

**ADDIS ABABA UNIVERSITY  
SCHOOL OF GRADUATE STUDIES**

**MODELING THE DETERMINANTS OF  
ETHIOPIA'S TRADE FLOW: A GRAVITY  
APPROACH**

**BY  
MULUGETA AYEHU ASNAKE**



**JUNE, 2009  
ADDIS ABABA**

Addis Ababa University  
School of Graduate Studies

**Modeling the Determinants of Ethiopia's Trade  
Flow: A Gravity Approach**

By  
Mulugeta Ayehu Asnake

A project submitted to the School of Graduate Studies of  
Addis Ababa University in partial fulfilment of the  
requirements for the Degree of Master of Arts in Applied  
Trade Policy Analysis

June, 2009  
Addis Ababa

Addis Ababa University  
School Of Graduate Studies

Modeling the Determinants of Ethiopia's Trade  
Flow: A Gravity Approach

By  
Mulugeta Ayehu Asnake

Approved by:

*Girma Kstiphanos*

Signature

*Mulugeta Ayehu Asnake*

## Acknowledgment

*Oh Lord! I am inspired with your passion and care... ... and it was all impossible to move a step ahead without your will. Many thanks!*

Of course, there are many people who took part in this work and take a place for my gratitude. My first gratitude and appreciation would go to my advisor Dr. Girma Estiphanos for his valuable guidance and comments. I owe a great deal of appreciation to Dr. Abbi Mamo Kedir and Dr. Adugna Lemi for providing me many important articles. I would like to extend my thanks to Atnafu G/Meskel for his technical support while setting up the data during the study.

I am also grateful to my colleagues Yishak Tekalign, Abudulaziz Ahmed, and others who involved directly and indirectly with moral and technical support during the study. I have also a profound and sincere appreciation to National Bank of Ethiopia Economic Policy and Research Department officers and Economic Commission for Africa librarians for they provide me necessary data and CD-ROMs. Finally, yet importantly, I am greatly indebted to my families for they stand along with me in all the ups and downs.

Thank you all!

## Table of Contents

	Page
<i>Acknowledgment</i> -----	<i>i</i>
<i>Table of Contents</i> -----	<i>ii</i>
<i>List of Tables</i> -----	<i>iii</i>
<i>List of Figures</i> -----	<i>v</i>
<i>Abstract</i> -----	<i>vi</i>
<b>I. Introduction</b> -----	<b>1</b>
<b>II. An Overview of Ethiopian Foreign Trade</b> -----	<b>3</b>
2.1 Structure of Trade-----	4
2.2 Direction of Trade-----	5
<b>III. Literature Review</b> -----	<b>8</b>
3.1 Theoretical Framework-----	8
3.2 The Gravity Model-----	11
3.3 Empirical Evidences-----	13
<b>IV. Model Specification and Estimation</b> -----	<b>18</b>
4.1 The Data -----	18
4.1.1 Dealing with Missing values and zero data-----	19
4.2 Model Specification-----	20
4.2.1 The Baseline Model-----	23
4.2.2 The Augmented Gravity Model-----	23
4.3 Model Selection, Estimation and Interpretation of Results-----	29
4.3.1 Estimation Diagnostics-----	29

4.3.2 Model selection and Estimation-----	31
4.3.3 Discussion of Results-----	35
V. Conclusion and Policy Implications -----	37
5.1 Conclusion -----	37
5.2. Policy Implications-----	39
References-----	40
Appendix-----	45

## List of Tables

Table	Page
4.1 Results of Fixed Effect Estimation for Export Model -----	33
4.2 Results of Fixed Effect Estimation for Import Model -----	34
A-1 Summary Statistics of Export and Import Model Variables -----	45
A-2 Skewness/Kurtosis Tests of Normality for Export and Import Model Variables -----	45
A-3 Hausman Specification Test for Export Model -----	46
A-4 Hausman Specification Test for Import Model -----	46
A-5 Hausman Test of Endogeneity for Export Model -----	47
A-6 Hausman Test of Endogeneity for Import Model -----	48
A-7 Correlation Matrix of Export Model Variables -----	49
A-8 Correlation Matrix of Import Model Variables -----	50
A-9 Variance Inflation Factors of Export Model Variables -----	51
A-10 Variance Inflation Factors of Import Model Variables -----	51
A-11 Test for Serial Correlation -----	52
A-12 Test for Heteroskedasticity -----	52

## List of Figures

Figure		Page
2.1	Geographical pattern of Ethiopian exports -----	5
2.2	Geographical pattern of Ethiopian imports -----	6
2.3	Geographical pattern of Ethiopian trade -----	7

## *Abstract*

*In this paper we have attempted to analyze the determinants of Ethiopia's trade flow with its major trading partners using the gravity model. We used panel data estimation technique. The pre estimation Hausman specification test shows that fixed effect is favoured for both export and import models. Moreover, both the theoretical framework and Hausman test for endogeneity shows domestic GDP is endogenous in the export model. Therefore, instrumental variable estimation is used to estimate the export model while OLS is used for import model estimation. Post specification results show the major determinants of Ethiopia's export are domestic per capita GDP, trading partners per capita GDP, distance, trading partners trade policy, domestic infrastructure, and domestic institutional quality. All these determinants affect export positively while distance has a negative effect. The results also revealed that the major determinants of Ethiopia's import are home GDP, partners GDP, and home institutional quality. Among the basic gravity variables GDP works well in explaining import but not distance. The other most important finding is that variables that can be reflected in prices are little to work in determining import. The insignificant exchange rate and distance variables are examples for this. In general, the study implies strong institutions, better infrastructure and liberalized trade policies are required so as to integrate the country with the rest of the world and thereby benefit from trade.*

**Key Words:** *Gravity Model, Trade flow, Panel Data, Fixed Effect Model*

## I. Introduction

Trade is an essential element in broadening the prospects for economic expansion and deriving economic growth. It promotes efficiency, specialization, international competitiveness, and ultimately leading to greater levels of output. Ethiopia's economy is largely depending on foreign trade activities. It is heavily dependent on imports and exports. Exports are the price or the means by which the country pays for having access to imports. However, it is only a smaller proportion of Ethiopian imports, which could be covered by export earnings. For instance, 25.78% and 22.78% of total imports are paid by these means for the periods between 2001-2003 and 2004-2006 respectively (Customs Authority-Direction of Trade Statistics). This excess of imports over exports led to the ever increasing trade deficit.

The external trade policy of the current government of Ethiopia is market based economic policy, which has been adopting after the downfall of the Derg regime (1974-1991). The protectionism policy implemented during the Derg regime was changed to a more relaxed and liberalized policy. Quota imposed on imports was replaced by a tariff and export taxes were minimized and even eliminated with the exception of which was imposed on coffee.

Policy measures and strategies such as the rural development policy and strategy, the industrial development policy, and the investment policy have been adopted to implement a sort of export promotion and import substitution as the main trade strategy. Despite a

wide range of policy reforms adopted since then, the export sector has not shown improvements as much as expected. Befekadu and Berhanu (2000) explained growth in revenue from export was not only unstable but also failed to match the increase in volume. Besides, the basic structure of Ethiopia's export remains unchanged and there has been no decline in the dependency level of primary commodities and no significant shift towards the export of semi processed or manufactured goods. Tura (2001) also indicated the scarcity of agricultural land to expand traditional exports, lack of access to urban land due to the overall land policy, lack of access to domestic sources of export finance, the erratic nature of international prices for primary commodities, and low income and price elasticity of exports for primary goods are among the major factors that hampered the expansion of exports.

Imports have not also declined despite strong desire to reduce them through adopting devaluation and enhancing domestic production. This is because of the fact that since domestic production is import-intensive, substitution elasticity of imported good is low. As a result, it is difficult to substitute imports through domestically produced products.

Looking the country's direction of export, it is not only concentrated on the type of commodities exported but also on the markets to which exports are destined. Since 1991, Ethiopia's major export market was Europe, America, Asia and Middle East. Moreover, the country's import has also been dominated by a few developed countries. This study is

therefore an attempt to analyze the trade pattern and determinants of trade relations of Ethiopia with its major trading partners using the gravity model of trade.

The remainder of the paper is organized as follows. Chapter 2 contains an overview of the external sector of Ethiopia and assess the structure and direction of trade. Chapter 3 presents the review of different literatures on the theory of trade flow, theoretical underpinning of the gravity model and empirical findings. Chapter 4 describes the empirical analysis of the determinants of trade flow with a brief description of econometric modeling techniques and presents the results and its interpretations. Finally, chapter 5 provides conclusions and policy implications steaming from the overall results.

## **II. An Overview of Ethiopian Foreign Trade**

As to many Least Developed Countries (LDCs), the nature of Ethiopia's foreign trade reveals export of few primary commodities, i.e., commodity concentration particularly on coffee and imports of manufactured goods, fuel and semi-finished goods. Besides, the market is concentrated to and from Middle East, Western Europe, Japan and North America. Analysis on the structure and direction of foreign trade is presented in the following sub section.

