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TESTING THE EXPORT-LED GROWTH HYPOTHESIS FOR BOTSWANA: A CAUSALITY ANALYSIS

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Abstract

This paper investigates the causal relationship between export and economic growth for Botswana, using quarterly data for the period 1995.1-2005.4. It uses two measures of economic growth namely, GDP and GDP excluding export. When GDP is used as a proxy for economic growth, the investigation reveals that GDP causes export. However, when using GDP excluding export as a proxy for economic growth, the results show that there is bi-directional causality between export and economic growth. The results suggest that Botswana can promote its economic growth by exporting more products. The results also suggest that export in Botswana can be raised by increasing economic growth.

Keywords: Africa, Botswana, Exports, Granger Causality, Growth, Cointegration

1. Introduction

Export of goods and services is an important source of foreign exchange reserves and can reduce balance of payments problems, and creates employment opportunities. This led to many countries such as Botswana to adopt a growth strategy that is led by exports. The export-led growth strategy of Botswana started during the colonial era (1885-1966) when the country was a British protectorate (see Sentsho, 2000). There is a wide range of empirical studies on the importance of exports in developing countries, however, studies on the causal relationship between exports and economic growth for Botswana is limited or scarce. The purpose of this paper is to analyse the causality between exports and economic growth of Botswana and to evaluate the relationship of these variables for the period 1995 to 2005. Granger causality econometric techniques will be applied to test the hypothesis of an export-led growth strategy. It tests whether export Granger causes economic growth, or whether the causality runs from economic growth to exports, or if there is bi-directional causality between exports and economic growth. The results of this paper will help to evaluate the effectiveness of Botswana's strategy of growth led by exports. The paper is organised as follows. Section 2 reviews the literature. Section 3 discusses the Granger causality analysis of export and economic growth, while Section 4 outlines the estimation technique and empirical methodology. The data and estimation results are presented in Section 6, while Section 6 concludes.

2. Literature Review

One of the fundamental economic questions is the issue of how a country can achieve economic growth. An export-led growth hypothesis which states that exports are a key to promoting economic growth provides one of the answers to this fundamental question. There is considerable literature that investigates the link and causation between exports and economic growth, but the conclusions still remain a subject of debate.

Exports are the most important source of foreign exchange, which can be used to ease pressure on the balance of payments and generate much-needed job opportunities. Abou-Sait (2005) states that an export-led growth strategy aims at providing producers with incentives to export their goods through various policies. The strategy also aims at increasing the capability of producing goods that can compete in the world market using advanced technology and make provision for foreign exchange needed to import capital goods. Exports can help the country to integrate into the world economy and help to reduce the impact of external shocks on the domestic economy. Exports allow domestic production to achieve a high level of economies of scale. Tsen (2006) stated that the experiences of East Asian economies provide good examples of the importance of the export sector to economic growth and development, and this stress the role of exports as an engine for economic growth.

3. Export and Economic growth: A granger causality Analysis

The Granger causality test was developed by Granger (1969), and according to him, a variable (in this case export) is said to Granger cause another variable (GDP) if past and present values of export help to predict GDP. To test whether exports Granger cause GDP, this paper applies the causality test developed by Granger (1969). A simple Granger causality test involving two variables, exports and GDP is written as:

$$Export_t = \sum_{j=1}^{p} \alpha_j Export_{t-j} + \sum_{j=1}^{p} \beta_j GDP_{t-j} + u_t \qquad (1)$$

$$GDP_t = \sum_{j=1}^{p} \eta_j Export_{t-j} + \sum_{j=1}^{p} \gamma_j GDP_{t-j} + v_t \qquad (2)$$

The null hypotheses to be tested are:

$H_1 : \eta_j = 0,\ j = 1......p,$ this hypothesis mean that export does not Granger cause GDP.

$H_2 : \beta_j = 0,\ j = 1......p,$ this hypothesis means that GDP does not Granger cause exports.

If none of the hypotheses are rejected, it means that export does not Granger cause GDP and GDP also does not Granger cause exports. It indicates that the two variables are independent of each other. If the first hypothesis is rejected, it shows that exports Granger causes GDP. Rejection of the second hypothesis means that the causality runs from GDP to exports. If all hypotheses are rejected, there is bi-directional causality between exports and GDP.

