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Analysing the Relationship between Agricultural Production and Exports Diversification in South Africa: A Granger Causality Approach for Apple, Avocado, Mango and Orange from 1994 to 2012

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ABSTRACT The study analysed the relationship between agricultural production and exports diversification of avocado, apple, mango and orange exports in South Africa from 1994 – 2012. The main objective of the study was to investigate the relationship between agricultural production and diversified exports of apple, avocado, mango and orange in South Africa. To test this the study used time series data to analyse the causality between agricultural production and exports diversification using a granger causality test and tested correlation between each enterprise in a form of correlation matrixes. The correlation matrixes showed positive relationship among all produce indicating that agricultural export moves in the same direction as the agricultural production. Based on the empirical analyses avocado, mango and orange production and diversified exports showed both unidirectional and bidirectional relationship which implied that agricultural production and exports push each other to different directions. Future policies aimed at securing the adoption of modern agricultural technology which will improve agricultural production and increase exports need to be developed.

INTRODUCTION

Both empirical and theoretical literatures indicate that the notion of exports diversification can trigger economic growth and development in both the short and long-run. Whereas these literatures on export diversification and economic growth are abundant, only a handful of empirical studies examine the role of agricultural exports diversification towards GDP derived from production. With these studies arguing that higher diversification affects economic growth positively, while developed countries are more able to diversify their production structures (Agosin et al. 2012). After 1994, trade policy in South Africa focused on replacement of controls over exports, with lower tarrifs set below the bound rate of the Marrakech Agreement of 1994. Like any developing country, South Africa has been moving away from liberalisation policies to one that can help exports more to increase the GDP. This can be witnessed by a new proposed policy that is documented in the National Development Plan, the second transaction, which is aimed at moving from developmental issues to growth issues.

One particular sector which has been given special attention in developing country's strategies is agriculture. South Africa's agricultural sector is increasingly becoming export-oriented with approximately one third of total production exported as shown in the appendix. According to OECD (2006), changes in South African agriculture trade policies in the past decade have been shaped by substantial macroeconomic and social reforms implemented during the mid-1900s to date, although reforms of agricultural policies were also initiated. Avocado, apple, mango and orange plantations in South Africa are favoured by farmers and huge amount of these fruit crops are produced and this leads to surplus in the domestic market. This surplus fruit crops results in dumping and less returns in the long-run which impedes economic growth due to low output.

The share of agricultural exports in South Africa does not change, with the most comprehensive study to date conducted by Daya and Steenkamp (2005) noted that exports of agricultural goods on an annual basis increased from 2001 to 2005, due to an increase in the total world imports of agricultural products. The issue of whether exports diversification increases agri-

cultural exports hence economic growth or the other way round raises a lot of questions which cannot go unanswered. In order to address this question, a positive causality between exports diversification and agricultural production must be established so that it can offer an insight towards a better way to improve the agricultural contribution to GDP.

Exports diversification has been the main policy focus for many developing and developed countries aimed at achieving sustainable economies. Empirical evidence showed a non-linear relationship between income and product diversification which was also extended to measures of export diversifications by Klinger and Lederman (2004) and Cadot et al. (2011). According to Siliverstovs and Herzer (2007) export-driven growth is often accompanied by conscious industrial policy that seeks to diversify the economic base on the liberalized economy with reference from the Chilean export-led growth experience, which involved a government-led effort to move away from mining toward manufacturing a case that can easly relate to South Africa. Agosin (2007) argues that long run growth is associated with learning to produce an expanding range of produce and that growth is viewed as the result of adding new products that represent productivity change to the production and export basket so that countries that have few local sources of productivity growth benefit by opening new sectors that have higher factor productivity.

According to Dennis and Shepherd (2011), product diversity varies between destinations because the presence of fixed export costs limits the number of agricultural exporters whom find it profitable to sell their goods across markets.

