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Efficiency of Selected Sudanese Cattle Markets: Multivariate Cointegration Approach (1995-2011)

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Abstract

The importance of the livestock trade to the national economy of Sudan is significant; however, Sudan was adversely affected by the global crisis through a decline in oil and other external receipts. The main objectives of this study is to investigates price movements among important livestock markets in the Sudan to explore their performance and pricing efficiency. The stationarity of data tested using the unit root test and then market integration was tested using multivariate cointegration analysis. The study found that most cattle markets were integrated with each other, which showed the co-movement of prices, and this indicates market efficiency in sense that efficiency means existent of integration and cointegration of market prices. The prices of Omdurman cattle market has effect on all cattle markets in Sudan in short and long run.

Keywords: Efficiency; Analysis; Cattle markets; Multivariate cointegration Sudan

Introduction

The international financial crisis affected the Sudanese economy indirectly as the growth rate dropped from 7.8% in 2008 to 5.9% % in 2009 to 5.2% in 2010 to 2.7% in 2011, rise in the inflation rate from 11.2% in 2009 to 13% in 2010 to 18.1% in 2011. After the South Sudan's cessation, Sudan lost 90% of export revenue and 40% of public revenue which lead to adverse effects on economic activity in which represented in falling of real GDP from 1.9% in 2011 to 1.1% in 2012, added to the challenges faced by the economy. However, Sudan will need to address the challenges and to bolster non-oil growth and find alternative sources of foreign exchange receipts. The importance of the livestock trade to the Sudanese national economy is significant in sense that the share of agricultural sector in GDP in 2012 was 30%, the share of agricultural sector in total export in 2012 was 23% and the share of livestock in agricultural sector export in 2012 was 52%, Bank of Sudan [1]. Agricultural pricing are used as a major policy tool in developing countries to change levels of production. Developing countries are often characterized by intensive government interventions to regulate their economies, seldom allowing free market forces to operate. Agricultural price trends can be a good indicator of market efficiency. Previously, price correlation coefficients were used to investigate whether or not markets were linked by price changes. However, price correlation coefficients can be misleading due to the presence of trends (nonstationary data) in the data [2].

The analysis of livestock integration, cointegration and market efficiency of previous Sudanese studies was mostly conducted by using statistical framework which does not consider the property of the data. These approaches used correlation coefficient and Ordinary Least Square (OLS), which lead to spurious regression. This paper studies price integration and cointegration among important livestock markets in Sudan to investigate their price efficiency, referring to efficiency criteria means namely integration and cointegration of market prices.

The weak price correlation between pairs of markets, both in terms of per head and per unit of live weight, indicates weak integration between the markets and this is an indicator of marketing inefficiency implying high costs and/or weak transmission of information within the marketing system, Ethiopian Society of Animal Production [3].

Regression analysis has also been used to analyze integration. This practice was modified using price variables in their first difference form, but this caused the loss of long-run information, Alexander and Wyeth [4].

Cointegration allows a way of dealing with time series data that avoids spurious results, thus enhancing the authenticity of research findings. Johansen's approach to cointegration is now used widely to test the level of cointegration among markets.

Data and Methodology

The study focused on scrutinizing the cattle markets in Sudan by considering the prices of five livestock markets which were Elobied, Omdurman, Medani, Sennar and Nyala.

The study covered the periods from January 1995 to December 2011. The data used in these prices were monthly prices which have been collected from the animal resources company, these prices were wholesale prices i.e. the selling price of a head of animal measure in Sudanese Pound (S.P). To attain the cointegration analysis the data should be in real terms to avoid spurious regression, so all price series were deflated by GDP deflator rather than consumer price index. The deflated prices data were transformed in term of natural logarithm so as to attain a constant variance in the series, and then this logged deflated prices data used in the empirical analysis.

Johansen Maximum Likelihood Ratio Approach

Johansen's methodology takes its starting point in the vector auto regression (VAR) of order p given by:

$$Y_t = \mu + A_1 y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_t \quad (1)$$

Where y_t is a k-dimension vector of variables which are assumed to be I(1) series (but can also be I(0)), A_i, i=1, . . .p is the coefficient matrix, and ε_t is a k-dimension vector of residuals. Subtracting y_{t-1} from both sides of equation (1) yields:

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$$\Delta y_t = \mu + \Pi y_{t-1} + \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{p-1} \Delta y_{t-p+1} + \varepsilon_t \quad (2)$$

