



# “ECONOMETRIC MODELLING OF ETHIOPIA’S COFFEE EXPORTS” PANEL DATA EVIDENCE FROM SIDAMA COFFEE

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## ABSTRACT

*This paper attempts to analyze the determinants of Ethiopia's Sidama coffee exports in the international market over fourteen years for four years. In this regard, the tobit random effect model were developed to come up with the findings of the study. Accordingly, the result of the traditional gravity model shows that most of the exogenous variables has shown the already expected signs. However, only economic size of exporter nation, difference in per capita income and the resistance factor of distance have possessed a significant effect on in trade with Sidama coffee. Concentration of export in a limited number of countries is clearly seen from the structure of Ethiopian foreign trade. With regard to the direction of Ethiopia's exports, Europe was a major trading partner accounting for almost all of its export including Sidama coffee. The identified determinants will provide a guideline for future move on exports in identifying those of importer nation's propensity and the proper quality of the goods must be maintained as well as the promotions must be increased as the Ethiopia's exports largely depend on the foreign demand.*

**Keywords:** Sidama, coffee, Gravity, tobit

## 1.INTRODUCTION

Coffee is the most significant agricultural commodity enjoyed across the world and merit up to US \$ 14 billion per annum for producing country, which is exported as raw, roasted product to more than 165 countries wide-reaching providing a basis of income for an estimation of 100 million people in our planet (ICO, 2001). Many nations are involved in coffee production and trade, and estimated more than 125 countries engage in export and re-export of coffee products (CTA, 1999).

Like other developing countries, the Ethiopian economy is based on agriculture, which contributes about 45 percent to GDP and more than 80 percent of exports, and employs 85 percent of the population. Ethiopia heavily relies on agriculture for its foreign exchange earnings. The major agricultural export crop is coffee, providing approximately 35 percent of Ethiopia's foreign exchange earnings. Ethiopia is the hometown of coffee and well-known for its production of high-quality coffee. The excess of this commodity has found well-established and profitable markets; rewarding huge amounts of foreign currency and enhancing economic development.

In Ethiopia, the SNNPRS has taken the lion share in the production coffee. Coffee is the most important crop in the region giving out about 45 percent in the national market (Simayehu et al. 2008). Among these, Sidama and Gedeo zones represent the key coffee growing areas where different Coffee is known to exist. These coffee types have their own taste and preference used to distinguish them.

Agricultural product exports are drivers of balanced rural economic growth. It also contributes for inflow of foreign capital; it creates additional jobs, increases the adoption of advanced production technologies and practices as well as the enhancement of overall competitiveness of the agricultural sector in the international market.

In Ethiopia, about 1/4th of the populations of the country are being depends on production, processing, distribution and export of coffee. It accounts for more than 25 percent of the GNP, 40 percent of the total export earnings, absorbing 25 percent of the employment opportunity for both rural and urban dwellers, and 10 percent of the total government revenue GDP (MoARD, 2008). Predominantly, coffee is produced by small-scale subsistent farmers, private and government owned large-scale farmers.

In southern regions of Ethiopia, about 50 districts are producing coffee and 235,000 ha of land are allocated with 120000- 140000 tons coffee production per annum, of which 70,000 to 100,000 tons are supplied to the central commodity exchange market (Simayeh et al., 2008). According to Sidama Coffee Farmers Cooperative Union (SCFCU), Sidama is very well known for its production of garden coffee. The total area covered by coffee is about 70,000 hectares, with a total production of 35,000 tones of clean coffee per annum. It is known for its balanced taste and fine flavor and is called sweet coffee.



Lack of diversification, both in the type of commodity and direction of exports, for nearly half a century is a witness for the lack of structural change in production, where traditional mode of production in agriculture remains predominant, yet (BerhanuNega et.al., 2002). In addition to supply side constraints in the production of agricultural products, Ethiopia still vulnerable to fluctuations in global commodity prices in its export markets. Moreover, the demand for agricultural commodities is in general more price-inelastic, especially in developed countries markets.

However, Ethiopia has shown a significant growth in the exports of coffee over the last years. Although the importance of supply side factors like production cost and climatic conditions, the international market channeling factors of coffee may give insight for future policy implications. For example, it accounts for 55 percent of the export revenue and contributes over 25 percent of GNP (Ashenafi 2006). Given its significant contribution in the national export earning, studying factors affecting exports of Sidama coffee is paramount importance for policy makers and future research undertaking. For the very reason that, this study were mainly attempt to investigate the determinants of coffee exports particularly Sidama coffee.

