Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.5, No.15 2014

Determinants of Bilateral Trade between Ethiopia and Its Major Trading Partners': A Gravity Model Approach

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Abstract
International trade has increasingly become a keystone of economic prosperity in many countries of the world. Ethiopia is the one which benefit from foreign trade. Therefore, the main focus of this paper is to identify factors influencing bilateral trade between Ethiopia and its major trading partners'. The gravity model of trade was employ for the purpose. A gravity model based on a panel data for the period of 10 years (2000-2009) of sample countries was estimated by fixed effect estimators. The coefficients obtained are then used to predict the basic total trade and export trade potentials for Ethiopia.
As a result, we found that the total trade flow was determine by mass (economic size) of the importing and exporting countries, real bilateral exchange rate, FDI of Ethiopia, weighted distance and bordering between Ethiopia and the major trading parents. Ethiopia's export performance to those major trading countries' are also determine by GDP of the importing countries, GDP of the exporting country, the weighted distance. The results of this study indicate that a depreciation of the real exchange rate would affect the international competitiveness of Ethiopian exports, therefore, we recommends Depreciation of a country's real exchange rate because it will cause a gain in competitiveness of that country and government needs also to pay adequate attention to destination markets with cheaper transport costs.
Keywords: Trade Flows, Gravity Model, Ethiopia.

1. INTRODUCTION

One of the most important developments in world trade over the past thirty years has been the growing participation of developing countries. While the value of global merchandise trade expanded on average by 10 percent per year from 1970 to 1999, outpacing the growth of output, developing countries' exports grew at 12 percent per year and their share of total trade expanded from about one-quarter to one-third. Emerging market countries in Asia and, to a lesser extent, Latin America were the main contributors to this impressive performance. This includes China and India since they initiated reforms and some of the middle- and higher-income countries in Asia that were themselves poor in the 1970s. These countries were also the main recipients of the dramatic increase in foreign direct investment in developing countries that occurred in the late 1980s and 1990s as advances in transportation and communication facilitated the geographic dispersion of production processes and a rapid expansion of intra-industry trade (Deardorff, 2001).

While developing Asia's share in total world exports increased from 11.7% in 1985 to 21.5% in 2005, Africa's share decreased from 4.3% to 2.9% over the same period (Bacchetta, 2007). Deep rooted structural problems, weak policy frameworks and institutions, protection at home and abroad (IMF and World Bank, 2001), and the structure of African exports, which is characterized by dependence on primary commodities (Alemayehu, 2006; Biggs, 2007; UNCTAD, 2008) are considered as the reasons for Africa's poor export performance.

Like other African countries, Ethiopia has faced these problems for a long time. For instance, in 1983 the Provisional Government of Socialist Ethiopia noted that the basic constraints for Ethiopian exports include the low volume of exportable products, the limited degree of diversification of exports, which are made up mainly of unprocessed primary products, frequent economic crisis which substantially reduce the demand for and prices of primary products, artificial trade barriers by trading partners etc. (Abay and Zewdu 1999). Moreover, after the downfall of the Derg regime, the Transitional Government of Ethiopia stated that "it is essential to increase and diversify exports" (1991: 33, as cited in Abay and Zewdu 1999).

In response to the problem, Ethiopia has taken different measures such as export financing incentive schemes, export trade duty incentive scheme and duty free importation scheme to those wholly engaged in supplying their products to foreign markets. When compared to the pre-1991 period, the trade policy regime has become more liberal (Alemayehu, 1999).

Owing to this policy shift some improvements in export performance have been registered. Trade statistics show that export earnings have increased during the post reform period. According to the Ministry of Trade and Industry (MOTI), the real value of export earnings increased from ETB 5 billion during the first six year period of the Derg regime (1973-1978) to ETB 39.7 billion in the last six years of the EPRDF regime (2000/1-2006/7).

Regarding the composition of exports, until the 1990s the Ethiopian export sector could be

characterised as a 'three-commodity sector' consisting of coffee, hides and skins, and oilseeds and pulses. Between 1966 and 1996, on average 59% of the country's export earnings came solely from coffee (Abay and Zewdu, 1999). According to MOTI data, although coffee is still the dominant export item, since 2001/02 its contribution to total export earnings has declined to 36.3% in 2007. On the other hand, the share of non-coffee agricultural exports and major manufacturing export commodities (leather and leather products; textile; and agro processing products) has increased remarkably and reached 63.7%.

