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Interactions Between Agricultural Export and Growth in Southern African Countries: Evidence from Panel Co-Integration

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ABSTRACT

Background and Objective: The low drive of agricultural export in most African countries has a serious implication for agricultural growth in these countries. This study investigated the relationship and drivers of agricultural growth. **Materials and Methods:** The study adopted the proposition of the Breusch and Pagan LM test to perform the cross-sectional dependency test and the Pedroni residual co-integration test was used to establish co-integration. The study analyzed the second-generation unit root. All the variables except agricultural labor were stationary after the first difference. **Results:** The result obtained from Kao residual co-integration test was statistically significant at a 1% level of confidence therefore, the study failed to accept the null hypothesis and concluded that there is a long-run relationship among the variables. Also, growth and import showed a uni-directional relationship, likewise agricultural land and agricultural import. A long-run Granger causality was affirmed by agricultural growth and agricultural import. **Conclusion:** It is evident that agricultural import-controlled policies will have less effect on the agricultural growth in Southern African countries. Also, negative shocks to agricultural labor will negatively affect agricultural capital and agricultural growth.

KEYWORDS

Africa, agriculture, country, export, growth, policy, import, Southern Africa

INTRODUCTION

The contribution of Agriculture to the economic development of many nations could not be overlooked, Southern African countries are included. Most of the inhabitants of the region, directly and indirectly, depend on agriculture as the main source of their livelihood due to its potential for poverty reduction. Agricultural growth and trade have in the past received attention from policymakers, especially in developing economies[1]. In recent times, the agricultural sector witnessed a structural transformation in countries that are in their early stages of development. The sector is known for its contribution to employment of the total labor force, gross domestic product (GDP), foreign exchange earnings and also in salvaging economic instability. For instance, between 1999 and 2004, annual exports from Africa to China and India grew to 48 and 14%, respectively[2].

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The rural economy basically spins on agriculture, that is, the livelihood activities of the rural sector rely on agriculture. It is a major source of household income and employment in the sector. The agricultural growth rate in the Southern African Region has been recorded low as a result of several constraints facing the sector, in spite of its enormous contribution to the development of the region[3]. Several border measures affected agricultural trade within the walls of Africa and across the globe. Example of such is the World Trade Organization (WTO) and the Pacific Islands Countries Trade Agreement on the import flows[4]. The consequence of these measures deprives nations of the ripening benefit of global trade. To increase trade flow among nations, some studies[5,6] have reported exchange rate, economic growth, population, transport system and export or trade between the countries to facilitate agricultural growth.

Several research works[6-9] have been done on agricultural trade or export and growth. Boansi *et al.*[9] estimate the cointegration between agricultural exports and economic growth in Ghana. The research dwells on macroeconomic time-series data to establish the co-integration between the two subjects. In the same vein[9], while establishing the causality between agriculture and economic growth in Thailand reported that economic development encourages the growth of agriculture for there exists a long-term relationship between agriculture and economic growth. Both the study of Allaro[6] and Ohlan[7] examine the causal relationship between agricultural export and agricultural GDP and the result showed a unidirectional causal relationship between the variables. The study conducted by Osama and Walid[10] showed that a long-run positive relationship between agricultural exports and the share of agriculture in the GDP in Egypt was established.

Agricultural exports are known to be the main engine of rural economic growth in developing nations[11]. It is significant in terms of the creation of sustainable jobs, foreign exchange earnings, an adaptation of new and innovative technologies, production practices and aid promotion of both local and global food and nutritional security[11,12]. Though, agricultural export value is not commensurate with import value in Africa, like other cross-international trade it has witnessed an increase in recent years[13]. The causal interactions between some of these macroeconomic variables need to be established. This will inform stakeholders of appropriate measures when the decision to drive growth is debated. On this, the study seeks to establish the long-run relationship between agricultural export and growth and uses panel data to examine causal interactions between the entities.

MATERIALS AND METHODS

Study area: Southern African countries lie in the southern part of Africa. The region is home to some prominent rivers in Africa such as Victoria Falls and Zambezi River. The climate in the region basically includes both subtropical and temperate climates[14]. Countries within the region include Angola, Botswana, Comoros, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Zambia and Zimbabwe. South African region is distinct with a developed mining sector and this forms the basis of most exports from the region.