This VAR can be re-written as:

$$\Delta y_t = \mu + \Pi yt - 1 + \sum_{i=1}^{t-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \quad (3)$$

$$\text{Where } \Pi = \sum_{i=1}^{t} A_i - 1 \quad (4)$$

$$\text{and } \Gamma_i = \sum_{j=i+1}^{p} A_j \quad (5)$$

From equation (3) the only one term in the equation, Πy_{t-1}, is in levels, cointegration relations depend crucially on the property of matrix Π. It is clear that Πy_{t-1} must be either $I(0)$ or zero except that y_t is already stationary. There are three situations:

(a) Π=**αβ'** has a reduced rank $0 < r < k$,

(b) Π=**αβ'** has a rank of zero, and

(c) Π=**αβ'** has a full rank.

Under situation (a), **α** and **β** are both $k \times r$ matrices and have a rank of *r*. There are *r* cointegration vectors $\boldsymbol{\beta' y_t}$ which are stationary $I(0)$ series. It is equivalent to having r common trends among $\mathbf{y}_t$. The stationarity of β'yt implies a long-run relationship among $\mathbf{y}_t$ or a subset of $\mathbf{y}_t$, the variables in the cointegration vectors will not depart from each other over time. $\boldsymbol{\beta' y_t}$ are also error correction terms in that departure of individual variables in the cointegration vectors from the equilibrium will be subsequently reversed back to the equilibrium, a dynamic adjustment process called error correction mechanism (ECM). Equation (3) is therefore called VAR with ECM. Under situation (b), there is no cointegration relation among yt and the variables in levels do not enter equation (3), and then equation (3) becomes a simple VAR without ECM. The variables in levels are already stationary under situation (c).

Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the Π matrix: the trace test and maximum eigenvalue test, shown in equations (6) and (7) respectively.

The trace statistic test

The trace statistic test the null hypothesis of r cointegrating relations against the alternative of k cointegrating relations, where k is the number of endogenous variables, for r = 0, 1, ..., k - 1. The alternative of k cointegrating relations corresponds to the case where none of the series has a unit root and a stationary VAR may be specified in terms of the levels of all of the series. The trace statistic for the null hypothesis of r cointegrating relations is computed as

$$\pi_{trace}(r \mid k) = -T \sum_{i=r+1}^{n} ln(1 - \hat{\lambda} i) \quad (6)$$

Where λ_i is the *i*-th largest eigenvalue of the matrix in (4) and (5).

The maximum eigen value statistic test

The second test is maximum eigenvalue statistic which tests the null hypothesis of (r) cointegrating relations against the alternative of (1+r) cointegrating relations. This test statistic is computed as:

$$\pi_{max}(r \mid r+1) = -T \, ln(1 - \hat{\lambda}_{r+1}) \quad (7)$$

Neither of these test statistics follows a chi square distribution in general; asymptotic critical values can be found in Johansen and Juselius [5] and are also given by most econometric software packages. Since the critical values used for the maximum eigen value and trace test statistics are based on a pure unit-root assumption, they will no longer be corrected when the variables in the system are near- unit-root processes. By default, E-views program reports the value based on MacKinnon, et al. [6], p- values for Johansen's cointegration trace test and maximum eigen value test.

Unit Root Tests Results for Cattle

In order to test stationarity of cattle prices for the markets considered in this study (Medani, Elobied, Omdurman, Sennar and Nyala), three approaches were applied to prices in level. These are Dickey-Fuller and its augmentation (DF/ADF) test, Phillips and Perron [7] (PP) procedure and panel unit root test using the E-Views software computer program. Panel unit root tests provide an overall aggregate statistic to examine whether there exists a unit root in the pooled cross-section time series data and judge the time series property of the data accordingly. Therefore, the panel-based unit root tests have higher power than unit root tests based on individual time series. The automatic selection methods choose to minimize one of the following criteria: Akaike (AIC), Schwarz (SIC) and Hannan- Quinn (HQ) selection criteria. Here in this test three panel unit root tests would be used, which were the Levin- Lin and Chu (LLC) test, Fisher-ADF test and Fisher-PP test. The results for these tests in levels and first differences for selected markets (Medani, Elobied, Omdurman, Sennar and Nyala) during the periods (1995m1-2011m12) are reported in Table 1.

It was clear that in case of the test in level all the results indicate the presence of unit root, as the LLC test and both Fisher tests fail to reject the null hypothesis of non stationarity (presence of unit root) in view of p-values which were non-significant. On the other hand in case of first the differences test the null hypothesis was rejected in all three tests according to the p-values which were significant at less than 1% level.

