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A Vector Error Correction Model (VECM) Approach in Explaining the Impact of Livestock Export on Economic Growth in Somalia

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Abstract: *Somalia has suffered instability and civil war in the last two decades, which have wedged the economy of the country as wells as population. Although Somalia is the one of the impoverished country, it has registered a small growth in recent years. This study examines the short run impact of livestock export on economic growth in Somalia using annual time series data for the period 1990 – 2015 by applying cointegration analysis and vector error correction model (VECM). Cointegration was performed under Engle-and Johansen co-integration tests and a VECM were applied according to its result. Our model results point of the association between variables on a short run. The empirical resultsof the study indicate that, cattle and Sheep exportshave a positive and significant relationship with economic growth, whereasexports of camel and goat have been found to have a positive but insignificant effect on economic growth. Based on the findings, this study recommendsthe government of Somalia should support livestock exports by making subsidies in both federal and state level, and have to finance the fundamental veterinary serves to fuel the productivity of the sector. And the government of Somalia should activate the policies of the livestock sector. Further, the government should make a separate ship that can easily transport for camels in order to avoid the price of take care of (watering, feeding and health care) of the animal.*

Keywords:*Livestock-Export; Economic Growth; Cointegration test;VECM, Somalia.*

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I. Introduction

Livestock export is essential for many developing economies, especially those in the Horn of Africa. Humans derive the main source of protein from animals, which once again provide income, employment and foreign exchange for the country. For many farmers and families, livestock serves up as a source of wealth, providing drafting capacity and a source of organic fertilizer for crop production, is also a means of transport and plays a role in social functioning. The consumption of animal products in the world has increased rapidly. This sectoral empowerment provides poor families with opportunities to improve their daily lives and livelihood(Leonard, 2007).

Livestock systems have made a significant contribution to the nationwide economy of the world. The value of livestock production represents respectively 40% and 20% of the value of total agricultural production of developed and developing countries respectively. For years, discussions in the livestock industry have focused on ways to increase production in a sustainable manner. However, the UN(United Nations) 2030 Agenda for Sustainable Development has added a new dimension to the discussion. It shifts the focus of the discussion from promoting sustainable production itself to strengthening the sector's contribution to achieving sustainable development goals. The livestock industry can contribute directly or indirectly to each sedge: strengthen the assets that rural households use to achieve their livelihood goals; assisting to generate income; job creation; provide the world with adequate and reliable meat, milk, eggs and Dairy supply; improving children's cognitive and physical development as well as school performance; empowering rural women; improving the efficiency of natural resource use; expanding access to clean and renewable energy; supporting sustainable economic growth; creating fiscal revenues and earning foreign exchange; providing opportunities for value-added and industrialization; stimulating small-scale entrepreneurship and dropping inequity gap; sanctioning sustainable production and consumption patterns; Improve households' ability to adapt to climate shocks; and bring together multiple stakeholders to achieve all of these goals(FAO, 2018).

Somalia is emerging from the 25-year civil war and the economy is growing steadily. The main active sectors livestock industry and services sector, which have developed rapidly in recent years, such as telecommunications, remittances, construction, hotels and transportation (Hassan et al., 2018).

The livestock industry dominates the Somali economy, creating nearly 60% of economic employment opportunities, creating 40% of Somalia's gross domestic product and 80% of foreign exchange earnings (European Commission, 2009). As a result, the economy has been driven by the export of meat and animals, which has steadily changed livelihoods, especially in rural areas.

In 2014, Somalia exported 5 million head of livestock to the Arabian Gulf market, with a total of 4.6 million sheep and goats, of which 340,000 cattle and 77,000 camels are estimated at $360 million, accounting for 40% of the country's GDP. This is the largest number of live animals exported by Somalia in the past 20 years(FSNAU, 2014).

Somalia's livestock have a unique taste in the global market, which plays a big role in the sector's trade with the Gulf and other countries. Not only live animals, but also animal products such as skins, leather and meat are exported to foreign markets. The Gulf States occasionally consume these animals during festivals and religious seasons, such as Eid al-Fitr, pilgrimages and other requirements(Hassan et al., 2018).