**General Objective:** The broad objective of this study is investigate the determinants of coffee exports particularly Sidama coffee by using augmented gravity modeling approach.

**Specific Objectives:** The specific objectives are to envisage the amount of Sidama coffee in nation's export and to identify major recipient countries of Sidama coffee exports.

## 2.MATERIALS AND METHODS

### Description of the Study Area

According to Sidama Coffee Farmers Cooperative Union, Sidama is located in SNNPRS, Ethiopia and very well known for its production of garden coffee. Specialty Coffee is grown in many villages. Sidama has ideal soil type and climatic conditions-including altitude, rainfall and temperature – for production of Arabica Coffee. The total area covered by coffee is about 70,000hectares, with a total production of 35,000 tones of clean coffee per annum.

Four production systems are known and practiced in Ethiopia: semi - forest coffee, forest coffee, plantation coffee and garden coffee. In Sidama, however, only the garden coffee production system is widely distinguish and practiced. It is grown near home steads. The coffee is planted at low densities, ranging from 1000 to 1,800 trees per hectare, is mostly fertilized with organic waste (mainly animal dung) and often intercropped with enset (false banana) plant. All of the coffee produced under this system is a ergonomically organic.

### Study Subject and Design

Countries were selected based on the extent of trading partnership with Ethiopia in trading of Sidama coffee in the international market and the availability of the trade data. In this study, the researcher had a plan to incorporate an extensive years of export data. Unfortunately, lack of the data at regional and national level restricted the scope of the research only to four years and fourteen nations. Thus, Australia, Belgium, Canada, France, Germany, Italy, Japan, Korean Republic, Netherlands, Norway, Russia, Sweden, United Kingdom and United States over the period of 4 years were selected to investigate.

### Study Methodology

This study were intends to investigate with the ex-post approach which uses historical data to conduct analysis of the effects of a past trade policy. This method applies econometric approaches. In this study the generalized gravity model were adopted using panel data estimation technique. Panel data analysis is a method of studying a particular subject within multiple sites, periodically observed over a defined time period. The potential advantages of a panel frame work were two fold (Matyas, 1997). First, it can increase degrees of freedom, and to enable identification of business cycle and local (or exporting) country effects. Secondly, it correctly account for target (or importing) country effects. The gravity model is particularly chosen to the extent that the gravity model is policy neutral.

### Data Source and collection procedures:

Data on the annual US dollar value of total export of Sidama coffee to partner countries are extracted from National bank of Ethiopia data base over the period of 2002-2005E.C. Data on GDP, GDP per capita and population are obtained from Ethiopian Economic Association data base (2002). The physical distance in kilometers from Ethiopia's capital to importer country extracted from Indonesian website:[WWW.indo.com/distance](http://WWW.indo.com/distance).

### Data Management and Analysis

The gravity model has been defined as the workhorse of international trade and its ability to correctly approximate bilateral trade flows makes it one of the most stable empirical relationships in economics (Leamer and Levinsohn, 1995). In its simplest form, the analogy with Newton's "Law of Universal Gravitation" implies that a mass of goods or labor or other factors of production at origin  $i$ ,  $E_i$ , is attracted to a mass of demand for goods or labor at destination  $j$ ,  $E_j$ , but the potential flow is reduced by distance between them,  $ij$ .



The gravity model is analogous to Newton’s law of gravity. The analogy is that bilateral trade is a function of attraction factors such as “economic mass” (generally measured by GDP) and resistance factors such as “economic centers of gravity” distance or various obstacles to trade.

$$\text{Trade}_{ij} = \alpha \cdot \frac{\text{GDP}_i \cdot \text{GDP}_j}{\text{Distance}_{ij}} \text{-----(1)}$$

Taking logarithms of the gravity model equations in (1) we get the linear form of the model and the corresponding estimable equation as:

$$\text{Log (Trade}_{ij}) = \alpha + \beta_1 \log (\text{GDP}_i \cdot \text{GDP}_j) + \beta_2 \log (\text{distance}) + u_{ij} \text{----- (2)}$$

The gravity model has been used extensively in international trade studies since the independent pioneering works of Tinbergen (1962) and Poyhonen (1963). The traditional gravity model predicts that bilateral trade (exports or imports) between countries is determined by the gross national products of the exporting and importing countries and the geographic distance between them. The gross national product (GNP) of the exporting country indicates the supply capacity whereas the importing country’s GNP indicates the total demand. On the other hand, the geographic distance between the countries is used as measures of transport costs. According to the model, bilateral trade between countries tends to increase when the GNP of both the exporting and importing countries increase; and it decreases if the geographic distance between the trading partners increases.