Since the country is emerging, needs to pay more attention to improve its trade with world countries. Therefore the main focus of this paper is to identify factors influencing Ethiopian trade performance within the major trading partners.

2. METHODOLOGY

2.1. Sources and Nature of the Data

Our study has been conducted based on bilateral trade flows between Ethiopia and the major trading partners. The study uses Panel data for the period 2000 to 2009 for fifteen world countries and Ethiopia.

Annual data for the years 2000 through 2009 about Ethiopia and the major trading partners were collected from the following sources: Ethiopian GDP and the major trading partners GDP are collected from International Monetary Fund's (IMF) International Financial Statistics database. Ethiopia's bilateral exports and imports are from the Ethiopian Economic Association (EEA) statistical Database. All monetary values are measured in dollar at the current prices. Population data (in millions) was accessed from the world Economic Outlook Database, while the distances in kilometres between the capital cities are from the website http://www.indo.com/distance/. The exchange rates are gathered from the National Bank of Ethiopia. As the bilateral exchange rates between the Ethiopian birr (ETB) and trading partner's currencies are not available, they are calculated through the US dollar (USD) by multiplying the value of foreign currencies per US dollar with the ETB/USD exchange rate.

2.2. Gravity Model of International Trade

Gravity models are econometric models that many economists often use for ex-post analyses of international trade flows. If after estimation the model is used for simulations, it can also predict future values (Piermartini and Teh, 2005). The gravity model of trade is based on the idea that overall trade volumes between two nations depend on the size of the two nations and the distance they are apart (Armstrong, 2007). Unlike trade indices, the gravity model of trade is one of the most empirically successful approaches in economics, both to explain the state of trade flows and estimate trade potentials (Helmers and Pasteels, 2005). It is also widely used as a baseline model for estimating the impact of a variety of policy issues (Baldwin and Taglioni, 2006). We can generally say that the estimation of trading partners within the gravity framework is a line of research that has been studied extensively (Helmers and Pasteels, 2006). There are a couple of reasons for the central role played by the gravity model in such empirical works (Piermartini and Teh, 2005).

The first has to do with the high explanatory power of the model in explaining bilateral trade flows. The second reason is that it provides an easy method to test the role that other variables play in affecting trade. Besides, the model can overcome the basic limitations of trade indices. For instance, it can incorporate dynamic effects (Bun and Klaassen, 2002), measure the impact of policy shocks or trade agreements (Piermartini and Teh, 2005) and capture the level as well as structure of trade (Alemayehu *et a.l*, 2010). It should be noted, however, that in analyzing trade between two countries, say X and Y, the model makes no provision for third party effects (Batra, 2004). That is, the model does not capture the conditions and opportunities that prevail between X and Z as well as Y and Z.

A theoretical basis developed by Baier and Bergstrand (2002) underlies the gravity model. This model originated from the Newtonian Physics notion. Newton's gravity law in mechanics states that two bodies attract each other proportionately to the product of each body's mass (in kg) divided by the square of the distance between their respective centres of gravity (in metres).

Later on an Astronomer, Stewart and Sociologist Zipf (Zhang and Kristensen, 1995) transferred this law to the social sciences and attempted to apply it to spatial interactions, such as trips between cities, using the following specifications:

$$I_{ij} = G\left(Pop_{i} Pop_{j}\right) / D_{ij}^{\alpha} \qquad (1)$$

Where is trips between city i and city j; POPij is population of city i(j); Dij is distance between city i and city j; and G and α are the respective coefficients.

