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Economic Analysis of Factors Affecting Sudanese Live Sheep Exports to Kingdom of Saudi Arabia*

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Abstract: The major objective of this paper was to analyze the effects of factors responsible for the exported quantity of Sudanese live sheep to the market of the Kingdom of Saudi Arabia (KSA). For this end, data on exported quantities, import prices, competitors' prices, exchange rate and Saudi chilled mutton imports was used. Multiple regression analysis was used for estimating the effect of these factors via a transformed generalized Cobb-Douglas function. Among the four hypothesized variables, only import price and exchange rate were having significant effect on exported live sheep quantities. Consistent with the economic logic, the former was having an elastic effect while the latter had an inelastic effect. The other two variables with insignificant effect were competitors' price and KSA imported chilled mutton. All four variables exerted increasing returns to scale to the Sudanese exported live sheep quantity. To increase live sheep exports to the Saudi market, the paper recommends improvement of quality control measures, reduction of production cost as well as minimizing the tax margins levied by the different local governments involved, adopting long term contracts in future markets and have Sudan Central Bank adopt exchange rate policy measures to encourage investments in this foreign trade business.

Key words: live sheep; exports; generalized Cobb-Douglas function; elasticity; import price; competitors' price; exchange rate; competitiveness.

INTRODUCTION

The Sudanese livestock sector plays an important role in the country's socioeconomic setup. Its share in GDP accounted for more Than 17% equivalent to more than 45% of the contribution of the agriculture sector. It contributed significantly to export earnings through exports of live animals, meat, hides and skins. The average annual export earnings from livestock sector accounted for 176 million dollars for the period 1992-2013, representing about 4.5% of the total Sudan exports and about 36% of the total agricultural exports (Figure1). From the figure, it is clear that a direct relationship exists between agricultural and livestock exports with the latter playing an increasing effect by time. Among the exported live animals and meat to different Gulf and Middle East countries, live sheep constituted the major component in both number and value with the majority directed to the Kingdom of Saudi Arabia (KSA), Qatar and United Arab Emirates markets. On the other hand, mutton constituted a major part of meat exports. It accounted for as much as 73% of the total exported meat during the period of this study. Most of the exported Sudanese live sheep (96%) was to KSA markets (Table 1).

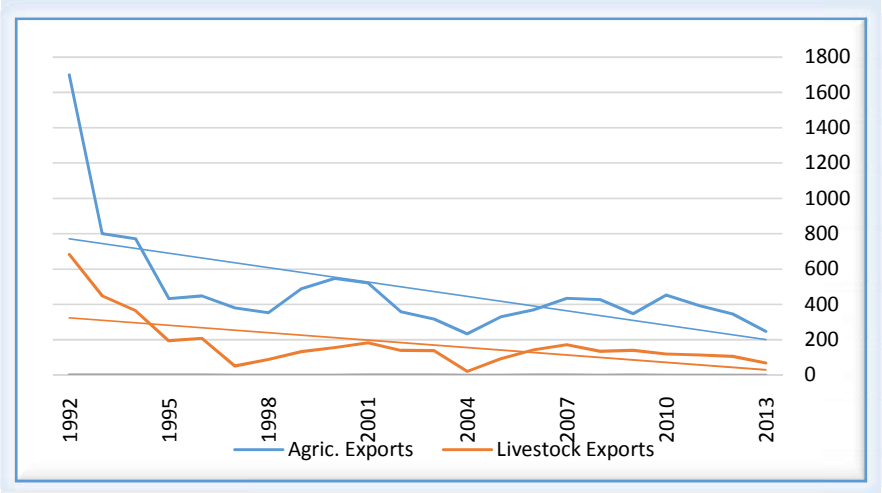

Figure 1. Contribution of livestock exports to total agricultural exports (US $ million)

KSA is reported to rank sixth with respect to red meat consumption in the world, with increasing demand attributed to increasing population rate, regulations and systems governing importation and handling sheep and mutton, consumer preferences and other factors (Riyadh Chamber of Commerce 2017). The Saudi market is classified as free and open with no trade barriers or restrictions where live sheep and mutton imported are from all over the world including Sudan. KSA imports live sheep and a variety of sheep meat (mutton). According to the Central Department of Statistics and Information (CDSI 1992-2013) classification, KSA imports eight sheep meat items including lamb and sheep carcasses whether fresh, chilled or frozen. The Saudi demand for live sheep and mutton is unique. While mutton is demanded all year round, live sheep is also demanded for local consumption as well as for religious purposes "Hady" during "Omra" and "Hajj" seasons. Such demand renders the complementary and substitutive relationship between these two commodities undetectable.