The results of other tests show that all price series are non-stationary in level, while they were stationary in first differences for all variables, so all prices were integrated of order I(1) and then these series could be tested for the existence of a long run (cointegration) relationship between them through multivariate cointegration approach. Babiker [8] used Dickey-fuller stationary test and she found that for cattle prices in level Nyala and Medani were non stationary while Omdurman and Elobied stationary but they were stationary in first differences.

Results and Discussion of the Multivariate Cointegration Approach for Cattle

A major requirement in conducting Johansen [9,10] cointegration tests and estimation of a VAR system is the choice of an optimal lag length. Noting that, the lag length ought to be set long enough to ensure that the residuals are white noise [11]. The lag structure of the estimated VAR was then examined using a combination of VAR lag

Tests	Levels		First Differences	
	Test Statistic	The p-values	Test Statistic	The p-values
Levin, Lin and Chu	-0.7785	0.2181	-30.7911	0.0000
ADF-Fisher	6.32811	0.7870	595.795	0.0000
PP-Fisher	5.62558	0.8457	796.400	0.0000

Table 1: The Panel unit root test (in levels and First Differences) in selected markets (1995m1-2011m12).

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-169.2283	NA	4.07e-06	1.77780	1.86146	1.81169
1	247.6562	808.243	7.47e-08	-2.22091	**-1.71922**	**-2.01784**
2	275.0867	**51.7821**	**7.29e-08**	**-2.24578**	-1.325903	-1.87337
3	289.9038	27.2151	8.09e-08	-2.14187	-0.80380	-1.60018
4	299.0509	16.3340	9.54e-08	-1.98011	-0.22398	-1.26914
5	313.7355	25.4733	1.06e-07	-1.87485	0.29940	-0.99460
6	329.3426	26.2773	1.18e-07	-1.77900	0.81338	-0.72948
7	347.1230	29.0292	1.28e-07	-1.70533	1.30517	-0.48653
8	366.0183	29.8853	1.37e-07	-1.64304	1.78559	-0.25496

Table 2: Vector autoregressive (VAR) lag order selection criteria.

Trace Test				
Null Hypothesis	**Eigen value**	**Trace Statistic**	**0.05 Critical Value**	**p-value**
None *	0.17129	106.479	76.9727	0.0001
At most 1 *	0.1254	68.7137	54.079	0.0015
At most 2 *	0.08637	41.7814	35.1927	0.0085
At most 3 *	0.0706	23.6241	20.2618	0.0166
At most 4	0.04334	8.90569	9.16454	0.056
Maximum Eigen value Test				
None *	0.17129	37.766	34.8058	0.0215
At most 1	0.1254	26.9323	28.588	0.0801
At most 2	0.08637	18.1573	22.2996	0.1717
At most 3	0.0706	14.7184	15.8921	0.0757
At most 4	0.04334	8.90569	9.16454	0.056

Trace test indicates 4 co-integrating equations at the 0.05 level.

Max-eigenvalue test indicates 1 co-integrating equation at the 0.05 level.

*denotes rejection of the null hypothesis at the 0.05 level.

Source: Authors calculation.

Table 3: Johansen tests results for number of cointegrating vector, cattle prices 1995M1-2011M12.

order selection information criteria (Akaike (AIC), Schwarz Bayesian (SBC), likelihood ratio (LR) and Hannan-Quinn (HQ) information criterion) and checking that the inverse roots of the characteristic polynomial lie within a unit circle, which is a condition for having a stable VAR system. This process led to the choice of two lags as shown in Table 2, which was used in the cointegration test and subsequent analyses. Examination of the inverse roots of the AR characteristic within the unit circle for the VAR specification indicated that a VAR satisfies the stability condition under using two lag, i.e., if the estimated VAR process is stationary, then all AR roots should lie inside the unit circle.

