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Analysis of Factors Constraining the Competitiveness of Sesame Export in the Sudan

Imad Eldin Elfadil Abdel Karim Yousif[1]

Abstract

The paper analyzed sesame export performance and competitiveness and its main constraints in Sudan. Vector error correction model was applied using data from 1970-2014. The results showed that low yield, area variation and unstable fluctuating exchange rate are the main factors affecting sesame export earnings in the long run, and area variation in the short run. Improvement of sesame yield and stabilized exchange rate will have positive impact on sesame export value in the long run, while expansion of area under sesame production could have negative influence on sesame export value due to Sudan large share of sesame export in the world market. In order to improve foreign exchange earnings from sesame export, Sudan should address the problem of low yield, area variation and fluctuating exchange rate especially in the long run. The paper recommends adopting economic policies that lead to improvement of sesame yield, control of area under sesame production and to stabilize exchange rate of Sudanese currency.

Keywords: Sesame export, Competitiveness, Constraints, Sudan

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1 Introduction

Agriculture is an important sector of Sudan economy and is the backbone of growth, poverty reduction and sustainable development, especially after cut of oil resources after secession of South Sudan. Sesame, gum Arabic and livestock are the most important cash crops produced in Sudan. Sesame is considered one of the major cash crops for export and domestic use in Sudan, and the country is one of the world's largest producers and exporters. Sesame in Sudan is mainly produced under semi-mechanized and traditional farming systems. It is grown entirely under rain-fed conditions, and is grown with little or no use of machinery or modern inputs under the traditional farming system. The major sesame growing areas in the Sudan are located in the Kordofan, Sinnar, Kassala, and Blue Nile states.

Sudan exports about two third of its sesame production, and is among the main exporters of sesame seeds worldwide. The main sesame exporters worldwide include India, Ethiopia, Nigeria, Sudan, China, Paraguay, Myanmar, and Mexico. Sudan ranks second after India in cultivated area, but Sudanese sesame yields are lower than any of the above-mentioned countries. Sesame yield in Sudan is equivalent to 18%, 27%, 58% and 51% of productivity in China, Ethiopia, India and Nigeria, respectively in 2010. With 10% share in total world export of sesame, Sudan's ranked fourth after Nigeria, India and Ethiopia who had 38%, 20% and 16% share of the market in 2010 (FAO Statistics).

Table 1: Sesame export values and quantities (2008-2013)

Years	Quantity (1000 ton)	Value (million US $)	Unit value (US $/Ton)	Share in agricultural exports (%)	Share in total exports (%)
2008	96.7	141.9	1467.4	36.1	1.2
2009	137.6	143.3	1041.4	31.2	1.7
2010	224.1	167.3	746.5	38.2	1.5
2011	211.8	231.0	1090.6	30.2	2.4
2012	208.9	223.5	1069.8	28.5	6.6
2013	242.7	472.7	1947.6	29.0	6.6
Average	186.6	229.9	1227.2	32.2	3.3

Source: Central Bank of Sudan Annual Reports.

Table 1 shows sesame exports value, quantity and share during the period 2008-2013. Sesame exports in 2008-2013 accounted for about 32% of agricultural exports and about 3.3% of total export, on average. Sesame exports are emerging to become one of the leading export commodities in Sudan after decrease of oil export as its share in total exports increased to more than 6% in 2013. Sudan's markets for sesame are quite diversified having penetrated markets in China, Europe and African countries as well as traditional markets in the Gulf and Arab countries. Gulf and Arab countries are the major importers of sesame from Sudan with a share of more than 34% in 2012, followed by China with a share of 25%.

There are many obstacles restraining the use of potential that sesame represents for small farmers and trade in Sudan. These obstacles are associated with rainfall variability, land tenure, harvesting and post-harvesting, quality of seeds and weak links in its value chain. In addition to ineffectiveness of agricultural extension, lack of agricultural rotation, low or no use of technology, frequent mono-cropping and used of non-certified seed. Macroeconomic policies, represented by high inflation rate and distorted exchange rate market, are also constrained sesame production and exports.

