International Journal of Economics & Management Sciences

Bushara and Abdelmahmod, Int J Econ Manag Sci 2016, 5:2
http://dx.doi.org/10.4172/2162-6359.1000321

Research Article | Open Access

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

Mohammed OA Bushara[1]* and Murtada KA Abdelmahmod[2]

[1]*Department of Agricultural Economics, University of Gezira, Wad Medani, Sudan*
[2]*Department of Economics, University of AL-Butana, Rufaa, Sudan*

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 bivariate cointegration analysis. The study found strong evidence of cointegration of pairs of markets. The error correction mechanism adjusts significantly to shocks to its equilibrium relationship. The estimated coefficients for ECM were fluctuated between 4% and 24% and significant at 1% level, suggesting slowing adjustment towards the long-run equilibrium. This implies that any shock that forces prices from their long-run value would take a long time for prices to return to their equilibrium, although the speed of adjustment was highest in case of Omdurman on Nyala and lowest in case of Nyala on Elobied, this might be due to supply and demand relation between Nyala and Omdurman in sense that Nyala and Elobied were supply markets. The recent paved roads that linked between the markets might accelerate and facilitated the movement between these markets, in addition to a huge capital that allocated to livestock business recently.

Keywords: Market efficiency; Cattle; Coinegration; Bivariate; Sudan

Introduction

Most researchers agree that the problems of livestock marketing in Sudan are limited to the specific problems which can be summarized in a weak infrastructure especially in the area of transport and veterinary services, lack of finance, areas of production distant from areas of consumption and together with lack of suitable transport render animals weak and meat quality low, smuggling especially across the borders to Egypt, Eritrea and Libya Markets that are not integrated may convey inaccurate price signal that might distort producers marketing decisions and contribute to inefficient product movement [1] and traders may exploit the market and benefit at the cost of producers and consumers.

Testing for the existence of cointegration among economic variables has been widely used in the empirical literature to study economic interrelationships. Its existence would imply that the two series would never drift too far apart. A non-stationary variable, by definition, tends to wander extensively over time, but a pair of nonstationary variables may have the property that a particular linear combination would keep them together, that is, they do not drift too far apart. Under this scenario, the two variables are said to be co integrated, or possess a long-run (equilibrium) relationship. Several studies of market integration have been done in previous literature. Concepts of market integration and market efficiency present cornerstones of modern economics. Yet, the discipline struggles with the important, practical challenges of clearly defining a market empirically and of establishing whether markets are efficient in allocating scarce goods and services [2]. Babiker and Abdalla [3] studied price movements among important sheep markets in the Sudan to explore their performance and pricing efficiency. Six geographically separated livestock wholesale markets were tested spatially, using [4] Cointegration test and time-series price data for the period 1990-2004. Spatial analysis of the whole dataset indicates the absence of cointegration among the selected markets, while a subset of the data, for the period 2000-2004, after some infrastructural facilities were introduced, shows that the same markets are co integrated. Ibrahim [5] concluded the pastoral economy as exists in the Sudan was still having strong potential despite the many problem related to the overstocking, low levels off take and quality of animals breed, which had reduced productive capacities. These problems resulted from long run neglect of this sector. Idris [6] studied the livestock marketing with the reference to Southern Darfur Region. He categorized the livestock markets according to supply of animals and their location with regard to availability of transportation facilities to primary, secondary and terminal markets. He also traced the cost incurred in trekking cattle from Nyala to Khartoum. In his study he also found that livestock trade was controlled by a small number of merchants and the barriers to entry in this system were high. M. SA [7] studied livestock farming systems and argued that several successive years of low rainfall; decorticating and inappropriate usage of land led to damage of some region lands and increased pressure on less affected areas. He concludes that to maintain the balance between animals and pasture in short run the off take percentage to the market should be increased and pasture regeneration and investment in this sector were essential steps on the long run. Further insights on livestock markets cointegration were documented by El Agip [8] who examined cointegration and causality in five livestock markets (Omdurman, Medani, Elobied, Sennar and Nyala towns) using monthly nominal prices from January 1990 through December 1999. He found that spatial market cointegration was present between these cattle and sheep markets and the leading price discovery location was Elobied, in other words the system was supply driven. Babiker [9] studied market price integration for livestock in Omdurman, Medani, Nyala and Elobied. She applied several approaches which were Engle and Granger bivariate cointegration approach, Granger causality test and Johansen Multivariate approach to the nominal monthly prices of cattle and