## 2.1 Structure of Trade

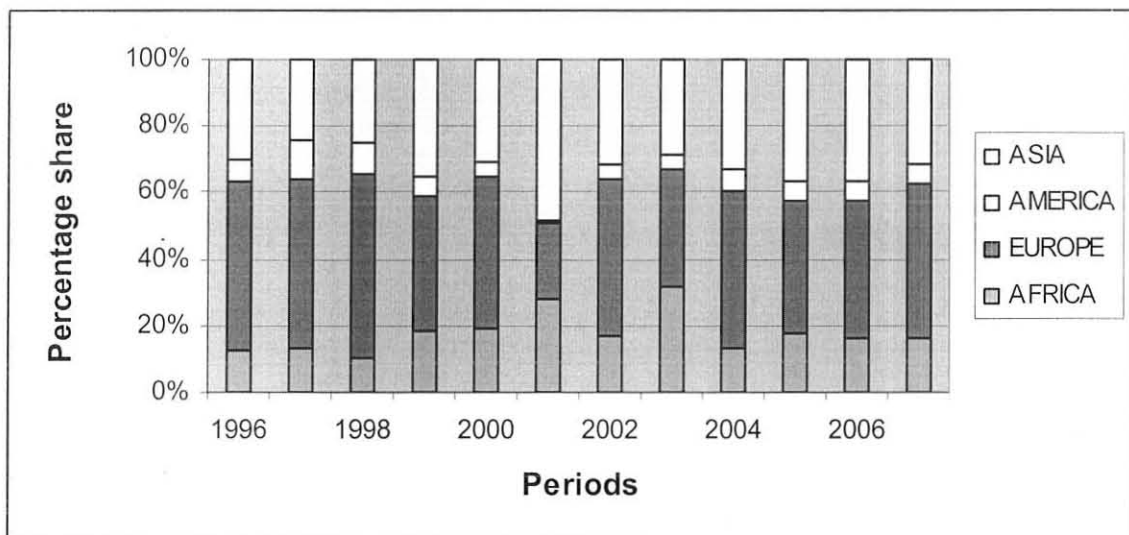
Ethiopia is a country in which its economy highly depends on agriculture. Owing to this fact the country's export has been concentrated on few primary products. About 90% of the export commodities are obtained from agriculture though the sector is highly susceptible to the erratic nature of prices and unpredictable demand in the international market (Tura 2001). Moreover, the report by World Bank (2008) shows that Ethiopia's average export product concentration index was 43.4% during the periods 2000-2004, and 41.6% during the periods 2005-2006. Top five merchandise export products constitute 76.6% of the total exports: Coffee (47%), sesame (20%), sheep skins (4%), beans (3%), and oil seeds (3%). Similarly, according to the report by UNCTAD (2005) diversification index of Ethiopia's exports were 49.9% in 2003 showing the country's exports are not diversified enough.

Ethiopia's import is mainly composed of capital goods, semi-finished goods, fuel and miscellaneous. Capital goods and fuel were the most important imported items. For instance, report on the Ethiopian economy 2005/06 indicated among the imported items, imports of raw materials, imports of fuel, imports of capital goods and imports of consumer goods grew by 89%, 115.4%, 118.2%, and 50.7%, respectively, during 2004/05 relative to 2003/04.

## 2.2 Direction of Trade<sup>1</sup>

As depicted in figure 1 below the major export markets of Ethiopia in recent years, 2004-2007, were Europe, Asia, Africa and America accounting 43.52%, 34.36%, 15.45%, and 5.78% of the total exports respectively. Italy, Germany, and United Kingdom are the largest European markets buying 21.2%, 13.19%, and 8.62% of the exports to the Europe<sup>3</sup>. From the Asian market china (mainland), Saudi Arabia, India, and Japan are the largest markets buying 25.64%, 25.58%, 12.12% and 8.11% of the total exports to this region. Of the total African exports Egypt (26.48%), Djibouti (23.36%), Kenya (13.56%), and Sudan (11.11%) are the largest export markets. United States, Brazil, and Canada accounts 78.01%, 15.98%, and 2.86% of the total American imports from Ethiopia.

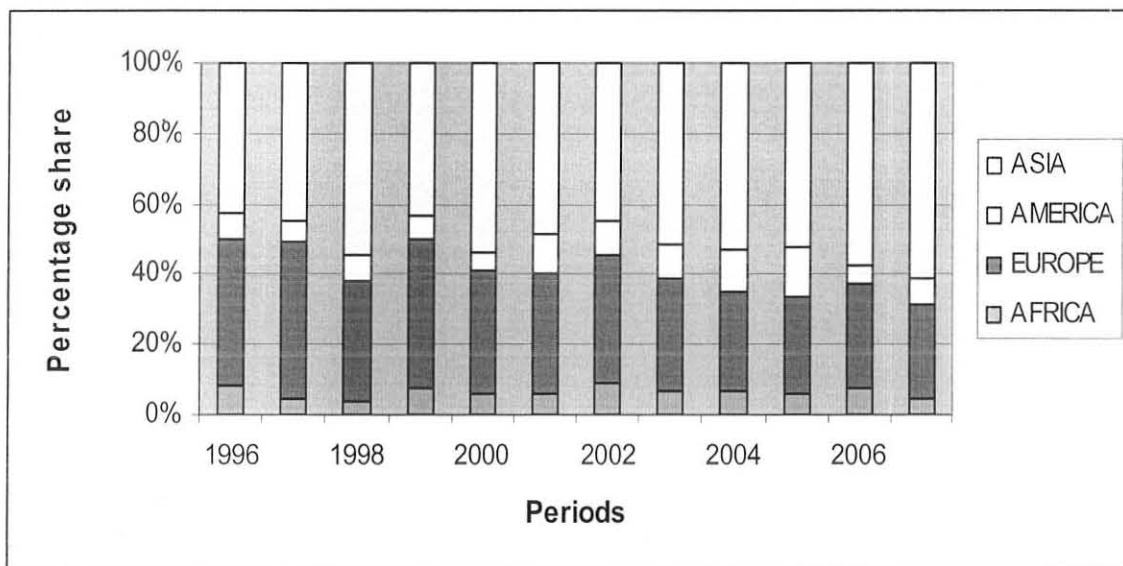
Figure 2.1: Geographical pattern of Ethiopian exports



<sup>1</sup> The source for all the figures and percentages computed in this section is customs authority.

During the sample periods for this analysis, 1996-2006, the major export markets for Ethiopia were Europe, Asia, Africa and America with 43.22%, 32.43%, 17.65%, and 5.94% share (customs Authority).

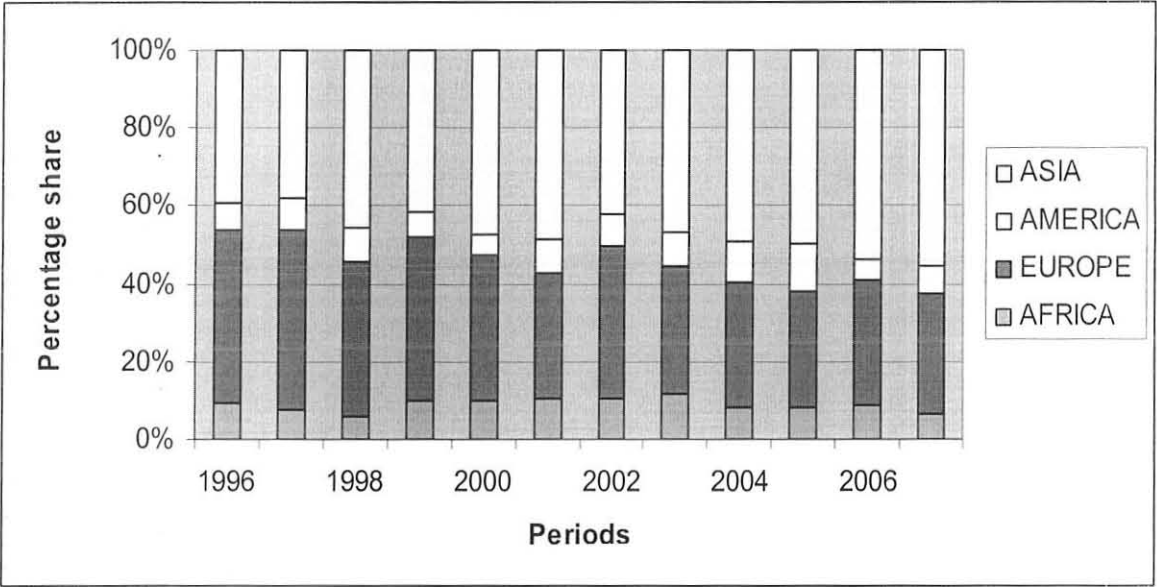
Figure 2.2: Geographical pattern of Ethiopian imports



Looking the origin of imports for the periods 2004-2007, 55.76% of Ethiopia's import originated from Asia where china (mainland) accounted for 25.64% followed by Saudi Arabia (25.57%), and India (12.12%). The second largest import market was Europe where Italy being the largest with 21.21% share. Germany and United Kingdom follows with 13.19% and 8.62% share respectively. America was the third largest import market accounting for 9.49% of Ethiopia's imports where United States (78.01%) contributes the lion's share followed by Brazil (15.93%) and Canada (2.86%). African countries accounted

for 6.04% of Ethiopia's imports being Egypt (26.48%), Djibouti (23.36%), Kenya (13.56%), and Sudan (11.11%) are the leading exporters. For the periods 1996-2007 Asia, Europe, America, and Africa contribute 50.3%, 34.29%, 8.37% and 6.24% of Ethiopia's imports.

Figure 2.3: Geographical pattern of Ethiopian trade



Looking the total bilateral trade (import plus export) relation of Ethiopia with different continents of the world for the periods 2004-2007, Asia takes 52.46%, where china accounts 26.18%, Saudi Arabia 23.83%, India 11.19% and Japan 10.16%. This higher trade concentration ratio shows higher trade integration with the region. This can be because more developed economies tend to trade variety of products. Europe is the second largest continent that trade with Ethiopia with 31.03% share of which Italy, Germany and Turkey contribute 19.97%, 16.74% and 8.1% respectively.

Africa is the third largest continent trading with Ethiopia and it takes 8.35% of the total trade. Djibouti, Egypt, Sudan and Kenya contribute 26.01%, 18.55%, 14.94% and 9.33% respectively. United States, Brazil and Canada contribute 80.58%, 12.65% and 4.05% for the total 7.69% bilateral trade share.

Looking the average share of exports, imports and total trade to GDP it was 12.75%, 26.75%, and 39.5% during the periods 2000-2003 as compared to 11.5%, 20.5% and 32% during the periods 1996-1999. This share was further increased to 16%, 37.67% and 53.67% during the periods 2004-2007 which shows an increasing importance of trade in the Ethiopian economy.