In figure 1 explains how the trend of livestock export in Somalia was. In the last twenty-five years, it has increased out of the persistent challenges ahead. The declines in the graph line state when Somalia had some numerous difficultieswhich are: I; A drought. II A ban of animals from Arab World; this was because the livestock production was a major exporting items. The latest ban in this series was imposed by Saudi Arabia, which has usually taken up to 95% of Somalia's livestock. III; the collapse of government functions during the civil war, which weakened the supply chain for veterinary medicines, reduced the availability of veterinary services and caused the loss of laboratory facilities for livestock testing. But in recent years, when we established the government, livestock exports even exceeded the 1980s. This reinforces the findings of Leeson in which he found that Somalia had a better experience in anarchy than in the government (Leeson, 2007).

Somalia's exports depend mainly on a very few of livestock (camel, cattle, goat and sheep) exports. Though the country is reliant on livestock exports, we have seen just only one study investigated the Contribution of Livestock and crop production on Somali export(Isak & Ali, 2015).And our previous research(Jie & Nadira, 2018) which basically in line with on this study. Obviously we have studied how livestock exports havean impact on economic growth of Somalia in the long run using a long run Granger causality test, but in this study, we have estimated how livestock export in Somalia hasan impact on GDP in Short run using a vector error correction model (VECM).And plot a graph which shows the trend of livestock export over the last 25 years. In so far as, the matter of novelty of this study, a number of studies have been made to investigate the significance, nature of relationships, and intensity of relationships between agricultural exports and economic growth in many countries across the world, but apart from our earlier research which is in line with on this research no other study has so far updated probed that exists of the short run impact of livestock export on economic growth in Somalia. This study identifies and weigh up the short run impact of Somalis livestock export on economic prosperity along within depth analysis of historical trends and structure of livestock exports.

The other aspects of the study are organized as follows: Section two based on empirical review. Section threedata description and methodological framework. Section four Empirical results, analysis and discussions of the outcomes. And Section five concludes the study along with recommendations

II. Empirical Review

A huge quantity of literature is available on issues relating the agricultural exports to the economic growth of nations, especially least developing countries struggling for sustained economic growth but only very few of literature is available on livestock exports.

Table 1

No	Authors	Countries	Titles	Periods	Econometric Techniques	Key findings
1	AssociatesAustralia and Hassall (2006),	Australia	Livestock export industrial Value, Outlook and Contribution to the Economy in Australia.	2000-2006	Empirical model	LE=>GDP
2	Vlad *et al.* (2015)	Romania	Dynamics and seasonality in Romania's international exchanges regarding live animals and animal products.	2004-2013	Additively & multiplicative methods	LEX=>GDP
3	Gilbert et al. (2013)	Cameroon	Studied the impact of agricultural exports on economic growth of Cameroon with the reference of coffee, banana and cocoa b	1975-2009	Cointegration Analysis & VECM	AEX=>GDP

4	(Mahmood & Munir, 2018)	Pakistan	Agricultural exports and economic growth in Pakistan: an econometric reassessment	1970-2014	Cointegration Analysis, VECM and Granger Causality Tests	AEX ≠ GDP
5	(Toyin, 2017)	South Africa	Causal Relationship between Agricultural Exports and Economic Growth: Evidence from South Africa Causality.	1975-2012	Cointegration Analysis & Granger Causality Tests	AEX ≠ GDP
6	(Ijirshar, 2015)	Nigeria	The empirical analysis of agricultural exports and economic growth in Nigeria	1970-2012	Cointegration Analysis & VECM	AEX=>GDP
7	(Gutema et al., 2015)	Ethiopia	Causal Relationship between Agricultural Exports and Economic Growth in Ethiopia: A Case of Coffee, Oilseed and Pulses	1973-2013	Cointegration Analysis & Granger Causality Tests	AEX=>GDP
8	(Suresh & Kumar, 2017)	India	The Casual Relationship Between The Agriculture Export And Agriculture Growth In India	1980-2016	Granger Causality Test &VECM	AEX=>GDP

** LEX (Livestock Export); AEX (Agriculture Export*

III. Methodology

3.1 Data description

To analyze the short impact of livestock exports on economic growth of Somalia. This study utilized the time series data based on 25 annual observations for the time period of 1990–2015. The brief description of variables is given as under in Table 2.