***Corresponding author:** Mohammed OA Bushara, Department of Agricultural Economics, University of Gezira, Wad Medani, Sudan, Tel: (+249)511 - 841623; E-mail: mosman@uofg.edu.sd

Received January 04, 2016; **Accepted** January 27, 2016; **Published** January 30, 2016

Citation: Bushara MOA, Abdelmahmod MKA (2016) Efficiency of Selected Sudanese Cattle Markets: A Bivariate Cointegration Approach (1995-2011). Int J Econ Manag Sci 5: 321. doi:10.4172/2162-6359.1000321

Copyright: © 2016 Bushara MOA, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Citation: Bushara MOA, Abdelmahmod MKA (2016) Efficiency of Selected Sudanese Cattle Markets: A Bivariate Cointegration Approach (1995-2011). Int J Econ Manag Sci 5: 321. doi:10.4172/2162-6359.1000321

sheep for the period 1980m1-200412. She concluded that markets were co integrated, and the system was centered on Omdurman which means the market was demand driven.

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 this study were monthly price which have been collected from the animal resources company, these prices were wholesale prices i.e. the selling price of a head of animal measured in Sudanese Pound (SDG). 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(base year 1994) 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 logged and deflated prices data were used in the empirical analysis.

Testing for cointegration at the first step requires testing the order of stationarity of the variables. Integration tests or unit root tests are a prerequisite for cointegration tests, thus, an econometric model cannot be specified unless its order of integration of the variables is known. The order of integration in the time series checked by the Augmented Dickey-Fuller [10] (ADF) and Phillips and Perron tests [11], which are the most widely used methods for unit root tests. According to Babiker, in testing cointegration two conditions must be fulfilled: first the data series must have similar statistical properties; in particular, they must be integrated of the same order, because a variable with a constant mean cannot explain movements in a variable whose mean is changing through time. The second condition for cointegration is that there should be some linear combination between the data series. If and only if the hypothesis of no cointegration is rejected an error correction model (ECM) would be estimated to integrate the dynamics of short run (changes) with long run (levels) adjustment process.

Engle and Granger Approach

The Engle-Granger residual-based test for cointegration is simply unit root test applied to the residuals obtained from OLS estimation of the following Equation:

$$Y_{t1} = \alpha + \beta Y_{t2} + u_t \quad (1)$$

Where Y_{t1} and Y_{t2} are the two price series and u_t is the error term. This model called cointegration regression.

Under the assumption that the series are not cointegrated, all linear combinations including the residuals from OLS, are unit root nonstationary. Therefore, a test of the null hypothesis of no cointegration against the alternative of cointegration corresponds to a unit root test of the null of nonstationary against the alternative of stationarity. Accordingly, Engle-Granger test uses a parametric, augmented Dickey-Fuller (ADF) approach to accounting for serial correlation in the residual series.

The Engle-Granger test estimates a p-lag augmented regression of the form

$$\Delta\hat{u}_{1t} = (\rho - 1)\,\hat{u}_{1\,t-1} + \sum_{j=1}^{p} \delta j\ \Delta\hat{u}_{1\,t-j} + v_t \quad (2)$$

Where u_t represents the residual of OLS regression, $\Delta\hat{u}_{1t}$ is the difference of residual and p is then number of lagged differences chosen to remove any evidence of serial correlation in the residuals. Two standard ADF test statistics consider, the one based on the τ-statistic (tau) for testing the null hypothesis of nonstationary ($\hat{\tau}$) and the other based directly on the normalized autocorrelation coefficient ($\hat{z}$):

$$\hat{\tau} = \frac{(\hat{\rho} - 1)}{se(\hat{\rho})} \quad (3)$$

$$\hat{z} = \frac{T(\hat{\rho} - 1)}{(1 - \sum_j \hat{\delta} j)} \quad (4)$$

Where $se(\hat{\rho})$ is the usual OLS estimator of the standard error of the estimated $\hat{\rho}$. The null hypothesis (H_0) of no cointegration in equation (4) is $\rho = 1$ and the alternative one (H_a) is $\rho < 1$. The lag length in the model was determined using Akaike Information and Bayesian model selection criteria, and then the estimate ADF statistic compared with the critical values:

If $ADF_{cal} > ADF_{critical}$ reject H_0: u_t is stationary, and then Y_{t1} and Y_{t2} are cointegrating.

