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DETERMINANTS OF COFFEE EXPORT IN ETHIOPIA: AN APPLICATION OF CO-INTEGRATION AND VECTOR ERROR CORRECTION APPROACH

Purpose. *The study aimed to analyze the determinants of coffee export through the variables of coffee production, trade openness, world coffee export in tone, population and export prices for the period of 1977–2016 for 38 observations.*

Methodology / approach. *The co-integration approach was employed to investigate the long-run causal association between Ethiopian coffee export in kg and export price, world coffee export level, population and coffee production, trade openness. The coffee export demand functions in Ethiopia were estimated using co-integration analysis and Vector Error Correction Models.*

Results. *The co-integration result confirmed the existence of a long-run relationship between Quantity Ethiopian coffee exported and export price, coffee production world export coffee in tone and population size of age between 15 to 64. The analysis pointed out that in the long run the extent of Ethiopia coffee export inversely related to coffee production in the country and world coffee supply in tone and directly related to export price and population size of active aged category. The speed of adjustment was estimated to be 24 % that implied the economy will converge towards the long run equilibrium in approximately one year following a shock.*

Originality / scientific novelty. *The empirical analysis indicated the existence of short term causal link from lagged export level of coffee, population size of active labour force, trade opens and export price towards export in the coffee export model. In short run Ethiopian coffee export defined as positive function of trade opens and negative function of lagged year coffee export in tone, export price and population size of active labour force in the country.*

Practical value / implications. *The policy implication of the time series analysis calls for improved works on value addition and productivity improvement to respond for soaring national and international demand and betterment in trade relation with nations abroad that expected to optimization of the organic attributes of Ethiopian coffee in sustainable manner. The Vector Error Correction Model also indicated a significant short-run as well as long run relationship between changes in exports and changes in export price and population size.*

Key words: *coffee, co-integration, export, long run, short run, vector error correction model.*

Introduction and review of literature. Out of the total coffee exporters in the country, 95 is private entrepreneurs; five coffee growing farmer cooperatives and two government enterprises. The top five Ethiopian coffee importers are Germany, US, Saudi Arabia, Belgium and Italy. Emerging from a country famous as the birthplace of coffee, Ethiopian coffee could get unique brand name. Ethiopian coffee is exported majorly as green bean which is roasted by receiving countries. Ethiopian coffee has got a significant place in the global value chain due to its exceptional quality. Ethiopia is also noted for being the largest coffee consumer among African countries. While examining the social aspects, it is vivid that coffee is well ingrained in the

social fabric of the country. Coffee for Ethiopians is among the sentiments insulating them against the cultural penetration in the era of globalisation (Sivakumar *et al*., 2014; FAO, 2014).

Coffee is the major source of foreign exchange for the Ethiopian economy and its governments. The small scale farmers are the known small-scale peasant producers located in parts of the south, southwest and east of the country (Love, 2001). Despite the rigorous price of coffee shocks has been disturbing its value chain, it remains an elemental component of the Ethiopian economy and export. The prolonged price decline has substantially weakened coffee production basis and prospects that demands appropriate financial services in a sustainable way (Bastin and Matteucci, 2007).

Caffeine is the world's most popular drug and coffee is its most popular agent. Coffee clearly has important physiological effects that have led it to be considered a drug for spiritual contemplation, a medicine for numerous ailments from digestive problems to headaches and hyperactivity, a remedy for hunger and fatigue, an elixir for creativity, an athletic and labour performance enhancer (Neilson and Bamyeh, 2012).

Export performance is the relative success or failure of the efforts of a firm or nation to sell domestically-produced goods and services in other nations. Export performance can be described in objective terms such as sales, profits, or marketing measures or by subjective measures such as distributor or customer satisfaction. The Short term short-term export performance the stem scale or dimensions focuses on satisfaction with short-term performance improvement, exporting intensity improvement, and expected short-term performance improvement (Lages and Lages, 2004).

Ethiopia foreign earnings from export challenged by, high dependency on traditional primary agricultural commodities and recurrent world market price fluctuations and instability. As remedial measure diversification of trade from primary agricultural commodities into high-value commodities and working on improvement of value addition activities has to be give due attention of policy makers and actors in the production system (Dube *et al.*, 2018).

Even if Ethiopia coffee export supports the country economy and contributes a lots in the country foreign exchange earnings, its determinants factors and export trends in the last three to four decades not well studied and documented for policy implication. Hence, the study aimed to identify factors affecting influencing coffee exports through time series analysis.

Empirical review on export performance. The performance in export markets is defined as positive function of market segmentation, product quality, pricing strategy, dealer support, and advertising (Leonidoua *et al.*, 2002). The study result by Svedberg (1991) justified the existence of strong positive relationship between export performance and real-income growth across the Sub Saharan Africa.

The study result by Fugazza (2004) indicated that major important constraint on export performance remained trade barriers and poor supply-side conditions in Africa

and the Middle East. The factors like good transport infrastructures, macroeconomic soundness and good quality institutions appear to be major determinants in the development process of the external sector.

There is difference in the sectors over competitiveness of market. The banana sector is in a position to achieve competitiveness, whiles performance of the rubber and coffee sub-sectors is hindered by prevailing inefficiencies and developmental constraints (Boansi, 2014).

The results revealed that export supply of cocoa was found to be influenced by export cost and rainfall in the long run while output, cost of production and export affected it in the short run. Rubber export supply was influenced by cost of export and exchange rate in the long run while world export-output ratio and cost of export affected it in the short run (Nwachukwu, 2015).

The export demand in Sub Saharan Africa is defined as function of the economic prosperity of trading partners of SSA countries and their ability to compete in the foreign market on the basis of price. Being a landlocked country in SSA can adversely influence the performance of merchandise export. Increasing domestic supply capacity and enhancing international competitiveness should rank high among the strategic objectives of policies at the macro, sectoral and micro levels (Babatunde, 2009).

The export performance of Ethiopia in the long run is defined as function of terms of trade, trade openness, gross domestic product, real effective exchange rate and domestic credit. The short run export performance of the country is determined by trade openness, gross domestic product, real effective exchange rate and domestic credit (Muhabaw, 2015).

The study result by Menji (2011) reveals that Ethiopian export performance was highly volatile during 1981 to 2004 period. In the period the average growth of merchandise and manufacturing exports at 7 % and 4 % per annum. Ethiopia's export sector is mainly dominated by few primary commodities, where manufacturing exports account for less than 15 %. The result also indicated that merchandise the average merchandise export volumes defined as function of production capacity and trade liberalization.

The performance Ethiopia's trade has been constrained by high trade costs due to poor trade logistics and burdensome official requirements, an unsupportive macroeconomic policy mix, and private sector under-development (Ciuriak and Preville, 2010).

The performance Ethiopia's export determined by institutional quality and internal transport infrastructure, the growth of domestic national income, foreign market access conditions, import barriers imposed by Ethiopia's trading partners and national income of partners, and distance (Tekaligne, 2009).

