3	63.1	64.9	67.3	43.6	59.4	63.2	49.0
Yemen	68.9	63.5	55.6	47.7	45.6	40.6	41.2	45.5	29.3	35.4	40.8	46.6	66.1	55.8	48.8
Indonesia	17.3	44.5	16.5	44.3	49.5	45.0	60.0	66.0	54.8	60.2	60.3	55.8	49.9	51.6	48.3
Canada	49.0	54.3	52.9	45.9	49.9	37.7	42.2	41.8	45.1	49.9	52.0	33.5	51.3	48.0	46.7
Singapore	57.3	68.1	65.3	48.3	25.8	13.6	8.4	9.2	50.0	37.8	48.1	37.8	66.2	74.6	43.6
Netherlands	39.7	47.7	44.4	59.0	41.1	34.5	29.7	30.7	31.7	30.8	30.3	20.7	73.5	73.0	41.9
Saudi Arabia	45.6	49.4	46.2	46.1	44.9	37.3	39.4	41.7	44.5	41.9	43.2	30.9	35.1	38.2	41.7
Italy	55.9	52.4	46.8	45.1	60.7	38.5	37.1	39.8	35.0	33.2	34.4	15.2	29.6	25.3	39.2
Turkey	45.1	41.9	45.3	41.1	42.0	37.8	51.0	47.1	36.3	24.1	33.8	30.1	34.1	28.3	38.4
United Kingdom	41.5	48.9	51.3	50.4	50.8	32.2	36.9	35.5	27.2	29.5	33.8	16.9	26.2	20.5	35.8
India	36.0	33.9	34.2	38.4	35.7	33.5	34.3	41.4	42.6	41.5	27.3	26.1	43.0	24.8	35.2
Togo	14.3	0.8	31.5	24.4	4.1	12.0	0.1	1.7	1.4	68.4	75.7	73.4	71.3	68.2	32.0
Malaysia	60.9	49.3	26.2	12.0	28.6	3.0	25.1	17.1	3.2	34.2	6.0	2.9	59.6	65.5	28.1
Sweden	39.9	15.5	32.6	36.1	52.3	36.3	28.5	31.9	31.1	27.5	21.2	9.7	11.3	11.8	27.5
Somalia	7.4	1.2	1.8	6.7	17.1	3.4	8.6	31.2	27.9	18.9	21.1	65.2	80.7	80.6	26.6
South Africa	18.1	24.5	16.3	70.7	11.4	19.0	26.0	39.7	23.9	25.8	19.2	13.6	13.9	15.1	24.1
Russian Federation	21.9	13.2	6.2	6.4	17.8	16.6	30.0	40.0	33.2	34.2	41.1	18.3	27.2	25.3	23.7
Greece	27.4	37.1	19.8	14.1	25.9	17.5	28.3	30.4	25.8	26.5	23.7	12.5	17.0	10.4	22.6
Bulgaria	53.9	14.7	12.1	8.8	12.7	31.5	28.7	32.8	31.9	17.0	15.5	20.1	14.3	15.2	22.1
France	20.0	14.8	13.5	25.7	31.4	25.5	19.1	27.9	32.4	24.7	22.3	9.5	15.7	14.4	21.2

Portugal	3.1	5.8	6.3	7.3	4.8	19.2	17.5	32.6	19.4	27.6	30.9	26.6	22.7	22.6	17.6
Senegal	11.1	30.4	4.6	16.3	6.2	2.3	4.3	0.9	4.3	13.5	47.7	1.7	49.7	37.9	16.5
Latvia	21.0	0.8	20.6	33.1	17.9	3.1	15.3	15.8	0.5	0.0	21.5	7.0	31.3	30.5	15.6
Finland	3.7	22.7	6.2	9.5	34.2	23.5	12.5	15.7	21.9	16.3	21.4	6.1	11.5	12.0	15.5
Kenya	13.7	10.1	8.5	7.7	20.2	10.9	14.1	23.2	20.4	18.8	26.5	11.3	10.5	5.2	14.4
Egypt	19.1	29.3	15.8	15.4	15.2	10.2	14.5	17.6	6.0	5.6	7.3	8.7	14.5	4.1	13.1
Spain	9.1	15.9	11.5	10.5	16.1	14.1	12.5	9.1	10.4	7.6	11.5	8.8	19.4	17.3	12.4
Norway	7.7	9.2	5.0	10.8	12.4	12.5	11.2	9.8	18.4	15.5	9.8	4.4	18.1	18.7	11.7
Zambia	1.8	5.4	2.9	3.8	3.0	3.1	3.1	33.8	2.1	7.4	6.8	19.2	14.1	24.0	9.3
Nigeria	1.3	1.6	0.5	1.1	0.6	0.6	0.4	0.8	3.9	5.6	37.7	0.2	13.4	9.8	6.3
Tanzania	2.1	4.0	2.1	3.3	3.4	2.1	0.7	9.5	0.9	0.8	4.0	9.7	10.9	5.9	4.2
Average	37.8	38.5	35.5	38.6	38.6	36.0	37.5	41.0	37.8	38.8	41.1	31.1	39.8	38.9	37.9

Source: Own Computation based on the maximum likelihood estimates of the SFGM

Annex 2: Estimated Export Efficiency of PFA for the period 2007-2020

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Ave**
COMESA	34.6	5.8	30.3	30.6	32.0	31.1	31.1	36.7	26.8	24.6	30.5	26.8	30.3	28.1	30.7
AGOA	16.2	18.6	14.7	22.1	13.2	12.8	13.1	18.9	12.1	20.3	30.8	21.4	28.2	24.5	19.1
EU	31.1	28.6	27.3	32.7	37.1	30.6	29.2	32.6	30.0	27.3	29.5	17.6	29.5	28.0	29.4
APEC	48.3	50.9	45.7	45.6	49.4	48.2	53.2	55.3	54.5	57.7	57.1	43.0	55.5	56.2	51.5
OTHERS	47.8	48.6	46.5	48.1	45.9	43.1	46.0	49.6	46.6	43.7	42.5	39.3	41.2	41.6	45.0
Total	35.6	36.5	32.9	35.8	35.5	33.2	34.5	38.6	34.0	34.7	38.1	29.6	36.9	35.7	35.1

Source: Own Computation based on the maximum likelihood estimates of the SFGM