Regolo (2013) analysed the determination of diversification from the demand using models with non-homothetic demand structure and monopolistic competition drawn from (Fajgelbaum et al. 2011; Fieler 2011). The analyses found that results changed after the introduction of per capita GDP differences and to the introduction of total factor productivity differences that capture respectively the impact of preference-based and productivity-based comparative advantage differences. Acharyya (2007) exports diversification stabilise earnings in the long-run which then later improve production. Furthermore, Rodrik (2006) noted that the nature and composition of export baskets may not matter with the view that specialization nor diversification can aid growth as long as exports comprise of predominantly low value added commodities which are primarily agricultural exports.

South African apple, avocado, mango and orange exports has a fair share in the destined market (EU and US) due to different climatical conditions compared to competators (DAFF 2011). According to Zeren and Savrul (2013), the increase in exports as a component of the total demand is a catalyst for increase in production. It is said that an increase in the demand for produce exported can cause an increase in the amount of overall output. Exports of avocado, apple, mango and orange from South Africa to the African continent have been declining during the past three years, moving from 866 tons in 2007 to 396 tonnes in 2009. As a result, avocado, apple, mango and orange exports to the America have been consistent over the last decade, remaining below 100 tons for most of the decade and only peaking to 160 tons in 2011 (DAFF 2011). On average, South African avocado, apple, mango and orange production, in both commercial and small-scale sectors, is growing every year but the exports revenue growth potential has become limited as the market becomes flooded with fierce competition from Mexico, Brazil, Philippines, etc. This paper sees a need to diversify to curb this competitiors now andin the long-run.

Objectives

The first working objective of the study was to determine the correlation between agricultural production and diversified exports of apple, avocado, mango and orange in South Africa from 1994 to 2012. After establishing the correlation, the study investigated the causality between agricultural production and diversified exports of apple,avocado, mango and orange in South Africa from 1994 to 2012.

METHODOLOGY

Study Area and Sampling Procedure

This study on the relationship between agricultural production and export diversification was conducted in South Africa. The study used secondary time series data that were sourced from the National Department of Agriculture,

Fishery and Forestry Statistical Directorate covering a sample size of 17 years of apple, avocado, mango and orange production and diversified export in South Africa.

Analytical Technique

The Granger Causality model was adopted to analyse the variables which had an effect on the relationship between apple, avocado, mango and orange production and diversified export in South Africa.

Granger Causality Model

The most common way to test the causal relationship between two variables is the Granger Causality proposed by Granger (1969). The test involves estimating the following simple Vector Auto Regressions (VAR).

$$X_t = \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{j=1}^{n} \beta_j X_{t-j} + \mu_{1t} \quad (1)$$

$$Y_t = \sum_{i=1}^{m} \lambda_i Y_{t-i} + \sum_{j=1}^{m} \delta_j X_{t-j} + \mu_{2t} \quad (2)$$

Where it is assumed that the disturbances μ_{1t} and μ_{2t} are uncorrelated. Equation (1) represents that variable X is decided by variable Y and X so does equation (2) except that its dependent variable is Y instead of X. Both variables were lagged in order to account for the causality between Y and X. All the X_t and Y_t are stationary variable, u_{1t}, u_{2t} are the disturbances satisfying then regularity assumptions of the classical linear normal regression model, m & n and are the optimal lag in the system. Then we will say Y_1 is said not Granger causing X_t if β_1=0 in (1), for any $i=1,...n$.. In other words, the past values of Y_t do not provide any additional information on the performance of X_t. Similarly, X_t does not Granger Cause Y_t if $\lambda_1 = 0$ in (2), for any. $i=1,...,m$

In this analysis the Granger Causality through Toda and Yamamoto (1995) approach by applying a vector autoregressive (VAR) model with lag) ($k+d_{max}$) was used. As the alternative Granger Causality test, when the process is considered for a long-run causal relationship, and that the time series should contain unit root, stationary at the same order of its integration, and then co-integrated (Engle and Granger 1987). However, the procedure by Toda and Yamamoto (2005) has been found superior in terms of accuracy in any potential of non-stationary and co-integration between the time series before testing for the causality. Therefore, this procedure is utilised to present the direction of a long-long causal relationship between agriculture and economic growth which can be expressed by following a bi-variate regressive model.