The study result by Worako *et al.* (2008) indicated that the short-run transmission of price signals from world to domestic markets has improved in Ethiopia, but has remained weak in both auction-to-world and producer-to-auction markets. The weak institutional arrangement and coordinating was worsened the

domestic coffee system and contract enforcement.

The major incentives coffee exports for wholesalers and producers comprised of lucrative coffee prices in the international market, improved infrastructure and market information system in the country, strong local demand combined with an increase in per capita income. The major challenges coffee trade included market inefficiencies and policy distortions that resulted from overvalued exchange rate, high level of impurities and weight losses, excessive margins from traders over producers and high transport and marketing costs (FAO, 2014).

Ethiopian coffee export supply in the short run is determined by real exchange rate, foreign capital inflow, real income and term of trade. In the long run it depends on domestic price, real exchange rate, real income and term of trade. In the long run there is high price elasticity but in the short run it is low (Hussien, 2015).

The study result by Bastin and Matteucci (2007) summarized the challenges of coffee market as a limited supply of financial services to the coffee farmers, existence of informal and inefficient market system.

Empirical review of trade performance. The intermediate basis for trade stems from relative commodity price differences among nations. The important determinants of the basis for trade such are endowments, technology, and national income. Transportation costs, therefore, tend to reduce the volume of trade, the degree of specialization in production among the nations concerned, and thus the gains from trade (Carbaugh, 2009).

The small firms are more likely to improve the export performance for activate learning from foreign markets' few export of small firms needed to be targeted and concentrated to its resources to develop expertise, build strong distribution network. The better performing small firms could not be the one that located geographically close nations, rather more developed and specialized market (Brouthers *et al.*, 2009).

The Heckscher-Ohlin theory based trade analysis pointed out those low levels of education and abundant natural resources and related primary products export play detrimental role in export performance of Africa. In some African countries, the share of manufactures in exports could be raised by improving infrastructure and policies. For most of Africa, however, the highest priority is to raise the absolute level of exports in all sectors, and particularly in sectors based on natural resources, following a development path more like that of land-abundant America than of land-scarce Asia (Wood and Mayer, 2001).

The major factors caused low levels of economic and social development in Ethiopia comprised of the foreign debt burden, the insufficient achievements in financial resource mobilization, price and exchange rates distortions, the high dependency on exports of few commodities, and un favourable weather and internal security conditions (Sefano, 1991).

The performance of financial export determined by pricing capabilities, product development capability, communication capability, low cost advantage and branding advantage (Zou *et al.*, 2003).

The empirical result by Kingu and Singh (2015) revealed that export

performance of selected cash crops such as cloves, cotton lint, cashew nuts, tea and coffee are determined both by internal and external factors such as global prices, real exchange rates and production volume.

The sale of home produced goods at higher export prices and the purchase of foreign produced goods at lower prices is expected to increase wellbeing. The real value of a country's exports for period t, estimated as the income, terms of trade and the export volume. The barter terms of trade are defined as export of prices over import price. The export supply was found to be defined as function of include production capacity and export producer prices. From this equation, the producer prices are defined as function of world market prices, the real exchange rate, and net taxes levied on the export sector. World market prices are external in the small country case, while the real exchange rate and net taxes are internal variables (Svedberg, 1991).

Empirical review of error correction approach. Error-correction models applied for co integrated economic variables are commonly interpreted as reflecting partial adjustment of one variable to another. Error-correction models applied for forecasting one variable based on times series data from other variables (Campbell and Shiller, 1988). Error correction models enforce strong and testable non-linear restrictions on dynamic econometric equations. It is referred as one of effective ways of characterising the dynamic multivariate interactions characteristic of economic data (Alogoskoufis and Smith, 1991).

Econometrics applied to integrate short run dynamics with long run dynamics. The analysis of short run dynamics is carried out by first eliminating trends in the variables by differencing. Detrending or running a regression in time assumes the presence of deterministic trend and differencing assumes presence of stochastic trend. Co-integration related to stochastic trends. Co-integration analysis first note static regression and then estimating the short run dynamics by variants of VECM by two stage estimation method using estimation coefficients from co-integration regression (Maddala, 1992).

Co integration test have been used for testing permanent income hypothesis, rationality f expectations, marketing efficiency in different markets and purchasing power parity. The co-integration regression captures long run equilibrium relationships of economic variables. The VECM can be used to merge the short run and long run forecasts in consistent fashion (Maddala, 1992).

The purpose of the article. The study aims to analyze the determinants of coffee export through the variables of coffee production, trade openness, world coffee export in tone, population and export prices for the period of 1977–2016 for 38 observations.

Research methodology. For time series analysis the major steps adopted include collecting data for production and other macroeconomic variables from FAOSTAT and world trade organization data base. Testing stationary, differencing the data at 1st level to make the data stationary, lag selection, undertaking Johansen co integration test, long run and short run model specification and summarizing the findings. The

model validity was checked by diagnostics testing of residual testing done for heteroscedasticity, autocorrelation and normality. The coefficient diagnostics and stability diagnostics of the model was tested using Wald test for investigating short run effect of defined variables and recursive estimate on the stability. For statistical significance and sample size adequacy the time series analysis was carried out by including Eritrea. The functional form defined for the specific year defined as extent of coffee exported across year is equals to summation of export price, coffee production, world coffee export in tone, population of age between 15 to 64 and trade opens. The time considered for analysis was from 1977 to 2016 time series and 38 observations after adjustment.

Model specifications. The study was aimed to see the long run & short relationship between Ethiopian coffee export, export price (+), coffee production (+), trade opens (+), population of active labour force (-) and world supply for Ethiopia (-) using 39 years' time series data. Assuring existence of one co-integration equation at 1st difference that was none stationary at level, we can run VECM to examine both short run & long run dynamics. Let start from conventional ECM for co integrated series can be written as:

$$\Delta Yt = B0 + \sum Bi\,\Delta Yt - 1 + \sum \mu AEi\Delta Xt - i + SZt - 1 + \mu t$$

This implies changes in Yt is function of not only previous change in Y but also past changes in X. All the variables are considers endogenous.

$$Yt = B0 + B1Xt + et \cdot and\ is\ defined\ as\ ECT = Yt - 1 - B0 - B1Xt - 1$$

Z is ECT and is the OLS residual from following long run co integrating regressions:

Variable definitions and Model specification. For period 1977 to 2016 the normalized equation defined as:

LOG(X_QAKG) LOG(ETX_PQT) LOG(C_PRDNTON) LOG(PO15_64) LOG(X_WA) LOG(OPENS)

Extent of coffee exported. The amount of coffee exported across years measured in kg and assumed to vary across years due to different in economic variables. The extent of coffee exported contains all the exported coffee across years and included in the model as important economic variables.

Export price. The export price of coffee defined as dependent variable included in the model and assumed to have positive influence in level of coffee exported. The export price for coffee known as benefit for coffee trade, it was assumed to have accelerating effect on coffee exported for the country.

Export price: refers to price of coffee exported across the year and it expected to influence positively the supply extent of coffee for export. The export price of Ethiopia coffee was measured by USA dollars.

