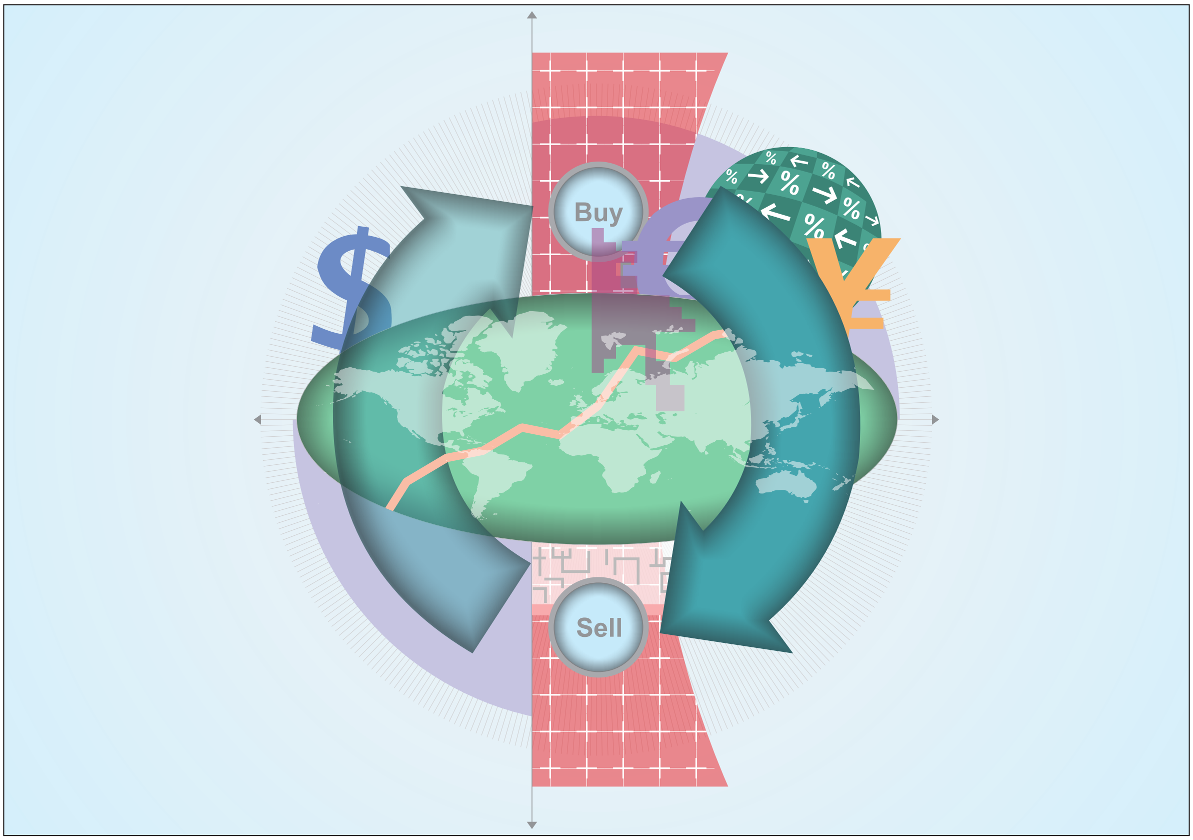

The International Journal of Applied Economics & Finance

ISSN 1991-0886

The International Journal of Applied Economics and Finance 8 (3): 109-117, 2014
ISSN 1991-0886 / DOI: 10.3923/ijaef.2014.109.117

Measuring Spatial Price Transmission of Coffee between Bench Maji Zone and Central Market in Ethiopia

[1]Dessalegn Gachena and [2]Amsalu Mitiku
[1]Department of Agricultural Economics, School of Agricultural Economics and Agribusiness Management, Haramaya University, Ethiopia
[2]Department of Agricultural Economics and Extension, Jimma University, Jimma, Oromia Regional State, Ethiopia

Corresponding Author: Dessalegn Gachena, Department of Agricultural Economics, School of Agricultural Economics and Agribusiness Management, Haramaya University, Ethiopia

ABSTRACT
This study tries to analyze the spatial price transmission of coffee between Bench Maji Zone and Addis Ababa markets. Monthly prices data (September 2006 to August 2011) for producer and central market prices were collected from Central Statistical Agency of Ethiopia. The Engle and Granger procedure was employed to test for co-integration between prices. The ADF test for unit root was applied for individual price series. The results of stationarity tests indicate that, after the first difference, the null hypothesis was rejected at 1percent level of significance implying that the price series are integrated of order I(1). The results of Engle and Grange Co-integration show that there exists a long run relationship between local market (Bench Maji-Zone) and the central market (Addis Ababa) price. A one unit change in Addis Ababa price series brings about 56% changes in Bench Maji-Zone coffee price series. Moreover, Error Correction model revealed the existence of a weak short-run price transmission effect to local market. About 31% of the current change in the local market price is due to the current change in the central market price. However, the hypothesis of full market integration was rejected at 5% significance level. It takes two months' time to complete full adjustment indicating that market equilibrium in the short-run was inefficient.