The traditional Granger causality test uses the simple F-test statistics. Several studies such as Chow (1987), Marin (1992), Pomponio (1996), McCarville and Nnadozie (1995), Darat (1996) have used the traditional (F-test) to test for causality. The use of a simple traditional Granger causality has been identified by several studies (such as Engle and Granger, 1987; Toda and Yamamoto, 1995; Zapata and Rambaldi, 1997; Tsen, 2006; Ahmad and Harnhirun, 1996; Shan and Tian, 1998) as not sufficient if variables are I(1) and cointegrated. If time series included in the analysis are I(1) and cointegrated, the traditional Granger causality test should not be used, and proper statistical inference can be obtained by analysing the causality relationship on the basis of the error correction model (ECM). Many economic time-series are I(1), and when they are cointegrated, the simple F-test statistic does not have a standard distribution. If the variables are I(1) and cointegrated, Granger causality should be done in the ECM and expressed as:

$$\Delta Export_{t-1} = \sum_{j=1}^{p} \alpha_j \Delta Export_{t-j} + \sum_{j=1}^{p} \beta_j \Delta GDP_{t-j} + \phi_1 \varepsilon_{1t-1} + u_t \tag{3}$$

$$\Delta GDP_{t-1} = \sum_{j=1}^{p} \eta_j \Delta Export_{t-j} + \sum_{j=1}^{p} \gamma_j \Delta GDP_{t-j} + \phi_2 \varepsilon_{2t-1} + v_t \tag{4}$$

where ε_{1t-1} and ε_{2t-2} are the lagged values of the error term from the following cointegration equations:

$$Export_t = \delta + \varphi GDP_t + \varepsilon_{1t} \tag{5}$$

$$GDP_t = a + \psi Export_t + \varepsilon_{2t} \tag{6}$$

4. Estimation Technique and Empirical Methodology

The first step in the empirical estimation is the univariate characteristics which show whether the variables are stationary or non-stationary. If the variables are non-stationary, their order of integration is tested. This paper uses the Augmented Dickey-Fuller (ADF) statistic to test the stationarity or non-stationarity of the variables and their order of integration. If the variables are I(1), the next step is to test whether they are cointegrated. This is done by using the Johansen (1988; 1995) full information maximum likelihood. This econometric methodology corrects for autocorrelation and endogeneity parametrically using a vector error correction mechanism (VECM) specification. The

Johansen procedure is described as follows. Defining a vector x_t of *n* potentially endogenous variables, it is possible to specify the data generating process and model x_t as an unrestricted vector autoregression (VAR) involving up to *k*-lags of x_t specified as:

$$x_t = \mu + A_1 x_{t-1} + ... + A_k x_{t-k} + \varepsilon_t \qquad u_t \sim IN(0, \sum), \tag{7}$$

where x_t is (*n x 1*) and each of the A_i is an (*n x n*) matrix of parameters. Sims (1980) advocates this type of VAR modelling as a way of estimating dynamic relationships among jointly endogenous variables without imposing strong *a priori* restrictions (see also Harris, 1995). This is a system in reduced form and each variable in x_t is regressed on the lagged values of itself and all the other variables in the system. Equation (7) can be re-specified into a vector error correction model (VECM) as:

$$\Delta x_t = \mu + \Gamma_1 \Delta x_{t-1} + ... + \Gamma_{k-1} \Delta x_{t-k+1} + \Pi x_{t-k} + \varepsilon_t \tag{8}$$

where $\Gamma_i = -(I - A_1 - ..... - A_i)$, $(i = 1, ..., k-1)$ and $\Pi = -(I - A_i - ...... - A_k)$, I is a unit matrix, and $A_i\,(i = 1, ...p)$ are coefficient vectors, *p* is the number of lags included in the system, ε is the vector of residuals which represents the unexplained changes in the variables or influence of exogenous shocks. The Δ represents variables in differenced form which are I(0) and stationary and μ is a constant term. Harris (1995: 77) states that this way of specifying the system has information on both the short and long-run adjustment to changes in x_t through estimates of Γ_i and Π respectively. In the analysis of VAR, Π is a vector which represents a matrix of long-run coefficients and it is of paramount interest. The long-run coefficients are defined as a multiple of two (*n x r*) vectors, α and β', and hence $\Pi = \alpha\beta'$, where α is a vector of the loading matrices and denotes the speed of adjustment from disequilibrium, while β' is a matrix of long-run coefficients so that the term $\beta' x_{t-1}$ in Equation (8) represents up to (*n-1*) cointegration relationships in the cointegration model. It is responsible for making sure that the x_t converge to their long-run steady-state values. Evidence of the existence of cointegration is the same as evidence of the rank *(r)* for the Π matrix. If it has a full rank, the rank $r = n$ and it is said that there are *n* cointegrating relationships and that all variable are $I(0)$. If it is assumed that x_t is a vector of nonstationary variables $I(1)$, then all terms in Equation (8) which involves Δx_{t-i} are $I(0)$, and Πx_{t-k} must also be stationary for $\varepsilon_t \sim I(0)$ to be white noise. The cointegrating rank is tested with two statistics, the trace and maximum eigenvalue.

