PRICE INTEGRATION IN THE ETHIOPIAN COFFEE MARKET

BY

FILAGOT SILESHI TILAHUN

A Thesis Submitted to the Department of Economics (IGNOU)

In

Partial fulfillment of the requirements for the Degree of Master of Arts in Economics

April 2016

PRICE INTEGRATION IN THE ETHIOPIAN COFFEE MARKET

BY

FILAGOT SILESHI TILAHUN

A Thesis Submitted to the Department of Economics (IGNOU)

In

Partial fulfillment of the requirements for the Degree of Master of Arts in Economics

April 2016

Programme Code: MEC

Course Code: MECP-001

Name of the Candidate: ***Filagot Sileshi Tilahun***

Enrolment No.	***0***	***9***	***9***	***1***	***2***	***1***	***2***	***5***	***5***

Study Centre Code	***8***	***1***	***0***	***5***

Study Centre: St. Mary's University

Regional Centre: Ethiopia

DECLARATION

I hereby declare that the project work entitled ***"PRICE INTEGRATION IN THE ETHIOPIAN COFFEE MARKET***" submitted to the Indria Gandhi National Open University in partial fulfillment of the requirements for the award of the Degree-Master of Arts (Economics) is my own original work and has not submitted earlier, either to IGNOU or to any other institutions for purpose of study. I also declare that no chapter of this manuscript in whole or in part is lifted and incorporated in this report from any earlier work done by me or others.

Signature of the candidate: ……..……..…….

Name of the candidate: **Filagot Sileshi Tilahun**

Enrollment No: 099121255

Address*: Addis Ababa, Ethiopia*

E-mail: filuye@gmail.com

Telephone: +251-911-300199

CERTIFICATE

I certify that the Project paper entitled: **"*PRICE INTEGRATION IN THE ETHIOPIAN COFFEE MARKET*"**, submitted by **Filagot Sileshi Tilahun** is her own work and has been done under my supervision.

It is recommended that this project work be placed before the examiner/s for evaluation.

(Signature of the supervisor)

Name: Negussie Semie (Ph.D) _____

Addis Ababa University, College of Dev't Studies

Address: Tel: 0911892049

E-mail: nsemie@yahoo.com

ACKNOWLEDGEMENT

First of all I would like to thank the almighty God who led me through all the rough and difficult times and gave me the strength and encouragement to complete this study. With the deepest gratitude, I want to express my very profound gratitude for my Advisor Dr. Nigusse Semie, who has assisted me in every step of the thesis. His guidance helped me in all the time of the research and writing of this thesis.

I cannot express enough thanks to my family for their continued support and encouragement. A special thanks goes to my husband Tewodros Makonnen, for providing me with unfailing support and continuous encouragement throughout the thesis. This accomplishment would not have been possible without you.

ABSTRACT

The main purpose of this thesis is to show the price integration between the producers and the traders in the coffee market of Ethiopia. It looked the price difference and relationship of the main coffee producing areas as well as the final export price. As coffee is the country's major foreign exchange product, the study gave the possible indications about the dynamics in the price difference in the coffee market. It took primary data from major coffee producing cooperatives as well as secondary data from different organizations. There are different factors that will determine the price of coffee, which price of buyers / retailers will play the major role. Since the country is still at the early stage of setting up market institutions, it is adversely affecting the welfare of producers and consumers.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

ADF Augmented Dickey Fuller

CSA Central Statistic Agency

ECX Ethiopian Commodity Exchange

GNP Growth National Product

ICO International Coffee Organization

LOP Law of One Price

SNNP Southern Nations Nationality People of Ethiopia

VAR Vector Autoregressive Model

I. INTRODUCTION

1.1 Background

Coffee is produced in more than 60 countries of which three accounts for more than half of the world's production: Brazil, Vietnam and Colombia. These countries produced coffee Robusta, one of the two varieties of coffee, which is easier to produce and is more resistant to disease. World coffee production has been trending up, with Brazil in the lead. Though Brazil goes up and down the cycle, it produces around 50-60 million bags of coffee, and there is high national consumption. The key factors which led to this are socio economic and increased development in the coffee industry. As a result, the Brazilian agronomy is growing at a fast rate. Coffee production in Vietnam also had rapid growth, but past few years it has leveled. Other Coffee producing countries have been experiencing stagnation in production. Production in most of these countries depends on small holder farmers, and they could not compete with the mechanized and developed supply from Brazil and Vietnam. In Asia, the coffee production is stagnating.

In Africa, the Robusta production has declined over the years, especially due to political instability in the Ivory Coast and competitiveness and productivity issues. The second fine-flavored aromatic variety of coffee, Arabica coffee makes up 60-65% of the total production and usually fetches the highest prices. Recently natural Arabica in the export volumes have overtaken Robusta. Around 75% of all its coffee is exported. The world annual production is currently around 115 million 60 kg bags or 7 million tones.(International Coffee Organization, ICO.org)

With regard to consumption, data obtained from ICO indicated that the United States is currently the world's largest market for coffee. Annual consumption per capita is just over 4kg compared with 5kg on average in Europe. Consumption in Europe varies from around 10kg per capita per year in the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) to around 3kg in the United Kingdom and most of Eastern Europe.

At a country level, the economic growth of many of coffee producing developing countries is closely linked with coffee production, as well as other primary commodities. Many producer countries depend on coffee exports for a large part of their foreign exchange

earnings (for instance 35% in the case of Ethiopia, (National Bank of Ethiopia, 2011) and their government revenue. When international coffee prices are low, governments have difficulties in meeting debt service obligations and are unable to make much-needed investments in basic health, education and infrastructure.

70% of the world's coffee supply is provided by smallholders cultivating less than 10 hectares in 80 countries in Africa, Asia and Latin America. However, the extreme volatility and long-term decline in coffee prices on international markets endangers the livelihoods of the 10 million small coffee farmers dependent on coffee for their primary source of income.

Coffee is widely traded in international commodity futures markets. As such, main objective of the study was to see the market linkage of coffee from the producers (farmers') to the consumers. The reason for looking deeply the market integration is that coffee is characterized by high levels of price fluctuation, which exposes coffee producers to price risk. This makes it difficult and producers could not manage their price risk by hedging on these markets. Further it also assessed the price difference across the major coffee producing areas in Ethiopia. In December 2000, international coffee prices hit a 30-year low. On the other hand in the year 2012 it reached the highest price of more than $3-$4/lb (ICO.org), which was not seen for a decade but going down aftermath and further falls expected.

The livelihoods of millions of rural workers involved in coffee picking on big plantations and coffee processing factories also directly depend on coffee. When prices decline, rural workers involved in coffee harvesting and processing find themselves unemployed or see their wages decline as farmers attempt to reduce production costs. This low coffee revenue will not be enough to cover essential family expenditures such as primary school fees and medicines

The main problem that arises on the coffee market is the lack of market linkage, which makes the income of coffee producers unstable. In most countries, especially in developing countries, the marketing channel is not strong enough leading the farmers to lose their income which becomes, on the other side, profiting the middle market players, wholesalers and coffee traders.

In the Ethiopian case, coffee is purchased through one of three main channels: from exporters, cooperative unions, and directly from private estates.

Exporters generally purchase their coffee through the Ethiopian Commodities Exchange (ECX). Private estates that hold their own export license may sell and export directly to international buyers. Coffee lots of Ethiopia's many primary cooperatives are generally channeled through cooperative unions.

Coffee export accounts for approximately 30% of the foreign exchange earnings for Ethiopia. In the year 2011, coffee production engages almost 25% of the working population followed by oilseeds. The country is endowed with various nature and characteristics of *Coffee Arabica* which contributes to the world market. More than 25% the population is engaged on production, processing, distribution and export of the coffee. It contributes about 36% of the total export earning of the country and 25% of the GNP and about 25% of employment opportunity and accounts about 10% of the total government revenue.

1.2 Statement of the Problem

The absence of market integration or of complete pass-through of price changes from one market to another has important implications for economic welfare. Incomplete price transmission arising either due to trade and other policies, or due to transaction costs such as poor transport and communication infrastructure, results in a reduction in the price information available to economic agents and consequently may lead to decisions that contribute to inefficient outcomes.

In the Ethiopian coffee market, the major coffee producing areas are Southern regions (Sidama and Yirgacheffee), Northern (Jimma, Kaffa, Agaro, Bedelle etc) and Eastern Parts(Harar). Although coffee is produced in the above mentioned areas in bulk there is a high price fluctuation across the regions.

The difference between the prices of a homogenous commodity in different places is accounted by the transaction costs and other inefficiencies in the market. It is therefore important to check which part of the difference can be attributed to transaction costs and which part comes from inefficiencies. The difference that is attributed to transaction costs is

a legitimate difference since there is nothing that can be done to avoid it. But that which occurs through inefficiencies indicate that markets through space are less integrated to one another. Inefficiencies include information asymmetry, trade barriers etc… In cases where the price differences exceed the transaction cost, it opens a window for arbitrage. This is theoretically expected to equalize prices.

The existing literature on market integration in Ethiopia mainly focuses on major cereal crops, Teff, wheat and maize. The literature on the coffee market and its integration focuses on specific local markets especially around the producers and does not take into account the demand side prices (Tadesse, 2009). This study has covered the analysis at national level using regional prices. Filling this gap would be beneficial for regional and national policy making as it showed the causality of prices from the demand and the supply side.

1.3 Objective of the Study

The general objective of this study was to measure market integration for the Ethiopian coffee to determine the existence of long-run price relationships and spatial market linkages. Specific objectives of the study were

- To look at the general trends in production, consumption and export of coffee
- To Assess the role of middle men in the coffee chain
- Price analysis of market integration between different coffee markets
- To Compare the prices across the major producing areas of Ethiopia and look what the causes behind.

1.4 Significance of the Study

Understanding spatial price integration is even more important with regards to the Ethiopian economy. One line of argument relates to the efficiency of domestic markets spatially is that domestic markets are increasingly becoming integrated. With integration the producers are getting a higher price compared to the past and this has kept domestic prices high. Another line of argument pertains to high transaction costs and multiple players in the market are adding to the margin and resulting in higher prices.

In this context the understanding of spatial price integration among regions is an important task that can help understand these agents. This study thus attempted to test the level of price integration of coffee in the different regions of the country and gave possible indications about the dynamics in the difference in the country's major foreign exchange earning product.

1.5 Scope and Limitations of the Study

Ethiopian coffee production system consists of forest, Semi-forest, garden or cottage and plantation production systems. The country's 90% of coffee production comes from smallholder farmers; while the remaining comes from private and public owned large scale farms. Coffee production come from the Oromia National Regional State of Ethiopia (more than 64%), 35% from Southern Nations Nationality People of Ethiopia (SNNP) and the remaining 1% from Gambela National Regional State. Therefore the study focused on these coffee producing areas and took a time serious data of two decades. Furthermore, it has given significant emphasis to the market linkage with the major Ethiopian coffee buyers and consumption trend.

The study has also looked at the supply chain of coffee from the cooperatives to the buyers. The limitation of the study was difficult to get the cost of coffee production of the farmers.

1.6 Organization of the Thesis

This thesis has included five parts. Following this introductory part is part II, the literature review. In this part, definition and models used for market integration has been discussed. In part III, Research Methodology, the data type and methodology that were used for the thesis including the descriptive analysis were described. In part IV, the result of the data was shown. The final part, part V the final findings of the study has been stated in the conclusion and summary part.

II. LITERATURE

2.1 Concepts and Definitions

There are some concepts that require clarification in this study. They are defined in this section. *The law of one Price*: The first concept that requires a precise definition is the law of one price. According to Mankiw (2003)the law of one price states that the price of the same commodity in two places at the same time is the same. Here it is important to note that the commodities have to be physically homogenous in all places that the comparison of prices is made. Here are some direct definitions in the literature;

> *"The law of one price (LOP) states that for a given commodity a representative price adjusted by exchange rates and allowance for transportation costs will prevail across all countries"(Yang, Bessler, & Leatham, 2000)*

Arbitrage defined as the process of buying and selling a same commodity at different prices and to profit from the price difference. It is the process of earning a riskless profit by taking advantage of different prices for the same good, whether priced alone or in equivalent combinations. Randall Billingsley(2005) stated that arbitrage violates the expectation that the same product should sell for the same price. Arbitrage offers guaranteed profit with no risk, and therefore undermines the stability and functionality of markets. *(Understanding Arbitrage: An Intuitive Approach to Financial Analysis,2005)*. Thus, due to mispricing, a riskless position is expected to earn more than the risk-free return. A true arbitrage opportunity exists when simultaneous positions can be taken in assets that earn a net positive return without exposing the investor to risk and, importantly, without requiring a net cash outlay.

The absence of arbitrage opportunities is consistent with equilibrium prices, wherein supply and demand are equal. Conversely, the presence of an arbitrage opportunity implies disequilibrium, in which assets are mispriced. Thus, arbitrage-free prices are expected to be the norm in efficient financial markets.*Owen A. Lamont and Richard H. Thaler(2003)*

Arbitrage exploits violations of the Law of One Price by buying and selling assets, separately or in combination that should be priced the same but are not. Implicit in an

arbitrage strategy is the expectation that the prices of the misvalued assets will ultimately move to their appropriate values. Indeed, arbitrage should push prices to their appropriate levels.