The gravity for trade is analogous to this law. The analogy is as follows: "the trade flow between two countries is proportional to the product of each country's 'economic mass', generally measured by GDP, each to the power of quantities to be determined, divided by the distance between the countries' respective 'economic centres of gravity', generally their capitals, raised to the power of another quantity to be determined" (Christie, 2002). This formulation can be generalised to:

$$M_{ij} = K Y_i^{\beta} Y_j^{y} D_{ij}^{\sigma} \quad (2)$$

Where, is the flow of imports into country i from country j, k is constant, and are country i's and j's GDPs, Dij is the geographical distance between the countries' capitals and , y and are the respective coefficients. The linear form of the model is as follows:

$$Log(M_{ij}) = K + \beta Log(Y_i) + yLog(Y_j) + \sigma Log(D_{ij}) \quad (3)$$

Even though when estimated, this baseline model gives relatively good result, most estimates of gravity models add a certain number of dummy variables to equation (3) to test for specific effects. The gravity model has been applied to a wide variety of goods and factors of production moving across regional and national boundaries under different circumstances since the early 1940s (Oguledo and Macphee, 1994). Thus the functional form of the gravity model estimated in this study was as follows:

$$\ln TRD_{ijt} = \beta_o + \beta_1 \ln \mathrm{Re}albilateralER + \beta_2 \ln(\mathrm{fdiofetiopia}) + \beta_3 \ln(GDP_{it} \cdot GDP_{it}) + \beta_4 \ln DST_{ij} + \beta_5 \ln \mathrm{paveroad} + U_{ijt} \quad (4)$$

and

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln GDP_{jt} + \beta_2 \ln realbilaeralER + \beta_3 \ln \mathrm{paveroad} + \beta_4 \ln percapita\ diff + \beta 5_6 \ln DIST_{ij} + \beta_6 \mathrm{border} + \beta_7 \ln \mathrm{fdiethiopia} + U_{ijt} \quad (5)$$

In the above model (Equation 4 and 5):

1) Xijt indicates the amount of trade exports of country i to country j at time t. Since the gravity model refers to the trade volume, the study deflated the values of the annual imports, measured in US dollars, using the US Consumer Price Index (CPI).
2) TRDijt indicates the total trade flow (export + import) between trading partners
3) GDPit and GDPjt represent the GDPs in current values (US dollar) of countries i and j, respectively.
4) $percapitaGDPdiff$ per capita represents absolute value GDP difference of country i to j at a time t.
5) WDIST measures the weighted distance between Ethiopia and its trading partners for each year in the observation period.
6) $\mathrm{Re}albilateralER$ is the real bilateral exchange rate between country i and country j at time t measured by the following formula: TCR ijt = (TCNi/$/TCNj/$ × (CPIj / CPIi), where TCN is the nominal exchange rate vis-à-vis the dollar and CPI is the price index, notably the GDP deflator.
7) Percentage of pave roads of importing countries
8) Border is the dummy variable relating to whether the two trading countries border each other. It takes the value 1 if the two are neighbouring countries and 0 otherwise.
9) FDI is the Foreign direct investment of Ethiopia
10) U_{ij} is the stochastic term, log normally distributed error with E(Uij)=0.

2.3. Econometric Issues

Before setting up our estimation models, it has to be explored whether the variables specified in the model are normally distributed random variables. A graphical (histogram and box plot) and numerical inspection (Skewness-Kurtosis test) has been performed for testing normality. The results indicate that, for most of the variables in the sample, the null hypothesis of a normally distributed random variable is rejected. In order to make the variable as close as to a normally distributed one, I take the log transformed variables. The graphical and numerical inspection of the log transformed variables confirms that they exhibit an almost normal distribution (see details in figures Appendix figure1 up to figure 8; I performed a Variable Inflation Factor (VIF) Analysis to check for multicollinearity. The analysis indicates that all the variables have a VIF value of less than 10, meaning there is no a problem of multicollinearity in the data (see Appendix Table 1 and 2).

A diagnostic analysis has been conducted to examine which estimation technique fits the model and the data well (Appendix Table 3). The Hausman specification test (Hausman, 1978) is performed to discriminate between fixed and random effects model. The test result indicates that the fixed effect is strongly preferable to the random effects model for the total trade flow and also for the export, random effect is was used for the analysis.

One common problem encountered in panel data studies is a problem of heteroskedasticity, whose

presence renders OLS estimators inefficient. The Breusch-Pagan / Cook-Weisberg test for heteroskedasticity is applied, and the null hypothesis of homoskedastic disturbances is rejected. The hetroskedasticty problem was handled by robusting the data.