If there is cointegration, it shows evidence of a long-run relationship between the variables and appropriateness of proceeding to test the direction of causality as illustrated in Equations (3) and (4). Cointegrated variables share common stochastic and deterministic trends and tend to move together through time in a stationary manner even though the two variables in this study may be non-stationary. It is important to note that there are three possible cases:

- The rank of Π can be zero. This takes place when all elements in the matrix Π are zero. This means that the sequences are unit root processes and there is no cointegration. The variables do not share common trends or move together over time. In this case, the appropriate model is a VAR in first differences involving no long-run elements.

- The rank of Π could be full (in this study, rank =2). In this case, the system is stationary and the two variables can be modelled by VAR in levels. It represents a convergent system of equations, with all variables being stationary.
- Finally, the rank of Π can be a reduced (in this study, rank =1). In this case, even if all variables are individually I(1), the level-based long-run component would be stationary. In this case, there are *n-1* cointegrating vectors. The appropriate modelling methodology here is a VECM.

5. Data and Estimation Results

5.1 Data

The study uses quarterly data and the estimation covers the period 1995.1 to 2005.4. The data were sourced from various issues of the Annual Report of the Bank of Botswana. The variables used are GDP for economic growth, and export of goods and services. Since export is a component of GDP, the study uses another proxy for economic growth, namely GDP excluding exports. This was done by deducting exports from GDP. Informal investigation of GDP and exports in Figure 1 suggests that the variables are moving together and this may suggest that they are cointegrated, and cointegration implies that there must be causality at least from one direction.

Insert Figure 1. here

The first step in estimation is the univariate characteristics of the data. The univariate characteristics of the data test for stationarity of the variables used in the estimation. The unit root test are presented in Table 1.

Insert Table 1. here

The results of Table 1 show that all variables are stationary in levels. The next step is to test for cointegration using Johansen's full information maximum likelihood. The lag length was set to 3, and this is based on the Akaike information criterion, log likelihood, final prediction error, Schwartz information criteria, and Hannan-Quinn information criterion. The results of cointergration test are presented in Tables 2 and 3.

Insert Table 2. here

Insert Table 3. here

Tables 2 and 3 indicate that the trace and maximum eigenvalues statistics show that there are two cointegration vectors. This was expected because all variables are I(0) and this is a full rank. Since the rank of Π is full, the two variables would appropriately be modelled by using a VAR in levels. Granger causality is then tested using a VAR in levels. The long-run results for the two equations as specified in Equations (1) and (2) are:

$$\ln GDP = -3.508 + 1.480 \ln Export$$
$$(-2.636) \quad (9.080)$$

(9)

$$\ln Export = 2.371 + 0.676 \ln GDP$$
$$(2.763) \quad (7.042)$$

Equation (9) shows that export has a positive relationship with export, and GDP is also associated with an increase in export. The long-run relationship between export and GDP (excluding exports) is presented in Equation (10):

$$\ln GDP(excluding\ exports) = -6.010 + 1.695 \ln Export$$
$$(-3.019) \quad (6.975)$$

(10)

$$\ln Export = 3.545 + 0.590 \ln GDP(excluding\ exports)$$

Equation (10) also shows that there is a positive relationship between export and economic growth. The next step is to test for the direction of causality between export and economic growth. The results of Granger causality test using VAR in levels are presented in Table 4.

Insert Table 4. here

The hypothesis that export does not Granger causes GDP is not rejected. However, Table 4 shows the hypothesis that GDP does not Granger causes export is rejected and imply that the causality runs from GDP to export. In the GDP (excluding export) and export

Equation, the results shows that there is bi-directional causality between GDP and export. These results confirm the finding of the literature that there is causal relationship between economic growth and export. There is bi-directional causality between GDP and export in Botswana.