As for the price transmission, vertical and horizontal price linkages are the two branches in the area of price transmission. Horizontal price linkages are typically concerned with spatial price relationships. Vavra and Goodwin (2005) stated that the literature analysing vertical price transmission has concentrated on evaluating the links between farm, wholesale, and retail prices. Aguiar and Santana (2002) found that price transmission results from previous studies cannot be applied to other products or for other periods. They showed that price increases are more rapid and fully transmitted compared to price decreases by analysing the price transmission mechanism for coffee beans in Brazil. They also concluded that neither product storability (e.g. perishable fruits or storable beans) nor market concentration was required for an intense transmission process. Bettendorf and Verboven (2000) found weak transmission of coffee bean prices to retail prices in Netherlands because coffee bean prices were a relatively small share of total product cost. Delille (2008) concluded that the reduction of world coffee price is transmitted less rapidly than its increase to retail price in Belgium. A report from the U.K. found little evidence of systematic asymmetric transmission in the EU food chains between the evolution of farm and retail prices during 1990s for about 90 products (London Economics 2004). In this study, the asymmetric transmission will mainly focus on how the world and grower price of Arabica and Robusta perform and investigate their long-run equilibrium.

2.2 Theoretical Review

The analysis of market integration is not well equipped with structured theoretical framework. So studies use varied methods to assess market integration (Mcnew, 1993). Most of these studies focus on spatial price relationships and dynamics to assess market integration.

The study of spatial price relationships in the study of market integration is related to the concept of the Law of One Price. Originally the law states that one price for a commodity will prevail among countries when the prices are adjusted for exchange rate and

transportation costs. This law asserts that if causal relationship between can be established between the prices of a commodity in two regions there is market integration in the region. There is also a stronger version of this law that asserts that price of a commodity in two regions will eventually equalize if we take into account transaction cost and other trade restrictions in the calculation (Viju, Nolan, & Kerr, 2006). In this strong case of the law of one price there is no room for arbitrage.

The analysis of the Law of One Price to check for market integration has been widely exercised and some studies used it to analyze market integration(Berkowitz & Dejong, 2000). It is however, important that non-linear models be used rather than just the law of one price to assess market integration (Mcnew, 1993). An alternative tool of analyzing market integration is through the analysis of trade flows and excess demand in different places for a commodity. (Mcnew, 1993) proposes the assessment of excess demand for and price of a commodity in one place and its relation with the excess demand for and price of the same commodity in another location. The framework of this model is:

$$q_i - b_i(a_i - p_i) \quad where\ i - 1,2,3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\sum q_i = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$p_i - p_i - r_{ij} \leq 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$s_{ij} \geq 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$s_{ij}(p_i - p_i - r_{ij}) = 0 \quad \forall\, i \neq j \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where q_i is the excess demand of a commodity in location i; p_i is the price in location i; a_i is the autarkic price in location i; $b_i$is a strictly positive parameter. The first equation (1) expresses the excess demand for a commodity in location i. When q_i >0 then it means there is excess demand and a commodity will be shipped to location i. For another location j let r_{ij} be per-unit cost of transporting the commodity from location i to location j and s_{ij} be the amount of the commodity shipped from i to j. Given these, the equilibrium conditions are equations 2-5 above. Equation 2 indicates that at equilibrium there will be no excess demand. Equation 3 presents the notion of law of one price in that in order to sustain equilibrium the price differential should not encourage trade by being larger than the cost of getting the good from one place to the other. Equation 4 imposes a non-negativity constrain on trade between

location i and location j. Equation 5 guaranties that both equation 3 and 4 are met with equality since at equilibrium the price differentials have to be less than zero for there not to be trade.

This basic framework shows the relationships and the variables included in the assessment of market integration. The major equation of course remains equation 3 which showed the behavior of prices when in equilibrium. In addition to prices the movement of goods among the two places is essential(Barrett, 2001). Probably due to the difficulty of finding consistent trade flow data and price data, the analysis of market integration has focused on price analysis more often. Quite a significant body of literature dwells on the relationship between prices(Goodwin & Piggott, 2001)(Uchezuba, 2005). Therefore the empirical literature surveyed mostly focus on price analysis of specific commodities.

2.3 Empirical Review

Law of One Price

Quite a number of studies have tested the Law of One Price. (Pippenger, 2007) argue that the law of one price usually works and the body of literature that proves otherwise has shortcomings. These shortcomings arise because of four factors. One of the factors is that the studies mostly use retail prices. This makes arbitrage impossible as people buy the goods for final consumption and not for resale. The second factor is the exclusion of transaction cost from most studies that assess co-integration of prices among two places. The third factor that is not usually considered in these studies is the issue of time. Commodity arbitrage usually takes time unlike financial assets that require less time. Finally testing for the theory requires that one chooses an identical commodity in two places. Without that arbitrage is not possible. Taking these problems into consideration (Pippenger, 2007) tested integration of the market for a specific type of wheat between Japan and USA. They find results that support the notion of one price. The fact that the study considered the possible misses in the analysis of law of one price is commendable. It further deepens the theory of market integration analysis.

According to Protopapadakis and Stol (1983) the law of one price (LOP) states that for a given commodity a representative price adjusted by exchange rates and allowance for

transportation costs will prevail across all countries. The LOP plays an important role in models of international trade and exchange rate determination. Furthermore, Persson (eh.net) relate the law of one price with the impact of market arbitrage and trade on the prices of identical commodities that have exchanged in two or more markets. In an efficient market there must be, in effect, only one price of such commodities regardless of where they have traded. The intellectual history of the concept traces back to economists active in France in the 1760-70's, that applied the "law" to markets involved in international trade. Most of the modern literature also tends to discuss the "law" in that context. However, since transport and transaction costs are positive the law of one price must be re-formulated when applied to spatial trade (eh.net).

III. RESEARCH METHODOLOGY

a. Description of the Study Area

This research has covered the major coffee production areas of Ethiopia, as they are mainly the main sources of determining the price. It has also covered some major coffee exporting cooperative unions as well as the major coffee marketing area in the country, Ethiopian Commodity Exchange (ECX).

b. Data Type and Data Collection

The study used secondary data. It was taken from the Central Statistics Agency. This represents regional consumer prices from the Central Statistics Agency. It took the category for Coffee (beans and whole) and tea leaves reported monthly. It has compiled monthly data from January 2000 to January 2012. This was collected for 11 administrative regions; Addis Ababa, Afar, Amhara, Benishangul Gumuz, Dire Dawa, Gambella, Harari, Oromia, SNNP, Somali and Tigray. Some of these regions are supplying regions while others are demanding regions. As a very popular drink, the price of coffee is important in the consumption basket of households. The data are nationally representative of consumption prices. Most studies took into consideration specific market prices in selected towns of the country mostly reflecting producer prices that reflected mainly the supply side of the market. It is however important to look at the nationally representative consumer price data to analyze the changes and transmissions of the prices in the market.

c. Data Analysis

Both descriptive and econometric methods were used to analyze the presence of co-integration between the coffee prices between different regions. Basic descriptive analysis like percentages graphs, correlations and tests were made to have a general overview of the relationship between the variables. In addition to this a multivariate Vector Autoregressive Model (VAR) model was used to establish co-integration between the different prices.

3.3.1 Descriptive analysis

A number of approaches were used to measure spatial integration of markets. I started from the simple mean equality t-test just to have an indication of which regions' prices on average are significantly different. I also used simple pairwise correlation of variables; the granger causality analysis, the Ravallion model and Co-integration analysis were among the major methods used in this paper to measure integration of prices spatially. As would be expected, each of these methods had their advantages and disadvantages.

The mean equality t-test took the difference of the mean of two price series and divided it by joint estimate of the standard deviation to measure the significance of the difference. It could be described by the following equation.

$$t = \frac{\bar{x} - \bar{y}}{\left\{\frac{(n_x-1)s_x^2+(n_y-1)s_y^2}{n_x+n_y-2}\right\}^{\frac{1}{2}}\left\{\frac{1}{n_x}+\frac{1}{n_y}\right\}^{\frac{1}{2}}}$$

where; t is the t statistic $\bar{x}$ and $\bar{y}$ are mean values for two series, n_x and n_y are the number of observations within the series x and y; s_x^2 are s_y^2 variances of the two series. If the t statistic is bigger than the table t value for N-2 degress of freedom then we say the two means are statistically significantly different. This doesn't say anything about either the correlation or the series or the causal relationship between these series. However, it gives an indication of which regions on average have the same mean prices.

If we want to see if the two price time series move together (correlate) we can use the correlation coefficient. Again this shows the strength of the co-movement but doesn't show the relationship or causality between the two series. The Pearson unweighted product moment correlation coefficient is used in this study to see the correlation between the two series (Snedor and Cochran 1989). It is given by

$$\hat{\rho} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

3.3.2 Econometric analysis

In order to establish the relationship between the coffee prices of different regions we needed to specify a model and test for causality. The model selected in this paper was Vector Autoregressive (VAR) model. The reason for this choice was that VAR doesn't assume direction of relationship between variables and it considered all variables to be endogenous to the system. As discussed in the theoretical literature we don't know whether the demand side issues or supply side issue strongly influence coffee prices. Therefore we assumed that the coffee prices of all regions to be endogenous and used VAR model for the integration. Before estimating VAR we needed to conduct some tests.

As we were dealing with time series data, we had to check for some peculiar characteristic of these types of data. A very important assumption in time series data that has implications for consistency and inference is the assumption of Stationarity. A stationary time series is one that has a constant long run mean and variance. Without this assumption the regression coefficients will not have a distribution on which to make inference which makes the use of standard regression spurious. Therefore it was important to check for stationarity of the variables. In order to do this, we checked of current values of the variable was related to past values in a convergent way in that whenever it deviates due to a shock it goes back to the long run equilibrium. This test equation was estimated by putting the differenced variable as dependent and regressing this on a constant, the lag of the variable, and the lagged differences of the variable. We checked for the significance of the lag coefficient to check for stationarity. This test is called the Augmented Dickey Fuller (ADF) test and the test statistic followed the Dickey Fuller distribution rather than the normal t-distribution. Therefore we used the ADF test of stationarity on the variables. The following equation describes the test;

$$\Delta Y_t = c + \beta Y_{t-1} + \sum_{k=1}^{L} \Delta Y_{t-k} + \varepsilon_t \quad \text{.....(6)}$$

In the above equation the tests is the stationarity of the variable Y. Here the target was to check whether the coeffience β is significantly different from zero or not. Variables that were stationary at level were called integrated of order 0 or I(0). If a variable had to be

differenced once to become stationary it was said to be I(1). Similarly, if a variable had to be differenced d times to become stationary it was said to be I(d).

It is very common that most economic time series are not stationary. But this doesn't mean that there is no hope of analyzing these types of series. If a group of variables that are not stationary have a stationary long run relationship they are said to be co-integrated. That is, if they move together in the long run, and if the deviation between them is stationary over time these variables are co-integrated. This allows for the analysis of the variables as a group and helps to identify the relationship between them. Therefore if we have non-stationary time series, co-integration is necessary to establish or understand the relationship between these variables. A co-integration test for a single equation with many variables could look like;

$$\hat{e}_t = Y_t \quad \hat{\beta}_1 X_{1t} \quad \hat{\beta}_2 X_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$\Delta\hat{e}_t = c + \beta\hat{e}_{t-1} + \sum_{k=1}^{L} \Delta\hat{e}_{t-k} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

First we estimate the parameters of the models using OLS and test the stationarity of the residual using the ADF test to establish if there is a long run relationship between the variables. It should be noted that in the above case we have specified that Y is the dependent variable and the X's are independent variables.

Therefore, in this paper we used the co-integration analysis to establish if there is long-run relationship between the coffee prices in the different markets. But in our case we didn't allow any price to be exogenous so we specified all the variables to be endogenous to the model. The reason for this was both supply and demand factors could drive prices and we presumed that causality could be both ways if the price variables were co-integrated.

Since we were not assuming any causality or restriction on the prices we used the Vector Autoregressive Model (VAR). This model considered all variables to be endogenous and estimated a matrix of coefficients by including lags of all included variables in to the model. Using the Johansen procedure then it was possible to know how many co-integrating vectors relate the variables given above. In the case when there were more than one co-integrating vectors we tried to use economic theory to identify which co-integrating vector made economic sense. A standard VAR representation could be expressed as;

$$Y_t^j = c^j + \sum_{j=1}^{k} \sum_{i=1}^{T} \Pi_i^j Y_{t-i}^j + \epsilon_t^j \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

The Y_t^j represented (nx1) vector of variable j where n is the number of observation while Π_i^j represented vectors of coefficients for each lag i of variable j. As the number of variables increased and as the number of lags increased, the number of parameters to estimate increased by multiples. In the case of this study the Ys represented the prices of coffee in different markets.