Table 2 Description of Variables

Variable	Description	Source
$\mathbf{GDP_t}$	Gross domestic product (Dependent Variable)	FAOSTAT
$\mathbf{TLf_t}$	Total labor force	WDI
$\mathbf{CA_t}$	Gross Domestic Fixed Capital Formation	FAOSTAT
$\mathbf{ER_t}$	Exchange Rate	FAOSTAT
$\mathbf{CAMLX_t}$	Camel Export	FAOSTAT
$\mathbf{CATLX_t}$	Cattle Export	FAOSTAT
$\mathbf{GOUTX_t}$	Goat Export	FAOSTAT
$\mathbf{SHEPX_t}$	Sheep Export	FAOSTAT

(*FAOSTAT) Food and Agricultural Organization statistic data on countries' trade*
(WDI) World Bank Development Indicators

3.2 Theoretical Framework

The study starts with the decisive work, neo-classical growth model developed bySolow (1956)**.** The model seeks to estimate the short-run economic growth of Somalia by taking into cognizance the Capital Accumulation and Labor, in this study did not emphasis on the non-economic variables of the classical growth theory.

$$Y = F(L_t, K_t) \quad (1)$$

Where Y depicts the output; L denotes Labor and K denotes capital.

This production function is expanded by adding livestock exports as shown in equation 2.

$$Y_t = F(L_t, K_t, CAML_t\, CATLX_t, GOATX_t, SHEPX_t) \quad (2)$$

To reflect the price competitiveness in the international markets, the model 2 is re-written in equation 3 by adding Exchange Rate as follows:

$$GDP_t = f(TLf_t, CA_t, ER_t, CAML_t\, CATLX_t, GOATX_t, SHEPX_t, \mu) \quad (3)$$

GDP_t Is the Gross Domestic Product, TLF_tIs the Total Labor Force, CA_t Is the Gross Domestic Fixed Capital Formation, ER_t,Exchange Rate $CAML_t$ Is Camel Export, $CATLX_t$ is Cattle Export, $GOATX_t$ Is Goat Export, $SHEPX_t$ is Sheep Export and μ is the Random disturbance.

From the Equation 3, the study derived the Equation 4 by taking the natural logarithm on both sides of equation 3 in order to discard the differences in the units of measurements for the variables and to minimize the gap between independent variables and dependent variables**.**

$$GDP_t = \beta_0 + \beta_1 \ln TLf_t + \beta_2 \ln CA_t + \beta_3 \ln ER_t + \beta_4 \ln CAML_t + \beta_5 \ln CATLX_t + \beta_6 \ln GOATX_t + \beta_7 \ln SHEPX_t + \varepsilon_t \quad (4)$$

β_0 Is the Constant Term and $\beta_1, \beta_2, \beta_3.\beta_4, \beta_5, \beta_6 and \beta_7$ Are the parameters of independent variables to be estimated.

3.3Unit Roots Test

In this study, time-series data of macro-economic nature was used for the estimation of the model. The data generating processes exhibit trends and volatility which could result in a non-stationary issue. A non-stationary time series has a different meaning at different points in time and its variance increases with the sample size. As a rule, a non-stationary data, are unforeseeable and cannot be demonstrated.

So that a non-stationary data should transform into a stationary, in order to achieve a reliable outcome. (Gujarati, 2004)**.** Augmented Dickey-Fuller is used in this study to examining the presence of the unit root problem. In this equation is evaluated:

$$DX_t = \alpha + PX_{t-1}\, \varepsilon_t \quad (5)$$

3.4 Co-integration test.

If the variables of the study are found to be integrated, that is, there exists a linear, stable and long-run relationship among variables, such that the disequilibrium errors would tend to fluctuate around zero mean. In literature, Co-integration tests, e.g. Engle and Granger (1987) , (Johansen, 1988),Søren and Katarina (1990)used to confirm the presence of potential long run equilibrium relationship between two variables. This study employed Johnsen's Johansen's technique in order to establish how many cointegration equations exist between variables, by using the following equations:

$$\varepsilon_t = Y_t - \beta_0 - \beta_1 X_t \quad (6)$$

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \sum_{t=1}^{p-1} \Pi i \Delta Y_{t-1} + \varepsilon_t \quad (7)$$

3.5 Short Run ECM Analysis

To examine that either our functional error correction mechanism is effective in short span of time or not? This study relied on short run ECM analysis. This mechanism elaborates about the speed of adjustment that at which our given dependent variable moves back toward the equilibrium within given lag of time.