If $ADF_{cal} \leq ADF_{critical}$ accept H_0: u_t is not stationary, and then Y_{t1} and Y_{t2} not cointegrated. If the hypothesis of no cointegration is rejected i.e. long run relationship exists between the variable, an error correction model (ECM) developed by Engle and Granger [12] would be estimated, it considers bivariate market cointegration between any pairs of markets i and j. The probability values were derived from the Davidson and MacKinnon response surface simulation results

Error correction model (ECM) is a time series model in first differences that contains an error correction term, which works to bring two I(1) series back into long-run equilibrium (Wooldridge). To learning about a potential long-run relationship between two series, the concept of cointegration enriches the kinds of dynamic models at our disposal. If y_t and x_t are I(1) processes and are not co integrated, a dynamic model might be estimated in first differences as considered in the following derivation.

Driving Error Correction Model (ECM)

Assuming the following two variables cointegration regression model:

$$Y_t = \alpha + \beta X_t + u_t \quad (5)$$

The Engle-Granger residual-based test for cointegration is simply unit root test applied to the residuals obtained from OLS estimation of the above Equation in two steps:

Step (1) regress Y on X in level to obtain the cointegration vector which is the predicted equilibrium relationships.

From step (1), $u_{t=} (Y_t - \alpha - \beta X_t)$ =the error term.

This is not for causal inference, but a necessary prerequisite. If and only if u_t is stationary, we can proceed to step (2). If u_t is not stationary then the Y,X relationship is spurious, not cointegrating.

Step (2) modifies the model in (5) to be:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \beta_0 X_t + \beta_1 X_{t-1} + u_t \quad (6)$$

Assume Y_t and X_t ~I(*1*)

Subtract Y_{t-1} from both sides of equation and get:

$$\Delta Y_t = \alpha_0 + \rho_1 Y_{t-1} + \beta_0 X_t + \beta_1 X_{t-1} + u_t$$

Where $\rho_1 = (\alpha_1 - 1)$

Now add: $\beta_0 X_{t-1} - \beta_0 X_{t-1}$ and get:

$$\Delta Y_t = \alpha_0 + \rho_1 Y_{t-1} + \beta_0 \Delta X_t + \theta_1 X_{t-1} - \beta_0 X_{t-1} + u_t \quad (7)$$

Where $\theta_1 = (\beta_1 + \beta_0)$

If ΔY_t stationary, Y_t and X_t cointegrated, then u_t must be I(0) as well. Now from equation (5) the error term $u_t = (Y_t - \alpha - \beta X_t)$ then $u_{t-1} = (Y_{t-1} - \alpha - \beta X_{t-1})$ which is the error correction mechanism, then the error correction model is:

$$\Delta Y_t = \alpha_0 + \beta_0 \Delta X_t + \pi(Y_{t-1} - \alpha - \beta X_{t-1}) + e_t$$

Then $$\Delta Y_t = \alpha_0 + \beta_0 \Delta X_t + \pi u_{t-1} + e_t \quad (8)$$

Equation (8) is the error correction model implies the last step of Engle and Granger cointegration test, and accordingly;

Coefficient on ΔX_t will tap short-run effect.

Negative coefficient on u_{t-1} will be error correction.

In equation (8) $\pi<0$; If $y_{t-1} > \beta x_{t-1}$, then y in the previous period has overshot the equilibrium because $\pi<0$, the error correction term works to push *y* back toward the equilibrium. Similarly, if $y_{t-1} > \beta x_{t-1}$, the error correction term induces a positive change in y back toward the equilibrium.

Unit Root Tests Results for Cattle

In order to test stationarity of cattle prices for the markets considered in this study, three approaches were applied to prices in level. These are Dickey-Fuller and its augmentation (DF/ADF) test, Phillips (PP) procedure and panel unit root test using the E-Views software computer program [13]. 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 and Quinn (HQ) selection criteria [14-16]. Here in this test three panel unit root tests would be used, which were the Levin, Lin test, Fisher ADF test and Fisher-PP test [17-19]. The results for these tests in levels and first differences for selected markets during the periods (1995m1-2011m12) are reported in Table 1.

Automatic lag length selection based on Schwarz information criteria (SIC).