Classical gravity models use cross- section data to estimate trade effects and trade relationships for a particular time period. Although inference was drawn either up on a cross- section of a country data or up on single time-series of data, heterogeneity across countries in trade flows is extremely likely. Erroneously ignoring either of these effects will expose to seriously miss-specified econometrics models and biased and miss-interpreted parameter estimates. Hence, a pooled time-series of cross- sections (panel data) requires identifying those effects, and correctly specifying the econometrics model.

The potential advantages of a panel frame work were two fold (Matyas, 1997). First, it can increase degrees of freedom, and to enable identification of business cycle and local (or exporting) country effects. Secondly, it correctly account for target (or importing) country effects. Egger (2002) also points out the potential advantages of a panel framework. A Panel makes it possible to capture the relationships among the relevant variables over a longer period of time, and to identify the role of overall business cycle phenomenon.

The existence of trade flows which have a bilateral value equal to zero is full of implications for the gravity equation because in Newton’s equation the gravitational force can be very small, but never zero. Even if zeros may reflect mis-reporting and mis-measurement, particularly that of small and poor countries, observed zeros contain valuable information which should be exploited for efficient estimation. As a matter of fact, if the zero entries are the result of the firm choice of not selling specific goods to specific markets (or its inability to do so), the fact that trade between several pairs of countries is literally zero may signal a selection problem (Chaney 2008; Helpman et al. 2008).

This is why in our estimation techniques, we also consider the following issues. The data of Ethiopia’s export may involve zero or missing values, since it is not possible to differentiate them due the nature of the data itself. Given the log specification, these values would be translated into undefined values. This problem of a limited dependent variable in a censored sample produces biased results if OLS estimation is used.

Besides the above mentioned problems associated with estimating the gravity equation by OLS, there is problem of zero trade between countries that poses difficulty in using the log linear transformation and estimate it by OLS. Three alternative methods have been applied in the literature to handle the problem of zero trade issue. The first one is to drop the zero trade observations and truncate the sample; the second alternative is to add a small constant to the value of trade before taking logarithms or to estimate the model in levels. The first alternative is appropriate only if the zeros are randomly distributed. However if they are not randomly distributed, dropping these observations results in loss of important and useful information.

In this paper the Random-effects tobit maximum- likelihood method is employed, which explicitly deals with the zero values in the censored sample. This estimation treats zero or missing trade flows as unobserved data points. The Tobit model, which was first suggested by Tobin (1958), uses the advantage of unobserved measures of dependent variables.

**Variable Description:**  $\ln X_{ijt}$  denotes the Sidama coffee exports from Ethiopia (country i) to country j at time t. The GDP of the exporting country ( $\ln Y_{it}$ ) is used to control for the supply side, while the GDP of importing country ( $\ln Y_{jt}$ ) controls the demand side. A high level of income in the exporting country is an indicative of a high level of

production, so that exports are expected to be high as well. At the same time, a high level of income in the importing country suggests that imports will be higher. So, both variables are expected to have a positive effect on the regressand. The signs of the coefficients of the population of the exporter ( $\ln n_{it}$ ) and importer country ( $\ln n_{jt}$ ) may be either positive or negative. If the exporter is big in terms of population, it may either need its production to satisfy domestic needs, so that it exports less (absorption effect), or it may export more than any other small country, as it happens when small and large enterprises achieve economies of scale. The same holds true for importing country ( $\ln n_{jt}$ ); if it is big, it may either import less because it is more self-sufficient or it may import more because it can not satisfy all internal demand with its own production.