Short run variations of variables specify the following error correction model (ECM):

$$\Delta Y_t = \beta_0 + \beta_1 \Delta X_t + \beta_2\, \mu_{t-1} + \varepsilon_t \quad (8)$$

Where $\Delta Y_t = Y_t - Y_{t-1}, \Delta X_t = X_t - X_{t-1}, \beta_1 and \beta_2$ Are the dynamic adjustment coefficients, μ_{t-1} is the lag of residual representing short run disequilibrium adjustments of the estimates of the long run equilibrium error, whileε_t is the random error term (Gujarati, 2004).

The error correction coefficient must be negative, which indicates the existence of a short-run relationship. The size of the error correction coefficient determines the speed of adjustment towards equilibrium. The Error correction model (ECM) is estimated as follows;

$\Delta GDP_t = \beta_0 + \beta_1 \Delta lnTLf_t + \beta_2 ln\Delta CA_t + \beta_3 \Delta lnER_t + \beta_4 \Delta lnCAML_t + \beta_5 \Delta lnCATLX_t + \beta_6 \Delta lnGOUX_t + \beta_7 \Delta lnSHEPX_t + \alpha ECM_{(t-1)} + \varepsilon_t$ (9)

Where; ΔGDP_t is the change in natural logarithm of gross domestic product, $\Delta lnTLf_t$ is change in natural logarithm of total labor force, $ln\Delta CA_t$ is change in natural logarithm of gross domestic fixed capital formation. $\Delta lnER_t$ is change in natural logarithm of real exchange rate, $\Delta lnCAML_t$,is change in natural logarithm of camel export, $\Delta lnCATLX_t$ is change in natural logarithm of cattle export,$\Delta lnGOUX_t$ is change in natural logarithm of goat export, $\Delta lnSHEPX_t$ is change in natural logarithm of sheep export . $\beta_1, \beta_2, \beta_3. \beta_4, \beta_5, \beta_6 and \beta_7$ Are the parameters of the independent variables and ε_t is the stochastic error term. $ECM_{(t-1)}$ represents the speed of adjustment of economic growth to its equilibrium level andα is the coefficient of the error correction term.

IV. Empirical Estimation and Analysis

4.1 Unit Root Analysis

The result of the augmented Dicker Fuller test was applied to all variables mentioned in the model of this study at level 1(0) and first difference I (1) data at present in table 3. The lag length of this study is two and its decision is taken according (AIC) to the Akaike information criterion lag selection technique(Akaike, 1979)

Table 3 Augmented Dickey–Fuller unit root test.

	Test at level form I (0)				Test at level form I (1)		
Variables	ADF test statistics	5% Critical value	P-value	Variables	ADF test statistics	5% Critical value	P-value
lnGDP	-3.093	-3.600	0.1078	DlnGDP	-2.061	-1.950	0.0000*
lnTLF	3.042	-3.600	0.1206	DlnTLF	-1.916	1.771	0.0357**
lnCA	-1.802	-3.600	0.7039	DlnCA	-3.763	1.771	0.0007***
lnER	-1.858	-3.600	0.6761	DlnER	-3.116	1.771	0.0030***
lnCATLX	-2.754	-3.600	0.2145	DlnCATLX	-6.008	-1.771	0.0000***
lnSHEPX	0.121	-3.600	0.9953	DlnSHEPX	3.415	1.771	0.0014***
lnGOATX	-1.517	-3.600	0.8231	DlnGOATX	-2.974	-1.771	0.0041***
LnCAMLX	-2.115	-3.600	0.5375	DlnCAMLX	-2.100	-1.771	0.0279**

****, ** and *indicates level of significant at 1% ,5% and 10% respectively*.

In Table 3 shows the Augmented Dickey Fuller test statistic. When we take the absolute value for each variable, we would realize that ADF test statistics values were less than the critical value. This affirms that all the variables are non-stationary at I (0). And in the 1st differences show that the Augmented Dickey Fuller test statistic, which in absolute terms for each variable, are all greater than the critical value. This confirms that all the variables are stationary at I (1). So, this showed that, the series data is stationary at first difference and hence the variables are considered as integrated of order one or I (1) process.