Once the co-integration was established we also used Granger Causality Test to check which way the causality existed as this has implication for policy interventions. In the VAR framework granger causality uses the sequence of trends to check which variable changes first. It does this by testing the exclusion of the lags of the variable hypothesized to cause in the equation of the variable that is being caused. It uses Wald exclusion test if for example we are testing whether Y_t^1 is granger causing Y_t^2 then we test whether all the lags of Y_t^1 are jointly significant in Y_t^2's equation given by;

$$Y_t^2 = c^2 + \sum_{i=1}^{T} \Pi_i^1 Y_{t-i}^1 + \sum_{j=1}^{k} \sum_{i=1}^{T} \Pi_i^j Y_{t-i}^j + \epsilon_t^j \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Granger causality tests the null hypothesis

$$H_0: \Pi_1^1 = \Pi_2^1 = \Pi_3^1 = \cdots = \Pi_T^1 = 0$$

This is done using a Wald exclusion test which uses a chi-square distribution for the test.

In addition to establishing co-integration and causality, VAR allowed the analysis of transmission of shocks between markets through the analysis of impulse responses. The impulse response function showed the response of target variables to shocks. In our case the impulse response function were analyzed to further establish the transmission of coffee price shocks either from the demand or the supply side or both depending on the causality. This helps policy makers to anticipate possible transmission of shocks in some markets and the effect that will have on the other markets.

IV. RESULTS AND DISCUSSION

4.1 Descriptive Analysis: Coffee Market in Ethiopia

Ethiopia is the largest coffee producer in Africa. Official statistics for 2009/2010 indicate that the total area covered by coffee under private peasant holding is about 400,000 hectares, with a total production of 265,000 tons of coffee. Ethiopia is of particular interest to the world because it is the birthplace of the Arabica coffee tree, *Coffea arabica*.

Export and trade are essential. Ethiopia is probably the oldest exporter of coffee in the world. In 2009 it was the 6th largest coffee producer and the 10th largest exporter worldwide. 40% of the coffee production from Ethiopia is exported, mainly to Japan, Germany and Saudi Arabia. In 2009/2010 Ethiopia secured 2 billion US$ export revenue, of which coffee generated 528 million US$ (26.4%).

Demand and Supply

Coffee is one of the most important sectors, since around 30% of Ethiopia's foreign exchange is attributed to this product, and the production process engages almost 25% of the working population. Ethiopian coffee production systems consist of forest, semi-forest, garden or cottage and plantation production systems. The largest portion of coffee production comes from small holder farmers. More than 64% of the coffee comes from Oromia, 35% from SNNP and the remaining 1% from Gambella regional States. The major coffee types in Ethiopia, along with their places of origin include Yirgacheffee, Harar, Sidama, Limmu, Djimma, Tepi, Bebeka and Lekempti.

World coffee production is generally characterized by considerable instability, with a large crop in one year frequently followed by a smaller crop in the next. As shown in the graph below there are fluctuations in the coffee production across the world. Despite these factors, the world consumption of coffee is growing at an increasing rate.

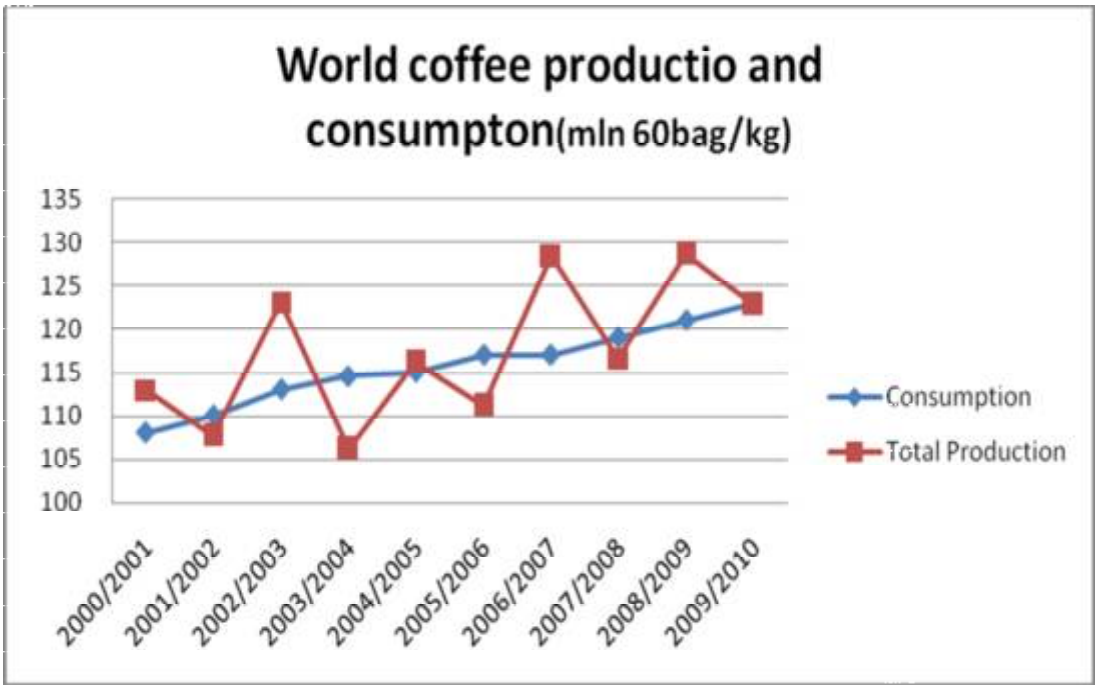


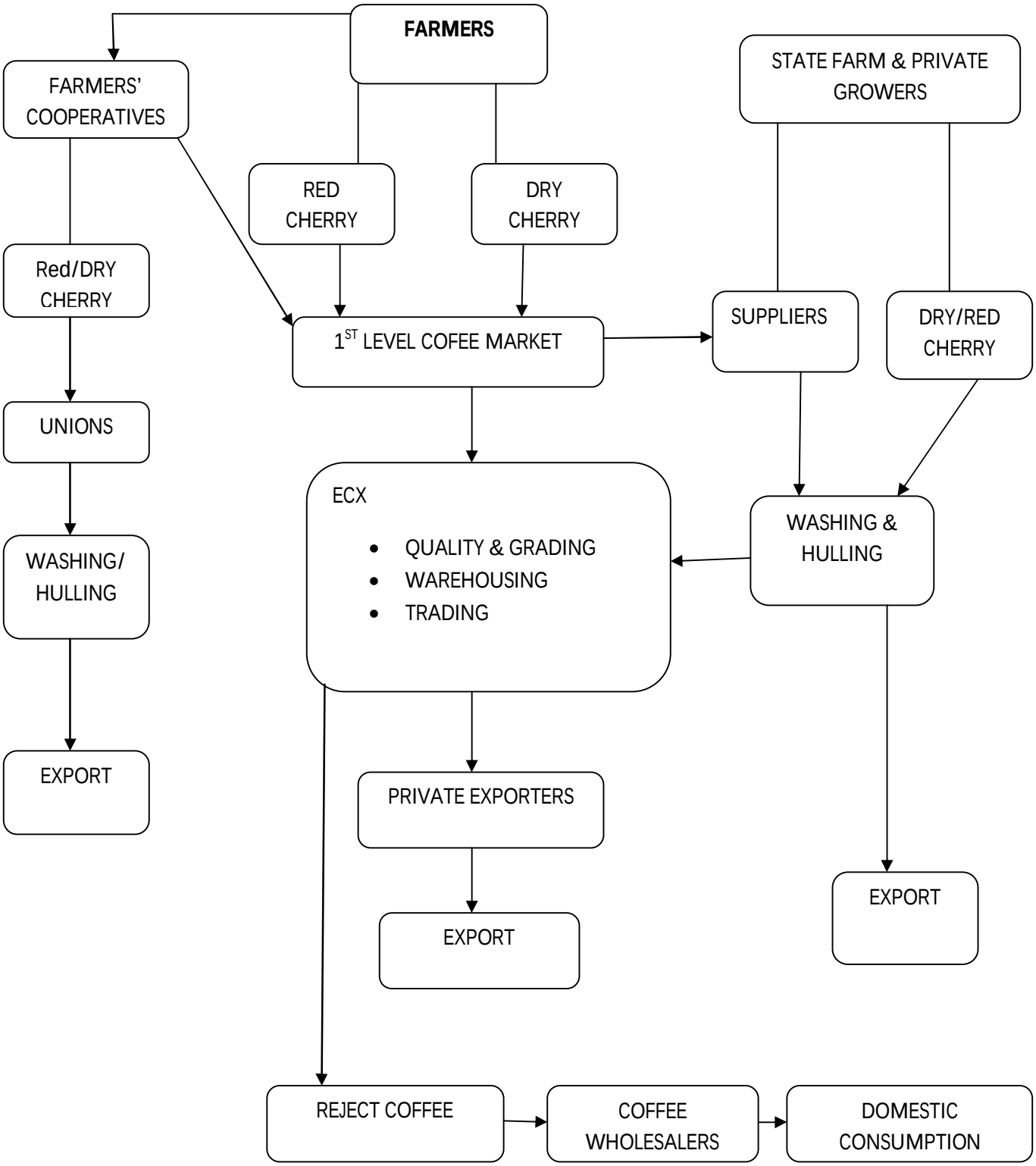
Figure 1 Quantity of world coffee production and consumption

Source ICO

Channels and Market Actors

Coffee may be purchased in Ethiopia through one of three main channels: from exporters, cooperative unions, and directly from private estates. Exporters generally purchase their coffee through the Ethiopian Commodities Exchange (ECX). Private estates that hold their own export license may sell and export directly to international buyers. Coffee lots of Ethiopia's many primary cooperatives are generally channelled through one of the four cooperative unions, Oromia coffee cooperative union, Yirgacheffee Coffee cooperative union, Sidama Coffee Cooperative Union and Kaffa Coffee cooperative union.

Ethiopian Coffee Supply Chain



Producer Prices and International Prices - Price Dynamics

There is a significant difference in the price of coffee that the producers pay and the international retail price. The graph below shows the average retail coffee price paid to coffee growers (producers) and the international retail price.

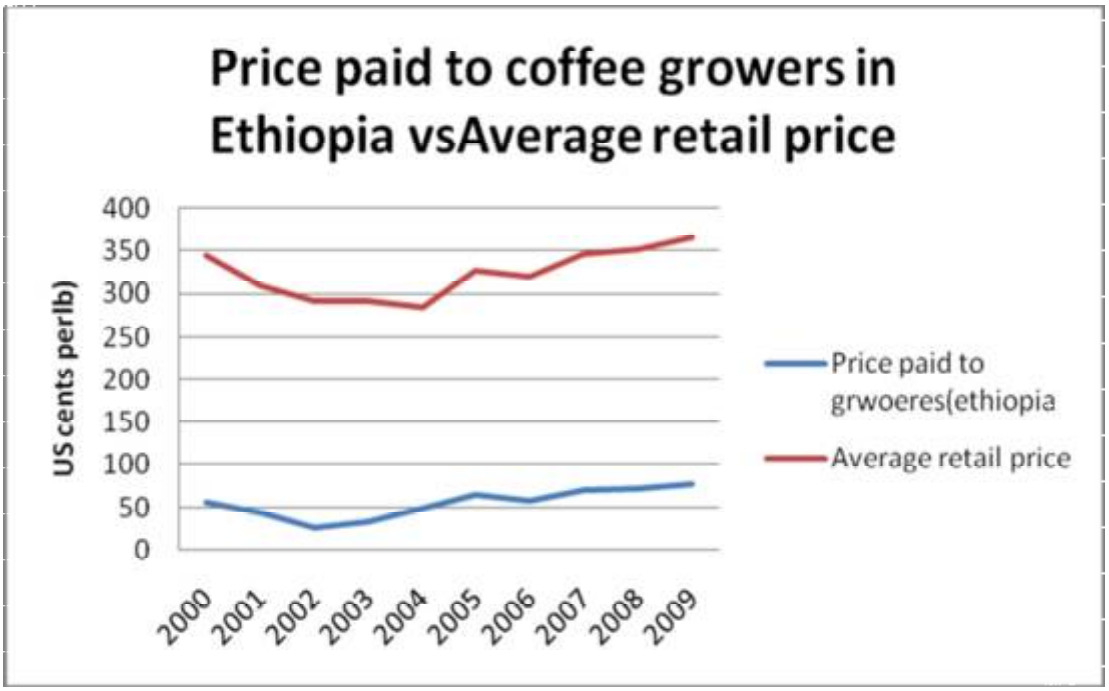


Figure 2Ethiopian average retail price and price paid to coffee growers…

Source ICO

Ethiopian farmers will deliver and sell their coffee (red cherry) directly to their cooperatives with a price range of 3-10 birr/kg depending on the international price. In 2010 the international coffee price was around $2.23/lb, where there was a price fluctuation. In this year the Ethiopian coffee producers deliver their coffee at an average price of birr 8/kg. But the consumer price at that time was around birr 97/hg.

Below is a graph showing the producers price and the consumer price of some cooperatives in the Oromia region for the year 2010.