5.3 Impulse Responses

Impulse responses were introduced by Sims (1980) and show the response of GDP to shocks in exports. It also shows the response of export to shocks in GDP. The impulse response of GDP to shocks in exports is presented in Figure 2, while those of GDP (excluding export) and export are plotted in Figure 3. Figure 2 shows that GDP responds positively to shocks in export. Export also responds positively to shocks in GDP. The results in Figure 3 are also similar to those of Figure 2. Both variables also respond positively to their own shocks.

Insert Figure 2. here

Insert Figure 3. here

6. Conclusion

This paper examined the causal relationship between export and economic growth in Botswana using quarterly data for the period 1995 to 2005. Granger causality through a cointegrated vector autoregression method was applied to test the causal relationship between GDP and economic growth. Since the variables used in the estimation are I(0), a VAR in level is the appropriate modelling method.

The results show that there is evidence that GDP causes export, and evidence of bi-directional causality between export and economic growth in Botswana. The results are favourably comparable to those obtained in the literature. The results suggest that Botswana can expand its limited domestic market by exporting more in order to increase economic growth. The results also suggest that export in Botswana can be promoted by increasing economic growth.

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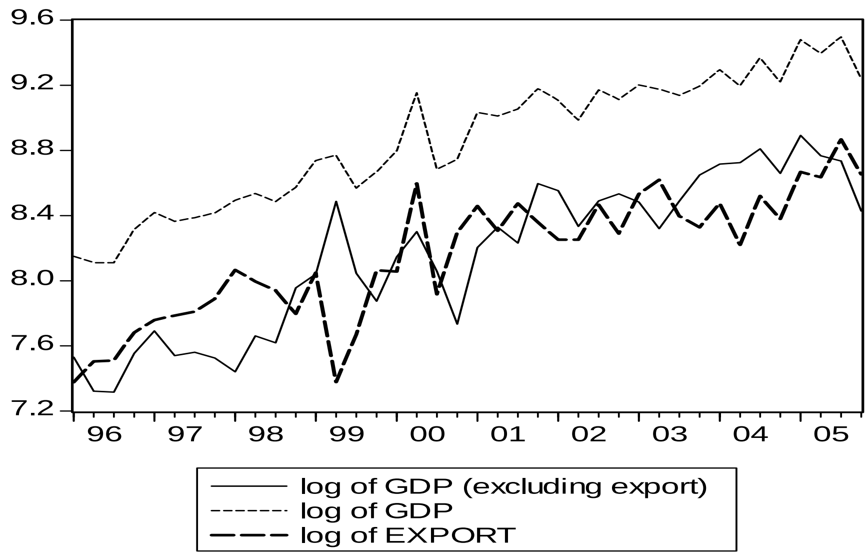
FIGURES AND TABLES

