ADITUM Journal of Agricultural Research Pesticides and Biofertilizers

Open Access Research Article

Determinants of Oilseeds Export in Ethiopia: A Vector Error Correction Model Approach

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Article Info

Received: May 08, 2021
Accepted: May 17, 2021
Published: June 02, 2021

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Citation: Firomsa.M.Tekalign. (2021) "Technical Efficiency of Ethiopian Agriculture: A Meta-Analysis.", Journal of Agricultural Research Pesticides and Biofertilizers, 1(3); DOI:http;//doi.org/05.2021/1.1013.

Abstract

The paper examines the determinants of oilseeds export performance of Ethiopia by using an econometric model for the period 1974- 2017. It analyzes the long run determinants and short run dynamics of oilseeds export performance of Ethiopia with the application of vector error correction model. The data were collected from National Bank of Ethiopia annual report, food and agricultural organization data file, and World Bank report. The findings of the study revealed that in the long run oilseeds export performance has found to be positively and significantly influenced by gross domestic product, price of oilseeds and exchange rate, and negatively influenced by consumer price index. In the short run only last year gross domestic product, consumer price index and exchange rate has directly involved in enhancing oilseeds export performance of current year. Ensuring a stable exchange rate policy in order to avoid the exchange rate risk attached to the assets, macroeconomic policy reforms aimed at improving the growth of gross domestic product, controlling up rising movement of domestic price and allow further nominal depreciation of local currency should due emphasis so as to improve Ethiopia's oilseeds export performance.

Keywords: oilseed; export performance; Ethiopia; vector error correction model

Introduction

The international trade of Sub-Saharan African countries is mainly based on exporting primary agricultural commodities in which they have comparative advantages due to cheap labor and tropical climate. As in the case of many developing countries, Ethiopia's export has been limited to few primary products, which are mainly agricultural commodities. That is a few primary products that account for a country's export earnings have dominated the sector. According to the World Bank (2009), the share of Ethiopia's manufactures export in the total export is only 9.0 percent implying primary agricultural commodity to be 91 percent. The agricultural sector, in turn, operates at the mercy of nature and the effects of nature on the sector are directly transmitted on to the performance of the export sector. Hence, agriculture is the most important determinants of Ethiopia's overall export performance.

Oilseeds are the second export earner of Ethiopia. Growth and improvement of the oilseed sector can substantially contribute to the economic development at national, regional level and at family level and it is considered as high value export products by the Ethiopian government. Oilseeds that are a mainstay of the rural and national economy in Ethiopia and more than three million smallholders are involved in its production. Exports actually consist of sesame and Niger seed, for which there is a growing demand in the world market. In addition, castor, linseed and safflower have good export potential. The growing demand in the world market for these specialty products and the available capacity to expand production could make oilseeds turn into one of the engines of economic growth of Ethiopia (Wijnands et al., 2009).

Even though agriculture is based on subsistence farm households, Ethiopia's oilseed sector plays an important role in generating foreign exchange earnings for the country. In 2016/17 MY exports of major oilseeds sesame, Niger seed, and soybeans generated nearly $360 million in export earnings. Sesame exports are forecast to reach 360,000 metric tons in MY18/19, surpassing the previous year by a little more than 20,000 metric tons while Soybean export jumped a little more than 30,000 metric tons to nearly 80,000 metric tons in large part and Niger seed forecast to remain largely unchanged at nearly 30,000 metric tons. In addition, the oilseed sector provides income to millions of growers and others market actors along the value chain (GAIN, 2018).

In addition to the government's effort to increase the country's foreign exchange earnings by boosting the country's export performance and hence economic growth, pursuing concrete policy measures and incentive schemes and based on available trade data year-over-year export volumes are expected to increase, it still calls for specific case studies concerned with systematic identification of factors constraining oilseed export performance. Thus, identifying and examining those factors that significantly affect Ethiopia's oilseed export as to take corrective actions helps us to know what explains variation in Ethiopian oilseed export that should facilitate the design of policies to improve the performance and ultimately overall economic growth. Therefore, the objective of this paper is to analyze the long run determinants and short run dynamics of oilseed export performance of Ethiopia with the application of a vector error correction model.