Number of cointegration vectors for cattle prices

The results of the previous stage were used to determine the cointegrating vectors in the models on the maximum eigen value, the trace of the stochastic matrix test of Johansen (1988 and 1991). The trace test is a joint test, the null hypothesis is that the number of cointegrating vectors is the less than or equal (r), where r=0, 1, 2 …t, against alternative hypothesis that there are more than (r). While the maximum eigen value test conducts separate tests on each eigen value. The null hypothesis is that there are (r) cointegrating vectors present against the alternative that there are (r+1) cointegrating vectors present. Table 3 below displays the result of Johansen likelihood ratio test. In this table the null hypothesis of no cointegration (r=0) among variables was rejected in both trace test statistic and the maximum eigen value statistic. The trace of stochastic matrix was (106.48) and the maximum eigen value statistics (37.77) were above their corresponding 95% critical values of (76.97) and (34.80), respectively. Moreover, a hypothesis of numbers of cointegration vector in trace test under three forms, which is (at most one cointegration relation (r=1), at most two cointegration relations (r=2) and at most three cointegration relations (r=3) were found (Table 3). In all cases the statistic values exceed the critical values under (0.05) significance level, then the trace indicates four cointegrating equations at the 0.05 significance levels.

The maximum eigenvalue test suggested one cointegration relation among the five variables while trace test suggested four cointegrating equations, therefore, according to Banerjee, et al. [12] and Dickey and Fuller [13], if any divergence of results between these two tests (The maximum eigen value and the trace tests) exits, it is advisable to rely on the eigenvalue test since the results of the latter test are more reliable in small samples. If rely in this argument, the cattle price data in Sudan (1995m1-2011m12) appears a stable long run relationship and suggested one cointegration vector.

Estimating vector error correction (VECM) models for cattle prices

Given the Order of vector autoregressive models, the Number of cointegration vectors and estimation of vector autoregressive (VAR) model results, the next stage in the model building process requires the construction of a multivariate VECM for cattle prices in Elobied, Omdurman, Medani, Sennar and Nyala where the time series were found to be co integrated. Using information constructed from above results, one cointegration vector and two lag lengths were imposed in estimation of Vector Error Correction (VECM) Models and the long and short run matrices were extracted and presented below. These matrices describe the system dynamics.

Cointegration short run dynamics matrices (Γ) for cattle prices

To illustrate the result, beginning by the first equation (1) of Medani market the changes in the prices of Medani market in the short run, equation (1), jointly causes by the prices of previous month of Omdurman market and Medani itself lagged two months, and causes by the prices of Sennar lagged one and two months. This is a logic finding in term of geographical location of these markets which located on one road. With respect to Elobied market equation, the changing accrues resulting of the prices of Medani and Omdurman markets in the previous month in addition to the prices of Elobied itself lagged one and two months. Again the result is seemed to be logic in sense that Elobied market was a producer market while Medani and Omdurman were consumer markets. The sings of the significant vector auto regression suggested that, an increase in the level of Medani and Omdurman prices in the previous month leads to an increase in the level of the prices in Elobied and the opposite is true. It was clear that Elobied markets is more response to the prices changing in Medani market than Omdurman, may be the cost of transportations caused this gap between the degree of the response.

$$M= 0.18\ M(-2) + 0.18\ O(-1) + 0.28\ S(-1) + 0.16\ S(-2) \quad (1)$$

$$E=0.40\ M(-1) - 0.25\ E(-1) - 0.21\ E(-2) + 0.28\ O(-1) \quad (2)$$

$$S=- 0.26\ O(-1) \quad (3)$$

$$O=0.16O(-2) \quad (4)$$

$$N=0.28\ N(-1) \quad (5)$$

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Where M stand for Medani, E for Elobied, O for Omdurman, S for Sennar and N stand for Nyala market.

According to Omdurman market model the change in the price causes just by itself lagged two months, but the change in the prices of Sennar market was happened because of the prices of Omdurman in the previous month.

The linkages between the markets in the short run presented in Figure 1, below which shows that Medani, Omdurman, Elobied and Nyala were affected by their own prices while Sennar was not. Omdurman and Medani have effect on Elobied market but Elobied affected itself. Nyala market seems to be separated of the other markets, i.e., it does not affect by other markets nor had an effect on any other markets. In the short term Omdurman market effect on most cattle markets in Sudan but was not affected, and this is may be due to the direction of the increasing growth of investments in all areas in the national capital leads to increasing cattle demand and classified Omdurman cattle markets as demand leader. The cause of the separation of Nyala market from the rest of the markets may be due to the ongoing conflicts in this region, which makes cattle traders refrain from entering into this market, this leads to leakage of livestock from this market to neighboring countries in the form of smuggling.