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-stationary (presence of unit root) in view of p-values which were non-significant. On the other hand in case of the first 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 shows that all price series are non-stationary in level, while it was stationary in first differences for all variables, so all prices were integrated of order I(1).

Bivariate Residual Based Approach (Engle and Granger)

Engle and Granger note that a linear combination of two or more I(1) series may be stationary, or I(0), in which case it might be said that the series are co integrated. Such a linear combination defines a cointegrating equation with cointegrating vector of weights characterizing the long-run relationship between the variables.

The Engle-Granger residual-based test for cointegration is simply unit root test applied to the residuals obtained from OLS estimation of Equation (1). Under the assumption that the series are not co integrated, all linear combinations including the residuals from OLS, are unit root nonstationary. Therefore, a test of the null hypothesis of no cointegration against the alternative of cointegration corresponds to a unit root test of the null of nonstationary against the alternative of stationarity. Given the five markets Elobied, Omdurman, Medani, Sennar and Nyala, twenty pairwise comparisons are possible for the two direction of dependency in case of cattle prices for the period 1995m1- 2011m12. For Engle-Granger test, two standard ADF test statistics consider, the one based on the τ-statistic (tau) for testing the null hypothesis of nonstationary and the other based directly on the Normalized Autocorrelation Coefficient ($\hat{z}$). The lag length in the model was determined using Akaike Information and Schwarz Bayesian model selection criteria, and then the estimated ADF statistic compared with the critical values.

Cointegration Regression Results

The Engle-Granger method involves firstly running a cointegration regression of one variable on another, and secondly checking whether the regression residual from the first step is stationary using an ADF test. Table 2 below reports twenty pairwise cointegration regression results for cattle prices in the selected markets. Estimated parameters (constant- explanatory) are presented with corresponding p-value between two brackets for t-ratio. Goodness of fit (R^2) and Cointegration Durbin-Watson statistic (CRDW) also presented in Table 2 below.

The interesting in these results is that, in all cases R^2<DW which means that, they do not suffer any spurious regression. According to Granger and Newbold (1974), an R^2>DW is a good rule of thumb to suspect that the estimated regression is spurious. With regard to the goodness of fit (R^2) for these relationships, it ranged from 1% low in case of Elobied on Medani and Nyala on Elobied to 30% high in case of Sennar on Medani relationship. That means the explanatory power to illustrate the strength of relationship is very weak. With regard to the variables coefficient there were sixteen out of twenty relationship were significant, these relations could be summarized in term of effectiveness, following, Omdurman and Medani markets affected by all others markets, while, Nyala market does not connected with Elobied and Sennar markets but it was connected to other markets. An important notice in all these relationship the directions was positive, that is to say an increase in prices in one market lead to an increase in the other market and the vice versa.

CRDW is the cointegration regression Durbin-Watson

- The figures in parentheses in column 3 and 4 stand for p-values of t-ratio.

According to Omdurman on Elobied and Omdurman on Nyala, the relationship between the two markets is significant at less than 1%

Tests	Levels		First Differences	
	test statistic	the p-values	test statistic	the p-values
Levin et al.	-0.7785	0.2181	-30.7911	0
ADF - Fisher	6.32811	0.787	595.795	0
PP - Fisher	5.62558	0.8457	796.4	0

Source: calculated from Appendix (A) using E-Views software computer programs.

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

Dependent variable	Independent variable	Parameter estimates		R²	CRDW
		Constant	Explanatory		
Elobied	Omdurman	1.17701 (0.0526)	0.51356	0.11156	0.62771
			-0.0033		
Elobied	Medani	2.04265 (0.0000)	0.28584	0.10716	0.57214
			-0.0208		
Elobied	Sennar	1.46704 (0.0024)	0.47937	0.10962	0.58479
			-0.0019		
Elobied	Nyala	2.60466	0.130243	0.01201	0.52334
		0	-0.3968		
Omdurman	Elobied	2.82516 (0.0000)	0.221297	0.11281	0.71619
			-0.0053		
Omdurman	Medani	2.66042	0.254405	0.16913	0.71558
		0	-0.001		
Omdurman	Sennar	2.67055	0.259463	0.09664	0.65681
		0	-0.0113		
Omdurman	Nyala	2.60217	0.317079	0.17045	0.71482
		0	-0.0004		
Medani	Elobied	2.23178	0.335492	0.08201	0.30873
		0	-0.01		
Medani	Omdurman	0.87348 (0.1582)	0.675964	0.142	0.37479
			-0.0002		
Medani	Sennar	0.79714	0.777497	0.28088	0.35992
		-0.076	0		
Medani	Nyala	1.88094	0.48569	0.10373	0.32449
		0	-0.0013		
	Elobied	2.33876 (0.0000)	0.265052	0.11176	0.51471
			-0.0045		
Sennar	Omdurman	1.93225 (0.0001)	0.342617	0.09625	0.49159
			-0.0125		
Sennar	Medani	1.84181 (0.0000)	0.398235	0.3034	0.54402
			0		
Sennar	Nyala	2.71452	0.148012	0.0321	0.46556
		0	-0.2093		
Nyala	Elobied	2.46663	0.102208	0.01299	0.31175
		0	-0.3845		
Nyala	Omdurman	0.5587	0.635222	0.15819	0.45271
		-0.2889	0		
Nyala	Medani	1.60984	0.359288	0.12776	0.38148
		0	-0.0011		
Nyala	Sennar	2.06271	0.226334	0.03234	0.32143
		0	-0.1278		