The per capita GDP differential ( $\ln pc_{dijt}$ ) between two countries variable is frequently included in to the gravity model to test the two hypothesis of international trade associated with the effect of the difference between the two countries (Ethiopia and its trading partners) level of per capita income. The sign of this coefficient will depend on the traditional comparative advantage effect on trade (the H-O theory) and the intra-industry theory of trade (Linder hypothesis). If the sign is positive, it suggests the H-O type of proposition and if the sign is negative, it suggests a Linder-type hypothesis.

The geographical concept of distance may not be an accurate reflection of transaction costs in certain instances. Transaction costs refer to costs in obtaining information, the costs of bureaucratic processes involving government regulations and the costs of financing the transactions depending on how efficient and developed financial institutions are in specific countries. From the works of Ogunkola (1994), there is a high correlation between transportation costs and distance. In this very study of mine, distance ( $\ln DIS_{ij}$ ) is used as a proxy variable for resistance to trade. Assuming that the further a country is away from another, the more expensive-bilateral trade will be. Accordingly, distance is expected to have a negative impact on bilateral trade flows.

### 3.RESULT AND DISCUSSION

#### Sidama Coffee Export Structure and Performance

Like most of the Least Developed Countries (LDCs) in Africa, the commodity structure of Ethiopian export sub-sector is a mirror reflection of the country's overall economic structure at large. The nation's exports are highly comprised agricultural commodities, while the share of non-agricultural products in total merchandize exports is almost insignificant. The country keeps export of the same primary commodities, dominated by coffee as it has been doing decades ago.

It is an utter legitimacy that coffee production and consumption is closely entangled with Ethiopian people and its economy for extended historical periods. This cash crop is contributing significantly to the daily life of individuals and on the macro level for the state of Ethiopia as a whole.

**Table 1** Major Importer nations of Sidama coffee (in birr and E.C)

Nations	2002	2003	2004	2005	Total
Australia	702623.683	1521645.516	3328967.1	4596553.1	10149789
Belgium	14626281.5	29108956.17	18050374	26782715	88568327
Canada	1303579.99	2705375.363	1601439	4987334.1	10597729
France	5321086.5	13702192.93	10128810	5643219.8	34795309
Germany	76470131.4	142334115	59319085	97725729	375849061
Italy	8685592.65	15533184.51	13431141	19686226	57336143
Japan	15945542.6	12861936.6	15070776	33425228	77303483
Korean Republic	3829954.27	7831863.666	9385352.4	6457696.7	27504867
Netherlands	2168536.5	2274935.555	967147.18	5258010.3	10668630
Norway	2724005.08	2664144.396	1004292.2	-	6392442
Russia	2285681.13	314115.42	1173490.9	7462529.3	11235817
Sweden	10416673.8	18762514.1	9107551.7	12961355	51248095
United Kingdom	2207911.3	7144635.935	7874834.7	16704871	33932253

Source: Own Computation from NBE,2013

Concentration of export in a limited number of countries is clearly seen from the structure of Ethiopian foreign trade. With regard to the direction of Ethiopia's exports, Europe was a major trading partner accounting for almost all of its export. As shown on the table, Germany has took the first place followed by the US are the major recipient countries of Ethiopia's Sidama coffee. The amount of total Sidama coffee exports raised in all years across the above trading partner nations. The robust growth of export earnings was mainly due to improvements in other components of exportable items.

### The Intuitive Gravity Model Result

The model used in this particular study is specified as follows:

$$\ln X_{ijt} = \beta_1 \ln(Y_{it}) + \ln(Y_{it} Y_{jt}) + \beta_2 \ln N_{it} + \beta_3 \ln N_{jt} + \beta_4 \ln PCD_{ijt} + \beta_5 \ln DIS_{ij} + \alpha_i + \epsilon_{ijt} \quad (3)$$

where,

$\alpha_i$  is country-specific factors that are allowed to be random;

$X_{ijt}$  is Value of exports of Ethiopia to country  $j$  at time  $t$ ;

$Y_{it}$  is the value of exporter country's GDP

$Y_{it} Y_{jt}$  is the product of Ethiopia and country  $j$  GDP at time  $t$ ;

$N_{it}$  ( $N_{jt}$ ) is the number of population in county  $i$  ( $j$ ) at time  $t$ ;

$PCD_{ijt}$  is per capita GDP differential between country  $i$  and  $j$  at time  $t$ ;

$DIS_{ij}$  is the distance between them and  $ADJ_{ij}$  is a dummy variable capturing the effect of sharing a common border;

After the sensitivity analysis about the robustness of the result for the traditional gravity model, the estimation results from the Random-effects tobit-Maximum Likelihood are presented in table below. Half of the traditional gravity variables have showed significant statistically in explaining Sidama coffee with their impulse magnitude.