Co-integration long run equilibrium matrix (Π) for cattle prices: The long run equilibrium matrix (Π) describes the long run effect As evident from the matrix, the error correction terms of Medani market have been found to be statically significant, indicating that, the level of cattle prices in Medani, Omdurman, Sennar and Nyala markets exert significant long run effect on the prices of Medani, suggesting the validity of the long run equilibrium relationship. The same result found in Omdurman and Sennar markets. But the levels of cattle prices in the long run equilibrium relationship of Elobied and Nyala markets does not affected by the prices of other markets.

From the above table the following equations could be constructed:

$$M=0.011\ \Delta M + 0.021\ \Delta O + 0.026\ \Delta S \quad (6)$$

$$E=0.019\ \Delta M + 0.035\ \Delta O + 0.045\ \Delta S \quad (7)$$

$$O=-0.106\ \Delta M + -0.196\ \Delta O + -0.251\ \Delta S \quad (8)$$

$$S=-0.078\ \Delta M + -0.145\ \Delta O + -0.185\ \Delta S \quad (9)$$

$$N=0.028\ \Delta M + 0.052\ \Delta O + 0.066\ \Delta S \quad (10)$$

Where M stand for Medani, E for Elobied, O for Omdurman, S for Sennar, N for Nyala and Δ denoted the change in the variables.

The sings of the significant error correction terms suggest that the increase in the level of Medani, Omdurman and Sennar prices in the long run leads to an increase in the level of prices in Medani, Elobied and Nyala in the long run and the opposite is true. On the other hand, the increase in the level of Medani, Omdurman and Sennar prices in the long run leads to decreases in the level of prices in , Omdurman and Sennar in the long run and vice versa, Figure 2, below presents these linkages between these markets. The prices of cattle in the markets of Omdurman, Medani and Sennar affect all cattle markets prices, this is normal because these markets for consumption purposes. While the cattle prices of Elobied and Nyala markets only affected other markets and do not affected by any market, and this is due to that, these markets considered as supply market.

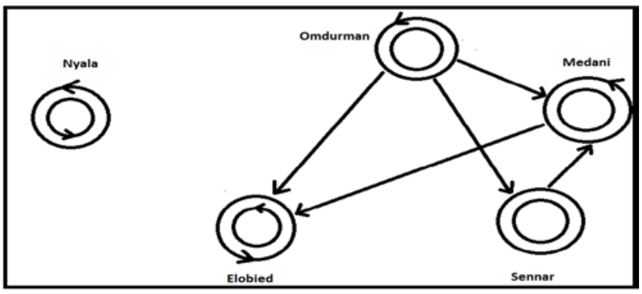

Figure 1: Lines connected multivariate cattle markets whose prices were co-integrated in the short run, 1995m1- 2011m12.

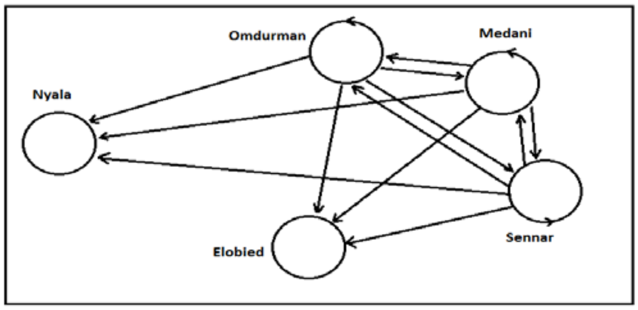

Figure 2: Lines connected cattle markets whose prices were co-integrated in the long run, 1995m1-2011m12.

	Medani	Elobied	Omdurman	Sennar	Nyala
D (Medani)	**0.011123** [2.18926]	**0.018977** [2.18926]	**-0.105638** [-2.18926]	**-0.078049** [-2.18926]	**0.027814** [2.18926]
D (Elobied)	0.006608 [0.94987]	0.011274 [0.94987]	-0.062757 [-0.94987]	-0.046367 [-0.94987]	0.016523 [0.94987]
D (Omdurman)	**0.020635** [3.89581]	**0.035207** [3.89581]	**-0.195985** [-3.89581]	**-0.144801** [-3.89581]	**0.051601** [3.89581]
D (Sennar)	**0.026397** [5.04803]	**0.045037** [5.04803]	**-0.250708** [-5.04803]	**-0.185233** [-5.04803]	**0.066009** [5.04803]
D (Nyala)	-0.000646 [-0.13703]	-0.001102 [-0.13703]	0.006135 [0.13703]	0.004533 [0.13703]	-0.001615 [-0.13703]

The figures in parentheses are the t-ratio for the estimates.

D stand for the changes in the variables concerned, Source-Authors calculation.