Research protocol: The research work was initiated in the last quarter of the year 2021 specifically in November and it spanned through to May, 2022 when the final draft was proofread by the authors. The study aimed to examine the relationship between agricultural growth and agricultural export in Southern African countries. Five Southern African countries were sampled including South Africa, Botswana, Lesotho, Namibia and Swaziland, for the period of 1991 to 2018 based on data availability. To avoid spurious regression results and inappropriate policy implication(s), the study tested for cross-sectional dependency as proposed by Pesaran[15]. Also, the long-run equilibrium relationship was established through the methodology (panel co-integration relationship test) of Pedroni. And lastly, the Panel Granger causality test was used to establish the direction of causality among our variables of interest.

Variables measurement and data: The study used six different variables to establish the relationship. In the study, agricultural value added (constant 2015 US$) was used as a proxy for growth. 'Total labour or force and employment in agriculture (percentage of total employment) was multiplied with employment to population ratio (15+ (%))' to derive Agricultural Labour (AGLAB). Agricultural land (AGLAND) in hectares, agricultural export (AGEXPORT) and import (AGIMPORT) (index (2014-2016 =100)) and agricultural capital (GFCF-gross fixed capital formation constant 2015 US$). All the data were sourced from the Food and Agriculture Organization data portal except agricultural labour[16].

Estimations methods: In estimating the panel time series dataset, the conventional unit root test for stationarity of data may not be appropriate if there exists a cross-sectional dependency, this will keep the power of the general unit root low[17,18]. Since, this is however paramount, the study failed not to test for the cross-sectional dependence before establishing the panel unit root test[19]. The choice of Pesaran methodology as cited by de Hoyos and Sarafidis[19] and Salisu *et al.*[20] to examine cross-sectional dependence in this study was pivoted on (I) Its uses for both balance and unbalanced panel data and (ii) It has a better edge on other test methodology if T<N, that, is, the number of the time dimension, T, is less than cross–section dimension, N. Also, the test is appropriate with a high level of cross-sectional dependence even when both t and n are small[15].

Following y_{it} is the i-th cross-section and t-th time observation obtained from a simple dynamic linear heterogeneous panel data model presented as follows[15]:

$$y_{it} = (1-\psi_i)\mu_i+\psi_i y_{i}, t-1+u_{it}, i = 1, N, t = 1,...,T \quad (1)$$

The additional assumptions are: The initial value of y (y_{i0}) is derived from the density function with finite mean and variance; moreover, the error term (μ_{it}) has a unit factor structure[15]:

$$u_{it} = \gamma_i f_t+\varepsilon_{it} \quad (2)$$

where, f_t is the unobserved common effect and ε_{it} is an individual-specific error. Equations 1 and 2 can be represented as follows:

$$\Delta y_{it} = \alpha_i+\beta_i y_i, t-1+\gamma_i f_t+\varepsilon_{it} \quad (3)$$

where, $\alpha_i = (1-\psi_i)\mu_i$, $\beta_i = -(1-\psi_i)$ and $\Delta y_{it} = y_{it}-y_i, t-1$. If, there is a unit root, then $\psi_i = 0$ and the null and alternative hypotheses are as follows:

$$H0: \beta_i = 0 \text{ for } \forall_i$$

$$H_1: \beta_i<0, i = 1, 2,..., N_1, \beta_i = 0, i = N_1+1, N_1+2, N \quad (4)$$

For panel cointegration analysis, Kao and Pedron cointegration tests are employed. Pedron cointegration can be represented as:

$$y_{it} = \alpha_{it}+\delta_{it}t+X_i\beta_i+\varepsilon_{it} \quad (5)$$

where, y_{it} and X_{it} are the apparent variables with dimensions whereas the Kao test for panel cointegration can be represented as:

$$y_{it} = \alpha_i+\beta x_{it}+\varepsilon_{it} \quad (6)$$

where, α_i is the fixed effect changing across the cross-sectional observations, β is the slope parameter and y_{it} and x_{it} are independent random walks for all i. The residual series εit should be I(1) series. This study adopts the proposition of Breusch and Pagan LM test to perform the cross-sectional dependency test which is very important to perform this test before furthering into panel analysis, the estimation was done and presented on a 5% level of confidence.