Materials and Methods:

Data source and type:

Time series secondary data is used in the study. The data was collected from National Bank of Ethiopia (NBE) annual report, world Trade organizations report, FAOSTAT data file and World Bank annual report. For analyzing the country's determinants of oilseed export, the data covers the period from 1974 - 2017.

Methods of estimation and procedure: test used

Stationary test

The standard classical methods of estimation, which are used in the applied econometric work, are based on a set of assumptions one of which is the stationary of the variables. A variable is said to be covariance (weakly) stationary if the mean and the variances of the variables are constant over time and the covariance between two periods depends only on the gap between the periods, and not the actual time at which this covariance is considered. Whereas a non-stationary series has a different mean at different points in time and its variance, increases with the sample size (Debel G., 2002).

According to Madala (1992), a time series is said to be strictly stationary if the joint distribution of any set of N observations Y_1, Y_2------Y_t is the same as the joint distribution of Y_{1+k}, Y_{2+k} …Y_{t+k} for all N and K. The distribution of Y_t is independent of time and thus it is not only the mean and the variance that is constant but also all higher values of t are independent of t.

In time series analysis, most encountered series are in fact non-stationary. Contrary to the situation of stationary process that fluctuates around their mean, the reversion to a fixed value rarely occurs for non-stationary process. If a non-stationary time series is regressed on one or more non-stationary time series, the results are prone to spurious regression problems. This is a situation where results obtained suggest there are statistically significant relationships between the variables in the regression model when in fact all that is obtained is evidence of contemporary correlations rather than meaningful causal relations.

Therefore, it is necessary to check whether the variables included in the model are stationary or not before going to the next step which is regression analysis.

Unit root test

Unit-roots are important to detect the stationary of time-series data. To test if the series, used have unit-roots we apply a test based on the work of Fuller (1976) and Dickey and Fuller (1979, 1981). The Augmented Dickey-Fuller test is a similar but modified version of the Dickey-Fuller test which is used when error term is not a white noise. While testing for stationary, if a variable becomes stationary at level, then it is said to be integrated of order zero, I (0). In addition, if the variable is stationary at its first difference, it is said to be integrated of order one I [1]. Similarly, if a variable can be transformed to stationary series by differencing n times, then it is integrated of order n, I (n) (Verbeck, 2004).

Co-integration and the error correction model:

Co-integration is used to regard or take care of the non-stationary of the variables and to examine whether there exist long run equilibrium relationships among the variables under consideration (Gujarati, 2004)

The co-integration test shows that even though the variables taken separately are not stationary, i.e., are I (1), their linear combination may be stationary. In such a case the variables are said to be co integrated series is not spurious and hence, it enables to establish long run relationship between independent and dependent variables.

The Engel Granger (EG) two-stage procedure and Johansen maximum likelihood approach are the two methods of testing for the existence of co-integration among variables. According to Gujarati (2004), while using EG approach, in the first step, the long run model in the level form which is integrated of order one, I [1], is estimated. In the next step, the residual forms the long run model is tested for its stationary. If the residual is found to be stationary, then the variables are co- integrated. That is, there exists long run equilibrium relationship among the variables. We use EG approach in this study to test the co-integration using ADF tests.

The error correction model (ECM):

The error correction model used to capture both the long run and short run model. Co integration test only indicates long run relationship but not short run. That is why error correction model required. To explain the short run relationship between independent and dependent variables that are co-integrated, ECM is used.

According to Gujarati (2004), even if the variables of the model are co-integrated, there may be disequilibrium in the short run. ECM tells us how much time it takes to adjust this short run shocks. As a result, the residual of the long run model can be treated as the equilibrium residual and it can be used to connect the short run behavior the model ‘s dependent variables to its long run value. The ECM is also important since it conveys information for the speed of adjustment from short run disturbance to long run equilibrium.