This paper attempts to analyze and quantify the effect of some of the major factors that constrained the competitiveness of sesame export in Sudan, namely yield, rainfall and exchange rate through application of vector-error-correction model. These factors are the major constraints of sesame exports as they affect its revenues and competitiveness in the world market.

2 Materials and Methods

The study employed the co-integration vector-error-correction model (VECM) to examine factors affecting sesame export in Sudan. Co-integration technique is superior to other techniques like panel and gravity modeling because this technique is able to establish the short-run and long-run relationship amongst variables, and estimate unit root and co-integration test. Granger (1986) pointed out that testing for co-integration of the regression residual is imperative condition to avoid the possibility of producing spurious regression output.

In VECM, an equilibrium relationship exists when variables in the model are co-integrated. Two conditions must be satisfied for variables to be co integrated. First, the data series for each variable involved should exhibit similar statistical properties, that is, be integrated to the same order; and second, a stationary linear combination must exist (Malik 2010). For a time series to be stationary, it means, variance and covariance at various lags stay the same over time.

Several studies have suggested a number of co-integration methodologies including Hendry (1986); Engle and Granger (1987); Johansen (1988); Johansen and Juselius (1990); and Goodwin and Schroeder (1991). In this paper, Johansen's vector error correction model (VECM) has been used. VECM permits the testing of co-integration as a system of equations in one step and does not require the prior assumption of erogeneity of the variables.

2.1 Model Specification

The study used yield (Y), area (A) and real exchange rate (RER) as the main factors that affect sesame export earnings in Sudan. The RER is key determinant of agricultural export of any countries. It is expected that as the domestic currency depreciate the agricultural export will increase and vice versa, and it is a measure of competitiveness. The inclusion of yield is to measure the contribution of agricultural production capacity and technology use in Sudan to sesame export earnings. The area variable is used as indirect measure to capture the effect of rainfall variation. The following function for sesame export value is accordingly formulated:

$$LnX = f(LnY, LnA, LnRER) \quad (1)$$

Where Ln is natural logarithm, X is export value of sesame, Y is yield, A is the area and RER is real exchange rate. B_0 is the constant and B_1, B_2 and B_3 are the coefficients, and U_t is error term.

Real exchange rate is calculated by using the following equation (see Kingu 2014):

$$RER = \frac{CPI_{sud}}{CPI_{us}} * NER \quad (2)$$

Where CPI_{sud} is consumer price index of Sudan, CPI_{us} is consumer price index of United States of America (US) and NER is the nominal exchange rate in local currency.

To estimate long relationship among variables in equation (1), a VECM was estimated. To estimate the VECM model the following steps are followed: First, a test of stationary for the variables included in the model was conducted using Augmented Dickey Fuller test (ADF) at level and first difference. The variables found to be non-stationary at level which means the output of regression of equation (1) is spurious. Engle –Granger (1987) and Gujarati, (2004) pointed out that if the regression residual of equation are stationary this indicates the existence of long run relationship amongst the variables. Thereafter, a first difference of the variables has been taken in order to obtain stationary variables. Second, a co-integration test for selected variables was conducted using Johansen co-integration test. Third, the VECM model is specified and estimated.

2.2 Data Sources

Time series data from 1970 - 2014 for model variables were used in the analysis. Data were compiled from different sources, sesame yield, area and export value, nominal exchange rate, and consumer price index for Sudan were collected from annual reports of the Bank of Sudan, while the consumer price index of US is collected from US Department of Labor Bureau of Labor Statistics.

2.3 Stationary Test

To check the stationary of the data, Augmented Dickey-Fuller (ADF) unit root test was applied. For this test, intercept terms are included in the regression. Table 1 shows the results of ADF unit root test for the model variables both at level and first difference. For all variables in levels, the null hypothesis that each series has unit root test cannot be rejected as the ADF statistics are below the critical value at 5% level of significance. These results indicate that the regression output of the model represented by equation (1) is spurious, but the regression residual for the variable at level is stationary. This indicates the existence of long run relationship amongst the variables. Also, Table 2 shows that all variables become stationary and have no unit root after taking first difference, therefore, we can go to the next step and conducting a co-integration test.