Table 1. Average annual Sudanese exports of live animals (1992-2013)

Item	Live Animals (head)		
	Total Exports	Exports to KSA	%
Cattle	5,123	0	0
sheep	1,360,806	1,303,516	95.8
Goats	64,083	46,396	72.4
Camels	117,483	4,618	3.9

Sources: - Ministry of Economy and planning, Central Department of Statistics and Information, Foreign Trade Statistics, KSA, 1992-2013.

Sudanese live sheep exports to KSA started way back in history, given their geographic location, being very close neighbors, while mutton exports were experienced starting 1992. Out of the eight mutton Saudi import items, Sudan exported only lamb and sheep carcasses and half carcasses, fresh or chilled, with the bulk (82%)being sheep carcasses and half carcasses during the period 1992-2007 after which Sudan disappeared

from the Saudi mutton imports list. That was because of the ban imposed by KSA due to suspected infection of Sudanese livestock by foot and mouth disease.

The major objective of this paper is to analyze the extent of effects of factors responsible for the quantity of Sudanese live sheep exports to KSA. Specific objectives include:

- Investigating the significance and magnitude of the individual effect of import price, competitors' price, exchange rate and the Saudi chilled mutton imports on the Sudanese live sheep exports to the Saudi market.
- Determining the magnitude of the combined effect of the above variables on the quantities of Sudanese live sheep exported to KSA.
- Suggesting recommendations that could enhance quantities and strengthen competitiveness of exported Sudanese live sheep to the Saudi market.

RESEARCH METHODOLOGY AND DATA SOURCES

Regression analysis, as a common statistical tool, that utilizes the relation between two or more quantitative variables so that one variable is predicted from the other or others, was used to attain the study objectives (Neter *et al*. 1983; Freund and Wilson 2003). Many statistical forms are available to analyse the data on Sudanese live sheep exports to KSA, out of which the best-fit model was selected for the paper's purposes. The adopted regression model was of the Generalized Cobb-Douglas Function form. The Cobb-Douglass, in addition to giving the best fit, has the advantage of depicting the coefficient of a variable as elasticity and the sum of these coefficients indicate the state of the returns to scale. The general form of the function is given by the following equations (Vilcu 2011):

$$Q(x_1, \ldots, x_N) = A \prod_{i=1}^{N} x_i^{\alpha_i}, \quad .. (1)$$

The function is homogeneous of degree $\varepsilon = \sum_{i=1}^{n} \alpha_i$.

Multiple regression analysis, as one of the most widely used of all statistical tools, was referenced for testing the hypotheses on the relation between the dependent variable and the independent variables. Linear multiple regression model was applied for the transformed, double log, form of the generalized Cobb-Douglas Function as

$Ln\ Q_i = Ln\ A + \Sigma\alpha_I\ Ln\ X_i + \mu_i$.. (2)

where:

Ln = Natural logarithm of base 2.718282,

Q = Dependent variable, quantity of exported live sheep,

X = A vector of four variables namely: import price (SR/ton), exchange rate (SDG/US$), competitors' price of live sheep (SR/ton) and quantity of mutton, CIF Jeddah (Metric ton).

i= 1, 2, 3, ..., n

μ = An independent random error term with the following assumptions:

E (μ) = 0 and E (μ)^2= σ^2, $\mu \approx$ N (0, σ^2).