4.2 Cointegration analysis

After we get the results of unit roots, the upcoming step is to scheme, whether there exists cointegration, using the same order of integrated variables. To discuss for co-integration, the Søren and Katarina (1990)procedure was involved, which brings to two test statistics, trace test and maximum Eigenvalue test, for cointegration

Table 4 Test for the number of co integration vectors

Maximum rank	Trace statistic	5%critical Value	1% critical Value	Max statistic	5% critical Value	1% critical Value
0	815.3217*	156.00	168.36	545.0195*	51.42	57.69
1	270.3022*	124.24	133.57	80.4539*	45.28	51.57
2	189.8483*	94.15	103.18	60.2633*	39.37	45.10
3	129.5850*	68.52	76.07	54.3457*	33.46	38.77
4	75.2392*	47.21	54.46	32.2691*	27.07	32.24
5	42.9702*	29.68	35.65	28.4847*	20.97	25.52
6	14.4855	15.41	20.04	14.0039	14.07	18.63
7	0.4815	3.76	6.65	0.4815	3.76	6.65

****** indicates that both trace and max static is significant at 5% and 1%*

The Table 4 shows the co-integration test results for the economic growth model based on the maximum and trace Eigen values. According to the test, there are total eight vectors of targeted variables, and the six out of eight are integrated at 5% and 1% level of critical value. Both Trace and max statistics are greater than the critical value of 5% and 1% for all these 5 vectors therefore, the null hypothesis of no Co integrated

vector was rejected against the alternative hypothesis of Co integrated vector at 5% and 1% level of significance level.

4.3Error Correction Model(ECM) Analysis

The error correction coefficient tells us the speed at which our model returns to equilibrium after an exogenous shock. As a result, the error correction term should be negatively signed to indicate a move towards long run equilibrium.

The coefficient of error term α in equation 9 means that the system corrects its previous period dis-equilibrium at speed of α present yearly,

because our data is yearly data. The sign of α should be negative and significant to indicate the validity of the long run equilibrium relationship of the model. A positive sign indicates a move away from equilibrium. The coefficient should lie between 0 and 1, 0 suggests no adjustment one-time period later, while 1 indicates full adjustment. The result of the error correction term is presented in table 4 with corresponding short run coefficients of the variables using equation 9.

Table 5 Results of Error Correction Model

Dlngdp	Coef.	Std. Err.	t	P>|t|	[95% Conf	Interval]
DlnTLF	45.68202	11.50885	3.97	0.003***	20.0387	71.32534
DlnCA	3.523181	1.945344	1.81	0.100	0.8113159	7.857677
DlnER	0.956781	.102226	9.36	0.000 ***	0.7290073	1.184555
DlnCATTLEX	0.1274017	.0531748	2.40	0.038**	0.0089208	0.2458826
DlnSHEEPX	0.1922141	.0560792	3.43	0.006 ***	0.0672617	0.3171664
DlnGOATX	0.0549214	.0432168	1.27	0.233	0.0413716	0.1512145
DlnCAMELX	0.127314	.0182641	0.97	0.345	0.168009	0.086619
ECM(t-1)	-0.845826	.3982734	-2.12	0.040 *	1.733234	0.0415825
_cons	201.5698	49.96511	4.03	0.002***	312.899	90.24056

*Stata software version 12.0 ***significant at 1%, ** significant at 5% *significant at 10%*
Prob> F = 0.0000
R-squared = 0.9942
Adj R-squared = 0.9896
Durbin-Watson statistic= 1.840933
Number of obs = 25

In table 5, it can be deduced that both dependent and independent variables are stationary at first difference. This is because the coefficient of the error correction term is negative, less than one (-0.845826) and significant at 5%. The results of the entire model in the short run reveal that the exogenous variables all did not have the expected outcome.