### **III. Literature Review**

#### **3.1 Theoretical Framework**

International trade theory is fundamentally the extension and application of microeconomic theories of production and exchange to the study of economic transactions between agents in different countries. Accordingly, it utilizes and enriches the paradigms of profit and utility maximization to explain why countries trade, what goods they will export and import, how trade affects resource allocation within and between nations, and whether a country benefits from international trade (Bowen et. al., 1998).



In considering the basis for trade, trade theory utilizes the important concept of comparative advantage, which implies differences in the relative price of goods across countries. Since relative prices in turn derive from the fundamental determinants of supply and demand, theories of trade based on comparative advantage look to differences in these fundamentals (e.g. relative factor supplies or technology) across countries as the bases for trade and its composition. Operating in the framework of perfectly competitive markets and homogeneous goods, these theories predict the emergence of trade and the goods countries will export and import, i.e., the inter-industry pattern of trade (Bowen et al., 1998).

The neo classical trade theory, which explains trade on the basis of relative factor abundance called the Hecksher-Ohlin (H-O) model, gave more strong explanation for the theory of comparative advantage. This model establishes the following set of assumptions: i) perfect competition, ii) two countries, two goods and two factors of production, iii) factor mobility between industries in a country, iv) constant returns to scale, v) different production function between industries, vi) there are no impediments to the domestic movement of goods. It states the role of nations' factor endowments (such as land, labour, and capital) as the key supply factor underlying comparative advantage. According to the theory, relative price levels differ among nations because (1) the nations have different relative endowments of factor inputs and (2) different commodities require that the factor inputs be used with differing intensities in their production.

However, the neoclassical models of international trade: Heckscher-Ohlin (H-O), Heckscher-Ohlin-Samuelson (H-O-S), or Ricardo model, was little to work with explaining patterns or volumes of trade. For instance, Helpman (1999) argued that large portion of trade was not explained by factor endowment differences.

The New Trade Theory (N-T-T), therefore, provides an alternative explanation of trade with the presence of economies of scale, combined with product differentiation and transportation costs (Krugman, 1980). It relaxes the assumption of the conventional trade theory regarding market structure and conditions of production and develops imperfect competition model and economies of scale. For instance, Markusen and Venables (2000) develop a monopolistic-competition model of international trade which includes positive trade costs and endogenous multinational firms. They demonstrate how the presence of trade costs changes the pattern of trade, creates incentives for factor mobility which may lead to agglomeration of activity in a single country, and may lead to multinational firms. The mix of national and multinational firms that operate in equilibrium depends on technology and on the division of the world endowment between countries. Multinationals are more likely to exist the more similar are countries in both relative and absolute endowments.

Examining which trade theory actually accounts for trade pattern of Ethiopia would allow us to understand the causes of international trade and to seek for appropriate policies for continual increase in trade and sustainable economic growth.

### 3.2 The Gravity Model

The gravity model has been widely used to analyze the determinants of bilateral trade flows. The model was first used by Walter Isard in 1954. In applied econometric work Tinbergen (1962) is the pioneer to use the gravity equation for empirical analysis of bilateral trade flow with intuitive theoretical justification. Linnemann (1966) added more variables and went further towards a theoretical justification. The Heckscher-Ohlin (HO) and Increasing Returns to Scale (IRS) model were the main theoretical foundations (See also Deardorff, 1995; Andersen, 1999; Andersen and Wincoop, 2001; Egger, 2002; Rose, 2004 (2006); Helpman et. al., 2008).

One of the theoretical justification of gravity model of trade is the Newton's law of gravity which states two bodies attract each other proportionately to the product of each body's mass (in kilograms) divided by the square of the distance between their respective centre of gravity (in meters).

The gravity model of trade in international economics predicts trade flows based on the economic sizes and distance between the two countries. The basic theoretical model for trade between two countries  $i$  and  $j$  takes the form:

$$F_{ij} = G [(M_i^\alpha M_j^\beta) / D_{ij}^\delta] \text{-----} (2.1)$$

where,  $F_{ij}$  is the trade flow between country  $i$  and country  $j$ ,  $M_i$  and  $M_j$  are the economic sizes of country  $i$  and country  $j$  respectively,  $D_{ij}$  is the geographical distance between the two locations, and  $G$  is a constant. Equation (2) predicts bilateral trade is positively related to with income and negatively related with distance. Converting into logarithms, we get its linear equivalent:

$$\text{Log } F_{ij} = G^* + \alpha \text{log } M_i + \beta \text{log } M_j - \delta \text{log } D_{ij} \text{-----} (2.2)$$

Where,  $G^*$  is  $\text{log } G$ , and  $\alpha$ ,  $\beta$ , and  $\delta$  are parameters to be estimated.

The gravity equation can be thought as a representation of demand and supply forces. Assuming country  $i$  is the origin,  $M_i$  represents the total amount willing to supply to all customers while  $M_j$  represents the total amount destination  $j$  demands. Distance act as a sort of tax, imposing trade costs. Thus, gravity model works well in explaining trade flows\*/ with the sizes of economies mass and their distance. However, significant amount of variation in trade cannot be explained in the basic gravity variables. Therefore, many authors augment the model with few other variables such as adjacency, per capita income,

common language, colonial links and boarder effects (Head, 2003). The model has also been used to evaluate the impact of different preferential trade agreements and currency unions on trade.

### 3.3 Empirical Evidences

The gravity model has been widely conducted to explain trade flow and trade potential in different countries. For instance, Deardorff (1995) has derived the gravity equation from Hecksher-Ohlin theory. He shows that the gravity model can be derived from two extreme cases of the classical framework of the Hecksher-Ohlin model. The first case is frictionless trade, in which the absence of all impediments to trade in homogenous products causes producers and consumers to be indifferent among trading partners. Resolving this indifference randomly expected trade flows correspond exactly to the simple frictionless gravity equation if preferences are identical and homothetic or if demands are uncorrelated with supply and they depart from that equation systematically when there are such correlations. The second case is that different countries produce distinct goods, as in the H-O model with complete specialization. Expression for bilateral trade are derived first with Cobb-Douglas preferences and then with CES preferences. Distance is included in the second model.

Helpman et. al. (2008) also utilizes a model of international trade with heterogeneous firms consistent with a number of stylized features of the data. The model predicts positive as well as zero trade flows across pairs of countries, and it allows the number of exporting firms to vary across destination countries. As a result, the impact of trade frictions on trade flows can be decomposed into the intensive and extensive margins, where the former refers to the trade volume per exporter and the latter refers to the number of exporters. This model yields a generalized gravity equation that accounts for the self-selection of firms into export markets and their impact on trade volumes. They found that the traditional estimates of trade are biased and most of the bias is due to the omission of the extensive margin, not due to selection. Moreover, the effect of the number of exporting firms varies across country pairs according to their characteristics. This variation is large particularly for trade between developed and less developed countries and between pairs of less developed countries.

Lan, Zulkornain, and Hook (2006) examined the China-ASEAN bilateral trade relationship using the Gravity model where the per capita income difference is included in the specification for testing the hypothesis. The empirical results based on bounds test show that the transportation cost and real GDP are statistically significant determinants of bilateral trade. The trade distance remains an important deterrent to China-ASEAN trade, and higher economy size of a country has positive and significant influence on bilateral



trade flows. The significant positive sign of the per capita GDP difference variable suggests that Linder Hypothesis does not hold for the entire region.

Rahman (2004) also used the gravity model to analyze the Bangladesh's trade with its major trading partners using the panel data estimation technique. He estimated the gravity model of trade (sum of exports and imports), the gravity model of exports and the gravity model of imports. The results showed that Bangladesh's trade is positively determined by the size of the economies, per capita GNP differential of the countries involved and openness of the trading countries. The major determinants of Bangladesh's exports are the exchange rate, partner countries' total import demand and openness of the Bangladesh economy. All three factors affect the Bangladesh's exports positively. The exchange rate, on the other hand, has no effect on the Bangladesh's import; rather imports are determined by the inflation rates, per capita income differentials and openness of the countries involved in trade. Transportation cost is found significant in influencing Bangladesh's trade negatively. Bangladesh's import is also found to be influenced to a great extent by the border between India and Bangladesh. The country specific effects show that Bangladesh would do better by trading more with its neighbouring countries. Multilateral resistance factors also affect Bangladesh's trade and exports positively.

Alemayehu and Haile (2002) modeled the determinants of trade flows taking COMESA as a case study. Their model is specified in such a way that bilateral trade between COMESA

members is a function of GNP, GNP per capita, infrastructure, policy (such as FDI, Parallel market Premium, financial deepening), Political situation (such as occurrence of war, coup, revolution), and culture and geographic factors (language, common boarder, landlocked). The results show that bilateral trade flows among the regional groupings could be explained by the standard variables and almost all the standard gravity models variables have plausible (except the dummy for proximity) and statistically significant coefficients, while regional groupings has had insignificant effect on the flow of bilateral trade.

Another important result is that good macro-economic policies (such as financial deepening and infrastructural development) are important determinants of bilateral trade in Africa. The proxies used to measure political instability (except war) have revealed the expected signs. But regional integration arrangements failed to positively affect intra-regional trade. In fact, intra-COMESA trade is not significantly different from its trade with non-member countries.

Simwaka (2006) investigated Malawi's trade with her major trading partners using an econometric gravity model. In his model, the bilateral trade is a linear function of economic size of the country, geographical distance, and exchange rate volatility, among other factors. In constructing the model he considers a sample of eight countries for the periods from 2000 to 2004. The results showed that Malawi's bilateral trade is positively

determined by the size of the economies (GDP of the importing country) and similar membership to regional integration agreement. On the other hand, transportation cost, proxied by distance, is found to have a negative influence on Malawi's trade. Likewise, exchange rate volatility depresses Malawi's bilateral trade whereas regional economic groupings have had insignificant effect on the flow of bilateral trade.