Key words: Price transmission, short run and long run relationship, local and central coffee markets, co-integration and error correction model

INTRODUCTION
In Ethiopia, coffee as the major export crop is the driving force of the economy. Over millions of the farming households and about 25% of the total population of the country are dependent on the production, processing, distribution and export of coffee. It also accounts for more than 25% of GDP, about 40% of the total export earnings, absorbs around 25% of employment opportunity for both rural and urban dwellers and 10% of the total government revenue (FAO, 2011). Ethiopian coffee is of superior quality and organic, indicating the huge potential of fetching high price premium in the international markets (Marsh, 2006).

Despite its economic and social importance for the Ethiopian economy, the performance of the coffee sub-sector has remained unsatisfactory. Amongst other things, imperfect competition, inadequate transportation networks, limited number of traders with inadequate capital and facilities, high handling costs, inadequate market information, weak bargaining power of farmers and a long chain of intermediaries were cited as major causes of weak performance of coffee market (IFPRI, 2003; Nicolas, 2007; Shumeta *et al*., 2012).

Due to the fact that Bench Maji Zone (The study area) is located at far distant (561 km) from Addis Ababa, above mentioned coffee marketing problems overwhelming in the country could be suspected which may lead to weak or no coffee price transmission or price responses at all from central to local market. An integrated and responsive marketing system that is marked with good price transmission is crucial for optimal allocation of resources in agriculture and for stimulating producers to increase output (Nicolas, 2007).

Spatial price transmission is an issue that has been widely analyzed in the context of the "Law of one price" which assumes that if two markets are linked by trade in an efficient market, the movement of prices in one market will be equalized with the movement in the other in the long run while allowing for deviations in the short run (Margarido *et al.*, 2007). Knowledge about the extent to which spatial prices are transmitted is useful to guide subsequent interventions aimed at improving the efficiency of coffee markets. An introduction of new marketing policies calls for an understanding of whether the system is performing well or not. However, most previous studies on coffee marketing gave more emphasis on already prominent coffee producing areas such as Kaffa, Sidama, Illubabor, Wellega and Hararghe. No research has been conducted on coffee marketing efficiency in terms of partial price transmission between local and central markets. Therefore, the main purpose of this study is to evaluate the level of spatial coffee price transmission between local (Bench Maji Zone) and central markets (Addis Ababa).

METHODOLOGY

Description of the study areas and data: This study was conducted in Bench Maji Zone, South West Ethiopia the case of Bench Maji, is one of the 13 zones in the Southern Nations, Nationalities and People's Region (SNNPR) of Ethiopia. It is located at 651 kms southwest of Addis Ababa. The zone comprises of 10 with a total of 230 Peasant Associations (PAs). Among these 10 woredas, Sheko and South Bench are the leading coffee producing woredas of the zone (BMZARD, 2008). Therefore, this study particular has been undertaken in these two coffee producing districts of the the Zone.

The data used in this study was obtained from Central Statistical Agency (CSA). The producer and central coffee market prices are the two major time-series prices which comprises of the monthly data from September, 2006 to August, 2011. In this case, Bench Maji Zone monthly producers' prices were taken as local market prices and Addis Ababa wholesale price as central market price series data. Addis Ababa is assumed as the central market because coffee wholesaler from different parts-after some processing will dispatch coffee bean from production area in this market. To facilitate the comparison, all price data has been converted to clean coffee equivalent expressed in terms of 17 kg of clean bean assuming Jenfel[1] to clean bean extraction ratio of 100:48 . That means 100 kg of Jenfel will be resulted in 48 kg of clean coffee been after processing (ECX, 2009).

Tests and time series econometrics model specification: Price series for agricultural commodities are often non-stationary. However, estimating price adjustment as the impact of a change in one price on another price should be based on appropriate methods, which allow for non-stationary variables. In market integration models, the Error Correction Model (ECM) specification has gained popularity because of its intuitively appealing interpretation (Engle and Granger, 1987).