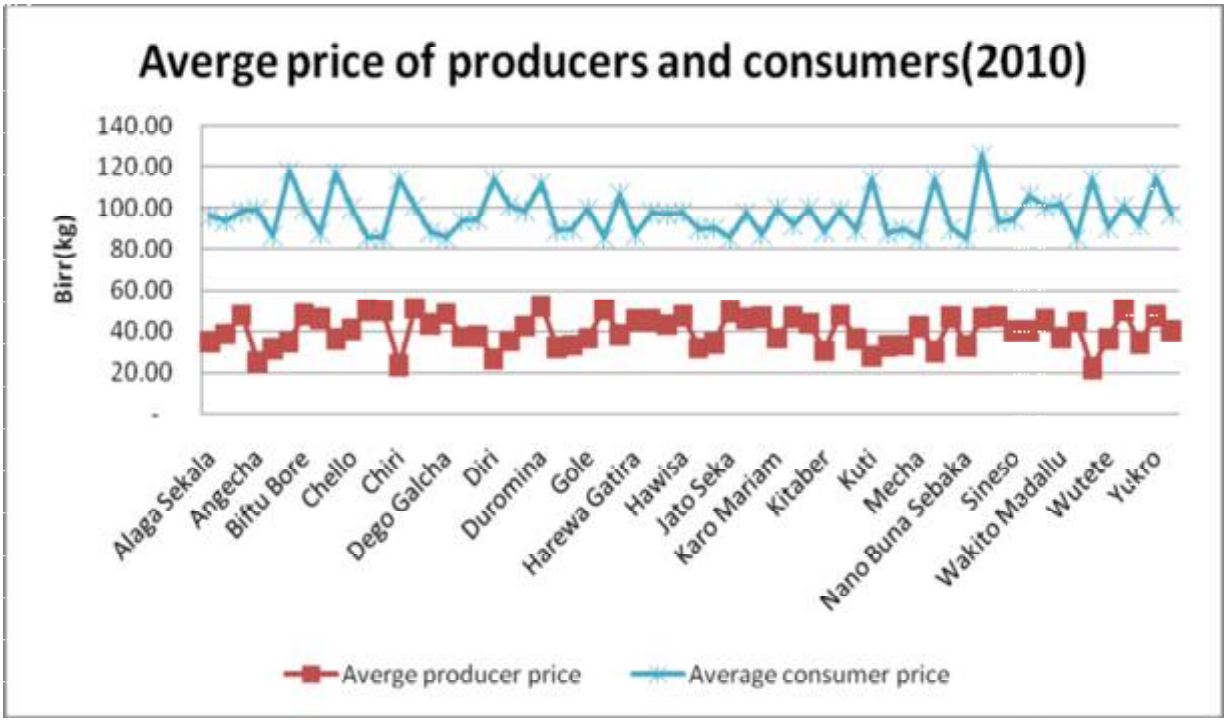


Figure 3. Average price of producers and consumers

Source: Technoserve Ethiopia (2010)

Consumer Prices

All the first grades of coffee (High grade coffee) produced in Ethiopia is exported through the four cooperatives unions or ECX. The major buyers of Ethiopian coffee are Starbucks, Stumptown, Nestle, Peets etc..,with an average export price of $/lb 2.71(up to high $/lb 3.15, depending on the quality of coffee.

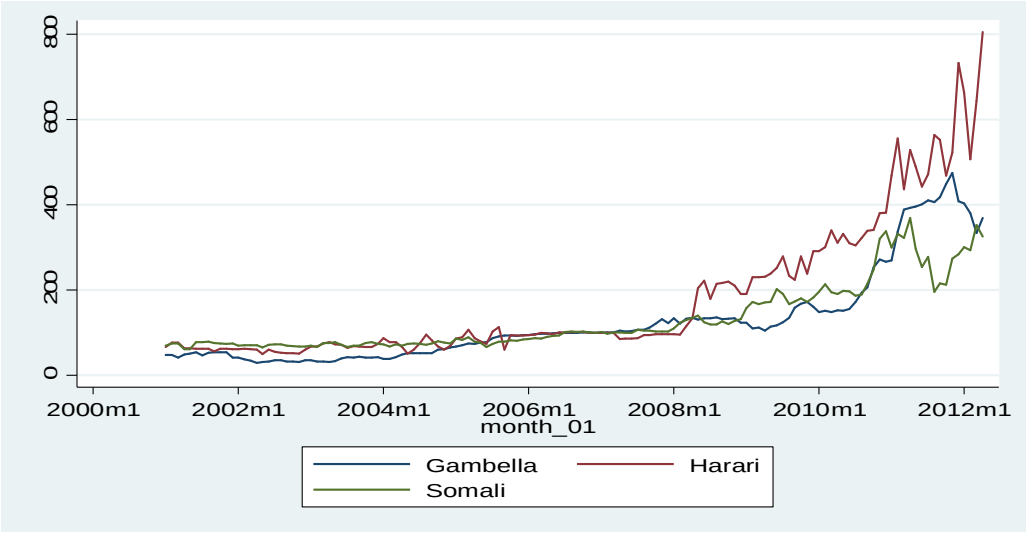
Below is a table showing the major buyers of the Ethiopian coffee from the oromia coffee cooperatives sold through the Cooperative union (Ormia and Kaffa).As indicated in the table below the price given for the high grade green coffee is high up to $7/kg(around 110 birr/kg).

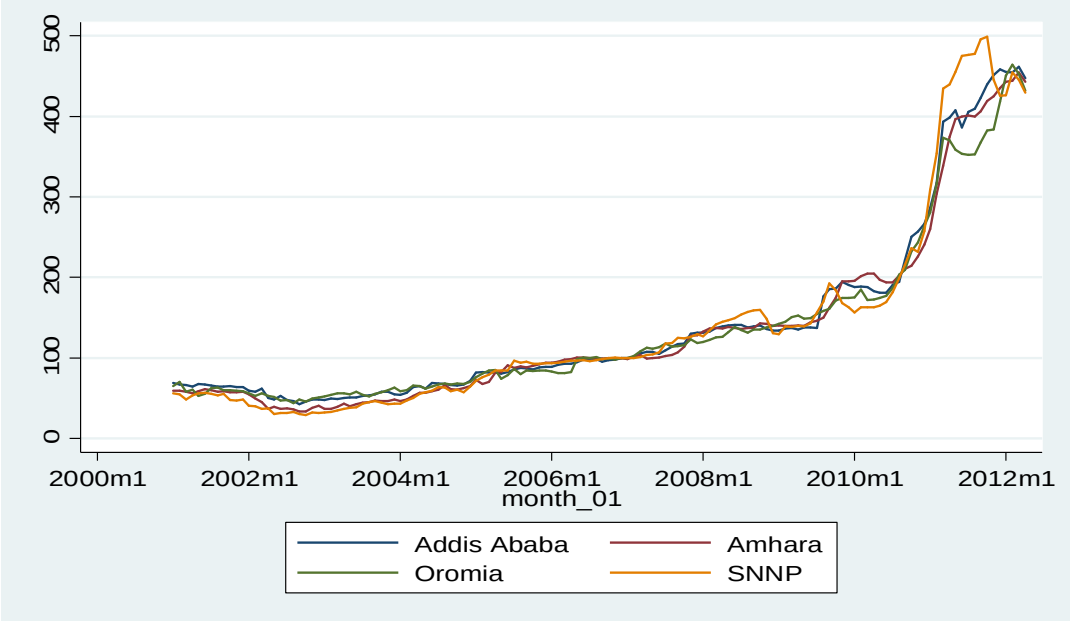
Table 1. Average Ethiopian coffee buyers price (2010)

Buyer	USD/KG
Starbucks	5.07
Stumptown	7.04
Coffee Circle	6.83
Olam	5.91
Atlas	6.19
Mother Parker	5.91
Nestle	5.97
Sweet Marias	7.14
Neuman/InterAmerican Coffee	6.72
Peet's	6.85
Intellegencia	7.80

Export Market and ECX

Ethiopia for long had a traditional coffee auction system which was replaced by a modern automated transaction system under the Exchange Commodity Board, known as ECX, as of August 2008. The shift from the traditional coffee auction to ECX has brought a fundamental change in the trading system, one of historic proportion. Currently coffee trade largely dominates the ECX, with nearly 80% of commodities traded in the platform (the rest is constituted by sesame, 15%, white pea beans, 4.1%, maize, 1.1%, and wheat ,0.01%).


0
200
400
600
800
2000m1
2002m1
2004m1
2006m1
2008m1
2010m1
2012m1
month_01
Gambella
Harari
Somali


0
100
200
300
400
500
2000m1
2002m1
2004m1
2006m1
2008m1
2010m1
2012m1
month_01
Addis Ababa
Amhara
Oromia
SNNP

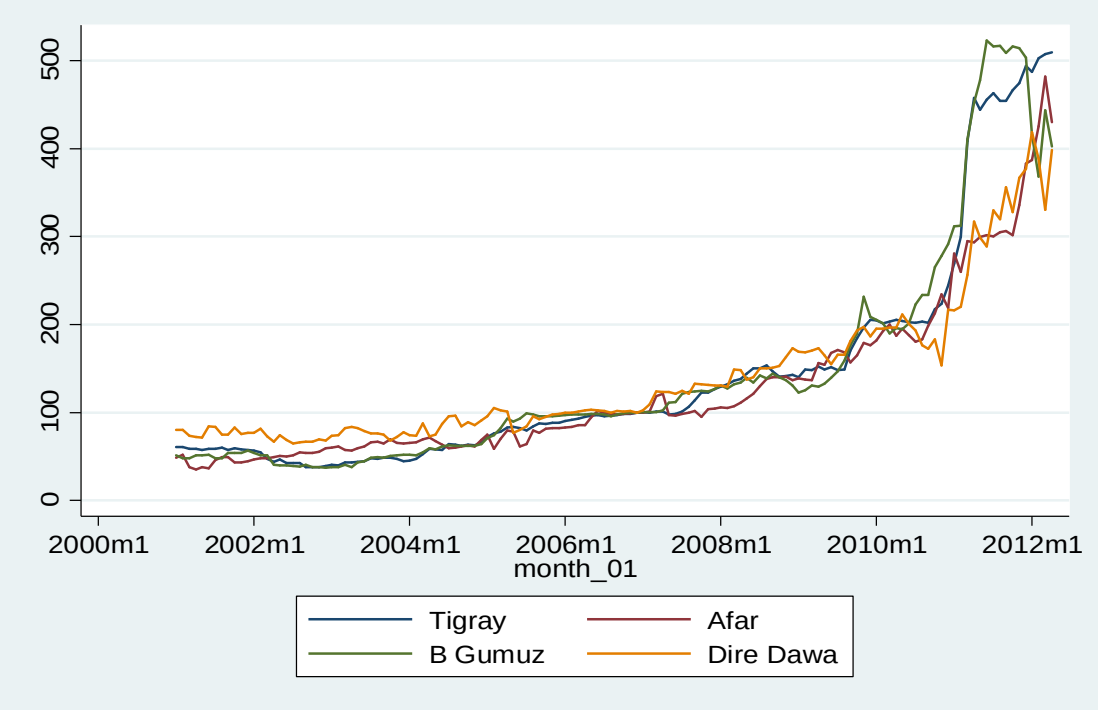


Figure 4. Trends in Coffee Price Index in Consumer Markets in Ethiopia (Jan 2000 – Jan 2012)

Source: Central Statistics Agency, Consumer Price Indices

As can be seen from the above figure coffee prices enjoyed a relatively steady growth until 2007/08 when international food prices started increasing sharply which has possibly led to the increase in consumer price of coffee in the local markets. In addition the general consumer price trend in other commodities has been continuously increasing since 2005. This shows that the inflationary trends in other commodities could also have had impact on the increase in the prices. In addition to this the government has been working hard to improve market information especially to the farmers that increased farm gate prices. This also contributed to the increase in the final consumer price of coffee after 2007.

4.2 Statistical and Econometric Results

As described in the methodology section I have conducted a number of tests to analyze the relationship between coffee regional prices in the country. Unlike other studies the variables taken here are consumer prices collected from all over Ethiopia. This reflects the final price

paid by the consumer so it takes into account the increase in prices due to transaction costs and profit margins by middle men.

As seen in the time series plots above the trends in the different regional prices are closely moving together. This logically leads to the hypothesis that they are linked together and their mean is statistically the same. The result of the mean equality t-test is presented in the following table. With the exception of Harari region, which is a coffee producing region, we don't find a statistically significant difference in the mean prices of coffee. We also expected to find a considerably different consumer price in other coffee producing regions like Oromia and SNNP. However, these regions are very big and the coffee producing areas within these regions is relatively small. Therefore the higher consumer price in other parts of these regions compensates for the lower producer prices in producing areas. The pair wise mean comparison test results for all pairs is presented in the appendix. The table below just shows the pairs for which there is significant difference in the mean of prices.