**Table 2.** Regression Results from the Random Effects Tobit Regression Model

Variable	( $\ln x_{jt}$ ) Coefficient	Std. Err.
$\ln y_{it}$	1.567902**	2.447863
$\ln y_{it} y_{jt}$	.1616557	.3963372
$\ln n_{it}$	1.219426	14.20982
$\ln n_{jt}$	-.2138388	.4446035
$\ln pcd_{ijt}$	.6530771**	.6763803
$\ln dis_{ij}$	-.6422169**	.6641547
Constant	.6280425	55.49061
Number of obs.	55	

Note: \*\* denotes for a 5 % level of significance

In line with the expected signs, the coefficient of Ethiopia's GDP is significant and positive effect on exportation of Sidama coffee to the rest of the world. This implies that as the exporter nation's economy goes up over time exportation of such kind of items would rise due to high production in economies of scale.

The coefficient of product of GDP of Ethiopia and importer nations from the estimation result is positive and insignificant. This can be interpreted as the country tends to export relatively more to larger economies as a world income has a favorable impact on trade. The coefficients of exporter country's population and importer country's population are shown positive and negative impact respectively, and insignificant effect in determination of exportable items. The increasing population in the exporting country (Ethiopia) contributes to the economies of scale while increasing population in the importing country results in the fall in trade relation as the country is self sufficient. The non-significant of the above coefficients,  $\ln y_{it} y_{jt}$  and  $\ln n_{it} \ln n_{jt}$ , depicts that a weak participation of exporters of Sidama coffee in the international market.

To test for the strength of the Linder hypothesis as against the H-O hypothesis we have included the log of the absolute difference in GDP per capita between Ethiopia and country  $j$ . This allows us to address the question whether Ethiopia exports more to similar or dissimilar countries in terms of national income. Our estimation result supports the traditional comparative advantage effect (H-O); that is the country exports more to dissimilar countries. The per capita GDP gap appears as positive and significant statistically.





The traditional resistance variables such as distance has the anticipated sign. Distance, which is a proxy of transportation cost, shows negative but is statistically significant. This implies Ethiopia would be better if the country exports more with its neighbors.

#### 4. CONCLUDING REMARKS

The objective of this paper was to estimate the determinants of Sidama Coffee exports by applying the gravity model. With this aim we develop the econometrics model to annual exports of Sidama coffee from Ethiopia to fourteen nations over the period four years. The aim of this exercise is to gain knowledge on the role of agricultural trade and export growth to ultimately provide guidelines for future export opportunities.

Our results show that Ethiopia's Sidama coffee export is positively determined by the size of exporter's economies. The world income found to be positive and insignificantly affect the trade flows. Both Ethiopia's and importer's population have insignificant positive and negative effect on bilateral trade flows respectively. The coefficient of per capita GDP differential between Ethiopia and country j is also significant and has a positive sign. From the positive sign of this coefficient we can have an indication that the H-O effect (differences in factor endowments) dominates the Linder effect in case of Ethiopia's export flows. Finally, distance bear expected sign statistically significant in determining bilateral trade.

The empirical result witnesses that Ethiopia tends to have geographically concentrated destination of exports, a large share of its exports is destined to Europe and Asia.

The implication of these outcomes is that the focus of future coffee exportation should be strategized along the following guidelines from a marketing perspective:

- Economic growth in Ethiopia spurs growth in agricultural exports particularly exportation of Sidama coffee, and growth in agricultural exports stimulates economic development. Thus a synergetic relationship between the two exists, possibly rationalized by an increase in investor's confidence
- The stage of development of in a destined market is not of trivial importance to agricultural export growth. Thus export diversification should focus on markets in all stages of economic development: developing, emerging and developed nations.
- The proper quality of the goods must be maintained as well as the promotions must be increased as the Ethiopia's exports largely depend on the foreign demand. All trading partner countries' propensities to import of Ethiopian commodities must be taken in to account sufficiently and adequately when trade policy is set.

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