Population aged between 15 to 64 of age. The population time series data gathered from world development index data base and FAOSTAT.ORG.NET. The specific age category defined as one of dependent variable due to its strong association with coffee production and consumption. Since coffee one of the major consumable items in the country the population sized expected to have negative

influence in extent of coffee exported.

Coffee production across years. This is one of the variables included in the model for estimating export extent of coffee for Ethiopia with other variables. It assumed to have provoking role in supporting coffee export. As the level of coffee production increased, the extent of export coffee expected to own increased supply as income opportunity increasing and optimizing option.

Opens. The trade of coffee openness was estimated by dividing the summation of total export and import to Gross domestic product of the country. The trade opens of the country assumed to have positive influence in relation to improved trade relation, accessing information and advertising and experience sharing.

Extent of Export coffee from the world in tone. This one of the economical variable included and assumed to affect the export level and price of coffee for Ethiopia. Since supply and demand are inversely related, when the commodity supplied by numerous producers in excess quantity, its influence on extent of Ethiopia would expected to be inversely.

Summary of basic steps adopted in estimating a Vector Error Correction Model.

1. Data collection and synthesizing.

Time series data were collected from FAOSTAT base and world trade organization and world development index data base. For adequacy of sample size years considered was from 1977 to 2016. The major data gathered were export value and quantity of Ethiopian and world coffee, Ethiopian total export and import, Gross domestic product, total population and population of active labour force (15 to 64 years old), export price for Ethiopia and world, exchange rate and real exchange rate, trade opens and coffee production.

2. Undertaking Augmented duck fuller test (ADF). For model specification the stationary of variables defined in the model is prerequisite and the unit root testing and differencing at level one done for the purpose.

3. Optimal lags determination (p). As indicated in the table bellows based on VAR Lag Order Selection Criteria, the optimal lag length selected for the model is three and this lag length used for the error model specification and further statistical analysis. In the Lag selection process for period of 1977 to 2016, the Endogenous variables defined as: LOG(X_QAKG) LOG(ETX_PQT) LOG(C_PRDNTON) LOG(PO15_64) LOG(X_WA) LOG(OPENS) and the Exogenous variables is C and Sample period from 1977 to 2016 for 38 included observations. As indicated in the table bellow, based on different lag selection criteria, the optimal lag length selected is one for the specific period.

4. Co-integration Test. The co-integration test was done to see the existence of one co-integration vectors in the model. The co-integration test was done by checking the significance of trace value and maximum Eigen value. The result confirmed the existence of single co-integration test and directed for further statistical analysis and model specification.

5. Specification of error correction model. Error correction model was estimated by defining extent of coffee exported from Ethiopia in the last 38 year as dependent

variable and export price, population of active labour force, world export quantity of coffee, trade openness as independent variables. For the model specification, 38 observations of time series and five explanatory variables were used. From five explanatory variables used four found to affect significantly the long run model and from seven independent variables with lagged cases 3 found to affect the short run supply model significantly.

6. Long run and short run model specification. The long run and short association between independent and dependent variables estimated for specific time periods. The coefficients of error coefficients confirmed that the existence of long run association between coffee production, population, export price, trade opens and worked export supply of coffee to Ethiopian coffee export. The joint short run association between defined explanatory variable and dependent variables examined by undertaking Wald test and it confirmed the existence of short run association between variables toward equilibrium.

7. Diagnostic testing and validation of the model. The validity and checked by undertaking residual autocorrelation test, heteroscedasticity test, normality test and model stability test. The non-spuriousness of the model was examined by observing Residual Square and F. statistics and Watson test. The coefficient diagnostics was also made for validation of the coefficients.

8. Method data analysis. Before Econometric analysis, all necessary data organized and made ready for analysis by excel sheet 2007. Excel 2007 also used for graphical and tabular presentation of time series data. For Econometric analysis and diagnostic checking of the model of the specific time series data, statistical software adopted was Eviews version 9.

Results and discussion. As depicted in the fig. 1, the trend of world coffee export showed increasing trend.

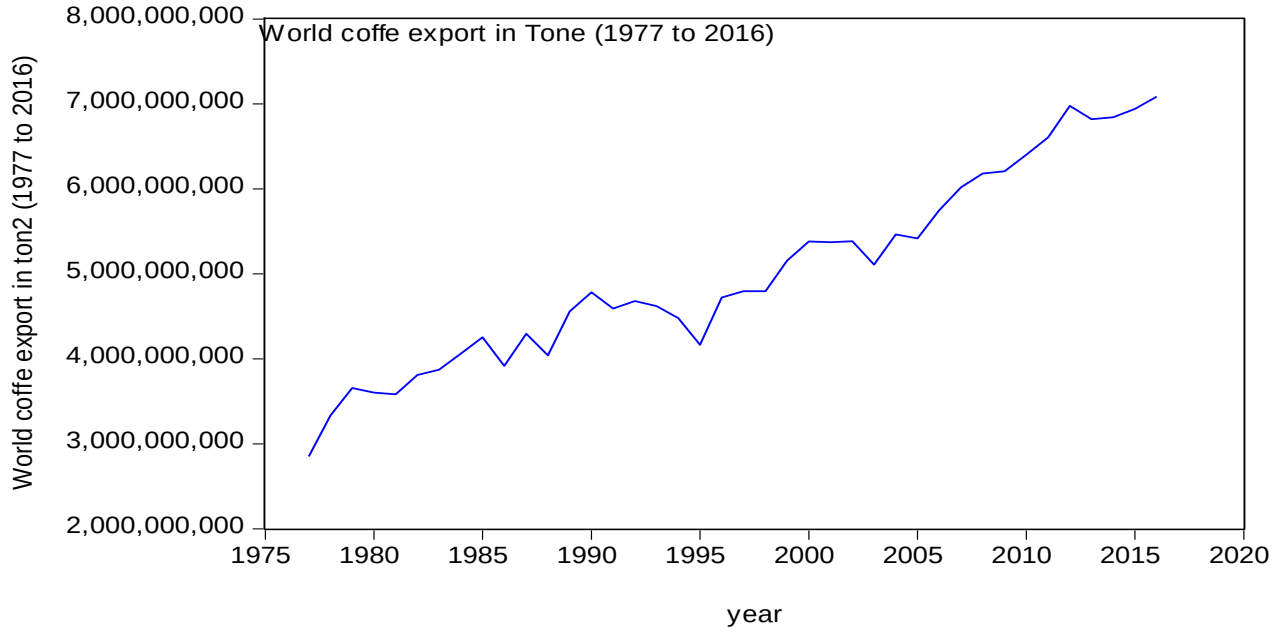

Fig. 1. Trend of world coffee supply

Source: author's research.

The graph in the fig. 2 indicated that trade opens showed different characteristics across the two regimes of Ethiopia. After fall of Derge regime trade opens showed increasing trend due to changes in structure of the economy and related economic booms. A similar trend is characteristic for export price of coffee (Fig. 3).