The general test of variable significance of effect (t-test) of the form (Chirbagi 1985):

$T_i = \alpha_i / SE_{est}$..*(3)*

where:

$SE_{est.} = \sqrt{MSE}$ ..*(4)*

was then applied. The Durbin-Watson test of the form:

$$DW = \frac{\sum_{i=2}^{T}(e_t - e_{t-1})^2}{\sum_{i=1}^{T} e_t^2} \text{.. (5)}$$

Where e_t *are residuals of the ordinary least square regression*.

Time-series data on KSA live sheep and chilled mutton imports from Sudan and other countries for the period 1992-2013, was obtained from the CDSI of the Saudi Ministry of Economy and Planning for the period 1992-2013. Data included imported quantities and prices. Other data on exchange rates, for the same period, was obtained from Sudan Central Bank publications. Average competitors' prices were calculated by

dividing the value of imports by the respective quantity exported by competitor countries.

RESULTS AND DISCUSSION

The hypothesized variables affecting Sudanese live sheep exports to KSA included import prices, competitors' prices and the exchange rate along with the substitutive/complementary effect of chilled mutton quantity imported by the Saudi market. Graphical representation was used to detect the trend followed by the exported product against import and competitors' prices. Regression analysis was then used to determine the level of significance of the hypothesized variables as well as their overall combined effect.

Figure 2 depicts the general trend followed by the Sudanese exported live sheep quantity as opposed to import and average competitors' prices as well as the Saudi chilled meat imports during 1992-2013. Although exported live sheep quantities did not follow a steady pattern through time, their general trend was increasing, however. On the other hand, live sheep import price appears to follow a steady pattern while competitors' price is following a slightly increasing pattern with time. Exchange rate followed an almost consistent increasing trend through the period of paper having a value of 0.1 at the beginning of the period and reaching 5.71 towards the end (see Appendix 1). These trend patterns suggest further analysis to estimate the individual and combined effect of these factors on the Sudanese exported live sheep quantities.

The generalised Cobb-Douglas function was estimated via multiple regression analysis as detailed above. The results are summarised in Table 2. According to the regression results, the estimated function is having a good representation of the relationship between the variables as reflected by the adjusted R-squared, F-value and D-W statistic.

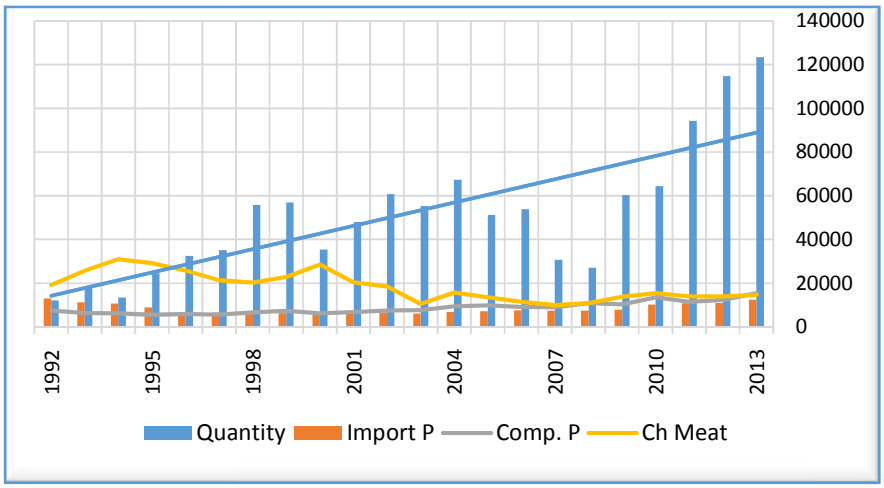

Figure 2. Exported live sheep quantities vs prices and chilled meat imports (000 tons)

Table 2. Estimated effects of factors affecting exported Sudanese live sheep quantities to KSA

Variable	Coefficient	T- value
Constant (*Ln A)*	2.07	0.475
Import price (X_1)	1.32*	2.208
Competitors' price (X_2)	- 0.44	- 0.695
Exchange rate (X_3)	0.71**	5.072
Imported chilled mutton (X_4)	0.05	0.179
F-Value	27.963**	
Adjusted R-squared (R^2_a)	0.84	
D.W.	2.0	
N = 22 years		

* Significant at the 5% level.
** Significant at the 1% level.