The variables of interest, sheep export and cattle export have a positive effect on economic growth and significant at 1% and 5% level. Camel and goat exports have positive impact, but not statistically significant which contradicts what was expected. Labor force growth and real exchange rate have a positive and significant effect on growth, which is in line with what is expected. The coefficient of ECt-1(-0.845826) is negative and significant at the 5% level. ECt-1 shows the speed of adjustment.

We have observed 84% percent speed of adjustment in the present analysis. It means that 84 percentage point adjustment would take place each year towards the long run period.

Somali's Livestock sector is main driver of country's economy. But the major problems that this sector has suffering are prolonged droughts, lack of enough rainfall, civil war, which makes the government of Somalia to be busy with to solve the security problems and have less time to solve the problems of this sector. And poor veterinary services. In 2002 the Somalia's livestock was accused of not having good health, Especial the goats which were said that they were having Rift Valley Virus disease and Arabian Peninsula banned live animal and their products from the country. Which were about 95% of animals goes there. And This is what makes for goats to have not statistically significant impact on economic growth, as well as is one of the reasons that make camels to have a negative impact on economic growth. Another reason that makes camel export to have a negative impact on economic growth is that; as researchers of (Samanter and Hassan (1990)) found that the livestock carriers are mainly designed for cattle, sheep and goat but not camels. The space available on livestock carriers is not suitable for camels, which need to stand in a 3.5-meter-high space. And These problems can cause delay in its transportation since most of the ships cannot accommodate camels. The waiting time for a suitable ship sometimes often extends into several months and consequently results in increases in the price of camels, which during that time have to be taken care of (watering, feeding and health care) animal.

Analysis of autocorrelation and Heteroscedasticity test were carried out in order to confirm appropriateness of the short run ECM.

4.3.1 Post-estimation diagnostic tests for ECM

Table 6 Autocorrelation test result for ECM

Breusch-Godfrey LM test for autocorrelation

F-Statistics	0.351	Prob> F	0.5684
Chi-Statistics	0.351	Prob> chi2	0.5538

H0: no serial correlation

From Table 6, the probabilities of the F-statistic and chi-statistics both are greater than 0.05, confirming the absence of autocorrelation. The test for Heteroscedasticity was also conducted using the Breusch-Pagan-Godfrey Test. The following results were obtained.

Table 7heteroscedasticity test for ECM.

Breusch-Pagan / Cook-Weisberg test for heteroscedasticity

F(8 ,10)	1.82	Prob> F	0.1846
chi2(8)	7.16	Prob> chi2	0.5195

Ho: Constant variance.

Results in Table 7, indicate the absence of Heteroscedasticity since the probabilities of both F-statistic and Chi-statistics are greater than 0.05. Thus, the errors from the ECM are homoscedastic. Therefore, the ECM is void of autocorrelation and heteroscedasticity.

V. Conclusion

This present study is one of very few studies, which have examined, empirically, the short run impact of livestock export on economic growth of a small poor country Somalia. The empirical analysis is based on the time series Econometrics during the period 1990 – 2015. The Co-integration and the Error Correction Model are applied to investigate this relationship. The unit root properties of the data were examined using the Augmented Dickey Fuller test (ADF) after that the cointegration and the Error Correction Model were conducted. Empirical results show that all variables were stationary in the first differences. The application of the cointegration test indicates the existence of cointegration relations, which obviously forces us to apply the Error Correction Model.

The current research concludes that cattle and sheep export have a short run effect on economic growth. That means as their export increases the economic growth goes up. Further, we have found that Goat and camelexports have a positive influence, but not statistically significant. Which is contradicted what we're expecting. Drought "lack of enough rainfall ", a ban of animals from the Arab world and the collapse of government functions during the civil war, makes the sector weak and reduces the quantity and quality of livestock export.

By the way, since the livestock sector is the only sector that contributes more on economic growth, the authors recommend to The government of Somalia should support livestock exports by making subsidies in both federal and state level, and have to finance the fundamental veterinary serves to fuel the productivity of the sector. And the government of Somalia should activate the policies of the livestock sector. Further, the government should make a separate ship that can easily transport for camels in order to avoid the price of take care of (watering, feeding and health care) of the animal. The government of Somalia is struggling with state building and actually it takes a long time to support the country's productivity, but at least it should prepare the means to solve –or even lessen- these challenges.

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