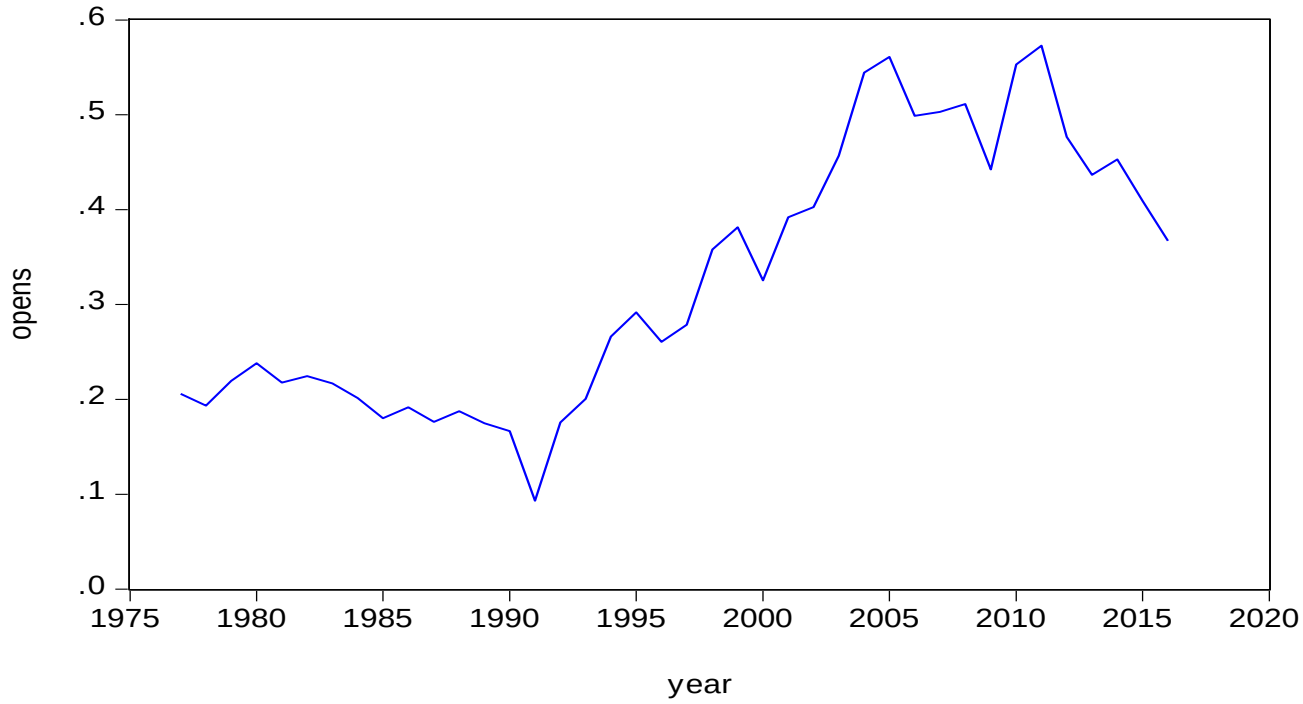

Fig. 2. Trend of trade opens for Ethiopia across years

Source: author's research.

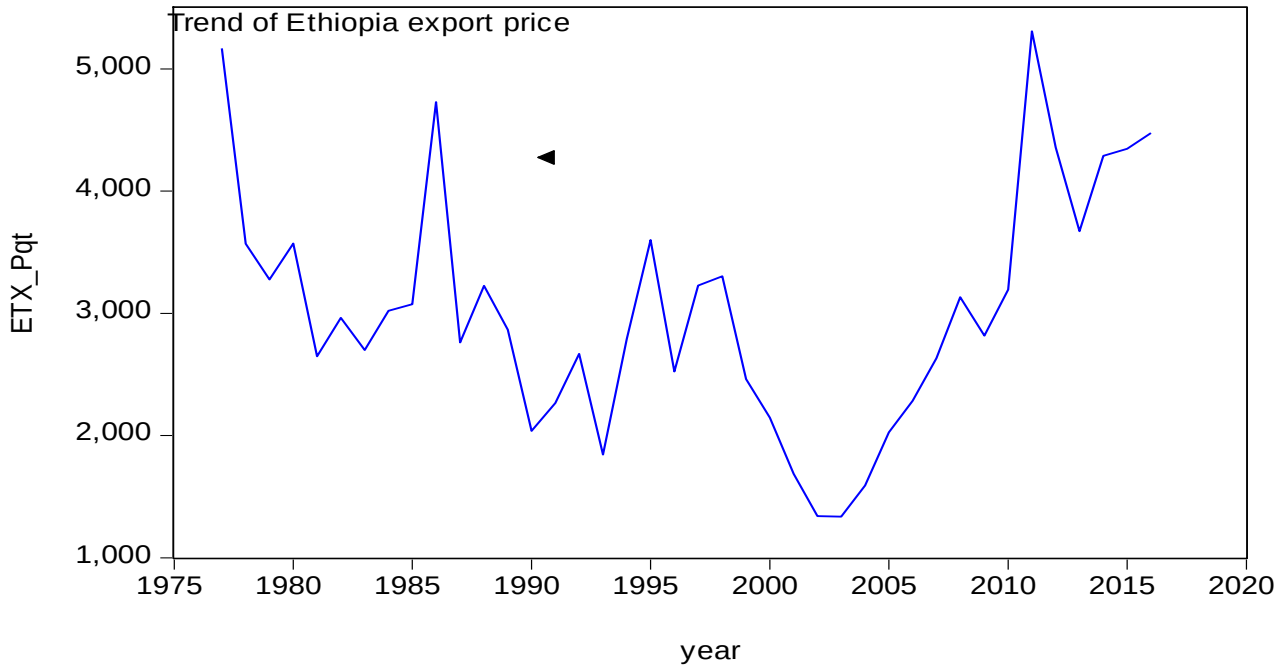

Fig. 3. Trend of Ethiopia export price

Source: author's research.

Optimum lag selection. As it justified in the Table 1 for the model the optimum lag length selected was one.

Table 1

VAR Lag Order Selection Criteria for 1977 to 2016 periods

Lag	LogL	LR	FPE	AIC	SC	HQ
0	78.59434	NA	7.96e-10	-3.924019	-3.662789	-3.831923
1	274.0084	316.8877*	1.48e-13*	-12.54100	-10.71239*	-11.89633*
2	302.7079	37.23173	2.58e-13	-12.14637	-8.750383	-10.94913
3	351.7239	47.69129	2.02e-13	-12.84994*	-7.886573	-11.10012

Note. *indicates lag order selected by the criterion; ***LR***: sequential modified LR test statistic (each test at 5 % level); ***FPE***: Final prediction error; ***AIC***: Akaike information criterion and ***SC***: Schwarz information criterion and ***HQ***: Hannan-Quinn information criterion.

Source: author's research.

The Ethiopia coffee production and exporting trend followed undulating trend in the in both with Eritrea and after departure from Eritrea. For instance, the production of coffee showed increment by 0.56 % for 1970 to 1991 but export on average decreased by 3.77 %. The growth trend of coffee production and its export showed increment by 0.59 % in production and 0.024 % in export of coffee in the periods of 1992 to 2016. As illustrated in figure bellow, export was bellow export from year of 2003 to 2005 (Fig. 4).