Apart from the gravity model, Tura (2001) develop an error correction model to identify the determinants of international trade flows of Ethiopia through the estimation for aggregate import and aggregate export demand and their respective components. He found that policies that affect the foreign exchange availability in the form of capital inflow and export earnings are likely to have a larger impact on import volumes than those that depend exclusively on exchange rate and aggregate demand management.

The estimation results of aggregate export and its components also indicate that the price and income elasticities that the exports of the country's primary commodities face in the international markets are relatively smaller. The inelastic price and income elasticities for export demand imply that there is a need for further diversification of exports that helps to shift towards the export of manufactured goods. The negative relationship of lagged exports with the current export demand also implies that the country has to diversify the destination of its exports.

#### IV. Model Specification and Estimation

This chapter would present the main findings of the study, which is the analysis of the determinants of Ethiopian trade flow by using the gravity model of trade. Data sources and sampling issues are discussed first and model specification, estimation, and interpretation of the results would follow.

##### 4.1 The Data

The dataset covers 11 years (1996 – 2006) and 32 major trading partners. These trading partners are from African countries (Egypt, Kenya, Sudan, Tanzania, Uganda, and Zambia), European countries (Italy, Germany, Japan, United Kingdom, France, Belgium, Netherlands, Switzerland, Sweden, Denmark, Spain, Greece, Turkey), countries of Asia (Russia, Thailand, Malaysia, Yemen, India, China, Saudi Arabia, S. Korea, Israel, Singapore), and from countries of North and Latin America (United States, Canada, and Brazil). These trading partners are selected based on the significance and value of trade relation with Ethiopia.

Regarding the data sources - data on GDP and GDP per capita are found from World Bank World Development Indicators (WDI) data base. Trade policy index is found from Heritage Foundation economic freedom index. Infrastructure data is found from WDI data base and World Fact Book. Real exchange rate is calculated based on International Financial Statistics (IFS) nominal exchange rate and WDI consumers' price index data.

Data on distance between countries is found from *www.indo.com/distance*. Institutional indicators are found from World Bank governance indicator index. Moreover, the database of International Monetary Fund (IMF) Direction of Trade Statistics CD-ROM is used to access countries import and export data. Concerning membership on trade arrangement (COMESA) the web site *www.comesa.com/intro* is used.

#### 4.1.1 Dealing with missing values and zero data

Missing values are dealt using two techniques.

- By calculating the arithmetic mean of data preceding and following the missing year - interpolation technique.
- Mirror data exploring<sup>2</sup> – this method is used to deal import and export missing values. Given a pair of countries, missing trade values of the exporter country is allowed to be matched with the corresponding importer country trade value record.

A zero trade flow is also observed at normal circumstances due to the absence of trade between countries. In this case, it is difficult to transform the model in to its log - linear<sup>3</sup> equivalent. In controlling this problem, we have tried to explain the dependent variable as

---

<sup>2</sup> This is used for import and export data

<sup>3</sup> In the log- linear specification all the variables in the gravity equation are in logarithms except the dummies. This specification is chosen as it allows easy interpretation of the parameters as elasticities.

(1+Trade)<sup>4</sup> approximation to trade so that the model can be estimated using the ordinary least square method. Dummy variables are used without any log transformation so as to avoid the problem in the estimation of log linear form when zero values are included in the dataset.

## 4.2 Model Specification

Many international trade studies attempt to explain a country's trade flow, but the result is generally dependent on the model specification. For this reason, a careful empirical work should critically be required in analyzing the determinants of trade flow. On account of this, variables are selected with great caution for specifying the trade flow model<sup>5</sup> of Ethiopia. The general frame work of the model can first be written as,

$$TF_{ij} = X\beta + u, u \sim \text{IID}(0, \sigma^2) \text{-----} (4.1)$$

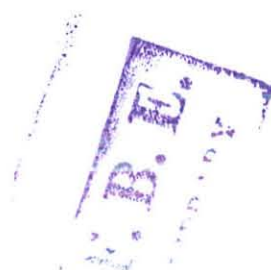
Where X is a vector of (logs of) explanatory variables and u is a white noise error term.

Factors contributing to trade flow between any pair of countries can be classified into three categories. These are factors that indicate total potential supply of the exporting country on the world market, factors that indicate total potential demand of the importing country on the world market, and factors that explain the “resistance” to a trade flow from potential supplier to potential buyer. The “resistance” factors are cost of transportation,

---

<sup>4</sup> For instance, refer the paper by H. Kamils and A. ons (2001:9).

<sup>5</sup> This paper basically uses the trade flow model by Kukharchuk, et al., (2006), and Geda and Kibret (2002), and Egger (2002).



tariff, quota, and other obstacles to trade (Linnemann, 1966). Attraction factors like free trade area can also play an important role in determining trade flow between countries. This can be generalized to:

$$TF_{ij} = f(SP_{ij}, DP_{ij}, R_{ij}, A_{ij}, u_{ij}) \text{-----} (4.2)$$

Where,  $TF_{ij}$  is the total trade flow between country  $i$  and country  $j$  at time  $t$

$SP_{ij}$  is the total potential supply of country  $i$  to country  $j$

$DP_{ij}$  is the total potential demand of country  $i$  to country  $j$

$R_{ij}$  is the “resistance” factor to the trade flow between countries  $i$  and  $j$

$A_{ij}$  is the attraction factor to the trade flow between country  $i$  and country  $j$

$u_{ij}$  is the error term

In specifying the determinants of Ethiopia’s trade flow, different determinants of import and export are explained as important explanatory variables. Accordingly, the trade flow model is explained as a function of the basic gravity variables such as economic mass (mostly proxied by GDP/GNP), and distance (proxy of transport cost) and augmented gravity variables: per capita GDP, real exchange rate, infrastructure, institution, trade policy, boarder, and trade arrangement. This flow of trade is, however, analyzed in separate import and export model as,

$$X_{ijt} = f(\text{GDP}_{it}, \text{GDP}_{jt}, \text{PCGDP}_{it}, \text{PCGDP}_{jt}, \text{Dis}_{ijt}, \text{TP}_{jt}, \text{RER}_{ijt}, \text{Infra}_{it}, \text{Inst}_{it}, \text{Bor}_{ijt}, \text{FTA}_{ijt}, u_{ijt})$$

----- (4.3)

and,

$$M_{ijt} = f(\text{GDP}_{it}, \text{GDP}_{jt}, \text{PCGDP}_{it}, \text{PCGDP}_{jt}, \text{Dis}_{ijt}, \text{TP}_{it}, \text{RER}_{ijt}, \text{Inst}_{it}, \text{Bor}_{ijt}, \text{FTA}_{ijt}, u_{ijt})$$

----- (4.4)

Where,

$X_{ijt}$  = the value of total Ethiopia's export to country j at time t

$M_{ijt}$  = the value of total Ethiopia's import from country j at time t

$\text{GDP}_{it}$  ( $\text{GDP}_{jt}$ ) = Gross Domestic Product (GDP) of country i or j at time t

$\text{PCGDP}_{it}$  ( $\text{PCGDP}_{jt}$ ) = Per Capita GDP of country i or j at time t

$\text{Dis}_{ijt}$  = Distance between Ethiopia and country j at time t

$\text{TP}_{it}$  ( $\text{TP}_{jt}$ ) = Trade Policy of country i or j at time t

$\text{RER}_{ijt}$  = Real Exchange Rate between Ethiopia and country j at time t

$\text{Infra}_{it}$  = Infrastructure of country i at time t

$\text{Inst}_{it}$  = Institutions of country i or j at time t

$\text{Bor}_{ijt}$  = Common boarder between country i and j at time t

$\text{FTA}_{ijt}$  = Trade agreement dummy (COMESA FTA) between country i and j at time t

$u_{ijt}$  = white noise error term (normal random error term) with

constant variance and zero mean

### 4.2.1 The Baseline Model

As stated in chapter 2 (theoretical framework of the gravity model) bilateral trade flow between countries is directly proportional to their GDPs and inversely related to distance.

$$\ln (X_{ijt} \text{ or } M_{ijt}) = \alpha_0 + \alpha_1 \ln (GDP_{it}) + \alpha_2 \ln (GDP_{jt}) + \alpha_5 \ln (Dis_{ijt}) + u_{ijt} \text{ ----- (4.5)}$$

### 4.2.2 The Augmented Gravity Model

The natural logarithm yields of the basic and augmented gravity variables of export (equation 4.3) can systematically be explained as,

$$\begin{aligned} \ln (X_{ijt}) = & \alpha_0 + \alpha_1 \ln (GDP_{it}) + \alpha_2 \ln (GDP_{jt}) + \alpha_3 \ln (PCGDP_{it}) + \alpha_4 \ln (PCGDP_{jt}) + \alpha_5 \ln (Dis_{ijt}) + \\ & \alpha_6 \ln (RER_{ijt}) + \alpha_7 \ln (TP_{jt}) + \alpha_8 \ln (Infra_{it}) + \alpha_9 \ln (Inst_{it}) + \alpha_{10} (Bor_{ij}) + \alpha_{11} FTA_{ijt} + u_{ijt} \\ & \text{----- (4.6)} \end{aligned}$$

Where,  $u_{ijt} = \mu_{ij} + e_{ijt}$ ,  $\mu_{ij}$  is the unobserved (fixed or random) bilateral effect and  $e_{ijt}$  is the remaining error. And,  $\ln$  is the natural logarithm operator and  $\alpha_s$  is Parameter in the model (elasticity/the change in the dependent variable for a unit change of explanatory variable).

Similar to the gravity model of export, import model is explained as,

$$\begin{aligned} \ln (M_{ijt}) = & \alpha_0 + \alpha_1 \ln (GDP_{it}) + \alpha_2 \ln (GDP_{jt}) + \alpha_3 \ln (PCGDP_{it}) + \alpha_4 \ln (PCGDP_{jt}) + \alpha_5 \ln (Dis_{ijt}) + \\ & \alpha_6 \ln (RER_{ijt}) + \alpha_7 \ln (TP_{it}) + \alpha_8 \ln (Inst_{it}) + \alpha_9 (Bor_{ij}) + \alpha_{10} (FTA_{ijt}) + u_{ijt} \\ & \text{----- (4.7)} \end{aligned}$$

## Description of Variables and Expected signs

The dependent variables are total export and total import of Ethiopia in US dollars. The explanatory variables are defined as follows.