RESULTS AND DISCUSSION

The correlations among the growth rate of the variables used. Agricultural growth positively correlated with all other variables. The coefficient of agricultural labour (0.820), agriculture land area (0.923) and agricultural capital (0.965) showed a strong relationship with agricultural growth. The result of agricultural labour (p = 0.023) and land (p = 0.018) was significant at 5%, this result indicated that agricultural trade is crucial to agricultural growth in Southern African countries. It seems that agricultural growth was based on labour and land technology advancement as shown in Table 1.

From Table 2, most of the variables: Agricultural growth (65.777, p = 0.000), agricultural export (15.469, p = 0.000), import (32.957, p = 0.000) and labour (-2.701, p = 0.000) were significant at a 1% confidence level, that is, the variable showed a strong cross-sectional dependency. Therefore, the result implied the non-acceptance of the null hypothesis of no cross-sectional dependency (correlation) at a 1% level.

Subject to the knowledge of the presence of unit root or not, Table 3 presented the first generation unit root test as proposed by Levin *et al.*[21] and Im *et al.*[22]. Like the renowned Dicky-Fuller (DF) unit root test, Im, Pesaran and Shin (IPS) test entail testing for the existence of unit roots in panel data. It is superior to DF in that it combines the information from the time series dimension with that from the cross-section dimension and it could cater for fewer time observations for the test to have power[19]. The result revealed that some of the variables were stationary at a level while others were stationary at first differencing. At level, LLC showed agricultural growth (1.628), agricultural labour (-2.251) and agricultural land (-2.879) to be stationary, only agricultural land (-4.999) was found stationary on IPS while agricultural growth (5.204), agricultural export (2.202) and agricultural import (6.257) and GFCF (6.572) were stationary on Hadri. At first differencing, it was observed that all the variables became stationary, especially on LLC and IPS models.

Table 1: Correlation estimate of the variables

	AGRGROWTH	AGEXPORT	AGIMPORT	AGLLAB	AGLAND	GFCF
AGRGROWTH	1					
AGEXPORT	0.067	1				
AGIMPORT	0.071	0.738	1			
AGLLAB	0.820	-0.238	-0.137	1		
AGLAND	0.923	0.097	-0.062	0.789	1	
GFCF	0.965	0.136	0.203	0.738	0.845	1

Source: Authors' computation, AGRGROWTH: Agricultural growth, AGEXPORT: Agricultural export, AGIMPORT: Agricultural import, AGLAB: Agricultural labour, AGLAND: Agricultural land area and GFCF: Agricultural capital

Table 2: Cross-sectional dependency test

	Variable					
Tests	AGRGROWTH	AGEXPORT	AGIMPORT	AGLLAB	AGLAND	GFCF
AGRGROWTH	65.777***	79.180***	157.803***	114.141***	15.244	134.617***
AGEXPORT	12.472***	15.469***	33.050***	23.287***	1.173	27.865***
AGIMPORT	12.379***	15.376***	32.957***	23.194***	1.080	27.773***
AGLLAB	6.310***	8.358***	12.340***	-2.701***	-1.028	2.965***
AGLAND	10	10	10	10	10	10
GFCF	0.000	0.000	0.000	0.000	0.000	0.000

Source: Authors' computation, ***Denote significant at 1% level, AGRGROWTH: Agricultural growth, AGEXPORT: Agricultural export, AGIMPORT: Agricultural import, AGLAB: Agricultural labour, AGLAND: Agricultural land area and GFCF: Agricultural capital

Table 3: First generation unit root (individual intercept)

	Level			First differencing		
Variable	LLC	IPS	Hadri	LLC	IPS	Hadri
AGRGROWTH	1.628 (0.000)**	-1.041 (0.149)	5.204 (0.000)***	-11.959 (0.000)***	-13.628 (0.000)***	-0.072 (0.529)
AGEXPORT	0.226 (0.589)	0.229 (0.591)	2.202 (0.014)***	-11.923 (0.000)***	-10.805 (0.000)***	1.518 (0.065)*
AGIMPORT	-0.646 (0.259)	0.697 (0.757)	6.257 (0.000)***	-10.491 (0.000)***	-10.204 (0.000)***	-1.047 (0.852)
AGLLAB	-2.251 (0.012)***	-1.072 (0.142)	6.468 (0.000)	-3.696 (0.000)***	-4.420 (0.000)***	-0.454 (0.675)
AGLAND	-2.879 (0.002)***	-4.999 (0.000)***	-0.377 (0.647)	-8.367 (0.000)***	-9.128 (0.000)***	0.339 (0.367)
GFCF	-0.870 (0.192)	1.036 (0.849)	6.572 (0.000)***	-6.446 (0.000)***	-6.596 (0.000)***	0.000 (0.111)