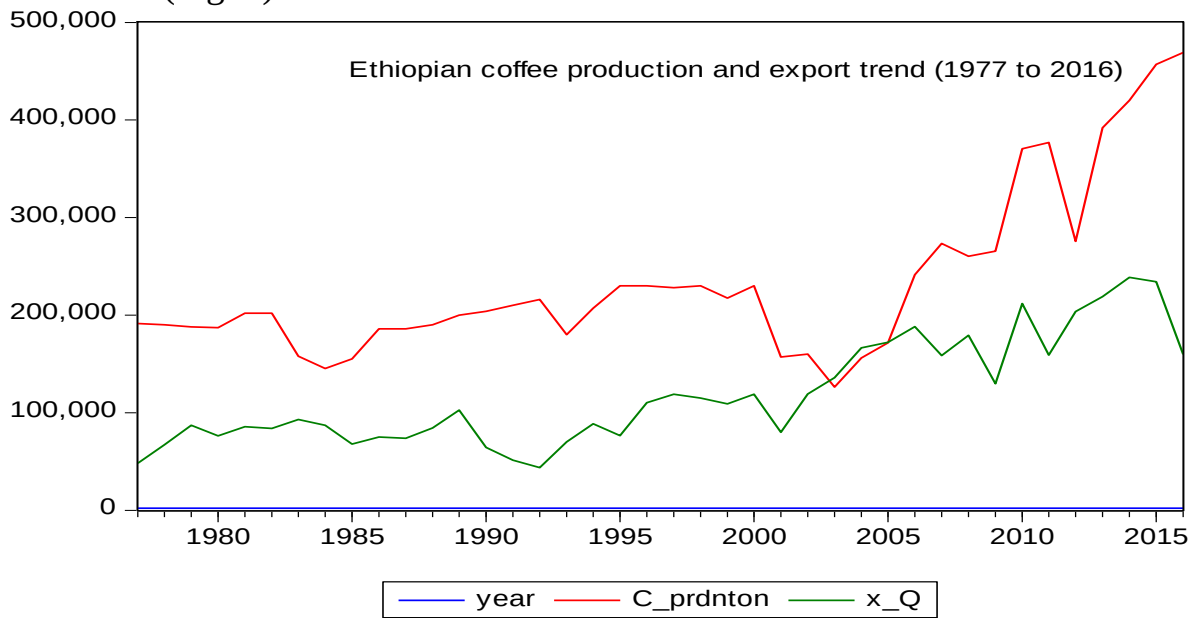

Fig. 4. Ethiopian coffee production and export trend, 1977–2016

Source: author's research.

Stationarity test of variables. For model specification the stationary of variables defined in the model is prerequisite and the unit root testing and differencing at level one done for the purpose (Table 2).

1. Johansen Co integration Test and Normalized equations. One of the steps – performing Johansen co-integration tests with optimal lag length for 52 observations after adjustments Sample (adjusted): 1977–2016 the trend assumption: linear deterministic trend. As illustrated in the table below both trace and maximum Eigen value confirmed that there is one co integration equation in the model (Table 3). This means that dependent and explanatory variables are linked together in achieving their steady state equilibrium.

Table 2

Duck fuller Undertaking Augmented duck fuller test (ADF)

Variable	At station level		At 1st difference	
	ADF t static	P rob*	ADF t static	P rob*
Log (coffee export in kg)	-2.07	0.26	-7.59	0.00
Log (population aged 14 to 64	2.94	1.00	-5.31	0.00
Log (coffee export price in qt)	-0.63	0.85	-8.17	0.00
Log (world coffee supply)	-1.06	0.72	-8.22	0.00
Log (opens)	-1.32	0.61	-7.21	0.00
Log (coffee production)	-0.60	0.86	-6.54	0.00

Source: author's research.

Table 3

Johansen Co-integration Test and Normalized equations for 1977 to 2016

Unrestricted Co-integration Rank Test (Trace)					Unrestricted Co-integration Rank Test (Maximum Eigen value)			
Hypot-hesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**	Hypot-hesized Eigen value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.67	105.73	95.75	0.01	0.67	42.62	40.08	0.0253
At most 1	0.47	63.11	69.82	0.15	0.47	24.20	33.87	0.4406
At most 2	0.34	38.90	47.86	0.26	0.34	15.95	27.58	0.6699
At most 3	0.27	22.95	29.79	0.25	0.27	11.90	21.13	0.56
At most 4	0.24	11.04	15.49	0.21	0.24	10.59	14.26	0.17
At most 5	0.01	0.46	3.84	0.49	0.01	0.45	3.84	0.49
Trace test indicates 1 co-integrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values					Max-eigen value test indicates 1 co-integrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values			

Source: author's research.

In the model Log (X_QAKG is defined as dependent variable and ETX_PQT (export price), coffee production (C_PRODN), population of age between 15 to 64 (po15_64), world coffee export supply (X_WA), trade opens (OPENS). These results suggest that there is a co-integration vector among five variables for the analysis period, in other words, there is a long-term link among Ethiopian coffee export, export price, population of 15 to 64 age category, world coffee export supply, trade opens and quantity of coffee produced during the period. In addition, long-term elasticity of export model is demonstrated in the normalized co integration results in Table above.

As illustrated in co-integration equation one, the coefficient of co-integration model is negative and significant, which indicates that the existence long run causality running from export price, coffee population, population aged between 15 to 64 and coffee supply to market from the world toward extent of coffee export equilibrium (Table 4). Multivariate co-integration results revealed that there exists a single co-integrating vector in the estimation. This means the variables included in

the model are linked together in achieving their steady state equilibrium.

Table 4

First Co-integrating Equation(s): (Log likelihood: 280.8858)

Log (coffee export)	Log (export price)	Log (coffee production)	Log (POP15_64)	Log (world coffee supply)	Log (trade opens)
1.000000	-2.144071	2.671379	-8.229772	8.639244	-0.383954
	(0.40044)	(0.61736)	(1.57407)	(1.95403)	(0.31318)
Adjustment coefficients (standard error in parentheses)					
D (LOG (export quantity))		-0.240926			
		(0.05780)			
D (LOG (export price))		0.117400			
		(0.07732)			
D (LOG (coffee production))		-0.113844			
		(0.05227)			
D (LOG(POP15_64))		1.91E-05			
		(0.00302)			
D (LOG (world coffee supply))		-0.042903			
		(0.01559)			
D (LOG(trade opens))		0.006830			
		(0.06187)			

Source: author's research.

Export price of coffee: The export price elasticity of normalized equation is -2.14 and reported as 2.14 by reversing the sign that statistically significant at 1 % level. The indicates that 1 % increase in export price results in 2.14 % increase in export of Ethiopian coffee, other variables are held constant. The finding indicated that the export price promotes the export quantity of Ethiopian coffee that increase benefits the market actors.