The above results indicate that the estimated function is as follows:

$$\hat{Ln\hat{Q}} = Ln(2.07) + 1.32\ Ln(X_1) - 0.44\ Ln(X_2) + 0.71\ Ln(X_3) + 0.05\ Ln(X_4) \quad (6)$$

(4.36) (0.60) (0.63) (0.14) (0.28)

Thus, the actual estimated function is of the form:

$$\hat{Q} = 7.92 X_1^{1.32} X_2^{-0.44} X_3^{0.71} X_4^{0.05} \quad (7)$$

Figure 3 outlines the relationship between the actual and estimated quantities of Sudanese exported live sheep to the Saudi market. The pattern of the estimated function as well as the trend line shows how close is the estimated attitude to the actual one. Such high degree of fitness is required for realistic conclusions and recommendations.

As far as the variables' level of significance is concerned, only coefficients (elasticities) of import price and exchange rate are of significant effects. Import price is, as expected, very elastic with a 100 % increase resulting in increased exported quantity of live sheep by 132%. On the other side, exchange rate is inelastic with a 100 % increase resulting in increased quantity of exported live sheep by only 71%.

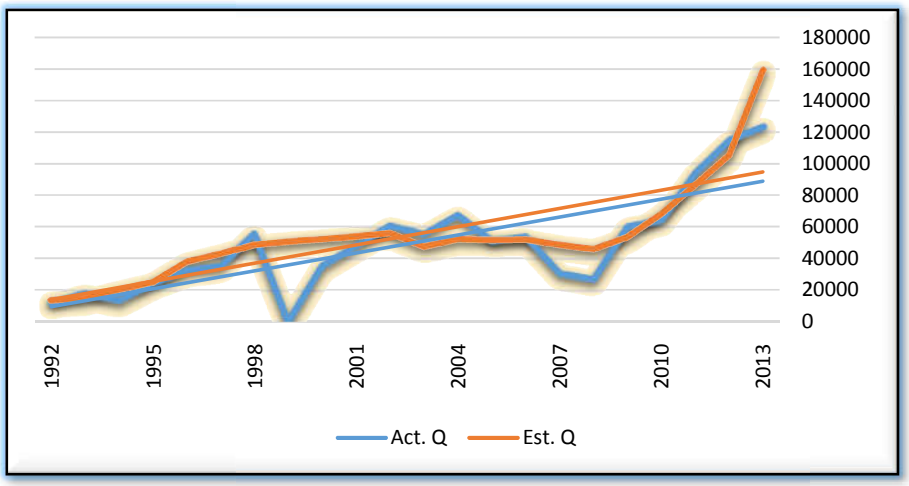

Figure 3. Actual vs estimated exported live sheep quantities (tons)

However, neither competitors' price nor Saudi imported quantity of chilled mutton has significant effect on the exported quantity of live sheep. This result is confirmed by the nature of the exported commodity in terms of the purpose and uniqueness, *i.e.* demand for Sudanese live sheep is inelastic to the religious rituals "Omra" and "Hajj" as well as the Sudanese "Sawakni" sheep breed is known to be of preference in the Kingdom through history. Other reasons include the very short time taken by shipments from place of origin in Sudan to Jeddah port indicating reduced cost of finishing at point of destination until marketed.

On the other hand, the collective influence of all variables on the exported quantity indicates increasing returns to scale, *i.e.* $\varepsilon = 1.64$, implying a 100 % increase in all factors will increase the quantity of exported live sheep by 164%. Such results are acceptable as they coincide and are consistent with the economic logic.

CONCLUSIONS

1. Only import price and exchange rate are having significant effect on exported quantities of Sudanese live sheep to KSA. While import price is subject to many external and internal factors, exchange rate manipulation remains a sole Sudanese affair. Therefore, if the government is to increase exported live sheep quantities to KSA market for increased foreign earnings, more attention should be given to import price and exchange rate:
2. In order to get better import prices, improved quality controlmeasures on the exported commodity are to be observed by the exporters and the responsible authorities. Such measures include improving the hygiene standards, the transporting vessels and handling procedures.
3. Reducing production cost is another alternative to better import prices. This could be attained by Avoiding weight loss when moving animals from production areas to export points and by relaxing the taxation policies and systems adopted by the different local governments involved.