Source: Authors' computation, AGRGROWTH: Agricultural growth, AGEXPORT: Agricultural export, AGIMPORT: Agricultural import, AGLAB: Agricultural labour, AGLAND: Agricultural land area, GFCF: Agricultural capital, LLC: Levin, Lin and Chu. IPS: Im, Pesaran and Shin and ***,**,*Significance levels at 1, 5 and 10%, respectively

Table 4: Second generation unit root test

	Breitungt-stat			
	Level		First differencing	
Variable	Statistics	Probability	Statistics	Probability
AGRGROWTH	-3.271	0.0005***	-3.356	0.0004***
AGEXPORT	-0.957	0.1693	-9.320	0.0000***
AGIMPORT	-2.452	0.0071***	-4.940	0.0000***
AGLLAB	-1.937	0.026**	-0.860	0.1949
AGLAND	0.850	0.8025	-2.524	0.0058***
GFCF	1.854	0.9682	-2.380	0.0087***

Source: Authors' computation, AGRGROWTH: Agricultural growth, AGEXPORT: Agricultural export, AGIMPORT: Agricultural import, AGLAB: Agricultural labour, AGLAND: Agricultural land area, GFCF: Agricultural capital and ***,**,Significance levels at 1 and 5%, respectively

Furthermore, Table 4 presents the second-generation unit root test. The Breitung t-stat test was performed after the first-generation unit root test failed to mitigate the requirement of cross-sectional dependence. The result revealed only three of the six variables to be stationary at the level of agricultural export, agricultural land and agricultural capital were not stationary at that level. However, all the variables agricultural growth (-3.356, p = 0.0004), agricultural export (-9.320, p = 0.0000), agricultural import (-4.940, p = 0.0000), agricultural land (-2.524, p = 0.0058) and agricultural capital (-2.380, p = 0.0087) except agricultural labour were stationary after the first difference.

Panel cointegration result is presented in Table 5. Pedroni applied two different tests for cointegration, these tests are within-dimension and between-dimension. The result showed four different statistics within-dimension in which the panel pp-statistics and panel Augmented Dickey-Fuller (ADF) statistics coefficient were statistically significant at a 1% level of confidence. A similar result was obtained with the weighted within-dimension and between-dimension.

The study equally observed the same trend of results when the technique was performed with intercept and trend. Only the statistics of panel pp-statistics and panel ADF-statistics were statistically significant at a 1% level of confidence for within-dimension (-2.871 and -2.791, respectively), weighted within- dimension (-4.404 and -4.014, respectively) and between-dimension (-9.622 and -5.786, respectively). Most of the results failed to accept the null hypothesis, however, there is an affirmation of the existence of co-integration among the variables. Furthermore, the result obtained from Kao residual co-integration test (ADF = -3.113) was statistically significant at a 1% level of confidence, this result also affirms the first result obtained from Pedroni residual co-integration test and therefore, this study did not agree with the acceptability of the null hypothesis but conclude that there is a long-run relationship among the variables. The result was in line with Seok and Moon[23], who revealed the existence

Table 5: Panel cointegration estimate of agricultural growth and export in Southern African countries

	Pedroni residual cointegration test			
	With intercept		With intercept and trend	
Variables	Statistics	Probability	Statistics	Probability
Within-dimension				
Panel v-statistics	-0.605	0.728	-1.502	0.934
Panel rho-statistics	0.330	0.629	1.147	0.874
Panel pp-statistics	-2.871	0.002***	-2.229	0.013***
Panel ADF-statistics	-2.791	0.003***	-2.502	0.006***
Weighted				
Panel v-statistics	-0.329	0.629	-1.305	0.904
Panel rho-statistics	-0.176	0.430	0.614	0.731
Panel pp-statistics	-4.404	0.000***	-4.245	0.000***
Panel ADF-statistics	-4.014	0.000***	-4.075	0.000***
Between-dimension				
Group rho-statistics	0.493	0.689	1.349	0.911
Group pp-statistics	-9.622	0.000***	-9.261	0.000***
Group ADF-statistics	-5.786	0.000***	-5.530	0.000***
Kao Residual cointegration test				
ADF	-3.113	0.000***		