Table 2. Mean Difference T-Test between Regional Coffee Prices

Two Sample Mean Comparison T-Test* H0:A-B=0				
A	**B**	**Ha:diff≠0**	**Ha:diff<0**	**Ha:diff>0**
		P-values		
Addis Ababa	**Harari**	**0.020**	**0.010**	**0.990**
Afar	**Harari**	**0.001**	**0.001**	**1.000**
Amhara	**Harari**	**0.008**	**0.004**	**0.996**
B.Gumuz	**Harari**	**0.043**	**0.021**	**0.979**
Dire Dawa	**Harari**	**0.011**	**0.005**	**0.995**
Gambella	**Harari**	**0.002**	**0.001**	**0.999**
Harari	**Oromia**	**0.007**	**0.997**	**0.004**
Harari	**SNNP**	**0.019**	**0.991**	**0.010**
Harari	**Somali**	**0.002**	**0.999**	**0.001**
Harari	**Tigray**	**0.033**	**0.983**	**0.017**

* Equal variances assumed in the test

As indicated in the methodology section the fact that there is no significant difference in the prices is not sufficient to conclude that the prices move together. The see if the trends change together we construct the correlation matrix. The following table presents the correlation matrix between the consumer prices of coffee. The correlation coefficients range between 0 and 1 with 1 indicating perfect correlation and 0 indicating no correlation at all.

Table 3. Correlation Matrix for Regional Coffee Prices

	Addis Ababa	Afar	Amhara	B. Gumuz	Dire Dawa	Gambella	Harari	Oromia	SNNP	Somali
Addis Ababa	1									
Afar	0.974	1.000								
Amhara	0.996	0.977	1.000							
B. Gumuz	0.984	0.939	0.982	1.000						
Dire Dawa	0.975	0.969	0.982	0.951	1.000					
Gambella	0.987	0.940	0.982	0.989	0.951	1.000				
Harari	0.960	0.972	0.962	0.934	0.958	0.930	1.000			
Oromia	0.995	0.985	0.992	0.968	0.977	0.976	0.966	1.000		
SNNP	0.990	0.950	0.987	0.989	0.958	0.991	0.935	0.981	1.000	
Somali	0.915	0.933	0.910	0.886	0.891	0.895	0.937	0.930	0.890	1.000
Tigray	0.995	0.972	0.997	0.982	0.981	0.980	0.956	0.991	0.988	0.899

Source: Own computation

The correlation matrix shows near perfect correlation between the prices of the different regions which is indicative further that the prices are integrated. This means that changes in coffee prices have been occurring relatively in all place of the country. Although correlation doesn't tell us the relationship between market or the causality between them it indicates that prices have been moving together.

We can now see the relationship between regional prices deeper by conducting an econometric analysis. The estimation of time series data requires checking stationarity as indicated in the methodology section. The Augmented Dickey Fuller unit root test is used the results are summarized in the following table. As the test is a one tailed test we reject the null hypothesis of a unit root when the test statistic is less than the critical values. Rejection of a unit root implies that the time series is stationary. As can be seen in the table below the

test statistics of levels of all variables is greater than the 10% critical value. Therefore we are unable to reject the null hypothesis of a unit root. Thus, none of the variables are stationary at level. This is expected as price of coffee has been increasing continuously and its mean and variance doesn't remain constant. Upon differencing once they all become stationary. This means they are all I(1) variables.

Table 4 Stationarity Test for the Level and First Differences of Coffee Price Indices

	Test Statistic		Critical Values		
	level	First Difference	1%	5%	10%
Addis Ababa	1.388	-5.427	-2.356	-1.657	-1.288
Afar	4.141	-4.767	-2.356	-1.657	-1.288
Amhara	0.395	-4.096	-2.356	-1.657	-1.288
B. Gumuz	-0.047	-4.218	-2.356	-1.657	-1.288
Dire Dawa	2.504	-7.299	-2.356	-1.657	-1.288
Gambella	0.539	-5.067	-2.356	-1.657	-1.288
Harari	3.915	-9.617	-2.356	-1.657	-1.288
Oromia	1.902	-5.177	-2.356	-1.657	-1.288
SNNP	0.097	-4.719	-2.356	-1.657	-1.288
Somali	-0.080	-6.481	-2.356	-1.657	-1.288
Tigray	1.712	-4.268	-2.356	-1.657	-1.288

*2 lags specified with drift

Since they are all I(1) variables it is possible that their long-run relationship is stationary. We can now test for cointegration. As discussed in the methodology section if we know the specification of the price relationship we can use the Engle-Granger cointegration test by

estimating the model and checking for the stationarity of the residual. In our case we are not assuming a certain specification. This is because we don't know which prices are exogenously determined as we don't know if demand side or supply side (or both) affect prices. It is possible to assume that smaller regions that are not producers of coffee face exogenously determined coffee prices. For this reason we will separate the analysis into two. The first part takes the small regions and conducts both Engle Granger cointegration analysis and VAR cointegration analysis. For the remaining regions we conduct the VAR cointegration analysis to check whether the variables are cointegrated or not. We selected Afar, Gambella, Somali and Benishagul Gumuz regions for the cointegration test based on the fact that they are relatively small regions in size and they are not coffee producer regions.

Table 5. Engle Granger Cointegration Test

	(1) Somali	(2) Afar	(3) B.Gumuz	(4) Gambella
addisababa	-0.46		0.59***	0.55***
	(0.31)		(0.20)	(0.14)
bgumuz	0.42***			0.28***
	(0.13)			(0.06)
diredawa	-0.22			
	(0.14)			
harari	0.25***	0.07***	0.05	
	(0.05)	(0.03)	(0.03)	
oromia	1.64***	0.80***	-1.17***	0.34**
	(0.25)	(0.10)	(0.14)	(0.13)
snnp	-0.25*		0.36***	0.34***
	(0.15)		(0.10)	(0.07)
tigray	-0.74***	-0.27**	0.36**	-0.64***
	(0.19)	(0.11)	(0.15)	(0.09)

amhara		0.67***	0.21	0.44***
		(0.13)	(0.16)	(0.12)
gambella		-0.45***	0.46***	
		(0.05)	(0.11)	
somali		0.06	0.14***	
		(0.04)	(0.05)	
afar				-0.37***
				(0.07)
_cons	36.39***	1.91	2.65	-3.32*
	(7.74)	(2.56)	(3.20)	(1.83)
N	136	136	136	136

Standard errors in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

A parsimonious estimation of the results are presented in the above table. The estimation is consistent with the geographic location of regions. The regions that are significantly related to these selected regions are neighboring regions mostly. Assuming that there is no error in specification we can now test of the residuals from these regressions are stationary. This would prove that there is long-run relationship between the coffee prices in these regions. The result of the Augmented Dickey Fuller test on the residuals is presented below.

Table 6. Stationarity of Residuals from the Long-Run Equations

	Test Statistic	Critical Values		
		1%	5%	10%
Somali Res	**-3.953**	-3.499	-2.888	-2.578
Afar Res	**-4.629**	-3.499	-2.888	-2.578
B.Gumuz Res	**-3.756**	-3.499	-2.888	-2.578
Gambella Res	**-4.938**	-3.499	-2.888	-2.578

The Augmented Dickey Fuller test is a one tail test that rejects the null hypothesis of a unit root when the test statistic is less than the critical values. We can see that for all these regions the test statistic is less than the critical values. Thus we reject the null hypothesis of a unit root thereby concluding that the long run relationship we estimated above is stationary. This in turn means that the coffee prices in these regions are cointegrated.

This estimation method assumes that the coffee prices in these regions dependent and the prices in the other regions are exogenously determined. We can relax this assumption and consider all prices to be endogenously determined. The VAR model helps to estimate cointegration by taking the lagged values of all variables as independent and assuming all variables as endogenous to the system. There are two issues to consider when estimating a VAR model. The first one is how many variables to include in the system while the second one is how many lags to consider. The more variables and lags included in the system the more number of regressors there will be. This will reduce the degrees of freedom and this affects the efficiency of the estimates. Therefore the degrees of freedom and the number of variables need to be balanced. To choose the optimal number of lags we can use information

criteria. Using Schwartz Bayesian Information criteria we find that 2 lags is the optimal lag. So we specify a VAR model with these.

Table 7. Vector Autoregressive Estimation Results

	Equations										
	daddisababa	doromia	dtigray	dsnnp	damhara	dsomali	dafar	dgambella	dbgumuz	dharari	ddiredawa
L.daddisababa	-0.35***	0.07	0.05	-0.13	-0.06	0.14	-0.38***	0.39***	-0.32**	0.65	0.28
	(0.09)	(0.10)	(0.10)	(0.13)	(0.07)	(0.17)	(0.14)	(0.13)	(0.14)	(0.40)	(0.18)
L2.daddisababa	-0.33***	0.06	-0.21**	-0.29**	0.03	0.83***	-0.03	0.08	-0.61***	-0.33	0.30
	(0.09)	(0.10)	(0.10)	(0.13)	(0.07)	(0.18)	(0.14)	(0.13)	(0.14)	(0.42)	(0.19)
L.doromia	0.40***	0.05	-0.03	-0.05	0.05	0.44**	0.63***	-0.00	-0.31*	-0.16	0.22
	(0.10)	(0.11)	(0.12)	(0.15)	(0.08)	(0.20)	(0.16)	(0.15)	(0.16)	(0.47)	(0.21)
L2.doromia	0.24**	-0.01	0.14	0.18	0.08	0.21	0.09	0.01	-0.08	-0.19	-0.28
	(0.11)	(0.12)	(0.12)	(0.15)	(0.08)	(0.21)	(0.16)	(0.15)	(0.17)	(0.48)	(0.22)
L.dtigray	-0.24***	-0.14	0.05	-0.36***	0.09	0.10	-0.33**	-0.39***	-0.30**	-0.09	0.45**
	(0.09)	(0.10)	(0.10)	(0.13)	(0.07)	(0.18)	(0.14)	(0.13)	(0.15)	(0.42)	(0.19)
L2.dtigray	-0.18*	-0.26**	-0.30***	0.36**	0.01	-0.78***	-0.03	-0.43***	0.44***	-0.49	-0.52***
	(0.10)	(0.11)	(0.11)	(0.14)	(0.08)	(0.19)	(0.15)	(0.14)	(0.15)	(0.45)	(0.20)
L.dsnnp	0.29***	0.03	0.12*	0.77***	0.20***	-0.27**	-0.10	0.54***	0.76***	-0.30	-0.41***

	Equations										
	daddisababa	doromia	dtigray	dsnnp	damhara	dsomali	dafar	dgambella	dbgumuz	dharari	ddiredawa
	(0.07)	(0.07)	(0.07)	(0.10)	(0.05)	(0.13)	(0.10)	(0.09)	(0.10)	(0.30)	(0.13)
L2.dsnnp	0.18**	-0.05	0.08	-0.12	-0.02	-0.29	0.04	0.47***	0.47***	-0.33	0.35*
	(0.09)	(0.10)	(0.10)	(0.13)	(0.07)	(0.18)	(0.14)	(0.13)	(0.14)	(0.41)	(0.18)
L.damhara	0.38***	0.31**	0.75***	0.34*	0.20**	-0.17	0.40**	0.24	0.26	0.20	0.19
	(0.12)	(0.13)	(0.13)	(0.18)	(0.10)	(0.24)	(0.18)	(0.17)	(0.19)	(0.55)	(0.25)
L2.damhara	0.02	0.14	0.43***	-0.31*	-0.01	0.34	0.62***	-0.32*	0.45**	1.14**	0.37
	(0.12)	(0.13)	(0.13)	(0.17)	(0.09)	(0.23)	(0.18)	(0.16)	(0.18)	(0.53)	(0.24)
L.dsomali	-0.12***	0.00	0.04	-0.04	-0.02	-0.12	-0.05	-0.01	0.07	0.22	-0.04
	(0.04)	(0.05)	(0.05)	(0.06)	(0.03)	(0.08)	(0.06)	(0.06)	(0.07)	(0.19)	(0.08)
L2.dsomali	-0.07**	-0.02	-0.03	0.06	-0.00	-0.03	0.16***	-0.05	0.04	0.43***	0.03
	(0.04)	(0.04)	(0.04)	(0.05)	(0.03)	(0.07)	(0.05)	(0.05)	(0.06)	(0.16)	(0.07)
L.dafar	-0.02	0.04	-0.11	-0.00	0.06	0.19	-0.18*	-0.11	-0.31***	0.77***	-0.09
	(0.06)	(0.07)	(0.07)	(0.09)	(0.05)	(0.12)	(0.09)	(0.09)	(0.09)	(0.27)	(0.12)
L2.dafar	0.22***	0.08	0.09	0.19**	-0.05	-0.15	-0.02	0.06	-0.02	-0.19	-0.01
	(0.06)	(0.07)	(0.07)	(0.09)	(0.05)	(0.12)	(0.09)	(0.09)	(0.10)	(0.28)	(0.12)
L.dgambella	0.34***	0.27***	0.36***	0.17*	0.18***	0.39***	0.30***	-0.29***	0.54***	0.42	-0.30**
	(0.07)	(0.08)	(0.08)	(0.10)	(0.05)	(0.13)	(0.10)	(0.10)	(0.11)	(0.31)	(0.14)
L2.dgambella	0.31***	0.19***	0.03	0.14	0.08	0.06	0.21**	-0.18*	0.71***	-0.22	0.05
	(0.07)	(0.07)	(0.07)	(0.10)	(0.05)	(0.13)	(0.10)	(0.10)	(0.10)	(0.30)	(0.14)