Table 2. Results of unit root test

Variables	Augmented Dicky-Fuller Test			
	Variables in Level	P value	Variables in 1st Difference	P value
LnX	-2..3	0.17	-5.72	0.00
LnA	-2.58	0.11	-8.57	0.00
LnY	-1.17	0.67	-9.66	0.00
LnRER	-1.05	0.72	-5.10	0.00

Source: Calculated in EViews 6.

2.4 Co-integration Test

After checking the hypothesis of non-stationary, the time series were examined for the co-integration. Co-integration analyzes the relationship between integrated series and explores a linear combination of integrated time series that was itself stationary. For co-integration, Johansen (1995) maximum likelihood procedure was used. Johansson's procedure for co-integration utilizes two statistics test for deciding the number of co-integrating vectors: i) Trace test**:** The null hypothesis (Ho) is that the number of co-integrating vectors is less than or equal to r and alternative hypothesis (H1) is that the number of co-integrating vectors is more than r; and ii) Maximum Eigenvalue: In Maximum Eigen value test, the null hypothesis (Ho) is that the number of co-integrating vectors is r and the alternative hypothesis (H1) is that the number of co-integrating vectors is r+1.

The results of co-integration test are presented in Table 3 along with the critical values of trace statistics and max-eigenvalue with lag length of 3 (k=3). The first row in the upper Table tests the hypothesis of no co-integration, the second row tests the hypothesis of one co-integration relation, the third row tests the hypotheses of two co-integrating relations, and so on, all against alternative hypotheses that there are more than r co-integrating vectors (r = 0,1,...,4) .

Table 3. Johansen co-integration test

Trace Test				
Number of co-integration	Eigenvalue	Trace statistics	Critical Value (5%)	Probability
None *	0.63	62.8	47.8	0.001
At most 1	0.36	24.3	29.7	0.187
At most 2	0.15	6.8	15.4	0.598
At most 3	0.01	0.3	3.8	0.614
Maximum Eigenvalue				
None *	0.63	38.5	27.5	0.001
At most 1	0.36	17.5	21.1	0.149
At most 2	0.15	6.6	14.3	0.541
At most 3	0.01	0.3	3.8	0.614

Source: Calculated in EViews 6.

*denotes rejection of hypothesis at 5% level of significance.

As shown in Table 3, both trace test and max-eigenvalue test indicate one co-integrating equation at 5% level of significance. Therefore, there are non-spurious long run relationships between the model variables and hence the VECM is a valid representation of the relationships between the dependent variable (sesame export value) and independent variables (yield, area and real exchange rate).

2.5 VECM Specification

The VECM model provides long term relationship and short term dynamics of the endogenous variables. The model shows the achievement of long term equilibrium and the rate of change in the short term to achieve equilibrium.

Depending on the results of Johansen co-integration analysis, we assumed only one co-integrating vector that affects only one equation. To capture both the short run dynamics between time series and their long run equilibrium relationship the following VECM model with 3 lags was estimated (see Jaupllari and Zoto 2013; Zulfiqar and Kausar, 2012):

$$\begin{aligned} D(LnX) &= \gamma LnX(-1) + b1LnY(-1) + b2LnA(-1) + b3LnRER(-1) + \propto \\ &+ C(2)DLnX(-1) + C(3)DLnX(-2) + C(4)DLnX(-3) + C(5)DLnY(-1) + \\ &C(6)DLnY(-2) + C(7)DLnY(-3) + C(8)DLnA(-1) + \\ &C(9)DLnA(-2) + C(10)DLnA(-3) + C(11)DLnRER(-1) + \\ &C(12)DLnRER(-2) + C(13)DLnRER(-3) \qquad (3) \end{aligned}$$

The first part of equation (3) represented by $(\gamma LnX(-1) + b1LnY(-1) + b2LnA(-1) + b3LnRER(-1) + \propto)$ captured the long run equilibrium relationships between the model variables, while the second part (C2-C13) captured the short run equilibrium relationships. γ is the error correction coefficient which shows the speed of adjustment of disequilibrium. If γ has negative sign and statistically significant, this indicates the existence of long run equilibrium relationship between the model variables (Anwar et al, 2010).