3. RESULTS AND DISCUSSION

3.1. Factors Influencing on the Total Trade of Ethiopian to Its Major Trading Partners

The result in Table 1 shows that out of five explanatory variables, four of them have significant effect and the model fitted the data well and explained over 52.85% of the variations in the total trade discussed as follows:

1. Economic size (GDP) of trading pairs is found to have a positive and significant effect on the total trade flows. The concept behind demonstrates that Ethiopia's trade relationship is stronger with larger economies than smaller economies. In absolute terms, when economic size increases by one percent, other things remain unchanged, the flow of trade between a pair of countries grows by some 2.715percent.
2. FDI of Ethiopia could represent a measure of production development in the of export sector. It can be expected to contribute to the enhancing of a country's competitiveness on international markets by increasing the technological content of exports. FDI is included in this study as stock since FDI stock measures its productive capacity. As it is believed that transformation of the composition of exports increases with FDI, the sign of this variable is expected to be positive. The results of this study shows as it expected.
3. Distance treated as a proxy for trade costs and has an inverse and statistically significant impact on trade flows. For every one percent increase in the distance between a pair of countries, merchandise trade tends to fall by 3.531percent, ceteris paribus.
4. Bilateral exchange rate was added to the gravity equation to estimate the effects of currencies exchange between the importing countries and those exporting countries. The coefficient estimated had negative sign and statistically significant at 10%. The significance of exchange rate of currency in the trading partners could be as a result of different currency used by those trading partners. This result implied that holding other variables constant, an increasing of bilateral exchange rate by one percent will decrease total trade flow by 2.04%.

Table 1. Gravity regression results of determinants of Ethiopian total trade flow to its major trading partners'

ltotaltrade	Robust Coef.	Std. Err.	T
lgdpgdp	2.715	0.784	3.46*
lwdista	-3.531	1.358	-2.60**
lfdiofetio~a	0.187	0.076	2.45**
lpaveroad	0.165	0.248	0.66
lbilateral~e	-2.066	1.071	-1.93***
_cons	-2.164	3.304	-0.65
F(5,14) = 14.64			
Prob > F = 0.000			
R-squared = 0.5285			
Number of obs = 120			
Number of groups = 15			

Source: Own Computation

*, ** and *** means significant at the 1%, 5% and 10% probability levels, respectively

3.2. Factors Influencing on the Ethiopian Export to Its Major Trading Partners

The estimation results indicate that the model has an overall R^2 of 0.5657. Overall, the variables in our model are jointly significant. This is evidenced by the Wald statistic of 390.00 with a p-value of zero at 1% (Table 2). Regarding the factor that influence Ethiopia trade exports four variables were found to be statistically significant.

1. The GDP of the importing countries (lgdpcurren~e) was used as proxies for marketing sizes of these countries. The coefficients of the GDP in importing countries were positively and statistically significant at 1% level of significance. The positive and statistically significant coefficients of the importing GDP for the augmented gravity model were consistent with the theory behind the conventional gravity model, suggesting that the size of the economies should enhance the amount of trade between trading partners. The result implied that a percent increase in GDP of the importing countries increased imports by 2.297% for the period under consideration.
2. The coefficients of the GDP of the exporting countries (lgdpofethi~a), which indicated the potentials for

supply, were found to be positive and statistically significant at 1% level of significance. The result suggested that holding other variables constant, a percent increase in GDP of the exporting countries increased the supply of goods and services by 9.768%. It, therefore, meant that GDP determined the pattern of trade in the bordering region.

3. The distance variable (lweigteddi~e) coefficient had a negative sign and was significant at 1% level. The negative coefficient of this variable indicated that the distance between Ethiopia and their partner-countries affected export negatively. Because distance factors are related with transportation cost. An increase in transport costs worsens Ethiopian export performance. A negative relationship is what we expect about the effect of transport costs. The estimated coefficient on log distance has the anticipated negative sign and is about 6.117%, indicating that exports falls by 9.716% for every 1 percent increase in the distance between them.
4. One of the geographical variables that explained variations of exports of goods was (border) that is, countries sharing common border. The coefficient for bordering was negative and statistically significant at 5% probability level. This result suggested that sharing common border does not enhanced trade as compared to those countries which is not bordered. That is for neighbouring countries, trade wasn't being intensive.