Ethiopian coffee production: The elasticity of coffee production is estimated to be -2.67 in the normalized model and it is statistically significant at 1 %. It tells about the 1% of increase in coffee production results in a 2.67 % decrease in Ethiopian coffee export, other variables are held constant. The result showed that Longevity of production system and fear of low price for high production prevailing make the exporters to supply low for export at high production period. The finding calls for works in value addition activities that diversify product type and quality.

The population Size of Active labour force: The elasticity of population aged between 15 to 64 was estimated to be -8.23 and it was significant at 1 % level. The estimate of population parameter pointed out that, holding other variables fixed, 1 % increase in population of active labour force, resulted in 8.24 % decrease in extent of coffee exported. This implies that active labour force played increasing effect in level of coffee exported in relation labour availability.

Quantity world coffee export: The elasticity of world coffee export in the normalized equation was estimated to be -8.64 and it was statistically significant at 1 % level. The estimated elasticity (8.64) value of world coffee export supply pointed out that 1 % increase in export quantity of coffee from other competent nation would

have 8.64 % decrease in export quantity of Ethiopian coffee, holding other variables fixed. The finding is against the finding of Aqeel and Nishat (2006) that implied Export in Pakistan are driven positively by volume of world trade. The finding calls for existence of high completion in the market and demands works on promotion activities.

To sum up, the findings implied that 1 % increase in export price and population size aged between 15 to 64 years will bear respective increase of 2.14 % and 8.23 % in the export of Ethiopian coffee, in the long run. But 1 % increase in coffee production and world coffee supply will bear in decrease of export coffee in 2.67 % and 8.67 %, at ceteris paribus condition. The result also implied that the elasticity of coffee export with respect to export price, population size and world coffee export is high, suggesting their strong effect on Ethiopia coffee export.

2. Vector Error Correction Estimates for adjusted periods 1979 to 2016.

Estimating VECM with Ethiopian coffee export in kg as target variable:

$$\Delta Coffee\ export\ in\ kg = 0.24ect_{t-1} - 0.4Exprtedcoffe_{t-1} - 0.46exportPrice_{t-1} - 6.64population\ size\ of\ active\ labour_{t-1} - 0.2\ worldCoffe\ supply_{t-1} + 0.14coffeprodctuon_{t-1} + 0.35tradeOpens_{t-1} + 0.22.$$

Co-integrating Equation: Long run Model

$$ext_{t-1} = 1coffeExport_{t-1} - popaged\ 15to\ 64_{t-1} - 0.38tradeopens_{t-1} + 2.67coffeProductn_{t-1} + 8.64worldcoffe\ supply_{t-1} - 85.66.$$

Interpretations of estimated VECM with X_QAKG as target variable:

Ect$_{t-1}$=-0.2409. The parameter of coefficients adjustment or errors correction estimated to be -0.2409. The speed of adjustment measures the speed at which Ethiopian coffee export returns to equilibrium after changes in defined previous year export, export price, population and opens. The result showed that the last year period deviation from long run equilibrium influences the short run dynamics of Ethiopian coffee export. This implied that the previous year deviation from the long run is corrected at current period by an adjustment speed of 24 %. This is to mean that long run equilibrium adjusted at speed of 24 % annually.

X_QKG$_{t-1}$=-0.40: This indicates that at citreous paribus condition a 1 % increase in lagged period export quantity yields 0.40 % decrease in current period coffee export. A percentage change in lagged export quantity of coffee associated with 0.40 % decrease on average in current period export, at citreous paribus condition.

Export price$_{t-1}$=-0.46: The result indicated that 1 % increase in export price in previous period resulted in 0.46 % decrease in quantity of coffee exported current year, holding other variables fixed. A percentage change in previous year export associated with 0.46 % decrease on average in export of coffee in the short run, other variables fixed. The result also supported by Altintaş and Türker (2014) that reported increase in export price will bear decreases the export.

OPENS$_{t-1}$=0.35: The parameter estimate implied that 1 % increase in trade opens in the last year brings about 0.35 % increases in extent of Ethiopia coffee, holding other variables fixed. The finding is in line with Hailegiorgis (2011) that

stated the country needs to increase its trade partnership with other nations, increase value addition level and trade openness in all various of commodities that own positive role in maximizing coffee export level.

Population (aged between 14 to 64)$_{t-1}$: The parameter estimate for the variable defined as population was estimated to be -6.64.The result indicated that 1 % increase in population in previous period brings about 6.64 % decrease in coffee export of the country, holding other variables constant.

System Equations of Ethiopian coffee export. System equation:

$$D(\log(\text{Coffee export})) = C(1) * (\text{Log(last year export level} - 2.14 * \log(\text{last year export price} + 2.67 * \log(\text{last year Coffee Production}) - 8.23 * \text{LOG(Last year pop size aged 15\_64)} + 8.64 * \log(\text{Lagged world coffee export}) - 0.38 * \log(\text{lagged trade opens}) - .66 - - - - Co - integration\ Equation$$
$$+ C(2) * D(\text{LOG(last year export)} + C(3) * D(\text{LOG(lagged export price)} + C(4) * D(\text{LOG(last year coffee production)} + C(5) * D(\text{LOG(PO15\_64(-1))}) + C(6) - -sh * D(\text{LOG(X\_WA(-1))}) + C(7) * D(\text{LOG(last year trade opens)} + C(8) - -$$
$$- -\text{where} \quad C3 \text{ to } C7 \text{ are } short\ run\ coefficients \text{ Equation 1}$$

Based on the test results-coefficients of determination result and probability of significance, the model fitness was checked. In the regressions outputs the value of R^2=0.56, this indicated that the included explanatory variables explained the 56 % change in the dependent variable (Table 5). The F-statistic is significant at 1 %, the model is all right and fits well, we can accept.

Table 5

Vector Error Correction Model Outputs

Coefficients	Coefficient	Std. Error	t-Statistic	Prob.
C(1)=coefficients of adjustment	*-0.240926***	0.057797	-4.168502	0.0002
C(2)=lagged coffee export in kg	*-0.40***	0.139479	-2.89	0.0071
C(3)=export price	*-0.46***	0.165390	-2.76	0.0098
C(4)=coffee production	0.13	0.217179	0.59	0.5554
C(5)=population (15 to 64 aged) $_{t-1}$	*-6.64**	3.290073	-2.02	0.0524
C(6)=Coffee exported from the world$_{t-1}$	-0.20	0.633162	-0.32	0.7536
C(7)=OPENS$_{t-1}$	*0.35***	0.167162	2.09	0.0454
C(8)=intercept	0.22	0.097097	2.28	0.0300
R-squared	0.56	Adjusted R-squared	0.46	
Prob(F-statistic)	0.000348			

Note. The significances of the variables denoted by *** for 1 %, ** for 5 % and * for 10 %.
Source: author's research.