Source: Own author calculation.

Table 2: Cointegration regression results for cattle prices 1995M1- 2011M12.

level of significance, the direction between Omdurman and these two markets was positive which meant that an increasing in cattle prices of Elobied and Nyala markets leads to increase in cattle prices of Omdurman market which is logic result in sense that Elobied and Nyala markets are considered as supply markets while Omdurman is demand one. Moreover, the goodness of fit show that about 11% changing in Omdurman market prices causes by the changing in Elobied market prices, whereas 89% of the changing causes by changing in other markets.

The Engle-Granger Results for Cattle Prices

The Engle-Granger residual-based test for cointegration is simply unit root test applied to the residuals obtained from OLS estimation and the results reported in Table 3.

The tests statistics values, residuals stationarity test and their corresponding p-values under 5% significance levels, are reported in the Table 3 above. The lag length in the model was determined automatically using Akaike Information and Schwarz Bayesian model selection criteria which is available in E-Views software program automatically.

As to the tests themselves, the Engle-Granger tau-statistic (t-statistic for ADF test equation for residuals) and normalized autocorrelation coefficient (which was termed as z-statistic) both reject the null hypothesis of no cointegration (unit root in the residuals) at the 1% level in all cases. On balance, the evidence clearly suggests that these markets were co integrated. Once the cointegration properties were found in price series, the second step to the Engle-Granger test is the residuals stationarity test. It is found obvious from Table 3 that all residuals stationarity tests were rejected.

– The figures in parentheses of Table 3 above are p-values.

The nonstationary at the 1% level and accept that all the residuals from OLS regression were stationary and therefore, the above relations

	Models	Engle-Granger tau-statistic	Engle-Granger z-statistic	Residuals Stationarity Test
1	Elobied on Omdurman	-6.08249 (0.0000)	-63.3895 (0.0000)	-0.31226 (0.0000)
2	Elobied on Medani	-5.80071 (0.0000)	-58.53103 (0.0000)	-0.28833 (0.0000)
3	Elobied on Sennar	-5.84350 (0.0000)	-59.10871 (0.0000)	-0.29117 (0.0000)
4	Elobied on Nyala	-5.49880 (0.0000)	-53.29833 (0.0000)	-0.26255 (0.0000)
5	Omdurman on Elobied	6.67538 (0.0000)	-73.37765 (0.0000)	-0.36146 (0.0000)
6	Omdurman on Medani	-6.70701 (0.0000)	-73.48324 (0.0000)	0.36198 (0.0000)
7	Omdurman on Sennar	-6.30781 (0.0000)	-66.81507 (0.0000)	-0.32913 (0.0000)
8	Omdurman on Nyala	-6.64597 (0.0000)	-72.87077 (0.0000)	-0.35896 (0.0000)
9	Medani on Elobied	-4.54545 (0.0014)	-34.38203 (0.0018)	-0.16937 (0.0000)
10	Medani on Omdurman	-4.89959 (0.0004)	-39.29877 (0.0005)	-0.19359 (0.0000)
11	Medani on Sennar	-4.86573 (0.0004)	-38.52192 (0.0006)	-0.18976 (0.0006)
12	Medani on Nyala	-4.64131 (0.0000)	-35.51242 (0.0010)	-0.17493 (0.0014)
13	Sennar on Elobied	-5.46043 (0.0000)	--5.460431 (0.0000)	-0.25757 (0.0000)
14	Sennar on Omdurman	-5.31116 (0.0001)	-49.95801 (0.0000)	-0.24609 (0.0000)
15	Sennar on Medani	-5.70327 (0.0000)	-55.85167 (0.0000)	-0.27513 (0.0000)
16	Sennar on Nyala	-5.15169 (0.0001)	-47.25617 (0.0001)	0.23278 (0.0000)
17	Nyala on Elobied	-3.22374 (0.0703)	-21.69171 (0.0346)	--0.12619 (0.0015)
18	Nyala on Omdurman	-3.46228 (0.0393)	-25.15623 (0.0159)	-0.15321 (0.0007)
19	Nyala on Medani	-3.55693 (0.0307)	-26.36532 (0.0121)	0.15256 (0.0005)
20	Nyala on Sennar	-3.19928 (0.0744)	-21.44032 (0.0365)	--0.12645 (0.0016)