Table 2. Gravity regression results of determinants of Ethiopia's Export to its major trading partners'

lexport	**Robust Coef.**	**Std. Err.**	**Z**
lgdpcurren~e	2.297	0.370	6.21*
Lwdista	-9.716	2.467	-3.94*
lfdiofetio~a	0.033	0.148	0.22
lpaveroad	0.305	0.229	1.33
lbilateral~e	-0.140	0.197	-0.71
lgdpofethi~a	9.768	2.244	4.35*
Border	-6.567	2.840	-2.31**
_cons	0.076	5.601	0.01
Wald chi2(7) = 390.00			
Prob > chi2 = 0.0000			
R-squared = 0.5756			
Number of obs = 120			
Number of groups = 15			

Source: Own Computation

* and ** means significant at the 1% and 5% probability levels, respectively

4. CONCLUSION AND RECOMMENDATIONS

In recognition of the importance of international trade in world countries, this study attempted to identify and analyse the determinants of trade in goods and services within the Ethiopia, the major trading partners' such as Djibouti, Kenya, Sudan, U.A.R, France, Germany, Italy, Netherlands, UK, Russia, Yugoslavia, U.S.A., China, Japan and Saudi Arabia. From the results, intra-trade within those world countries were consistent with the gravity theory that trade flow between countries depended on the mass (economic size) of the importing and exporting countries and inversely proportional to the distance between them. The FDI of Ethiopia turned out to be significant factors in determining the total trade among those major trading partners. Besides the above factors the total trade flow affected bilateral real exchange rate.

The empirical results also suggest that Ethiopia's export performance to those bordering countries are determine by GDP of the importing countries, GDP of the exporting country, the weighted distance between the exporting country and its trading partners and bordering between Ethiopia and the major trading parents.

Based on the findings of this study, the following recommendations are made:

1. Depreciation of a country's real exchange rate will cause a gain in competitiveness of that country. The results of this study indicate that a depreciation of the real exchange rate would affect the international competitiveness of Ethiopian exports.
2. The effect of transport costs on the Ethiopian trades (exports) tends to decrease over time. So the government needs also to pay adequate attention to destination markets with cheaper transport costs. Access to such markets should be facilitated by relevant policies to take advantage of the geographical location in strengthening Ethiopian trade (exports') competitiveness.
3. Finally, we provide some propositions that we think are relevant for future empirical studies. Our comments concentrate on specifications of the gravity model and the sample of countries required for

estimation of trade potentials. Thereafter, we suggest estimation of Ethiopia's trade potential that incorporates the maximum possible number of trade partners, and investigation of mechanisms through which such potentials will be exhausted. The number of sample countries can increase by taking trade values of the most recent few years. These issues are left for future investigations.

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APPENDIX

Table 1: Multicollinearity Test total trade (Variable Inflation Factor for the Variables)

Item	Variable	VIF	1/VIF
1	lwdista	6.21	0.16113
2	lgdpgdp	5.7	0.175483
3	lbilateral~e	1.48	0.673889
4	lfdiofetio~a	1.19	0.842292
5	lpaveroad	1.19	0.84299
	Mean VIF	3.15	

Table 2: Multicollinearity Test log export (Variable Inflation Factor for the Variables)

Item	Variable	VIF	1/VIF
1	lwdista	8.86	0.112923
2	lgdpcurren~e	6.49	0.153995
3	lgdpofethi~a	1.91	0.524849
4	lbilateral~e	1.66	0.603393
5	lfdiofetio~a	1.2	0.83588
6	lpaveroad	1.19	0.842942
7	lwdista	8.86	0.112923
	Mean VIF	3.55	

Table 3: Summary of diagnostic test

No.	Types of test	Dependent variables	Observed statistics	P-value
1	Lagrange multiplier test for presence of random effect	Total trade	117.86	0.0000
	Lagrange multiplier test for presence of random effect	Total export	200.97	0.0000
2	Housman Specification for Fixed and Random effect	Total trade	26.47	0.0001
	Housman Specification for Fixed and Random effect	Total export	-1.97	-
	Housman random	Total export	1.97	0.8533
	Housman fixed	Total export	-1.97	-
3	Breush-Pagan Test for Heteroskedasticity	Total trade	39.81	0.0000
4	Breush-Pagan Test for Heteroskedasticity	Total export	15.40	0.0001

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