$$AGRP_t = \alpha_1 + \sum_{i=1}^{k} \psi_{1i} AGRP_{t-1} + \sum_{i=1}^{d.max} \psi_{2i} AGRP_{t-1} + \sum_{i=1}^{k} \psi_{3i} EXPORT_{t-1} + \sum_{i=1}^{d.max} \psi_{4i} EXPORT_{t-1} + u_{1t} \quad (4)$$

$$EXPORT_t = \alpha_1 + \sum_{i=1}^{k} \zeta_{1i} EXPORT_{t-1} + \sum_{i=1}^{d.max} \zeta_{2i} EXPORT_{t-1} + \sum_{i=1}^{k} \zeta_{3i} AGRP_{t-1} + \sum_{i=1}^{d.max} \zeta_{4i} AGRP_{t-1} + u_{1t} \quad (5)$$

Definition of Variables

Where d_{max} is the maximum of its lag order of integration, k is the VAR lag selection which is based on the sequential modified log likelihood (LR) and the final prediction error (FPE) statistics, and u_t is the white noise. The null hypothesis of ψ_{3i} and ζ_{3i} is assumed to be equal to zero.

RESULTS OF EMPERICAL ANALYSIS

Correlation Analysis

To understand the relationship between the agricultural production of apple, avocado, mango and orange and their total exports, their correlation matrixes were generated. The correlation matrixes showed positive relationship between all produce indicating that agricultural export moves in the same direction as the agricultural production move (Table 1).

Table 1: Correlation matrixes between agricultural production and export

APPLE	*EXPORT*	*PRODUCTION*
EXPORT	1.000000	0.927716
PRODUCTION	0.927716	1.000000
AVOCADO	EXPORT	PRODUCTION
EXPORT	1.000000	0.978715
PRODUCTION	0.978715	1.000000
MANGO	EXPORT	PRODUCTION
EXPORT	1.000000	0.297682
PRODUCTION	0.297682	1.000000
ORANGE	EXPORT	PRODUCTION
EXPORT	1.000000	0.966425
PRODUCTION	0.966425	1.000000

Unit Root Test for Agricultural Exports

The constant variable had the coefficient value of (0.100402) EXPORTS are significant, even with t ratios less than 2 in absolute values and P-values less than t ratios. Here the P-value gives the probability that the hypothesis (unit root test in EXPORTS) is not true. It is conventional to reject the hypothesis if the P-value is less than 0.05. The ADF statistic value is 1.468174 and associated one-sided probability value is 0.1642 (Table 2).

Granger Causality Test

Based on the analyses the study four null hypotheses (APPLEPRO does not Granger cause APPLEEXP, APPLEEXP does not Granger cause APPLEPRO, MANGOPRO does not Granger cause MANGOEXP and ORAEXP does not Granger cause ORAPRO) were rejected and the other four null (AVOPRO does not Granger cause AVOEXP, AVOEXP does not Granger cause AVOPRO, MANGOEXP does not Granger cause MANGOPRO and ORAPRO does not Granger cause ORAEXP) hypothesis were not rejected and all the probability that agricultural production does not granger cause diversified export were not significant at any level. It was noted that AVOPRO does granger cause AVOEXP and AVOEXP does granger cause AVOPRO. This shows a bidirectional effect. While with mango and orange respectively a unidirectional effect was witnessed from production to exports and exports to production (Table 3).