Source: Authors' computation, ADF: Augmented Dickey Fuller and ***Significance levels at 1%, respectively

Table 6: Panel granger causality test

Variable	GROWTH	EXPORT	IMPORT	LAB	LAND	GFCF
GROWTH	-	0.266 (0.767)	3.718 (0.027)**	0.438 (0.647)	2.155 (0.120)	1.281 (0.282)
EXPORT	1.046 (0.355)	-	2.210 (0.114)	0.094 (0.910)	0.137 (0.872)	0.201 (0.817)
IMPORT	0.653 (0.522)	1.799 (0.169)	-	1.356 (0.262)	0.981 (0.378)	4.692 (0.011)**
LAB	0.140 (0.869)	0.077 (0.926)	0.257 (0.774)	-	0.124 (0.884)	2.697 (0.072)*
LAND	0.412 (0.663)	0.751 (0.474)	4.147 (0.018)**	0.045 (0.956)	-	0.044 (0.929)
GFCF	0.226 (0.798)	0.749 (0.475)	0.227 (0.787)	0.645 (0.527)	0.453 (0.637)	-

Source: Authors' computation, AGRGROWTH: Agricultural growth, AGEXPORT: Agricultural export, AGIMPORT: Agricultural import, AGLAB: Agricultural labour, AGLAND: Agricultural land area, GFCF: Agricultural capital and **,*Significance levels at 5 and 10%, respectively

of a long-run relationship between agricultural growth and export in the Organisation for Economic Cooperation and Development (OECD). In Egypt, Mlambo *et al.*[24] showed both the long and short-run relationships between agricultural export and growth and the long-run relationship is positive and significant. In the short run result was negative which implied that the contribution of export was marginal, however, it showed positive and significant implications in the long run[24].

Export is crucial to growth in developing countries as hypothesised by Kang[25]. The result presented in Table 6 showed the result from the Grangers panel causality. From the results, a directional relationship in the panel context was observed. None of the variables showed a bi-directional relationship, but growth and import (3.718, p = 0.027) showed a uni-directional relationship, likewise agricultural land and agricultural import. A long-run Granger causality was affirmed by agricultural growth and agricultural import (4.147, p = 0.018). The result was consistent with several studies by researchers[26-29], Awokuse and Xie[27] affirmed the existence of growth witnessed through improvement in agricultural-led export. Therefore, agriculture import-controlled policies will have less effect on the agricultural growth in these countries.

Similarly, agricultural import and agricultural capital (4.692, p = 0.011) had a uni-directional relationship with agricultural capital. The result showed long-run Granger causality between agricultural labour and agricultural capital (2.697, p = 0.072), they have a uni-directional relationship which implied that any negative shock on agricultural labour will negatively affect agricultural capital in Table 6.

The data availability of many macroeconomic variables was a constraint in this study. In dealing with spurious regression results and inappropriate policy implication(s), the study tested for cross-sectional dependency. Also, the long-run equilibrium relationship was established through the methodology (panel co-integration relationship test) of Pedroni. And lastly, the Panel Granger causality test was used to establish the direction of causality among the variables of interest. From the study, it was observed agricultural import-controlled policies will have less effect on the agricultural growth in these countries. Therefore, policymakers ought to pay more attention to import reduction to enhance regional growth. More importantly, agricultural export needs to be promoted through policies.

CONCLUSION

Intra-Africa trade has been recorded as low for a number of years. The fact that it greatly influences agricultural growth within the continent could not be overemphasized. In this study, after the cross-sectional dependency test was performed, the long-run equilibrium relationship was established. The long-run Granger causality between agricultural labour and agricultural capital implied that any negative shock on agricultural labour would negatively affect agricultural capital and also agricultural growth was observed to be controlled by agricultural import in South African countries.

SIGNIFICANCE STATEMENT

Regional trade is vital to the growth and development of nations within the region. How agricultural export/trade influences agriculture in Southern African countries was the focal point of this study. The finding indicated a long-run relationship between agricultural export and growth, invariably it implies a further increase in income aided through foreign exchange, employment and productivity in the agricultural sector of these nations.

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