*i. Gross Domestic Product (GDP):* supply of the exporter country and demand of the importer country is affected by income. That is, trade between two countries is expected to increase with their economic size, proxied by their GDP. Larger countries tend to trade more than small ones, given that they have a bigger potential supply of exports and potential demand of imports.

*ii. Per Capita GDP (GDP/ Population):* a higher income per population suggests sufficiency in domestic production and thus more trade (Helpman and Krugman, 1985). Achy (2006) also explained a rise in per capita GDP should have a positive impact on demand and therefore increase the volume of bilateral trade. So, by including per capita GDP in the gravity model we can consider the effect of a country's level of development on trade.

*iii. Distance:* to capture the effect of remoteness on trade between countries, transportation cost (proxied by distance) is incorporated. To this effect, the straight line geographical distance (in kilometres) between capital cities of a pair of countries is used.

But, when there is time dimension in a given analysis, definition of the distance is problematic. This is because variables which are constant over time (not across countries), get dropped from the model. To avoid the effect of this time invariability on the results of panel data estimation, we employed the weighted distance variable, following Karagoz and Saray (2008) definition of weighted distance.

$$WDIST_{ij} = \frac{DIST_{ij} * GDP_{it}}{\sum GDP_{it}} \text{-----} (4.8)$$

where,  $DIST_{ij}$  is the distance between country  $i$  and country  $j$ ,  $GDP_{it}$  is GDP of country  $i$  at year  $t$ ; and  $\sum GDP_{it}$  is the overall sum of countries GDP for the years 1996 to 2006.

*iv. Trade Policy:* this is measured by the overall restrictiveness of trade policy in a country. Of course, there are different methods of measuring trade policy. The *Heritage Foundation* (O'Driscoll et al., 2008), for instance, publishes an index of economic openness. The trade policy component of this “Economic Freedom Index” ( $HF_{i,t}$ ) is used as a measure of trade policy. The index includes tariff and non tariff barriers to trade as well as factors in customs corruption. It ranges from 1 (average tariff rates of less than 4%) to 5 (average tariff rates of more than 19%).

Another well-known index is the *Economic Freedom Index* developed by the *Fraser Institute* (Gwartney and Lawson, 2000). It is a comprehensive liberalization measure that

presents multiple dimensions of foreign trade openness such as average tariff rates, open capital flows, black market exchange rate and the estimated trade quotient. The overall rating of IMF Trade Restrictiveness Index is also another measure of trade policy (see, Kukharchuk, et al., 2006). For this analysis however the Heritage Foundation trade policy index is used. Higher values would mean a higher freedom to trade and hence a higher bilateral trade.

*v. Real Exchange Rate:* The inclusion of exchange rate captures the effect of depreciation or appreciation of domestic currency on trade flows. Real exchange rate is a useful indicator of a country's international price competitiveness (Pugel, 2004). Bilateral real exchange rate is calculated as:

$$RER = NER \cdot \frac{P^f}{P} \text{ ----- (4.9)}$$

Where, NER = the nominal exchange rate measured as the price of domestic currency per unit of foreign currency

p = the consumers price index of the home country at time t

P<sup>f</sup> = the consumer price index of partner country at time t

International price competitiveness is regarded as a key determinant of a country's international trade in goods and services. Theoretically, if the price of foreign goods and

services relative to the price of domestic economy's goods and services is higher, domestic demand for imports tend to be lower and foreign demand for domestic goods and services tend to be higher. If competitiveness improves, exports increase and imports decline. However, most studies show that in many least developed countries changes in relative price - for instance, increase in the relative price of goods and services does not go in line with what the above theory predicts. This is mainly because in many least developed countries imported goods are basic and therefore fail to respond to the rise in the relative price of goods and services.

*vi. Infrastructure:* Development of infrastructure can be an effective means in lowering trade costs. This plays an important role in enhancing trade facilitation. Domestic infrastructure measured by road density as the percentage change of paved roads to total road network of the home country leads to augment export. For instance, the empirical evidence by the work of Manchin and Francois 2006 shows that infrastructure is a significant determinant not only of export levels, but also of the likelihood of exports will take place at all. Accordingly, we use the variable infrastructure as determinant of export.

*vii. Institutions:* Improvement in institutional quality of the home country is pro trade and hence leads to a higher amount of import and export. The Ethiopian diagnostic trade integration study II (2004:69), for instance, asserts in order to facilitate trade there should

be a well structured institutional framework that would not only formulate and analyze trade policy, but also ensure its implementation, monitoring and evaluation.

To measure institutional quality, the weighted average of governance indicators is used in different studies. Kukharchuk et. al. (2006), for instance, used the average of World Bank's governance indicators for rule of law, the extent of corruption, and the quality of regulation. Gani and Prasad (2006) also used four indicators of institutional quality: government effectiveness, rule of law, regulatory quality, and control of corruption as a control for determinants of trade. Similarly, we used the average weights of all the four indicators.

*viii. Boarder:* It is a common boarder and takes a value 1 if the two countries share a common boarder and 0, otherwise. Countries that share common boarder trade more than those which do not.

*ix. Free Trade Area:* There is also a prospect to trade on the basis of regional trading agreement 'Common Market for East and South Africa' (COMESA) free trade area. This agreement provides great deal of market access for exportable products through trade creation and trade diversion.

In order to incorporate the effect of the above trading agreement on trade flow a dummy variable is used. The dummy takes a value 1 if both country i and country j belong to the same trading agreements and 0, otherwise.

The expected signs for the export model variables are:  $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_6, \alpha_7, \alpha_8, \alpha_9, \alpha_{10}, \alpha_{11} > 0$  and  $\alpha_5 < 0$ . Similarly, for the import model variables  $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_6, \alpha_7, \alpha_8, \alpha_9, \alpha_{10}$  are expected to be positive while  $\alpha_5, \alpha_6$  are expected to bear a negative sign.

### 4.3 Model Selection, Estimation and Interpretation of Results

#### 4.3.1 Estimation Diagnostics

##### a) Hausman Specification Test

We used balanced panel data model and individual effects are included in the regressions. So we should decide whether they are treated as fixed or as random. The Hausman test tests whether the fixed effects and random effects estimator are significantly different. An important reason why the two estimators would be different is the existence of correlations between explanatory variables and the error term. Therefore, we run the Hausman test (refer Annex 1: Table A-3 and Table A-4) and the results suggest fixed effect is appropriate for both import and export models.

## b) Hausman Test of Endogeneity

The straightforward gravity equation estimation for the theoretical framework of the model allows endogeneity of GDP. It arises because the regressor  $GDP_{it}$  may be explained by the dependent variable export or import. This may eventually result in biased and inconsistent parameter estimates. To this effect, the Hausman test (1978) for endogeneity was undertaken. The test statistics shows (Annex 1: Table A-5) we are unable to accept the null hypothesis of regressor exogeneity of the export model.

The best way to deal with this regressor endogeneity problem is through Instrumental Variable (IV) estimation technique. The instrument is selected in the following way:

- Find an exogenous instrument that is strongly correlated with the endogenous variable<sup>6</sup>.
- Ensure that the instrument is not correlated with the main equation residuals<sup>7</sup>.

Therefore, we use population as instrumental variable to GDP following the works of Cyrus (2002) and Batra (2004).

## c) Test of Serial Correlation

If the estimate residuals from the above regression are serially correlated, still the estimator is biased. Therefore, we test for autocorrelation in the fixed effects model based

---

<sup>6</sup> Correlation between GDP and population is 0.66 showing the strength of population to use as instrument.

<sup>7</sup> Correlation between the main equation residual and the instrument population is found to be 0.0004 for the export model and 0.0739 for the import model showing the second criteria for selecting the instrument is fulfilled.

on the Durbin-Watson test. Results for the DW test statistics (Annex: Table A-11) shows that there is no severe autocorrelation problem in both models.

#### d) Test of Heteroskedasticity

To test for heteroskedasticity in the residual of import and export models, we use the test of Breusch and Pagan, 1980. The test is based on the fact that the auxiliary regression of the test regresses the squared within residuals  $u_{ijt}^2$  upon a constant and J variables  $Z_{it}$  that we think may affect heteroskedasticity (Verbeek, 2000).

The test statistic computes as  $N(T-1)$  times the  $R^2$  of the auxiliary regression will have an asymptotic chi-squared distribution, with J degrees of freedom. The results (Annex 1: Table A-12) suggest that the variance of both models is heteroskedastic. Therefore, to control this problem the standard errors are robusted.

#### 4.3.2 Model Selection and Estimation

While estimating and selecting the model that best fits the data, we should be careful about the estimation procedures and diagnostics so as to get robust results. Thus, we first undertake the possible econometric tests and deal the bias. Consequently, the trade models are selected. In both import and export models, all the variables are fixed across individual countries. But, in considering a more parsimonious data representation, Hausman test is adopted. The test result suggests that the individual effects are not absorbed in the error

term. Since, ignoring this correlation leads to inconsistent estimators, fixed effect estimator is preferred.

#### a) Export Model

After instrumenting the endogenous variable  $GDP_{it}$  with  $POP_{it}$  (home population), the export equation (4.6) is estimated taking all the explanatory variables with two stages least square (2SLS) and within estimation (Fixed effect estimation) technique. The estimation result shows some insignificant variables. But, when variables are tested for multicollinearity  $GDP_{it}$  and  $PCGDP_{it}$  are found to have severe multicollinearity<sup>8</sup> problem (Annex 1: Table A-7 and A-9). This implies, it is necessary to remove either of the two variables. The model becomes more robust when  $GDP_{it}$  is dropped from the model than  $PCGDP_{it}$ . Accordingly,  $GDP_{it}$  is dropped from the model. At this stage, since all the explanatory variables are exogenous, the estimation procedure is not with 2SLS rather with the normal fixed effect (within) estimation method.