Long run causality interpretations. As shown in the table above, the C(1) the long run coefficient of adjustment value is negative and significant at 1 %. This indicates that there is long run causal relationship between the independent variables included and dependent variable in the model toward equilibrium. The Error correction term, relates to the facts that the last period deviation from long run

equilibrium (the error) influences the short run dynamics of quantity of coffee exported from Ethiopia. The speed of adjustment to long run equilibrium error term value has to be negative and significant for economic interpretation. The C(1) measure the speed of adjustment which extent coffee exported returns to equilibrium after a change in explanatory variables at speed of 24 %. The correction in one period draws back to the other period correction to reach equilibrium at speed of 24 %. The coefficient of error correction model was estimated to be (-0.2409) that implies existence the long run association would be corrected annually to retain to the equilibrium. The departure in one correction, the correction would fall back to other correction to retain in the equilibrium. The speed of adjustment in the long run causality running from population (aged between 15 to 64), world export quantity of coffee, export price and coffee production at rate of 24.09 %. The value of error correction coefficient measures the running speed at which coffee export in tone returns toward the equilibrium after changes in export price, consumer price index and coffee production in Ethiopia. To sum up, the result indicated that the previous period's deviation from long run equilibrium is corrected in the current period at an adjustment speed of 24 %.

Short causality of coffee export model. The regression result confirmed that the short run causality of Ethiopia coffee export defined as function of lagged export quantity in kg, export price, population and trade opens. The result is also supported by Tadesse (2015) that indicated real export price of coffee, domestic production of coffee and world supply of coffee affects coffee export supply in short run significantly.

Diagnostic checking and validation of the model. After estimating the VEC equation, the validation of the model tested by undertaking Diagnostics of residual, coefficient diagnostic and parameter stability. The residual diagnostic tested applied for normality, heteroscedasticity and serial correlation of the model that are necessary to verify if the hypothesis of classical regression are confirmed. The validity of the model tested by residual and coefficient diagnostics. All of diagnostic test result found that the data is devoid of any problem and validated the findings for policy formation.

3.1. Normality of Residuals. As indicated in the graph (Fig. 5) indicated, the residuals of the residuals of specific variables are normally distributed. The normality test graph above indicated the Probability value is above 5 % that implies the residuals are normally distributed. Test of normality in the residual following the same procedure indicated we cannot reject null hypothesis and as the results the residuals are normally distributed.

3.2. Serial correlation of residuals. Residual diagnostic to check whether there is serial correlation. The test by table 6 indicated that our model is fits good and no serial correlation. Probability value is more than 5 % and we can reject null hypothesis by confirming no autocorrelation in the model. The null hypothesis states that there is no serial autocorrelation in the model, the probability value more than 5 % implied that, we cannot reject ho that states there is no serial correlation, this

model does not have any serial correlation, good sign of the model. There is no evidence of serial correlation.

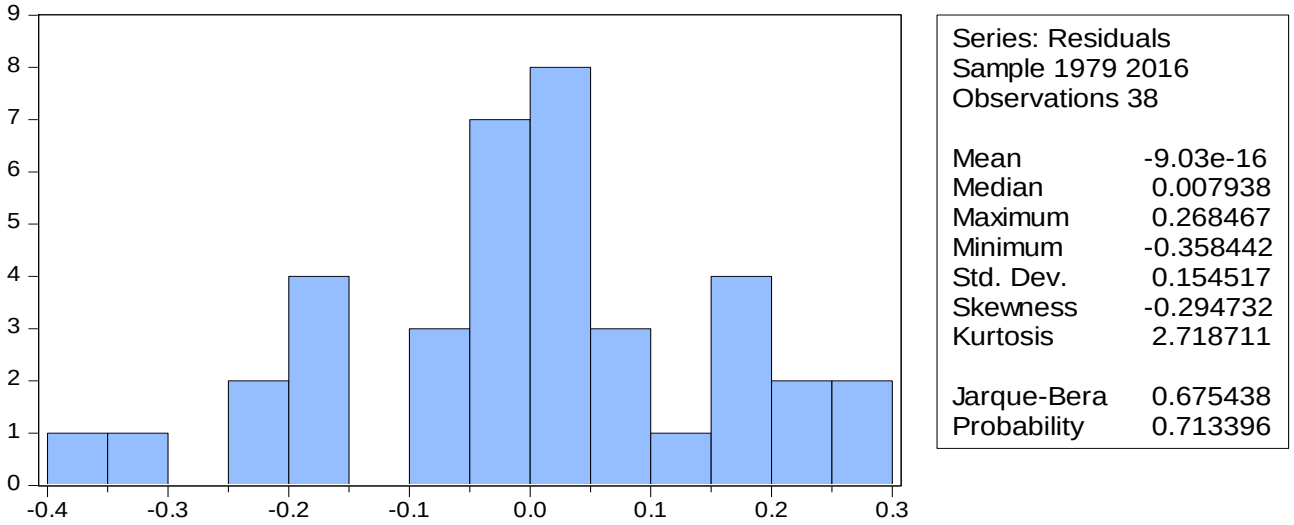

Fig. 5. Normality tests of residual of the model

Source: author's research.

Table 6

Serial correlation LM Test results

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.898726	Prob. F(1,29)	0.3510
Obs*R-squared	1.142243	Prob. Chi-Square(1)	0.2852

Source: author's research.

3.3. Heteroscedasticity Test of residuals. Since the probability value is higher than 5 % we cannot reject null hypotheses and accept H_o, this implies that there is no heteroscedasticity in the model that is desirable. This indicated that the specified model is homodescedaststic. The table 7 illustrated that the error correct model is not suffering from heteroscedasticity that validates the model to be good.

Table 7

Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.660503	Prob. F(12,25)	0.7712
Obs*R-squared	9.147448	Prob. Chi-Square(12)	0.6903
Scaled explained SS	4.899458	Prob. Chi-Square(12)	0.9613

Source: author's research.

3.4. Dynamic stability of the model. Stability diagnostics to measure parameter constancy is a critical issue for Ethiopian coffee export equations. In particular, to be able to interpret the estimated equation as an export equation, it is necessary to assure that the parameters are stable over the estimation period. To achieve this, the study implemented the methodology based on the cumulative sum (CUSUM) tests. The decision about the parameter stability relies on the position of the plot relative to the 5 % critical bound. The CUSUM test is based on the cumulative recursive sum of recursive residuals (Fig. 6).

The CUSUM test statistics is updated recursively and plotted against break points in the data. For stability of the short-run dynamics and the long-run parameters

of the coffee export function, it is important that the blue trend line has to be lied between the two red lines as shown in the figure bellow. Hence, the model is said to dynamically stable because the blue trend line lies between the red lines.