	Equations										
	daddisababa	doromia	dtigray	dsnnp	damhara	dsomali	dafar	dgambella	dbgumuz	dharari	ddiredawa
L.dbgumuz	-0.15***	-0.18***	-0.08	-0.12	-0.07	-0.04	-0.34***	0.22***	-0.40***	0.61***	0.12
	(0.05)	(0.06)	(0.06)	(0.07)	(0.04)	(0.10)	(0.08)	(0.07)	(0.08)	(0.23)	(0.10)

Table 8. Vector Autoregressive Estimation Results (Continued)

	Equations										
	daddisababa	doromia	dtigray	dsnnp	damhara	dsomali	dafar	dgambella	dbgumuz	dharari	ddiredawa
L2.dbgumuz	-0.07	-0.08	-0.19***	0.08	-0.03	-0.31***	-0.29***	0.21***	-0.50***	-0.56**	0.10
	(0.06)	(0.06)	(0.06)	(0.08)	(0.04)	(0.11)	(0.09)	(0.08)	(0.09)	(0.26)	(0.11)
L.dharari	0.11***	0.14***	0.10***	0.11***	0.05***	-0.04	-0.03	0.11***	0.01	-0.24***	0.12***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.01)	(0.04)	(0.03)	(0.03)	(0.03)	(0.08)	(0.04)
L2.dharari	-0.04*	0.04*	0.06***	0.07**	-0.01	-0.02	-0.09***	0.07**	-0.04	-0.73***	0.09**
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)	(0.09)	(0.04)
L.ddiredawa	0.05	0.07	-0.05	0.04	0.05	-0.34***	0.27***	-0.12*	-0.04	0.51**	-0.54***
	(0.05)	(0.05)	(0.05)	(0.07)	(0.04)	(0.09)	(0.07)	(0.07)	(0.07)	(0.21)	(0.09)
L2.ddiredawa	-0.06	0.04	0.01	-0.19**	0.07*	0.14	-0.09	0.10	0.05	-0.01	-0.23**
	(0.06)	(0.06)	(0.06)	(0.08)	(0.04)	(0.11)	(0.08)	(0.08)	(0.09)	(0.25)	(0.11)
_cons	0.45	0.73	-0.36	0.26	0.41	1.13	1.58**	0.52	0.71	3.95*	0.69
	(0.51)	(0.56)	(0.56)	(0.73)	(0.40)	(0.98)	(0.76)	(0.71)	(0.79)	(2.28)	(1.02)

	Equations										
	daddisababa	doromia	dtigray	dsnnp	damhara	dsomali	dafar	dgambella	dbgumuz	dharari	ddiredawa
N	133										
k	253.00										

Standard errors in parentheses

$^{*}p< 0.10$, $^{**}p< 0.05$, $^{***}p< 0.01$

The results of the VAR estimation is presented in the table above. We consider the difference of the variable as dependent variables in the system of equations and we took upto 2 lagged values of these as independent variables in the system. In general we find that most of the regions significantly relate to their neighboring regions with respect to coffee prices. As a center coffee price in Addis Ababa is significantly related to the lagged prices of all regions except Dire Dawa. The sign of the coefficient is also sensible. The coefficients of all the coffee producing regions have a positive sign to imply that increase in prices in these regions will lead in an increase in prices in Addis Ababa. The coefficients of the lags of the coffee producer regions are significant in all equations except Harari which itself is a producer region. This gives indication that supply is important. This however doesn't imply causality. Causality has to be tested separately using the Granger Causality test for VAR models. This test runs exclusion tests on the lagged value of a variable in the equation of the other variable to check if the former granger causes the latter. The results of the Granger causality test show that coffee price of Addis Ababa is granger caused by coffee prices in all regions except Dire Dawa. This means both supply and demand factors affect coffee price in the center. The table below shows a matrix of causality between regions. The shaded cells indicate causality of the row variable on the column variable. The second column for example shows that coffee price of Addis Ababa is caused by prices in all regions except Dire Dawa. In some cases there is bi-directional causality. This is the case with Addis Ababa-Somali, Addis Ababa-Afar, Addis Ababa-Gambella, Addis Ababa-B. Gumuz, Afar-Somali, B.Gumuz-Gambella, Afar-Tigray etc… These bi-directional causality is mostly among regions geographically adjacent to each other. This is expected as transaction cost is

lower and prices are likely to adjust quickly. The detailed causality test result is in the Appendix.

Table 9. Results of Granger Causality Test

	Equation										
Cause Var Diff	Addis Ababa	Oromia	Tigray	SNNP	Amhara	Somali	Afar	Gambella	B.Gumuz	Harari	Dire Dawa
Addis Ababa			■			■	■	■	■	■	
Oromia	■					■	■				
Tigray	■	■		■		■	■	■	■		■
SNNP	■				■	■		■	■		■
Amhara	■	■	■				■		■	■	
Somali	■						■			■	
Afar	■		■			■			■	■	
Gambella	■	■	■		■	■	■		■		■
B.Gumuz	■	■	■			■	■	■		■	
Harari	■	■	■	■	■		■	■			
Dire Dawa				■		■	■	■		■	

Source: Own Computation

An alternative away to see the causality of specific variable is to assess the impulse response functions. The impulse response function introduces exogenous changes (impulses) in one of the variables and shows the changes that occur in the system for subsequent periods. Thus, for our study we introduce impulses in the prices of all regions and see the effects. The effect of introducing impulses in the prices of each region on the prices in Addis Ababa.

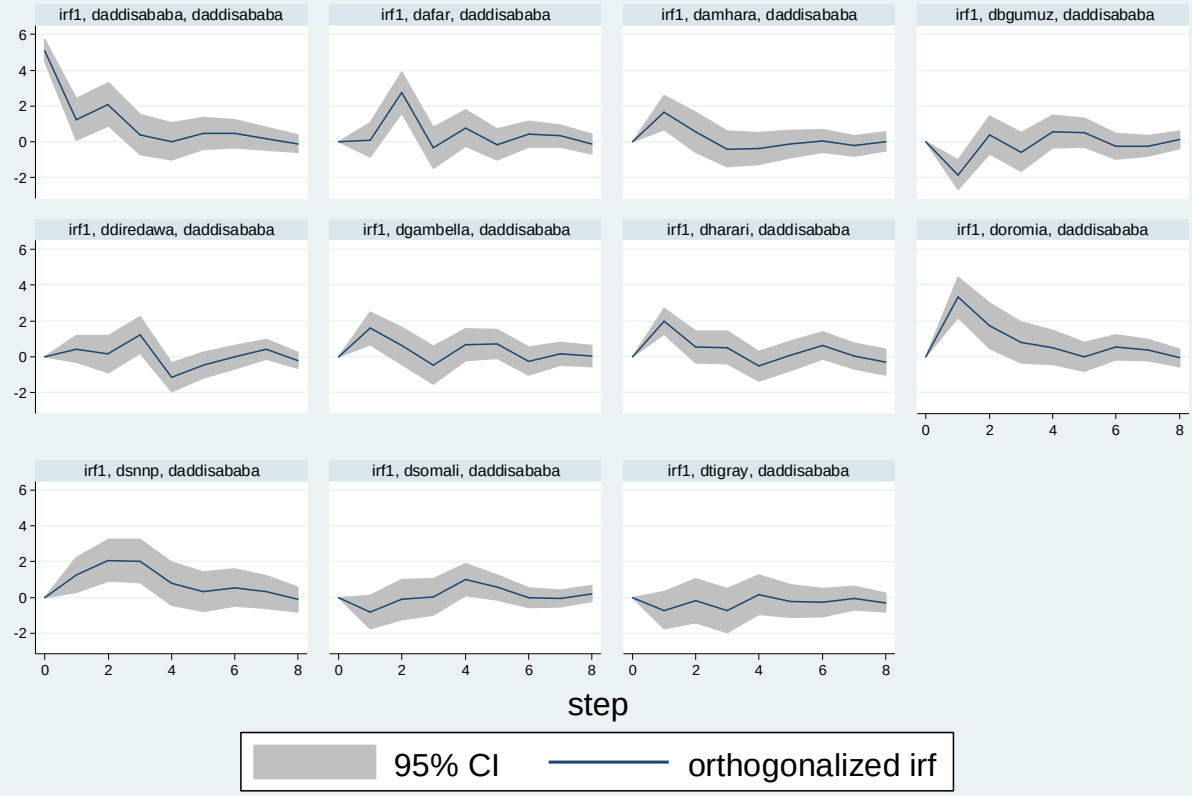


Figure 5Impulse Response Functions

Source: Own Computation

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary and Conclusions

We set out to check whether there is integration in coffee prices between administrative regions in Ethiopia. This is important for policy makers as some economic decisions are made at regional level and understanding the regional dynamics of prices for important products is crucial for such decisions. In addition, understanding price dynamics is important to better understand demand and supply issues in the market and to make infrastructure decisions to correct some of the obstacles to a smoothly function market. In this study we take the monthly consumer price index of coffee collected by the Central Statistics Agency of Ethiopia.

We conduct various statistical and econometric analyses to establish that coffee consumer prices are highly integrated in Ethiopia especially to the central markets. Starting from the mean comparison test correlation tests, we conducted both Engle Granger and VAR cointegration tests to better understand the relationship between the prices in the different administrative regions. With the exception of one there is no statistical difference between the prices in the other regions. Similarly, prices show very strong correlation coefficient with the minimum correlation between any two regional prices being 88 percent. This indicates a strong correlation between the prices.

We also conducted econometric estimations to derive the relationship and causality of coffee prices. For regions that are relatively small we assumed that they don't affect the prices in other regions and specify a model making them dependent variables and the prices of other regions independent. We then conducted the Engle granger cointegration test for Somali, Afar, Benishangul Gumuz and Gambella regions and checked whether they are integrated to the other regions' prices. We found that all the four equations are stationary and they are cointegrated.

We further relaxed the assumption that some of the prices are exogenously determined. We thus conducted VAR cointegration test. We found that the coffee price index in Addis Ababa is significantly related to those of other regions. In addition the prices in most regions are significantly related to those of their neighbors and this indicates strong price integration.

Granger Causality analysis reveals that, again, neighbors has bi-directional causality. The coffee producing regions are found to cause prices in other regions, expectedly.

5.2 Recommendations

As can be seen from the results of the research, the Ethiopian coffee market is highly integrated in terms of price transmission. There are different factors that will determine the price of coffee, which price of buyers / retailers will play the major role. Since the country is still at the early stage of setting up market institutions, it is adversely affecting the welfare of producers and consumers. Therefore, concerned government authorities or stakeholders need to take necessary action to improve the market linkage between farmers, distributors, retailers and consumers. This will have an impact on improving the production capacity of the farmers as well as increasing sustainability in the coffee market.

VI. REFERENCES

1. Ethiopian Commodity Exchange report (2012)
2. Ethiopian Central Statistic Agency(CSA) annual statistic report 2010/2011
3. Institutions and Market Integration , the case of coffee in the Ethiopian Commodity Exchange, Manuel A. Hernandez, Shahidur Rashid,Solomon Lemma, Tadesse Kuma(2015)
4. International Coffee Organization(ICO.org, 2011 annual coffee data)
5. National Bank of Ethiopia annual report(2011)
6. Price integration in the coffee sector Tadesse A. (2009)
7. Price transmission system in Ethiopian coffee Market Mengistu E. Seyoum(2010)
8. TechnoServe Ethiopia(TNS.org), Annual Report(2010/11)

VII. Appendix

Appendix 1 : Mean Comparison Test

Two Sample Mean Comparison T-Test* H0:A-B=0				
A	**B**	**Ha:diff≠0**	**Ha:diff<0**	**Ha:diff>0**
		P-values		
Addis Ababa	Afar	0.274	0.863	0.137
Addis Ababa	Amhara	0.698	0.651	0.349
Addis Ababa	B.Gumuz	0.804	0.402	0.598
Addis Ababa	Dire Dawa	0.970	0.515	0.485
Addis Ababa	Gambella	0.356	0.822	0.178
Addis Ababa	**Harari**	**0.020**	**0.010**	**0.990**
Addis Ababa	Oromia	0.682	0.659	0.341
Addis Ababa	SNNP	0.913	0.543	0.457
Addis Ababa	Somali	0.433	0.783	0.217
Addis Ababa	Tigray	0.887	0.443	0.557
Afar	Amhara	0.494	0.247	0.753
Afar	B. Gumuz	0.202	0.101	0.899
Afar	Dire Dawa	0.213	0.106	0.894
Afar	Gambella	0.919	0.459	0.541
Afar	**Harari**	**0.001**	**0.001**	**1.000**
Afar	Oromia	0.485	0.242	0.758
Afar	SNNP	0.359	0.180	0.821
Afar	Somali	0.666	0.333	0.667
Afar	Tigray	0.239	0.120	0.880
Amhara	B. Gumuz	0.540	0.270	0.730
Amhara	Dire Dawa	0.684	0.342	0.658
Amhara	Gambella	0.589	0.706	0.295
Amhara	**Harari**	**0.008**	**0.004**	**0.996**

Amhara	Oromia	0.993	0.504	0.496
Amhara	SNNP	0.795	0.397	0.603
Amhara	Somali	0.733	0.634	0.366
Amhara	Tigray	0.610	0.305	0.695