Empirical results and discussions:
Result of tests for order of integration (Unit root test):

The values of all economic variables were transformed into logarithmic values and the estimation begins with the testing of variables for unit roots to determine whether they can be considered as a stationary or non-stationary process. Table 1 presents the Augmented Dickey Fuller (ADF) tests of variables. The tests showed that all the variables were non-stationary at level and stationery at first difference implying that they were all integrated of degree 1 (I (1)) because ADF test statistics is greater than the critical value of the first difference. Annex 1 gives details of unit root test output of variables.

Variables	At level				variables	At first difference			
	Test Statistic	Critical Value				Test Statistic	Critical Value		
		1 %	5 %	10 %			1 %	5 %	10 %
Log (OLX)	-1.305	-3.592	-2.931	-2.604	DLog (OLX)	-6.336	-3.60	-2.935	-2.606
Log (CPI)	0.419	-3.592	-2.931	-2.604	DLog (CPI)	-4.881	-3.597	-2.933	-2.605
Log (GDP)	0.089	-3.595	-2.933	-2.605	DLog (GDP)	-3.628	-3.597	-2.933	-2.605
Log (PRC)	-0.309	-3.592	-2.931	-2.604	DLog (PRC)	-8.350	-3.597	-2.933	-2.605
Log (XRT)	0.007	-3.597	-2.933	-2.605	DLog (XRT)	-3.658	-3.597	-2.933	-2.605

Table 1: Result of unit root tests (at level and at first differences) of the variables
Source: Compiled from Eviews output, 2019

Co-integration test:

After testing the unit root and lag length is determined, the next step is to find out whether the variables share a common stochastic trend, i.e. to test whether two or more variables are co integrated or not. The concept of cointegration implies that if there is a long-run relationship between two or more non-stationary variables, deviations from this long-run path are stationary. Johansen's cointegration multivariate procedure is used to establish whether the variables are co-integrated in the long run. The result of likelihood ratio indicates one co-integrating equations at 5% significance level. In other words, it accepts alternative hypothesis of having one co-integrating vector. Since the test statistic (102.44) is greater than the 95% critical value (69.82) of the trace statistic value, it is possible to reject the null of more than one co-integrating vector (Table 2). The maximum Eigen value test starts with the null hypothesis of at most r co-integrating vector against the alternative of r+1. The result for maximum Eigen value test confirms the rejection of the null hypothesis; i.e., no co-integrated vectors. Therefore, both Trace statistic value and maximum Eigen value indicate that there are one co-integrating equations at 5% significance levels (Table 2).

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 critical value	Prob.**
None*	0.7478	102.4412	69.8189	0.0000
At most 1	0.4448	45.9692	47.8561	0.0744
At most 2	0.3097	21.8468	29.7971	0.3071
At most 3	0.1421	6.6503	15.4947	0.6186
At most 4	0.0089	0.3679	3.8415	0.5442

Table 2a: Cointegration Rank Test (Trace)

Trend assumption: Linear deterministic trend
Series: LOG (OLX) LOG (CPI) LOG (GDP) LOG (PRC) LOG (XRT)
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen statistic	0.05 critical value	Prob.**
None*	0.7478	56.4720	33.8769	0.0000
At most 1	0.4448	24.1224	27.5843	0.1305
At most 2	0.3097	15.1965	21.1316	0.2754
At most 3	0.1421	6.2824	14.2646	0.5772
At most 4	0.0089	0.3679	3.8415	0.5442

Table 2b: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
*denotes rejection of the hypothesis at the 0.05 level
** MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)
Max-Eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
*denotes rejection of the hypothesis at the 0.05 level
** MacKinnon-Haug-Michelis (1999) p-values

Estimation of Long Run and Error Correction model:

The long run relationship between oilseed export, consumer price index, gross domestic product, price of oilseed, and exchange rate for one cointegrating equation of Ethiopia in the period 1974-2017 is displayed Table 3 (standard errors are displayed in parenthesis). The estimation of the long run model reveals that, Gross Domestic Product, Price of Oilseed and Exchange rate has a positive impact on oilseed export performance while consumer price index has a negative impact on oilseed export of Ethiopia, on average, ceteris paribus. The coefficients are significant at the 1% level. Therefore, we can conclude that the null hypothesis of no cointegration is rejected against the alternative of a cointegrating relationship in the model.