Source: Own author calculation.

Table 3: Engle-Granger cointegration results for cattle prices in selected markets, 1995M1- 2011M12.

were long run, and then the error correction model (ECM) would be estimated to integrate the dynamics of short run with long run adjustment process

Following Babiker [19] once cointegration relationship is established, the validity of an error correction model, using residuals from these cointegration regressions, was to imply that the variables in concern were co integrated as suggested by Engle and Granger representation theorem. The model may be interpreted as possessing long run equilibrium, although random shocks push the system away from equilibrium. In the short run, the error correction term, therefore, causes changes in the variables of the model. In the error correction model the dynamics of the both short run and long run adjustment processes were modeled simultaneously.

As a pre-conditions for estimation of the model describing the error correction model of equation (8), that the cointegration relationship should be establish between the variables and the error term u_t is stationary. As it's presented in results above all these two conditions were satisfied, then the model in equation (8) was estimated using OLS technique. The results are summarised in Table 4.

– The figures in parentheses are p-values.

As shown in Table 4 above, analysis of the cattle prices would suggest that the error correction model test should be conducted under the assumption of having linear data trend in the series and thus allowing constant and trend (equation (8) in the methodology). The error correction coefficients in the ECM equations were significant at 1% level and associated with the desirable negative signs in all cases, this shows that the error correction mechanism adjusts significantly to shocks to its equilibrium relationship with its hypothesized

Models	Estimated Coefficient		R-squared	Durbin-Watson stat	ARCH test
	D (independent variable)	RESID(-1)			
Elobied on Omdurman	0.180198	-0.135565 (0.0026)	0.100681	2.266805	39.50262 (0.0000)
	-0.0184				
Elobied on Medani	0.234308	-0.127992 (0.0032)	0.1122	2.309869	38.69968 (0.0000)
	-0.0032				
Elobied on Sennar	0.255551	-0.143581	0.127078	2.232592	38.89655 (0.0000)
	-0.0006	(0. 0007)			
Elobied on Nyala	0.20907	-0.124692 (0.0016)	0.097452	2.195357	28.22790 (0.0000)
	-0.0118				
Omdurman on Elobied	0.111938	-0.224177 (0.0000)	0.162919	2.206571	0.686804 (0.4082)
	-0.0054				
Omdurman on Medani	0.254339	-0.227075 (0.0000)	0.194984	2.243806	0.038302
	0				-0.845
Omdurman on Sennar	0.229828	-0.208174 (0.0000)	0.185247	2.211422	0.692262
	0				-0.4064
Omdurman on Nyala	0.292985	-0.242575 (0.0000)	0.202505	2.186225	0.945908
	0				-0.3319
Medani on Elobied	0.154465	-0.058734 (0.0437)	0.078648	2.064032	0.170445
	0				-0.6802
Medani on Omdurman	0.227881	-0.067527 (0.0309)	0.104036	2.035329	0.006442
	0				-0.9361
Medani on Sennar	0.417013	-0.081341 (0.0133)	0.244517	2.121785	0.067652
	0				-0.7951
Medani on Nyala	0.165365	-0.074024 (0.0084)	0.074997	1.935802	0.12776
	-0.0025				0.7211-
Sennar on Elobied	0.170585	-0.136114 (0.0001)	0.129295	0.129295	10.83712
	0				-0.0199
Sennar on Omdurman	0.23145	-0.127665 (0.0001)	0.138253	2.138849	23.9457
	0				-0.0008
Sennar on Medani	0.47167	-0.151289 (0.0001)	0.270715	2.264598	47.29401
	0				0
Sennar on Nyala	0.157787	-0.129306 (0.0000)	0.112742	2.085724	7.83951
	-0.0024				-0.014
Nyala on Elobied	0.096076	-0.043953 (0.1216)	0.055564	2.464118	0.058792
	-0.0035				-0.8396
Nyala on Omdurman	0.214323	-0.065698 (0.0437)	0.103168	2.537321	33.9508
	0				-0.0069
Nyala on Medani	0.119755	-0.057936 (0.0714)	0.061935	2.481989	0.727948
	-0.0141				-0.3946
Nyala on Sennar	0.145063	-0.045169 (0.1170)	0.057617	2.492298	0.269864
	-0.0012				-0.604

