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Estimating Supply Function of Sugar Commodity in Sudan (1985-2015)

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Abstract

Sudan is one of the largest sugar producers in Africa and includes a number of sugar factories where it has vast areas and fertile agricultural lands suitable for sugar cane cultivation in addition to the presence of manpower and trained technical labors as well as the industries of high value added and its correlation and integration with agriculture, the main objective of the study is the estimation of the supply function on the sugar commodity in Sudan and the factors that affecting it during the period from 1985 to 2015 through the model of multiple regression, the problem of study was a gap between supply of sugar and demand, the hypothesis of the study that there were a statistically significant positive correlation between the supply quantity of sugar GDP, labor, price and capital, in addition to the multiple regression models are able to modeling supply determinants of sugar in Sudan.

The study was based on descriptive methodology to study the economics information of sugar in terms of the development and geographical distribution of sugar industry, in addition to the standard approach to study the current demand for sugar in Sudan, that is by used the secondary data collected from different sources.

The most important results of the study were that there is a statistically significant relationship between quantity supply of sugar, and both domestic price, gross domestic product, even at the level of 1%. The study recommended that encouraging Arab and foreign investment in sugar production and industry by promoting the country's internal resources and exchanging information to achieve common interests.

Working to pay attention to the factors affecting the production of sugar by increasing the cultivated areas of sugar crops and reduce taxes on import of production inputs and training the workers in the sugar sector.

Keywords: sugar, Sudan, supply function

INTRODUCTION:

Sudan is one of the largest sugar producers in Africa and includes six factories in addition to the newly established White Nile Sugar Factory, where the country enjoys large areas and fertile agricultural lands suitable for the cultivation of sugar cane. (AOAD 1997)

In addition to the presence of trained manpower and technical personnel as well as it is one of the industries with high added value and its connection and integration with Agriculture, this industry is the first in terms of investment and employment. (Ministry of Industry 2013)

The importance of sugar as a strategic commodity is concentrated through the increasing demand for it due to the increasing rate of population growth and the high level of consumer spending on the one hand and government policies on the other hand. With the continuity and development of decision-making theories and policy development, building standard models for various economic and social phenomena has become an important approach that executive planners rely on in policy-making and decision-making to ensure the necessity of completing policy-making and designing to draw their conclusions in setting up various development programs. (Omer 2015)

This study comes in the same context aiming to build a standard model for presenting the sugar commodity in Sudan by applying econometric methods to available from recent data on the various variables related to the study.

Importance of the study:

The study of supply occupies an important place in economic studies. Analysis of supply on a particular commodity is considered one of the most important elements of marketing study and a focal point for studying the market, given that the estimates of the expected supply are on the basis of which the various project policies are determined.

The practical importance of the study stems from sugar commodity importance as a strategic commodity and the heavy reliance on it in many foods production.

Study problem:

Although there are a number of sugar factories in Sudan, production is considered low compared to the population, meaning that the supply is less than the demand for the sugar commodity and as a result, the country imports its needs of sugar commodity to bridge the gap between supply and demand at the expense of its development and economic projects, in light of this, the problem can be formulated in the following questions: What are the most important determinants that control the supply function on sugar commodity in Sudan? How capable are ordinary least squares models to model the supply function on sugar commodity.

Study objectives:

The main objective of the study is to arrive at a proposed measurement model for supply function of sugar commodity in Sudan. The sub-goals are:

1. Study the factors affecting supply function of sugar commodity in Sudan.
2. Test the predictive ability of supply model.

Research hypotheses: are as follows:

1. There is a direct, statistically significant relationship between the quantity supplied of sugar and each of gross domestic product, labor, price and capital.
2. Regression models are able to model the determinants of supply function on sugar commodity in Sudan.

Research methodology:

It is represented in descriptive approach by collecting information on economics of sugar in terms of development in production, consumption and geographical distribution of sugar industry in Sudan, in addition to the standard method by identifying the necessary and specific data determinants of supply function on sugar and basic variables affecting it, then scheduling and preparing them in the form of a series time

period according to the requirements of standard analysis during the period from 1985 to 2015.