Re-estimating the model and correcting the standard errors for possible heteroskedasticity problem, we found the variables  $PCGDP_{it}$ ,  $PCGDP_{jt}$ ,  $WDIS_{ijt}$ ,  $TP_{jt}$ ,  $INST_{it}$ , and  $INFRA_{it}$  significant.

---

<sup>8</sup> We used the Variance Inflation Factors (VIF) vis a vis Simple Collinearity Table to test for multicollinearity. The Variance Inflation Factors are another measure that can be used to detect Multicollinearity. These are a scaled version of the multiple correlation coefficients between, say variable  $i$  and the rest of the independent variables.

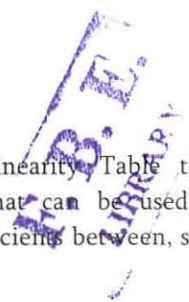


Table 4.1: Results of Fixed Effect Estimation for Export Model

Dependent Variable: Ln of Exports

Variable	Coefficient	Robust		
		Standard Error	t-Statistics	P-value
Ln of PCGDP <sub>it</sub>	9.682794	2.62521	3.69*	0.000
Ln of PCGDP <sub>jt</sub>	2.783905	0.9867388	2.82*	0.005
Ln of WDIS <sub>ijt</sub>	-7.965294	2.547375	-3.13*	0.002
Ln of EX <sub>ijt</sub>	0.0836565	0.0625893	1.34****	0.182
Ln of TP <sub>jt</sub>	1.339374	0.8257304	1.62***	0.106
Ln of INST <sub>it</sub>	2.943069	0.7725967	3.81*	0.000
Ln of Infra <sub>it</sub>	2.527756	0.7016732	3.60*	0.000
Cons	-32.60841	7.826827	-4.17	0.000

sigma\_u 4.5648689

sigma\_e 2.0069965

rho 0.83801075 (fraction of variance due to u\_i)

R-sq: within = 0.2044

F (7,313) = 10.95

Between = 0.1064

Prob > F = 0.0000

Overall = 0.0842

Corr (u\_i, Xb) = -0.8757

\* Significant at 1%, \*\* significant at 5%, \*\*\* significant at 10%, and \*\*\*\* Not significant

## b) Import Model

The gravity model of Ethiopia's import has been estimated for 352 observations. The results from this fixed effect estimation yields insignificant results for most variables. But, it is not the final import model. The model is tested for its robustness before interpreted. Accordingly, when variables are tested for multicollinearity,  $PCGDP_{it}$  and  $GDP_{it}$  have this problem. This is indicated in annex part table A-8 and A-10. Therefore,  $PCGDP_{it}$  was dropped from the model. The model is also tested for autocorrelation and hetroskedasticity (See Annex 11 and 12). Controlling the possible econometric problems and re-estimating the model only  $GDP_{it}$ ,  $GDP_{jt}$ , and  $INST_{it}$  are found significant.

Table 4.2: Results of Fixed Effect Estimation for Import Model

Dependent Variable: Ln of Imports

Variable	Coefficient	Robust		
		Standard Error	t-statistics	P-value
Ln of $GDP_{it}$	0.8499607	0.2823297	3.01*	0.003
Ln of $GDP_{jt}$	0.5266872	0.2922511	1.80***	0.072
Ln of $INST_{it}$	0.880086	0.2162142	4.07*	0.000
$FTA_{ijt}$	0.8849555	0.7035136	1.26****	0.209
Cons	-19.56219	6.662778	-2.94	0.004

sigma\_u 1.5968556

sigma\_e 1.215863

rho 0.63301303 (fraction of variance due to  $u_i$ )

R-sq: within = 0.1384	F (4,316) = 16.35
Between = 0.4853	Prob > F = 0.0000
Overall = 0.3737	

---

Corr (u\_i, Xb) = 0.3350

---

\* Significant at 1%, \*\* Significant at 5%, \*\*\* Significant at 10%, \*\*\*\* Not significant

### 4.3.3 Discussion of Results

For the above gravity models of export and import, fixed effect is favoured as indicated in the Hausman specification test. So, the intercept  $\alpha_0$  is considered to be country specific and the slope coefficients are the same for all countries.

The results of export model (Table 4.1) show that the variable home and partners per capita GDP are significant. This implies a rise in income per head would help exports to increase. The magnitude 9.68 and 2.78 indicates that a 1% increase in home and partners per capita GDP could increase Ethiopia's export by 9.68% and 2.78% respectively. The other basic gravity variable distance is significant as expected with magnitude of -7.97, indicating trade between two countries increases by 7.97% for a 1% decrease in the distance between them.

In line with expectation domestic improvement in government effectiveness, rule of law, extent of corruption and government regulation which constitute institutional quality

affect Ethiopia's export positively and significantly. A 1% increase in the domestic institutional quality increases Ethiopia's export by 2.94%. Trading partners' trade policy is also another significant factor that determines Ethiopia's export. At a reasonable 10% significance level, export would increase at 1.34% when trading partner's trade policy is improved by 1%. The coefficient of domestic infrastructure has the anticipated positive sign and is also significant. Improvement in infrastructure could decrease the cost of transport and thereby encourage exports. The coefficient 2.53 implies that export would increase by 2.53% for every 1% increase in infrastructure.

Depreciation of exchange rate is little to do with improving Ethiopia's export. The magnitude is also very minimal (0.084). We also found that the dummy for regional agreement is statistically insignificant. This can be partly attributed to the following reasons. First, products traded among COMESA members are mostly similar<sup>9</sup>. This leads to limit trade within the free trade area. Secondly, as explained by Alemayehu and Haile (2004:11), governments lack political commitments in practice to implement harmonized policies. Consequently, the free trade area works little to enhance trade through trade creation and trade diversion. Finally, the impact of COMESA FTA is very limited may be because the study covers only few member states. Border effect is dropped from the model because of collinearity. The overall significance of variables in the model is good enough as indicated by the significant F- Statistics.

---

<sup>9</sup> See for instance the report by UNCTAD 2005

With regard to the import model, GDP is found to be a significant determinant of import. For this variable, import increases by 0.85% and 0.53% (less than proportionate) for every 1% increase in home and foreign GDP respectively (Table 4.2). Similar to the export model, the results for the import model does not indicate a significant result for regional trade groupings<sup>10</sup>.

In line with expectation domestic institutional quality is significant and positive at a reasonable 1% significance level. About 0.89% of variation in import is explained by a 1% change of this variable. The results also revealed that exchange rate is not significant in affecting Ethiopia's import. This can be because since most Ethiopian imports are basic goods which are necessary for development, they have a low response to price changes. The coefficient of trade policy variable in our specification is also insignificant. The joint significance of variables in the model is found to be good as explained by the F-statistics,  $F(4,316) = 16.35$ , with zero probability value.

## V. Conclusion and Policy Implications

### 5.1 Conclusion

This study attempted to analyze the dynamics of trade flow between Ethiopia and its major trading partners using panel data estimation technique. The application of gravity

---

<sup>10</sup> For additional evidence see Alemayehu and Haile (2004:2).

model of trade is found relevant for this analysis. The period 1996-2006 is the time delimitation of the study.

The pre estimation Hausman specification test shows that the fixed effect is favoured for both export and import models. Our estimation results show that the major determinants of Ethiopian export are home per capita GDP, trading partners per capita GDP, distance, trading partners trade policy, domestic infrastructure, and domestic institutional quality. All these determinants affect export positively while distance has a negative effect. The effect of regional agreement on Ethiopia's export is insignificant.

The results also revealed that the major determinants of Ethiopia's import are: home GDP, partners GDP, and home institutional quality. That is among the basic gravity variables GDP works well but not distance. The other most important finding is that variables that can be reflected in prices have little effect in determining import. Unlike the export model, the results of the import model do not assert exchange rate to be a determinant of Ethiopia's import. The economic rational for this can be a low responsiveness of import to price rises as most goods imported are necessary for development. Besides, Ethiopia's import is little to do with transportation cost variations and regional trading agreements.

## 5.2 Policy Implications

There are possible policy stances that would emanate from this work. First, the country has to work more on minimizing the demand and supply constraints of foreign trade to derive large benefits from world market. In this regard, improvements in trade policies, trade facilitation and institutions are more likely to affect trade developments. But, these are necessary, not sufficient conditions. Thus, it should be supported by appropriate government action to promote export. This can be done through diversification of exports as Ethiopia has an export structure that is highly dependent on a few primary products for which the demand is mostly unpredictable. One option to diversify exports can be a shift towards the export of semi-processed and manufactured goods. This can be realized through a coordinated effort between the private sector and the government.

As far as imports are concerned, the low responsiveness of Ethiopian imports to price changes implies that establishment and expansion of import substitution industries with the involvement of domestic and foreign investors is essential. This helps to fill some of the domestic demands and thereby reduce the dependency of the domestic economy on imports.

## References

- Achy, L. (2006). "Assessing Regional Integration in North Africa", National Institute of Statistics and Applied Economics, Rabat, Morocco.
- Alemayehu, G. and Haile, K. (2002). "Regional Economic Integration in Africa: A review of Problems and Prospects with a case study of COMESA", Addis Ababa.
- Anderson, J.E. and Wincoop, E. V. (2003). "Gravity with Gravitas: A Solution to the Border Puzzle", *The American Economic Review*, Vol. 93, issue 1, pp. 170-92, Nashville.
- Atnafu, G. (2007). "The Impact of China and India on African Manufacturing Exports On the Third Market: Gravity Approach and A Test of Flying - Geese Theory for Africa", Unpublished Msc Thesis, Addis Ababa University, Ethiopia.
- Baltagi, B.H. (2001). "Econometric Analysis of Panel Data", Second Edition, Chichester: John Wiley and Sons, Ltd.
- Befekadu, D. and Berrhanu, N. (1999/2000). "Annual Report on the Ethiopian Economy", Vol. I.
- Bergstrand, J.H. (1990). "The Heckscher-Ohlin-Samuelson Model, the Linder Hypothesis, and the Determinants of Bilateral Intra-Industry Trade", *Economic Journal*, Volume 100, No. 403.