2.6 Variance Decomposition

To illustrate implication of the relationships among model variables, variance decomposition was employed.

3 Results and Discussion

Using the variables included in the equation (3), a VECM model is estimated as follows:

$$D(LnX) = -1.01LnX(-1) + 0.82LnY(-1) - 1.35LnA(-1) + 0.02LnRER(-1) + 2.26 + 0.15DLnX(-1) + 0.10DLnX(-2) + 0.05DLnX(-3) + 0.26DLnY(-1) + 0.36DLnY(-2) + 0.09DLnY(-3) - 0.85DLnA(-1) - 0.78DLnA(-2) - 0.73DLnA(-3) - 0.004DLnRER(-1) + 0.10DLnRER(-2) + 0.04DLnRER(-3) \quad (4)$$

To test the significance of the coefficients in equation (4), Wald test has been conducted and the results are presented in Table (4). The Wald test result showed that γ is significant and has a negative sign, which is an indication of the presence of long run equilibrium relationship between model variables. On the other hand, the coefficients from C (2) – C(13) are not significant except for C7, C8 and C9, and this indicates that there is a weak short run equilibrium relationship between the model variables specially between the dependent variable, yield and real exchange rate. On the other hand, the area variable has significant negative impact on sesame export value in the short run.

Table 4. Wald test results

Variable	Coefficient	Std. Error	t-Statistic	Probability
γ	-1.011	0.329	-3.065	0.005
C(2)	0.153	0.270	0.566	0.575
C(3)	0.101	0.224	0.452	0.654
C(4)	0.055	0.175	0.317	0.753
C(5)	0.266	0.338	0.786	0.438
C(6)	0.359	0.302	1.191	0.243
C(7)	0.092	0.301	0.306	0.761
C(8)	-0.858	0.392	-2.188	0.037
C(9)	-0.786	0.354	-2.219	0.035

Variable	Coefficient	Std. Error	t-Statistic	Probability
C(10)	-0.727	0.306	-2.373	0.025
C(11)	-0.004	0.097	-0.046	0.963
C(12)	0.100	0.098	1.022	0.315
C(13)	0.037	0.092	0.407	0.686

Source: Calculated in EViews 6.

For statistical accuracy of the residuals in the estimated VECM in equation (4), a number of diagnostic tests are performed. As indicated by the results in Table 5, the residuals of estimated VECM have no trace of autocorrelation or heteroskedasticity (ARCH effect) and are normally distributed. Therefore, we can consider the residual of VAR components of VECM model as a white noise (stationary and unrelated).

The residual diagnostic tests of the estimated VECM, which is calculated in EViews 6, show the following results:

1) Autocorrelation Test: LM (5) = 2.022 with p-value = 0.567.
2) Normality Test: Jarque-Bera $\chi 2$ (2) = 5.753 with p-value = 0.056.
3) ARCH Test: F value = 2.430 with p-value = 0.487.

3.1 Long-run Relationship

The long run equilibrium relationship between the dependent variable (LnX) and independent variables (LnY, LnA and LnRER), is extracted from equation (4) as follows:

$$D(LnX) = 2.26 + 0.82LnY(-1) - 1.35LnA(-1) + 0.02LnRER(-1) - 1.01LnX(-1) \quad (5)$$