A variable that is non-stationary is said to be integrated of order d, written I(d), if it must be differenced d times to be made stationary. In the same way, a variable that has to be differenced once to become stationary is said to be (I(1) i.e., integrated of order one (Engle and Granger, 1987).

[1]Jenfel refers to unprocessed sun-dried coffee

Testing for unit roots: In this study the Augmented Dickey Fuller (ADF) was used to test for stationarity. According to Engle and Granger (1987), the first step is to test whether each of the univariate series are stationary or not. Thus, Augmented Dickey-Fuller (ADF) test requires runs the following regression as:

$$\Delta P_t = \alpha + \beta P_{t-1} + \sum_{k=2}^{n} \theta_k \Delta P_{t-k} + e_t \tag{1}$$

Where:

Δ	=	Fist differnece operator
Δp_t	=	Pt-P_{t-1}
k	=	2, 3 ..... n (leged number)
α, β and θ	=	Parameter to estmated
ε_t	=	Error term

Augmented Dickey-Fuller (ADF) tests the null hypothesis that P_t is non-stationary by calculating a t-statistic for β = 0 from above equation. i.e., Ho: β = 0; the price series is non-stationary or existence of unit root and H1: $\beta \neq 0$; price series stationary. If null hypothesis is rejected, then the price series are stationery and it is possible to conduct the co-integration regression. In this study, the lag structure was identified using Akaike Information Criterion (AIC). The AIC procedure is one of the information based criterion most commonly used in econometrics, which suggests the choice of minimum number of explanatory variables to minimize the objective function that trades off parsimony against reduction in sum of squares (Akaike, 1969). The Akaike Information Criterion (AIC) defined by the following equation:

AIC_{ij} = n* log residual sum of squares of Eq. 1 +2x

$$AIC_{ij} = \log \sum \hat{e}^2 + \frac{2X}{n} \tag{2}$$

where, X is the number of parameter estimated and n* is the number of usable observation (usually not equal to the sample size). The value of n must be the same.

Co-integration tests (the engle-granger two-step procedure): Co-integration techniques received much attention in empirical research since the techniques solve the statistical problems associated with non-stationary time series data by providing a mechanism to test for the existence of non-spurious long-run relationship between variables with non-stationary time series properties. The two-step approach to co-integration analysis due to Engle and Granger (1987), involves prior test on the time series properties of the variables (unit root test) and proceeds with the estimation of the long-run relationships among the variables only when the test results reveal that the variables have balanced time series properties.

If two series, say P_{it} and P_{jt} are I(1), relationship between them found in the co-integrating regression in Eq. 3, defines the long run dynamics of the relationship. When series are differenced, they lose their long-run interpretation. The differences of these series represent short run marginal changes. Nonetheless, the first differences need to be employed to render the series stationary. When specifying regressions in time series, all the series in the equation have to be integrated by the same order. Engle and Granger (1987) suggested a two-step estimation procedure. First with ordinary least squares, we can estimate the co-integrating parameter or vector from the long-run equation:

$$P_{it} = \partial + \beta P_{jt} + e_t \tag{3}$$

If these series share a common trend, this co-integrating regression represents the long-run equilibrium around that trend between the two series. The residuals, representing long-run disequilibrium error, of this co-integrating regression should found to be I(0):

$$\hat{e}_t = P_{it} - \partial - \hat{\beta} P_{jt} \tag{4}$$

The residual from the Eq. 4 are considered to be temporary deviation from the long-run equilibrium. The Augmented ducky fuller unit root tests on the residuals estimated from the co-integrating regression are then conducted as follows:

$$\Delta e_t = \lambda e_{t-1} + \sum_{i=2}^{k} \theta_k \Delta e_{t-k} + \mu_t \tag{5}$$

where, Δe_t is the ordinary least square residual that can be interpreted as the deviation of P_{it} from its long-run path and λ, θ are parameters to be estimated and μ is the error term.

Note that the constant and time trend are omitted from the ADF test because the residuals from the co integrating regression will have a zero mean and be de-trended. In order to conclude that the price series are co-integrated, the residuals from the OLS estimation have to obey stationary process. That is, if the residual errors are stationary then the linear combination of the two price series is stationary (co-integrated). It tests the following hypothesis:

H0: Variables are not co-integrated (i.e., the OLS residuals admit a unit root, $\lambda = 0$)
H1: Variables are co-integrated (i.e., the OLS residuals do not admit a unit root $\lambda \neq 0$)

If the absolute value of the t-statistic of the λ coefficient is greater than the relevant critical value, the null hypothesis is rejected and two price series are said to be co-integrated of order (1, 1), so the two markets are co-integrated/there is a long run price transmission among the two markets.