Definition of the standard model and description of the standard model for determinants of supply function on sugar commodity in Sudan:

The economic model is defined as a set of economic relations that are usually developed in mathematical formulas called equations (or a set of equations), which explain the behavioral or mechanics of these relationships that show the functioning of an economy or a particular sector, and it is called structural equations, and the economic model is a simplified picture that represents activity the economy of country or sector during a certain period of time in the form of numerical symbols and values. (Ibrahim 2002)

Characterization of the standard model for the determinants of supply function on sugar commodity in Sudan

Classification of model variants:

1. Internal variables: They are variables whose value is determined by the model, that is, by estimating the model parameters, after knowing the values of the parameters and the values of the external variables, and they have other names, which are the dependent variables or the unexplained variables, and in this study we have the variable of the quantity presented in supply equation.
2. External variables: are variables whose value is not determined by the model, but rather is determined by factors outside the model, and sometimes their value is determined by another model that is different from the original model, and they are called independent explanatory and external variables and in this study we have four external variables in the equation of the quantity supplied, they are (volume of labor used in sugar production, capital used in sugar production, domestic price of sugar, and gross domestic product).
3. Time-lagging variables: If the internal variables have a slowdown period (time lag), then in this case they are treated as external variables, and they are combined with the external variables in this study. There are no slowing variables in the study models. (Omer 2015)

The proposed model for the study:

Mathematical form of supply determinants functions on a commodity of sugar in Sudan:

$$LOG(QS)F(GDP, L, P, K)$$

The above equation can be written in the following standard form:

$$LOG(QS) = \beta_0 + \beta_1 * GDP + \beta_2 * L + \beta_3 * P + \beta_4 * K + \mu$$

Whereas:

QS: quantity supplied, GDP: gross domestic product, L: labor used in producing sugar, P: domestic price of sugar, K: capital used in sugar production, μ: limit of random error.

Preselecting landmarks:

It is intended to determine the type of relationship between dependent variable and independent variable, based on the parameter signal according to the assumption of economic theory.

Preset references to the parameters of supply function determinants equation on sugar commodity in Sudan:

1. The constant ($ß_0$): according to the assumption of economic theory, its sign should be positive.
2. The parameter of gross domestic product (GDP) ($ß_1$): according to the assumption of economic theory, its sign is positive due to the positive relationship between GDP and quantity of sugar supplied.
3. The employment parameter ($ß_2$): According to the economic theory, its sign is positive due to the positive relationship between the labor used in producing sugar and the quantity supplied of sugar.
4. The parameter of domestic price of sugar ($ß_3$): according to the economic theory, its sign is positive due to the positive relationship between the price and quantity supplied of sugar.
5. The capital parameter ($ß_4$): according to the economic theory, its sign is positive due to the positive relationship between the volume of capital used in producing sugar and quantity supplied of sugar.

Test forecasting ability of supply function model of sugar commodity in Sudan:

Definition of forecasting: It is a quantitative estimate of expected values of dependent variables by use independent variable based on what we have available from information about the past and the present. (Elrasheed 2010)

Economic definition of forecasting: it is a process of estimating the future development of the values of economic phenomena based on the current situation and the factors affecting the development of those phenomena. (Elrasheed 2010)

Tests the model's predictability:

1. Test χ^2:

This test depends on forecasting after testing the model's ability to fulfill the significance of the difference between the expected values and the actual values. If the expected values are equal to the actual values or the difference between them is not substantial (H_0: $\hat{\mu}f = \hat{\mu}a$), then the model's ability to predict is high, but if the difference was substantial (H_1: $\hat{\mu}f \neq \hat{\mu}a$), so the model's ability to predict is weak.

2. T-test: This criterion is used to test the significance of the difference between the forecast values and the actual values, based on the determination of the following assumptions:

Nothingness hypothesis: there is no fundamental difference between the predicted value and the actual value (H_0: $\hat{\mu}f = \hat{\mu}a$), and the model in this case has a high predictability.

Alternative hypothesis: there is a fundamental difference between the predicted value and the actual value (H_1: $\hat{\mu}f \neq \hat{\mu}a$), and the model has a weak ability to predict.