Source: Own author calculation.

Table 4: Estimated Error Correction Model for Cattle Prices, 1995M1-2011M2.

determinants that are caused by exogenous changes in past values. The goodness of fit fluctuated between 5% in case of Nyala on Sennar and 27% in case of Sennar on Medani. While Durbin-Watson statistic explains the absence of autocorrelation problem as its values close to 2.

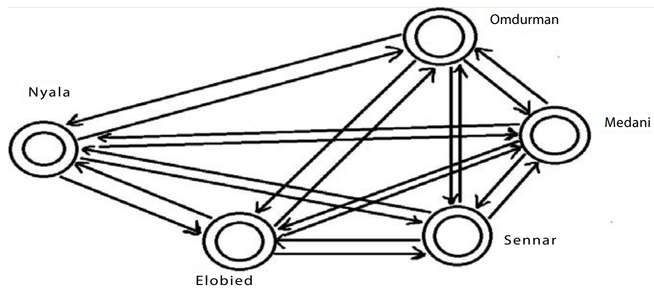
A significant coefficient in seventeen relations of the error correction terms provides evidence that the two markets prices were co integrated and that they share a long-run common trend. Examination of these coefficients in each equation provides information as to the degree and direction of the adjustment back towards the long-run equilibrium. There were three markets relation found to be non-significance which were Nyala on Elobied and Nyala on Sennar.

Hence a positive departure from equilibrium of the two markets prices in the previous period will be corrected by a negative coefficient of error correction term. Thus, the long-run relationship between the two markets prices is stable over time. The stable markets prices provide important information for long-run strategic planning. In Table 4 above, the estimated coefficients for ECM is fluctuated between 4% in case of Nyala on Elobied and 24% in case of Omdurman on Nyala, and it was significant at 1% level, suggesting that the last period (month) disequilibrium in prices of Nyala on Elobied, for example, corrected in the next month by 4%, where it seems to adjust slowly towards the long-run equilibrium, On the other hand, with respect to Omdurman on Nyala prices relationship, the last period (month) disequilibrium in prices corrected in the next month by 24%. However both values seem to adjust slowly towards the long-run equilibrium. This implies that any shock that forces prices from their long-run value would take a long time for prices to return to its equilibrium unless there are other shocks that counter the initial one. The short-run effect presented by the coefficient of independent variables in these models, which had positive signs and significant at all cases. This finding suggests that the short-run changes in independent market have a positive impact on short-run changes in dependent market with the value of coefficient. i.e. in the short-run Nyala cattle market affected Omdurman cattle market by 29% and so on with respect to others models.

Concluding Remarks

Considering the model without constant and trend, summing up the finding in the three unit root tests applied in this study, it's clear that all prices series were non-stationary in level, while they were stationary in first differences for all variables. From these results it could be concluded that all prices were integrated of order I (1). As the long run analysis of cattle prices in selected markets indicated, a strong evidence of cointegration of pairs of markets exists as shown in Figure 1. The error correction coefficients in the ECM equations show that the error correction mechanism adjusts significantly to shocks to its equilibrium relationship with its hypothesized determinants that are caused by exogenous changes in past values. The estimated coefficients for ECM were fluctuated between 4% and 24% and significant at 1% level, suggesting slow adjustment towards the long-run equilibrium. This implies that any shock that forces prices from their long-run value will take a long time for prices to return to its equilibrium, that means the speed of adjustment was highest in case of Omdurman on Nyala and lowest in case of Nyala on Elobied, this might be due to supply and demand relation between Nyala and Omdurman in sense that Nyala and Elobied were supply markets.