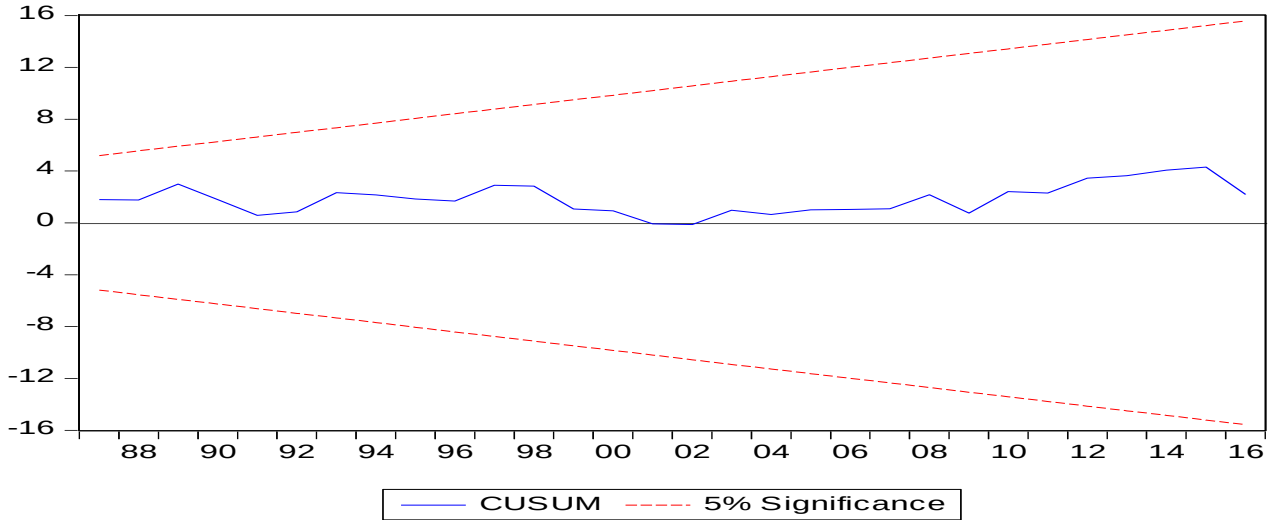

Fig. 6. Dynamic stability test

Source: author's research.

3.5. Wald test for joint effect of certain explanatory variable on Ethiopian coffee export.

Short run association of Variables by Wald test.

As show in table 6 above, the null hypothesis rejected and alternative hypothesis accepted for existence of short run association between explanatory variable and dependent variables in the movement of equilibrium. As illustrated in the table 8, the probability value of the estimate is less than 5 % and that assured the existence of evidence in movement from *export price, trade opens, coffee production, population of aged between 15 to 64, world coffee supply to market to extent of Ethiopia coffee export* in short run.

Table 8

Wald test for joint test of short run effects (1977 to 2016)

Test Statistic	Value	Degree of freedom	Probability
F-statistic	4.18	(5, 30)	0.0053
Chi-square	20.91	5	0.0008
Null Hypothesis: C(3)=C(4)=C(5)=C(6)=C(7)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C (3)	-0.46	0.16	
C (4)	0.13	0.22	
C (5)	-6.64	3.29	
C (6)	-0.20	0.63	
C (7)	0.35	0.17	
Restrictions are linear in coefficients.			

Source: author's research.

The summary of this regression indicated that there is short run and long run

causality running from world coffee export price, world coffee export, population and coffee production in tone to the equilibrium. It implied that the explanatory variables included in the model caused granger causality of Ethiopian coffee export jointly. It also showed there is evidence of shorten causality running from defined explanatory variables to Ethiopian coffee export.

In general, the estimated model also is normally distributed and does not suffer from problems of autocorrelation, heteroscedasticity, instability and specification errors. Therefore, the OLS standard errors are correct and can be used for inference and policy implication. The short run estimated coefficients for lagged population size, export price, trade opens and quantity of last year coffee export are -6.64, -0.46, 0.35 and -0.40 respectably. The long run coefficients of the model for population, export price, coffee production level and world coffee supply summarized as -8.23, -2.14, 2.67 and 8.64. The result implied that (in absolute value) all of short run coefficients estimates are smaller than their long run counterparts. However, trade opens influence the country coffee export in the short run, while the coffee production and world supply level variable are found to affect the Ethiopian coffee export only in the long run. The Vector error correction model (VECM) has the correct negative sign for its coefficient of adjustment. In addition, it is significant at conventional levels, substantiating the evidence for co integration of the variables in the system established earlier. The estimated coefficient of the VECM suggests the last period disequilibrium is corrected by about 24 % or more in the next.

Conclusions. The time series analysis aimed to identify factors affecting export of Ethiopian coffee for period of 1977 to 2016 for 38 observations after adjustments. The study used quantity of coffee exported to all importers as dependent variable and export price, population, world coffee export in tone, trade opens and coffee production as explanatory variables. Prior to the specification of Error correction model, tests done comprised of Augmented Dickey-Fuller tests for stationary and Johansen co-integration test for existence of this single co-integrating vector in the long run that defined based on estimate of trace value and maximum Eigen value. The optimum selected lag length was one based on different criteria. After differencing data the unit root test shows that the series are found to be integrated of order one i.e I(1).The study examined the order of integration of variables through Johansen co-integration test, and then assessed co integration among the variable and short-run adjustments to retain the long-run equilibrium. After undertaking co-integration test, normalized equation and Error correction model were estimated. At the end of analysis, diagnostic checking of the model tested for validation of the model and extent of independent variables capability to explain the dependent variables (56 %).

The negative value for coefficient of adjustment and statistically significance at 5 % level directed to further analysis and confirmed existence of the two type of causality (long run and short run). From the result it is concluded that there is a long run causality running from export price, world coffee exports, population and coffee production to extent of Ethiopian coffee exported. From Joint Wald test and

probability value it is also concluded that there is short run causality running from independent variables toward dependent variables. This implies that these five explanatory variables significantly affect the short run causal relationships on dependent variables and causal association toward the equilibrium.

The empirical result indicates that *export price, lagged exported coffee in tone, population size of active labour force and trade opens* determine and significantly affect the short run coffee export of Ethiopia. The long run supply of coffee export known to be defined as function *export price, world coffee export level, coffee production and population size aged between 15 to 64 years old*. The output also implied that export price and propulsion size of active labour force significantly affect both short run and long run supply of Ethiopian coffee export. The result of time series analysis implied that in the long run the quantity of country coffee production and world level of coffee export played diminishing effect on export quantity of Ethiopian Coffee; while increase in active population size and export price owned increasing effect. The short run association between Ethiopian Coffee exports with trade opens is known to be direct and supportive, while its association was inverse with population size, lagged export level and export price.

The finding of the study pointed out the country to work on production and productivity improved through technology adoption, value addition activities for soaring coffee demand in the country and to respond for strict competition globally. Improving trade relation is also found to support the Ethiopian coffee export. The longevity production system of the crop and high coffee demand in the country caused relatively better price of coffee in the country. The finding directed to summarize the point as prevailing high export price last year caused exporters to low supply in the next year for fear of price decrease and suspected hoarding the commodity and its time taking production system. In addition to these the result confirmed the major target of exporters seemed highly blinked to search of foreign currency for importing other capital goods than its economic gain of coffee export. Export price, world trade benefit, population size and trade opens needed to be seen as policy instrument for promoting Ethiopian coffee export. The policy implication for short run Ethiopian coffee supply calls for more import substitution and then export promotion, productivity improvement by adoption improved technologies and value addition practices. As long term solution for negative role of world coffee supply level and lagged country production the country to give due attention to domestic demand, specialization and value addition. The positive impact of active labour force and export price provokes existence of opportunity in linking human resource with coffee export and ample benefit in the world market in the long run.

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