3. Theil Test: Thiel has suggested this test, which depends on the following:

* If the actual change (dt) equals the actual change (da) then Thail coefficient value (T) is equal to zero (T = Zero) and this indicates the model's great predictability.
* If the expected change ((dt) is zero, then Thail coefficient value (T) equals one (T = 1). This indicates the case in which the dependent variable is expected to be constant over time.
* Whenever Thil coefficient value (T) exceeds one, this indicates a decrease in the model's ability to forecasting. (Elrasheed 2010)

Results and discussion:

Cointegration test for the variables of supply determinants function on the sugar commodity:

First: The concept of joint complementarity:

When a non-static time series is used in the estimation of regression equation, the regression may be false, but this does not happen if the time series has stability or co-integration property.

Second: Definition of Joint Integration:

The common complementarity between two time series defines that the fluctuations in one of these two series lead to canceling the fluctuations in the other series, meaning that when each of them is tested separately, they are not static, but as a group, we find that there is a linear relationship between them that can be static and stable. (Anani 2009)

Third: Reasons for using the boundary test apart from other integration tests:

The application of the Johansson-Jewelers test requires that all the variables of the study be stable at one level only (the first difference only, or the second difference only), which is not available in the data of the current study, while we find that the boundary test of the co-integration provided by the ARDL model requires that the variables be The study is stable at the level only or the first difference only or a mixture between them, which fits the data of the current study, where we find that the variables (quantity supplied - GDP - volume of employment - domestic price) stabilized at the first difference, while we find that the variable (capital) Settled at the level.

Fourth: Cointegration test (long-term relationship) between the variables of the display function:

Table (1): Bound Test

Number of External Variables	Calculated Value	Statistical Test
4	7.721266	F-Statistic
Critical Value Bound		
Upper Limit I1 Bound	Lower Limit I0 Bound	Significance Level
3.52	2.45	10%
4.01	2.86	5%
4.49	3.25	2.5%
5.06	3.74	1%

Source: Prepared by the researchers from the reality of analyzing the study model using (Eviews. V9) program

From Table (1) above, we find that the calculated value of the F test is equal to ((7.721266), which is greater than all the upper and lower critical values of the boundary test even at the level of statistical

significance of 1%, and this is an indication that there is a long-term relationship that is directed towards the explained variables (local price, capital, labor, GDP) to the dependent variable (quantity supplied of sugar).

Table (2): Results of estimating the determinants of supply of sugar in Sudan (1985-2015)

Variables	Estimated Parameters (Coefficient)	Standard Errors	(t) Value (T-Statistic)	Significance of Parameters Prob.	Overall Significance of the Model Prob.(F-Statistic)
C	11.89799	0.402673	29.54753	0.0000	0.000000
GDP	2.87E-08	6.41E-09	4.482131	0.0001	
L	1.54E-05	9.11E-06	1.688544	0.1033	
P	0.000307	2.02E-05	15.23273	0.0000	
K	2.40E-05	1.07E-05	2.240731	0.0338	

Source: Prepared by the researchers from the reality of analyzing the study model using (Eviews.V9) program

The values of the width function parameters on the commodity of sugar:

$$\mathrm{LOG}(\widehat{\mathrm{QS}}) = 11.898 + 0.0000000287 * \mathrm{GDP} + 0.0000154 * \mathrm{L} + 0.000307 * \mathrm{P} + 0.0000240 * \mathrm{K}$$

Evaluating the results of estimating supply function according to the economic, statistical and standard criteria:

First: Evaluation according to the economic criterion:

It is considered one of the criteria derived from economic theory and the first criteria that must be used to evaluate the results, as economic theory indicates specific assumptions about the signals of the parameters to be evaluated. These assumptions are used to judge the economic soundness of the estimates.

Economic evaluation of the determinants of supply function on a commodity sugar:

* constant signal (11.898) is a positive sign, which corresponds to economic theory.

* The value of labor volume coefficient is equal to (0.0000154) with a positive sign and this positive sign means that there is a positive relationship between the volume of labor used in producing sugar and the quantity supplied of sugar, that is, whenever the volume of labor increases in one unit, the quantity supplied of sugar increases by 0.0000154 and this is in line with the assumption of economic theory.