Error correction model (ECM): The Engle and Granger Error Correction Model (ECM) enable us to differentiate between long-run and short-run relationship of time series analyses. As the series show long-run relationship, Step 2 of the Engle and Granger makes use of the estimated error correction term the ECM needs to be applied to investigate further to estimate the short-run dynamics of the variables. Short-run market integration is defined such that a price change in one market will be "Immediately" passed onto another market. Short-run market integration is tested in the following model by using joint the (F-test).

$$\Delta P_{it} = \gamma_{11}\Delta P_{it-1} + \ldots + \gamma_{1n}\Delta P_{it-n} + \gamma_{20}\Delta P_{jt} + \gamma_{21}\Delta P_{jt-1} + \ldots + \lambda_{2n}\Delta P_{jn-n} + \gamma\,(P_{it-1} - \partial - \hat{\beta} P_{jt-1}) + v_t \tag{6}$$

Given:

$$\hat{e}_{t-1} = P_{it-1} - \partial - \hat{\beta} P_{jt-1}$$

where, γ_1, γ_2 and γ_3 are the estimated short-run counterpart to the long-run solution, n represents the lag length of time, δ represents the speed of adjustment parameter, which indicates how fast the previous moves back towards the equilibrium and v_t is stationary random process that capture other information not contained in either lagged values ΔP_{1t} and ΔP_{jt}. Short-run market integration is tested in the following model by the F-test. If the null hypotheses: $\gamma_{11} = = \gamma_{1n} = \gamma_{21} = ... = \gamma_{2n} = 0$; $\delta = 1$ and $\gamma_{20} = \partial$ are rejected, short-run integration doesn't exist and vice versa.

RESULTS AND DISCUSSION

Unit root test analysis: A variable is said to be non-stationary when the ADF t-statistics is smaller in absolute terms than the critical values. Regressions involving non-stationary time series will produce spurious results that show a significant relationship between variables that are not correlated. Therefore, in order to determine whether the time series contained a unit root or not, an augmented Dickey Fuller test on the first lag the dependent variable was used.

To avoid the spurious regression problem that may arise from regressing a non-stationary time series on one or more non-stationary time series, the firs differences of the time series were taken to make stationary. Accordingly, the outputs of the unit root tests at their levels indicate that for both prices series there is insufficient evidence to reject the null hypothesis of unit roots at the 1% significance level, suggesting that all the series are non-stationary processes. Thus, the null hypothesis of price changes in a market has a unit root was rejected for both markets at 1% level of the ADF critical (Table 1).

Accordingly, Akaike Information Criterion (AIC) procedure was used to secure uniformity and comparison among all other tests.This seems to be consistent with the econometric theory that if the time series has a unit root (non-stationary), the first differences of time series are stationary (Engle and Granger, 1987). Therefore, we moved head to do the integration test for Bench Maji zone and Addis Ababa markets or central market.

Co-integration analysis: Given that all the time series analyzed are non-stationary I(1) processes and taking into account co-integration theory, which states that two or more non-stationary series are long term co-integrated if both series are integrated of the same order and their linear combination yields a disturbance term that is stationary, we can proceed to EG approach to test for long-run co-integration. Economically speaking, two variables will be co-integrated if they have a long-term or equilibrium relationship between them.

In order to test the co-integration the local market coffee price (P_{it}) was first regressed on central market price (P_{jt}) and obtained the following regression results. Since F-calculated is by far exceeds the critical F-values at 5% significance level, the model is properly specified (fit).

From the above co-integration result indicated in Table 2 the value of the residual was predicted and tested for unit root using ADF test .The results of the unit root test on the residuals indicates that they are stationary since the computed $\tau(t)$ value in absolute term is greater than the Engle-Granger critical τ value at 1% significance level as summarized in Table 3.

Thus the two markets are integrated in the long-run which is evident from Table 3. That is there is a long term/equilibrium relationship between local and the auction market implying that the integrated series move together in the long run (Appendix 1).