Table 4: Co-integration long run equilibrium matrix (Π) for cattle prices, 1995m1-2011m12.

The error correction model takes into account the adjustment of long-run disequilibrium in markets and time to remove disequilibrium in each period depending on the value of estimated coefficient [14]. Table 4 shows that between 1% and 25% of disequilibrium are removed in one month in case of Medani and Omdurman equation respectively. With respect to equation (1) for the prices of Medani.

1%, 2% and 3% of disequilibrium is removed in Medani, Omdurman and Sennar in one month respectively. On the other hand with respect to equation (2) for the prices of Omdurman market about 11%, 20% and 25% of the disequilibrium is removed in Medani, Omdurman and Sennar in one month, respectively.

Babiker studied the spatial integration of sheep markets in the Sudan during the period January 1990 to December 2000 using bivariate approach, she found that the previous periods disequilibrium were corrected by 9% and 47% a month between Medani, Omdurman, Elobied, Nyala and Sennar. For the prices of Nyala market in equation (5) about 3%, 5%and 7% of the disequilibrium is removed in Medani,

Tests Equation	Lagrange multiplier test	Ramsey's RESET	Jarque-Bera test	ARCH test
Elobied	82.71338 (0.0000)	3.665418 (0.0570)	31.51802 (0.00116)	57.07221 (0.0000)
Omdurman	70.12216 (0.0000)	33.91329 (0.0000)	1.06242 (0.58789)	11.99574 (0.0000)
Medani	158.6081 (0.0000)	3.043719 (0.04990)	29.10015 (0.0000)	164.1491 (0.0000)
Sennar	118.9546 (0.0000)	18.21305 (0.0000)	8.12544 (0.01720)	39.19902 (0.0000)
Nyala	144.2089 (0.0000)	11.35569 (0.0000)	3.946117 (0.13903)	43.57100 (0.0000)

The figures between brackets are the rejection probability.

Table 5: Diagnostic tests results for the estimated equations of cattle prices, (1995-2011).

Omdurman and Sennar in one month. respectively. This means that Omdurman cattle market is the most one that pays to remove the gap between prices because it is more demand oriented for cattle. Babiker concluded that markets were cointegrated, and the system was centered on Omdurman which means the market was demand driven. This implies that agents in other markets take long time to complete their transaction and adjust to a long-run equilibrium.

Diagnostic tests: In order to select an ECM, it needs to satisfy a range of diagnostic tests. These diagnostics tests provide information about the data properties and evaluate restrictions on the estimated coefficients, including the special case of tests for omitted and redundant variables. The diagnostic tests usually include Lagrange multiplier test for autocorrelation, Ramsey's "RESET" test for functional form, normality and heteroscedasticity tests. The results of cattle prices in Table 5 were robust as they satisfied almost all relevant diagnostic tests. But with the exception of Omdurman, the model suffer from normality problem as indicted in Jarque-Bera test p-value (0.58789) which failed to reject the null hypotheses of non-normal distribution.

The same null hypothesis was accepted for Nyala equation (0.13903). One possible explanation for this problem is the characteristics of the data used in the models. When the series were drawn against time it was noticed that the time paths during 1990's were slightly different from previous years [8]. This is quite understandable because of the instability which has characterized the Sudanese economy during this period. Owing to this problem, the models for predicting the future path of its variables should be used cautiously.

Concluding Remarks

This paper discusses the multivariate co-integration regression results or cattle prices using the vector auto-regression (VAR) of Johansen. The long run analysis of cattle prices in selected markets indicates strong evidence of existing of long run relationship between the livestock markets in the Sudan, Interestingly of long run result is that Elobied and Nyala market prices affected by all other markets, while prices of other markets do not affect them at all. The interpretation behind this may be of the same nature of Elobied and Nyala as main source of livestock, in sense that the demand for cattle in Omdurman and Medani markets increase in the long run which causes these markets as leader prices (demand driven).

The results appear that there was a short run relation among livestock markets in Sudan except for Nyala market which seems to be separated of the other markets, this may due the far distance of Nyala. In the short term Omdurman market has effect on most cattle markets in Sudan but is not affected by them due to the direction of the increasing growth of investments in all areas in the national capital, in the sense that there is unbalanced development discrimination against other regions in Sudan. The cause of the separation of Nyala market from the rest of the market may be due to the ongoing conflicts in this region, which makes cattle traders refrain from entering into this market, this is it leads to leakage of livestock from this market to neighboring countries in the form of smuggling.

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