* The value of local price coefficient for sugar is equal to (0.000307) with a positive sign, and this positive sign means that there is a positive relationship between domestic price of sugar and the quantity supplied of sugar, that is, whenever the price increases in one unit, the quantity supplied of sugar increases by 0.000307, which is in line with the assumption of economic theory.
* The value of capital coefficient is equal to (0.0000240) with a positive sign and this positive sign means that there is a positive relationship between volume of capital used in producing sugar and the quantity supplied of sugar, that is, whenever the capital increases in an oasis unit, the quantity supplied of sugar increases by 0.0000240 and this is in line with the theory assumption Economic.
* The value of gross domestic product coefficient is equal to (0.0000000287) with a positive sign, and this positive sign means that there is a positive relationship between the GDP and the quantity supplied of sugar, that is, whenever the GDP increases by one unit, the quantity supplied of sugar increases by 0.0000000287 and this is in line with the assumption of economic theory.

Second: Evaluation according to statistical standard:

This criterion is considered one of the important criteria in the study of measuring economic relations, in order to identify the significance of estimates, and it is divided into three types of tests, which are the quality of fit test, the overall significance test of the model, and the partial significance test of the model.

Table (3): Evaluation for "supply determinants equation of sugar in Sudan."

Variables	value (t) T Statistic	Significance of Parameters Prob.	Value (f) F-Statistic	Overall Significance of the Model Prob.(F-Statistic)	Adjusted R-Squares
C	29.54753	0.0000	138.9161	0.000000	0.948424
GDP	4.482131	0.0001			
L	1.688544	0.1033			
P	15.23273	0.0000			
K	2.240731	0.0338			

Source: Prepared by the researchers based on analyzing the study model using Eviews. V9.

1. Adjusted R-Squared model fit:

The modified coefficient of determination is used to measure the explanatory strength of the model, and the modified determination

coefficient (0.95) indicates that the independent explanatory variables (GDP, L, P, K) are responsible for 95% of changes that occur in the dependent variable (the quantity supplied of sugar) as a result of change in the variables. The independent interpretation and the remaining 5% is the effect of the other (random) variables not included in the model, and this is an indication of the quality of model fitting the determinants of supply on sugar commodity in Sudan because the variables included in the model are the highest in dependent variable than the variables not included in the model.

2. The overall significance of the "F-Statistic" model:

The probability value of F-test is equal to 0.000000, which is less than the level of statistical significance 0.05. This indicates the overall significance of the model (determinants of supply on sugar commodity in Sudan).

3. The partial significance of "T-Statistic" model:

* The constant "mean", β_0, is significant, because the probability value of T-test is 0.0000 and it is less than 0.05.

* The parameter of labor volume coefficient, β_2, is significant, because the probability value of T-test is equal to 0.1033 and is greater than 0.05 indicating that labor volume does not have a significant effect on the dependent variable, "the quantity supplied of sugar".

* The parameter of local price of sugar β_3 is significant, because the probability value of T-test is equal to 0.0000 and it is less than 0.05, indicating that the local price of sugar has a significant effect on the dependent variable, "the quantity supplied of sugar".

* The parameter of capital coefficient β_4 is significant, because the probability value of T-test is equal to 0.0338 and it is less than 0.05. This is an indication that capital has a significant effect on the dependent variable, "the quantity of sugar supplied".

* The parameter of GDP coefficient β_1 is significant, because the probability value of T-test is equal to 0.0001 and it is less than 0.05, indicating that GDP has a significant effect on the dependent variable "quantity of sugar".

Third: Evaluation according to the standard parameter:

This standard aims to know the extent of conformity to the assumptions of the standard methods used, which differ in different standard methods. Therefore, before adopting the results of the estimates, it must be ensured that there are no standard problems in the model

under study, that is, the model is free from measurement problems, namely:

1. Variance variation problem.
2. The problem of self-correlation.
3. Multiple linear correlation problem.
4. The problem of non-normal distribution of residues.

In order for them to have the desired characteristics of impartiality, consistency, and adequacy, if the assumptions of econometrics used are not met, either the estimates lose their desired characteristics, or the statistical criteria become unfit for use and cannot be relied upon in determining the acceptability of the estimates statistically.