Table 1: Augmented Dickey-Fuller test for unit root of first differenced price series

	With drift			Without drift	
Variables	Lag length	ADF statistics	Critical value (1%)	ADF statistics	Critical value (1%)
Local market price (P_{it})	3	-4.972*	-2.403	-4.972*	-3.573
Central market price (P_{jt})	2	-5.613*	-2.400	-5.613*	-3.572

Computed from data in CSA (2011). *Significant at 5% level

Table 2: Co-integration regression model

Variables	Coefficient	t	p>t	Adjusted R^2	Model test[2] (F-value)
Central market price	0.561	10.55	0.000	0.658	111.369***
Constant	25.184	1.78	0.081	-3.187	53.555

Source: Computed from data in CSA, 2011, DW = 1.207

Table 3: Augmented Dickey-Fuller (Co-integration) test of residual

		Critical value (%)		
Variables	t-statistics	1	5	10
Residual(e)	-5.301	-3.572	-2.925	-2.596

Source: Computed from data in CSA (2011)

The long-run coefficients (considered as elasticities) show the magnitude of change or degree of response of local market price of coffee to unit changes in the respective repressor variables. The significance of the elasticity coefficient of the central market price (0.561) suggests that there is moderate a degree of price transmission from the central market to the local market indicating log run market integration. The reason could be since 2008 Ethiopian commodity exchange authority has brought improvement in coffee marketing system in the country.

Error correction model (ECM) results: Though economists are mainly interested in the long-run (equilibrium) relationships between economic variables, it is also important to have information about the short-run behavior of the relationships in order to know how long it will take for the equilibrium relationship to converge back to its position once it is in shock (speed of adjustment). Such information about the short-run relationships of economic variables can be obtained from estimated ECM. Taking into account the previous results ECM was specified to assess the short-term dynamics of the relationship between the two price series. This model allows us to capture the short-term effect that a shock in the independent variables has on the dependent variable and the speed at which the system will adjust to the new equilibrium after the shock.

To examine the short-run dynamics the study tests the joint hypothesis using F-statistics to evaluate the null hypothesis of: $\gamma_{11}==\gamma_{1n}=\gamma_{21}=...=\gamma_{2n}=0$; $\delta=1$ and $\gamma_0=\partial$. The output of the ECM (6) indicates that both the coefficient of the error correction term (γ = -0.549) and the coefficient of the short-term parameter (γ_{20}=0.308) are significant at the 5 and 10% level, respectively.

From ECM adequate evidence is detected to conclude that the central market plays a role as a short-and long-run determinant of the local market prices. Thus there is there is short-run effect of Addis Ababa price to that of Bench market price. From Table 4 it can be concluded that about 31% of the current change in the local market price is due to the current change in the central market price in Addis Ababa. Moreover, the error correction term (δ) has correctly signed (negative) and it is statistically significant implying that there is adjustment in the local market price prices

[2]Since F-calculated is by far exceeds the critical F-values at 5% significance level, the model is properly specified (fit)

Table 4: Results of the error correction model

Variables	Coefficient	Stndard error	t	p>t
ΔLMP_{t-1} (γ_{11}) =	-0.072	0.172	-0.420	0.676
ΔLMP_{t-2} (γ_{12}) =	-0.238	0.152	-1.560	0.125
ΔLMP_{t-3} (γ_{13}) =	0.158	0.142	1.110	0.271
ΔCMP (γ_{20}) =	0.308*	0.107	2.880	0.006
ΔCMP_{t-1} (γ_{21}) =	-0.120	0.120	-1.000	0.323
ΔCMP_{t-2} (γ_{22}) =	-0.081	0.106	-0.770	0.448
Δe_{t-1} (δ)	-0.549**	0.163	-3.370	0.001

Source: Computed from data in CSA (2011), ΔLMP (ΔP_{it}) = Dependent variable, F = 5.950, R^2 = 0.459 Adjusted R = 0.382, Durbin-Watson d-statistic (7, 56) = 2.042

of coffee back to the long-run (equilibrium) position once there is disturbance due to shocks. The equilibrium error correction coefficient of magnitude indicates that 54.9% or nearly half of the previous month's deviation from the equilibrium position is corrected in a particular month. However, using F-test at 5% significance level, the hypothesis of full market integration is rejected since the calculated F-statistics (5.950) exceeds the critical F-values (2.53). This shows that the market equilibrium in the short-run was inefficient due to imperfect competition, imperfect information and institutional constraints as indicted in Table 4.

CONCLUSION

The results of the stochastic analysis and their tests indicate that local market (Bench Maji Zone) and the central market (Addis Ababa) prices are moderately co-integrated over the studied period, implying that price integration is relatively efficient in the long-run. The coefficient obtained from long run regression model indicates that a one unit change in central price series brings about 56% changes in Bench Maji coffee price series. Similarly, Grange Error Correction (ECM) model shows that there exists relatively a weak short-run price transmission effect from Central market to local market. About 31% of the current change in the local market price is due to the current change in the central market price.