Appendix 1 : Mean Comparison Test (Continued)

Two Sample Mean Comparison T-Test* H0:A-B=0				
A	**B**	**Ha:diff≠0**	**Ha:diff<0**	**Ha:diff>0**
		P-values		
B.Gumuz	Dire Dawa	0.754	0.623	0.377
B.Gumuz	Gambella	0.266	0.867	0.133
B.Gumuz	**Harari**	**0.043**	**0.021**	**0.979**
B.Gumuz	Oromia	0.524	0.738	0.262
B.Gumuz	SNNP	0.733	0.633	0.367
B.Gumuz	Somali	0.318	0.841	0.159
B.Gumuz	Tigray	0.918	0.541	0.459
Dire Dawa	Gambella	0.306	0.847	0.153
Dire Dawa	**Harari**	**0.011**	**0.005**	**0.995**
Dire Dawa	Oromia	0.664	0.668	0.332
Dire Dawa	SNNP	0.930	0.535	0.465
Dire Dawa	Somali	0.367	0.817	0.184
Dire Dawa	Tigray	0.845	0.423	0.577
Gambella	**Harari**	**0.002**	**0.001**	**0.999**
Gambella	Oromia	0.584	0.292	0.708
Gambella	SNNP	0.441	0.221	0.779
Gambella	Somali	0.779	0.389	0.611
Gambella	Tigray	0.310	0.155	0.845
Harari	**Oromia**	**0.007**	**0.997**	**0.004**
Harari	**SNNP**	**0.019**	**0.991**	**0.010**
Harari	**Somali**	**0.002**	**0.999**	**0.001**
Harari	**Tigray**	**0.033**	**0.983**	**0.017**

Oromia	SNNP	0.783	0.391	0.609
Oromia	Somali	0.730	0.635	0.365
Oromia	Tigray	0.594	0.297	0.703
SNNP	Somali	0.541	0.730	0.270
SNNP	Tigray	0.810	0.405	0.595
Somali	Tigray	0.374	0.187	0.813

* Equal variances assumed in the test

Appendix 2 : Granger Causality Results

Equation	**Excluded**	**chi2**	**df**	**Prob**
daddisababa	doromia	19.554	2	0
daddisababa	dtigray	9.9223	2	0.007
daddisababa	dsnnp	35.156	2	0
daddisababa	damhara	9.9794	2	0.007
daddisababa	dsomali	11.695	2	0.003
daddisababa	dafar	13.801	2	0.001
daddisababa	dgambella	40.554	2	0
daddisababa	dbgumuz	10.494	2	0.005
daddisababa	dharari	40.976	2	0
daddisababa	ddiredawa	4.0584	2	0.131
daddisababa	ALL	284.86	20	0
doromia	daddisababa	0.62734	2	0.731
doromia	dtigray	7.4411	2	0.024
doromia	dsnnp	0.32646	2	0.849
doromia	damhara	7.4443	2	0.024
doromia	dsomali	0.42514	2	0.809
doromia	dafar	1.6631	2	0.435
doromia	dgambella	17.331	2	0
doromia	dbgumuz	12.777	2	0.002
doromia	dharari	45.246	2	0

doromia	ddiredawa	1.8116	2	0.404
doromia	ALL	146.44	20	0

Appendix 2 : Granger Causality Results (Continued)

Equation	**Excluded**	**chi2**	**df**	**Prob**
dtigray	daddisababa	6.2464	2	0.044
dtigray	doromia	1.3755	2	0.503
dtigray	dsnnp	5.2717	2	0.072
dtigray	damhara	47.317	2	0
dtigray	dsomali	1.292	2	0.524
dtigray	dafar	6.2452	2	0.044
dtigray	dgambella	22.708	2	0
dtigray	dbgumuz	12.728	2	0.002
dtigray	dharari	28.825	2	0
dtigray	ddiredawa	1.4935	2	0.474
dtigray	ALL	313.33	20	0
dsnnp	daddisababa	4.8737	2	0.087
dsnnp	doromia	1.4587	2	0.482
dsnnp	dtigray	13.421	2	0.001
dsnnp	damhara	6.3978	2	0.041
dsnnp	dsomali	1.9222	2	0.382
dsnnp	dafar	5.0048	2	0.082
dsnnp	dgambella	4.4701	2	0.107
dsnnp	dbgumuz	3.1219	2	0.21
dsnnp	dharari	20.028	2	0
dsnnp	ddiredawa	8.107	2	0.017
dsnnp	ALL	161.47	20	0

Appendix 2 : Granger Causality Results (Continued)

Equation	Excluded	chi2	df	Prob
damhara	daddisababa	1.1565	2	0.561
damhara	doromia	1.3215	2	0.516
damhara	dtigray	1.4227	2	0.491
damhara	dsnnp	16.429	2	0
damhara	dsomali	0.35417	2	0.838
damhara	dafar	3.7519	2	0.153
damhara	dgambella	12.321	2	0.002
damhara	dbgumuz	3.6291	2	0.163
damhara	dharari	11.787	2	0.003
damhara	ddiredawa	3.4985	2	0.174
damhara	ALL	120.79	20	0
dsomali	daddisababa	22.529	2	0
dsomali	doromia	5.9296	2	0.052
dsomali	dtigray	16.801	2	0
dsomali	dsnnp	11.827	2	0.003
dsomali	damhara	2.5416	2	0.281
dsomali	dafar	5.7769	2	0.056
dsomali	dgambella	8.5863	2	0.014
dsomali	dbgumuz	8.6533	2	0.013
dsomali	dharari	1.4826	2	0.476
dsomali	ddiredawa	23.155	2	0
dsomali	ALL	280.83	20	0

Appendix 2 : Granger Causality Results (Continued)

Equation	Excluded	chi2	df	Prob
dafar	daddisababa	8.4965	2	0.014
dafar	doromia	16.518	2	0
dafar	dtigray	5.3825	2	0.068
dafar	dsnnp	0.93396	2	0.627
dafar	damhara	19.45	2	0
dafar	dsomali	9.2358	2	0.01
dafar	dgambella	11.427	2	0.003
dafar	dbgumuz	33.778	2	0
dafar	dharari	10.408	2	0.005
dafar	ddiredawa	22.186	2	0
dafar	ALL	207.69	20	0
dgambella	daddisababa	9.7804	2	0.008
dgambella	doromia	0.00171	2	0.999
dgambella	dtigray	17.924	2	0
dgambella	dsnnp	76.086	2	0
dgambella	damhara	5.2251	2	0.073
dgambella	dsomali	1.062	2	0.588
dgambella	dafar	2.9126	2	0.233
dgambella	dbgumuz	17.744	2	0
dgambella	dharari	22.159	2	0
dgambella	ddiredawa	8.5001	2	0.014
dgambella	ALL	301.23	20	0

Appendix 2 : Granger Causality Results (Continued)

Equation	Excluded	chi2	df	Prob
dbgumuz	daddisababa	18.772	2	0
dbgumuz	doromia	3.9778	2	0.137
dbgumuz	dtigray	12.192	2	0.002
dbgumuz	dsnnp	101.78	2	0
dbgumuz	damhara	8.8975	2	0.012
dbgumuz	dsomali	1.7992	2	0.407
dbgumuz	dafar	11.527	2	0.003
dbgumuz	dgambella	64.464	2	0
dbgumuz	dharari	1.958	2	0.376
dbgumuz	ddiredawa	0.9922	2	0.609
dbgumuz	ALL	451.1	20	0
dharari	daddisababa	4.7183	2	0.095
dharari	doromia	0.26786	2	0.875
dharari	dtigray	1.217	2	0.544
dharari	dsnnp	2.726	2	0.256
dharari	damhara	5.0708	2	0.079
dharari	dsomali	8.1308	2	0.017
dharari	dafar	10.153	2	0.006
dharari	dgambella	2.6551	2	0.265
dharari	dbgumuz	10.462	2	0.005
dharari	ddiredawa	7.0239	2	0.03
dharari	ALL	120.75	20	0
ddiredawa	daddisababa	3.7298	2	0.155
ddiredawa	doromia	2.7578	2	0.252
ddiredawa	dtigray	12.452	2	0.002

ddiredawa	dsnnp	10.178	2	0.006
ddiredawa	damhara	3.3731	2	0.185
ddiredawa	dsomali	0.41101	2	0.814
ddiredawa	dafar	0.56264	2	0.755
ddiredawa	dgambella	4.9329	2	0.085
ddiredawa	dbgumuz	2.3224	2	0.313
ddiredawa	dharari	12.722	2	0.002
ddiredawa	ALL	139.7	20	0

Appendix 3: Project Proposal Proforma

Candidate information (to be filled by the candidate) Date 22/09/2015

Name **Filagot Sileshi Tilahun**

Course Code **MECP-001**

Program code **MEC**

Enrolment number: 099121255

Address…+251911300199

Email filuye@gmail.com

Regional Centre……

Study Centre Name ……..

Study Centre Code…….

Title of the Project **Market Integration in the Ethiopian Coffee Market**

(Enclose the proposal/ synopsis of the project)

(By The Supervisor)

I hereby certify that the proposal for the Project entitled(Name of the Project)…….by(nameofthecandidate)…… ……has been prepared after due consultation with me. I agree to supervise the above mentioned Project till its completion.

Signature of the Supervisor)

Name…….

Designation……

Address……

……..

……..

Appendix 4: Thesis Proposal Approval Sheet

Appendix 5: Approved Thesis Proposal

1. INTRODUCTION

1.1 BACKGROUND

Coffee is produced in more than 60 countries of which three accounts for more than half of the world's production: Brazil, Vietnam and Colombia. These countries produced coffee Robusta, one of the two varieties of coffee, which is easier to produce and is more resistant to disease. World coffee production has been trending up, with Brazil in the lead. Though Brazil goes up and down the cycle, it produces around 50-60 million bags of coffee, and there is high national consumption. The key factors which led to this are socio economic and increased development in the coffee industry. As a result, the Brazilian agronomy is growing at a fast rate. Coffee production in Vietnam also had rapid growth, but past few years it has leveled. Other Coffee producing countries have been experiencing stagnation in production. Production in most of these countries depends on small holder farmers, and they could not compete with the mechanized and developed supply from Brazil and Vietnam. In Asia, the coffee production is stagnating.

In Africa, the Robusta production has declined over the years, especially due to political instability in the Ivory Coast and competitiveness and productivity issues. The second fine-flavored aromatic variety of coffee, Arabica coffee makes up 60-65% of the total production and usually fetches the highest prices. Recently natural Arabica in the export volumes have overtaken Robusta. Around 75% of all its coffee is exported. The world annual production is currently around 115 million 60 kg bags or 7 million tones.(International Coffee Organization, ICO.org)

With regard to consumption, data obtained from ICO indicated that the United States is currently the world's largest market for coffee. Annual consumption per capita is just over 4kg compared with 5kg on average in Europe. Consumption in Europe varies from around 10kg per capita per year in the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) to around 3kg in the United Kingdom and most of Eastern Europe.

At a country level, the economic growth of many of coffee producing developing countries is closely linked with coffee production, as well as other primary commodities. Many producer countries depend on coffee exports for a large part of their foreign exchange earnings (for instance 35% in the case of Ethiopia, (National Bank of Ethiopia, 2011) and their government revenue. When international coffee prices are low, governments have difficulties in meeting debt service obligations and are unable to make much-needed investments in basic health, education and infrastructure.

70% of the world's coffee supply is provided by smallholders cultivating less than 10 hectares in 80 countries in Africa, Asia and Latin America. However, the extreme volatility and long-term decline in coffee prices on international markets endangers the livelihoods of the 10 million small coffee farmers dependent on coffee for their primary source of income.

Coffee is widely traded in international commodity futures markets. As such, main objective of the study is to see the market linkage of coffee from the producers (farmers') to the consumers. The reason for looking deeply the market integration is that coffee is characterized by high levels of price fluctuation, which exposes coffee producers to price risk. This makes it difficult and producers could not manage their price risk by hedging on these markets. Further it will also assess the price difference across the major coffee producing areas in Ethiopia. In December 2000, international coffee prices hit a 30-year low. On the other hand in the year 2012 it reached the highest price of more than $3-$4/lb(ICO.org), which was not seen for a decade but going down aftermath and further falls expected.

The livelihoods of millions of rural workers involved in coffee picking on big plantations and coffee processing factories also directly depend on coffee. When prices decline, rural workers involved in coffee harvesting and processing find themselves unemployed or see their wages decline as farmers attempt to reduce production costs. This low coffee revenue will not be enough to cover essential family expenditures such as primary school fees and medicines

The main problem that arises on the coffee market is the lack of market linkage, which makes the income of coffee producers unstable. In most countries, especially in developing countries, the marketing channel is not strong enough leading the farmers to lose their

income which becomes, on the other side, profiting the middle market players, wholesalers and coffee traders.

In the Ethiopian case, coffee is purchased through one of three main channels: from exporters, cooperative unions, and directly from private estates. Exporters generally purchase their coffee through the Ethiopian Commodities Exchange (ECX). Private estates that hold their own export license may sell and export directly to international buyers. Coffee lots of Ethiopia's many primary cooperatives are generally channelled through cooperative unions.