The coefficients of real exchange rate and yield have the expected sign and statistically significant (see Table 4). Thus, the real exchange rate and yield has positive impact on sesame export value. In terms of magnitude, the effect of yield is higher than that of real exchange rate. When the yield of sesame increase by 1% the sesame export earnings will increase by 0.82%. Meanwhile, when the real exchange rate depreciated by 1% the export value will increase by only 0.02% (note that the coefficients of the equation are long run elasticity). On the other hand, the coefficient of area is negative and statistically significant. This means that an increase of grown area of sesame has negative impact on sesame export value. This can be explained by the fact that Sudan is the one of major sesame exporters in the world market; any increase in total export volume may depressed world prices of sesame and hence export value. Therefore, it is important for Sudan to have clear policy of export quantity especially during good production season

As the error correction term was significant with negative sign, the results of vector error correction model depicted that the adjustment in LnX is due to the error correction term (γ). The empirical findings found a greater coefficient of the error-correcting term (-1.01); this signifies that the variables in the model are adjusting faster from the short run to the long run equilibrium. LnX adjusted almost in one year to the long run equilibrium meaning that it took almost only one year to eliminate the disequilibrium.

3.2 Short-run Relationship

The short run equilibrium relationship between the dependent variable (LnX) and independent variables (LnY, LnA and LnRER), is extracted from equation (4) as follows:

$$D(LnX) = 0.10DLnX(-2) + 0.05DLnX(-3) + 0.26DLnY(-1) + 0.36DLnY(-2) + 0.09DLnY(-3) - 0.85DLnA(-1) - 0.78DLnA(-2) - 0.73DLnA(-3) - 0.004DLnRER(-1) + 0.10DLnRER(-2) + 0.04DLnRER(-3) \quad (6)$$

As shown in Table (4), most of the variables included in the equation (6) are statistically insignificant, which means that there is weak short run equilibrium relationship between sesame export value and real exchange rate and yield, this finding is in line with Kingu (2014) and Diakosavvas and Kirkpatric (1990) results which found in some Sub Saharan Africa countries. On the other hand, the coefficients of area are negative and statistically significant which reflect the negative influence of area expansion and variation on sesame export value in the short run. Although the coefficients of real exchange rate and yield are not statistically significant, they are still important determinants of sesame export earnings in short run too.

3.3 Variance Decomposition

Table 5 shows the results of variance decomposition of the dependent variable during 10 periods. Impulse or innovation or shock in the short run in sesame export value account for 72% of fluctuation in export value (owned shocked), while real exchange rate shock in short run accounts for 7.9% fluctuation in sesame export value, while in the long-run account for 7%. Yield shock in the short run accounts for 9% of fluctuation or variation in export value of sesame, while in the long run account for 11.4%. Area shock in the short run accounts for 10% of variation in sesame export value, and in long run accounts for 18%. This results support the findings of the VECM model of the significance of real exchange rate, yield and area for sesame export value especially in the long run.

Table 5. Variance decomposition of sesame export value

Period	S.E.	X	RER	Y	A
1	0.408	100.00	0.00	0.00	0.00
2	0.464	87.19	5.16	0.08	7.55
3	0.505	78.05	6.16	5.63	10.14
4	0.528	72.49	7.93	9.02	10.55
5	0.595	65.86	6.69	9.86	17.57
6	0.648	64.34	6.27	11.03	18.34
7	0.678	64.58	6.06	11.21	18.12
8	0.703	64.53	6.74	11.25	17.47
9	0.729	64.26	7.24	11.17	17.32
10	0.759	63.43	7.09	11.42	18.04

Source: Calculated in EViews 6.

4 Conclusions

The paper analyzed the main factors affecting sesame export in Sudan through applying vector error correction model. The results showed that low yield, area variation and unstable fluctuating exchange rate are the main factors affecting the sesame export earnings in the long run, and area variation in the short run. Improvement of sesame yield and stabilized exchange rate will have positive impact on sesame export value in the long run, while expansion of area under sesame production could have negative influence on sesame export value due to Sudan large share of sesame export in the world market. In order to improve foreign exchange earnings from sesame export, Sudan should address the problem of low yield, area variation and fluctuating exchange rate especially in the long run. The paper recommends adopting economic policies that lead to improvement of sesame yield, control of area under sesame production and to stabilize exchange rate of Sudanese currency.

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