Bowen, H. P. et. al. (1998). "Applied International Trade Analysis", Hong Kong, Macmillan Business.

Common Market for East and Southern Africa official website [www.comesa.com](http://www.comesa.com).

Cyrus, T. L. (2002). "Income in the Gravity Model of International Trade: Does Endogeneity Matter?" *The International Trade Journal* XVI(2): 161-180.

Deardorff, A.V. (1998). "Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World", J.A Frankel (ed), *the Regionalization of the World Economy*: Chicago, The University of Chicago Press, p: 7-31

Direction of Trade (DOT) CD-ROM, International Monetary Fund (IMF).

Egger, P. (2002). "An Econometric View on the Estimation of Gravity Models and the Calculation of Trade Potentials", *World Economy* 25(2): 297-312.

Gani and Prasad (2006). "Institutional Quality and Trade in Pacific Island Countries', Asia-Pacific Research and Training Network on Trade", Working Paper Series, No. 20, (rev. 2/07).

Greene, W.H. (1997). "*Econometric Analysis*", Fifth Edition, New Jersey, New Jersey, Prentice-Hall, Inc.

Harris, M.N. and Mátyás, L. (1998). "The Econometrics of gravity Models, Melbourne Institute Working paper No. 5/98 ISSN 1328-4991.

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

Indonesian official website [www.indo.com](http://www.indo.com).

International Financial Statistics (IFS) CD-ROM, International Monetary Fund (IMF).

Kamil, H. and Ons, A. (2001). "Determinants of the Pattern of Bilateral Trade Under Regional Trade Agreements: An Application to MERCOSUR", Lacea, Montevideo, Uruguay.

Karagoz, K. and Saray M. O. (2008). "Trade Potential of Turkey with Asia-Pacific Countries: Evidences from Panel Gravity Model", Malatya, Turkey.

Kukharchuk, et. al., (2006). "Gravity and Integration: Determinants of International Trade in South-Eastern Europe and the former Soviet Union", Tashkent, Uzbekistan.

Linnemann, H. (1966). "An Econometric Study of International Trade Flows", Amsterdam, North Holland.

NBE, Annual Reports, Various Issues.

Norak, H. and Makoto, K. (2007). "Trade Structure and Trade Flows in Cambodia: A Gravity Model", Asian Economic Bulletin.

- O'Driscoll, Jr. et al. (2008). "Index of Economic Freedom", Heritage Foundation, Washington, DC.
- Ozden, C. and Reinhardt, E. (2004). "The perversity of preferences", *Journal of Development Economics* 78 (2005) 1– 21.
- Pugel, T.A. (2004). "International Economics", McGraw Hill Irwin, New York.
- Rahman, M. M. (2004). "The Determinants of Bangladesh's Trade: Evidence from the Generalised Gravity Model", the Economic Society of Australia's 33, Conference of Economists, University of Sydney, NSW 2006, Australia.
- Simwaka, K. (2006). "Dynamics of Malawi's Trade Flows: a Gravity Model Approach", Research & Statistics Department.
- Tinbergen, J. (1962). "An Analysis of World Trade Flows", J. Tinbergen (ed.): in *Shaping the World Economy*, New York: The Twentieth Century Fund.
- Tura, K. (2001). "Determinants of International Trade Flows: The case of Ethiopia", Unpublished Msc Thesis, Addis Ababa University, Ethiopia.
- UNCTAD Handbook of Statistics (2005), United Nations Conference on Trade and Development.
- Verbeek, M. (2000). "A Guide to Modern Econometrics", New York: John Wiley and Sons, Ltd.

Wooldridge, J. M. (2002). "Econometric Analysis of Cross Sectional and Panel Data", The MIT press.

World Bank, (2004). "Ethiopia-Trade and Transformation, Diagnostic Trade Integration Study", Volume II: synthesis.

World Bank official web site [www.worldbank.org](http://www.worldbank.org).

*World Development Indicators*, (2008) CD-ROM, World Bank.

## Appendix

Table A-1: Summary Statistics of Export and Import Model Variables

Variable	Obs	Mean	Standard Deviation	Min	Max
lnx <sub>ijt</sub>	352	14.58135	3.012687	0	18.81753
lnm <sub>ijt</sub>	352	16.50529	2.374193	0	20.44143
lngdp <sub>it</sub>	352	22.91552	0.2185853	22.72866	23.44245
lngdp <sub>jt</sub>	352	26.18355	1.904202	21.86494	30.20957
lnpcgdp <sub>it</sub>	352	4.922145	0.1712224	4.705016	5.308268
lnpcgdp <sub>jt</sub>	352	8.718991	1.742842	5.44932	10.88445
lnwdis <sub>ijt</sub>	352	5.747225	0.7601903	3.901973	7.252266
lnex <sub>ijt</sub>	352	-0.721049	2.758884	-11.51293	2.856709
ln <sub>tpit</sub>	352	3.861688	0.2327861	3.295837	4.143135
ln <sub>tpjt</sub>	352	4.186372	0.3216921	2.580217	4.442651
lninst <sub>it</sub>	352	3.015417	0.2689325	2.322388	3.397858
lninfra <sub>it</sub>	352	2.616456	0.1345831	2.484907	2.949688
bor <sub>ijt</sub>	352	0.0625	0.242406	0	1
fta <sub>ijt</sub>	352	0.1647727	0.3715034	0	1

Table A-2: Skewness/Kurtosis Tests of Normality for Export and Import Model Variables

Variable	Pr(Skewness)	Pr(Kurtosis)	Joint	
			adj chi2(2)	Prob>chi2
lnx <sub>ijt</sub>	0.000	0.000	.	0.0000
lnm <sub>ijt</sub>	0.000	0.000	.	0.0000
lngdp <sub>it</sub>	0.000	0.035	58.05	0.0000
lngdp <sub>jt</sub>	0.002	0.149	10.57	0.0051
lnpcgdp <sub>it</sub>	0.000	0.943	28.44	0.0000
lnpcgdp <sub>jt</sub>	0.000	0.000	.	0.0000
lnwdis <sub>ijt</sub>	0.000	0.202	19.47	0.0001
lnex <sub>ijt</sub>	0.000	0.000	54.61	0.0000
ln <sub>tpit</sub>	0.000	0.015	50.70	0.0000
ln <sub>tpjt</sub>	0.000	0.000	.	0.0000
lninst <sub>it</sub>	0.000	0.000	61.50	0.0000
lninfra <sub>it</sub>	0.000	0.013	49.71	0.0000
bor <sub>ijt</sub>	0.000	0.000	.	0.0000
fta <sub>ijt</sub>	0.000	0.001	.	0.0000

Table A-3: Hausman Specification Test for Export Model

Vairables	Coefficients			
	(b) Fixed	(B) Random	(b-B) Difference	Sqrt(diag(V_b-V_B)) S.E.
lngdp <sub>it</sub>	-1550.15	-4.322848	-1545.828	617.8318
lngdp <sub>jt</sub>	-1.90226	0.9659689	-2.868228	0.8702666
lnpcgdp <sub>it</sub>	8.30785	9.020688	-0.712838	0.7112079
lnpcgdp <sub>jt</sub>	4.824867	0.3508672	4.474	1.184792
lnwdis <sub>ijt</sub>	1543.262	-2.118473	1545.38	617.9601
lnex <sub>ijt</sub>	0.073406	0.0985405	-0.0251345	0.0272507
ln <sub>tpjt</sub>	1.594398	0.8635241	0.7308735	0.4378724
lninst <sub>it</sub>	2.898424	2.928243	-0.029819	.
lninfra <sub>it</sub>	2.458607	2.76615	-0.3075433	.
fta <sub>ijt</sub>	-0.8764201	-0.4780356	-0.3983845	0.6745443

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$$\text{Chi}^2(7) = (b-B)'[(V_b-V_B)^{-1}](b-B)$$

$$= 22.70$$

$$\text{Prob}>\text{chi}2 = 0.0019$$

Table A-4: Hausman Specification Test for Import Model

Vairables	Coefficients			
	(b) Fixed	(B) Random	(b-B) Difference	Sqrt(diag(V_b-V_B)) S.E.
lngdp <sub>it</sub>	-4.058731	3.820924	-7.879655	374.7185
lngdp <sub>jt</sub>	0.7144835	0.9924805	-0.2779971	0.5171839
lnpcgdp <sub>it</sub>	-4.510802	-2.971517	-1.539285	0.3348909
lnpcgdp <sub>jt</sub>	-0.9317224	0.0351307	-0.9668531	0.7140363
lnwdis <sub>ijt</sub>	9.17818	-0.9051019	10.08328	374.8001
lnex <sub>ijt</sub>	0.0096466	0.024561	-0.0149144	0.0119314
ln <sub>tpit</sub>	-0.4974284	-0.5668088	0.0693804	.
lninst <sub>it</sub>	0.2856897	0.4920593	-0.2063696	.
fta <sub>ijt</sub>	1.034122	-0.451986	1.486108	0.3281963