1 Cointegrating Equation(s)		Log likelihood 170.5131		
Normalized cointegrating coefficients (standard error in parentheses)				
LOG(OLX)	LOG(CPI)	LOG(GDP)	LOG(PRC)	LOG(XRT)
1.0000	34.21025	-16.52449	-12.67329	-8.360108
Std.error	(3.32829)	(2.19248)	(1.90409)	(2.29459)
t-statistic	10.27863	-7.53689	-6.65583	-3.64339

Table 3: Cointegrating equation (Normalized)

The above Johansen test revealed the existence of one long run relationship among the variables implies that we have both the long run and short run models.

The short run dynamics:

The next step is to estimate the VECM for oilseed export equation by saving the error term obtained from the long run model. Thus, to integrate the short run dynamics with long run model, the first difference of the variables to allow for delayed response is estimated using OLS. Since all the variables in the model are now I (1), statistical inference using standard t- and F tests is valid.
The most important thing in the short run results is speed of adjustment term. It shows that how much time would be taken by the economy to reach at long run equilibrium. Negative sign of speed of adjustment term shows that the economy will converge

towards long run equilibrium. However, if it is positive, the economy will not converge to the long run equilibrium. Thus, the output from Eviews 9 is presented as follows.

Error Correction	D(LOG(OLX))	D(LOG(CPI))	D(LOG(GDP))	D(LOG(PRC))	D(LOG(XRT))
CointEq1	-0.062885	-0.007244	-0.011176	0.044338	0.014793
Std. Error	0.03557	0.00581	0.00675	0.01639	0.00453
t-statistic	-1.76800	-1.24720	-1.65518	2.70546	3.26736

Table 4: Speed of Adjustment

The above table shows speed of adjustments coefficients, which show that three variables are adjusting to their long run equilibrium. Here the adjustment coefficient is negative which shows that the variables will converge towards long run equilibrium after taking 6.3 percent annually adjustments in the short run.

The estimation of the error correction model is constructed by including in the model, the lagged terms of the variables and the correction terms was constructed. Estimation of Error Correction Model combines both the short run dynamics and long run properties and at the same time avoids the spurious regression problem.

The ECM can be expressed as follow:

$Dlog\ (OLX)_t = \alpha_0 + \beta_1 Dlog(CPI)_{t-1} + \beta_2 Dlog(CPI)_{t-2} + \beta_3 Dlog(GDP)_{t-1} + \beta_4 Dlog(GDP)_{t-2} + \beta_5 Dlog(PRC)_{t-1} + \beta_6 Dlog(PRC)_{t-2} + \beta_7 Dlog(XRT)_{t-1} + \beta_8 Dlog(XRT)_{t-1} + zy_{t-2} + \varepsilon_t$……………...1

Where, zy_{t-2} represents the error terms lagged by two periods for oilseed export performance. The coefficient measures the long run equilibrium relationship while **β_1 … β_8** measure the short run causal relation. The result of the error correction model is discussed in Table 5 as follows:

Variables	**Coefficients**	**Std error**	**P-value**
LOG (OLX (-1))	-0.1059	0.0284	0.0007***
D (LOG (CPI (1)))	-4.5522	1.1172	0.0003***
LOG (CPI (-2)))	-1.9328	1.1922	0.1142
D (LOG (GDP (-1)))	3.5891	1.2906	0.0088***
D (LOG (GDP (-2)))	-0.9950	0.9819	0.3181
D (LOG(XRT (-1)))	8.1245	1.3200	0.0000***
Constant	-0.0261	0.1469	0.8597
R-squared =	0.6482	Prob(F-statistic) =	0.000001
Adjusted R-squared =	0.5862	Durbin-Watson stat =	1.9746
F-statistic =	10.4424		

Table 5: Results for short run relationship of the model

Dependent Variable: D (LOG (OLX))
Method: Least Squares (Gauss-Newton/Marquardt steps)
Included observation: 41 after adjustments