4. Long term contracts in future markets are to be referenced by exporters, Animal Resources Bank and other exporters with the major importing entities in KSA including the Islamic Development Bank which is a major live sheep importer.
5. To avoid the negative effects of the increasing exchange rate on exported live sheep quantities, Sudan Central Bank should protect the export transactions from changes in exchange rate through foreign currency policies.

Appendix 1. Imports quantity, imports price, competitor's price, exchange rate and quantity chilled meat for the period 1992-2013.

Years	Imports quantity Y	Imports price X_1	Competitors price X_2	Exchange rate X_3	Q. Chilled meat X_4
1992	12104	12918	7452	0.1	19187
1993	18060	11341	6366	0.13	25822
1994	13387	10624	6209	0.22	31035
1995	24471	8791	5559	0.4	29282
1996	32467	6700	5928	1.25	25756
1997	35153	6476	5734	1.58	21320
1998	55715	6659	6685	1.99	20328
1999	56836	6221	7397	2.52	22889
2000	35324	5935	6312	2.57	28622
2001	47996*	6287.5*	6808	2.59	20363
2002	60668	6640	7467	2.63	18516
2003	55381	6047	7614	2.61	10556
2004	67373	6919	9406	2.58	15764
2005	51214	7218	9836	2.44	13564
2006	53835	7600	9124	2.16	11511
2007	30704	7501	9060	2.02	9944
2008	26921	7494	10899	2.09	10844
2009	60242	7779	10415	2.3	13832
2010	64424	10162	13601	2.31	15443
2011	94341	10671	11446	2.66	13992
2012	114745	10885	12478	3.56	13987
2013	123282	12359	15458	5.71	14701

*Average of the years 2000 and 2002

Source:-Ministry of economy and planning, central department of statistics, foreign trade statistics, imports statistics, Riyadh, 1992 – 2013- Central Bank of Sudan, Annual reports; (1992-2013).

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تحليل اقتصادي للعوامل المؤثرة على صادرات السودان من الأغنام الحية للمملكة العربية السعودية

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المستخلص: الهدف الرئيس لهذه الدراسة تحليل مدى تأثير العوامل المحددة لكمية صادرات الأغنام الحية السودانية إلى المملكة العربية السعودية. ولبلوغ هذا الهدف جمعت بيانات ثانوية موثقة عن كمية الأغنام الحية التي تم تصديرها، وأسعارها، وأسعار الدول المنافسة، واسعار الصرف وواردات المملكة من اللحوم الطازجة للفترة 1992-2013. وقد تم تحليل هذه البيانات باستخدام تحليل الانحدار المتعددة لدالة كوب-دوجلاس المعممة. ومن بين العوامل الأربعة المفترضة للتأثير على كمية الصادرات أثبتت النتائج معنوية تأثير سعر الاستيراد وسعر الصرف فقط. وتوافقاً مع المنطق الاقتصادي، فقد كان تأثير هذين العاملين مرناً لسعر الاستيراد وغير مرن لسعر الصرف ولم تثبت معنوية تأثير سعر المنافسين ولا الكمية المستوردة للمملكة من اللحوم المبردة. وقد أثبت التأثير الكلي للعوامل الأربعة تزايد العائد على السعة. زيادة كمية الصادرات السودانية من الأغنام الحية للمملكة العربية السعودية تتطلب تحسين مقاييس ضبط الجودة، و خفض تكاليف الإنتاج عن طريق تفادي الوزن المفقود خلال عمليات نقل الحيوانات من مناطق الإنتاج لمناطق التصدير مع خفض الجبايات والرسوم التي تفرضها الولايات المعنية، و تبني العقود طويلة الأجل في أسواق المستقبل، واعتماد بنك السودان المركزي لسياسات سعر صرف محفزة للشركات ورجال الأعمال والتجار لزيادة استثماراتهم في عمليات هذه التجارة الخارجية.