1. Test the variance instability problem of residuals in display function:

Table (4) Heteroskedasticity Test in Supply Model

Type of test	Test value		Probability value	
B P G	F-statistic	1.601849	Prob. F(4,26)	0.2037
	Obs*R-squared	6.129135	Prob. Chi-Square(4)	0.1897
White	F-statistic	1.307414	Prob. F(14,16)	0.3009
	Obs*R-squared	16.54096	Prob. Chi-Square(14)	0.2815

Source: Prepared by the researchers from the reality of analyzing the study model using (Eviews.v9) program.

Since the probability value of all tests in the above table is greater than 5%, this is an indication that the model of supply determinants on sugar commodity does not suffer from the variance problem, which is a good and desirable characteristic of the model.

2. Test the residual autocorrelation problem in supply function:
a. Durbin Watson Test

Table 5: Durbin-Watson stat

Durbin-Watson stat	1.866315

Source: Prepared by the researchers from the reality of analyzing the study model using (Eviews. V9) program.

The value (1.87) is greater than 1.5 and very close to 2. Therefore, this is an indication that the rest of the model of supply determinants on sugar commodity does not suffer from a self-correlation problem, which is a good and desirable characteristic of the model.

b. Q-Statistic Test

Table (6): Q-Statistic Test:

Deceleration periods LAG	Autocorrelation AC	Partial correlation PAC	Q- Stat Q- test	Probability value
1	0.060	0.060	0.1238	0.1238
2	-0.097	-0.101	0.4555	0.4555

Source: Prepared by the researcher from the reality of analyzing the study model using (Eviews. V9) program.

The result of Correlogram Q-Statistic test until the second slowdown indicates that there is no self-correlation problem in the supply function because the probability value in whole correlogram test is greater than 5%, which is a good and desirable characteristic of the model, and confirms the result of Durbin Watson test.

3. The problem of multiple linear correlation between independent variables in a supply function

Table (7): Detecting Multicollinearity by Using Variance Inflation Factors (VIF) Test

Variable	Centered VIF
GDP	1.465591
L	2.988145
P	2.530033
K	1.139964

Source: Prepared by the researchers from the reality of analyzing the study model using (Eviews. V9) program.

Through the results of Table (7), it becomes clear to us that there is no linear correlation problem between the independent variables supply determinants function on sugar commodity, because all the axial values of variance coefficient inflation for the independent variables are less than the standard value 10 and therefore this is an indication of supply function absence from the problem of correlation multiple linearity is a good and desirable characteristic of the model.

4. Test for the problem of absence of a normal distribution residues in supply function:

Table (8): Jarque-Bera Test

Test value (Jarque-Bera)	Probability value (Jarque-Bera)
1.133328	0.567415

Source: Prepared by the researchers from the reality of analyzing the study model using (Eviews V.9) program

The probability value of Jarque-Bera test is equal to (0.567415) it is greater than 5%. Therefore, this is an indication that the residues in supply determinants model on sugar commodity in Sudan follow the distribution, which is a good and desirable characteristic of the model.

Test ability of domestic demand determinants for sugar commodity in Sudan to forecasting:

Table (9): The following table shows the results of Thail unequal coefficient test in supply function

Test name	Test value
Theil Inequality Coefficient	0.003736

Source: Prepared by the researcher from the reality of analyzing the study model using a program. (Eviews. V9)

Through the results of Table (9), it is clear that the inequality of Thail coefficient value is equal to (0.004), which is very close to zero, indicating high capacity of supply determinants model on sugar commodity in Sudan.

CONCLUSION:

The results of boundary test concluded that there is a long-term equilibrium relationship between the variables of supply function and therefore the model of determinants of supply function has the characteristic of joint complementarity, static and not fake, the results of analysis proved that there is a positive relationship between the quantity supplied of sugar and each of labor volume, capital size, domestic price and total GDP, the study concluded that there is a statistically significant relationship between the quantity supplied of sugar and each of local price and gross domestic product even at level

of significance (1%), and that there is a statistically significant relationship between quantity supplied of sugar and capital at level of significance (5%).), the study also found that there is no statistically significant relationship between quantity of sugar supplied and volume of employment even at level of significance (10%). Analysis results indicated that quality of matching supply function for sugar in Sudan, as we find that the variables included in supply model explain more than 90% of changes that occur to supply function of sugar commodity in Sudan, where the value of modified determinant factor of supply function reached 95%, the results of analysis demonstrated the existence of high predictability of supply determinants model of sugar commodity in Sudan, as the value of inequality coefficient of (0.003736) for supply function is very close to zero indicating the model's high predictability.