Coffee export accounts for approximately 30% of the foreign exchange earnings for Ethiopia. In the year 2011, coffee production engages almost 25% of the working population followed by oilseeds. The country is endowed with various nature and characteristics of *Coffee Arabica* which contributes to the world market. More than 25% the population is engaged on production, processing, distribution and export of the coffee. It contributes about 36% of the total export earning of the country and 25% of the GNP and about 25% of employment opportunity and accounts about 10% of the total government revenue.

1.2 STATEMENT OF THE PROBLEM

The absence of market integration or of complete pass-through of price changes from one market to another has important implications for economic welfare. Incomplete price transmission arising either due to trade and other policies, or due to transaction costs such as poor transport and communication infrastructure, results in a reduction in the price information available to economic agents and consequently may lead to decisions that contribute to inefficient outcomes.

In the Ethiopian coffee market, the major coffee producing areas are Southern regions (Sidama and Yirgacheffee), Northern (Jimma, Kaffa, Agaro, Bedelle etc) and Eastern Parts(Harar). Although coffee is produced in the above mentioned areas in bulk there is a high price fluctuation across the regions.

The difference between the prices of a homogenous commodity in different places is accounted by the transaction costs and other inefficiencies in the market. It is therefore important to check which part of the difference can be attributed to transaction costs and

which part comes from inefficiencies. The difference that is attributed to transaction costs is a legitimate difference since there is nothing that can be done to avoid it. But that which occurs through inefficiencies indicate that markets through space are less integrated to one another. Inefficiencies include information asymmetry, trade barriers etc… In cases where the price differences exceed the transaction cost, it opens a window for arbitrage. This is theoretically expected to equalize prices.

The existing literature on market integration in Ethiopia mainly focuses on major cereal crops, Teff, wheat and maize. The literature on the coffee market and its integration focuses on specific local markets especially around the producers and does not take into account the demand side prices (Tadesse, 2009). This study will do the analysis at national level using regional prices. Filling this gap would be beneficial for regional and national policy making as it shows the causality of prices from the demand and the supply side.

1.3 OBJECTIVE OF THE STUDY

The general objective of this study is to measure market integration for the Ethiopian coffee to determine the existence of long-run price relationships and spatial market linkages. Specific objectives of the study will be:

- Looking at the general trends in production, consumption and export of coffee
- Assessing the role of middle men in the coffee chain
- Price analysis of market integration between different coffee markets
- Comparing the prices across the major producing areas of Ethiopia and look what the causes behind.

1.4 SIGNIFICANCE OF THE STUDY

Understanding spatial price integration is even more important with regards to the Ethiopian economy. One line of argument relates to the efficiency of domestic markets spatially is that domestic markets are increasingly becoming integrated. With integration the producers are getting a higher price compared to the past and this has kept domestic prices high. Another line of argument pertains to high transaction costs and multiple players in the market are adding to the margin and resulting in higher prices.

In this context the understanding of spatial price integration among regions is an important task that can help understand these agents. This study thus attempts to test the level of price integration of coffee in the different regions of the country and possibly give indications about the dynamics in the difference in the country's major foreign exchange earning product.

1.5 SCOPE AND LIMITATIONS OF THE STUDY

Ethiopian coffee production system consists of forest, Semi-forest, garden or cottage and plantation production systems. The country's 90% of coffee production comes from smallholder farmers; while the remaining comes from private and public owned large scale farms. Coffee production come from the Oromia National Regional State of Ethiopia (more than 64%), 35% from Southern Nations Nationality People of Ethiopia (SNNP) and the remaining 1% from Gambela National Regional State. Therefore the study will focus on these coffee producing areas and will take a time serious data of two decades. Furthermore, it will give significant emphasis to the market linkage with the major Ethiopian coffee buyers and consumption trend.

The study will also look at the supply chain of coffee from the cooperatives to the buyers. The limitation of the study is that it will be difficult to get the cost of coffee production of the farmers.

1.6 ORGANIZATION OF THE THESIS

This thesis will include five parts. Following this introductory part is part II, the literature review. In this part, definition and models used for market integration will be discussed. In part III, Research Methodology, the data type and methodology that will be used for the thesis including the descriptive analysis will be described. In part IV, the result of the data will be shown. The final part, part V will be the conclusion and summary of the thesis.

2. RESEARCH METHODOLOGY

2.1 DATA TYPE AND DATA COLLECTION

The study will use secondary data. It is taken from the Central Statistics Agency. This represents regional consumer prices from the Central Statistics Agency. We take the category for Coffee (beans and whole) and tea leaves reported monthly. We have compiled monthly data from January 2000 to January 2012. This is collected for 11 administrative regions; Addis Ababa, Afar, Amhara, Benishangul Gumuz, Dire Dawa, Gambella, Harari, Oromia, SNNP, Somali and Tigray. Some of these regions are supplying regions while others are demanding regions. As a very popular drink the price of coffee is important in the consumption basket of households. The data are nationally representative of consumption prices. Most studies take into consideration specific market prices in selected towns of the country mostly reflecting producer prices that reflect mostly the supply side of the market. It is however important to look at the nationally representative consumer price data to analyze the changes and transmissions of the prices in the market.

2.2 DATA ANALYSIS

Both descriptive and econometric methods will be used to analyze the presence of co-integration between the coffee prices between different regions. Basic descriptive analysis like percentages graphs, correlations and tests will be made to have a general overview of the relationship between the variables. In addition to this a multivariate Vector Autoregressive Model (VAR) model is used to establish co-integration between the different prices.

2.2.1 Descriptive Analysis

A number of approaches will be used to measure spatial integration of markets. I start from the simple mean equality t-test just to have an indication of which regions' prices on average are significantly different. I also use simple pair wise correlation of variables, the granger causality analysis, the Ravallion model and Co-integration analysis are among the major methods used in this paper to measure integration of prices spatially. As would be expected, each of these methods have their advantages and disadvantages.

The mean equality t-test take the difference of the mean of two price series and divides it by joint estimate of the standard deviation to measure the significance of the difference. It can be described by the following equation.

$$t = \frac{\bar{x} - \bar{y}}{\left\{\frac{(n_x-1)s_x^2+(n_y-1)s_y^2}{n_x+n_y-2}\right\}^{\frac{1}{2}}\left\{\frac{1}{n_x}+\frac{1}{n_y}\right\}^{\frac{1}{2}}}$$

Where; t is the t statistic $\bar{x}$ and $\bar{y}$ are mean values for two series, n_x and n_y are the number of observations within the series x and y; s_x^2 are s_y^2 variances of the two series. If the t statistic is bigger than the table t value for N-2 degrees of freedom then we say the two means are statistically significantly different. This doesn't say anything about either the correlation or the series or the causal relationship between these series. However, it gives an indication of which regions on average have the same mean prices.

If we want to see if the two price time series move together (correlate) we can use the correlation coefficient. Again this shows the strength of the co-movement but doesn't show the relationship or causality between the two series. The Pearson un-weighted product moment correlation coefficient is used in this study to see the correlation between the two series (Snedor and Cochran 1989). It is given by

$$\hat{\rho} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

2.2.2 Econometric Analysis

In order to establish the relationship between the coffee prices of different regions we need to specify a model and test for causality. The model selected in this paper is Vector Autoregressive (VAR) model. The reason for this choice is that VAR doesn't assume direction of relationship between variables and it considers all variables to be endogenous to the system. As discussed in the theoretical literature we don't know whether the demand side issues or supply side issue strongly influence coffee prices. Therefore we will assume that the coffee prices of all regions to be endogenous. Therefore we use VAR model for the integration. Before estimating VAR we need to conduct some tests.

As we are dealing with time series data we have to check for the some peculiar characteristic of these types of data. A very important assumption in time series data that has implications for consistency and inference is the assumption of Stationarity. A stationary time series is one that has a constant long run mean and variance. Without this assumption the regression coefficients will not have a distribution on which to make inference which makes the use of standard regression spurious. Therefore it is important to check for stationarity of the variables. In order to check for stationarity we will check of current values of the variable is related to past values in a convergent way in that whenever it deviates due to a shock it goes back to the long run equilibrium. This test equation is estimated by putting the differenced variable as dependent and regressing this on a constant, the lag of the variable, and the lagged differences of the variable. We check for the significance of the lag coefficient to check for stationarity. This test is called the Augmented Dickey Fuller (ADF) test and the test statistic follows the Dickey Fuller distribution rather than the normal t-distribution. Therefore we will use the ADF test of stationarity on the variables. The following equation describes the test;

$$\Delta Y_t = c + \beta Y_{t-1} + \sum_{k=1}^{L} \Delta Y_{t-k} + \varepsilon_t \text{.....(1)}$$

In the above equation the tests is the stationarity of the variable Y. Here the target is to check whether the coeffience β is significantly different from zero or not. Variables that are stationary at level are called integrated of order 0 or I(0). If a variable has to be differenced once to become stationary it is said to be I(1). Similarly, if a variable has to be differenced d times to become stationary it is said to be I(d).

It is very common that most economic time series are not stationary. But this doesn't mean that there is no hope of analyzing these types of series. If a group of variables that are not stationary have a stationary long run relationship they are said to be co-integrated. That is, if they move together in the long run, and if the deviation between them is stationary over time these variables are co-integrated. This allows for the analysis of the variables as a group and helps to identify the relationship between them. Therefore if we have non-stationary time series, co-integration is necessary to establish or understand the relationship between these variables. A cointegration test for a single equation with many variables could look like;

$$\hat{\varepsilon}_t = Y_t - \hat{\beta}_1 X_{1t} - \hat{\beta}_2 X_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\Delta\hat{\varepsilon}_t = c + \beta\hat{\varepsilon}_{t-1} + \sum_{k=1}^{L} \Delta\hat{\varepsilon}_{t-k} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

First we estimate the parameters of the models using OLS and test the stationarity of the residual using the ADF test to establish if there is a long run relationship between the variables. It should be noted that in the above case we have specified that Y is the dependent variable and the X's are independent variables.

Therefore in this paper we use the co-integration analysis to establish if there is long-run relationship between the coffee prices in the different markets. But in our case we don't allow any price to be exogenous so we specify all the variables to be endogenous to the model. The reason for this is both supply and demand factors could drive prices and we presume that causality could be both ways if the price variables are co-integrated.

Since we are not assuming any causality or restriction on the prices we use the Vector Autoregressive Model (VAR). This model considers all variables to be endogenous and estimates a matrix of coefficients by including lags of all included variables in to the model. Using the Johansen procedure then it is possible to know how many co-integrating vectors relate the variables given above. In the case when there are more than one co-integrating vectors we try to use economic theory to identify which co-integrating vector makes economic sense. A standard VAR representation can be expressed as;

$$Y_t^j = c^j + \sum_{j=1}^{k} \sum_{i=1}^{T} \Pi_i^j Y_{t-i}^j + \epsilon_t^j \ldots\ldots\ldots\ldots\ldots (4)$$

The Y_t^j represents (nx1) vector of variable j where n is the number of observation while Π_i^j represent vectors of coefficients for each lag i of variable j. As the number of variables increase and as the number of lags increase the number of parameters to estimate increases by multiples. In the case of this study the Ys represent the prices of coffee in different markets.

Once the co-integration is established we also use Granger Causality Test to check which way the causality exists as this has implication for policy interventions. In the VAR framework granger causality uses the sequence of trends to check which variable changes first. It does this by testing the exclusion of the lags of the variable hypothesized to cause in the equation of the variable that is being caused. It uses Wald exclusion test if for example we are testing whether Y_t^1 is granger causing Y_t^2 then we test whether all the lags of Y_t^1 are jointly significant in Y_t^2's equation given by;

$$Y_t^2 = c^2 + \sum_{i=1}^{T} \Pi_i^1 Y_{t-i}^1 + \sum_{j=1}^{k} \sum_{i=1}^{T} \Pi_i^j Y_{t-i}^j + \varepsilon_t^j \dots\dots\dots\dots\dots\dots (5)$$

Granger causality tests the null hypothesis

$$H_0: \Pi_1^1 = \Pi_2^1 = \Pi_3^1 = \cdots = \Pi_T^1 = 0$$

This is done using a Wald exclusion test which uses a chi-square distribution for the test. In addition to establishing cointegration and causality, VAR allows the analysis of transmission of shocks between markets through the analysis of impulse responses. The impulse response function shows the response of target variables to shocks. In our case the impulse response function will be analyzed to further establish the transmission of coffee price shocks either from the demand or the supply side or both depending on the causality. This helps policy makers to anticipate possible transmission of shocks in some markets and the effect that will have on the other markets.

3. EXPECTED OUTCOME

The research is expected to come up with adaptive results that could help Ethiopia and international coffee marketing. Coffee is among the important commodities that Ethiopia depends on. To attain this big interest of the country, this research will deal with market integration in coffee transaction which leads to significant reduction in transaction costs and reduces opportunity costs impacting overall performance and coffee contribution to the nation. The study also expects to find ways of design in policy making in this regard. Any interested researcher is also expected to exploit the new information that will be generated from the research.

Appendix 6: Advisor's CV