Table 3: Granger causality test results for apple, avocado, mango and orange production and exports

Sample: 1994 to 2012
Lags: 3

Null hypothesis	*F-Statistics*	*Prob*
APPLEPRO does not Granger cause APPLEEXP	0.23198	.0.8716
APPLEEXP does not Granger cause APPLEPRO	0.81057	0.5228
AVOPRO does not Granger cause AVOEXP	1.05918	0.4186
AVOEXP does not Granger cause AVOPRO	1.06613	0.4160
MANGOPRO does not Granger cause MANGOEXP	0.69196	0.5822
MANGOEXP does not Granger cause MANGOPRO	1.60739	0.2627

DISCUSSION

Empirically export diversification has stronger impact on economic growth; this is notion holds when export of South Africa is greater than world average export. The correlation matrixes showed that agricultural production and agricultural exports are equally correlated to each other. Despite a positive movement between both variables, the high coefficient coupled with the high probability shows that the positive correlation observed was by chance. Empirically it is known that there exist causality, between agricultural production and H^2_0 agricultural exports based on the above interpretation. The Granger causality notes that when hypothesis is accepted but Hypothesis is H^1_0 rejected, their linear causality runs unidirectional from Y_t to X_t. So in

Table 2: The ADF unit root for average exports

Null Hypothesis: EXPORTS has a unit root
Exogenous: Constant

ADF Test Statistic	1.468174	1% Critical Value*		-2.7275
		5% Critical Value		-1.9642
		10% Critical Value	-1.6269	
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXPORTS(-1)	0.100402	0.068385	1.468174	0.1642
D(EXPORTS(-1))	-0.330970	0.285063	-1.161041	0.2650
R-squared	0.051093	Mean dependent var.		18268.75
Adjusted R-squared	-0.016686	S.D. dependent var.		53585.57
S.E. of regression	54030.79	Akanke info criterion		24.74896
Sum squared residua	4.09E+10	Schwarz criterion		24.84554
Log likelihood	-195.9917	Durbin-Watson stat		2.119193

***, **, * represent significance at 1%, 5% and 10% respectively
*MacKinnon critical values for rejection of hypothesis of a unit root.

this case since the null hypothesis that agricultural production does not granger cause agricultural exports is accepted and null hypothesis that diversified exports does not granger because agricultural production is rejected, then their linear causality runs unidirectional from exports to production. South Africa like any developing world seeking to speed up agricultural share to GDP to aid increase economic growth through exports; agricultural exports which plays a role to determine whether diversification, rather than the intensive margin, is the best route to achieve this goal (Besedeš and Prusa 2007).

CONCLUSION

The aim of the study was to analyse the relationship between agricultural production and diversified exports of apple, avocado, mango and orange in South Africa. Granger causality analysis was then adopted to analyse this variables. Based on the analyses avocado, mango and orange production and exports showed both unidirectional and bidirectional relationship between those variables. This implies that both agricultural production and exports push each other in different directions. The study apply one of the four theoretically possible test results that when hypothesis H^1_0 is rejected but H^2_0 is accepted, then linear causality run unidirectional from Y_t to X_t. Again the study applied one of the four theoretically possible test results that if both hypotheses H^1_0 and H^2_0 are rejected, there exist feedback linear causal relationships between X_t to Y_t. The study recommends the need to fasten the adoption of modern agricultural technology which will improve agricultural production and thereby increase exports. This will make sure that farmers, specifically small-scale, can enter the international market to improve their standard of living and earn more return to better stabilise the agricultural share of GDP in the long-run. Determining the relationship between agricultural exports and production draw attention from key policy makers in South Africa, since it can help address the labour discomforts seen earlier in 2014 and also aid stabilise the agricultural sector which is not strong compared to other sectors.

RECOMMENDATIONS

The study reveals a need to establish the importance of export composition and agricultural exports index in South Africa. It is paramount importance that human capitals like education, skill and knowledge which are considered to be important determinants of economic growth need to be investigated. It will also be beneficial to note the market access of apple, avocado, mango and orange exports to different destinations around the globe. These calls for similar studies for their competitor products to better know the challenges which these farmers face.

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