From the estimation results of the short run error correction model in table 5 above, the coefficient of the error correction term is significant with expected negative sign, which implies that there is a feedback mechanism in the short run. The error correction model helps to correct for disequilibrium in the short run and therefore the negative coefficient in the results above in confirmation that there is no disequilibrium of the variables in the short run and relatively to the magnitude (-0.1059). Its magnitude indicates that deviation from the long run equilibrium is adjusted quickly where 10.59% of the disequilibrium is removed each period. The result of R2 is also 0.648(64.8%). Which reveals that of Ethiopian oilseed export performance is caused by the explanatory variables included in the model, while 35.2% is by other variables, which were not included in the model. Furthermore, F-statistic is significant with a probability of 0.00001, which implies that the model fit.

Furthermore, consumer price index, Gross Domestic product and Exchange rate are the significant determinants of the country ‘s oilseed exports in the short-run. Consistent with expectation, Gross Domestic Product and Exchange rate are positively related with the country‘s oilseed exports and negative relation was found in the case of consumer price index.

The coefficients of the short run model show that consumer price index, GDP and exchange rate are significant; indicating that the variables significantly affect oilseed export performance of Ethiopia in the short run. In the estimation one period lagged price of oilseed were found to be insignificant and left out of the short-run dynamics model. The insignificant price of oilseed variable may signify the possibility of failing price of oilseed in the short-run. The result also shows that there is a short run causality running from consumer price index, Gross Domestic Product and exchange rate to oilseed export quantity while there is no short run causality running from price of oilseed-to-oilseed export quantity. Hence, there is short run and long run causality running from consumer price index, GDP, and exchange rate to oilseed export.

Diagnostics Test:

The model was tested for normality, serial correlation, autoregressive conditional, Heteroscedasticity and stability, the model is reasonably well specified, and tests results are (reported in Table 6 and Annex 1). Diagnostics tests also indicated that the residuals are normally distributed, homoscedastic and serially uncorrelated and the parameters appear to be stable.

Test	**Method of Test**	**Statistics**		**Probability**
Normality	Jarque Bera Statistics	χ^2 - statistics	0.2788	0.8699
Serial Correlation	Breusch-Godfrey Serial	F-statistics	0.0129	0.9872
	Correlation LM test	χ^2 - statistics	0.0391	0.9807
Heteroscedasticity	Breusch-Pagan-Godfrey test	F-statistics	1.1920	0.3384

Table 6: Diagnostics (Post-estimation) test

Annex 1: Diagnostic tests for estimated long run equation: Test for heteroscedasticity:

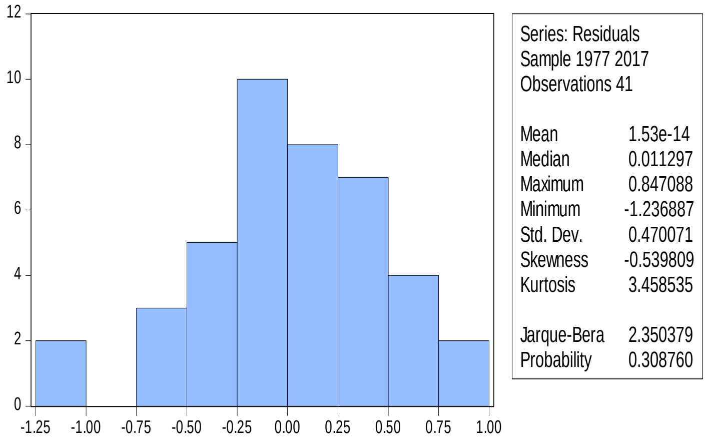
Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.192036	Prob. F (15,25)	0.3384
Obs*R-squared	17.09639	Prob. Chi-Square (15)	0.3131
Scaled explained SS	10.51427	Prob. Chi-Square (15)	0.7862