Figure 1 reveals that the prices of cattle markets had effect on each other's in the short run, i.e. any market was affected by other markets and has effect on other markets. This result seems to be reasonable, because of the recent paved roads that linked between all these markets which accelerated and facilitated the movement between these markets, addition to a huge capital that earmarked to livestock business recently. Babiker [19] found that Omdurman prices were affected by its own prices and exert short effects on all other markets while Medani and Elobied exert short run effects on Omdurman but not Nyala.



Source: Based on the values of Estimated Error Correction of Table 4.

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

References

1. Goodwin BK, Schroeder TC (1991) Cointegration tests and spatial price linkages in regional cattle markets. American Journal of Agricultural Economics 73: 452-464.
2. Barrett CB, Jau RL, DeeVon B (2000) Factor and product market tradability and equilibrium in Pacific Rim pork industries. Journal of Agricultural and Resource Economics 25: 68-87.
3. Babiker BI, Abdalla AGM (2009) Spatial price transmission: A study of sheep markets in Sudan.African Journal of Agricultural and Resource Economics 3: 43-56.
4. Johansen S (1988) Statistical analysis of cointegration vectors. Journal of economic dynamics and control 12: 231-254.
5. Ibrahim AA (1999) The Development of the Livestock Sector in Sudan: A Case Study of Public Policy Analysis. OSSEREA's research report series, Addis Ababa.
6. Idris B (1986) Marketing System. In Zahlan A B (edn): Agricultural Sector of the Sudan: Policy and Systems Studies, London: 358-379.
7. M.SA (1986) Livestock Farming Systems In: Zahlan, AB (edn): Agricultural Sector of the Sudan: Policy and Systems Studies, London 215-238.
8. El Agip FM (2001) Marketing of Livestock in the Sudan: An Analysis of its Efficiency. Unpublished Ph.D. Thesis: University of Khartoum, Sudan.
9. Babiker NM (2006) Livestock Markets in the Sudan: A cointegration Approach, Ph D Thesis, Gazira University.
10. Dickey DA, Fuller WA (1981) Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica: Journal of the Econometric Society 49: 1057-1072.
11. Phillips PC, Perron P (1988) Testing for a unit root in time series regression. Biometrika 75: 335-346.
12. Engle RF, Granger CWJ (1987) Co-integration and error correction: representation, estimation, and testing. Econometrica: Journal of the Econometric Society 55: 251-276.
13. McKenzie CR, Takaoka S (2012) EViews 7.2. Journal of applied econometrics 27: 1205-1210.
14. Akaike H (1987) Factor analysis and AIC. Psychometrika 52: 317-332.
15. Schwarz G (1978) Estimating the dimension of a model. The annals of statistics 6: 461-464.
16. Hannan EJ, Quinn BG (1979) The determination of the order of an autoregression. Journal of the Royal Statistical Society. Series B (Methodological) 41: 190-195.
17. Levin A, Lin, CF, James C, Chia S (2002) Unit root tests in panel data: asymptotic and finite-sample properties. Journal of econometrics 108: 1-24.

18. Fisher RA (1932) Statistical Methods for Research Workers, (5th edn), Edinburgh, Oliver and Boyd, UK.

19. Babiker NMM, Bushara MOA (2006) Integration Between Cattle Markets in the Sudan, 1980-2000. Gezira Journal of Agricultural Science 4: 130-146.

Citation: Bushara MOA, Abdelmahmod MKA (2016) Efficiency of Selected Sudanese Cattle Markets: A Bivariate Cointegration Approach (1995-2011). Int J Econ Manag Sci 5: 321. doi:10.4172/2162-6359.1000321

OMICS International: Publication Benefits & Features

Unique features:

- Increased global visibility of articles through worldwide distribution and indexing
- Showcasing recent research output in a timely and updated manner
- Special issues on the current trends of scientific research

Special features:

- 700+ Open Access Journals
- 50,000+ editorial team
- Rapid review process
- Quality and quick editorial, review and publication processing
- Indexing at major indexing services
- Sharing Option: Social Networking Enabled
- Authors, Reviewers and Editors rewarded with online Scientific Credits
- Better discount for your subsequent articles

Submit your manuscript at: http://www.omicsonline.org/submission/