The equilibrium error correction coefficient indicates that 54.9% of the previous month's deviation from the equilibrium position is corrected in a particular month. However, using F-test at 5% significance level, the hypothesis of full market integration is rejected. i.e, the short-run market integration result indicates that there is no full market integration which takes a period of about two months between pair markets (Bench Maji and Addis Ababa). This implies that there is poor market information system, limited barging power of farmers and oligopolistic nature of market structure. The degree of integration and the speed of price adjustment between markets have significant policy implications in that the timing and the location of policy interventions should consider these indicators. Based on the results, the following policy implications are forwarded:

- In order to improve the magnitude and speed of price transmission between local and central market the governments should emphasize the development of market infrastructure and information systems as well as the construction of transportation systems
- Analyses of market integration based on price data alone have been criticized because they often neglect the role of transaction costs. However, this study had used only the price series data due to scarcity of data on costs. This call for further study to use models that can account

for the effects of transaction costs in price transmission analysis without directly relying on transaction cost data. Moreover, the analysis and resulting information would have been more useful had it been possible to extend the sample period

Appendix 1: Price series in local market (P_{it}) and price series in auction market (P_{jt})

Observation	P_{it}	P_{jt}
1	93.60	130.38
2	54.23	123.60
3	55.93	188.00
4	62.39	122.60
5	70.89	144.00
6	75.48	151.59
7	102.00	166.92
8	157.25	166.57
9	131.04	173.82
10	129.98	176.28
11	121.83	116.00
12	101.21	124.80
13	157.25	176.98
14	157.25	172.33
15	126.00	220.50
16	119.00	234.70
17	135.98	239.02
18	150.45	266.50
19	141.27	219.60
20	171.53	281.00
21	169.79	219.60
22	197.20	265.00
23	204.00	171.55
24	157.25	168.39
25	186.17	270.75
26	155.89	270.75
27	205.70	291.88
28	168.98	278.21
29	195.33	284.93
30	201.28	270.85
31	155.89	266.99
32	196.18	268.20
33	210.12	263.08
34	186.17	247.65
35	186.17	265.00
36	186.17	270.75
37	174.63	289.00
38	174.63	267.90
39	173.74	288.95
40	183.60	313.83
41	158.61	294.50
42	129.88	275.49
43	185.47	273.75

Appendix 1: Countinue

Observation	P_{it}	P_{jt}
44	185.00	320.00
45	144.67	288.75
46	190.06	315.00
47	196.12	252.04
48	199.11	267.52
49	228.14	343.95
50	246.50	369.77
51	217.60	379.52
52	218.45	370.01
53	229.33	343.04
54	245.31	368.65
55	274.38	364.15
56	258.57	361.30
57	174.63	359.00
58	250.92	334.63
59	251.00	330.22
60	174.63	337.85

REFERENCES

Akaike, H., 1969. Fitting autoregressive models for prediction. Ann. Inst. Stat. Math., 21: 243-247.

BMZARD, 2008. Commodity and trade policy research. Annual Report, Food and Agriculture Organization, (Bench Maji Zone Agriculture and Rural Development) Mizan Teferi.

ECX, 2009. Making market for all: Solving an age old problem. Ethiopian Commodity Exchange (ECX), Addis Ababa, Ethiopia.

Engle, R.F. and C.W.J. Granger, 1987. Co-integration and error correction: Representation, estimation and testing. Econometrica, 55: 251-276.

FAO, 2011. FAO Statistical Year Book. FAO, Rome, Italy.

IFPRI, 2003. Getting markets right: An institutional and legal analysis of grain and coffee marketing in Ethiopia. Final Report, International Food Policy Research Institute (IFPRI), New York, USA.

Margarido, M.A., F.A. Turolla and C.R.F. Bueno, 2007. The world market for soybeans: Price transmission into Brazil and effects from the timing of crop and trade. Nova Econ., 17: 241-270.

Marsh, A., 2006. Specialty organic coffee industry of Rome, Italy. East Timor Coffee Project, East Timor.

Nicolas, P., 2007. Ethiopia's coffee sector: A bitter or better future?. J. Agrarian Change, 7: 225-263.

Shumeta, Z., K. Urgessa and Z. Kebebew, 2012. Analysis of market chains of forest coffee in Southwest Ethiopia. Acad. J. Plant Sci., 5: 28-39.