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$$\text{Chi}^2(7) = (b-B)'[(V_b-V_B)^{-1}](b-B)$$

$$= 28.49$$

$$\text{Prob}>\text{chi}2 = 0.0002$$

Table A-5: Hausman test of Endogeneity for Export Model

Variables	Coefficients		(b-B) Difference	Sqrt(diag(V_b-V_B)) S.E.
	(b) Fixed	(B) Random		
lngdp <sub>it</sub>	-4.268702	-4.226474	-0.0422289	0.0224248
lnpcgdp <sub>it</sub>	9.015017	8.966285	0.0487321	0.0258782
lnpcgdp <sub>jt</sub>	0.2917113	0.292155	-0.0004438	0.0002356
lngdp <sub>jt</sub>	0.9814883	0.9814066	0.0000817	0.0000434
lnwdis <sub>ijt</sub>	-2.125936	-2.126228	0.0002915	0.0001548
lnex <sub>ijt</sub>	0.1062525	0.1060726	0.0001799	0.0000955
ln <sub>tpjt</sub>	0.5534656	0.5517613	0.0017043	0.0009051
lninst <sub>it</sub>	2.958676	2.948715	0.0099607	0.0052894
lninfra <sub>it</sub>	2.762057	2.763238	-0.0011809	0.0006271
bor <sub>ijt</sub>	-0.7602057	-0.7605066	0.0003009	0.0001598
fta <sub>ijt</sub>	-0.9043038	-0.9042006	-0.0001032	0.0000548
Cons	33.81132	33.11739	0.693933	0.368499

b = consistent under Ho and Ha; obtained from ivreg

B = inconsistent under Ha, efficient under Ho; obtained from regress

Test: Ho: difference in coefficients not systematic

$$\text{Chi}^2(2) = (b-B)'[(V_b-V_B)^{-1}](b-B)$$

$$= 3.55$$

$$\text{Prob}>\text{chi}2 = 0.0597$$

Table A-6: Hausman Test of Endogeneity for Import Model

Variables	Coefficients			
	(b) Fixed	(B) Random	(b-B) Difference	Sqrt(diag(V_b-V_B)) S.E.
lngdp <sub>it</sub>	3.787312	3.803623	-0.0163104	0.022686
lngdp <sub>jt</sub>	0.9766857	0.9737374	0.0029483	0.0133961
lnpcgdp <sub>it</sub>	-2.601217	-2.622455	0.0212373	0.0249203
lnpcgdp <sub>jt</sub>	-0.05116	-0.0504049	-0.0007551	0.003216
lnwdis <sub>ijt</sub>	-1.155059	-1.151373	-0.0036857	0.0173582
lnex <sub>ijt</sub>	0.0341526	0.0342748	-0.0001222	0.0008489
ln <sub>tpit</sub>	-0.6173568	-0.6177417	0.0003849	0.0004588
ln <sub>instit</sub>	0.6289163	0.6250058	0.0039105	0.005128
bor <sub>ijt</sub>	2.039734	2.042318	-0.0025839	0.011837
fta <sub>ijt</sub>	-2.292064	-2.296201	0.0041364	0.0182887
Cons	-75.20563	-75.41154	0.2059117	0.5381141

b = consistent under Ho and Ha; obtained from ivreg

B = inconsistent under Ha, efficient under Ho; obtained from regress

Test: Ho: difference in coefficients not systematic

$$\begin{aligned} \text{Chi}^2(2) &= (b-B)'[(V_b-V_B)^{-1}](b-B) \\ &= 0.73 \end{aligned}$$

$$\text{Prob}>\text{chi}2 = 0.6927$$

Table A-7 Correlation Matrix of Export Model Variables

	lnx <sub>ijt</sub>	lngdp <sub>it</sub>	lngdp <sub>jt</sub>	lnpcgdp <sub>it</sub>	lnpcgdp <sub>jt</sub>	lnwdis <sub>ijt</sub>	lnex <sub>ijt</sub>	ln <sub>tpjt</sub>	lninst <sub>it</sub>	lninfra <sub>it</sub>	bor <sub>ijt</sub>	fta <sub>ijt</sub>
lnx <sub>ijt</sub>	1.0000											
lngdp <sub>it</sub>	0.2129	1.0000										
lngdp <sub>jt</sub>	0.5145	0.0997	1.0000									
lnpcgdp <sub>it</sub>	0.1965	0.9203	0.0758	1.0000								
lnpcgdp <sub>jt</sub>	0.4828	0.0958	0.7224	0.0791	1.0000							
lnwdis <sub>ijt</sub>	0.2686	0.2875	0.7645	0.2646	0.6428	1.0000						
lnex <sub>ijt</sub>	0.3530	0.0684	0.4368	-0.0075	0.4961	0.2913	1.0000					
ln <sub>tpjt</sub>	0.2307	0.0965	0.2677	0.0459	0.6846	0.3627	0.1875	1.0000				
lninst <sub>it</sub>	0.1626	0.3605	0.0604	0.0599	0.0474	0.1036	0.1230	0.1041	1.0000			
lninfra <sub>it</sub>	0.1337	0.1448	0.0127	0.2565	0.0186	0.0416	-0.0499	-0.0253	-0.2251	1.0000		
bor <sub>ijt</sub>	-0.1938	0.0000	-0.3737	-0.0000	-0.3781	-0.4672	-0.0724	-0.2654	0.0000	-0.0000	1.0000	
fta <sub>ijt</sub>	-0.4190	-0.0152	-0.6782	-0.0119	-0.6563	-0.5823	-0.3626	-0.2875	0.0067	-0.0078	0.5813	1.0000

Table A-8 Correlation Matrix of Import Model Variables

	lnm <sub>ijt</sub>	lngdp <sub>it</sub>	lngdp <sub>jt</sub>	lnpcgdp <sub>it</sub>	lnpcgdp <sub>jt</sub>	lnwdis <sub>ijt</sub>	lnex <sub>ijt</sub>	ln <sub>tpit</sub>	lninst <sub>it</sub>	bor <sub>ijt</sub>	fta <sub>ijt</sub>
lnm <sub>ijt</sub>	1.0000										
lngdp <sub>it</sub>	0.1542	1.0000									
lngdp <sub>jt</sub>	0.6771	0.0997	1.0000								
lnpcgdp <sub>it</sub>	0.0881	0.9203	0.0758	1.0000							
lnpcgdp <sub>jt</sub>	0.4861	0.0958	0.7224	0.0791	1.0000						
lnwdis <sub>ijt</sub>	0.3791	0.2875	0.7645	0.2646	0.6428	1.0000					
lnex <sub>ijt</sub>	0.3997	0.0684	0.4368	-0.0075	0.4961	0.2913	1.0000				
ln <sub>tpit</sub>	0.0947	0.3958	0.0557	0.1971	0.0474	0.1138	0.0801	1.0000			
lninst <sub>it</sub>	0.1543	0.3605	0.0604	0.0599	0.0474	0.1036	0.1230	0.6780	1.0000		
bor <sub>ijt</sub>	-0.1089	0.0000	-0.3737	-0.0000	-0.3781	-0.4672	-0.0724	-0.0000	0.0000	1.0000	
fta <sub>ijt</sub>	-0.5453	-0.0152	-0.6782	-0.0119	-0.6563	-0.5823	-0.3626	-0.0081	0.0067	0.5813	1.0000

Table A-9: Variance Inflation Factors of Export Model Variables

Variable	VIF	1/VIF	Dropping lngdp <sub>it</sub>	
			VIF	1/VIF
lngdp <sub>it</sub>	17.88	0.055943		
lngdp <sub>jt</sub>	4.24	0.236061	4.23	0.236344
lnpcgdp <sub>it</sub>	15.85	0.063110	1.24	0.807147
lnpcgdp <sub>jt</sub>	6.03	0.165878	5.90	0.169404
lnwdis <sub>ijt</sub>	3.20	0.312533	3.19	0.313543
lnex <sub>ijt</sub>	1.54	0.647923	1.49	0.670376
ln <sub>tpjt</sub>	2.73	0.366077	2.67	0.374728
lninst <sub>it</sub>	2.62	0.381412	1.14	0.873839
lninfra <sub>it</sub>	1.15	0.869811	1.12	0.895713
bor <sub>ijt</sub>	1.72	0.580967	1.72	0.581344
fta <sub>ijt</sub>	2.77	0.361581	2.77	0.361622
Mean VIF	5.43		2.55	

Table A-10: Variance Inflation Factors of Import Model Variables

Variable	VIF	1/VIF	Dropping lnpcgdp <sub>it</sub>	
			VIF	1/VIF
lngdp <sub>it</sub>	17.43	0.057357	1.38	0.724696
lngdp <sub>jt</sub>	3.64	0.274712	3.64	0.274772
lnpcgdp <sub>it</sub>	15.11	0.066164		
lnpcgdp <sub>jt</sub>	2.65	0.377440	2.64	0.378292
lnwdis <sub>ijt</sub>	3.16	0.316131	3.16	0.316255
lnex <sub>ijt</sub>	1.47	0.678080	1.44	0.696057
ln <sub>tpjt</sub>	1.95	0.513654	1.95	0.513656
lninst <sub>it</sub>	3.33	0.300341	1.91	0.523479
bor <sub>ijt</sub>	1.70	0.587731	1.70	0.588005
fta <sub>ijt</sub>	2.67	0.374214	2.67	0.374235
Mean VIF	5.31		2.28	

From the above Tables, A-9 and A-10, GDP<sub>it</sub> and PCGDP<sub>it</sub> show severe multicollinearity problem. The simple correlation matrix asserts this. Therefore, while running the regressions the variable that does not yield a more robust result is dropped. Accordingly,

GDP<sub>it</sub> from export model and PCGDP<sub>it</sub> from import model are dropped to control this problem.

Table A-11: Test for Serial Correlation

---

	Modified Bhargava et al. Durbin-Watson
Export Model	1.8761154
Import Model	1.7287852

---

Note: All the critical values are at 5% significance level

Table A-12: Test for Heteroskedasticity

---

	Calculated Value	Critical Value
Export Model	1835.33	19.81
Import Model	1831.81	18.55

---

Note: All the critical values are at 5% significance level

## Declaration

I, the undersigned, declare that this project is my original work and has not been presented for a degree in any other university, and that all source of material used for the project have been duly acknowledged.

Declared by:

Name: Mulugeta Ayehu

Signature: 

Date: June 2009

Confirmed by:

Name: Girma Estiphanos

Signature: 

Date: July 1/2009