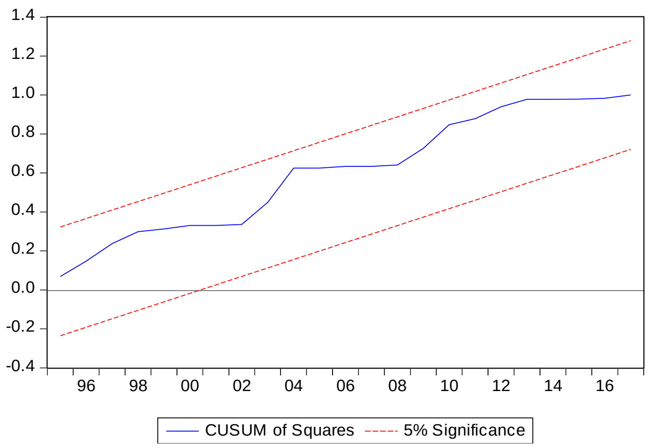
Test for Serial Correlation:

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.012873	Prob. F (2,27)		0.9872
Obs*R-squared	0.039059	Prob. Chi-Square (2)		0.9807

Test for Normality:



Test for Stability of Model:



Conclusions and policy implications:
Conclusions:

The main objective to be investigated in this paper is to identify factors significantly affect the oilseed export performance of Ethiopia. To address this question, we use the time series data consisting of the period 1974-2017. In order to know the long run and short run determinants, Johansson co-integration analysis is employed. The study uses secondary data collected from different sources. In this study total oilseed export (in Kilogram) is used as dependent variable and consumer price index, gross domestic product, price of oilseed, and exchange rate are expected to affect oilseed export performance of the country are used as independent/explanatory variables.
Accordingly, the first task was estimation using OLS technique to test the relationship between oilseed export performance and explanatory variables. Pre-estimation tests of the statistical behavior of the variables using Augmented Dickey Fuller test for the presence of unit root showed that all the variables were non-stationary at level. However, all the variables were stationary at first difference. Thus, they are regarded as integrated of order one. The next step was co-integration test, which helps us to know the presence of long run relationship between the dependent variable and the explanatory variables. After co-integration test was conducted using Engle Granger procedure and its presence was confirmed, since the error correction term is significant and negative in sign as expected. The long run equation was estimated and according to the result all the variables were found to significantly affect oilseed export performance of the country. In addition, the sign of variables was found to be the same as what already expected. The significant coefficient of GDP shows that high production capacity at a point in time determines the export potential utilization and total supply of export for a country.

Next, the Error Correction Model (ECM) was estimated to show the short run relationship between the dependent and explanatory variables. Accordingly, the regression result shows that price of oilseed was insignificant in the short run. That means in the short run this variable has no impact on the oilseed export performance of Ethiopia. On the other hand, except this explanatory variable all other variables such as consumer price index, gross domestic product, and exchange rate over a period were found to affect the dependent variable significantly as expected.

Policy implications:

Based on the findings of this study the following policy implications can be drawn:

- ✓ The government has to ensure a stable exchange rate policy in order to avoid the exchange rate risk attached to the assets, import prices and profit considerations to improve and promote export growth sector.
- ✓ Macroeconomic policy reforms aimed at improving the growth of GDP enhances the total oilseed export performance of Ethiopia.
- ✓ The government has to control up rising movement of domestic price and allow further nominal depreciation of local currency in longer run in order to encourage more export.
- ✓ In promoting export, the role of maintaining a high and sustainable economic growth is crucial. Because maintaining this has an implication of boosting the supply capacity of the country's export sector.

Abbreviations:

GAIN: Global Agricultural Information Network; NBE: National Bank of Ethiopia; FAOSTAT: Food and Agriculture Organization Statistical; ADF: Augmented Dickey Fuller; ECM: Error Correction Model; VECM: Vector Error Correction Model

Acknowledgement:

We are grateful to the Haramaya University.

Funding:

Not Applicable

Availability of data and materials:

The data that support the findings of this article can be obtained from the authors based on request.

Authors' contributions:

FMT conceptualized, designed, performed the analysis, interpreted the results and write-up the manuscript. DG was responsible for the advising. Both authors read and approved the final manuscript.

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Ethics approval and consent to participate:

Ethical approval and consent to participate is not applicable for our study.

Competing interests:

The authors declare that they have no competing interests.

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