Figure 1. GDP, GDP (excluding exports) and Exports



Source: Data for the graph obtained from Bank of Botswana's Annual Reports

Figure 2. Impulse response of GDP and export

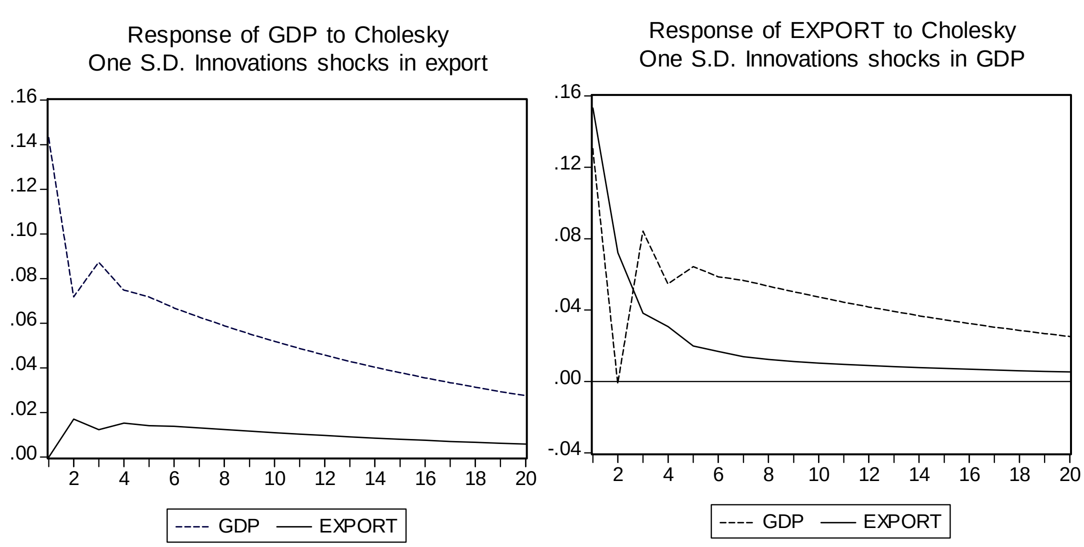


Figure 3. Impulse response of GDP (excluding export) and export

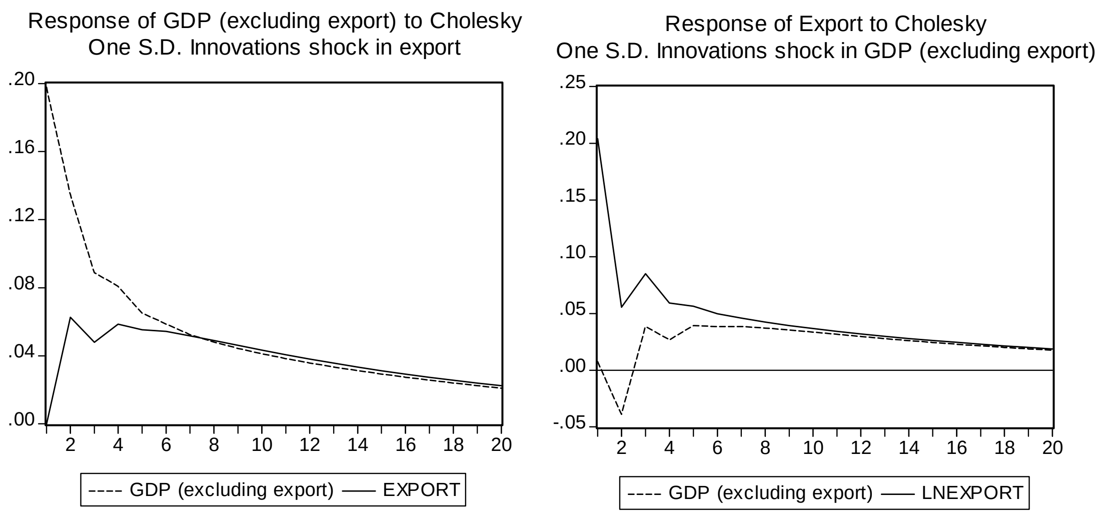


Table 1. Unit root test

Variable	Model Specification	ADF statistic	Joint test (F-statistic)	Conclusion
LnGDP	Intercept and trend	-5.144***		I(0) no unit root
lnGDPEX (excluding export)	Intercept and trend	-3.804**		I(0) no unit root
lnExport	Intercept and trend	-5.212***		I(0) no unit root

*/**/*** significant at 10%/5%/1% level

Table 2. Cointegration test results: GDP and exports

Null hypothesis	Alternative hypothesis	Test statistic	0.05 critical value	Probability value[b]
		Trace statistic		
r=0	r=1	39.769[a]	20.262	0.000
r=1	r=2	11.502[a]	9.165	0.018
		Maximum Eigenvalue statistic		
r=0	r>0	28.266[a]	15.892	0.000
r≤1	r>1	11.502	9.165	0.018

[a] Denotes rejection of the null hypothesis at 0.05 level

[b] MacKinnon-Haug-Michelis (1999) p-values

Table 3. Cointegration test results: GDP (excluding export) and export

Null hypothesis	Alternative hypothesis	Test statistic	0.05 critical value	Probability value[b]
		Trace statistic		
r=0	r=1	34.241[a]	20.262	0.000
r=1	r=2	10.691[a]	9.165	0.026
		Maximum Eigenvalue statistic		
r=0	r>0	23.550[a]	15.892	0.003
r≤1	r>1	10.691[a]	9.1465	0.026

[a] Denotes rejection of the null hypothesis at 0.05 level

[b] MacKinnon-Haug-Michelis (1999) p-values

Table 4. Granger causality test results

H_0	Wald test/χ^2	Conclusion
	GDP and export equation	
Export does not Granger cause GDP	0.521 (0.771)	Fail to reject the hypothesis. There is no causality
GDP does not Granger cause export	6.846 (0.033)	Reject the null hypothesis. There is causality from GDP to export.
	GDP (excluding export) and export equation	
Export does not Granger cause GDP (excluding export)	4.798 (0.091)	Reject the null hypothesis. There is causality from export to GDP (excluding export)
GDP (excluding export) does not Granger cause export	5.690 (0.058)	Reject the null hypothesis. There is causality from GDP (excluding export) to export.

Note: Probabilities are in parentheses