Recommendations:

1. The country should pay attention to sugar industry in order to reach the maximum production capacity by supporting the existing sugar factories, solving their problems, providing agricultural machinery, disposing of damaged machinery and replacing it with new machines, providing fertilizers, improving the auxiliary structures for growth of sugar industry and investing secondary waste.
2. Encouraging foreign and Arab investment in sugar production and industry field by promoting the country's internal resources and exchanging information to achieve common interests.
3. Providing the necessary funding for sugar factories under implementation, rehabilitating the idle factories, making use of foreign capital to finance sugar projects included in economic development projects, and paying attention to the areas planted with sugar cane, and removing the obstacles facing the cultivation and manufacture of sugar cane in Sudan to achieve economic and social development.
4. Attention to sugar production by increasing the cultivated areas of sugar crops, reducing taxes on importing production inputs, and training and raising the efficiency of workers in sugar sector.

REFERENCES

Firstly: Books and Theses

1. Anani, M. A. (2009). Econometric and Statistical Analysis of Economic Relations, Alexandria University.
2. Elrasheed, T. M. Mansor, S. H. (2010). Applied Econometrics Series Using Eviews (Forecasting, Using Regression Models), J. Town Press, Sudan.
3. Ibrahim, N. B. (2002). Introduction to Econometrics Principles, Alexandria University, page 20.
4. Omer, M. O. H. (2015). Standard Models of Demand and Supply Functions of Electricity Commodity in Sudan Using Joint Integration Methodology and Unrestricted Error Correction Model, Sudan University of Science and Technology, Ph. D. Thesis.

Secondly: Reports

1. Arab Organization for Agricultural Development (AOAD), Development of Production and Processing Sugary Corps in Arab World, Sudan, (1997).
2. Central Bank of Sudan, Department of Statistics, Yearly Reports, (2003 - 2016).
3. Central Bureau of Statistics, Ministry of Finance, Yearly Reports, (1985 - 2016).
4. Ministry of Industry, Yearly Reports, Sudan, (1994 - 2014).
5. Sudanese Sugar Company, Yearly Reports, (1985 - 2016).

Appendix: Study data

Year	QS	GDP	K	L	P
1985	451690.6	7040.1	26208	30741	0.62
1986	482018	9591.9	25056	28482	0.62
1987	408950.7	11807.4	22752	30333	2.065
1988	359766	15357.2	20496	30428	2.065
1989	387300.2	20218.1	17664	32466	6.41
1990	387271.7	36479.8	19824	31810	8.66
1991	437415.6	46791.1	25368	31759	14.66
1992	448975.1	82562	25296	31773	20.88
1993	476609.7	110110.7	25944	31929	60
1994	423264.7	192660.5	24072	31275	100
1995	430259.6	421818	23064	29013	225.02
1996	460145.7	948448	23408	31202	505.02
1997	500590.7	1881289	22200	33336	897.8
1998	557475	4049739	21816	32336	850.54
1999	611640.8	1047814	21000	33584	987.31
2000	684863.5	1613737	21528	33376	1070.32
2001	763577	2193591	23688	31468	1113.5
2002	682204	2705881	21240	32616	1560
2003	757754.6	3366271	24864	32245	1694.1
2004	771972.6	4065856	22176	31197	1830
2005	728519	4775611	23568	27717	1887.6
2006	745821.8	5573378	21703.93	24536	2000
2007	759890.5	6872139	22600.08	23483	2000
2008	744922.9	8570713	22308.24	23662	2079
2009	941607.3	9829190	19134	23263	2250
2010	1598149	11983727	22588.08	24245	2957
2011	1356926	13551171	20861.04	23754	3180
2012	1394565	186556.3	21724.56	23999	4550
2013	1746871	243412.9	21292.8	23876	4500
2014	1389550	342803.3	21508.68	23937	5000
2015	1731510	582936.7	21400.74	23906	4900

Source: Central Bank of Sudan, Central Bureau of Statistics, Sudanese Sugar Company.